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CONTENTS

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AGASTACHE MEXICANA SUBSP. XOLOCOTZIANA (LAMIACEAE), A NEW TAXON FROM THE MEXICAN MEDICINAL PLANTS.

Robert Bye, Edelmira Linares, T. P. Ramamoorthy, Federico García, Ofelia Collera, Guadalupe Palomino, and Victor Corona

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ABSTRACT. Ethnobotanical studies in Mexican markets revealed a new taxon of a cultivated plant, Agastache mexicana subsp. xolocotziana, differing from the typical A. mexicana morphologically, chemically and pharmacologically.

RESUMEN. Estudios etnobotánicos realizados en los mercados de México dieron a conocer un nuevo taxon de una planta medicinal cultivada, Agastache mexicana subsp. xolocotziana, la cual difiere del típico A. mexicana morfologicamente, quimicamente y farmacologicamente.

Agastache section Brittonastrum is centered in Mexico and adjacent United States. Fourteen species are divided into three series (Sanders, 1979). While conducting research on the botanical diversity in markets in central Mexico (Bye and Linares, 1983), the authors encountered what appeared to be a simple mutant of A. mexicana (HBK.) Lint & Epling of A. series Mexicanae. Subsequent collaborative studies suggest that it deserves taxonomic recognition as:

Agastache mexicana subsp. **xolocotziana** Bye, Linares et Ramamoorthy subsp. nov. A. mexicanae affinis, a qua corolla alba differt. Typus: MEXICO: México: mpio. Atlautla, San Juan Tepecoculco, 17 Sep 1984 Bye, Davis & Williams 13021 (holotypus MEXU).

Perennial herbs to 1.5 m tall with slender spreading rhizomes. The stem erect, branched, 4-angled, puberulous with white hairs, some of them reflexed. Leaves with petioles 0.5-1.5 cm long, the blades ovate-lanceolate, 2-2.5 cm long, 1-2.1 cm wide, generally acute at apex, obtuse to cuneate at base,

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RB, EL, GP & VC: Jardín Botánico, Apdo. Post. 70-614;
TPR: Herbario Nacional, Apdo. Post. 70-233;
FG & OC: Instituto de Química.

crenate-serrate except near tip where sometimes entire, largest teeth 2-2.5 mm long and these gradually reduced towards apex, surfaces glandular punctate, particularly below, often puberulent above, with 3-5 pairs of veins. The inflorescences terminating branchches, of interrupted verticils of many-flowered cymes; the internodes separating verticils 1-6 cm long, indumentum as in stem, the bracts to 1.7 cm long, linear-lanceolate, the bracteoles to 1 cm long, similar to bracts. The pedicels upto 0.4 cm long, white pilose. The calyx 1-1.3 cm long, hirtellous to pilose, the tube 7-8 mm long, teeth to 3 mm long, triangular acute, the upper set slightly longer than the lower. The corolla white, to 2.4 cm long, the tube to 1.8 cm long, dilated about 1/3 the distance from the base, 3-5 mm wide at throat, the upper lip bilobed, the lobes rounded, the lower of three lobes, the laterals smaller, 2 by 2 mm, rounded, the middle larger, extended into a flaring undulate 5 by 5 mm, large limb with a 2 mm wide and short claw bearing a few scattered trichomes on the upper surface. The stamens didynamous, exserted, the anther ca. 1 mm long. The style to 2.8 cm long, bifid at tip with the upper arm slightly longer. The ovules barely 0.5 mm high. The nutlets ca. 2.5 mm long, ca. 1 mm wide. Chromosome number 2n = 18. Cultivated throughout the year, and flowering from June through September. Distribution: cultivated in east-central Neovolcanic Axis, Mexico. TYPE: MEXICO: México: mpio. Atlautla, San Juan Tepecoculco, 17 Sep 1984 Robert Bye, Tilton Davis IV, & David Williams 13021 (holotype MEXU; isotypes to be distributed).

Efraim Hernández Xolocotzi, for whom we dedicate this new taxon, has been an inspiration to all of us interested in useful plants of Mexico. We take this opportunity to honor him with this plant which reflects his philosophy as we perceive it: 1) interdisciplinary approach to ethnobotany 2) importance of markets in ethnobotanical studies, 3) the evolutionary influence of indigenous peoples on the Mexican flora and 4) ethnobotany in the service to Mexican peoples.

SPECIMENS EXAMINED: **MEXICO**: DISTRITO FEDERAL: Delegación V. Carranza, Mercado Sonora. Origin: San Juan Tepecoculco, México, 23 Jul 1983 Bye & Linares 12214; Origin: Ozumba, México, 29 Sep 1985 Bye & Linares 14138; Origin: Santa Catarina del Monte, México, 23 Jun 1986 Bye & Linares 14631; Origin: state of México, 17 Jul 1980 Galindo 1 (IMSSM); Origin: Cholula, Puebla, 13 Jun 1986 Bye, Linares & Flores 14576. Delegación Milpa Alta, Mercado Milpa Alta. Origin: Santa Ana Tlacotenco, 28 Sep 1985 Bye & Linares 14128. MEXICO: Mpio. Atlautla, San Juan Tepecoculco, 2 Feb 1982 Bye &

Linares 10701, 17 Sep 1984 Bye, Davis & Williams 13020, 13021, 18 Jan 1985 Bye, Linares & Ramamoorthy 13566, 5 Jun 1985 Bye & Linares 13714; Mpio. Toluca, Toluca, Mercado Benito Juárez. Origin: Mercado Sonora, Distrito Federal, 23 Sep 1984 Bye & Linares 13044; San Andres Timilpan, Barrio Iturbide, 1 Oct 1983 Camacho 390 (IMSSM). MORELOS: Mpio. Cuernavaca, Cuernavaca, 25 May 1985 Bye & Linares 13690; Mpio. Tepoztlán, San Juan Tlacotenco, 21 Jun 1985 Bye, Linares, Ramamoorthy & Meraz 13782. Except those collections from IMSSM, these specimens are deposited in MEXU and the duplicates will be distributed.

This plant is generally called **toronjil blanco** and is part of the medicinal plant complex, **los tres toronjiles**. The other members of this complex are **toronjil morado** or **toronjil rojo** (Agastache mexicana) or Mexican giant hyssop (Bailey and Bailey, 1976) and **toronjil azul** or **toronjil chino** (Dracocephalum moldavica L.), an annual cultivated herb of Eurasian origin.

The infusion of **toronjil blanco** along with other plants is valued in treating various gastrointestinal, nervous, and cardiovascular ailments (Baytelman, 1979; Gali, 1984; González, 1981; Linares et al., 1984; Martínez, 1969) as well as such cultural bound illnesses as "espanto" and "susto" (González, 1981; Sandoval, 1977). The herb is drunk as an aromatic tea after meals. **Toronjil morado** has a pungent licorice flavor and aroma while **toronjil blanco** has a subtle lemon fragrance. Both of these **toronjiles** can be used fresh or dried while **toronjil azul** is employed only fresh because of the loss of its aromatic properties upon drying. The native **toronjiles** are preferred to the foreign types (e.g. **toronjil europeo** or **meliza** (Melissa officianalis L.) (Sociedad Farmaceutica de México, 1904). On the "hot-cold" spectrum of indigenous medical systems, the **toronjiles** are classified as "fresh."

Both native **toronjiles** are cultivated in monocultures of small plots and home gardens for domestic consumption and sale. Occasionally wild plants are collected but this practice has decreased considerably in recent years due to the extinction of the local populations. Both forms are said to have been introduced into cultivation by transplanting wild plants and subsequently dividing the rhizomes for vegetative propagation. Field work with **toronjil** collectors in the mountains south and east of the Valley of Mexico failed to encounter any wild populations of **toronjil blanco** while a few depauperate **toronjil morado** populations were found. Plantings of both **toronjiles** are

subject to diebacks, fungal infections and insect predation. Propagation of new plants from seeds has not been practiced because the herbs are said to be most aromatic prior to and during anthesis at which they are harvested.

Although the magenta red flower form has been cited in early post-conquest documents (De la Cruz, 1964; Hernández, 1959) as **tlalahuehuetl** and **tlalamatl**, respectively, the white flower form did not appear in the literature until the first half of the 20th century (Martínez, 1939).

Agastache mexicana subsp. xolocotziana differs from the typical A. mexicana in several characters. Morphologically, the most visual character distinguishing it is its white corolla (rather than red). Among other morphological features are the presence of trichomes on the claw of the corolla's lower lip (rather than absence), the near complete nature of crenation on the margin (rather than serration confined to the lower half of the margin), and the acute leaf apex (rather than acuminate). The subspecies xolocotziana shares with the typical subspecies such characteristics as general inflorescence and floral structure, herbaceous perennial habit, pine-oak forest habitat and same chromosome number ($2n=18$). Although **toronjil blanco** shares some of the common chemical constituents with A. mexicana, it has the following unique compounds: breviflorine, a clerodane type diterpenoid; flavonoids, chrysine and pratol; and essential oil principally formed of bornil acetate (Contreras et al., 1986). Pharmacologically, infusions of **toronjil blanco** produced effects opposite those of **toronjil morado** (Galindo, 1982). These infusions of 25 gm of dried herb in 300 ml of double distilled water contracted markedly the aorta, bladder, intestinal and uterine muscles and increased considerably the amplitude to contraction in frog hearts. Horticulturally, stem rooting of **toronjil blanco** was significantly lower than that of **toronjil morado** based upon different propagation treatments and measuring primary and secondary roots, root length and root diameter (Chávez, 1986).

The origin and phylogenetic relationship of **toronjil blanco** is currently under study. As a working hypothesis we suggest that it is a product of hybridization and introgression between A. mexicana and A. palmeri (Robins.) Lint & Epling with which Roger Sanders (pers. comm.) concurs. Agastache mexicana has an interrupted inflorescence of relatively long flowers pollinated by specialist bees and hummingbirds. It is found on Transvolcanic Axis which runs perpen-

dicular to the Sierra Madre from Michoacán to Veracruz. Agastache palmeri has a compact inflorescence of short flowers pollinated by generalist bees. It is distributed in the Sierra Madre Oriental from Coahuila to the Sierra's prolongation in southern Puebla, northern Oaxaca and adjacent Veracruz. Agastache palmeri var. breviflora (Regel) Sanders is narrowly sympatric with A. mexicana. Sanders (1979, p.232) identified two wild putative hybrids from Hidalgo (Jimate s.n., ENCB) and México (Paray 1590, ENCB). However, the authors consider these two specimens to fall within the normal range of typical A. mexicana and, consequently, do not share the diagnostic features of subsp. xolocotziana.

The speciation of Agastache section Brittonastrum has been characterized by geographical isolation and depletion of variability followed occasionally by hybridization, introgression and further isolation (Sanders, 1979). During glaciation, it is thought that ancestors of the species of A. series Mexicanae migrated south along the Cordilleras. Subsequent range reduction, isolation and selection by pollinators (in particular hummingbirds) lead to rapid divergence. It is possible that an A. mexicana - A. palmeri hybrid product survived during the present interglacial period and was subsequently selected and isolated by its cultivation by humans in pre- or post-Conquest Mexico. Although unknown to the authors in the wild state, it has been documented in cultivation in Distrito Federal, Morelos, and the State of México, all on the Transvolcanic Axis. Preliminary interform crosses (between **toronjil morado** and **toronjil blanco** and reciprocals) are less fertile (n=54, seed set = 30%; n=29, seed set = 21%, respectively) than intraform **blanco** crosses (n=17, seed set = 47%). Future field, garden and laboratory studies should clarify the origin and relationship of A. mexicana subsp. xolocotziana.

Because of the cultural and economic importance of **toronjil blanco** and its biological differences and reproductive isolation, we think that it is worthy of taxonomic status. Because it is strongly associated with humans and its survival depends upon cultivation, we have selected the classification philosophy with a genetic perspective that was proposed by Harlan and de Wet (1971). **Toronjil blanco** and **toronjil morado** belong to the same gene pool (gp-1). The cultivated (and genetically altered) races of **toronjil blanco** belong to subsp. xolocotziana, while spontaneous races (including unselected transplants) of **toronjil morado** or **rojo** are classified as A. mexicana subsp. mexicana.

Two actions are urgently needed with respect to both subspecies of Agastache mexicana. First, native populations should be located and protected from over exploitation and habitat destruction. Second, direct interaction is needed to propagate the various races under cultivation. In order to justify more human effort in the conservation of **toronjil**, commerialization could be initiated for both subspecies so as to make cultivation more attractive economically than wild collection. These and other species are valued for domestic consumption and in local markets; some species are even exported to other regions of Mexico and the world. Chemical analysis of **toronjil blanco** have indicated the relatively high production of certain compounds of pharmaceutical, pesticide and perfumary value. If these substances are the results of hybridization, the elucidation of the evolutionary origin of **toronjil blanco** can be a guide to future breeding programs.

Specific data on the biosystematics, chemistry, cytogenetics, ethnobotany and horticulture will be published in the future by the collaborators and their students.

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The herb vendors, campesinos and native health practitioners shared generously their knowledge, experiences, plants and hospitality. The staff and students associated with the Jardín Botánico, Herbario Nacional (MEXU), Instituto de Biología, Instituto de Química and Facultad de Ciencias of the Universidad Nacional Autónoma de México, Escuela Nacional de Ciencias Biologicas of the Instituto Politecnico Nacional (ENCB), Unidad de Investigación Biomédica en Medicina Tradicional y Desarrollo de Medicamentos of the Instituto Mexicano de Seguro Social (IMSSM), and Jardín Botánico Medicinal y Museo de Medicina Tradicional (Morelos) of the Instituto Nacional de Antropología e Historia assisted in various parts of the study. We are particularly indebted to the following students: Bernarda Contreras Trejo, Carmen Yenitzia Chávez Carpio, Alejandro Díaz, Lilia Patricia Espiritu V., Carlos Guido Formosa, Noé Meraz Cruz, Laura Elizabeth Nava Ramirez, Ernesto Olmos Cabrera, and Martha L. Rodriguez Morales. Roger W. Sanders kindly shared his knowledge and opinions with us. B. L. Turner, W. A. Weber, and Margarita Aviles helped in various ways. F. Chiang assisted with the Latin diagnosis. Financial support for chemical analysis was provided by CONACyT PCCBBNA 021142.

LITERATURE CITED

Bailey, L.H. and E.Z. Bailey. 1976. Hortus Third. New York, NY: Macmillan Publ. Co., Inc.

Baytelman, B. 1979. Etnobotánica en el Estado de Morelos. México, DF: INAH.

Bye, R., and E. Linares. 1983. The role of plants found in the Mexican markets and their importance in ethnobotanical studies. Journal of Ethnobiology 3(1): 1-13.

Chávez Carpio, C.Y. 1986. Propagación vegetativa de **toronjil morado** (Agastache mexicana (HBK) Lint & Epling) and **toronjil blanco** (Agastache sp.) por esquejes de tallo, bajo condiciones de invernadero. México DF: Tesis de Biología, Facultad de Ciencias, UNAM.

Contreras, B., L.P. Espiritu, O. Collera y F. García. 1986. Estudio quimiotaxonómico de Agastache mexicana var. roja y blanca. Memoria del 1er. Congreso Latinoamericano de Fitoquímica. Instituto de Química, UNAM.

De la Cruz, M. 1964. Libellus de Medicinalibus Indorum Herbis. Mansuscrito Azteca de 1552 según traducción latina de Juan Badiano. México, DF: IMSS.

Gali, H. 1984. 100 Flores que Curan. México, DF: Gómez Gómez Hnos. Editores.

Galindo Manrique, Y. 1982. Estudio faramacológico de algunas plantas medicinales reportadas popularmente por la población mexicana para el tratamiento de padecimientos cardiovasculares. Mexico, DF: Tesis de Biología, Escuela Nacional de Estudios Profesionales, Iztacala, UNAM.

González Rodrigo, J. 1981. Ecología humana y ethnobotánica de un pueblo campesino de la Sierra Nevada, Méx.: Santa Catarina del Monte. México, DF. Tesis Profesional, Facultad de Ciencias, UNAM.

Harlan, J.R., amd J.M.J. de Wet. 1971. Toward a rational classification of cultivated plants. Taxon 20: 509-517.

Hernández, F. 1959. Historia Natural de Nueva España. México, DF: UNAM.

Linares Mazari, M.E., R. Bye and B. Flores Peñafiel. 1984. Tes Curativos de Mexico. Mexico, DF: FORNART.

Martínez, M. 1939. Las Plantas Medicinales de México. México, DF: Ediciones Botas.

Sanders, R.W. 1979. A Systematic Study of Agastache section Brittonastrum (Lamiaceae, Nepetae). Austin, TX: Ph. D. Dissertation, University of Texas.

Sociedad Farmacéutica de México. 1904. Nueva Farmacopea Mexicana. México, DF: Oficina Tipográfica de la Secretaría de Fomento.

TWO NEW COMBINATIONS IN CHROMOLAENA (ASTERACEAE: EUPATORIEAE) FOR DOMINICA.

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In writing Asteraceae for the Flora of Dominica it became evident that combinations were needed in Chromolaena for two endemic species of Eupatorium, sensu lato. Drs. Robert King and Harold Robinson confirmed the need for the new combinations and suggested that they be published quickly in the hope they could be incorporated in their nomenclator of the Eupatorieae, now in press.

Chromolaena impetiolaris (Griseb.) Nicolson, comb. nov.
Eupatorium impetiolare Griseb., Fl. B.W.I. 357. 1861.

I have not seen the type, an Imray collection (K?) from the mountains of Dominica, but later collections with sessile, subbasally triplinerved leaves gland-dotted below matched with Grisebach's description. I have six collections from three localities on Dominica: summit of Morne Trois Pitons, Freshwater Lake area and Rosehill (on the way to Morne Anglais).

Chromolaena macrodon (DC.) Nicolson, comb. nov.
Eupatorium macrodon DC., Prodr. 5: 145. 1836.

The type is in the de Candolle Herbarium (microfiche no. 34174), from the summits of mountains of Dominica. De Candolle said that he got it from L'Heritier but no collector was indicated (de Porthieu?). It is distinguished from other Dominican species by its lack of gland-dots on the lower leaf surface, as noted by de Candolle. I have six collections from four localities on Dominica: Morne Anglais, Morne Diablotins, Morne Plat Pays, and Morne Trois Pitons, on summits or associated ridges.

THE SUBSPECIES OF *SOLANUM GOURLAYI* HAWKES

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Solanum gourlayi Hawkes, a wild tuber bearing species, is commonly found in dry valleys at about 3000 m above sea level in the provinces of Jujuy and Salta in northwestern Argentina. This species includes both diploid and tetraploid cytotypes which have been found to differ only in minor morphological characters (Clausen *et al.*, 1987).

According to the morphological and geographical evidences, these cytotypes may be recognized as subspecies. The purpose of this paper is to describe the diploid and tetraploid cytotypes of *S. gourlayi* and propose their taxonomic recognition under the subspecies rank.

Solanum gourlayi Hawkes (Bull. Imp. Bur. Pl. Breed. Genet., Cambridge, 120-212, 1944).

Herbaceous; tubers ovoid to globular, 2-3 cm. diam., skin and flesh white. Stem generally erect, slender, 2-3 cm diam., branched, sparsely pubescent. Leaf green to slightly glaucous, 3.0-8.5 cm broad x 7.0-15.0 cm long. Leaf (2-) 3-4 (-5) jugate with (0-) 2-6 (-10) pairs of interjected leaflets, which are small and orbicular; lateral leaflets elliptic to lanceolate, hairs denser on lower surface, petiolulate or sessile. First pair of uppermost primary lateral leaflets 7-27 mm broad and 17-42 mm long, often decurrent (1-3 mm long) on to the leaf rachis; second pair of primary lateral leaflets 6-20 mm broad x 10-40 mm long. Terminal leaflet ovate, apex acute 7-21 mm broad x 13-55 mm long, larger than or equal to the lateral leaflets. Inflorescence 6-15 flowered, peduncle normally forked, pubescent; pedicels pubescent articulated at the middle or at two thirds from the base. Calyx green or slightly purpled tinged, pubescent, 4-8 mm long with 1-10 mm long acumens. Corolla purple or purple-violet, pentagonal, long and short radii 9-21 mm and 6-14 mm long respectively. Anther column cylindric, anthers (3-) 4 - 5 - 6 mm long. Style 8-14 mm long, 2-9 mm exserted above the anther tube; stigma clavate. Berries globular, 1-2 cm diam., green with white dots. Diploid pollen 18-22 μ diam.; tetraploid pollen 22-25 μ. Chromosome numbers 2n = 2x = 24 and 2n = 4x = 48.

Solanum gourlayi ssp. *gourlayi*

Leaf (2-) 3 (-4 -5) jugate; lateral leaflets generally smaller than the terminal leaflet, often decreasing rapidly in size towards the leaf base; petiolules 0-3 mm long. Calyx acumen 6-10 mm long. Anthers (4-) 5 - 6 mm long., style exserted 3-9 mm above the

anther tube. Diploid pollen 18-22 μ diam., 22-25 μ the diam. of tetraploid pollen. Chromosome number 2n = 4x = 48 rarely 2n = 2x = 24 (Fig. 1).

The most variable characters were analized utilizing Student's T - test (Table 1). When the tetraploids are compared with the sympatric diploids, it can be observed that they differ significantly only in a few characters such as size of the first pair of primary lateral leaflets, style length and pollen diameter. Due to the low frequency of the diploids in Jujuy (only four collections have been found so far), they have been included in subspecies *gourlayi*.

S. gourlayi ssp. *gourlayi* is restricted only to the Quebrada de Humahuaca and its side valleys in the province of Jujuy, having a south-north extension of about 100 km. It is found between 1900 and 3800 m above sea level on dry and stony hillsides and at the edge of cultivated fields.

Specimens examined
Province of Jujuy, dept. Tumbaya

Diploids

Abra de Tumbaya Grande, alt. 1900 m, Hof 1800; 9 km from Purmamarca on route 16, alt. 2800 m, Oka 4307; Quebrada de Sepulturas, Puerta de Potreros, Oka 4333.

Tetraploids

Quebrada de Sepulturas, alt. 3100 m, Oka 4336; Quebrada de Sepulturas, Puerta de Potreros, Oka 4330; Oka 4335.

Province of Jujuy, dept. Tilcara

Diploid

Quebrada de Hornillos, alt. 3050 m, Hoff 1636.

Tetraploids

Sierra de Malpaso, Quebrada de Huichaira, near Tilcara 6 km from route 9, alt. 2800 m, Oka 3801; Oka 3802; Oka 3804; Oka 3808; Oka 3810; Oka 3811; Oka 3812; Oka 3813; Oka 3814. On the road to Alfarcito, near Garganta del Diablo, alt 3000 m, Oka 4287; Quebrada del Chorro, on the way to Casa Colorada, Oka 4432; Oka 4434; on the way from Quebrada del Chorro to Molulo, Oka 4445.

probably tetraploid

Above Tilcara, Quebrada de San Gregorio, Balls, Gourlay & Hawkes 5979 (K, JGH Type collection).

Province of Jujuy, dept. Humahuaca

Tetraploids

Cianzo, alt. 3800 m, Oka 4493; Oka 4494; Oka 4495; Esquina blanca, ruta nac. 9, 100 m from Río Grande, alt. 3500 m, Oka 4549; Oka 4553; Serranía de Aparzo, Angosto de Aparzo, 39 km east of Humahuaca, alt. 3600 m, Oka 5376; Pucará, alt. 3500 m, Oka 6725; between Estación Azul Pampa and Esquina blanca, alt. 3600 m, Oka 7040; Oka 7043; Oka 7050; Oka 7051; Quebrada de Incacuevas o Chulín, alt. 3600 m, Oka 7085; Oka 7086; Esquina blanca, alt. 3600 m, Oka 7135.

Solanum gourlayi subspecies *saltense* Clausen & Okada *ssp. nova.*

Folium (3-) 4 (-5) *juga; foliola lateralia foliolum terminale plerumque aequantia petiolulis* 2 - 5 mm *longis saepe sine in rhachim decurrentibus. Acumina calycis* 1 - 3 mm *longa. Antherae* (3-) 4 (-5) mm *longae. Stylus tubum antheram* 2-5 mm *superans. Pollen* 18 - 21 μ *diametro. Chromosomatum numerus:* 2n = 24. *Differt haec subspecies a subspecie typica foliolis lateralibus basim folii non celeriter decrescentibus.*

TYPE: Argentina, Prov. of. Salta, Department La Poma, on route 40, 1 km south of El Rodeo, near the road. Alt. 3900 m, 21 March 1973. Okada, Ross, Haisma & Lucarini 4841 (HOLOTYPE, Herb. Bal.).

Province of Salta, dept. La Poma

El Rodeo, on route 40. Alt. 3900 m, Oka 4837; El Rodeo, 500 m south on route 40, alt. 3900 m, Oka 4840; El Rodeo, on route 40, km 1315, 18 km south of Abra de Acay, alt. 3880 m, Okada & Lucarini 4866; El Rodeo, 1 km south on route 40, alt. 3740 m, Okada & Lucarini 4867; on route 40, between La Quesera and El Rodeo, alt. 3700 m, Okada & Lucarini 4869; La Quesera, on route 40, alt. 3700 m, Okada & Lucarini 4870; between El Trigal and Esquina Azul, 20 km north from La Poma, alt. 3300 m, Okada & Lucarini 4919; Okada & Lucarini 4920; Okada & Lucarini 4921; near Puerta de Tomayos o Finca Azul, alt. 3480 m, Okada & Lucarini 4922; Oka 4925.

Province of Salta, dept. Los Andes

San Antonio de los Cobres, on route 51, alt 3800 m, Okada & Lucarini 4872; Okada & Lucarini 4873; Okada & Lucarini 4876; Okada & Lucarini 4877; Oka 4891; Oka 4887; Oka 4892; Oka 5570; Oka 5571; Matancillas, alt. 3700 m, Oka 5572; Sierra del Cobre, on route 51, km 1645, alt. 3800 m, Oka 5586.

Leaf (3-) 4 (-5) jugate, lateral leaflets generally similar in size to the terminal leaflet; petiolules 2-5 mm long; decurrency generally absent. Calyx acumen 1-3 mm long. Anther (3-) 4 (-5) mm long. Style exserted 2-5 mm above the anther tube. Pollen grain 18-21 μ diam. Chromosome number 2n = 2x = 24 (Fig. 2).

In ssp. *saltense* the primary lateral leaflets do not decrease in size rapidly towards the leaf base as shown by the length of the first and second uppermost pairs (Table 1).

Subspecies *saltense* can be also distinguished from ssp. *gourlayi* by its smaller terminal leaflet, by the shorter style and anthers, by the shorter exsertion and by the smaller pollen grains. Subspecies *saltense* occurs in western Salta at altitudes of 3300-3900 m, from Sierra del Cobre southwards through the upper course of the Río Calchaquí and further south into mountain ranges of La Poma, Cachi and Isonza, with a north-south extension of about 150 km. It grows on rocky hillsides, on stream banks and about cultivated fields.

LITERATURE CITED

Clausen, A., M., K.A. Okada and J.V. Crisci. 1987. Multivariate analysis of morphological variation in diploid and tetraploid populations of *Solanum gourlayi* Hawkes and related species. Submitted for publication.

TABLE 1 - Comparative morphology of ssp. *saltense* (2x) and ssp. *gourlayi* (2x, 4x)

Subspecies	Characters *							
	1	2	3	4	5	6	7	8
saltense (2x) N = 56	31.9_a	12.9_a	26.9_a	9.9_a	4.4_a	9.62_a	3.6_a	20.4_a
gourlayi (2x) N = 19	36.6_b	15.4_b	27.8_{ab}	8.7_b	4.5_{ab}	10.1_a	4.6_b	19.6_b
gourlayi (4x) N = 138	40.3_c	17.7_c	24.7_b	9.5_{ab}	4.6_b	11.2_b	5.2_c	23.3_c

*Key to characters: 1-2 = length and width of terminal leaflet (mm); 3 = length of second uppermost lateral leaflet (mm); 4 = short radii of the corolla (mm); 5 = anther lenght (mm); 6 = style lenght (mm); 7 = style exsertion (mm); 8 = pollen diameter (μ).

Column means followed by the same letter are not significantly different ($P \leqslant 0.05$) according to the Student's T test.

N = number of plants grown in a screenhouse.

Fig. 1. *Solanum gourlayi* subspecies *gourlayi* collected at 3900 m near Tilcara, prov. Jujuy. 2n = 4x = 48. Oka 4434.

Fig. 2. *Solanum gourlayi* subspecies *saltense* Clausen & Okada, collected at 3900 m near El Rodeo, prov. Salta. 2n = 2x = 24. Holotype; Okada, Ross, Haisma & Lucarini 4841.

THE GENUS TRUKIA KANEHIRA (RUBIACEAE)

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This genus was set up by Kanehira in 1934 to accommodate a large shrub (or small tree) that he had found on Truk in 1931. The genus was considered monospecific and endemic in the Truk group, a small group of volcanic islands surrounded by a great atoll-like coral reef, in the central Caroline Islands, Micronesia.

Kanehira described his species first in 1932, as Timonius megacarpus Kaneh., then, the same year, transferred it to Rhopalobrachium Schlechter & Krause, a New Caledonian genus, with a single ovule in each of two ovary locules. Then, in 1935, Kanehira discovered that the fruit of his plant has many seeds, rather than one in a cell, and described the genus Trukia for it. Later, in 1936, he found that Valeton had described the same species in 1930, as Randia carolinensis, based on a Kraemer specimen, collected in 1910, also from Truk. Kanehira and Hatusima then, in 1937, transferred Valeton's species to Trukia.

However, it fit readily in Randia, then accepted as having a very broad circumscription, and it has since been generally referred to as Randia carolinensis Valeton.

In 1968 I studied the type material of Randia tahitensis Nadeaud, in Paris, and noted that it seemed related to R. carolinensis.

Since then, Dr. Deva D. Tirvengadum has undertaken a study of the Rubiaceae-Gardeniae of South Asia and Ceylon, most of which were then regarded as belonging to Randia. This study was started when he was a Smithsonian Fellow, in 1974-75, and has continued since. He has concluded that Randia included a great diversity of elements, and has gone a long way in dismembering it.

While not being ready to accept completely this segregation, I can maintain, at least, such genera as Aidia, Rothmannia, and probably Porterandia, as distinct from Randia, pending an overall conspectus of the Gardenia tribe, which Tirvengadum will hopefully have ready soon.

Randia carolinensis and Randia tahitensis are representative of a small alliance of species, in southeast Asia and the Pacific,

mostly not well-known, and very poorly represented in herbaria immediately accessible to me, that is no closer to Randia L. sensu stricto than the three above-mentioned genera. Among these species may be mentioned Randia dryadum (S. Moore) Merr. & Perry, from New Guinea to the Solomon Islands, R. macarthurii F. Muell. from New Guinea, R. fitzalanii F. Muell. ex Benth. from Australia, R. macromera Lauterb. & Schum., from New Guinea, and R. candolleana W. & A. from India.

These five species, and probably others of which we have no material, have in common, spinelessness, large elliptic to obovate petiolate leaves, relatively few-flowered, sometimes condensed cymes, flowers pedicellate, with cup-shaped calyx, corolla with relatively short tube and limb in bud tapering from a thick base to a sharp point, entire or with 5 free tips; stigma of 2 thick elliptic coherent lobes, tardily separating; fruit large subglobose, surface scurfy, seeds many, irregularly compressed, embedded in pulpy placentae filling the 2 cells.

We do not find a generic name that applies to this alliance, or to any member of it, except Trukia Kanehira. Since we need names for the Polynesian and Micronesian species, we will maintain Trukia for our species and their immediate allies, at least until Randia is better understood on a pan-tropical basis. Its type species is Timonius megacarpus Kanehira (= Trukia carolinensis (Valeton) Kanehira and Hatusima.

Trukia Kanehira, Bot. Mag. (Tokyo) 49: 278-279, 1935.

Randia pro min. parte, non L., Gen. Pl. 1753: Sp. Pl. 1192, 1753.

Small trees or large shrubs, unarmed, diffusely branched; leaves opposite, petiolate, coriaceous or subcoriaceous or membranous(?), elliptic, oblong, or obovate; stipules ovate to lanceolate, subpersistent; inflorescence fasciculate to cymose, axillary or at terminal node and becoming axillary; flowers pedicellate, calyx cup-shaped; corolla salverform, tube short, enlarged upward, limb tapering and pointed in bud, lobes 5, spreading or reflexed; anthers oblong, dorsifixed near base of corolla throat; style slender, stigma fusiform, of 2 coherent tardily separating lobes, ovary bilocular, ovules many; fruit subglobose, 2-3 cm or more diameter, becoming scurfy on drying, locules filled with fleshy placenta; seeds 8-10 or more in a locule, embedded in placenta, irregularly compressed.

A small, poorly known genus, a segregate from Randia, perhaps closest to Rothmannia, extending from India to Thailand and Australia, eastward in the Pacific to Truk and Tahiti.

Trukia carolinensis (Valeton) Kanehira & Hatusima. Bot. Mag. (Tokyo) 50: 606, 1936; Hosokawa, Bull. Biogeogr. Soc. Japan 7: 20, 1937.

Randia carolinensis Valeton, Bot. Jahrb. 63: 301-302, 1930; Kanehira, Enum. Micr. Pl. 424, 1935; Fosberg, Occ. Pap. Bishop Mus. 15: 216, 1940; Fosberg, Sachet & Oliver, Micronesica 15: 277, 1979.

Timonius megacarpus Kanehira, Bot. Mag. (Tokyo) 46: 494, 1932.

Rhopalobrachium megacarpum [sic] (Kanehira) Kanehira, Bot. Mag. (Tokyo) 46: 624, 1932; Fl. Micr. 377-78, fig. 201, 1933.

Trukia megacarpa (Kanehira) Kanehira, Bot. Mag. (Tokyo) 49: 279, 1935; Enum. Micr. Pl. 426, 1935.

Shrub or small tree, to 10 m tall, vegetative parts glabrous or sub-glabrous, stems gray, squarish but not sharply angled; leaves obovate to elliptic, to 30 x 14 cm, usually much smaller, shortly and bluntly acuminate at apex, base cuneate, veins 9-10 (-12) on a side, network not prominent, petiole rather stout, 1-2 cm long; stipules ovate-lanceolate, acute to acuminate, dorsally carinate, shortly connate at base; inflorescence a once or twice dichotomous cyme, variously reduced to sub-fasciculate, axillary or more rarely at terminal node and becoming axillary, branches somewhat scorpioid or sub-helicoid, flowers very few on a branch at any one time, pedicellate, pedicels 5 (-10) mm long, jointed to very short "branchlets" (actually short successive axes), subtended by ovate scale-like bracts in pairs, whole cyme glabrous; hypanthium and calyx turbinate-cup-shaped, truncate or margin obscurely obtusely dentate; corolla white with short swollen tube to 7 mm long, densely white sericeous-strigose, "tubus intus dense hirsutus pilis erectis", lobes to 1 cm long, broadly lanceolate, slightly hastulate at base, glabrous, in bud tapering, very slightly contorted and overlapping to left; anthers narrowly oblong, apiculate, dorsifixed at base of throat; style glabrous, stigma fusiform, obtuse, of 2 coherent tardily separating halves; fruit globose, to about 4 cm diam., lepidote externally, and somewhat rugose when dry, mesocarp very thin, endocarp thin but hard, indurated, circular scar of calyx 10 mm broad surrounding disk 6 mm broad, septum very thin, breaking away from endocarp; seeds compressed, hard, 16-20 embedded in the loosened placental mass.

Specimens examined:

CAROLINE ISLANDS: Yap: Mt. Matade, 160 m, Fosberg 25533 (US, BISH). Truk: Moen: Mt. Trokken, Hosokawa 8405 (BISH, A, US); slopes and main ridge of Mt. Teroken, Fosberg 24610 (US, BISH, POM, NY, L); on slope back of Moen village, 5 m, Anderson 767 (US, BISH, POM, NY, L), 788 (US, BISH, POM, NY, L), Mwan, 150-200 m, Falanruw 3506 (US); Spence 443 (BISH); E ridge of Mt. Winipwen, Fosberg 60249 (US, BISH, POM, NY, L); Wichen River, Stemmermann 3053 (BISH). Dublon: Natsushima (Dublon), Takamatsu 69 (BISH),

83 (BISH), 158 (BISH), 155 (BISH); 800 ft [245 m], Hosaka 2766 (US, BISH, POM, NY, L); upper ridge & top of Mt. Tolomen, 200-360 m, Fosberg 24552 (US, BISH, POM, NY, L), 24540 (US, BISH, POM); Toloas, Pelzer 42 (US, BISH, POM, NY, L); "Auf dem Rücken Ils." (or "Ruken des Tolowan" or Tolomen), Hallier (HBG, 2 sheets, US). Tol: Takamatsu 38 (BISH); 300-400 m, Kanehira 1275 (BISH, US, NY, P); Uriribot, Hosokawa 8279 (BISH, A, US); Pelzer 30 (US, BISH); Mt. Winipwoot, 1400 ft [425 m], Wong 266 (A, US, BISH); Mt. Tumuital (Uiniboet), 200-460 m, Fosberg 24470 (US, BISH, POM, NY, L), 24469 (US, BISH, POM, NY, L). Udot: Monowe, hill back of village, Fosberg 60242 (US, BISH, POM, NY, L). Fefan: Mt. Ibal, Hosokawa 8368 (BISH, A); Messa village, 100-200 m, Falanruw 3528 (US).

Trukia tahitensis (Nadeaud) Fosberg, new comb.

Randia tahitensis Nadeaud, Enum, Pl. Tahiti 54, 1873; Drake, Ill. Fl. Ins. Mar. Pac. 83-84, 191, T. 42, 1889, 1892; Fl. Polynes. Fr. 90, 1892, 1893.

Tree 10-12 m tall, branchlets glabrous, wood hard; leaves glabrous, elliptic or narrowly obovate to 14 x 5 cm, apex slightly acuminate, veins about 8 on a side, petiole about 1 cm; stipules ovate, shortly appressed hispid, connate at base, caducous; flowers on long pedicels, several from condensed dwarf axillary branchlets about 5 mm long; pedicels filiform, to 28 mm long, thickened at apex, passing into hypanthium; calyx campanulate, truncate, puberulent; corolla in bud swollen at base, tube urceolate, about 6 mm long, limb tapering to about 20 mm long, 5 free tips unequal, tube externally appressed pilose, 5 lobes elongate, oblong-acute, strongly recurved; anthers elongate, sessile in corolla tube; stigma "conic" (in Drake's illustration of 2 separate thick elliptic lobes) subglobose, 22 x 20 mm, septum "evanidis", resulting in a unicellular fruit filled with large irregularly compressed seeds 5-10 mm across. (Description from syntype collection, amplified from original description). Drake's Tab. 42 is an excellent illustration with analyses.

Closely allied to Trukia carolinensis, differing in details. Found by Nadeaud on high ridges in Tahiti.

In a manuscript account of his visit in 1896, Nadeaud mentions recollecting this species April 5, "sur les cretes de droite de pirae á 1100 m, á Puairi". I have not seen this collection.

A sterile specimen collected in Orofero Valley, Fosberg 63730, is probably this species, but the young growth is sparsely appressed pubescent, leaves are membranous and the stipules acuminate. John W. Moore collected it on Raiatea in 1927. There are remarkably few collections, possibly because it is very ordinary-looking, inconspicuous plant when not in flower or fruit.

From the 2 Raiatea collections we may add to the above description that the leaves may be thin-chartaceous, up to 16.5 x 8 cm; flowers white (not present in Bishop Museum sheets); fruit larger, up to 50 x 32 mm, broadly oval, slightly pointed, wall perhaps thinner than in T. carolinensis.

Specimens examined:

SOCIETY ISLANDS: Tahiti: Tapuna, above Pirae (ridge to Aorai, Nadeaud 359 (P, syntype, 7 sheets, flowering sheet designated by me as lectotype, as it best represents the species). Raiatea: on ridge N end of highest mountain, J. W. Moore 714 (BISH); on ridge of mountain N of Faaroa Bay, 400 m, J. W. Moore 554 (BISH).

Transfers are made for three species that clearly are this affinity, though I have not had available specimens or information sufficient for a proper comparative study. Of others which may belong here I have not had sufficient material even to justify transfers.

Trukia dryadum (S. Moore) Fosberg, new comb.

Gardenia dryadum S. Moore, Journ. Bot. 65: 247, 1927.
Randia dryadum (S. Moore) Merr. & Perry, Journ. Arn. Arb. 25: 201, 1944.

This species differs only in detail from T. carolinensis. The leaves and fruits are significantly larger, the pedicels longer and more slender.

Known from New Guinea, New Britain and from the Solomon Islands.

Specimens examined:

NEW GUINEA: Papua: Milne Bay Dist.; Goodenough Island, 150 m, Brass 25124 (US); Menapi, Cape Vogel Pen., 80 m, Brass 21964 (US). NEW BRITAIN: Otto Island, 25 mi WNW of Fulleborn Harbour, Isles and Croft 32223(US); Neco Gengia, Tetemara, L. Maenu'u (BSIP) 6105 (US). SOLOMON ISLANDS: Santa Ysabel: Binusa, Beer's collection, (BSIP) 6603 (US).

Trukia fitzalanii (F. Muell.) Fosberg, new comb.

Gardenia fitzalanii F. Muell., Rept. Burdk. Exp. 12, 1860.
Randia fitzalanii F. Muell. ex Benth., Fl. Australia 3: 411, 1867.

Inflorescences very large and open. Cultivated material, only, seen. Native of Australia.

Specimen examined:

Honolulu: H. L. Lyon Arboretum, Ishikawa 72 (US); Bogor, Hort. Bogor., s. coll. (US).

Trukia macarthurii (F. Muell.) Fosberg, new comb.

Randia macarthurii F. Muell., Notes Papuan Pl. 1: 68, 1876.

A species with large flowers, with linear corolla lobes, that probably belongs here.

Known from New Guinea and neighboring islands.

Specimen examined:

ARU ISLANDS: Lutor, Beccari in 1873 (US).

A NEW PISONIA (NYCTAGINACEAE) FROM THE HAWAIIAN ISLANDS

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Pisonia wagneriana Fosberg, new species.

Pisonia valde affinis P. umbellifera (Forst.) Seem. praeter cymas juniores et perigonia in alabastra pilosa, alabastra masculina subacuta, hypanthia turbinata costata, cymas fructificantes expansas, ramificationes cymarum habentes ad articulos nodas-aggregatas parvulas.

Tree 7-10 m tall, "several trees grouped together", habit of P. umbellifera, perhaps fewer internodes compressed together, no more than 4 leaves at an aggregate node, glabrous, stem appearing fistulous, squarish, internodes 2-9 cm; leaves spatulate-obovate, blades to 30 x 9.5 cm, apex rounded to shortly and rather abruptly acuminate, base gradually cuneately contracted decurrent on the short (1-2 cm) petiole, venation not prominent, 8-10 nerves on a side, forking once or twice and anastomosing toward margin, network obscure; staminate cymes slender, shortly pilose, to 20 cm long, peduncle to 15 cm, 3 times umbellate, 3-5 rays in an umbel, to 6 cm long, ultimate triads with buds subsessile to pedicellate, a very small pubescent scale-like bractlet at base of pedicel or part way up, or at base of receptacle; perianth in bud pointed, cylindric-campanulate to funnelform campanulate at anthesis, tube 2.5 mm long, ribbed, turbinate, lobes 4, ovate, equalling tube, spreading to recurved, slightly puberulent externally, glabrous within, margins papillose, slightly thickened, crispate when dry, apices acutish; perianth-lobes and filaments white; stamens 6-9, exserted to twice length of lobes, anthers orbicular, pistillode exserted about 2 mm, stigma somewhat enlarged, recurved or hooked, apex papillate-puberulent, at least on concave part of apex; pistillate cymes, at anthesis, 5-6 cm long, on very short branchlets, several of these of different ages from one aggregate node, peduncle slender, 4 cm long, minutely puberulent, with 2-4 short branches, these ending in irregular umbellules of 4-7 very shortly pedicellate flowers, or very shortly branching again, each ramification originating in a miniature "aggregate node" with scars of bracts and branchlets or pedicels, the pedicels 1-3 mm, elongating in fruit to as much as 7 mm, dilating gradually into receptacle, pistillate perigone at anthesis tubular or slightly prismatic, tube 4-5 mm long, slightly thicker at base or not, very minutely puberulent, lobes 4, ovate, somewhat spreading, thick, about 1.5-1.7 mm long, margins papillate puberulent, glabrous within, staminodia 5-6, antherodia oblong, 0.5 mm long, included

or almost so, style glabrous, slightly exceeding perigone tube, stigma much branched, the branches capillary and somewhat plumose, the whole like a minute mop or feather duster; fruiting cymes very open, to 20 x 15 cm, peduncle to 11 cm, anthocarps (not quite mature) about 4 cm long, basal half slightly swollen, distal half narrow, cylindric, "rostrate", lobes thick, indurate, somewhat spreading, inner edge prolonged slightly beyond the thickened margin, whole anthocarp somewhat 4-sided, slightly 4-carinate, very viscous.

This species would be included in Pisonia umbellifera (Forster) Seemann, sensu latissimo, but seems closer to some of the Society Islands members of this affinity than to the variable Hawaiian species commonly considered to be P. umbellifera. Characters that set this species off are the somewhat pointed rather than rounded staminate buds, pilose staminate cymes, turbinate and ribbed, rather than campanulate staminate perigone tube, with lobes as long as tube, fruiting cymes with miniature aggregate nodes at ramifications. This latter tendency is also apparent in at least two Oahu collections of P. umbellifera, Yuncker 3234 (US) and Fosberg 10798 (US). Some intergradation seems to be found between most species of Pisonia sect. Prismatocarpa. Further field study of populations of Pisonia on windward Kauai should either strengthen and better define this taxon, or show it to merit a lower rank.

Named for Dr. Warren L. Wagner, of the B. P. Bishop Museum, Honolulu, in recognition of his work in producing a Guide to the Hawaiian Flora.

Specimens examined:

HAWAIIAN ISLANDS: Kauai: "Maunahina, Wainiha, 3--325 m", Earle 49 (BISH); Limahuli Valley, along stream in very rocky area, 770 ft, 17-XII-1985, T. Flynn & M. Bergau 1453 (PTBG, holotype, 2 sheets); 1100 ft. Perlman & Wichman 204 (BISH); Power trail, 650 m, MacDaniels 696 (BISH).

BOBEA PLATYPES FOSBERG, NEW SPECIES (RUBIACEAE), FROM MAUI, HAWAIIAN ISLANDS

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This paper describes and discusses a taxon of the endemic Hawaiian genus Bobea Gaudichaud, related to Timonius in the Rubiaceae. This species has awaited publication for some years, pending a review of the genus, but time and other commitments have not permitted completion of the study. It is presented here to be in time for consideration for inclusion in the forthcoming Manual of the Hawaiian Flowering Plants, being prepared at the Herbarium Pacificum, B. P. Bishop Museum, Honolulu.

Bobea platypes Fosberg, new species.

Arbor, foliis ellipticis vel obovatis obtusis vel acutis basi in petiolis plus minusve decurrentibus, stipulis triangulo-lanceolatis, flore pistillato solitario super pedunculo 1-6 cm longo valde compresso, calyce truncato, flore staminatis in cymo triflore, calyce bilobato, drupa globosa pyrenis 8, rugosis.

Tree to 10 m tall, 1 m diam., ultimate ramification tending to be somewhat terminalioid, branchlets corky, glabrous to very slightly strigulose, tending to be squarish, somewhat fistulose, young internodes collapsing somewhat when dried, proximal internodes of a growth cycle 4-8 cm long, becoming shortened and nodes crowded distally, to as close as 5 or even 2 mm apart, internodes 3-5 mm thick, nodes prominent, 5-7 mm in widest dimension, with transverse rows of appressed straight hairs in axils of stipule scars, leaf scars prominent, orbicular to somewhat shield-shape, with a rounded V-shaped bundle scar, branchlet tips gummy; leaf blades thin, elliptic to somewhat obovate, mostly 3.5-5 cm wide, 5-10 cm long, apex obtuse to acutish, base contracted to subcuneate, main veins not prominent, 6-7 on each side, arching upward except the basal pair which are close to the margins, network fine but conspicuous on underside, lower side of midrib and margins rarely appressed hairy, petioles 1-2 cm long, somewhat flattened above, blade narrowly decurrent on petiole to halfway or even to base; stipules covering terminal bud, soon caducous, triangular lanceolate, usually acuminate, glabrous without, a densely appressed hairy triangle within on lower half; peduncles in upper axils, 1-6 cm long, 1.5-3 mm wide, strongly flattened dorsiventrally, pistillate generally shorter than staminate, with a complete or incomplete stipular collar or involucre at summit, pistillate flowers sessile, solitary in collar, calyx a truncate cup, corollas unavailable, staminate with a subsessile

central flower and two flattened branches in the involucre, each branch up to 1 cm long, ascending, with 2 connate scale-like bracts at summit, free parts very low triangular obtuse, this involucel hirsute within near base, bearing a very shortly pedicellate flower, calyx cup-like, with 2 very low, broadly rounded lobes, corolla (almost mature buds) 10-13 mm long, tube about 3 mm long, 1.2 mm thick, throat 6 mm long, 2 mm thick, lobes 4, broadly oblong, 3 mm long, imbricate, outer pair over inner, apices rounded and somewhat cuculate, outer pair somewhat auriculate at base; anthers linear-oblong, dorsifixed about 1 mm from base, attached 6.5 mm from base of corolla, pistillode 5 mm long, bifid about 2 mm; fruit globose, 6-7 mm (1 cm when ripe and crushed) diameter, disk about 3 mm across, surrounded by remains of split calyx, in center an enlarged callose style-base about 1.5 mm across and high, pyrenes 8, 4 mm long, carinate and strongly rugose on backs.

This species is distinguished from all other species of the genus by its strongly flattened peduncles, as the specific epithet chosen is intended to suggest.

It seems in several respects to belong with the B. elatior group, having leaves tending to be obovate, peduncles long, calyx truncate or shallowly 2-lobed, and drupes with 8 pyrenes, but differs in leaf-base and texture of blade, in the strongly flattened peduncle, and in the rugose dorsal surface of the pyrenes. The available material shows very little variation in most features. Lamoureux & DeWreede 4045 has the young growth, petioles, midribs, main veins and leaf margins strigose, mostly lightly so. The inner corolla lobes are very thinly strigose without. Other than this, the variation does not seem at all significant.

B. platypes grows in the extremely wet forested areas at low to middle elevations on the east and northeast slopes of East Maui, where it has been collected a number of times.

HAWAIIAN ISLANDS: Maui (East): Kipahulu, west part of valley, 2600', Lamoureux & DeWreede 4045 (US, UH); Ridge at side, Kipahulu, Forbes 1666 M (BISH); Kipahulu, summit of west ridge of Kaukaua Gulch, 2600', St. John & Catto 17801 (BISH, holotype, US, K, POM, isotypes); Nahiku, Forbes 259 M (Bish, US, K, POM, MO, L, A, NY, P, UC); Along ditch trail from Haiku via Honomanu Valley to Keanae, Degener 11,632 (BISH).

NEW NOMENCLATURAL COMBINATIONS FOR GALAPAGOS PLANT SPECIES

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In a number of cases I accept different generic limits, and, hence, some different generic names from those adopted by Wiggins and Porter, Flora of the Galapagos Islands, 1971. In a few instances, appropriate specific names do not exist in the genera that I accept, and transfers and new combinations must be made.

In the Rubiaceae, I include the genus Borreria G.F.W. Mey., in the older genus Spermacoce L., in agreement with Dr. B. Verdcourt (Kew Bull. 30: 366, 1975). Wiggins and Porter place all but one of the eight Galapagos species in Borreria, six of which do not have names in Spermacoce. The one called by them Borreria laevis (Lam.) Griseb., introduced in the Galapagos is a pantropical weed that has been almost universally misidentified. Both Verdcourt and I have examined the type of Spermacoce laevis Lamarck, in the Paris Herbarium, and agree that it has nothing to do with the widely introduced, weedy species found in the Galapagos, which should be called Spermacoce assurgens R. & P. Dr. Verdcourt has established that the type of Spermacoce laevis belongs to Spermacoce tenuior L. (Kew Bull. 37: 545-546, 1983).

I do not accept the genus Lycopersicon L as sufficiently distinct from Solanum L. to constitute more than a section of the latter genus. The slight difference in the dehiscence of the anthers does not outweigh all the similarities in other features. The endemic Galapagos wild tomato has not, to my knowledge, heretofore been placed in Solanum, and requires a name in that genus.

The new combinations, with basionyms and references, follow:

Family SOLANACEAE

Solanum cheesmaniae (Riley) Fosberg, N. Comb.

Lycopersicum cheesmanii [sic] Riley, Kew Bull. 1925: 227, 1925; Wiggins & Porter, Fl. Galap. Is. 469, 1971.

Riley used the ii ending, despite the fact that the plant is named for the collector, Miss L. Evelyn Cheesman. The type is from Indefatigable Island (Santa Cruz), Cheesman in Riley

403 (K). In making the combination, I have changed the ending appropriately.

It is unfortunate that this epithet is so similar to that of Solanum cheesemanii Gerasimanko of New Zealand, named for a different person, altogether, and spelled slightly differently, but the two epithets are neither orthographic variants nor homonyms and must be maintained.

FAMILY RUBIACEAE

Spermacoce assurgens R. & P., Fl. Peruv. 1: 60, pl. 92, f. c, 1798.

Borreria laevis sensu auct. plur., et Wiggins & Porter, Fl. Galap. 424, 1971, non (L.) Griseb., Gött. Abh. 231, 1857 (Spermacoce laevis Lam., Ill. Gen. 1: 273, 1791).

Verdcourt, Kew Bull. 37: 545-546, 1983, has shown that Spermacoce laevis Lam. is synonymous with Spermacoce tenuior L.

Spermacoce confusa Rendle, Jour. Bot. Brit. & For. 74: 12, f. d-f, 1936; Wiggins & Porter, Fl. Galap. Is. 439, f. 112, 1971.

This species and S. tenuior L., from which it is scarcely distinct, are distinguished from those species treated by Wiggins and Porter as belonging to the genus Borreria G.F.W. Mey., only by having the two cells of the capsule slightly unequal, only one of which dehisces and releases its seed. This scarcely seems sufficient, especially as the two genera are indistinguishable when not fully mature.

Spermacoce dispersa (Hook. f.) Fosberg, n. comb.

Borreria dispersa Hook. f., Tr. Linn. Soc. Lond. 20: 217, 1847; Wiggins & Porter, Fl. Galap. Is. 421, 1971.

Spermacoce ericaefolia (Hook. f.) Fosberg, n. comb.

Borreria ericaefolia Hook. f., Tr. Linn. Soc. Lond. 20: 218, 1847; Wiggins & Porter, Fl. Galap. Is. 422, 1971.

Spermacoce linearifolia (Hook. f.) Fosberg, n. comb.

Borreria linearifolia Hook. f., Tr. Linn. Soc. Lond. 20: 217, 1847; Wiggins & Porter, Fl. Galap. Is. 426, 1971.

Spermacoce perpusilla (Hook. f.)

Borreria perpusilla Hook. f., Tr. Linn. Soc. Lond. 20: 218, 1847; Wiggins & Porter, Fl. Galap. Is. 426, 1971.

Spermacoce rotundifolia (Anderss.) Fosberg, n. comb.

Borreria rotundifolia Anderss., Kongl. Svensk. Vet.-Akad. Handl. 1861: 77, 1861; Wiggins & Porter, Fl. Galap. Is. 427, 1971, (non Borreria rotundifolia Valeton, 1930).

Spermacoce suberecta (Hook. f.) Fosberg, n. comb.

Borreria suberecta Hook. f., Tr. Linn. Soc. Lond. 20: 217, 1847; Wiggins & Porter, Fl. Galap. Is. 428, 1971.

NOTES ON THE GENUS *CLERODENDRUM* (*VERBENACEAE*). XXXIII

Harold N. Moldenke

CLERODENDRUM Burm.

Additional & emended bibliography: H.B.K., Nov. Gen. Sp. Pl., ed. folio, 2: [198] (1817) and ed. quart., 2: [244]--245. 1818; Hochst., Flora [Bot. Zeit. Regensb.] 25: 225--228. 1842; Manetti, Cat. Pl. Hort. Modic. Suppl. 2: 9. 1842; F. Krause, Flora [Bot. Zeit. Regensb.] 28: 68. 1845; Visiani, Sem. Hort. Patav. 2: 20, pl. 4. 1848; Visiani, Revis. Pl. Min. Cognit. Hort. Patav. 1855; Schlecht., Bot. Zeit. 14: 477. 1856; Visiani, Ill. Piante Orto Padova 3: 20, pl. 3, fig. 2 a--d. 1856; N. J. Andersson, Galap. Veg. 82 & 201. 1859; Teijsm. & Binn., Natuurk. Tijdschr. Ned. Ind. 25 [ser. 5, 5]: 409. 1863; Miq., Ann. Mus. Bot. Lugd.-Bat. 3: 251--254, pl. 9. 1867; Hook. f., Curtis Bot. Mag. 96 [ser. 3, 26]: pl. 5838. 1870; Edgeworth, Pollen, ed. 1, 26, 76, & 94, pl. 1, 2, 6, 8, 12, 15, 18, & 20, fig. 100--103 (1877) and ed. 2, 26, 76, & 94, pl. 1, 2, 6, 8, 12, 15, 18, & 20. 1879; Balf. f., Trans. Roy. Soc. Edinb. 31: [Bot. Socotra] 235--237 & 417, pl. 80. 1880; Rose, Contrib. U. S. Nat. Herb. 1: 136. 1892; Robinson & Greenm., Amer. Journ. Sci. 150 [ser. 3, 50]: 147. 1895; Barnhart, Bull. Torrey Bot. Club 29: 590. 1902; B. L. Robinson, Proc. Amer. Acad, Sci. 38: 194--195. 1902; E. D. Merr., Govt. Lab. Publ. Philip. 35: 62--64. 1906; DeWild., Ann. Mus. Congo Bot., ser. 5, 3: 256. 1909; C. B. Robinson, Philip. Journ. Sci. Bot. 6: 220. 1911; Backer, Tropische Natuur 5: 72 & 87--94. 1916; E. D. Merr., Philip. Journ. Sci. Bot. 12: 302, 303, & 383. 1917; Mildbraed, Wiss. Ergebn. Zent. Afr. Exped. 2: 99. 1920; Svenson, Amer. Journ. Bot. 22: 251. 1935; Arthur & Cummins, Philip. Journ. Sci. 61: 479. 1936; Lam & Meeuse in Holthuis & Lam, Blumea 5: 108--109, 121, & 235--236. 1942; Fairchild, Gard. Isls. Great East 179 & 229. 1943; Svenson, Amer. Journ. Bot. 33: 413 & 422. 1946; Cobin, Amer. Eagle Hort. Rev. 42 (14): 6. 1947; Quisumb., Philip. Dept. Agr. Tech. Bull. 16: 787--791, 1045, & 1208. 1951; Menninger, 1954 Price List [2], [4], & [9]. 1954; Menninger, 1957 Price List [3]. 1957; Estores Anzaldo, Marañon, & Ancheta, Philip. Journ. Sci. 86: 236. 1958; Burtt, Notes Bot. Gard. Edinb. 23: 95. 1960; Menninger, Trop. Tree Seeds, imp. 1, [1] (1960) and imp. 2, [1]. 1961; Malaviya, Proc. Indian Acad. Sci. B.58: 351--[363], fig. 1--10, 25, & 26, pl. 31 (1), & pl. 32 (4). 1963; W. C. Burger, Haile Sallas. Univ. Exp. Sta. Bull. 45: 198, fog. 60 (4). 1965; Boaler, Journ. Ecol. Brit. 54: 474. 1966; Bowman, Galap. 229 & 303. 1966; W. C. Burger, Fam. Flow. Pl. Ethiop. 198, fig. 60 (4). 1967; Schofield, Field Guide Galap. [5], pl. 1 & 14. 1970; Mold. in Wiggins & Porter, Fl. Galap. Isls. 483--486, fig. 127, & pl. 84. 1971; Thornton, Darwin's Isl. 77 & 271. 1971; Usinger, Mem. Pacif. Coast Entomol. Soc. 4: 276--277. 1972; López-Palacios, Revist. Fac. Farm. Univ. Andes 9 (13): 16--17 & 65--66. 1973; Mold., Phytologia 62: 126--153. 1987.

CLERODENDRUM MANETTI Visiani

Additional bibliography: Mold., Phytologia 62: 153. 1987.

Illustrations: Visiani, Sen. Hort. Patav. 2: pl. 4. 1848; Visiani, Ill. Piante Orto Padova 3: pl. 3, fig. 2 a--d. 1856; Visiani, Mem. Istit. Veneto. 6: pl. 3. 1856.

Visiani (1856) describes this plant as follows: "*Clerodendron Manetti* Vis. Sem. h. patav. coll. ann. 1848 et 1849, No. 2, tab. IV. Cl. molliter subcanescens, ramuli quadrangularibus, foliis petiolatis ovali-lanceolatis acuminatis integris, panicula terminali laxa, cymis trifidis, bracteisque obverse lanceolatis acutis deciduis pilosis, pedicellis nutantibus, calyce campanulato hiante esquamato quinquefido, laciniis lanceolatis acutis apice conniventibus, corolla hypocraterimorpha superne extra puberula, tubo cylindrico, calycem quadruplo superante, limbo patente quinquefido. Syn. *Clerodendron splendens* Manetti, cat. pl. h. modic. suppl. II, pag. 9, non Don. Hab...Locum obtinet inter *Euclerodendra paniculata* Schauer in DC. prodr. XI, pag. 666, a quibus omnibus ibidem recensitis differt. A *Cl. splendente* Don, sub quo nomine saepius in hortis colitur, jam prima fronte differt pubescentia, foliorum forma, panicula terminali, colore florum. Spiegazione della tavola del *Clerodendron*. a. Fiore di grandezza naturale. b. Fiore ingrandito. c. Frutto maturo, e vestito del calice. d. Lo stesso tagliato orizzontalmente per vederne i quattro noccinoli." The accompanying plate seems to be excellent. He adds: "Dixi in honorem J. Manetti rei horticolae peritissimi hortiq. Modiciensis directoris eximii, a quo h. Patav. habuit."

Baker (1900), in speaking of *C. buchholzii* Gürke, says that "This may be identical with *C. Manetti*, Vis. Ill. Piante Orto Padova, iii. (1856) 20, t. 3, a garden plant of uncertain origin." If this is true, then Visiani's binomial has priority over that of Gürke, but the conspecificity does not seem at all likely to me

Lam (1919) credits *C. manetti* to "Vis. Sem. Hort. Patav., no. 2 (1848--49)" and lists it among his "Species with unknown native country".

Thomas (1936) states that he applied to the directors of the herbaria at both Rome and Florence for access to the type specimen, but without success. Bakhuizen (1921) definitely adopts *C. manetti* as the valid name for the *C. buchholzii* of Gürke.

Citations: MOUNTED ILLUSTRATIONS: Visiani, Ill. Piante Ort. Padov. 3: pl. 3, fig. 2 a--d. 1856 (Ld).

CLERODENDRUM MANNII J. G. Baker in Thiselt.-Dyer, Fl. Trop. Afr. 5: 519 [as "*Clerodendron*"]. 1900; B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 13, 21, & 25. 1936.

Synonymy: *Clerodendron thyrsoideum* Baker in Thiselt.-Dyer, Fl. Trop. Afr. 5: 309--310. 1900 [not *C. thyrsoideum* Gürke, 1900]. *Clerodendron mannii* Baker in Thiselt.-Dyer, Fl. Trop. Afr. 5: 519. 1900. *Clerodendron schultzei* Mildbraed, Wiss. Ergebn. Zent. Afr. Exped. 2: 99, nom. nud. 1920. *Clerodendrum thyrsoideum* Baker apud B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 70 in syn. 1936. *Clerodendrum schultzei* Mildbraed apud B. Thomas, Engl. Bot. Jahrb.

68: [Gatt. Clerod.] 70 in syn. 1936.

Bibliography: J. G. Baker in Thiselt.-Dyer, Fl. Trop. Afr. 5: 294 & 309--310. 1900; K. Schum., Justs Bot. Jahresber. 28 (1): 495 & 496. 1902; Thiselt.-Dyer, Ind. Kew. Suppl. 2: 44. 1904; Mildbraed, Wiss. Ergebn. Zent. Afr. Exped. 2: 99. 1920; B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 13, 21, 26, 40, & 70. 1936; Mold., Alph. List. Inv. Names 20. 1942; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 47, 48, & 90. 1942; H. N. & A. L. Mold., Pl. Life 2: 82. 1948; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 113, 114, & 182. 1949; Mold., Résumé 139, 140, 269, 270, & 451. 1959; Mold., Résumé Suppl. 9: 3. 1964; Mold., Fifth Summ. 1: 223, 450, 454, & 457 (1971) and 2: 869. 1971; Mold., Phytol. Mem. 2: 214, 216, & 539. 1980.

A climbing shrub; stems to 8 m. long; branchlets glabrous; leaves decussate-opposite, short-petiolate; leafblades oblong, 15--25 cm. long, 7.5--11 cm. wide, apically cuspidate, marginally entire, basally deltoid, moderately firm in texture, green and glabrous on both surfaces; inflorescence composed of lax, few-flowered cymes forming a leafless thyrsoid panicle 20--40 cm. long, the ramifications glabrous; pedicels nearly as long as the calyx; calyx 6--10 mm. long, glabrous, the tube narrowly infundibular, the lobes ovate, much shorter than the tube; corolla hypocrateriform, the tube slender, straight, 2.5 cm. long or longer, glabrous, the lobes subequal, oblong, about 3 mm. long; stamens twice as long as the corolla-lobes.

This species is based on *Mann 1715* from the Sierra del Crystal, Gabon, deposited in the Kew herbarium. Thomas (1936) cites also *Mildbraed 6197* from the Cameroons, type collection of *C. schultzei*.

A key to help distinguish *C. mannii* from other species in Section *Siphonocalyx* will be found under *C. mildbraedii* Thomas in the present series of notes, which see.

Nothing is known to me of *C. mannii* beyond what is stated in its brief bibliography (above).

CLERODENDRUM MANOMBENSE Mold., Lloydia 13: 210. 1950.

Bibliography: Mold., Lloydia 13: 210. 1950; E. J. Salisb., Ind. Kew. Suppl. 11: 56. 1953; Mold. in Humbert, Fl. Madag. 174: 155, 241--243, & 268, fig. 39 (6 & 7). 1956; Mold., Résumé 155 & 451. 1959; Mold., Fifth Summ. 1: 260 (1971) and 2: 869. 1971; Mold., Phytol. Mem. 2: 249 & 540. 1980; P. Holmgren & al., Ind. Vasc. Pl.Type Microf. 441. 1985; Mold., Phytologia 58: 190. 1985.

Illustrations: Mold. in Humbert, Fl. Madag. 174: 241, fig. 39 (6 & 7). 1956.

A shrub; branchlets and twigs very slender, obtusely tetragonal, rather sparsely strigillose; nodes more or less annulate with a band of dense hairs; principal internodes 1--4 cm. long; leaves decussate-opposite; petioles subfiliform, 1--2 cm. long, canaliculate above, mostly glabrous except for a line of scattered minute hairs in the channel above; leafblades membranous, dull-green on both surfaces, elliptic or elliptic-lanceolate, 4.5--8 cm. long, 2--3.8 cm. wide when fully developed, apically acute or acuminate. marginally entire, basally acute, glabrate on both surfaces; midrib filiform, flat above, subprominulent beneath; secondaries filiform, 5--7 per

side, flat or almost so on both surfaces or very slightly subprominulous beneath, arcuate-ascending, obscurely anastomosing in loops near the margins; veinlet reticulation indiscernible or obscure on both surfaces; inflorescence terminal, cymose, many-flowered, sometimes subtended by a pair of axillary cymes; peduncles filiform, flattened, nigrescent, 5--10 mm. long, strigillose; pedicels filiform, 1--3 mm. long, strigillose; bractlets setaceous, about 1 mm. long, strigillose; calyx campanulate, chartaceous, nigrescent in drying, 1.5--2.5 mm. long, 1.5--2 mm. wide, externally glabrous, the rim truncate, very shortly 5-apiculate; corolla infundibular, nigrescent in drying, 7--8 mm. long in all, externally glabrous, the tube narrow-cylindric, the limb about 4 mm. wide; stamens and pistil exserted almost 1 cm. from the corolla-mouth; fruiting-calyx and fruit not known.

This endemic Madagascar species is based on *Humbert 20004* from a tropophilous forest and xerophilous bush on limestone rocks, at 100-350 m. altitude, in the gorge of the Manombe River, in southwestern Madagascar, collected on January 25 or 26, 1947, and deposited in the Paris herbarium. It is known thus far to me only from the original collection.

A key to help distinguish this species from other Madagascar taxa in the genus will be found under *C. baronianum* Oliv. in the present series of notes [58: 184--190].

Citations: MADAGASCAR: *Humbert 20004* (E--photo of type, F--photo of type, Ld--photo of type, N--isotype, N--photo of type, P--type).

CLERODENDRUM MARGARITENSE Mold., Geogr. Distrib. Avicenn. 20 nom. nud. 1939; Phytologia 1: 446. 1940.

Bibliography: Knuth, Feddes Repert. Spec. Nov. Beih. 43: [Init. Fl. Venez.] 607. 1927; Mold., Geogr. Distrib. Avicenn. 20. 1939; Mold., Phytologia 1: 446. 1940; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 30 & 90. 1942; Mold., Alph. List Cit. 1: 302 & 305. 1946; Hill & Salisb., Ind. Kew. Suppl. 10: 55. 1947; Mold., Alph. List. Cit. 2: 418, 437, 469, 499, & 593 (1948), 3: 738 (1949), and 4: 1027, 1030, & 1041. 1949; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 58 & 182. 1949; Mold., Phytologia 4: 45. 1952; Mold., Résumé 64 & 451. 1959; Mold., Fifth Summ. 1: 113 (1971) and 2: 869. 1971; López-Palacios, Revist. Fac. Farm. Univ. Andes 9 (13): 65--66. 1973; López-Palacios, Fl. Venez. Verb. 264 & 267--268. 1977; López-Palacios, Revist. Fac. Farm. Univ. Andes 20: 20. 1979; Mold., Phytol. Mem. 2: 104 & 540. 1980; P. Holmgren & al., Ind. Vasc. Pl. Type Microf. 441. 1985; Mold., Phytologia 58: 181. 1985.

A shrub; branchlets and twigs rather slender, obtusely tetragonal, brownish, densely short-pubescent or merely puberulent in age; younger nodes seemingly annulate through the confluence of persistent petiole-base margins, the older ones not annulate; principal internodes 1--21 mm. long, usually extremely abbreviated on young twigs or even subobsolete; leaves ternate or ternate-approximate; petioles very slender, 1--7 mm. long, densely short-pubescent, the base persisting as a stout, corky, non-aculeate, spur-like projection 1--2 mm. tall after the blade is shed, in whose axil may often

be found a sharp or bluntish spine 3--4 mm. long, which is the lowest part of the peduncle left when the upper portion broke off after fruiting; leafblades membranous, dark gray-green above, light- or yellow-green beneath, elliptic, 1--4.5 cm. long, 5--14 mm. wide, apically acute or very shortly subacuminate, marginally entire and often more or less revolute in drying, basally acute or subacuminate, rather densely short-pubescent above, much more densely so beneath with yellowish-brown hairs and densely punctate; midrib very slender, impressed above, prominulent beneath; secondaries very slender, 3--7 per side, arcuate-ascending, obscure or indiscernible above, slightly prominulent or obscure beneath; vein and veinlet reticulation very delicate, impressed or obscure above, not at all prominulent and often even obscure beneath; inflorescence axillary, congested at the tips of the twigs so as to appear terminal, the cymes abbreviated, ternate, solitary, 1.5--3 cm. long, 0.6--2 cm. wide, rather loosely many-flowered, very densely short-pubescent (like the lower leaf-surfaces) throughout; peduncles slender, 6--10 mm. long, pubescent; pedicels slender, 2--4 mm. long, pubescent; bractlets linear-subulate, 2--5 mm. long, densely pubescent; prophylla minute, setaceous; calyx about 3 mm. long and wide, shortly appressed-pubescent; corolla hypocrateriform, the tube 7--10 mm. long, the limb about 7 mm. wide.

This apparently endemic species is based on *J. R. Johnston 82* from along the road from El Valle to Asuncion, Margarita Island, Venezuela, collected in August of 1903 and deposited in the United States National Herbarium in Washington. The species has mostly been confused with the continental *C. molle* H.B.K. It has been collected in flower in July and August. López-Palacios (1977) comments that "Hasta ahora ha sido confundido con el continental *C. molle* H.B.K., al cual se parece muchisimo y del que a simple vista apenas se distingue. La diferencia parece estar en el indumento, que es mucho menos denso en el *C. margaritense*." The leaves are also much smaller and the calyxes smaller, with shorter less caudate lobes.

López-Palacios (1977) cites *Johnston s.n.* [1903] and *Miller & Johnston 8 & 82*. His key to the species of *Clerodendrum* in Venezuela is worth repeating here, in translation and with some modifications:

1. Climbing plants.
  2. Calyx wine-red.....*C. umbellatum* (and its varieties).
  2a. Calyx white.....*C. thomsonae*.
1a. Erect shrubs or trees.
  3. Corolla doubled.....*C. philippinum* f. *multiplex*.
  3a. Corolla simple.
    4. Petioles elongate, 5--40 cm. long; pedicels reddish; leaves always opposite.....*C. speciosissimum*.
    4a. Petioles and pedicels not as above; leaves sometimes opposite but more usually ternate.
      5. Petioles basally markedly spinescent.....*C. aculeatum*.
      5a. Petioles basally only inconspicuously spinescent.
        6. Leafblades tomentose beneath.....*C. margaritense*.

6a. Leafblades not tomentose beneath.
7. Leaves not more than 2.4 cm. long.....*C. pittieri.*
7a. Leaves more than 2.5 cm. long.....*C. ternifolium.*

Citations: NORTHERN SOUTH AMERICAN ISLANDS: Margarita: *J. R. Johnston 82* (B--isotype, Ca--146712--isotype, Cp--isotype, F--174494--isotype, G--isotype, K--isotype, L--isotype, Ld--photo of type, Mu--3999--isotype, N--isotype, N--photo of type, V--isotype, W--531921--type, W--956183--isotype, X--isotype); *Miller & Johnston 8* (B, Bm, E--118870, F--126583, G, K, N, N, P, Po--64679, W--417745).

CLERODENDRUM MELANOCRATER Gürke, Engl. Bot. Jahrb. 18: 180 [as "*Clerodendron*"]. 1893; B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 41, 72, & 94. 1936.

Synonymy: *Clerodendron melanocrater* Gürke, Engl. Bot. Jahrb. 18: 180. 1893. *Clerodendron sereti* DeWild., Ann. Mus. Cong. Belg., ser. 5, 3: 256. 1909. *Clerodendrum sereti* DeWild. apud B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 72 in syn. 1936. *Clerodendron melanophyllum* S. Moore, in herb.

Bibliography: Gürke, Engl. Bot. Jahrb. 18: 180. 1893; Gürke in Engl., Pflanzenw. Ost-Afr. C: 341. 1895; J. G. Baker in Thiselt.-Dyer, Fl. Trop. Afr. 5: 293 & 299. 1900; Gürke, Engl. Bot. Jahrb. 28: 297. 1900; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 1, 101. 1901; DeWild., Ann. Mus. Cong. Belg. Bot., ser. 5, 3: 256. 1909; DeWild., Etud. Fl. Bas- Moyen-Congo 3: 256 & 468, pl. 43. 1910; DeWild., Bull. Roy. Soc. Bot. Belg. 51 (3) [ser. 2, 1]: 180. 1913; DeWild., Bull. Jard. Bot. Brux. 7: 174. 1920; DeWild., Pl. Bequaert. 2: 268. 1922; Hutchins. & Dalz., Fl. W. Trop. Afr., ed. 1, 2: 272 & 274. 1931; B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 7, 9, 10, 14, 16, 41, 72, & 94. ;936; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 2, 101. 1941; Mold., Alph. List Inv. Names 20. 1942; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 47--49 & 90. 1942; W. Robyns, Fl. Sperm. Parc Nat. Albert 2: 141 & 144. 1947; H. N. & A. L. Mold., Pl. Life 2: 83. 1948; Mold., Alph. List Cit. 3: 828. 1949; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 113--116 & 182. 1949; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 3, 101. 1959; Mold., Résume 139--141, 143, 144, 146, 266, 269, & 451. 1959; Dale & Greenway, Kenya Trees 582. 1961; Huber in Hutchins. & Dalz., Fl. W. Trop. Afr., ed. 2, 2: 441 & 444. 1963; Mold., Résumé Suppl. 8: 4. 1964; Gillett, Numb. Check-list Trees Kenya 46. 1970; Mold., Fifth Summ. 1: 223, 225, 229, 232, 233, 236, 240, 450, 454, & 463 (1971) and 2: 869. 1971; Lewalle, Bull. Jard. Bot. Nat. Belg. 42 [Trav. Univ. Off. Bujumb. Fac. Sci. C.20]: [230]. 1972; Mold., Phytol. Mem. 2: 214, 215, 219, 222, 223, 225, 230, & 540. 1980; Mold., Phytologia 58: 441 (1985), 59: 335 (1986), and 60: 271. 1986.

A small, thin tree, 3 m. tall, or a small to tall, climbing, sciophilous shrub or shrubby, woody liana, 2--7 m. long, turning black when dry; stems thin; branches tetragonal, alate, divergent, scrambling, the lower ones glabrescent, the upper ones rather densely short-pubescent with appressed twisted hairs; leaves decussate-opposite, turning ink-blue when bruised, nigrescent in drying; petioles 1--4.5 cm. long or longer; leafblades ovate or oblong-ovate to

ovate-elliptic or suborbicular, 5--10 cm. long, 3--9 cm. wide, apically short-acuminate, marginally entire, basally obtuse or subcordate to cordate, glabrous on both surfaces; inflorescence terminal, paniculate, 10--12 cm. long, very regularly branched, densely pubescent throughout with short, appressed, twisted hairs, the cymes corymbose, subsessile, lax, the axis greenish-white; bracts linear or filiform, mostly 3--4 (rarely to 5) mm. long; pedicels elongate, 8--10 mm. long, greenish-white; flowers fragrant; calyx cupuliform, externally puberulent or subglabrous, 2--2.5 mm. long, white when fresh or the tube "darkish-green", uniformly black when dry, the puberulence mostly sparse and appressed, the rim 5-dentate, the teeth deltoid, apically acute, hardly more than 1 mm. long, the sides mostly subequal, pale-,or light-green when fresh; corolla hypocrateriform, brownish-yellow or whitish to white, turnihg yellowish when old and ink-blue when bruised, nigrescent when dry, the tube 2--2½ times as long as the calyx, 5--6 mm. long, usually less than 1 mm. wide, externally finely puberulent or glabrous and glandulose, the lobes 2--3 mm. long, dorsally finely puberulent; stamens long-exserted; filaments pale-greenish; anthers dark-blue; style long-exserted, pale-greenish; stigma bilobed, greenish.

This very distinctive species is based on *Stuhlmann 2698* from woods at 1300 m. altitude near the Itiri River, Zaire, collected on September 15, 1891, and *Stuhlmann 3322, 3650, 3720,* & *3891,* all from Bukoba, in Karagwe, Tanganyika (Tanzania), collected, respectively, in February of 1892, on March 20, 1892, on March 25, 1892, and on April 7, 1892. Of these, Thomas (1936) has designated *Stuhlmann 3322* as the type.

Clerodendron sereti is based on *Seret 996* and is said by DeWildeman (1909) to differ from *C. melanocrater* in having quadrangular subalate branches and larger leaves.

Robyns (1947) describes *C. melanocrater* in Zaire as an "Arbuste lianeux, habitant les formations forestières équatoriales, se recontrant dans le District Forestière Central, le Moyen-Katanga et dans les montagnes a l'ouest de lac Kivu. C'est un élément guinéen, s'étendant depuis le Cameroun jusque dans l'Uganda à l'Est."

Collectors have found this plant growing in virgin and gallery forests and forest edges, in shade along the sides of streams, and in the secondary tree layer of swamp forests, at altitudes of 470--2700 m., in flower from January to April and July to October. Maas-Geesteranus encountered it "in a very dense tall forest with few clearings and transected by a rectangular system of paths" in Kenya.

The specific epiphet, for some reason unclear to me, is sometimes uppercased (e.g., by Hutchinson & Dalziel, 1931, and Baker, 1900).

The corolla is described as "white" on *Bequaert 6565, Dümmer 1005* & *5475, Lebrun 3988,* and *Robyns 1325,* "deep-cream" on *Drummond & Hemsley 4578,* and "green to yellow" on *Lewalle 3250*

Vernacular names recorded for *Clerodendrum melanocrater* are "korokindi", "mbambake e boliki", "mosale", "nbiremo", and "ngeta".

The Gürke (1893) reference to this species is sometimes inaccurately cited as "1894", the titlepage date of the volume; similarly, the DeWildeman (1913) reference is often cited as "1912", again,

the titlepage date.

Gürke (1900) calls attention to similarities between *C. melanocrater* and *C. bipindense* Gürke and *C. yaundense* Gürke.

DeWildeman (1922) cites *Bequaert 6565* from Zaire; Hutchinson (1931) cites *Mildbraed 10510* from the Cameroons. Thomas (1936) cites *Stuhlmann 3322, 3650, 3720,* & *3891* from Tanganyika, *Mildbraed 2247, Seret 996, Stuhlmann 2698,* and *Witte 1538* from Zaire, *Ledermann 1153, Mildbraed 5556, 5789,* & *10510,* and *Preuss 406* & *416* from the Cameroons, and *Mildbraed 6835* from Fernando Po.

Huber (1963) cites *Mildbraed 10510* from the Cameroons and *Melville 445* from Fernando Po, listing the species also from Zaire, Uganda, and Tanganyika; Lewalle (1972) cites *Lewalle 3250* from Burundi.

Keys to help distinguish *C. melanocrater* from other African species in the genus will be found under *C. dusenii* Gürke and *C. inaequipetiolatum* Good in the present series of notes [59: 335 and 60: 271].

Citations: CAMEROONS: *Preuss 416* (L). ZAIRE: *Bequaert 6565* (Br); *Brande 226* (Br); *Bredo 580* (Br), *696* (Br), *770* (Br); *Broun s.n.* (Br); *Claessens 600* (Br); *Collector undetermined 154* (Br); *DeGiorgi 1231* (Br); *DeGraer 341* (Br), *365* (Br, Br, Br); *DeWitte 1538* (Br); *Goossens 5018* (Br); *Humbert 7579* (Br); *Lebrun 3988* (Br, Br), *5146* (Br, Br); *Louis 13250* (Br, N), *15723* (B, Br, N, W--2091122); *Putman 99* (Br); *Reygaert 1103* (Br); *Robyns 1325* (Br, Br); *Sapin s.n.* [Dwado 1912] (Br, N); *Seret 996* (Br, Ld--photo, N--photo); *Van den Brande 55* (Br); *Vanderyst 897* (Br), *939* (Br). BURUNDI: *Lewalle 3250* (Ld). UGANDA: *P. Chandler 1210* (Br); *Drummond & Hemsley 4578* (B); *Dümmer 1005* (W--634708), *5475* (Af, W--1249834). KENYA: *Maas-Geesteranus 6264* (Ca--92367, Go, S).

CLERODENDRUM MEMBRANIFOLIUM H. J. Lam, Verbenac. Malay. Arch. 318--319 [as "*Clerodendron*"]. 1919; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 66 & 90. 1942.

Synonymy: *Clerodendron membranifolium* H. J. Lam, Verbenac. Malay. Arch. 318. 1919.

Bibliography: H. J. Lam, Verbenac. Malay. Arch 318--319 & 364. 1919; Bakh. in Lam & Bakh., Bull. Jard. Bot. Buitenz., ser. 3, 3: 95, 109, & ix. 1921; A. W. Hill, Ind. Kew. Suppl. 6, imp. 1, 49. 1926; Fedde & Schust., Justs Bot. Jahresber. 47 (2): 245. 1927; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 66 & 90 (1942) and ed. 2, 148 & 182. 1949; A. W. Hill, Ind. Kew. Suppl. 6, imp. 2, 49. 1959; Mold., Résumé 199 & 451. 1959; Mold., Fifth Summ. 1: 332 (1971) and 2: 869. 1971; Mold., Phytol. Mem. 2: 322 & 540. 1980.

Lam's original (1919) description is: "*C. membranifolium* H. J. Lam, prob. nov. spec. -- Frutex?; ramuli graciles, appresse pubescentes; folia opposita, valde membranacea, ovato-rotundata, basi rotundata, vel subrotundata, apice acuminata, margine integra; utrinque nervis puberulis exceptis glabra, subtus glanduloso-punctata; nervis utrinque 6--8; 10½--20 cM. longa, 5--11 cM. lata; petiolo, cum panicula terminale appresse pubescente, 2--12½ cM. longo; calyx pubescens; cetera non videmus."

This species is based on *Forsten s.n.*, no. 908.267--742 in the Leiden herbarium, from Luha, Amboina, in the Molucca Islands. Nothing is known to me of this plant beyond what is stated in its brief bibliography (above).

CLERODENDRUM MICANS Gürke, Engl. Bot. Jahrb. 18: 179--180 [as *"Clerodendron"*]. 1893; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 53 & 90. 1942.

Synonymy: *Clerodendron micans* Gürke, Engl. Bot. Jahrb. 18: 179. 1893.

Bibliography: Gürke, Engl. Bot. Jahrb. 18: 179--180. 1893; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 1, 101 (1901), imp. i, 496 (1906), and imp. 2, 101 & 496. 1941; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 53 & 90 (1942) and ed. 2, 123 & 182. 1949; Mold. in Humbert, Fl. Madag. 174: 156, 247, 251--252, 266, & 268, fig. 40 (10). 1956; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 3, 101 & 496. 1959; Mold., Résume 155 & 451. 1959; Mold., Fifth Summ. 1: 260 (1971) and 2: 869. 1971; Mold., Phytol. Mem. 2: 249 & 540. 1980; P. Holmgren & al., Ind. Vasc. Pl. Type Microf. 441. 1985; Mold., Phytologia 58: 190. 1985.

Illustrations: Mold. in Humbert, Fl. Madag. 174: 247, fig. 40 (10). 1956.

A shrub or woody vine; branchlets rather stoutish, often armed with woody spines, often rather acutely tetragonal, the edges often somewhat margined, lenticellate, minutely appressed-puberulent, glabrescent in age; twigs slender, acutely or obtusely tetragonal or even subterete, gray, lenticellate, densely appressed-puberulent; nodes not annulate; principal internodes 1--5 cm. long; leaves decussate-opposite or approximate, persistent; petioles slender, 5--19 mm. long, canaliculate above, more or less appressed-puberulent, sometimes borne at the apex of a woody spur-like spine 4--12 mm. long; leafblades membranous, brunnescent in drying, elliptic or elliptic-ovate, 4--8.5 cm. long, 2--5 cm. wide, apically acuminate, marginally entire, basally acute, glabrous and shiny on both surfaces, sometimes punctate beneath; midrib slender, flat above, prominent beneath; secondaries very slender, 5--8 per side, flat above, prominent beneath, ascending, arcuately joined in many loops near the margins beneath; veinlet reticulation abundant, varying from slightly prominulous to indiscernible above, mostly slightly prominulous beneath; inflorescence axillary and terminal, mostly aggregated in large panicles at the tips of the branchlets, the cymes many-flowered, 4 or 5 times dichotomous, individually rather loosely spreading but often aggregated into very dense panicles; peduncles rather stout, rounded, fistulose, 2--5.5 cm. long, minutely puberulent; pedicels under the central flower at each furcation elongated to 10 mm., those under the lateral flowers obsolete or to only 2 mm. long; foliaceous bracts sometimes present in the terminal panicle, leaf-like; bractlets linear, 2--6 mm. long, puberulent; flowers strongly odorous; calyx campanulate, 4--5 mm. long, 2--3 mm. wide, minutely and obscurely puberulent, the rim flaring, 5-lobed, the lobes triangular-ovate, 1--1.4 mm. long, apically acute; corolla

hypocrateriform, white, the tube very slender, about 1.5 cm. long, glabrous, the limb less than 1 cm. wide; stamens exserted about 1 cm. from the corolla-mouth; fruiting-calyx accrescent, incrassate, campanulate, 7--10 mm. long and wide, longitudinally striate-venose, the rim subtruncate and very shortly 5-apiculate; fruit drupaceous, shiny.

This endemic species is based on *Hildebrandt 3676* from the edge of woods at East Imerina, Andrangoloaka, Madagascar, collected in November of 1880 and deposited in the Berlin herbarium, now destroyed.

Collectors have encountered the plant in forests and at their edges, on gneiss, in river gorges, and around villages, at 1600--1700 m. altitude, in flower in August, September, and November. The corollas are described as having been "white" on *Decary 5903* and *Humbert & Perrier 2288* and *Perrier 10195*

A key to help distinguish this species from other Madagascar taxa in this genus will be found under *C. baronianum* Oliv. in the present series of notes [58: 184--190].

The Gürke reference in the bibliography (above) is sometimes cited as "1894", the volume titlepage date.

Material of *C. micans* has been misidentified and distributed in some herbaria as *C. putre* Schau.

Citations: MADAGASCAR: *Campenon s.n.* (P); *d'Alleizette 300m* (P); *Decary 5903* (P); *Herb. Jard. Bot. Tananarive 1102* (P), *3469* (P, P); *Hildebrandt 3676* (E--photo of isotype, F--photo of isotype, Ld--photo of isotype, K--isotype, Mu--isotype, N--isotype, N--photo of isotype, P--isotype, P--isotype); *Humbert 3577* (P); *Humbert & Perrier 2288* (P, P; *Perrier 10186* (P), *10195* (N, P); *Waterlot 583* (P).

CLERODENDRUM MICRANTHUM Gilli, Ann. Naturhist. Mus. Wien 77: 29--30. 1973.

Bibliography: Gilli, Ann. Naturhist. Mus. Wien 77: 29--30. 1973; Brenan, Ind. Kew. Suppl. 16: 71. 1981.

A shrub; branches obtusely 6-angular; younger branchlets 4-angular, very shortly white-pilose; upper internodes 2--5 cm. long; leaves ternate or on the more slender branchlets decussate-opposite; petioles 2--10 mm. long, densely pubescent; leafblades membranous, broadly lanceolate, mostly 4--7 cm. long and 2--3.5 cm. wide, apically acuminate, marginally crenate with minutely apiculate crenations, basally attenuate, pubescent along the venation above, otherwise glabrous, more densely white-pubescent beneath, the venation prominent; inflorescence terminal, paniculate, 2.5--5 cm. long, 1.5-7 cm. wide, basally foliose, the cymes loosely branched; peduncles 1.5--3 cm. long, velutinous-puberulent; pedicels 1--3 mm. long, velutinous; bracts ovate-lanceolate, 1 mm. long; bractlets subulate, 1 mm. long, velutinous; calyx pale-green, later yellowish-red and dilated, cylindric, 3--4 mm. long, externally densely villous with intermixed glanduliferous hairs, the lobes triangular, erect or curvate, 0.5--1 mm. long, unequal, apically acute; corolla white, zygomorphic, the tube narrowly tubular, 4--6 mm. long, slightly curvate, glabrous, the posterior side split to the middle, the lobes

obovate, 1--2 mm. long, dorsally tomentose; the 2 longer staminal filaments 5--6 mm. long, exserted, connate for 3/4 the length of the corolla-tube, free above, the 2 shorter filaments 4 mm. long, very sparsely pilose or glabrous; style 5 mm. long, exserted; stigma 0.2 mm. long; ovary cylindric-oblong, 1 mm. long, externally glabrous; immature fruit globose, to 5 mm. long and wide.

This species is based on *Gilli 448* from shrubbery at Lumbila, at 540 m. altitude, on the north shore of Lake Nyasa, Tanzania collected on August 11, 1958, in flower and immature fruit, deposited in the Vienna herbarium. Gilli (1973) comments that "Die Art wurde auch im blütenlosen Zustand am Nordwestufer des Nyassasees bei Mwaya gesehen. Ich reihe die neue Art in die Untergattung *Cyclonema* ein, obwohl sie sich von ihr durch die schmalzylindrische Corolröhre unterscheidet und auch durch die spitzen Kelchzipfel ein seltener Fall in dieser Untergattung ist, da die Corolle zygomorph und die Corollröhre gekrümmt sowie rückwärts ungefähr bis zur Hälfte gespalten ist. Auch die Tatsache, dass der an der Corollröhre angewachsene Teil der Filamente fast kahl ist, ist für die Untergattung ungewöhnlich.." He proposes for this species the new Section *Micrantha* whose characterization is "Paniculae terminales, calyx tubulosus dentibus triangularibus acutis, corollae tubus vix 6 mm longus, anguste tubulosus". He comments that "Die neue Sektion unterscheidet sich von der Sect. *Pleurocymosa* durch die lockeren endständigen Rispen, von den andered Sektionen der Untergattung durch die sitzen Kelchzipfel und die kleinen Blüten."

Nothing is known to me of this species beyond what is stated in its brief bibliography (above).

CLERODENDRUM MICROCALYX Ridl., Journ. Malay. Br. Roy. Asiat. Soc. 1: [Malay. For. Trees] 84 [as "*Clerodendron*"]. 1923; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 63 & 90. 1942.

Synonymy: *Clerodendron microcalyx* Ridl., Journ. Malay. Br. Roy. Asiat. Soc. 1: [Malay. For. Trees] 84. 1923.

Bibliography: Ridl., Journ. Malay. Br. Roy. Asiat. Soc. 1: [Malay. For. Trees] 84. 1923; A. W. Hill, Ind. Kew. Suppl. 7: 51. 1929; Fedde & Schust., Justs Bot. Jahresber. 59 (2): 417. 1939; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 63 & 90 (1942) and ed. 2, 143 & 182. 1949; Mold., Résumé Suppl. 14: 4 & 8. 1966; Mold., Fifth Summ. 1: 322 & 450 (1971) and 2: 869. 1971; Mold., Phytol. Mem. 2: 313 & 540. 1980; P. Holmgren & al., Ind. Vasc. Pl. Type Microf. 441. 1985; Mold., Phytologia 57: 35 (1985) and 58: 460. 1985.

Ridley's original (1923) description of this species is "Tree 15 to 20 feet tall; branches scurfy, velvety, 4-angled. Leaves thin, ovate, subacute, base broad, subtruncate rounded; nerves 6 pairs spreading, scurfy-velvety 6 to 9 in. long, 5 to 8 in. wide; petiole 7 in. long. Corymbs 2 in. wide; peduncle 1.5 to 3 in. long, densely tomentose velvety. Flowers numerous crowded, white sessile. Calyx .1 in. long, tubular-campanulate, velvety with very short acute teeth. Corolla glabrous, tube slender .5 in. long, lobes oblong, blunt, scabrid outside .1 in. long. Stamens filaments glabrous filiform exsert, .2 in. long (twice as long as corolla-lobes). Fruit

pyriform to subglobose, glabrous .25 in. through. Calyx short, saucer-shaped .1 in deep, with 5 minute teeth. Sibolangit, Bukit Semaik. Tree 15 to 20 feet. Fruit green; flower white (Mohamed Nur 7447). Allied to *C. villosum*, Bl., but with very small calyx lobes and bracts." The type locality is in Sumatra.

The two examples of *Nur 7447* seen thus far by me -- in the Britton Herbarium and in the Buitenzorg herbarium -- seem to represent a white-flowered form of *C. colebrokianum* Walp., so it is probable that Ridley's binomial must be reduced to the latter's synonymy or else given form status within that species.

CLERODENDRUM MICROPHYLLUM Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 102--104. 1936.

Bibliography: B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 41, 71, 94, & 103--104. 1936; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 46 & 90. 1942; Hill & Salisb., Ind. Kew. Suppl. 10: 55. 1947; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 110 & 182. 1949; Mold., Résumé 135 & 451. 1959; Cuf., Bull. Jard. Bot. Brux. 32: Suppl. 800 & 802. 1962; W. C. Burger, Haile Sallas. Univ. Exp. Sta. Bull. 45: 198, fig. 60 (4). 1965; W. C. Burger, Fam. Flow. Pl. Ethiop. 198, fig. 60 (4). 1967; Mold., Fifth Summ. 1: 213 (1971) and 2: 869. 1971; Mold., Phytol. Mem. 2: 204 & 540. 1980; Mold., Phytologia 57: 34 & 353. 1985.

Illustrations: W. C. Burger, Haile Sallass. Univ. Exp. Sta. Bull. 45: 198, fig. 60 (4). 1965; W. C. Burger, Fam. Flow. Pl. Ethiop. 198, fig. 60 (4). 1967.

A squarrose shrub; branchlets twiggy, cinereous, glabrous; principal internodes 1--2 cm. long; leaves small, ternate, short-petiolate; petioles 1--2 mm. long; leaf-blades oblong-elliptic, 0.8--1.1 cm. long, 3--5 mm. wide, apically rounded or shortly acute, marginally entire, basally attenuate, pubescent on both surfaces; flowers clustered in many-flowered heads, borne on short turions from the stems; peduncles and pedicels very short; bracts filiform, puberulent; calyx cupular-campanulate, about 3 mm. long, puberulent, the limb 5-denticulate, the teeth small, apically acute; corolla hypocrateriform, the tube 1.2 cm. long, slender, externally glandular-pilose, basally slightly dilated, the limb almost bilabiate, 4 lobes subequal, the fifth larger, obovate-oblong, 4--6 mm. long; stamens exserted, inserted at about the middle of the corolla-tube; filaments about 2.5 cm. long; anthers 2 mm. long; style about 2.5 cm. long; stigma bifid; ovary 1 mm. long, glabrous, glanduliferous, black; mature fruit not known.

This little-known species is based on *Riva 1067* [*Ruspoli 964*] from dry bushy places at Daodd, in what used to be Italian Somaliland [now Somalia], collected on January 20, 1891, and deposited in the Berlin herbarium, now destroyed.

Cufodontis (1962) cites the type collection as "*Ruspoli & Riva 1067, vel 964 [357]*" and asserts that the type locality is probably in Ethiopia ["locus 'Daodd' in Ogaden quaerendus"]. He reports the native Somali name as "dumod".

A key to help distinguish this species from others in section

Siphonocalyx will be found under *C. mildbraedii* Thomas in the present series of notes (below).

Citations: MOUNTED ILLUSTRATIONS: W. C. Burger, Fam. Flow. Pl. Ethiop. fig. 60 (4). 1967 (Ld).

CLERODENDRUM MILDBRAEDII Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 101. 1936.

Bibliography: B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 39, 68, 94, & 101. 1936; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 47 & 90. 1942; Hill & Salisb., Ind. Kew. Suppl. 10: 55. 1947; H. N. & A. L. Mold., Pl. Life 2: 72. 1948; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 113 & 182. 1949; Mold., Résumé 139 & 451. 1959; Mold., Fifth Summ. 1: 225 (1971) and 2: 869. 1971; Mold., Phytol. Mem. 2: 214 & 540. 1980.

A shrub; branchlets hexagonal, the lower ones sparsely hirsute, the upper ones densely so; internodes elongate; leaves irregularly ternate, petiolate, gradually decreasing in size upwards, the uppermost bract-like; petioles 1--2 cm. long, striate, hirsute; leafblades membranous, obovate-oblong, 9--12 cm. long, 5--6 cm. wide, apically acuminate, marginally entire, basally rounded or cuneate, glabrous above, pubescent on the prominent venation beneath; inflorescence cymose-paniculate, dark-hirsute, foliose; cymes axillary, ternate, crowded, the lower ones to 4 cm. long; sympodia elongate; peduncles about 1.5 cm. long; pedicels 1--3 mm. long, hirsute; bracts and bractlets small, subulate; calyx conic-tubular, almost cylindric, about 9 mm. long, externally appressed-pubescent, 5-dentate to about 1/5 its length, the teeth deltoid, apically acute; corolla-tube about 2.4 cm. long, externally marked with sessile glands, dilated at the apex and base, the limb 5-lobed, the lobes subequal, obovate-oblong, 4--6 mm. long; stamens long-exserted, inserted about 2/3 from the base of the corolla-tube; filaments about 4.2 cm. long, subequal; anthers 1.5 mm. long; style about 2.7 cm. long; stigma bifid; ovary 1.3 mm. long, dark-fuscous, glabrous; mature fruit not known.

This poorly known species is based on *Mildbraed 7703* from between Ebolowa and Jaunde, south of Njong, by Aboremwong, in the southern Cameroon forest region, Cameroons, collected on January 11, 1914, and deposited in the Berlin herbarium, now destroyed. Thus far it is known to me only from the original collection, and nothing is known to me of it beyond what is stated in its bibliography (above).

A key to distinguish this plant from the other African species of Sect. *Siphonocalyx* is given by Thomas (1936) and is reproduced, with modifications, herewith:

1. Cymes loose, foliose.
  2. Leaves decussate-opposite.
    3. Stamens longer than the style during full anthesis.
      4. Leafblades apically more or less irregularly crenate-serrate; petioles and lower leaf surface venation hairy; calyx more or less hairy.
        5. Calyx 5--6 mm. long; corolla-tube 1.7--1.8 cm. long.
          6. Leafblades at least 8 x 5 cm.; petioles 3--3.5 cm. long; corolla-tube 0.8--1.7 cm. long.

7. Calyx mostly 5 mm. long; corolla-tube about 1.7 cm. long, about 0.5 mm. wide; ovary round, about 1 mm. long.....*C. tanganyikense* var. *bequaerti*.
7a. Calyx mostly 6 mm. long; corolla-tube 8--10 mm. long, 1 mm. wide; ovary elongate-cylindric, about 1.8 mm. long.....*C. tanganyikense* var. *dubium*.
6a. Leafblades about 3.5 x 3 cm.; petioles 6--10 mm. long; corolla-tube about 1.8 cm. long.....*C. bingaense*.
5a. Calyx mostly 8--10 mm. long; corolla-tube about 2 cm. long.....*C. thonneri*.
4a. Leafblades marginally entire; petioles and leafblades glabrous or subglabrous.....*C. preussii*.
3a. Stamens shorter than the style.....*C. tanganyikense*.
2a. Leaves ternate.
8. Calyx about 10 mm. long, subglabrous; corolla-tube about 2.5 cm. long.....*C. mildbraedii*.
8a. Calyx 6--7 mm. long, hairy; corolla-tube about 1.4 cm. long.
9. Calyx glabrous or subglabrous; cymes dense..*C. hexangulatum*.
9a. Calyx hairy; cymes loose.....*C. consors*.
1a. Cymes loose, not foliose.
10. Corolla-tube shorter than the calyx.....*C. parvitubulatum*.
10a. Corolla-tube equaling or slightly longer than the calyx.
11. Leafblades always entire.
12. Inflorescence mostly cauliflorous at or near the base of the stems; larger branches mostly very conspicuously long-spiny; leaves mostly glabrous.
13. Calyx narrow-elongate, 6--8 mm. long; leafblades thinly membranous, fragile.
14. Petioles all short and completely glabrous, 5--18 mm. long; calyx glabrous.....*C. silvestre*.
14a. Petioles elongate, 4 cm. long or longer, pubescent, at least on the upper margin; calyx puberulous.....*C. buchholzii*.
13a. Calyx broadly obconic; leafblades somewhat leathery, not fragile.....*C. laxicymosum*.
12a. Inflorescence plainly axillary or terminating the branchlets.
15. Leafblades mostly leathery, glabrous; branches very conspicuously long-spiny.
16. Inflorescence congested, often subcapitate; calyx about 5 mm. long, nigrescent; veinlet reticulation mostly flat on the upper leaf-surface.....*C. botryodes*.
16a. Inflorescence very loose; calyx about 7 mm. long, stramineous, not nigrescent; veinlet reticulation mostly prominent on both leaf-surfaces.....*C. laxicymosum*.
15a. Leafblades mostly submembranous; branches usually not conspicuously spiny.....*C. thonneri*.
11a. Leafblades mostly more or less dentate.
17. Corolla-tube always uniformly short, 8--10 mm. long.....*C. tanganyikense* var. *dubium*.
17a. Corolla-tube mostly 14--17 mm. long when mature.

18. Calyx 7 mm. long.....*C. tanganyikense.*
18a. Calyx 5--6 mm. long....*C. tanganyikense* var. *bequaerti.*
18b. Calyx 2--4 mm. long....*C. tanganyikense* var. *microcalyx.*
10b. Corolla-tube 1½ to 3 times as long as the calyx.
19. Corolla-tube only 1½ times as long as the calyx; inflorescence very dense, subcapitate; side ramifications of the cymes less than 7 mm. long.....*C. botryodes.*
19a. Corolla-tube 2--3 times as long as the calyx; inflorescence loose, the side ramifications more than 7 mm. long.
20. Inflorescence few-flowered, no more than 8 cm. long.....*C. nuxioides.*
20a. Inflorescence many-flowered, 15--30 cm. long.
21. Corolla-tube at most 2.2 cm. long; calyx to 1 cm. long.
22. Calyx with parallel sides, to 10 mm. long.
23. Main bracts to 2.5 cm. long; inflorescence ramifications very thick, greatly lenticellate; leafblades basally cuneate; calyx appressed-hairy; spines 2--2.5 cm. long.....*C. silvestre.*
23a. Main bracts only 2--3 mm. long; inflorescence ramifications thin, not lenticellate; leafblades basally mostly rounded; calyx glabrous; spines only about 1 cm. long.....*C. buchholzii.*
22a. Calyx apically ampliate, 6--8 mm. long....*C. preussii.*
21a. Corolla-tube 2.5 cm. long or longer.....*C. mannii* & *C. chamaeriphes.*
1b. Cymes capitate.
24. Leaves ternate; branches hexagonal.....*C. hexangulatum.*
24a. Leaves decussate-opposite; branches terete or subterete.
25. Inflorescence terminal on foliose stalks.
26. Calyx about 4 mm. long; corolla-tube about 1.7 cm. long; inflorescence compact; leafblades basally cordate.....*C. fasciculatum.*
26a. Calyx about 8 mm. long; corolla-tube about 2 cm. long; inflorescence loose; leafblades basally rounded...*C. thonneri.*
25a. Inflorescence terminal on leafless axillary or cauliflorous stalks to 20 cm. long.
27. Corolla-tube 1½ to 3 times as long as the calyx; calyx 5--7 mm. long, the lobes short, not spreading.
28. Leafblades basally cuneate; branches ashy-gray.
29. Peduncles 4--11 cm. long.....*C. wildemannianum.*
29a. Peduncles only 5 mm. long.....*C. caulanthum.*
28a. Leafblades basally rounded; branches brown.*C. botryodes.*
27a. Corolla-tube 4--7 times as long as the calyx; calyx 2--4 mm. long, the lobes somewhat spreading.
30. Corolla-tube 3--4 cm. long; leaves large, at least 10 cm. long.....*C. schweinfurthii* & *C. gossweileri.*
30a. Corolla-tube only to 1.2 cm. long; leaves very small, at the most 1 cm. long.....*C. microphyllum.*

CLERODENDRUM MILNE-REDHEADI Mold., Phytologia 3: 264. 1950.

Synonymy: *Clerodendron milneredheadii* Mold. apud Boaler, Journ. Ecol. Brit. 54: 474. 1966. *Clerodendrum milne-redheadii* Moldenke apud F. White, Gard. Bull. Singapore 29: 69. 1977.

Bibliography: Mold., Phytologia 3: 264--265. 1950; E. J. Salisb., Ind. Kew. Suppl. 11: 56. 1953; Mold., Résumé 141, 148, & 451. 1959; F. White & Angus, For. Fl. North. Rhodes. 365 & 366. 1962; Mold., Boaler, Journ. Ecol. Brit. 54: 474. 1966; Mold., Résumé Suppl. 17: 8. 1968; Mold., Fifth Summ. 1: 229, 242, 245, & 450 (1971) and 2: 869. 1971; F. White, Gard. Bull. Singapore 29: 69. 1977; Mold., Phytol. Mem. 2: 219, 232, 235, & 540. 1980.

An erect perennial, rhizomatous herb or small, much-branched bush or shrub, 0.8--2 m. tall; stems often 3 or 4, erect, pale-green or reddish-tinged, obtusely tetragonal, often slightly sulcate above, rather densely puberulent or short-pubescent throughout, less so in age; nodes not annulate; principal internodes 1.5--9 cm. long; leaves decussate-opposite or ternate, sometimes approximate, ascending; petioles very short, 1--2 mm. long, or obsolete, puberulent; leaf-blades submembranous, rather uniformly green on both surfaces or slightly lighter beneath, oblanceolate, 5.5--16 cm. long, 1.5--4.5 cm. wide, apically acute or short-acuminate, marginally subentire or coarsely dentate with 3--6 antrorse teeth above the widest part, basally cuneate or long-attenuate, minutely and irregularly strigillose above, rather densely punctate and puberulent beneath; midrib slender, plane above, prominulent beneath; secondaries filiform, 3--6 per side, plane above subprominulous beneath, ascending and slightly arcuate, not anastomosing at the margins and not entering the marginal teeth; veinlet reticulation sparse, obscure or indiscernible above, obscure beneath; inflorescence terminal, paniculate, 9--23 cm. long, to about 10 cm. wide, the lowermost pair of cymes usually in the axils of the uppermost leaves; cymes few-flowered, on slender puberulent stalks to about 4 cm. long, usually once or twice dichotomously branched with a central terminal flower in each dichotomy; bracts usually only one pair, subtending the second pair of cymes, foliaceous, sessile, to 3 cm. long and 8 mm. wide, puberulent on both surfaces; bractlets numerous, linear, 1--4 mm. long, puberulent, occasionally somewhat ampliate and purplish; flowers large, irregular; calyx cupuliform, pale-green, 4--7 mm. long, about 5 mm. wide, puberulent, the lobes red, often irregular, apically rounded; corolla irregular, green when young, the larger lip violet or purple, the other lobes mauve or greenish-mauve, 1.5--2 cm. long, subglabrous; stamens and style arching forward, entirely green when young, later basally whitish-mauve; anthers yellow or brown, turning orange-brown; stigma mauve or purple; fruiting-calyx incrassate, more or less patelliform, about 1 cm. wide, deeply 4-lobed, the lobes apically rounded, externally (dorsally) puberulent; fruit drupaceous, deeply 4-lobed.

This species is based on *E. Milne-Redhead 3526* from *Brachystegia* woodland just east of the Matonchi River in the Mwinilunga district, Zambia, collected on December 6, 1937, and deposited in the Kew herbarium. The corollas are described as having been "violet" on *Antun-*

es 338 and "blue" on *Phillips 2249* and *Quarré 1376*.

Collectors have encountered this plant in red soil and in forest patches on sand, at 500 m. altitude, in flower in May, November, and December and in fruit in August. White (1977) lists it as characteristic of the Zambesian region. Material has been misidentified and distributed in some herbaria as *C. myricoides* (Hochst.) R. Br.

Citations: ZAIRE: *Bequet 50* (Br, N); *Herb. Salesiens S.572* (Br); *Pole-Evans & erens 1865* (Af); *Quarré 73* (Br, Br), *1376* (Af), *1556* (Br), *1960* (Br), *2629* (Br, Br, Br); *Saeger 108* (Br, Br). ANGOLA: Huila: *Antunes 338* (Ul); *E. J. Mendes 1538* (Ld, Ul). ZAMBIA: *E. Milne-Redhead 3526* (F--photo of type, K--type, Ld--photo of type, N--photo of type, Sg--photo of type), *3747* (K, N), *4299* (K, N). MALAWI: *Phillips 2249* (Ba--376731).

CLERODENDRUM MINAHASSAE Teijsm. & Binn., Natuurk. Tijdschr. Ned. Ind. 25: 409 [as "*Clerodendron*"]. 1863; B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 20. 1936.

Synonymy: *Clerodendron minahassae* Teijsm. & Binn., Natuurk. Tijdschr. Ned. Ind. 25: 490. 1863. *Clerodendron infortunatum* Fern.-Villar in Blanco, Fl. Filip., ed. 3, 4: Nov. App. 161. 1880 [not *Clerodendron infortunatum* Auct., 1963, nor Blume, 1918, nor Gaertn., 1885, nor Lam., 1947, nor Lindl., 1918, nor Lour., 1793, nor Schau., 1847, nor Walp., 1843, nor Wight, 1850, nor *Clerodendrum infortunatum* Auct., 1935, nor Blume, 1907, nor Dennst., 1959, nor Gaertn., 1788, nor Lour., 1935, nor Miq., 1968, nor Vent., 1819, nor Willd., 1976, nor *Clerodendron infortunata* L., 1753]. *Siphobaea commersoni* Baill., Hist. Pl. 10: 106. 1888. *Siphoboea commersonii* Baill. apud Durand & Jacks., Ind. Kew. Suppl. 1, imp. 1, 400. 1906. *Clerodendron minahassae* Miq. ex Bremekamp, Ann. Jard. Bot. Buitenz. 28: 93. 1914; E. D. Merr., Philip. Journ. Sci. Bot. 12: 303. 1917. *Clerodendrum minahassae* "(haud L.) Villar" ex H. Hallier, Meded. Rijks Herb. Leid. 37: 76 in syn. 1918. *Clerodendron minahassae* var. *typicum* H. J. Lam, Verbenac. Malay. Arch. 315. 1919. *Clerodendron calycinum* Zipp. ex H. J. Lam, Verbenac. Malay. Arch. 315 in syn. 1919 [not *C. calycinum* Turcz., 1863]. *Clerodendrum mimahassae* Buswell ex Mold., Alph. List Inv. Names Suppl. 1: 7 in syn. 1947. *Clerodendrom minahassae* Teijsm. & Binn. ex Menninger, 1960 Price List Flow. Trees [3] sphalm. 1960. *Clerodendrum minhassae* Teijsm. & Binn. ex Menninger, Flow. Trees World 282 sphalm. 1962. *Clerodendron minahassae* Teijsm. ex Malaviya, Proc. Indian Acad. Sci. B.58: 352. 1963. *Clerodendrum manahassae* Teijsm. ex Mold., Fifth Summ. 1: 463 in syn. 1971. *Siphobaea commersonii* Baill. ex Mold., Fifth Summ. 2: 621 in syn. 1971. *Clerodendrum minnanassee* Buswell ex Mold., Phytol. Mem. 2: 392 in syn. 1980. *Clerodendron minahassae* var. *hypocum* H. J. Lam ex H. N. & A. L. Mold. in Dassan & Fosb., Rev. Handb. Fl. Cey. 4: 442 in syn. 1983.

Bibliography: Blanco, Fl. Filip., ed. 1, 508--509 & 512 (1837) and ed. 2, 354. 1845; Teijsm. & Binn., Natuurk. Tijdschr. Ned. Ind. 25: [ser. 5, 5]: 409. 1863; Oliv. in Speke, Journ. App., ed. 1, 644 (1863) and ed. 2, 644. 1864; Miq., Ann. Mus. Bot. Lugd.-Bat. 3: 251, pl. 9. 1867; Blanco, Fl. Filip., ed. 3, 2: 291, pl. 223. 1878; Fern.-Villar in Blanco, Fl. Filip., ed. 3, 4: Nov. App. 161. 1880; Vidal, Rev. Pl.

Vasc. Filip. 211. 1886; Baill., Hist. Pl. 10: 106. 1888; Baill., Bull. Soc. Linn. Paris 1: 722 & 733. 1888; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 561. 1893; Oliv. in Speke, Journ. App., ed. 3, 644. 1893; Fritsch in Engl. & Prantl, Nat. Pflanzenfam., ed. 1, 4 (3b): 159. 1894; Koord., Ann. Jard. Bot. Buitenz., ser. 1, 14: 355--373 & [470]--471, pl. [21[& 22. 1896; Koord., Über Blütenknosp. Hydath. Trop. Pl. 1897; Koord., Meded. Lands Plant. Tuin. Buitenz. 19: 559 & 561. 1898; Schimp., Pflanzen-Geogr. 359. 1898; Koord. & Valet., Meded. Lands Plant. 42 [Bijdr. Boomsart. Java 7]: 164 & 212. 1900; E. D. Merr., Philip. For. Bur. Bull. 1: 52. 1903; E. D. Merr., Govt. Lab. Philip. Publ. 27: 68 (1905) and 35: 76. 1906; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 1, 400. 1906; E. D. Merr., Philip Journ. Sci. 1: Suppl. 122. 1906; C. B. Robinson, Philip. Journ. Sci. Bot. 6: 220. 1911; Koord., Exkursionsfl. 3: 137. 1912; E. D. Merr., Fl. Manila, imp. 1, 401 & 402. 1912; Bremekamp, Ann. Jard. Bot. Buitenz. 28: 93--97, pl. 13. 1914; E. D. Merr., Bull. Govt. Lab. Philip. 35: 62. 1915; Backer, Tropische Natuur 5: 72, 88, 93, & 94. 1916; Heyne, Nutt. Pl. Ned. Ind., ed. 1, 4: 121 & xxiii. 1917; W. H. Br., Merr., & Yates, Philip. Journ. Sci. Bot. 12: 222 & 240. 1917; E. D. Merr., Philip. Journ. Sci. Bot. 12: 302, 303, & 383. 1917; H. Hallier, Meded. Rijks Herb. Leid. 37: 75 & 76. 1918; E. D. Merr., Sp. Blanc. 334. 1918; H. J. Lam, Verbenac. Malay. Arch. 314, 315, 317, 362, & 364. 1919; Bakh. in Lam & Bakh., Bull. Jard. Bot. Buitenz., ser. 3, 3: 75, 85, 86, 108, 109, viii, & ix. 1921; Guerrero, Philip. Bur. For. Tech. Bull. 22: 230. 1921; Fedde, Justs Bot. Jahresber. 42: 848. 1923; E. D. Merr., Enum. Philip. Flow. Pl. 3: 403. 1923; H. F. MacMillan. Trop. Gard. Plant., ed. 3, 110. 1925; Heyne, Nutt. Pl. Ned. Ind., ed. 2, 1: 24 (1927) and ed. 2, 2: 1222--1223. 1927; Stapf, Ind. Lond. 2: 239 (1930) and 6: 544. 1931; Burkill, Dict. Econ. Prod. Malay Penins., imp. 1, 1: 589 & 590. 1935; H. F. MacMillan, Trop. Plant. Gard., ed. 4, 104, 105, & 514. 1935; Arthur & Cummins, Philip. Journ. Sci. 61: 479. 1936; B. Thomas, Engl. Bot. Jahrb. 68: [Gatt. Clerod.] 20. 1936; Mold., Alph. List Comm. Vern. Names 2--4, 10, 17, 18, 28, & 29. 1939; Mold., Geogr. Distrib. Avicenn. 37. 1939; Mold., Prelim. Alph. List Inv. Names 18--21. 1940; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 2, 400. 1941; Fedde & Schust., Justs Bot. Jahresber. 60 (2): 572. 1941; Mold., Suppl. List Comm. Vern. Names 4 & 13. 1941; Worsdell, Ind. Lond. Suppl. 1: 238. 1941; Lam & Meeuse in Holthuis & Lam, Blumea 5: 108--109, 121, & 286. 1942; Mold., Alph. List Inv. Names 16--19. 1942; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 62, 66, 72, & 90. 1942; Fairchild, Gard. Isls. Great East 179 & 229. 1943; H. F. MacMillan, Trop. Plant. Gard., ed. 5, imp. 1, 104, 105, & 514. 1943; H. J. Lam, Blumea 5: 768. 1945; Menninger, Stuart News p. 4, Jan. 11. 1945; Mold., Phytologia 2: 100. 1945; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 1: 561. 1946; H. F. MacMillan, Trop. Plant. Gard., ed. 5, imp. 2, 104, 105, & 514, 1946; Mold.,Alph. List Cit. 1: 5, 136, 137, 196, & 198. 1946; Cobin, Amer. Eagle Hort. Rev. 42 (14): 6. 1947; Mold., Alph. List Inv. Names Suppl. 1: 7. 1947; H. F. MacMillan, Trop. Plant. Gard., ed. 5, imp. 3, 104, 105, & 514. 1948; Neal, Gard. Hawaii, ed. 1, 644. 1948; Mold., Alph. List Cit. 2: 462 & 563 (1948), 3: 671, 707, 713, 727, 840, 848, & 891

(1949), and 4: 987, 1080, 1155, 1161, & 1193. 1949; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 141, 146, 159, & 182. 1949; H. F. MacMillan, Trop. Plant. Gard., ed. 5, imp. 4, 104, 105. & 514. 1949; W. L. Phillips, Cat. Pl. Fairchild Trop. Gard. 16. 1949; Quisumb., Philip. Dept. Agr. Tech. Bull. 16: 790--791. 1951; H. F. MacMillan, Trop. Plant. Gard., ed. 5, imp. 5, 104, 105, & 514 (1952) and ed. 5, imp. 6, 104, 105, & 514. 1954; Menninger, 1954 Price List [4] & [9] (1954) and 1956 Price List [4]. 1955;H. F. MacMillan, Trop. Plant. Gard., ed. 5, imp. 7, 104, 105, & 514. 1956; Menninger, 1957 Price List [3] (1957) and 1959 Price List [2]. 1958; Estores Anzaldo, Maraño̲n, & Ancheta, Philip. Journ. Sci. 86: 236. 1958; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 3, 400. 1959; Mold., Résumé 183, 194, 195, 197, 199, 216, 263, 265, 266, 273, & 451. 1959; Burtt, Notes Bot. Gard. Edinb. 23: 95. 1960; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 1: 561. 1960; Menninger, 1960 Price List Flow. Trees [3]. 1960; Mold., Résumé Suppl. 2: 7. 1960; Menninger, Trop. Tree Seeds, imp. 1, [1] (1960) and imp. 2, [1]. 1961; Hansford, Sydowia Ann. Myc., ser. 2, Beih. 2: 694. 1961; H. F. MacMillan, Trop. Plant. Gard., ed. 5, imp. 8, 104, 105, & 514. 1962; Menninger, Flow. Trees World 282 & 283. 1962; Mold., Résumé Suppl. 3: 21, 23, 28, & 30. 1962; Nair & Rehman, Bull. Nat. Bot. Gard. Lucknow 76: 14 & 15. 1962; Malaviya, Proc. Indian Acad. Sci. B.58: 352--355, 358, 359, & 361, fig. 7 & 8. 1963; Mold., Résumé Suppl. 6: 9. 1963; Sharma & Mukhopadhyay, Journ. Genet. 58: 359--361, 363, 364, 373, & 382, pl. 10, fig. 18 & 19. 1963; Cave, Ind. Pl. Chromos. 2: 330. 1964; Melchior in Engl., Syllab., ed. 12, 2: 436. 1964; Anon., Biol. Abstr. 46 (23): B.29. 1965; Backer & Bakh., Fl. Java 2: 608. 1965; Burkill, Dict. Econ. Prod. Malay Penins., imp. 2, 1: 589 & 590. 1965; Malaviya, Biol. Abstr. 46: 8468. 1965; Neal, Gard. Hawaii, ed. 2, 731. 1965; Airy Shaw in J. C. Willis, Dict. Flow. Pl., ed. 7, 1042. 1966; Mold., Résumé Suppl. 15: 18. 1967; E. D. Merr., Fl. Manila, imp. 2, 401 & 402. 1968; Bolkh., Grif, Matvej., & Zakhar., Chromos. Numb. Flow. Pl., imp. 1, 715. 1969; Corner & Watanabe, Illust. Guide Trop. Pl. 755. 1969; Mold., Fifth Summ. 1: 304, 316, 322, 330, 332, 359, 438, 441, 447, 450, 463, & 464 (1971) and 2: 621. 1971; Anon., Biol. Abstr. 54 (7): B.A.S.I.C. S.53. 1972; Mold., Phytologia 23: 315. 1972; Altschul, Drugs Foods 248. 1973; Bolkh., Grif, Matvej., & Zakhar., Chromos. Numb. Flow. Pl., imp. 2, 715. 1974; Hocking, Excerpt. Bot. A,23: 291. 1974; Mold., Phytologia 28: 449. 1974; J. F. Morton, 500 Pl. S. Fla. 54. 1974; Menninger, Color Sky 35 & [166], pl. 132. 1975; L. H. & E. Z. Bailey, Hortus Third 286. 1976; Mold., Phytologia 34: 269. 1976; López-Palacios, Fl. Venez. Verb. 264. 1977; Mold., Phytol. Mem. 2: 295, 306, 313, 320, 322, 350, 384, 392, 437, & 540. 1980; Brenan, Ind. Kew. Suppl. 16: 71. 1981; Mold., Phytologia 50: 143. 1982; H. N. & A. L. Mold. in Dassan. & Fosb., Rev. Handb. Fl. Ceyl. 4: 411, 442--444, 462, & 473. 1983; Mold., Phytologia 57: 344, 345, & 349 (1985), 58: 286 (1985), 59: 104, 106, & 469 (1986), 60: 282 (1986), 61: 25, 178, 182, 183, 394, 412, & 495 (1986), and 62: 130 & 139. 1987.

Illustrations: Koord., Ann. Jard. Bot. Buitenz., ser. 1, 14: pl. [21] & 22 [anat.]. 1896; H. F. MacMillan, Trop. Plant. Gard., ed. 4, 105 (1935), ed. 5, imp. 1, 105 (1943), ed. 5, imp. 2, 105 (1946), ed.

5, imp. 3, 105 (1948), ed. 5, imp. 4, 105 (1949), ed. 5, imp. 5, 105 (1952), ed. 5, imp. 6, 105 (1954), ed. 5, imp. 7, 105 (1956), and ed. 5, imp. 8, 105. 1962; Menninger, Flow. Trees World 282. 1962; Malaviya, Proc. Indian Acad. Sci. B.58 (6): [354], fig. 7 & 8 [anat.] 1963; Sharma & Mukhopadhyay, Journ. Genet. 58: 382, pl. 10, fig. 18 & 19 [cytol.]. 1963; Corner & Watanabe, Illust. Guide Trop. Pl. 755. 1967; Menninger, Color Sky [166]. pl. 132. 1975.

An erect, spreading, free-flowering shrub, 1--3 m. tall, or small tree, to 6 m. tall; trunk to 2 m. tall and 7.5--12 cm. in diameter; bark pale-gray; branchlets slender or stoutish, medullose, very obtusely tetragonal, glabrate, often shiny, lenticellate; nodes not annulate; principal internodes 2--7 cm. long; leaves decussate-opposite; petioles slender, 0.5--7.5 cm. long, very minutely and obscurely puberulent or subglabrate; leafblades chartaceous, dark- or bright-green, slightly lighter beneath, elliptic or oblong to ovate-oblong, 7.5--27.5 cm. long, 3--13 cm. wide, apically attenuate-acute or short-acuminate, marginally entire, basally obtuse or rounded (rarely subacute) to truncate or subcordate, minutely pulverulent on both surfaces, especially along the larger venation; inflorescence cymose, the cymes 1--many-flowered, aggregated into an abbreviated few- to many-flowered terminal panicle 5--12 cm. long (not including the corollas during anthesis) and 4.5--5 cm. wide; peduncles and sympodia short, minutely pulverulent-puberulent or glabrate; pedicels stout, 0.8--2.5 cm. long, minutely pulverulent or glabrate; foliaceous bracts none; bractlets and prophylla inconspicuous, linear-subulate, 1--3 mm. long, puberulent; flowers very large, with a spicy fragrance; calyx in bud filled with water, during anthesis fleshy, green or yellowish-green, tubular, 1.5--2.5 cm. long, 8--10 mm. wide, incised less than half way down, apically often red or reddish, externally glabrous or short-pubescent; corolla very long, hypocrateriform, the tube narrow-cylindric, creamy- or yellowish-white to light-yellow, 8--10.5 cm. long, glabrous, the limb to 6 cm. wide, the lobes white or streaked with pink, 2.5--4 cm. long, to 1.3 cm. wide; filaments and style white or else pink or purple and becoming whitish basally; fruiting-calyx fleshy, accrescent, maroon to red or blood-red to deep blue-black, often to 5 cm. wide, the lobes becoming widely divaricate in stellate fashion, apically sharply acute or acuminate; fruit drupaceous, blue-green to torquoise-blue or purple; chromosome number: 2n = 52.

This species is based on *Teijsmann 5298, 5774,* & *5868* from the Minahassae District, Menado Province, Celebes. From the flower size it is obviously a member of the Section *Siphonanthus* (L.) Schau.

Collectors have found this plant growing in thickets and open thickets, woods, forests, secondary bush, and ravines, at 50--500 m. altitude, in anthesis throughout the year, and in fruit in June and from August to December. Backer (1965) asserts that in Java it blooms throughout the year, but MacMillan (1925) gives June to August as its usual period of anthesis. Backer (1965) says that it is native to the Philippines, Celebes, and the Sulu Islands and that in Java it is only cultivated as an ornamental. The Baileys (1976) regard it as native to the Malay Archipelago. Holthuis & Lam (1942) record it

from Salebaboe Island in the Talaud Islands.

Furtado refers to the species as "an escape [at Singapore], no plant of this species within a radius of 150 feet". *Kaudern 499*, cited below, may have come from a cultivated plant. Corner & Watanabe, in their work on tropical plants, speak of this as an "occasional" ornamental.

Fairchild comments that the Loomis collection (cited below) was raised from seed collected by himself in a garden on the slopes of Soepoetan volcano and says that the plant is "An unusually attractive shrub with flowers and fruits in great contrast of color, red calyx, torquoise blue fruits. It is grown in gardens here for its leaves which are used for greens. [The] calyx [is] nearly 2 inches across, individual petals ½ in. wide. A very showy species." In his 1943 work he refers to it as "from Masamba" and claims that in Florida it "has become a tree, and its beautiful white flowers, four inches long, have borne fruits, and these in turn have grown into lusty little seedlings in a flower pot." Menninger, also in Florida, in 1955 offered 8--15-inch seedlings for $2 apiece.

Brown, Merrill, & Yates (1917) list the species from Luzon's Volcano Island, where, they affirm, it is "Widely scattered at low altitudes, in thickets and in ravines". Backer (1916) says "Inheemsch in de Minahassae en de Philippijnen, op Java hier en daar in tuinen aangeplant".

The typical form of this very variable species is native to the Philippine Islands and Indonesia; also known as an escape in Singapore and in cultivation in many parts of tropical Asia, the Hawaiian Islands, Florida, the West Indies, and (in greenhouses) Europe. It propagates readily from seeds or cuttings. The pollen has been described in detail by Nair & Rehman (1962) on the basis of Nat. Bot. Gard. Lucknow 44266, slide 2657. They assert that it has the ectine surface spinulate, the ends of the spinules either blunt or pointed, 3 (or 4)-zonicolpate, subprolate, 88 x 89 mu, range 86--99 x 80--90 mu, a few grains syncolpate.

The names, *Clerodendron fortunatum* Blanco and *C. blancoi* Naves are often placed in the synonymy of the typical form of *C. minahassae*, but actually belong to that of its var. *brevitubulosum* H. J. Lam, while *Volkameria grandiflora* Blanco, also sometimes placed here, is a synonym of *C. macrostegium* Schau., which see.

The young leaves of *Clerodendrum minahassae* are used as "greens" and medicinally to treat stomach-ache in parts of Indonesia; Ramos & Edano speak of the plant as "medicinal" on Jolo Island in the Philippines.. The leaves are sometimes attacked by the parasitic fungi, *Meliola clerodendricola* P. Henn. and *Puccinia erebia* Syd.

Curran describes our plant as "A large shrub with unusual and very attractive fruits which when ripe open up like a flower, exposing a purple seed pod, and extend 5 narrow maroon-colored arms, thus resembling a starfish". Indeed, the large and massive calyxes during anthesis, with their enclosed hydathodes, the long corolla-tubes, and the leaf-shape, all taken together, well distinguish this species from all others with which it might be confused.

In the typical form of this species the calyx during anthesis is

1.5--2.5 cm. long and the corolla-tube is 8--10.2 cm. long; in var. *brevitubulosum* the calyx in anthesis is 2.5--3.5 cm. long and the corolla-tube is only 5--8.5 cm. long; in var. *grandicalyx* the calyx is to 11 cm. long.

Merrill (1917) asserts that *C. mabesae* Merr. is related to *C. minahassae*, but has even longer flowers, the corolla-tube being about 12 cm. long. In his 1923 work he does not recognize Lam's var. *brevitubulosum* and affirms that the species occurs from "Northern Luzon (Cagayan) to Mindanao and Basilan, in most islands and provinces. Often common in thickets and secondary forests at low and medium altitudes" in the Philippines, giving its extralimital distribution as Celebes and the Sulu Islands.

Cobin (1947) notes that "The dark green foliage of *Clerodendron Minahassae*, which measures up to ten inches in length and four inches across, serves as a pleasing background to the creamy white blooms and the attractive fruits. The plant propagates readily from seed or cuttings, is tolerant to shade and sun alike, and it is forecast that it will not be long before it rivals in popularity its well-known *Clerodendron* relatives grown in South Florida."

Koorders (1896) has studied very carefully the hydathodes in the buds and flowers of this species. He notes thar "Die wasserhaltenden Kelche bei dieser Pflanze sind besonders interessant, weil dieselben nicht nur (wie bei *Parmentiera cerifera* und *Spathodea campanulata*) bei der Blüthenknospe ganz mit Wasser gefüllt sind und (wie bei *Iochroma macrocalyx*) auch bei der Blüthe prall von Wasser sind, sondern auch bei der Frucht einen bis oben am Rande mit Wasser versehenen Krug darstellen. Dieser letztere Fall ist nun bis jetzt nicht bekannt gewesen.....Weil dasselbe für die Erklärung des biologischen Zweckes der *Clerodendron*-Wasserkelche vielleicht Werth haben könnte muss hier erwähnt werden, dass sowohl bei allen von mir in der Heimath gesammelten specimina, wie bei allen Blüthenknospen, Blüthen und Fruchten der Kelch an der Aussenseiten an mehreren Stellen, zuweilen fast auf der ganzen Oberfläche, mehr oder weniger tief von Thieren, wohl von Insecten angebissen war. Nie aber fand ich so tief angebissene Kelche, dass die Innenwand zerstört war, und das Wasser herausgeflossen war. Die älteren Bisswinden hatten sich meistens geschlossen, aber infolge des Bissen waren meist mehr oder weniger starke Deformationen entstanden, welche besonders an alten Fruchtkelchen, namentlich im Buitenzorger Garten ziemlich auffallend waren. Im Letzteren erzeugt die Pflanze wie in der Heimath aber zahlreiche Samen. Obwohl Vermittlung der Befruchtung durch Thiere mir höchst wahrscheinlich scheint, kann ich in dieser Hinsicht leider keine Sicherheit gehen...." He gives very detailed anatomical and cytological descriptions of all the involved parts, chemical analysis of the enclosed water, etc.

The corollas of this plant are described as having been "white" on *Ferris s.n.*, *Grevenstuk 180*, and *Sumithraraachchi & Sumithraraachchi DBS.78*, "creamy-white" on *Curran 3459*, "yellowish-white" on *Topacio 20042*, "light-yellow" on *Pancho 1606*, "white streaked with pink" on *Gillis 7985*, "the tube cream, lobes white" on *Peterson J.585*, and "tube green, limb white" on *Furtado s.n.*

Common and vernacular names reported for *C. minahassae* are the following: "alagâo", "amambolígan", "ambulígan", "ayam-ayam", "bagalbak", "bagáuac", "bagáuak-itim", "bagáuak-na-puti", "bagava", "bakobok", "boenato", "boengan-merah", "boenga-petje", "danata", "Fairchild's clerodendrum", "Hugo's clerodendrum", "kajoe-tedoe", "kasopángil-qúbat", "ku-ku", "leilem", "leilèm in asoe", "lěilěm in asoe", "leilem-in-asoe", "lèilěm in taloen", "leilèm in taloen", "leilem-in-taloen", "lelema-in-taloen", "masaboekoe", "papait-ulongan", "soepángka asoewàn'a", "sunkol", "tabúgok", and "walana".

Malaviya (1963) found brachysclerids developed from transformed parenchyma cells of the cortex or pith in this plant. Melchior (1964) speaks of the calyx as a "Wasserkelch...mit wasserausschleidende Hydathoden".

The parasitic fungus, *Meliola clerodendricola* P. Henn., is recorded from this species by Hansford (1961) on the basis of *Herb. Philip. Bur. Sci. 8688, 16764, 23914, 25346,* & *26754,* C. B. *Robinson 2539,* and *Sydow 171* & *370* from the Philippines.

The genus *Siphobaea* was originally placed by Baillon (1888) in the *Gesneriaceae,* but was shifted to the *Verbenaceae* by B. L. Burtt in 1960. The type. *S. commersoni*, was not based on *Clerodendron commersonii* Spreng, as might be supposed, but was based on a plant received by Sonnerat from Commerson, collected by the latter in the Philippines, where it is said to be known as "bagava", and deposited in the Sonnerat herbarium at Paris.

It may be noted here that among the homonyms of *Clerodendron* (or *Clerodendrum*) *infortunatum* cited above those accredited to "Auct.", Blume, Miquel, Schauer, and Willdenow are synonyms of *C. viscosum* Vent., those accredited to Gaertner and to Ventenat are synonyms of *C. infortunatum* L., those credited to Dennstaedt, Lamarck, Walpers, and Wight are *C. villosum* Blume, that credited to Lam is *C. petasites* (Lour.) S. Moore, that credited to Lindley is *C. kaempferi* (Jacq.) Sieb., and that credited to Loureiro is in part *C. kaempferi* (Jacq.) Sieb. and in part *C. viscosum* Vent.

Keys to help distinguish *Clerodendrum minahassae* from other Indonesian species in the genus will be found under *C. klemmei* Elm. in the present series of notes [61: 410--415] and from other Indian and Hawaiian taxa under *C. indicum* (L.) Kuntze [61: 23--25].

Hallier (1918) cites *DeVriese & Teijsmann s.n., Forsten 9* & *s.n., Weber s.n.,* and *Zippelius s.n.* from Celebes, *Ramos 14729* and *Robinson 11778* from Mindanao, *Curran 17443* from Negros, *Hallier 3518, Topacio 20042,* and *Vidal 491* from Luzon, and *McGregor 10267* and *Robinson 9057* from Polillo. Lam (1919) cites for the typical form of *C. minahassae* only *Forsten s.n., Herb. Utrecht 43903,* and *Teijsmann & DeVriese s.n.* from Celebes. López-Palacios (1977)cites *Trujillo 8646* from cultivation in Venezuela.

[to be continued]

TAXONOMIC STUDY OF MACHAERANTHERA, SECTIONS MACHAERANTHERA AND HESPERASTRUM (ASTERACEAE)

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ABSTRACT

The sections Machaeranthera and Hesperastrum of the genus Machaeranthera are treated systematically. The former is comprised of two species, M. tanacetifolia and M. tagetina. The section Hesperastrum is comprised of three species: Machaeranthera asteroides, with three varieties; M. bigelovii, with three varieties; and M. canescens, with ten varieties divided among two subspecies. Keys to these various taxa are provided along with distribution maps. In addition, a chromosomal review of the sections is provided which includes numerous previously unreported chromosome counts. All counts were diploid with 2n=8. One new combination, M. canescens subsp. glabra, is proposed.

The genus Machaeranthera was established by Nees in 1832. The generotype, M. tanacetifolia, is a widespread, erect, tap-rooted, annual with lavender rays and a base chromosome number of x=4.

Most subsequent workers, A. Gray for example, reduced Machaeranthera to sectional status and placed it within the broad fabric of Aster. As such, the section included several seemingly disparate elements, for example the lavender-rayed Machaeranthera gymnocephala, which Greene (1894) placed in his newly resurrected Eriocarpum. Hall (1928) transferred all of the latter into his broadly conceived Haplopappus, placing these into his section Blepharodon. Shinners (1950) reunited Blepharodon (including Eriocarpum) with Machaeranthera, which he accepted as a genus distinct from Aster. Cronquist and Keck (1957), while recognizing Machaeranthera as a genus, nevertheless retained section Blepharodon in Haplopappus (sensu Hall), despite the removal of its type species, Machaeranthera gymnocephala, which, along with several other lavender-rayed taxa, was placed in the series Originales of Machaeranthera.

Hartman (1976) has reviewed in much greater detail the information presented above. Indeed, after poring over his unpublished thesis for a number of years now, I find his treatment remarkably thorough and taxonomically sound. Consequently I have little hesitation in taking up the arrangement and nomenclature which he provided.

Hartman treated Machaeranthera as comprizing eight sections. These were divided into two subgenera, as follows:

Subgenus Machaeranthera
1. Machaeranthera
2. Blepharodon
3. Hesperastrum
4. Arida
5. Psilactis

Subgenus Sideranthus
6. Sideranthus
7. Havardii
8. Stenoloba

Hartman's thesis largely dealt with the section Blepharodon and little detailed attention was given to the taxonomically difficult sections Machaeranthera and Hesperastrum. The latter, in particular, comprise the largest, most variable elements within Machaeranthera, these being the most commonly encountered taxa in the western United States.

The sections Machaeranthera and Hesperastrum were selected as an appropriate doctoral systematic problem by Mr. Larry Gieschen. After several years of field and herbarium studies he suddenly abandoned this project with the observation that "The past is fiction...", a quotation which he said was taken somewhere from the current writings of William Burroughs. To me, his major professor, however, the "past" meant that some 12,000 plus plant specimens on loan to the University of Texas from 20 or more herbaria had to be annotated and returned. To this end I invested some 6 months of my time during the spring and summer of 1986, with 6 weeks and 8000 miles of field work in the western U.S. during the late summer and fall months.

After working with the herbarium sheets and distilling from these a body of data which suggested that relatively few recognizable specific taxa made up the sections concerned (in spite of the 70 or more specific names proposed), I was pleased to have these concepts confirmed by subsequent field observations.

My studies suggest that the section Machaeranthera has but two partially sympatric species, M. tagetina and M. tanacetifolia, the former occurring at lower elevations in the Sonoran desert regions, the latter occurring at higher more mesic sites over a much broader area. If in close proximity occasional hybrid swarms will be found, along with some peripheral gene flow.

The section Hesperastrum is much more difficult. In this I recognize but three species: 1) M. asteroides, predominantly in the lower more arid regions of the southwestern United States and adjacent Mexico; 2) M. bigelovii, predominantly of high elevations in the south-central Rocky Mountain regions of the United States and; 3) M. canescens, a wide-ranging highly variable species of the north-central and western Rocky Mountain Regions. The latter is

comprised of ten, largely allopatric, morphological entities that integrade peripherally, either geographically or up-slope (where such varieties occupy the same montane massifs).

Finally, I do not contend that the views expressed here are etched in stone. Additional field work is needed to help clarify the spatial relationships of M. tagetina and M. tanacetifolia in southern Arizona and those of M. asteroides and M. bigelovii in southern New Mexico. In addition there appears to be occasional intergradation of M. canescens and M. bigelovii in Colorado. Whether this is occasioned by recent or ancestral hybridization is a question that might be resolved with populational analyses. I do, however, believe that most of the basic variation patterns and distributions documented here, and the names bestowed upon them, will weather the test of time and additional study.

SPECIES RELATIONSHIPS

The relationship of the two species recognized in section Machaeranthera seem fairly straight-forward. The large-headed, much more widespread, M. tanacetifolia, apparently gave rise to the small-headed relatively localized M. tagetina in relatively recent time, perhaps within the last 100,000 years or so, as the Sonoran desert became regional in scope. Whether or not the character-intergradations that can be found in the Arizona region is due to environmental sorting (primary divergence), or to gene flow following secondary peripheral contact, or to occasional instances of sympatric hybridization, was not resolved by this study.

Relationships among the section Hesperastrum are much more complex. I have recognized three species, each of which contains three or more infraspecific taxa which I have treated as varieties because their ranges are largely allopatric and each appears to intergrade in areas of contact with yet other varieties.

I am relatively content that Machaeranthera canescens with its ten, mostly intergrading, varieties is a natural or phyletic-grouping. I am less sure about the relationships within M. bigelovii, for this subalpine taxon appears to be quite variable, either as a result of periodic hybridization with the lower-elevational, M. canescens, or as a result of parallel selection for larger heads with more attenuate involucral bracts and captulescences with more extensive glandular-trichomes. Indeed, the populational units from south-central Utah which I have referred to as M. bigelovii var. commixta might as readily be included as a variety under M. canescens. I opted for the former course because it occupied fairly subalpine habitats, and possessed some of the key-characters of M. bigelovii (i.e., well-developed, glandular-trichomes upon its peduncles and involucral bracts). But in other characters, e.g. smaller heads with fewer florets, less-attenuate involucral bracts, etc. it strongly approaches M. canescens. So future workers might help resolve this minor

evolutionary enigma: are these subalpine populations selected out of the variable, widespread, M. canescens so that they superficially resemble M. bigelovii as it is typically represented in Colorado and northern New Mexico, or do these represent relict populations of a once more widespread and perhaps variable M. bigelovii.

Within Machaerantera asteroides I have also recognized three varieties: 1) a montane, widespread var. asteroides which appears to intergrade locally with M. bigelovii in southern New Mexico, presumably as a result of sympatric hybridization with some peripheral gene-flow; 2) a less-montane desert or semi-desert var. glandulosa, which possibly arose out of ancestral hybridization between M. asteroides and M. cinerascens; and 3) the localized var. lagunensis, which presumably also relates to ancestral gene exchange between M. asteroides and M. cinerascens, with subsequent divergence.

Additional comments regarding the above observations will be found below each of the taxa mentioned.

SECTIONAL RELATIONSHIPS

Machaeranthera and Hesperastrum are believed to be closely related taxa. They share numerous morphological features, possess similar flavanoids, and are are all characterized by the diploid chromosome number, 2n=8. The two sections are most readily distinguished by their vegetative features, Machaeranthera by its pinnately dissected leaves and Hesperastrum by its merely dentate, serrulate, or occasional entire leaves.

Of the aproximately 14,000 herbarium sheets examined in the present study and from the numerous populations examined in the field, hybridization between members of these two sections was inferred from only a single collection (Colorado: "Rocky Mts.", Hall & Harbour 285, US, collected in the year 1862). This plant appeared to be intermediate between M. tanacetifolia and M. bigelovii. Future workers might anticipate the rare hybrid where these two species occur together.

As to the relationship of the above two sections with yet other sectional groupings within Machaeranthera I refer the readers to the upcoming cladistic analysis by Nesom and Turner (1987). It is sufficient to say at this point that the cladistic (and phenetic) relationships among the various sections of Machaeranthera (sensu Hartman) and yet other genera (e.g., Isocoma) are much more reticulate than heretofore suspected.

CHROMOSOME COUNTS

The first published chromosome count for a member of the sect. Hesperastrum was presumably an erroneous count of n=5 for

Machaeranthera canescens var. canescens (reported as M. leucanthemifolia by Raven et al., 1960). As noted in Table 1, all subsequent counts (from about 80 populations) have been diploid with n=4.

Jackson (1959) was the first to report counts for the sect. Machaeranthera. This, and all subsequent reports on populations of this taxon, have been diploid with n=4. Gieschen (unpubl., Table 1) has made the most extensive chromosomal survey of the above two sections, providing numerous counts from nearly all of the included taxa. Species in both sections are relatively easy to count from meiotic material, but occasional plants may possess 1-3 fragments which probably accounts for the erroneous report for M. canescens, noted above.

In summary, sections Machaeranthera and Hesperastrum have been found to be uniformly diploid on a base of x=4. A base chromosome of x=4 has also been reported for other sections of Machaeranthera, except for species of the section Arida which have a base number of x=5 (Hartman, 1976). Chromosome numbers of 2n=4 and 2n=6 found in M. gracilis (Jackson, 1964) of the section Sideranthus and 2n=6 in M. heterocarpa Hartm. & Lane of the section Psilactis (Hartman and Lane, 1987) are believed to be aneuploid derivitives. The latter taxon also contains species with 2n=18 (Hartman, 1976; Nesom 1978), but these are believed to be polyploid derivitives from ancestral base numbers of x=4 or 5.

TABLE 1. Chromosome numbers in Sections Machaeranthera and Hesperastrum.

Taxon	Locality	Reference/voucher	Number
SEC. HESPERASTRUM			
M. asteroides var. asteroides			
	MEX. Chihuahua:	Powell et al 1304 (TEX)	n=4 II
"	USA. ARIZ: Greenlee Co.,	Gieschen 42 (TEX)	n=4 II
"	USA. ARIZ: Pinal Co.,	Gieschen 42 (TEX)	n=4 II
"	USA. N.MEX: Hidalgo Co., [reported as M. tephrodes]	Ward (1984)	n=4 II
"	USA. N.MEX: Otero Co., [reported as M. tephrodes]	Anderson et al. (1974)	n=5 II*
M. asteroides var. glandulosa			
	USA. ARIZ: Maricopa Co., [reported as M. tephrodes]	Pinkava & Keil (1977)	n=4 II
"	USA. ARIZ: Maricopa Co.,	Parfitt 2967 (ASU)	n=4 II
"	USA. ARIZ: Mohave Co.,	Reeves & Pinkava 11963 (ARIZ)	n=4 II
"	USA. ARIZ: Yavapai Co., [reported as M. bigelovii]	Keil & Pinkava (1979)	n=4 II

M. asteroides var. glandulosa cont.

USA. ARIZ: Yavapai Co., Solbrig et al. (1969) n=4 II
[reported as M. bigelovii]
" USA. ARIZ: Gila Co., Gieschen 46 (TEX) n=4 II
" USA. ARIZ: Greenlee Co., Turner & Powell 6114 (TEX) n=4 II

M. bigelovii
var. bigelovii

USA. COLO: Chaffee Co., Turner & Flyr (1966) n=4 II
" USA. COLO: Chaffee Co., Watson (1973) n=4 II
" USA. COLO: Gilpin Co., Watson (1973) n=4 II
" USA. COLO: Huerfano Co., Mosquin 5394 (NY) n=4 II
" USA. COLO: Larimer Co., Gieschen 98, 99 (TEX) n=4 II
" USA. COLO: Larimer Co., Semple (1985) 2n=8
" USA. COLO: Larimer Co., Turner & Horne (1964) n=4 II
" USA. COLO: Park Co., Gieschen 104 (TEX) n=4 II
" USA. COLO: San Juan Co., Gieschen 108 (TEX) n=4 II
" USA. COLO: San Juan Co., Watson (1973) n=4 II
" USA. COLO: Summit Co., Mosquin 5359 (NY) n=4 II
" USA. COLO: Teller Co., Gieschen 103 (TEX) n=4 II
" USA. N.MEX: Mora Co., Sundberg 1652 (TEX) n=4 II
" USA. N.MEX: Otero Co., Hartman 3464 (LL) n=4 II
" USA. N.MEX: Sandoval Co., Gieschen 117, 118 (TEX) n=4 II
" USA. N.MEX: Sierra Co., Ward & Spellenberg (1986) n=4 II
" USA. WYO: Albany Co., Keil 10908 (AZU) n=4 II
[approaches M. canescens]

M. bigelovii
var. commixta

USA. UTAH: Iron Co., Gieschen 90, 92 (TEX) n=4 II
" USA. UTAH: Iron Co., Hartman 3411b (TEX) n=4 II

M. bigelovii
var. mucrontata

USA. ARIZ: Coconino Co., Gieschen 86 (TEX) n=4 II
" USA. ARIZ: Coconino Co., Keil 11716 (TEX) n=4 II

M. canescens
var. ambigua

USA. ARIZ: Apache Co., Turner & Horne (1964) n=4 II
" USA. ARIZ: Coconino Co., Gieschen 84, 85 (TEX) n=4 II
" USA. ARIZ: Coconino Co., Keil 11734, Keil (1979) n=4 II
" USA. ARIZ: Coconino Co., Morefield 1766a (NY) n=4 II
[reported as M. tephrodes in Morefield & Schaack, 1985]
" USA. N.MEX: Santa Fe Co., Mosquin & Gillett 5413 (NY) n=4 II**

M. canescens
var. aristata

USA. ARIZ: Coconino Co., Solbrig et al. (1964) n=5 II
[reported as M. rigida]
" USA. ARIZ: Coconino Co., Turner & Horne (1964) n=4 II
[reported as M. linearis]

M. canescens var. aristata cont.

USA. ARIZ: Navajo Co.,	Turner & Horne (1964)	n=4 II
" USA. N.MEX: San Juan Co.,	Ward (1984)	n=4 II
" USA. UTAH: Grand Co.,	Gieschen 95 (TEX)	n=4 II
" USA. UTAH: Kane Co.,	Turner 5834 (TEX)	n=4 II
" USA. UTAH: San Juan Co.,	Turner 5840 (TEX)	n=4 II

M. canescens
var. canescens

CANADA. Alberta:	Mosquin & Benn 4728 (DS)	n=4 II
" USA. CALIF: Alpine Co.,	Gieschen 65 (TEX)	n=4 II
" USA. CALIF: Alpine Co.,	Solbrig et al. (1969)	n=4 II
[reported as M. shastensis]		
" USA. CALIF: Inyo Co.,	Gieschen 59 (TEX)	n=4 II
" USA. COLO: Grand Co.,	Gieschen 97 (TEX)	n=4 II
" USA. COLO: Gunnison Co.,	Gieschen 105 (TEX)	n=4 II
" USA. COLO: Montrose Co.,	Gieschen 106 (TEX)	n=4 II
" USA. COLO: Saguache Co.,	Watson (1973)	n=4 II
" USA. COLO: Saguache Co.,	Watson (1973)	n=4 II
[intermediate to M. bigelovii; reported as M. aspera]		
" USA. IDAHO: Fremont Co.,	Solbrig et al. (1969)	n=4 II
[reported as M. commixta]		
" USA. NEV: Clark Co.,	Gieschen 53 (TEX)	n=4 II
[intermediate to var. leucanthemifolia]		
" USA. NEV: Clark Co.,	Gieschen 52 (TEX)	n=4 II
[approaches var. leucanthemifolia]		
" USA. NEV: Clark Co.,	Raven et al. (1960)	n=5 II*
[reported as M. leucanthemifolia]		
" USA. NEV: White Pine Co.,	Solbrig et al. (1969)	n=4 II**
[reported as M. commixta]		
" USA. NEV: White Pine Co.,	Turner & Horne (1964)	n=4 II
[reported as M. commixta]		
" USA. UTAH: Iron Co.,	Gieschen 89 (TEX)	n=4 II
" USA. UTAH: Sevier Co.,	Sundberg 2004 (TEX)	n=4 II
" USA. UTAH: Utah Co.,	Gieschen 80 (TEX)	n=4 II
" USA. WYO: Sweetwater Co.,	Turner & Horne (1964)	n=4 II
[reported as M. commixta]		
" USA. WYO: Uinta Co.,	Solbrig et al. (1969)	n=4 II
" USA. WYO: Washakie Co.,	Watson (1973)	n=4 II

M. canescens
var. leucanthemifolia

USA. ARIZ: Coconino Co.,	Solbrig et al. (1964)	
[reported as M. canescens]		
" USA. CALIF: Inyo Co.,	Morefield 1603a (NY), 1654a (NY), 1738a (NY)	n=4 II
[reported in Moorefield & Schaack, 1985]		
" USA. NEV: Clark Co.,	Gieschen 54 (TEX)	n=4 II
" USA. NEV: Clark Co.,	Solbrig et al. (1960)	n=4 II
" USA. NEV: Esmeralda Co.,	Gieschen 56 (TEX)	n=4 II
" USA. NEV: Esmeralda Co.,	Strother (1972)	n=4 II
[reported as M. canescens]		

M. canescens var. leucanthemifolia cont.				
	USA. NEV:	Nye Co.,	Solbrig et al. (1969)	n=4 II
	[reported as M. canescens]			
M. canescens var. nebraskana				
	USA. NEB:		Turner 15664 (TEX)	n=4 II**
M. canescens var. shastensis				
	USA. CALIF:	Siskiyou Co.,	Semple 5710 (NY)	2n=8
"	USA. CALIF:	Lake Co.,	Strother (1972)	n=4 II
SEC. MACHAERANTHERA				
M. tagetina				
	USA. ARIZ:	Pima Co.,	Sundberg & Hardison 2116	n=4 II
"	USA. N.MEX:	Hidalgo Co.,	Jackson (1960)	n=4 II
M. tanacetifolia				
	USA. ARIZ:	Santa Cruz Co.,	Pinkava & Kiel (1977)	n=4 II
	[reported as M. tagetina]			
"	USA. ARIZ:	Santa Cruz Co.,	Pinkava & Kiel (1977)	n=4 II
	[reported as M. tagetina]			
"	USA. COL:	Weld Co.,	Solbrig et al. (1969)	n=4 II
"	USA. N.MEX:	Dona Ana Co.,	Pinkava & Kiel (1977)	n=4 II
"	USA. N.MEX:	Eddy Co.,	Solbrig et al. (1964)	n=4 II
"	USA. N.MEX:	Otero Co.,	Gieschen 33 (TEX)	n=4 II
"	USA. N.MEX:	Socorro Co.,	Jackson (1959)	n=4 II
"	USA. N.MEX:	Union Co.,	Watson (1973)	n=4 II
"	USA. N.MEX:	Valencia Co.,	Ward & Spellenberg (1986)	n=4 II
"	USA. TEX:	Midland Co.,	Solbrig et al. (1969)	n=4 II
"	USA. TEX:	Reeves Co.,	Powell & Powell (1977)	n=4 II
"	USA. TEX:	Reeves Co.,	Solbrig et al. (1964)	n=4 II
"	USA. UTAH:	Emery Co.,	Anderson et al. (1974)	n=4 II
"	USA. WYO:	Platte Co.,	Hartman (1976)	n=4 II
"	MEX.	Chihuahua:	DeJong & Longpre (1963)	n=4 II
"	MEX.	Chihuahua:	Lewis 214 (LL)	n=4 II
"	MEX.	Chihuahua:	Turner et al. (1962)	n=4 II
"	MEX.	Durango:	Turner et al. (1962)	n=4 II
"	MEX.	Nuevo Leon:	Turner et al. (1961)	n=4 II

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* probably an erroneous count
** with 1-3 fragments

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MACHAERANTHERA Nees, Gen. & Sp. Asterearum p. 224. 1832.

Chrysopsis subg. Pappochroma Nutt. = Machaeranthera subg. Machaeranthera
Haplopappus sect. Blepharodon DC.
Dieteria Nutt. = Machaeranthera sect. Hesperastrum A. Gray
Eriocarpum Nutt. = sect. Blepharodon DC.
Psilactis A. Gray = Machaeranthera sect. Psilactis (A. Gray) Turner & Horne
Haplopappus sect. Eriocarpaea Benth. & Hook.
Aster sect. Machaeranthera (Nees) Benth. & Hook. = Machaeranthera sect. Machaeranthera
Aster sect. Hesperastrum (A. Gray) A. Gray = Machaeranthera sect. Hesperastrum A. Gray
Aster subg. Hesperastrum (A. Gray) A. Gray = Machaeranthera subg. Hesperastrum A. Gray
Sideranthus (Nutt. ex Walpers) Rydb.
Haplopappus sect. Havardii R. C. Jackson

Tap-rooted, or rarely rhizomatous, annual, biennial or perennial herbs (rarely suffruticose) 2-120 cm high, glabrous to variously pubescent. Leaves alternate, simple to pinnately dissected, the margins entire, dentate or lobulate, the enations usually with minute or prominent apical bristles. Heads hemispheric to turbinate. Involucre 2-12 seriate, imbricate to subimbricate; bracts linear, appressed or reflexed, often prominently so, the appendages usually green and foliaceous, in contrast with the appressed indurate bases. Receptacle naked or "paleate", plane to convex, usually alveolate and glabrous. Ray florets 8-numerous in 1-3 series, pistillate and fertile (rarely neuter), sometimes absent; corollas variously purple or yellow, sometimes white. Disk florets 10-numerous, perfect and fertile; corollas yellow, tubular or gradually flaring, the tube only rarely sharply differentiated from the throat, the lobes 5. Anther appendages eglandular, ovate to narrowly ovate. Style branches with well-defined, acute to subulate, prominently hispid appendages. Achenes of disk and ray florets more or less similar (in sect. Psilactis the ray pappus usually absent), the body usually obovate, subfalcate to somewhat clavate, the walls thick or thin, with 4-9 prominent or obscure ribs, glabrous to pubescent with a small circular carpopod; pappus of 20-50 persistent ciliate bristles in 1-3 series, either the same length or much-graduated. Base chromosome number x=5 or 4 (the lower or higher numbers being derived by aneuploidy or polyploidy).

Type species, M. tanacetifolia (H.B.K.) Nees.

A wholly North American genus largely confined to the deserts and grasslands of the Western United States and adjacent Mexico.

Hartman (1976) treated the group as comprised of two subgenera: 1) Machaeranthera with five sections (Machaeranthera,

Blepharodon, Hesperastrum, Arida and Psilactis); and 2) Sideranthus with three sections (Sideranthus, Havardii and Stenoloba). I have followed this treatment believing this to be the best recent published account. However, Hartman and Lane (1986; pers. comm.) intent to remove the section Blepharodon (white rayed or rayless) and all of the subgenus Sideranthus (yellow-rayed) from Machaeranthera, returning this to Haplopappus, albeit in a much more restricted sense than conceived by Hall (1928).

Key to species of Sections Machaeranthera and Hesperastrum

1. Leaves manifestly dissected or deeply lobed (2) ..... Sect. Machaeranthera
1. Leaves entire or irregularly dentate (3). Sect. Hesperastrum

2. Heads hemispheric; involucral bracts 50-80; corolla lobes glabrous or nearly so (widespread) ..... 1. M. tanacetifolia
2. Heads broadly turbinate; involucral bracts 20-40; corolla lobes manifestly pubescent (S. Arizona and closely adjacent areas) ..... 2. M. tagetina

3. Involucral bracts and peduncles well-endowed with prominent glandular-trichomes 0.2-0.8 mm long; mostly subalpine plants of Colorado and N. Mex ..... 4. M. bigelovii
3. Involucral bracts canescent to appressed pubescent, or variously short-glandular but rarely with prominent glandular trichomes on both peduncles and bracts (4)

4. Involucral bracts linear-subulate, usually pubescent throughout; mid-stem leaves usually 0.8-2.0 cm wide. - Mostly mid-elevational plants from montane areas of New Mexico, S and W Arizona, S Calif. and adjacent areas of Mexico. 3. M. asteroides
4. Involucral bracts acute to merely subulate, only rarely pubescent throughout (in var. nebraskana, glabra and ambigua); mid-stem leaves usually 0.2-0.6(0.8) cm wide. Mostly north of the above taxon, ranging from lowland deserts to subalpine habitats ..... 5. M. canescens

Subgenus Machaeranthera

Chrysopsis subg. Pappochroma Nutt., J. Acad. Nat. Sci. Phila. 7: 34. 1834. Type species: Chrsyopsis coronopifolia Nutt.
Dieteria subg. Pappochroma (Nutt.) Nutt., Trans. Amer. Phil. Soc. II, 7: 302. 1840.

Aster subg. Hesperastrum (A. Gray) A. Gray, Proc. Amer. Acad. Arts 16: 97. 1881.
Machaeranthera subg. Dieteria (Nutt.) Greene, Pittonia 3: 59. 1896.

Section 1. Machaeranthera

Dieteria sect. Pappochroma (Nutt.) Walpers, Rep. Bot. Syst. 2: 587. 1843.
Aster sect. Machaeranthera (Nees) Benth. & Hook., Gen. Pl. 2: 272. 1873.
Machaeranthera series Verae Cronq. & Keck, Brittonia 9: 238. 1957. Type species: Machaeranthera tanacetifolia H.B.K. Nees.

Tap-rooted annuals or biennial herbs, 1-6 cm high. Leaves deeply dissected, pinnatifid to bipinnatifid. Heads radiate. Involucres hemispheric to turbinate. Phyllaries in 3-12 imbricate or subimbricate series, linear, the lower portion indurate with a midline, the upper 1/4-3/4 green, variously pubescent, widely divergent to reflexed, rarely appressed, acute, abruptly acuminate to long-attenuate. Receptacles alveolate. Ray florets pistillate, fertile, usually strongly violet-blue. Achenes narrowly obovate, flattened laterally, the walls moderately thick with 4-9 pronounced ribs per face, moderately pubescent. Achenes similar in ray and disc florets, the pappus white or tawny, the bristles mostly filiform, not basally flattened, in 1-3 poorly defined series. Base chromosome number, x=4.

1. MACHAERANTHERA TANACETIFOLIA (H.B.K.) Nees, Gen. & Sp. Asterearum, p. 225. 1832.

Aster tanacetifolius H.B.K., Nov. Gen. & Sp. 4: 95. 1820. TYPE: MEXICO. "Colitur in horto Mexicano", w/o date, Humboldt s.n. (phototype GH!; possible isotype B!; photoisotype TEX!).
Aster chrysanthemoides Willd. ex Spreng., Caroli Linnaei Syst. Veg. 3: 538. 1826. based upon the above.
Chrysopsis coronopifolia Nutt., J. Acad. Nat. Sci. Phila. 7: 34. 1834. TYPE: U.S.A. N. Dak.: "Towards the sources of the Missouri" (probably near Ft. Mandon), Jul-Aug 1811, Nuttall s.n. (isotype GH!; probable isotype NY!).

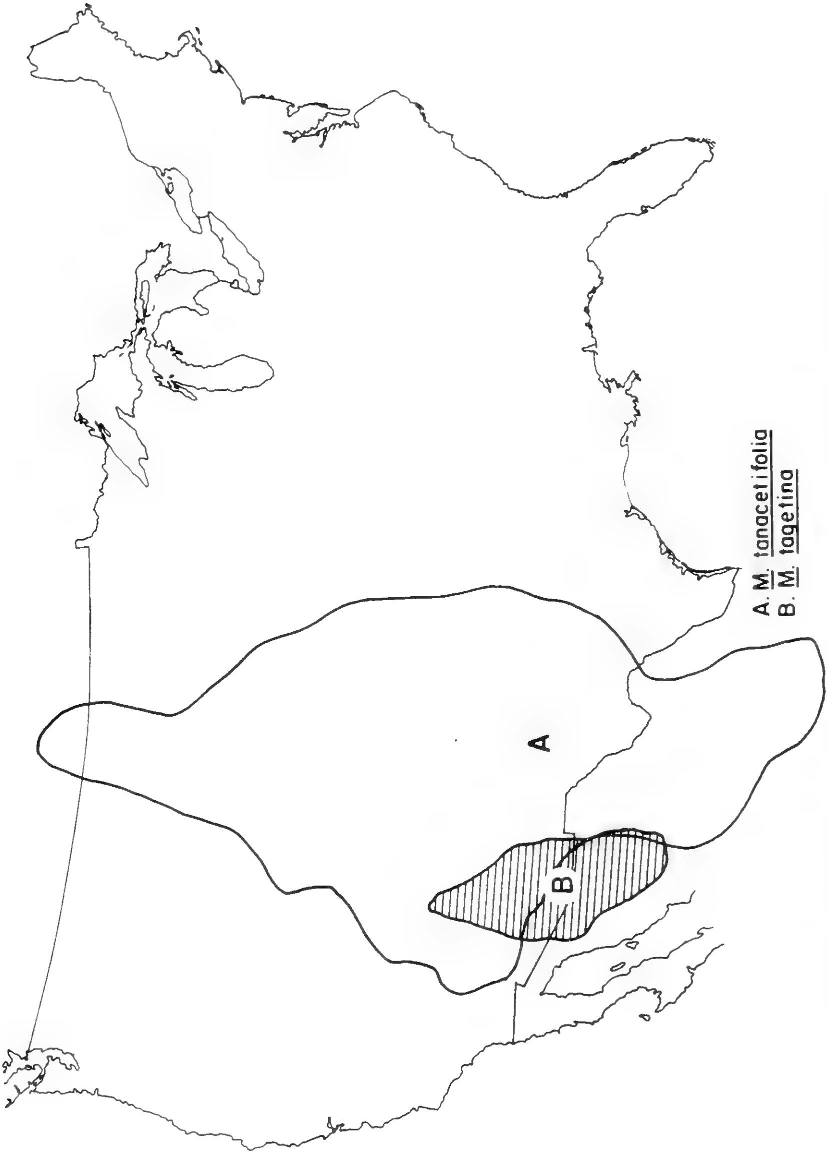

Fig. 1. Distribution of *Machaeranthera tanacetifolia* and *M. tagetina*.

Dieteria coronopifolia (Nutt.) A. Gray, Trans. Amer. Phil. Soc. II, 7: 302. 1840.

Aster pinnatifidus Sesse & Moc., 71. Mex. 2: 205. 1892. TYPE: MEXICO. Sinaloa: hot, dry fields, Sep w/o year, Sesse et al. 2076 (holotype M; phototype TEX!).

Machaeranthera parthenium Greene, Pittonia 4: 99. 1899. TYPE: U.S.A. Arizona: Pima Co., Davidson Canyon, Empire Mts., 10 Sep 1884, Pringle s.n. (lectotype ND; isolectotypes CAS!, F!, GH!, NY!, PHIL!, UC!, US!, WS!).

Machaeranthera coronopifolia (Nutt.) A. Nels., Bot. Gaz. 37: 268. 1904.

Erect annual or biennial, puberulent to viscid glandular, herbs 10-70 cm high. Leaves laciniate, mostly 3-12 cm long, 1-4 cm wide, once or twice pinnatifid, the lobes minutely spinulose. Heads few (to numerous when branched from the base), broadly turbinate to hemispheric; involucral bracts 30-70, puberulent to puberulent-glandular, 3-5 seriate, imbricate to subimbricate, indurate below the apices, usually leafy and reflexed for 1/2 their length. Receptacle convex, alveolate, 5-9 mm across. Ray florets (21)34-150, pistillate, fertile; ligules lavender, purple to blue, 1-2 cm long, 1.0-1.8 mm wide. Disk florets numerous; corollas yellow, tubular, 5-7 mm long, the limb glabrous, the lobes ca 0.5 mm long, glabrous or nearly so. Achenes obovate with 4-6 ridges on a face, 3-4 mm long, 1.0-1.5 mm wide, moderately appressed sericeous; pappus of 40-60, white, presistent, ciliate bristles mostly 4-6 mm long.

Chromosome number, 2n=8.

DISTRIBUTION (Fig. 1): widespread in the drier mostly grassland regions of the Rocky Mountains from Montana to southcentral Mexico, mostly in loose gravelly or sandy soils. Flowering: (Jun) Jul-Oct.

In spite of its widespread distribution the species is remarkably uniform. It does tend to vary between and within populations in habit, leaf dissection and vestiture, more notably in Arizona where it is thought to hybridize with M. tagetina (for discussion see below). Very rare hybrids with M. bigelovii might also occur (e.g., Colorado, Rocky Mts., Hall & Harbour 285, US) and at least one sheet (Langman 4067, PHIL) from Zacatecas Mex, be a rare hybrid between M. tanacetifolia and the yellow-rayed M. pinnatifida).

REPRESENTATIVE SPECIMENS: MEXICO. Aguascalientes: ca Margaritas, along highway 45, 10 Aug 1970, Mears 3523. Chihuahua: Chihuahua, 3-4 Sep 1935, Le Sueur 57 (GH, LL, MO, UC, TEX). Coahuila: 20 mi NW Hacienda La Babia, 3 Jul 1936, Wynd & Mueller 440 (ARIZ, GH, MO, NY, TEX, US). Durango: 13 mi N Durango, 17 Aug 1960, King 3754 (DS, NY, TEX, UC, US). Nuevo Leon: Munic. de Derrumbadera, Hacienda San Jose de Raices, 5 Aug 1935, Mueller 2358 (GH, MO, TEX). San Luis Potosi: Catorce, Sierra de Catorce, 24-25

Jul 1934, Pennell 17601 (GH). Zacatecas: near Concepcion del Oro, 11-14 Aug 1904, Palmer 302 (GH, MO, NY, UC, US).

UNITED STATES. ARIZONA: Apache Co.: Window Rock, 28 Aug 1964, Turner 5104 (TEX). Cochise Co.: 6000 ft, 17 Oct 1906, Blumer 1482 (ARIZ, F, NY, US). Coconino Co.: 35 mi E. Flagstaff, 2 Sep 1943, Schallert s.n. (GH, PH, RM, TEX). Gila Co.: Cibecue Ridge, 5400-5600 ft, 21 Aug 1968, Granfelt 68-273 (ARIZ). Graham Co.: 20 mi SE Safford, 17 May 1936, Maguire 11429 (GH, NY, RM, UC, WS). Maricopa Co.: 20 km NE Diamond Peak, 1200 m, 11 Jul 1982, Baker 4508 (ASU). Mohave Co.: 14 mi W Kingman, 2900 ft, 8 May 1964, Cronquist 9946 (GH, NY, UTC, WTU). Navajo Co.: Holbrook, 15 Oct 1897, Zuck s.n. (CAS, NY, UC). Pima Co.: Davidsons Canyon, 10 Sep 1884, Pringle s.n. (F, NDG, NY, PHIL, WS). Pinal Co.: Sacaton, 7 Apr 1916, Hasting's & Thornber 9009 (ARIZ). Santa Cruz Co.: Nogales, 22 Oct 1926, Jones 22671 (MO, POM). Yavapai Co.: near Prescott, 1-5 Sep 1929, Kusche s.n. (CAS, DS, LL, UC). Yuma Co.: Gila Valley 300 ft, Jul 18974, Rothrock 330 (F).

CALIFORNIA: San Bernadino Co.: New York Mts, 5500 ft, 30 Aug 1973, Henrickson 12712 (ASU, LL, NY).

COLORADO: Adams Co.: 10 mi E Brighton, 16 Jun 1937, Ramaley & Gambill 16083 (MONT, POM, RM). Archuleta Co.: Pagosa Springs, 30 Jun 1921, Bethel s.n. (CS). Baca Co.: 40 mi SW Springfield, 7 Jun 1972, Feddema 4419 (RM). Boulder Co.: 8 mi E. Boulder, 5 Jun 1913, Vestal s.n. (DS). Chaffee Co.: Salida, 11 Jul 1910, Eggleston 5926 (NY, US). Clear Creek Co.: Below Gray's Peak, 10 Aug 1871, Smith s.n. (NY, PHIL). Costilla Co.: 30 mi NE Alamosa, 8 Sep 1934, Ramaley 14480 (RM). Cheyenne Co.: 3 mi S Aroya, 2 Aug 1961, Harris 129 (CS). Crowley Co.: 4 mi W Olney Springs, w/o date, Lane s.n. (CS). Denver Co.: Denver, 10 Jun 1878, Jones 189 (NY, POM, UTC). El Paso Co.: 4 mi S Palmer lake, 7 Aug 1941, Waterfall 3200a (GH). Fremont Co.: between Fountain and Canon City, 20 Jul 1872, Redfield 476 (NY). Huerfano Co.: Walsenberg, 11 Jun 1912, Vestal 391 (DS). Larimer Co.: Fort Collins, 8 Jul 1884, Sheldon 13 (NY, PHIL). Las Animas Co.: Trinidad, 13 Jun 1916, Eastwood 5557 (CAS). Lincoln Co.: plains at Hugo, 17 Aug 1875, Patterson s.n. (F). Mesa Co.: Colorado National Monument, 11 Sep 1968, Porter & Porter 10595 (UC). Montrose Co.: Naturita, 11 Aug 1914, Payson 598 (F, GH, RM, WS). Otero Co.: E of La Junta, 3 Sep 1941, Drovet at al. 4075 (F, UC, WTU). Prowers Co.: 1 mi N Carlton, 3 Aug 1967, Davis D-35 (CA, DAV). Pueblo Co.: plains about Pueblo, 1 Sep 1882, Woodward s.n. (GH, UTC). Saguache Co.: Maria Baca Grant - Duncan, 15 Sep 1939, Gierisch 1195 (NY, RM). Washington Co.: Sandhill Native range, 25 Jul 1957, Dahl 14 (CS). Weld Co.: New Windsor, 6 Jun 1901, Osterhout s.n. (NMU, NY, POM, UC). Yuma Co.: Bonny Reservoir, 18 Aug 1961, Lemaire 1457 (NEB).

ILLINOIS: Adam's Co.: Quincy, Sep 1917, Beckwith 53 (F).

KANSAS: Clark Co.: Englewood, Sep 1891, Carleton 526 (ARIZ, US). Ellis Co.: Sandy fields, 1895, Hitchcock 241 (GH, NY, RM, US). Ford Co.: Dodge City, 14 Jun 1903, Grant 5804 (CAS, UC). Grant Co.: Ulysses, 27 Jun 1893, Thompson 47 (US). Greely Co.: Tribune, 24 Aug 1892, Reed s.n. (UC). Hamilton Co.: 5 mi E Syracuse, 16 Aug 1950, Fearing & Latham s.n. (GH, TEX). Kearney Co.: 10 mi W Lakin, 24 Jun 1966, Croat 2086 (GH, MO). Meade Co.: Meade Center, 26 Jun 1888, Kellerman s.n. (US). Morton Co.: N of Elkhart, 12 Jul 1929, Rydberg & Imler 950 (NY). Seward Co.: 20 mi NE Liberal, 11 Jul 1929, Rydberg & Imler 860 (NY). Wallace Co.: Wallace, 22 Aug 1885, Letterman s.n. (NY, OSC, TEX, WS).

MONTANA: Custer Co.: Miles City, 4 Jun 1937, Roberts 935 (MONT). Dawson Co.: Colgate, near Glendive, 6 Sep 1892, Sandberg et al. 1017 (DS, NY, US). Rosebud Co.: 8 mi E Birney, Jul 1957, Bennett s.n. (DS, F, NY, UC). McCone Co.: South Fork of Rock Creek River, 29 Jun 1978, Lackschweitz 8267 (MONTU). Musselshell Co.: Gage, 14 Jun 1937, Lackey 644 (MONTU). Wheatland Co.: 6 mi NE Shawmut, Aug 1934, Hitchcock 2425 (CAS, DS, MONT, POM, RSA, WIU). Yellowstone Co.: E of Billings, 6 Jul 1934, Rose 329 (MONT, MONTU, WS).

NEBRASKA: Chase Co.: SE of Enders, 8 Aug 1941, Tolstead s.n. (NEB). Dawes Co.: Crawford, 16 Jun 1897, Bates s.n. (GH, NEB, RM). Duel Co.: "sandy soil", Jul 1890, w/o collector (US). Dundy Co.: Benkelman, 28 Jul 1916, Bates 416 (NEB). Lincoln Co.: North Platte, 1 Aug 1902, O'Gara s.n. (NEB). Scotts Bluff Co.: Scotts Bluff, 23 Jul 1891, Rydberg 167 (NY, WS). Sioux Co.: near Harrison, Jul-Aug 1927, Kramer 99 (NEB, UT).

NEVADA: Lincoln Co.: 5 air miles NE Panaca, 2 Sep 1982, Shultz & Shultz 6283 (CS, NY, OSU, UTC).

NEW MEXICO: Bernalillo Co.: Sandia Mountains, Tijeras Canyon, 1 Aug 1914, Ellis 454 (NY, US). Catron Co.: 14 mi SW Horse Springs, 11 Aug 1948, Smith 154 (GH, PHIL, US). Chaves Co.: Roswell, Aug 1900, Earle & Earle 328 (NMC, NY, POM, RM, US). Colfax Co.: 1 mi E Springer, 8 Aug 1944, Lucas 127B (LL, TEX). De Baca Co.: 4.3 mi N Taiban, 3 Aug 1967, Secor 47 (TEX). Dona Ana Co.: Mesilla Valley, 6 Jul 1907, Wooton & Standley 3280 (ARIZ, DS, F, MONT, NMC, RM, WS). Eddy Co.: Carlsbad, 3 Oct 1902, Tracy 8162 (F, GH, NDG, NEB, NY, PHIL). Grant Co.: 18 mi NW Silver City, 9 Jun 1903, Metcalfe 199 (ARIZ, DS, GH, NMC, NY, POM, RM, UC, US). Guadalupe Co.: vicinity of Santa Rosa, 4 Aug 1926, Arsene & Benedict 16691 (PHIL). Hidalgo Co.: Playas Valley, 4440 ft, 17 Aug 1972, Chiang et al. 8638 (LL). Lea Co.: Lovington, 16 Aug 1940, Fisher 40115 (ARIZ, WS). Lincoln Co.: northern limits of Carizozo, 26 May 1964, Raven 19138 (DS, TEX). Luna Co.: Little Florida Mts, 24 Jul 1919, Abrams s.n. (DS, POM). McKinley Co.: Defiance Trading Post, 19 Sep 1938, Eastwood & Howell 6885 (DS, WU). Otero Co.: 16 mi WSW Alamogordo, 18 May 1983, Soreng 2108 (NMC). Quay Co.: Tucumcari, 19 Jul 1942, Suggs 43 (NMC).

Sandoval Co.: 20 mi SW Cuba, 22 Aug 1979, Pase 2619 (RM, UNM). San Juan Co.: ca 30 mi SE Bloomfield, 15 Jul 1972, Hartman & Turner 3400 (LL). San Miguel Co.: Las Vegas to Sante Fe, 3 Sep 1929, Tharp s.n. (F). Santa Fe Co.: 5 mi W Glorieta, 11 Aug 1966, Bennett 8794 (ARIZ, FM). Sierra Co.: 4 mi E Emory Pass, 9 Jun 1965, Crutchfield 174 (LL, NY). Socorro Co.: Socorro, May 1881, Vasey s.n. (DS, F, NY). Torrance Co.: 41 mi W Santa Rosa, 17 Aug 1953, Waterfall 11748 (GH, UC, UNM, TEX). Union Co.: 15 mi W Clayton, 23 Aug 1970, Watson 534 (MONTU, TEX). Valencia Co.: 20 mi S Grants, 18 Aug 1973, Spellenberg 3568 (NMC).

OKLAHOMA: Cimarron Co.: Vacant lot in Kenton, 1 Jun 1947, Goodman 4362 (NY, TEX).

SOUTH DAKOTA: Fall River Co.: 10 mi SW Hot Springs, 16 Jun 1925, McIntosh 685 (RM). Pennington Co.(?): "Badlands" 4 Aug 1950, Petrak & Brencke 50090 (NY).

TEXAS: Andrews Co.: along highway, Sep 1957, Scudday s.n. (LL). Armstrong Co.: Palo Duro Canyon, 17 Jun 1952, Gentry 1321 (TEX). Borden Co.: 5 mi W Gail, 28 Jun 1961, Barclay & Thompson 1036 (LL). Brewster Co.: Boquillas, 17 Apr 1919, Hanson 585 (NY, US). Childress Co.: 8 mi E Memphis, 4 Jun 1973, Higgins 7074 (NY). Comanche Co.: Comanche, Apr 1931, Phipps s.n. (TEX). Culberson Co.: Van Horn, 5 Apr 1936, Sperry T381 (NY, US). Dallam Co.: Dalhart, 24 Jun 1920, Jones 349 (GH). Deaf Smith Co.: 1/4 mi E Glen Rio, 19 Oct 1945, Cory 50372 (DS, GH, NY, UC). Donley Co.: 10 mi S Claredon, 15 May 1944, McCarty 45523 (TEX). Ector Co.: Odessa, 24 Apr 1927, Reed 1913 (US). El Paso Co.: 15 mi E Hueco Mts., Hitchcock et al. 4332 (CAS, DS, GH, UC, UTC, WS, WTU). Floyd Co.: Quitaque-Plainview Rd., 23 Aug 1921, Ferris & Duncan 3372 (CAS). Gaines Co.: 15 mi W Seminole, 20 Jun 1963, La Bonde 173 (POM). Garza Co.: 10 mi W Post City, 5 Oct 1923, Ruth 1133 (US). Hall Co.: 1 mi N Estelline, 21 Jun 1945, Shinners 8000 (GH, MO, NY, RM, TEX, UC, WTU). Hemphill Co.: Canadian, 17 Jun 1918, Palmer 14097 (MO). Hockley Co.: Pep, Jun 1947, Rachaner 137 (TEX). Howard Co.: Big Spring, 9 Sep 1917, Palmer 12476 (F, POM, RM). Hudspeth Co.: 4 mi W Sierra Blanca, 4 Jul 1921, Ferris & Duncan 2476 (CAS, DS, NY). Hutchinson Co.: near Fritch, 12 Aug 1975, Higgins 9669 (BRY). King Co.: 30 mi from Guthrie, 9 Jun 1974, Davis 251 (MO). Lubbock Co.: Caprock, 24 Apr 1930, Demaree 7543 (DS, GH, US). Martin Co.: Stanton, 8 Aug 1926, Tharp 4541 (F, TEX). Midland Co.: 4 mi E Midland, 1 Jun 1964, Raven & Gregory 19216 (DS, TEX). Mitchell Co.: Colorado, 28 May 1918, Palmer 13785 (MO). Ochiltree Co.: 12 mi SE Perryton, 13 Jul 1957, Wallis 4890 (TEX). Oldham Co.: Magenta, 25 Jun 1945, Shinners 8154 (GH). Pecos Co.: Toyah Creek, 21 Apr 1902, Tracy & Earle 92 (F, GH, NDG, NEB, NY, TEX, US). Potter Co.: Canadian River Bridge, 19 May 1945, Jespersen 2680 (DS, F, NY, RM, UC, UTC, WS, WTU). Presidio Co.: Marfa, Jul 1936, Hinckley (F, GH, NY). Randall Co.: Canyon, 12 Jul 1917, Palmer 12519 (F, RM). Reagan Co.: 1 1/2 mi S Big Lake, 24 Apr 1947, Cory 53429 (WS). Reeves

Co.: Pecos, 9 Jun 1931, Gillespie 5250 (DS, GH, UC, US). Roberts Co.: 27 mi S Perryton, 19 Sep 1958, Wallis 7814 (TEX). Sherman Co.: Stratford, 30 May 1931, McKelvey 2475 (GH, POM). Terrell Co.: below Sanderson, 16 Apr 1949, Tharp & Havard 49400 (NDG, TEX). Ward Co.: 1.4 mi S Grandfalls, 9 May 1970, Flyr 1417 (MO). Winkler Co.: 10 mi E Kermit, 13 May 1957, Correll 16358 (LL).

UTAH: Emery Co.: 24 mi N Hanksville, 3 Jun 1961, Cronquist 9190 (GH, NY, RSA, UC, TEX, WS, WTU). Garfield Co.: ca 20 mi SE Escalante, 26 Jun 1965, Holmgren et al. 2054 (NY, TEX, WS, WTU). Grand Co.: 2 mi S Crescent Junction, 20 May 1944, Holmgren 3277 (ARIZ, GH, NY, UTC, UC, WTU). Iron Co.: 6.4 mi SW Lund, 23 Aug 1980, Tiehm 6240 (CAS, MO, NY, RM, RSA, UTC). Kane Co.: 1 mi W Adairville, 5 May 1977, Welsh & Thorne 14699 (NY, RM). San Juan Co.: 38 mi Below Hite, 2 May 1954, Holmgren & Goddard 9959 (CAS, DAV, NY, UC, UTC, WS, WTU). Sevier Co.: NW edge of Walker Flat, 16 Jul 1979, Foster 8267 (BRY, RM). Utah Co.: Orem, 4 Nov 1981, Neese 11165 (BRY, NY). Washington Co.: St. George, 1877, Palmer 211 (F, NY, UC). Wayne Co.: Fruita Arch Canyon, 5 May 1940, Maguire 18122 (UTC, WTU, WS).

WYOMING: Big Horn Co.: 2 mi S and 2 mi W Lovell, 7 Jun 1964, Porter 6 (NY, RM). Campbell Co.: Black Thunder Strip Mining Area, 13 Jul 1973, Ries & Sabinske 29 (RM). Converse Co.: 2 mi E Glenrock, 2 Jul 1935, Williams 2314a (LL, NDG, UC, WTU). Fremont Co.: Dubois, 10 Aug 1894, Nelson 772 (US). Goshen Co.: 10 mi S Torrington, 3 Aug 1940, Ownbey & Gottlieb 611 (RM). Hot Springs Co.: 13 mi N Thermopolis, 15 Jul 1959, Fisser & Porter (RM). Laramie Co.: Guernsey, 26 Jun 1901, Nelson 8266 (RM). Natrona Co.: C. Y. Horse Ranch, 10 Jul 1901, Goodding 231 (DS, F, GH, NEB, NY, RM, UC, US). Niobrara Co.: 0.5 mi N Van Tassell, 21 Jun 1978, Nelson & Ehrmann 1792 (RM). Platte Co.: 3 mi N Wheatland, 9 Jun 1970, Hartman 2972 (ARIZ, NY, UTC). Sheridan Co.: between Sheridan and Buffalo, Jun-Jul 1900, Tweedy 3095 (RM, NY). Washakie Co.: W of Worland, 29 May 1962, Nichols 385 (RM). Weston Co.: near Newcastle, Degener & Peiler 16241 (F, NY, PHIL).

2. MACHAERANTHERA TAGETINA Greene, Pittonia 4: 71. 1899. TYPE: U.S.A. ARIZONA: Cochise Co., near Fort Huachuca, 1891, Wilcox s.n. (holotype US!).

Machaeranthera tanacetifolia var. humilis A. Gray, Pl. Wright. 2: 74. 1853. TYPE: U.S.A. NEW MEXICO: "near Ojo de Gavilan", 1851, Wright 1151 (holotype GH!; isotype GH!).
Machaeranthera humilis (A. Gray) Standl., Muhlenbergia 5: 48. 1909.
Aster tagetinus (Greene) S. F. Blake, Contr. U. S. Natl. Herb. 25: 263. 1925.

Erect annual, mostly glandular-puberulent, herbs 5-30 cm high. Leaves once or twice pinnately incised, mostly 2-5 cm long, 1.0-2.5

cm wide, with glandular trichomes above and below, often interspersed with longer eglandular trichomes. Heads broadly turbinate, 5-40 on much-branched plants. Involucre mostly 3-4 seriate, imbricate; bracts mostly 20-34, white, glabrous and indurate below, the apical portions, mostly appressed (rarely reflexing), green and glandular. Receptale convex, alveolate, mostly 3-5 mm across. Ray florets mostly (8)13-21, pistillate, fertile; ligules 1.0-1.5 cm long, ca 1.5 mm wide, lavender. Disc florets mostly 15-40(50), yellow; corollas 5-7 mm long, tubular, glabrous, except for the lobes which are markedly hispid. Achenes obovate 3-4 mm long 1.0-1.5 mm wide, densely sericeous, the faces with 4-6 ridges; pappus of 80-100 white, 2-3 seriate, ciliate bristles 2-6 mm long.

Chromosome number, 2n=8.

DISTRIBUTION (Fig. 1): Mostly at lower elevations of the Sonoran Desert in southern Arizona and adjacent Mexico and southwestern New Mexico. Flowering (Jun)Jul-Sep(Oct).

This taxon has been treated as a variety of Machaeranthera tanacetifolia by Gray but both Blake (as noted above) and Hartman (1976) accept it as a species. The latter worker, in particular contrasts the turbinate heads and appressed involucral bracts of M. tagetina with the hemispheric heads and reflexed involucral bracts of M. tanacetifolia.

Nevertheless occassional intermediates between these two taxa occur from over a broad area: e.g., Cochise Co., Lemmon s.n. (GH, UC); Gila Co., Toumey 660 (US); Navajo Co., Eggleston 15842 (US); Pima Co., Brandegee 124 (UC); Pinal Co., Peebles et al. 2468 (LL, US); Yavapai Co., Kearney & Peebles 9737 (ARIZ). Such intermediates are assumed to be putative hybrids, occurring mainly at mid elevations on the aprons of mountain slopes, M. tanacetifolia occurring at higher elevations, M. tagetina at lower elevations. At least in Cochise County Arizona both taxa have been collected at a single site along with occasional intermediates.

Considering the number of intermediates (only a few of which are cited above) one might opt for varietal treatment. But, if so, each ought to be placed as varieties within subspecific categories since their distinctions are several magnitudes greater than those which delimit the numerous, largely allopatric, varieties of M. canescens. Considering all data, I find it taxonomically satisfying to treat these as partially sympatric species which occasionally hybridize. Additional field and experimental studies should attempt to document such hybridization.

REPRESENTATIVE SPECIMENS: MEXICO. Chihuahua: Arroyo Carretas, Carretas, 28 Aug 1938, White 1104 (ARIZ); Municipio de Janos, Carretas, 26-28 Aug 1939, White 2514 (ARIZ, GH). Sonora: between San Pedro and Fronteras. 22-24 Sep 1890, Hartman 950 (GH, UC, US).

UNITED STATES. ARIZONA: Cochise Co.: Fort Huachuca, 12 Sep 1981, Spellenberg 6356 (NY). Coconino Co.: Grand Canyon, near El Tovar, 26-28 Sep 1913, Eastwood 3762 (CAS). Gila Co.: 8 mi NW Roosevelt, Oct-Nov 1951, Dickerman 128 (ARIZ). Graham Co.: 13 mi WNW Duncan, 14 Sep 1976, Norris 3466 (RSA). Greenlee Co.: Blue River, 1 Sep 1902, Davidson 709 (DS, UC). Maricopa Co.: W of Sunflower, 2 Nov 1962, Lehto 1419 (ARIZ). Navajo Co.: 1.75 mi S Whiteriver, 19 Aug 1968, Granfelt 238 (ARIZ, UTC). Pima Co.: Campus, Univ. Arizona, 28 Aug 1903, Thornber 192 (ARIZ, DS, NEB, NMC, NY, POM, UC). Pinal Co.: Oracle, 13 Sep 1935, Shreve 7445 (RSA, UT). Santa Cruz Co.: 3 mi W of Thumb Rock Picnic Area, 6 Sep 1975, Pinkava et al. k11069 (ASU, NY). Yavapai Co.: Beaver Creek, Sep 1903, Purpus (UC, US).

NEW MEXICO: Hidalgo Co.: Animas Mts., Indian Creek Canyon bottom, 13 Sep 1975, Wagner 1571 (UNM); junction IH 10 and N. Mex. 338, sandy edge of Alkali Lake, 22 Sep 1971, Leverich 1014C (TEX).

Section 2. Hesperastrum A. Gray, Proc. Amer. Acad. Arts 6: 539. 1865. Type species: Machaeranthera shastensis A. Gray

Dieteria Nutt., Trans. Amer. Phil. Soc. II, 7: 301. 1840. Type species: Dieteria canescens Nutt.

Aster sect. Hesperastrum (A. Gray) A. Gray, Syn. Fl. N. Amer. 1(2): 174. 1884.

Machaeranthera series variabiles Cronq. & Keck, Brittonia 9: 237. 1957. Type species: Machaeranthera canescens (Pursh) A. Gray.

Tap-rooted annuals biennials or short-lived perennials 10-100 cm high. Leaves entire to coarsely serrate or dentate, the teeth usually bristle-tipped. Heads radiate or not so. Involucre turbinate to hemispheric. Phyllaries in 3-12 imbricate to subimbricate series, linear-subulate to broadly oblong, the lower portion usually indurate, the upper 1/3-2/3 green or purple-tinged, glabrous to variously pubescent, erect to reflexed, obtuse to acuminate or long-attenuate. Receptacles convex, alveolate. Ray florets pistillate, fertile, rarely neuter or absent, white to dark blue or purple. Achenes mostly linear to obovate, often asymmetrical (subfalcate), markedly flattened laterally, the walls thin, smooth or obscurely 4-6 nerved, glabrous to moderately pubescent. Achenes similar in ray and disk florets; pappus of white or tawny, filiform, ciliate bristles, not basally flattened, in 1-3 poorly defined series.

Base chromosome number x=4.

Key to varieties of M. asteroides

1. Mid-stems markedly glandular-pubescent to nearly glabrous; leaves stiff with harsh

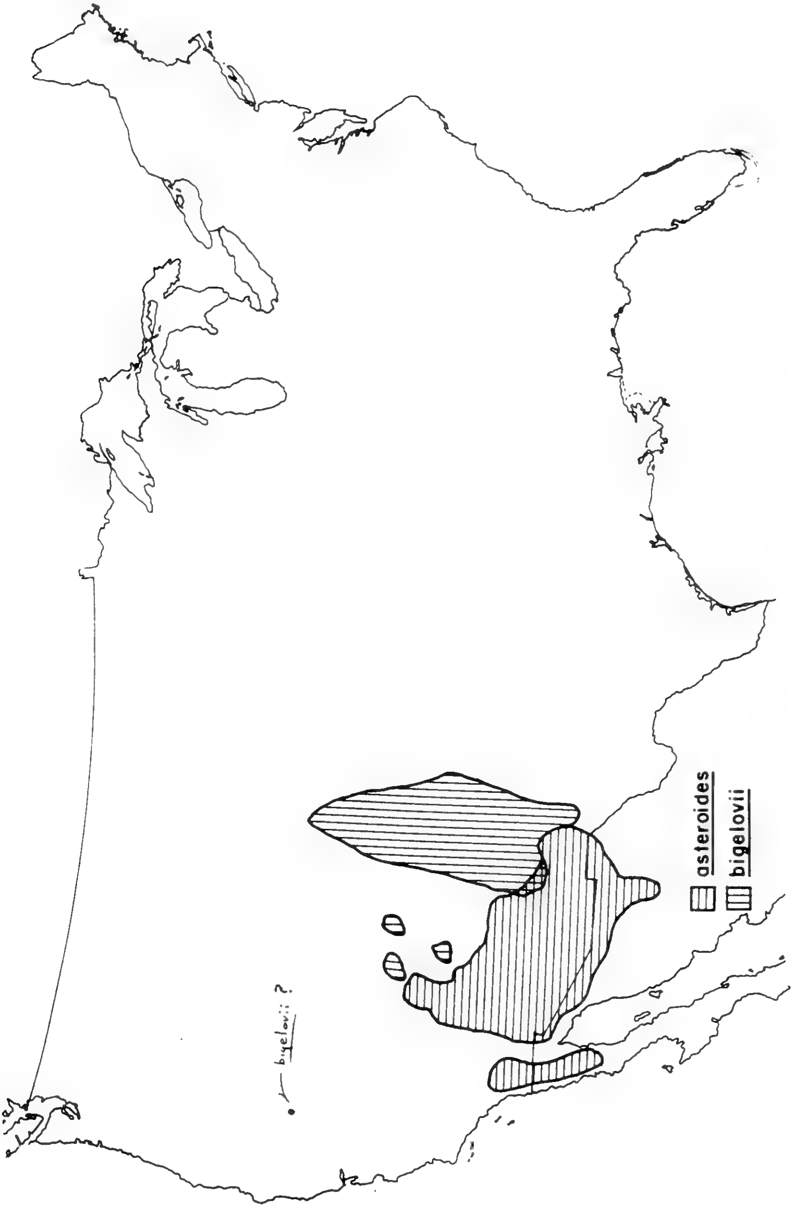

Fig. 2. Distribution of _Machaeranthera_ _asteroides_ and _M._ _bigelovii_.

glandular trichomes (intergrades with var. asteroides) ..... 3b. var. glandulosa

1. Mid-stems canescent, not at all glandular; leaves canescent, soft, without glandular trichomes.

2. Heads hemispheric; apices of involucral bracts narrowly elongate-subulate (3-6 mm long); mid-stem leaves 6-15(25) mm wide, clearly serrulate ..... 3a. var. asteroides

2. Heads broadly turbinate to somewhat hemispheric; apices of involucral bracts acute to shortly-subulate (1-3 mm long); mid-stem leaves mostly 2-5 mm wide, entire to obscurely serrulate ..... 3c. var. lagunensis

3a. MACHAERANTHERA ASTEROIDES (Torr.) Greene var. ASTEROIDES

Dieteria asteroides Torr., in Emory Report 142. 1848. Machaeranthera asteroides (Torr.) Greene, Pittonia 3: 63. 1892. TYPE: U.S.A. NEW MEXICO (?): "Elevated land between the Del Norte and the waters of the Gila", 16 Oct 1847, Major Emory s.n. (holotype NY!).

Machaeranthera canescens var. latifolia A. Gray, Pl. Wright. 2: 75. 1853. Aster canescens var. latifolia (A. Gray) A. Gray, Syn. Fl. 1^2: 206. 1884. TYPE: U.S.A. NEW MEXICO: Grant Co., "Near the Copper Mines" Sep 1851, C. Wright 1152. (Lectotype GH!; isolectotypes GH!, MO, NY!, PHIL!, UC!, US!).

Machaeranthera pruinosa Greene, Pittonia 4: 157. 1900. TYPE: MEXICO. Chihuahua: Soldiers Canyon, near Casas Grandes, 6500 ft, 11 Oct 1899, C. H. T. Townsend & C. M. Barber 371 (holotype NDG; isotypes GH!, NMC!, NY!, POM!, RM!, TEX!, US!).

Machaeranthera verna A. Nels., Bot. Gaz. 37: 267. 1904. TYPE: U.S.A. ARIZONA: Mohave Co., Virgin River, Big Bend, moist banks, 10 May 1902, L. N. Gooding 757 (holotype RM!; isotypes F!, GH!, NEB!, NY!, POM!, RM!, UC!, US!).

Machaeranthera amplifolia Woot. & Standl., Contr. U.S. Natl. Herb. 16: 187. 1913. Aster amplifolia (Woot. & Standl.) Kittell, in Tidestr. & Kittell, Flora Arizona and New Mexico 406. 1941. TYPE: U.S.A. NEW MEXICO, Dona Ana Co.: Organ Mountains, Filmore Canon, 23 Sep 1906. E. O. Wooton & P. Standley s.n. (holotype US!, Sheet 562446; isotypes NMC!, NY!).

Machaeranthera simplex Woot. & Standl., Contr. U.S. Natl. Herb. 16: 189. 1913. TYPE: U.S.A. NEW MEXICO. Lincoln Co., Capitan Mountains, 2100-2250 m, 31 Aug 1900, F. S. Earle & E. S. Earle 390 (holotype US!; isotypes MO!, NY!, RM!).

Erect biennial or short-lived, usually puberulent, nonglandular, perennial herbs 0-100 cm high. Leaves simple, lanceolate to oblanceolate, mostly 0.5-2.5 cm wide, 3-10 cm long, puberulous above and below, often intermixed with short glandular trichomes, the margins irregularly dentate, gradually tapering (lower leaves) to clasping (upper leaves). Heads usually hemispheric, relatively numerous (2-50); involucral bracts puberulent throughout (rarely intermixed with a few glandular trichomes), 5-12 seriate imbricate to subimbricate, numerous with mostly narrow, tapering, reflexed, elongate-subulate, often apiculate, apices. Receptacle convex, 3.5-6.5 mm across. Ray florets 34-150 pistillate, fertile; ligules purple (drying blue), 1-2 cm long, 0.8-1.5 mm wide. Disk florets numerous; corollas yellow, tubular, 5.5-8.0 mm long, the limb glabrous, the lobes ca 0.4 mm long, pubescent. Achenes somewhat subfalcate, 2.5-3.5 mm long, 0.6-1.1 mm wide, 5-7 striate on each face, glabrous to, less often, sericeous; pappus of 40-50, white or tawny, persistent, ciliate bristles, mostly 6-8 mm long.

Chromosome number, 2n=8.

DISTRIBUTION (Fig. 2): Northcentral Mexico (Chihuahua) and the adjacent Southwestern United States from New Mexico to southern Arizona and California mostly in dry montane oak-dominated habitats from 1000-2400 m. Flowering: Jul-Oct.

The var. asteroides is distinguished by its usually large hemispheric heads with numerous ray florets, elongate, recurved, mostly eglandular involucral bracts and broad leaves. It superficially resembles M. bigelovii and in south-central New Mexico these appear to intergrade, perhaps through occasional hybridization, either past or present.

In the region of Phoenix Arizona the var. asteroides grades into the more northern var. glandulosa which occurs at lower, drier, elevations and commences to flower in the spring months.

REPRESENTATIVE SPECIMENS: MEXICO. Chihuahua: N end of San Luis Mts., 10 Oct 1982, Spellenberg 6860 (NMC, NY); 1 km al Pominate de Casas Grandes, 1450 m, 23 Oct 1974, Valde VR-755 (LL). Sonora: Canyon Bellota, Sierra Cabellera, 4300 ft, 7-10 Oct 1941, White 4667 (ARIZ, GH, NY).

UNITED STATES. ARIZONA: Apache Co.: 5 mi E Nutrioso, 8500 ft, 28 Aug 1951 (ARIZ, RSA, US). Cochise Co.: Paradise, 1 Oct 1907, 5300 ft, Blumer 1748 (ARIZ, DS, F, GH, MO, NEB, NMC, NY, RM, US). Gila Co.: Pinal Mts. on road from Globe to Clifton, 26 Oct 1928, Eastwood 15879 (CAS, F). Graham Co.: Pinaleno Mountains, 5800 ft, 5 Sep 1944, Darrow et al. 1183 (ARIZ, NY). Greenlee Co.: White Mts., Hannagan Meadow, 9500 ft, 11 Aug 1935, Kearney & Peebles 12353 (ARIZ, F, US). Maricopa Co.: Tempe, along RR track S of 5th Street, E of Roosevelt, 1100 ft, 19 Mar 1978, Reeves 6409 (ASU). Navajo Co.: near White River, 29 Sep 1936, Gunning 4648

(ARIZ, NMC). Pima Co.: Grossetta's Ranch, 2400 ft, 20 May 1903, Thornber 356 (ARIZ, DS, MO, NEB, NMC, NY, POM, UC, US). Pinal Co.: Sacaton, 23 Apr 1926, Peebles et al. 1679 (ARIZ, LL). Santa Cruz Co.: SW of Patagonia, 4000 ft, 24 Sep 1977, Fay 655 (ARIZ). Yavapai Co.: Montezuma Castle, 3200 ft, 13 Jun 1967, Haskell 2405 (ARIZ). Yuma Co.: Colorado River bottom, Fort Yuma, 100 ft, 15 Apr 1927, Jepson 11732 (ARIZ, UC). Coconino Co.: Havasupai Canyon, 26 Apr 1941, Clover 6410 (ARIZ, LL, US).

NEVADA: Clark Co.: Colorado River, 1 mi S Davis Dam, 800 ft, 8 Apr 1947, Munz 11692 (CAS, DS, RSA, UTC, US, WS, WTU); St. Thomas, 1200 ft, 1 Jun 1938, Train 1909 (DS, F, MO, NDG, UC).

NEW MEXICO: Dona Ana Co.: Organ Mountains, Filmore Canyon, 23 Oct 1904, Wooton s.n. (NMU, US). Grant Co.: Mangas Springs, 18 mi NW Silver City, 4770 ft, 16 Sep 190, Metcalfe 715 (ARIZ, DS, MO, NMC, NY, RM, US). Hidalgo Co.: Peloncillo Mts., Skeleton Canyon, 5000 ft, 6 Sep 1981, Spellenberg 6323 (NMC, NY). Lincoln Co.: White Mountains, 7100 ft, 12 Aug 1897, Wooton 328 (DS, GH, MO, NDG, NMC, NY, POM, RM, UC, US). Otero Co.: 2 3/4 mi NE Mescalero, 8 Sep 1939, Cory 33312 (LL). San Miguel Co.: Las Vegas, Porvenir Creek, 6 Sep 1926, Arsene 17822 (F, US). Sierra Co.: Kingston, 6600 ft, 1 Oct 1904, Metcalfe 1426 (NMC, NY, UC). Socorro Co.: Magdelena Mountains, Water Canyon, 8600 ft, 30 Sep 1973, Hutchins 4885 (NMC).

3b. MACHAERANTHERA ASTEROIDES var. GLANDULOSA B. L. Turner

Phytologia 60:77. 1986. TYPE: ARIZONA. Maricopa Co.: U. S. highway 60, 2.6 mi E of Queen Creek Tunnel, 4200 ft., 19 Sep 1975, Pinkava, Keil & Lehto 118904 (holotype LL; isotypes ASU, CSU, NY).

Machaeranthera hansonii A. Nelson, Univ. Wyoming Publ. Bot. 1: 134. 1926. TYPE: U.S.A. ARIZONA: Mohave Co. (?), "Mount Ellen, near Flagstaff", 7500 ft, without date (in the description given as 16 Aug 1923), H. C. Hanson 814 (holotype RM!). According to Granger's ARIZONA PLACE NAMES (1975), Mt. Ellen is in Mohave Co.

Resembling var. asteroides but differing in its dense vestiture of stalked glandular trichomes (otherwise glabrous), shorter, subulate involucral bracts and generally stiffer, smaller leaves.

DISTRIBUTION (Fig. 2): Mostly central and western Arizona from 100-1000 m, but extending into adjacent New Mexico, Southern Nevada, southwestern Utah and probably Mexico. Flowering: May-Oct.

The variety glandulosa is largely confined to central and southcentral Arizona and is readily distinguished from var.

asteroides by its smaller heads and glandular vestiture. It grades into the var. asteroides east and southwest of Phoenix, as noted under the latter taxon.

In the lower elevations of Washington County, Utah, there occur a puzzling series of populations that superficially resemble M. a. var. glandulosa but such plant possess the involucre of M. canescens and I have annotated most of these as intermediates between M. c. var. canescens and M. c. var. leucanthemifolia (e.g., Christian 1005, ARIZ, POM, TEX, UT, etc.), the two varieties intergrading in this region. The single citation given below for M. asteroides var. glandulosa from Utah is seemingly "typical", being the only unquestionable collection of this taxon which I have seen from the state.

REPRESENTATIVE SPECIMENS: UNITED STATES. ARIZONA: Coconino Co.: Sycamore Canyon Wilderness Area, 11 Oct 1969, Pinkava et al. 58266 (ASU). Gila Co.: Tonto National Forest, Three Bar Game Management, 2 Jul 1958, Pase 947 (ARIZ, ASU, RM). Graham Co.: Pinaleno Mts., Frye Canyon, 15 Sep 1914, Shreve 4356 (ARIZ, US). Greenlee Co.: S of Clifton, 24 Oct 1937, Ramsey 2485 (POM). La Paz Co.: Harquahala Mountain Peak (33° 48' X 113° 23'), 5680 ft, 8 Jun 1983, Daniel & Butterwick 2930 (ASU, NY). Maricopa Co.: Seven Springs, w/o date, Keller s.n. (ASU). Mohave Co.: Chicken Spring Road, 3600 ft, 18 May 1979, Butterwick & Hillyard 4922 (ASU). Pima Co.: Rondstat Ranch, Robles Ranch to Sasabe, 23 Sep 1939, Kearney & Peebles 14529 (ARIZ, NY, US). Pinal Co.: Superstition Mts., southern slopes, 18 Oct 1931, Gillespie 8608 (DS, LL, US). Yavapai Co.: 0.5 mi N Sunset Point, 1 May 1976, Pinkava & Lehto 19931 (ASU, TEX).

NEVADA. Clark Co.: Virgin Mountains, Yant Pit Canyon, 4300 ft, 4 Jun 1941, Munz 16767 (DS, UTC, WS).

NEW MEXICO. Catron Co.: Luna, 28 Jul 1900, Wooton s.n. (US); ca. Glenwood, 13 Aug 1935, Moeller 266 (ARIZ); E Fork of Gila River, 1700 m, 20 Sep 1919, Eggleston 16044 (GH).

UTAH. Washington Co.: Bloomington Price Hills, 1 mi E of I-15, 26 May 1983, Higgins & Welsh 13426 (BYU, NY).

3c. MACHAERANTHERA ASTEROIDES var. LAGUNENSIS (Keck) Turner

Phytologia 60:77. 1986.

Machaeranthera lagunensis Keck, Brittonia 9: 238. 1957. TYPE: U.S.A. CALIFORNIA: San Diego Co., 2 mi S of the main recreation area, Laguna Mountains, 5200 ft, 20 Aug 1952, P. A. Munz & E. K. Balls 17948 (holotype NY!; isotypes RSA!).

Differing from var. asteroides in possessing smaller, broadly turbinate heads with merely acute or short-subulate involucral bracts, fewer ray florets and narrower, mostly entire, leaves.

DISTRIBUTION (Fig. 2): Chaparral and associated desert regions of Baja California from 800-2400 m between latitudes 30°-33° in gravelly or sandy soils; extending into the U.S.A. in San Diego Co. Flowering: Aug-Oct.

The type collection is a small plant with somewhat larger heads and broader involucral bracts than occurs in plants from Mexico. The Mexican populations might be treated as a distinct taxon, but these show considerable variation among themselves and appear to vary in the direction of the var. lagunensis. It should be noted that the latter variety stands somewhat intermediate to M. canescens and M. asteroides, much as M. canescens var. ambigua stands intermediate to M. canescens and M. asteroides. Indeed, lacking geographical data it would be difficult to distinguish var. ambigua from M. asteroides var. lagunensis. An equally good case might have been made for the inclusion of var. lagunensis under the broad rubric of the more northern M. canescens. If so, all of M. asteroides would tumbel into this fabric, as would M. bigelovii, since the typical elements of each, to some degree, intergrade at their peripheries.

REPRESENTATIVE SPECIMENS: MEXICO. Baja California: 1.3 mi NW Rancho Las Filipinas, 1650 m, 17 Sep 1966, Moran 13574 (ARIZ, LL, NY, RSA, UC); 5 mi NW La Grulla, Sierra San Pedro Martir, 6700 ft, Wiggins & Demaree 4862 (LL, NY, POM, UC).

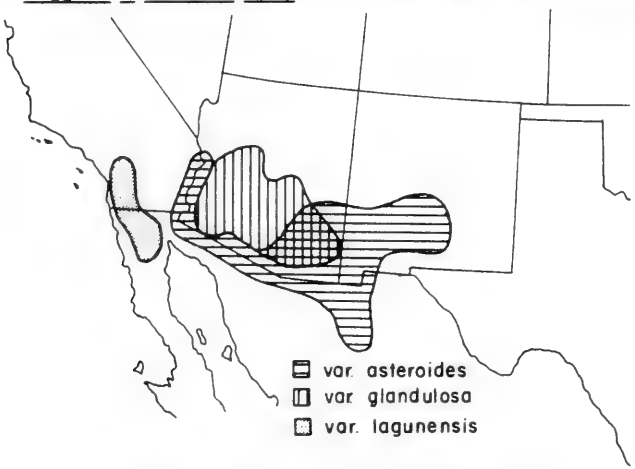

Fig 2b. Approximate distribution of varieties of M. asteroides.

Key to varieties of M. bigelovii

1. Involucres broadly turbinate to hemispheric 1/2-2(4) times as broad as high; involucral bracts 30-100, mostly 1-2 mm wide at mid-point, their appendages shortly acute to subulate; N Mex., Col; S Wyo and S Utah

    2. Involucral bracts mostly 25-40, ray florets mostly 21-35; plants of southcentral Utah ..... 4b. var. commixta
    2. Involucral bracts mostly 50-100, ray florets mostly 40-57; plants of S Wyo, Colo and N. Mex ..... 4a. var. bigelovii

1. Involucres hemispheric, 2-4 times as broad as high; involu-cral bracts 90-100, mostly 0.5-1.0 mm wide at mid-point, their apices linear-subulate; Northcentral Arizona ... 4c. var. mucronata

4a. MACHAERANTHERA BIGELOVII (A. Gray) Greene var. BIGELOVII

Aster bigelovii A. Gray, Pacific Railroad Report 4: 97. 1856. Machaeranthera bigelovii (A. Gray) Greene, Pittonia 3: 63. 1896. TYPE: U.S.A. NEW MEXICO. Bernalillo Co., "Arroyos in the Sandia Mts", 10 Oct 1853, Dr. J. M. Bigelow s.n. (holotype GH!; isotypes NY!).

Machaeranthera canescens var. alpina T. C. Porter, U.S. Dept. Int. Misc. Rept. 4: 59. 1874. TYPE: U.S.A. Colorado: Clear Creek Co. (?), "Alpine regions of Rocky Mountains", 1872, C. C. Parry s.n. (holotype PHIL!; probable isotypes F!, GH!, NEB!, NY!). According to Ewan (1981), Parry collected in the region of Clear Creek Co. in this year.

Aster pattersonii A. Gray, Proc. Amer. Acad. Arts 13: 372. 1878. Machaeranthera pattersonii (A. Gray) Greene, Pittonia 3: 63. 1896. TYPE: U.S.A. COLORADO: Clear Creek Co., Gray's Peak, "upper edge of wood-line", 2-5 Aug 1877, J. D. Hooker & A. Gray s.n. (lectotype, designated by Almut Jones upon annotation, GH!). Ewan (1981) gives a brief account of the collectors activity in this region.

Machaeranthera pattersonii var hallii A. Gray, Proc. Amer. Acad. Arts 13: 372. 1878. TYPE: U.S.A. COLORADO. "Rocky Mts", 1862, E. H. Hall & J. P. Harbour 285 (lectotype GH!; isolectotype F!).

Aster townshendii Hook., Curtis Bot. Mag. 105: t.6430. 1879. TYPE: U.S.A. COLORADO. Raised at KEW from seeds collected by R.

B. Townshend in southern Colorado in 1877 (holotype KEW; isotypes GH!).

Machaeranthera aspera Greene, Pittonia 3: 62. 1896. TYPE. U.S.A. COLORADO. Jefferson Co., Berger Park, 20 Aug 1877, E. L. Greene s.n. (holotype NDG!).

Machaeranthera varians Greene, Pittonia 4: 98. 1899. TYPE: U.S.A. COLORADO: Mineral Co., near Pagosa Peak, 8000 ft, 30 Aug 1899, C. F. Baker 695 (lectotype, as selected by the annotation of L. H. Shinners, NDG!; isolectotypes F!, GH!, NDG!, NY!, POM!, RM!, UNM!, US!).

Machaeranthera rubricaulis Rydb., Bull. Torrey Bot. Club 28: 506. 1901. TYPE: U.S.A. COLORADO. Las Animas Co., La Veta, on Mesas, 7000 ft, 26 Sep 1900, F. K. Vreeland 681 (holotype NY!; isotypes NY!, RM!).

Machaeranthera spectabilis Greene, Leafl. Bot. Observ. Crit. 1: 148. 1905. TYPE: U.S.A. COLORADO: Saguache Co., Clayey banks at Marshall Pass, 10,000 ft., 20 Aug 1901, C. F. Baker 873 (holotype NDG!, isotypes GH!, NY!, POM!, RM!, UC!, US!).

Machaeranthera viscosula Rydb., Bull. Torrey Bot. Club 32: 124. 1905. TYPE: U.S.A. COLORADO. Costilla or Huerfano Co., Veta Pass, 15 Jul 1896, C. L. Shear 3655 (holotype NY!).

Machaeranthera aquifolia Greene ex Woot. & Standl., Contr. U.S. Natl. Herb. 16: 188. 1913. Aster aquifolius (Greene) Blake, J. Wash. Acad. Sci. 30: 47. 1940. TYPE: U.S.A. NEW MEXICO. Socorro Co.: Gila Hot Springs in the Mogollon Mountains, ca 6500 ft, 26 Aug 1903, O. B. Metcalfe 856 (holotype US!; isotypes NDG!, NMC!, NY!, RM!).

Machaeranthera centaureoides Greene ex Woot. & Standl., Contr. U. S. Natl. Herb. 16: 188. 1913. TYPE: U.S.A. NEW MEXICO: Socorro Co., "Mogollon Mountains on the Middle Fork of the Rio Gila", ca 2250 m, 9 Aug 1903, O. B. Metcalfe 440 (holotype US!; isotypes NMC!, NY!, RM!).

Erect biennial or short-lived perennial, usually glandular, herbs 10-100 cm high. Leaves simple, lanceolate to oblanceolate, mostly 0.8-2.5 cm wide, 4-20 cm long, variously puberulent to nearly glabrous, the margins denticulate to nearly entire, gradually tapering (lower leaves) to clasping (upper leaves). Heads hemispheric, large and relatively few (1-30); involucral bracts glandular pubescent, 5-10 seriate, subimbricate, numerous with mostly tapering reflexed, elongate-subulate, glandular apices. Receptacle convex, alveolate, 4-8 mm across. Ray florets mostly 34-150, pistillate, fertile; ligules purple to bright lavender-blue, 1.0-2.5 cm long, 1-2 mm wide. Disk florets numerous; corollas yellow, tubular, 5-7 mm long,the limb glabrous, the lobes

ca 0.5 mm long, minutely pubescent. Achenes obovate to somewhat subfalcate, 3-5 mm long, sparsely appressed sericious; pappus of 40-50 white or tawny, persistent, ciliate bristles, mostly 5-6 mm long.

Chromosome number, 2n=8.

DISTRIBUTION (Fig. 2): Southern-most Wyoming to southcentral New Mexico mostly in open areas of spruce-fir subalpine forests from 2500-3500 m but extending into lower regions along streams, etc. Flowering: Jul-Oct.

Collections from Park County Colorado and surrounding areas presumably show past inflow of genes from M. canescens. Such plants are typically intermediate in habit between these taxa, possessing smaller heads with fewer ray florets (21-55). Indeed, collections of M. bigelovii from San Miguel Co. (Weber 3596) show strongly the influx of genes from M. canescens, and vice versa (e.g., Ownbey 1485 DS, GH, MONT, RM, UTC, which has the general habit of M. bigelovii, but in most other characters is typical M. canescens). Specimens more or less intermediate to M. bigelovii and M. canescens have been called M. spectabilis while those strongly tending toward M. canescens have been called M. rubricaulis.

In the White Mountains of Lincoln County New Mexico, and probably also in the Mogollon Mountains, where M. bigelovii comes into contact with M. asteroides, local populations show evidence of introgression from one into the other. Thus both M. centaureoides and M. aquifolia from Socorro Co., New Mexico, have the general habit of M. asteroides but possess the glandular peduncles and involucral bracts of Mi. bigelovii. Indeed, in these areas taxonomic designation becomes somewhat arbitrary, those individuals with more glandular peduncles and involucral bracts becoming M. bigelovii. In general, the latter occurs in more mesic, higher elevational sites than does M. asteroides.

Machaeranthera bigelovii occasionally shows variation towards M. canescens var. glabra, at least to judge from "bigelovii-type" involucres on what otherwise appear to be M. c. var glabra (e.g. sheets from the Raton Pass area in Mesa Co. Colorado, Standley 14418, etc.).

Finally, it should be noted that the Nevada dot shown in Fig.2 is based upon two collections, both from Glenbrook along Lake Tahoe (20 Jul 1931, L. S. Rose s.n., CAS; 6 Jul 1919, I. Tidestrom 10328, LL, US). The collections are unquestionably good M. bigelovii but are perhaps introduced into the region. I visited this site in July of 1986 and was unable to locate any such plants in this region. The village, including the old highway, is now part of a large highly restricted, private housing complex. In any case, I suspect the population concerned were "garden escapes".

REPRESENTATIVE SPECIMENS: UNITED STATES. COLORADO: Alamosa Co.: Open rocky flat, Sand Dunes Natl. Monument, 8000 ft, 7 Sep 1947, Harrington 3791 (CSU) - more or less intermediate with var. canescens. Archuleta Co.: 21 mi SE Pagosa Springs, 25 Aug 1952, Waterfall 11091 (UTC). Boulder Co.: Lake Eldora, 1 Aug 1918, Clokey 3166 (CAS, DS, GH, RM, TEX, US). Chaffee Co.: lower edge of Arkansas River at Salida, 22 Aug 1938, Ewan 11545; Buena Vista 21 Aug 1919, Clokey 3444 (CAS, DS, F, GH, MONT, NY, RM, UC, US, WS) - the latter collections are more or less intermediate to M. canescens. Clear Creek Co.: Empire, 2750 m, 11 Aug 1920, Clokey 3914 (CAS, DS, F, GH, LL, MONT, NY, POM, RM, US, WS). Costilla Co.: Chama, 4 Sep 1899, Baker 694 (GH, NY, RM). Custer Co.: Sangre de Cristo Range, Middle Taylor Creek, 10,000 ft, 5 Sep 1943, Ewan 15401 (RSA). Dolores Co.: vicinity of Rico, 13 Sep 1935, Maguire & Paranian 12926 (UTC). Douglas Co.: 5 mi N. Deckers, 6700 ft, 22-27 Aug 1966, Freeman & Lehto 29 (ASU). Eagle Co.: Tennessee Pass, 10,000 ft, 16 Aug 1919, Clokey 3476 (CAS, F, GH, MONT, NY, RM, US). El Paso Co.: above Manitou, 25 Aug 1915, Osterhout 5409 (POM, RM). Fremont Co.: Ore Creek, 28 Jul 1873, Brandegee 521 (DS). Gilpin Co.: 3 mi N of Golden Gate State Park, 20 Aug 1970, Watson 504 (MONTU, TEX). Grand Co.: Berthoud Pass, Jul 1903, Tweedy 5832 (NY, RM). Gunnison Co.: Rogers, 14 Aug 1901, Baker 803 (GH, NDG, NY, POM, RM, US, WS). Hinsdale Co.: 6 mi NW of Rio Grande Reservoir, 10,500 ft, 8 Aug 1936, Rollins 1505 (GH, NY). Huerfano Co.: Cuchara, Bear lake Camp, 25 Aug 1968, Demaree & Weber 59110 (UT). Jefferson Co.: foothills near Golden, 20 Jun 1878, Jones 274 (NY, POM, UTC). Lake Co.: Everett, 4 Aug 1919, Clokey 3507 (CAS, DS, F, GH, MONT, NY, POM, RM, UTC, US, WS). La Plata Co.: 20 mi N Durango, 26 Jul 1967, Porter 10474 (DS, GH, NY, RM, UC, US). Larimer Co.: ridge tops, Big Thompson Canyon, 3 Sep 1940, Nelson 4583 (DS, GH, RM, UC, US). Las Animas Co.: S of Morley, 7800 ft, 28 Aug 1934, Goodman 2302 (MO). Mineral Co.: 5 mi below Summit of Wolf Creek Pass, W side, 28 Jul 1928, Wolf 3073 (CAS, DS, GH, POM, UC). Montezuma Co.: Montezuma Natl. Forest, 8900 ft, 27 Aug 1922, Cayton 7 (RM). Montrose Co.: Montrose, 22 Jul 1897, Shear 4896 (RM, US). Park Co.: 13 mi W Florisant, 12 Aug 1983, Gieschen 104 (TEX). Saguache Co.: Rock Creek, Rio Grande Natl. Forest, 30 Aug 1939, Gierisch 1176 (GH). San Juan Co.: 21 mi S of Silverton, 14 Aug 1954, Waterfall 11709 (RSA, TEX). San Miguel Co.: 1 mi N of Ophir, 10 Sep 1947, Weber 3596 (CAS, DS, GH, RSA, UC, TEX, US, WS, WSU). Summit Co.: 5 mi E Tiger, 27 Jul 1972, Nelson 922 (CSU). Teller Co.: dry cuts, "Divide-Cripple Creek", 2 Aug 1920, Clokey 3913 (CAS, DS, F, GH, LL, MONT, NY, PHIL, POM, RM, UC, US, WS).

NEW MEXICO: Bernalillo Co.: Sandia Mountains, Balsam Park, 8200 ft, 10 Aug 1914, Ellis 220 (MO, NY, US). Catron Co.: Mogollon Mts., West Fork of Gila River, 8500 ft, 14 Aug 1903, Metcalfe 504 (ARIZ, GH, NMC, NY, RM, US). Colfax Co.: 4.3 mi W Yankee, 8 Aug 1970, Weber & Arp 14178 (CAS, BYU, NY). Grant Co.: Mogollon Mts., moist grassy summits, Sep 1881, Rusby 145 1/2 (GH, MO, NY, PHIL, US). Lincoln Co.: White Mts, E facing slopes, 9680

ft, 21 Aug 1968, Hutchins 1565 (NMC). Los Alamos Co.: Bandelier Natl. Monument, Frijoles Canyon, 9000 ft, 26 Sep 1982, Dunbar 321 (NMC). Mora Co.: highway 3, 5 mi SE Taos Co. line, 17 Aug 1982, Sundberg 1652 (TEX). Otero Co.: 9 mi S Cloudcraft, 9 Sep 1973, Spellenberg 3681 (ARIZ, NMC, NY). Rio Arriba Co.: Chama 4 Sep 1899, Baker (NDG, NMC, POM). Sandoval Co.: Jemez Springs, 23 Aug 1931, Nelson 11629 (DS, MO, PHIL, RM). San Miguel Co.: near Pecos Baldy Lake, 11,500 ft, 10 Sep 1959, Saunders s.n. (CAS). Sierra Co.: Sawyer's Peak, 9400 ft, 30 Sep 1904, Metcalfe 1438 (NMC). Taos Co.: Santa Barbara Canyon, 8000 ft, 6 Sep 1965, Niles 654 (ARIZ, TEX, UNLV). Valencia Co.: Milo Canyon, San Mateo Mts., 8900 ft, 27 Aug 1979, Moir & Fitzhugh 747 (NMC).

WYOMING: Albany Co.: Dry granite gravels, Colorado - Wyoming state line, 9 Sep 1928, Nelson 10957 (DS, RM).

4b. MACHAERANTHERA BIGELOVII var. COMMIXTA (Greene) B. L. Turner

Phytologia 60:77. 1986.

Machaeranthera commixta Greene, Pittonia 4: 71. 1899. M. canescens var. commixta (Greene) Welsh, Great Basin Naturalist 43: 316. 1983. TYPE: U.S.A. UTAH: Garfield Co., Henry Mountains, Bromide Pass, 10,000 ft, 27 Jul 1894, M. E. Jones 5695y (holotype US!; isotype POM!).

Differing from the var. bigelovii in its smaller heads with fewer ray florets and broader involucral bracts. Populations mostly occur in open areas of spruce-fir forests from 2800-3200 m. They appear to occasionally intergrade downslope with M. canescens, much as the var. bigelovii does in Colorado.

DISTRIBUTION (Fig. 2): UNITED STATES. Open areas of subalpine spruce-fir forests from 2800-3200 m in southern Utah. Flowering: Jul-Sep.

It should be noted that were these "disjunct" populations of M. bigelovii not already named, and to some extent in use, a varietal epithet would hardly seem appropriate for such weakly differentiated variants. Actually, I suspect that the glandular trichomes of involucral bracts and peduncles (characters which mark M. bigelovii) are independently derived in Utah, thus a less conservative treatment might place the var. commixta as closer to M. canescens. But it is also possible that the high elevational populations so marked are the result of "residual" gene flow or "swamping" from M. canescens into M. bigelovii in this region.

REPRESENTATIVE SPECIMENS. UNITED STATES. UTAH: Garfield Co.: Henry Mountains, Mt. Ellen, 9000 ft, 17 Aug 1980, Neese & Neese 9638 (BYU); 1 mi S Wickiup Pass, 9200 ft, 25 Aug 1977, Neese & White 4115 (BYU, DAV, NY). Iron Co.: 3 mi N Cedar Breaks Lodge,

10,300 ft, 12 Aug 1938, Hitchcock et al. 4604 (RM, UC, UTC). Kane Co.: west lodge, Navajo Lake, 14 Jul 1940, Maguire (BYU, NY, UC, UTC, WSU). Washington Co.: Kobb, near reservoir, 3070 m, 5 Aug 1983, Higgins 14123 (BYU, NY).

4c. MACHAERANTHERA BIGELOVII var. MUCRONATA (Greene) B. L. Turner, comb. nov.

Machaeranthera mucronata Greene, Pittonia 4: 72. 1899. Aster adenolepis Blake, J. Wash. Acad. Sci. 30: 471. 1940. Non A. mucronatus Sheldon, 1903. TYPE: U.S.A. ARIZONA: Coconino Co., Thompson Canyon, 8500 ft, 19 Sep 1894, M. E. Jones 6065bl (lectotype, selected here, US!).

Differing from the var. bigelovii in possessing more numerous slender involucral bracts with longer apical appendages and having peduncles which are inconspicuously glandular, if at all.

DISTRIBUTION (Fig.): Known only from the spruce-fir forests of the Kaibab Plateau in northcentral Arizona from 2800-3000 m. Flowering: Aug-Sep.

This taxon might sit as comfortably within M. asteroides as it does within M. bigelovii. I have included this within the latter because of its geographical location and proclivity for spruce-fir forests at elevations similar to those of M. bigelovii in Colorado. Certainly it is not as closely related to the var. bigelovii as is the var. commixta. Perhaps the var. mucronata has been derived from past hybridization between M. asteroides and M. bigelovii. Alternatively the var. mucronata might be a recently derived subalpine ecotype of the parapatric, lower elevational, M. canescens var. ambigua, in which case a better phylogenetic arrangement would call for the inclusion of both var. ambigua and var. mucronata under M. asteroides.

REPRESENTATIVE SPECIMENS. UNITED STATES: ARIZONA. Coconino Co.: Kaibab Forest, De Motte Park, 8700 ft, 26 Jul 1977, Gierisch 3969 (ASU, BYU); 15 mi S Jacob Lake, 8500 ft, 16 Aug 1946, Parker et al. 6210 (ARIZ, CAS, DS, F, LL, NY, UTC).

5. MACHAERANTHERA CANESCENS

5A. Machaeranthera canescens subsp. canescens

5a. var. canescens
5b. var. incana
5c. var. sessiliflora
5d. var. shastensis
5e. var. leucanthemifolia

5f. var. ziegleri
5g. var. ambigua

5B. Machaeranthera canescens subsp. glabra (A. Gray) Turner, comb. nov. - M. c. var. glabra Pl. Wright. 1: 89. 1850.

5h. var. glabra
5i. var. nebraskana
5j. var. aristata

Key to varieties of M. canescens

1. Involucral bracts manifestly reflexed, variously glandular or rarely both glandular and canesent (except in var. ambigua with appressed pubescent bracts); NW Nebraska, Dakotas, Montana, and Canada Southward to N. New Mexico and Arizona and Westward to Washington then southward along the eastern Sierras to Baja California, Mexico ..... 5a. subsp. canescens

2. Heads (12)14-20 mm high, 15-20 mm wide (pressed); suffrutcose perennials with persistent woody crowns; Santa Rosa Mountains of southern Calif ..... 5f. var. ziegleri
2. Heads mostly 6-12(14) mm high, 10-15 mm wide (pressed); annuals, biennials or short lived perennials; widespread.

3. Stem's canescent or puberulent throughout, without glandular trichomes or with a mixed canescent-glandular vestiture (except in peripheral or altitudinal intergrades)

4. Stems stiffly erect to 60 cm high divaricately branched with usually numerous heads; ray florets pistillate and fertile; sandy soils mostly along streams of Washington, Oregon, N California and adjacent Idaho and Canada. 5b. var. incana
4. Stems various but usually smaller, with a relaxed branching and generally few to a moderate number of heads; ray florets absent, neuter, or pistillate and fertile; more

montane habitats to the south and west.

5. Heads without ray florets or these variously reduced or neuter (w/o styles); involucres mostly 6-10 mm high, often 3-5(7) seriate; N Calif. and Oregon and adjacent Nevada ..... 5d. var. shastensis

5. Heads with well-developed ray florets, these variously pistillate and fertile; involucres mostly (6)8-12(14) mm high, usually 5-10 seriate.

6. Involucral bracts with appressed, pubescent, apices; leaves mostly linear to lanceolate; achenes glabrous or nearly so; pine forests of N Arizona and adjacent New Mexico ..... 5g. var. ambigua

6. Involucral bracts variously glandular and to some extent reflexed; leaves usually obovate to spatulate; achenes pubescent; widespread at various elevations in montane habitats from Canada to S Calif ..... 5a. var. canescens

3. Stems prominently beset with glandular trichomes, otherwise glabrous or variously intermixed with a canescent vestiture.

7. Involucral bracts mostly acute, not usually sharply reflexed; stems both canescent and atomiferous-glandular; heads usually turbinate and

nearly sessile; sands along the Snake River in Idaho.. 5c. var. sessiliflora

7. Involucral bracts mostly obtuse, sharply reflexed; stems with well-developed glandular trichomes; heads usually campanulate and pedunculate; intermontane desert regions of SE Ore., Nev., and adjacent regions of Utah and Calif ..... 5e. var. leucanthemifolia

1. Involucral bracts mostly appressed, variously pubescent, only rarely glandular or glabrous but if so nearly always appressed, foreplains and lower elevations of the Rocky Mountains from S Montana to N Mexico, westward into New Mexico to Arizona and adjacent Utah ..... 5B. subsp. glabra

8. Involucral bracts densely appressed puberulent, any glands obscured by the pubescence; involucres 10-20 mm high.

9. Involucral bracts canescent, usually recurved; sand hills of Nebraska and adjacent areas ... 5i. var. nebraskana

9. Involucral bracts appressed pubescent, usually appressed; pine forests of N Ariz., N New Mex and adjacent Colo ..... 5g. var. ambigua (subsp. canescens)

8. Involucral bracts glandular or nearly glabrous; involucres mostly 8-10 mm high.

10. Mid-stems with prominent glandular trichomes (rarely glabrous); SE Utah, adj Ariz, N Mex and Colo. 5j. var. aristata

10. Mid-stems glabrous to canescent; fore plains of the Rocky Mts. from S Mont. to Tex into northern Mexico then eastward to E Ariz and SE Utah and adjacent Colo ..... 5h. var. glabra

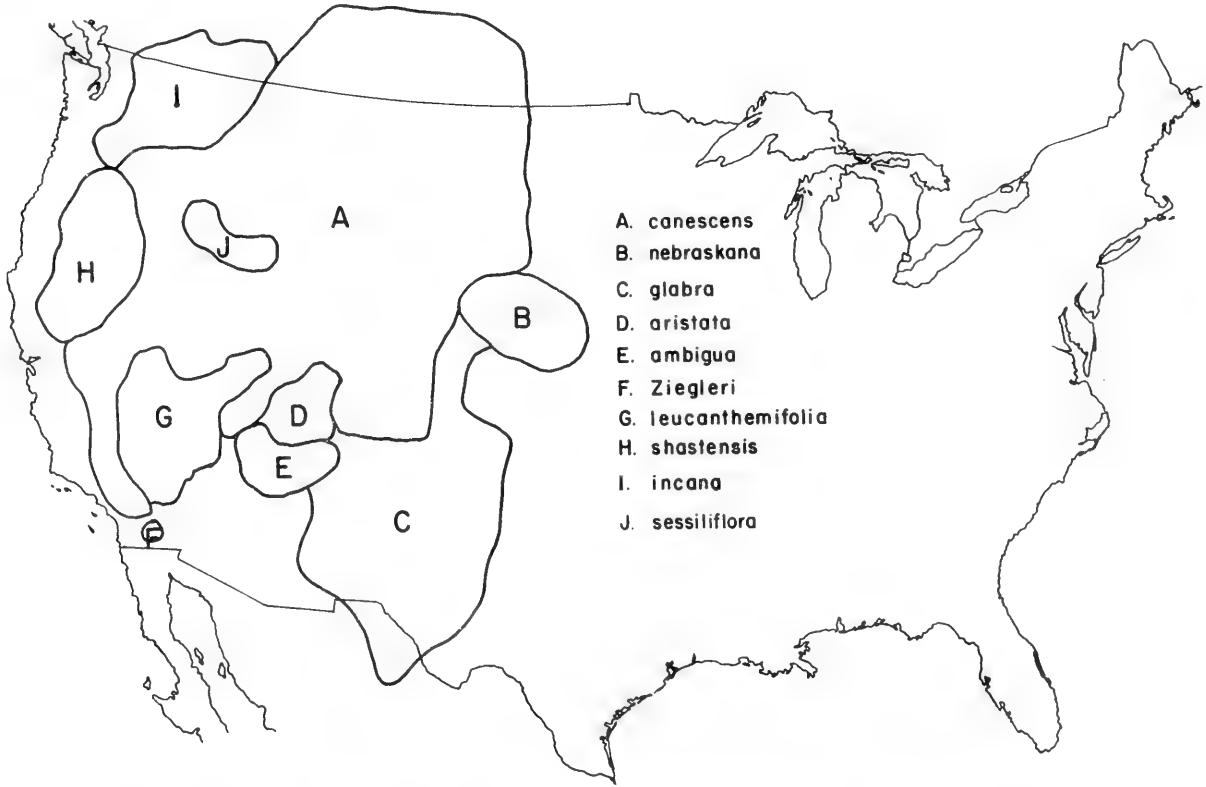

Fig. 3. Approximate distribution of varieties of Machaeranthera canescens.

5a. MACHAERANTHERA CANESCENS (Pursh) A. Gray var. CANESCENS

Aster canescens Pursh, Fl. Am. Sept. 547, 1814. Dieteria canescens (Pursh) Nutt., Trans. Amer. Phil. Soc. II. 7: 300. 1840. Machaeranthera canescens (Pursh) A. Gray, Pl. Wright. 1: 89. 1850. TYPE. U.S.A. N. Dakota: "On the denuded banks of the Missouri". (in the vicinity of Fort Mandon), 1811. Nuttall s.n. (holotype BM; possible isotypes NDG!).

Dieteria viscosa Nutt., Trans. Amer. Phil. Soc., N. Ser., 7: 301. 1840. Aster canescens var. viscosus (Nutt.) A. Gray, Syn. Fl. 1^2: 206. 1884. Machaeranthera viscosa (Nutt.) Greene, Pittonia 4: 22. 1899. Machaeranthera canescens var. viscosa (Nutt.) Piper, Contr. U.S. Natl. Herb. 11: 576. 1906. TYPE: U.S.A. NEBRASKA: Scotts Bluff Co., "near Scott's Bluff, on the Platte", 1834, Nuttall s.n. (lectotype BM).

Dieteria divaricata Nutt., Trans. Amer. Phil. Soc., n. ser., 7: 300. 1840. Machaeranthera divaricata (Nutt.) Greene, Pittonia 4: 23. 1899. TYPE: U.S.A. "Denudated plains of the Rocky Mountains, and Oregon, common". 1834., Nuttall s.n. (lectotype BM; isolectotypes NDG!, GH!). The specimen at GH bears the locality "Borders of the Platte", presumably in Nuttall's script.

Dieteria pulverulenta Nutt., Trans. Amer. Phil. Soc., N. Ser. 7: 300. 1840. Machaeranthera pulverulenta (Nutt.) Greene, Pittonia 4: 23. 1899. TYPE: U.S.A. "Arid plains toward the sources of the Platte", 1834, Nuttall s.n. (lectotype BM; isolectotype GH!).

Machaeranthera laetevirens Greene, Pittonia 3: 61. 1896. Aster leiodes Blake, Contr. U.S. Natl. Herb. 25: 563. 1925., not A. laetevirens Greene (1900). TYPE: U.S.A. NEVADA: Lincoln Co., Clover Mountains, 26 Jul 1894, E. L. Greene s.n. (holotype NDG!; isotype NDG!).

Machaeranthera montana Greene, Pittonia 3: 60. 1896. Machaeranthera shastensis var. montana (Greene) Cronq. & Keck, Brittonia 9: 238. 1957. TYPE: U.S.A. CALIFORNIA: Mono Co., near Mono Lake, Sep 1866, Bolander 6147 (lectotype, selected by L. H. Shinners, NDG!; isolectotypes F!, GH!, MO!, UC!, US!).

Machaeranthera subalpina Greene, Pittonia 4: 23. 1899. TYPE: U.S.A. WYOMING: Teton Co., Bacon Creek, 15 Aug 1894, A. Nelson 904 (holotype NDG!; isotypes GH!, NDG!, PHIL!, RM!).

Machaeranthera spinulosa Greene, Pittonia 4: 24. 1899. TYPE. U.S.A. OREGON: Baker Co., dry hillsides, 3500 ft, Powder River Mountains, Aug 1897, W. C. Cusick 1811 (holotype NDG!; isotypes DS!, MO!, NDG!, UC!, US!, WS!).

Machaeranthera linearis Rydb., Mem. N.Y. Bot. Gard. 1: 398. 1900 - non M. linearis Greene. Machaeranthera angustifolia Rydb., Bull. Torrey Bot. Club 37: 147. 1910. not M. angustifolia Woot. & Standl. TYPE: U.S.A. WYOMING; Yellowstone Park, 8500 ft, 6 Aug 1885, G. W. Letterman s.n. (holotype NY!).

Machaeranthera superba A. Nels, Bot. Gaz. 30: 197. 1900. TYPE: U.S.A. WYOMING: Yellowstone Natl. Park, Yellowstone Lake, 6 Aug 1900, A. & E. Nelson 6337 (holotype RM!; isotypes GH!, NDG!, NY!, POM!, RM!, US!).

Machaeranthera ramosa A. Nels, Bull. Torrey Bot. Cl. 28: 233. 1901. TYPE. U.S.A. WYOMING: Albany Co., Laramie, 27 Aug 1900, A. Nelson 8152 (holotype RM!; isotypes GH!, LL!, NEB!, NY!, RM!, US!, UTC!).

Aster glossophyllus Piper, Bull. Torrey Bot. Cl. 29: 646. 1902. A. shastensis var. glossophyllus (Piper) Cronq., in Hitchc., Cronq. et al., Vascular Pl. Pacific N.W. 5: 94. 1955. Machaeranthera shastensis var. glossophylla (Piper) Cronq. & Keck, Brittonia 9: 238. 1957. TYPE: U.S.A. OREGON: Malheur Co., "Black Butte", 19 Jul 1901, W. C. Cusick 2680a (holotype US!).

Machaeranthera glabella Greene ex Rydb., Colorado Agric. Exptl. Sta. Bull. 100: 358. 1906. TYPE: U.S.A. COLORADO: Gunnison Co.: Cerro Summit, 8000 ft, 1 Aug 1901, C.F. Baker 701 (lectotype NY!; isolectotypes NDG!, POM!, RM!, UC!, US!).

Machaeranthera selbyi Rydb., Bull. Torrey Bot. Cl. 32: 123. 1905. TYPE: U.S.A. COLORADO: Ouray Co., SE of Ouray, chaparral covered hills, 2300-2600 m, 7 Sep 1901, L.M. Underwood & A. D. Selby 93a (holotype NY!).

Machaeranthera latifolia A. Nels., Proc. Biol. Soc. Wash. 20: 38. 1907. TYPE: U.S.A. UTAH: Salt Lake Co., Big Cottonwood Canyon, 8950 ft., 9 Aug 1933, A. O. Garrett 1933 (holotype RM!; isotypes GH!, LL!, US!).

Machaeranthera paniculata A. Nels., Proc. Biol. Soc. Wash. 20: 38. 1907. TYPE: U.S.A. UTAH: Salt Lake Co.: "Mountains of Parley's Park", 6500 ft, 13 Sep 1906, A. O. Garrett 2083 (holotype RM!; isotypes LL!, US!).

Machaeranthera leptophylla Rydb., Bull. Torrey Bot. Cl. 37: 147. 1910. TYPE: U.S.A. UTAH: Cache Co., Logan, 9 Aug 1895, P. A. Rydberg s.n. (holotype NY!).

Aster shastensis var. latifolius Cronq., in Hitchc., Cronq. et al., Vascular Pl. Pacific N.W. 5: 94. 1955. Machaeranthera shastensis var. latifolia (Cronq.) Cronq. & Keck, Brittonia 9: 238. 1957. TYPE: U.S.A. OREGON: Wallowa Co., source of Middle Fork of the Imnaha River, Wallowa Mountains, "Alpine, loose, sliding

soil", 12 Aug 1911, W. C. Cusick 3701 (holotype WS!; isotypes NY!, UC!, WTU!).

DISTRIBUTION (Fig. 3): Along the front-range of the Rocky Mountains from Canada to Colorado and montane regions of Wyoming, northern Colorado and adjacent Utah and Idaho where it is fairly uniform, but westward and southward in the montane regions of Utah, Nevada Arizona, and adjacent California it grades into the allopatric variatal taxa which surround it. Flowering: Jul-Nov.

In central Colorado and southern Utah var. canescens is sympatric with M. bigelovii. The latter grows in more alpine habitats but downslope it intergrades upon occasion into the var. canescens, presumably through the formation of localized hybrid populations from which introgression in both directions, either past or present, might be inferred. Indeed, some of these putative introgressed populations appear to be fairly uniform in south-central Colorado (low plants which branch from the base and possess smaller heads with generally fewer ray florets), and these have been called M. spectabilis, which I have placed in synonymy with M. bigelovii since they possess the technical characters of the latter.

In Washington Co. Utah a broad range of intermediates of var. canescens with adjacent, mosly allopatric, varieties of aristata, leucanthemifolia and ambigua may be found, as noted in the specimens cited for this county (below).

A bewildering array of intermediates between the var. canescens and var. leucanthemifolia may also be found in northern Inyo and adjacent Mono counties California. To cite but a few: Inyo Co., Marble Canyon Spring, White Mountains, 8450 ft, 6 Aug 1930, Duran M34 (NY, UC, UTC); 9.1 mi N of Westgard Pass, 10,4000 ft, 15 Sep 1959, Twisselmann 5810 (CAS, UC); Mono Co., Sherwin Hill, 3 Sep 1942, Alexander & Kellogg (LL, MO, NY, UC, UTC). Most of these are found at high elevations and probably are the result of gene flow from the allopatric but lower-elevation populations of var. leucanthemifolia. The large-headed, stiffly divaricate, individuals of var. canescens which occur at high elevations above the western edge of Inyo County and into Kern and Los Angeles Counties are probably fairly stabalized populations showing past gene-flow from var. leucanthemifolia. Even the smaller-headed, dwarf, alpine forms of var. canescens in these regions show a branching habit and glandularity which is suggestive of such gene-flow.

Likewise in eastern San Bernardino County there is a variable group of intermediates between var. canescens and var. leucanthemifolia, especially on and about the New York Mts. (e.g., Henrickson 10336, DS; 10412 LL, RSA; 11192, RSA; 12588, RSA; 12652 DS, LL; Thorne et al. 47937, ARIZ, RSA; etc.). These are mostly at higher elevations on dry rocky slopes; relatively "pure"

leucanthemifolia occurs in the same vicinity but at lower elevations on dune sands. No doubt there has been considerable gene flow between the two varieties in this region, much as about Mono Lake.

Finally it should be noted that the isolated populations of var. canescens in Ventura Co., California, partake of characters (ray florets much-reduced or absent) that suggest the more northern var. shastensis. Indeed, were these found along the periphery or within the distribution of the latter I would surely have annotated these as such. However, since the plants concerned are similar to those of San Bernardino County (habitally and by the mixed canescent-glandular vestiture) it would seem more reasonable to accept these as phyletically closer to the var. canescens.

REPRESENTATIVE SPECIMENS. CANADA. ALBERTA: vicinity of Rosedale, 14 Aug 1915, Moodie 1206 (DS, F, GH, NY, US). BRITISH COLOMBIA: E of Osoyoos, 3 mi up Richter Pass road, 30 Aug 1937, McCabe 4578 (UC). SASKATCHEWAN: Maple Creek, 14 Jul 1947, Breitung 4872 (MO, NEB).

UNITED STATES. ARIZONA: Coconino Co.: Road above House Rock Canyon, 7 Jun 1936, Peebles 13025 (ARIZ, LL) - this, and most collections from Coconino Co. are intergrades into the var. leucanthemifolia. Mohave Co.: West base of Vulcan's Throne, Toroweap, 6 Sep 1953, Cottam 13866 (UT) - This and a few other collections from Mohave Co. intergrade into var. leucanthemifolia.

CALIFORNIA: Alpine Co.: just E of Luther Pass, highway 89, 20 Jul 1983, Gieschen 65 (TEX). Amador Co.: 2 mi S Carson Spur, 25 Jul 1940, Weier s.n. (DAV). Eldorado Co.: Richardson's Landing, near Tallic, 15 Aug 1927, Blake 10288 (GH, TEX, UC). Fresno Co.: Kings Canyon Natl. Park, upper Paradise Valley, 3 Sep 1941, Alexander & Kellogg 2639 (DS, LL, UC, WS, WTU). Inyo Co.: N fork of Titus Canyon, 23 Jun 1935, Gilman 1836 (LL) - small-headed more typical form; Olancha Pass to Sage Flat, 6500-8000 ft, 26 Jul 1450, Howell 27738 (CAS, US) - large-headed, stiffly erect forms. Kern Co.: Harris Grade, 5.8 mi E Landers Meadow, 16 Sep 1964; Twisselmann 10204 (CAS, UC). Lassen Co.: Doyle, arid plains, 30 Sep 1923, Applegate 4031 (DS, UC). Los Angeles Co.: San Gabriel Mts., Mescal Creek, 30 Aug 1923, Peirson 4008 (RSA, UC). Madera Co.: Minaret Summit, 9200 ft, 15 Jul 1951, Raven 3488 (CAS). Mono Co.: Leevining Grade, 7300 ft, 29 Sep 1937, Rose 37704 (CAS, MO, NY, UC). Nevada Co.: near Donner Lake, 1865, Torrey 222 (US). San Bernadino Co.: N base of Sugarloaf Mt., 7600 ft, 22 Jul 1926, Munz 10783 (GH, LL, POM, UC, US). Tulare Co.: Kern Plateau, Ridge between Troy Meadow and Beach Meadow, 21 Aug 1964, Twisselmann 9975 (RSA, UC). Tuolumne Co.: 8 mi E of Sonora Pass, 28 Jul 1961, Bacigalupi et al. 8010 (UC). Ventura Co.: Mt. Pinos, end of Iris Point Spur road, 13 Jul 1966, Twisselmann 12606 (CAS, OSC, RSA, UC).

COLORADO: Chaffee Co.: Cochetopa Natl. Forest, 1937, Snyder 135 (RM). Clear Creek Co.: Georgetown, 11 Aug 1871, Smith s.n. (NY, PHIL). Costello Co.: 2 mi N San Luis, 1 Sep 1942, Ginter 665 (CSU, RM). Delta Co.: Paonia, 23 Jul 1911, Osterhout 4596 (RM). Dolores Co.: ca King, 26 Aug 1935, Maguire et al. 12703 (CAS, GH, WS). Eagle Co.: 4 mi W Gypsum, 17 Aug 1942, Ginter 642 (CSU, RM). Garfield Co.: N side of Douglas Pass, 4 Aug 1978, Painter & Emrich 206 (CSU). Grand Co.: 6 mi NE Granby, 18 Aug 1937, Beetle 2304 (GH, LL, NDG, NY, RM). Gunnison Co.: Gunnison, 11 Sep 1917, Clokey 3013 (CAS, GH, NY, RM). Jackson Co.: W of Walden, 1 Aug 1917, Johnston 304 (RM). Larimer Co.: North Fork, 17 Aug 1903, Goodding 1922 (DS, F, NY, PHIL, RM). Mesa Co.: 20 mi SW Whitewater, 12 Aug 1937, Rollins 1922 (DS, LL, NDG, NY, RM, US). Moffat Co.: Dinosaur Natl. Monument, 19 Aug 1959, Barmore s.n. (WS). Montezuma Co.: Montezuma Natl. Forest, 2 Sep 1920, Copple 34717 (RM). Montrose Co.: Coventry, 2 Sep 1912, Walker 537 (GH, NY, RM, US). Ouray Co.: Ridgway, 20 Aug 1920, Payson 2311 (CAS, GH, NY, RM). Pitkin Co.: Highland Peak Quadrangle, Snowmass Creek, 23 Aug 1981, Feldman s.n. (NY). Rio Blanco Co.: Douglas Creek, 22 Sep 1979, Wilken 13563 (ASU, CSU). Routt Co.: Steamboat Springs, Aug 1892, Eastwood s.n. (CAS, MSU, OSU). Saguache Co.: Marshall Pass, 23 Aug 1896, Crandall s.n. (MO, RM). San Miguel Co.: Norwood Hill, 10 Aug 1912, Walker 434 (GH, NY, POM, RM). Summit Co.: Green Mountain Reservoir, 23 Jul 1972, Nelson 811 (CSU, NY, RM).

IDAHO: Adams Co.: 3 mi N Starkey, 24 Aug 1941, Christ 12945 (NY). Bannock Co.: 5 mi S Pocatello, 18 Aug 1949, Lingenfelter 747 (NY, RSA, UC, US, WS, WTU). Bear Lake Co.: Bloomington Lake, 5 Aug 1939, Davis 1619 (LL, NY, UTC). Bingham Co.: Taber, 12 Aug 1939, Davis 1730 (LL, UTC, WS). Blaine Co.: 4 mi N Ketchum, 24 Jul 1895, Henderson 3210 (DS, RM, WTU). Boise Co.: 10 mi S Lowman, Taylor 1811 (DAV). Bonneville Co.: 8 mi NW Swan Valley, 6 Aug 1952, Baker 9691 (NY, OSU, WTU). Butte Co.: Craters of Moon Natl. Monument, N Crater, 17 Jul 1953, Baker 10467 (NY). Camas Co.: Sawtooth Forest, Big Smokey Meadow, 11 Aug 1931, Hockaday 28 (RM). Canyon Co.: Dautrich Memorial Desert Preserve, 10 Jul 1978, Holsinger Kh780710-2 (NY). Cassia Co.: Mt. Harrison, 14 Jul 1939, Davis 1295 (NY, UTC). Clark Co.: 10 mi E Argora, 18 Aug 1939, Cronquist 1971 (NDG, NY, UTC). Custer Co.: ca 3/4 mi below Ocalkens Lake, 24 Aug 1980, Ertter 4022 (BYU, CAS, MONTU, NY, RM, UTC). Elmore Co.: ca 1/4 mi above Shake Creek Ranger Station, 8 Aug 1930, Pearse 16 (RM). Franklin Co.: W of Preston, 18 Sep 1932, Maguire 3827 (GH, MO, RM, UC, UTC). Fremont Co.: 1.5 mi S Last Chance, 25 Aug 1952, Baker 9935 (NY, OSU, WSU). Gooding Co.: Hagerman Valley, 21 Aug 1941, Davis 4291 (NY, WS). Jefferson Co.: Mud Lake, 24 Aug 1940, Christ 11816 (NY). La Plata Co.: 5 mi N Wendall, 30 Sep 1970, Hull s.n. (UTC) - approaches var. sessiliflora. Lemhi Co.: Salmon Forest, 18 mi E Big Creek, 27 Sep 1930, Bradley 58 (RM). Madison Co.: Range 43E, 7100 ft, 28 Jun 1979, Diffenback et al. 270 (UTC). Minidolca Co.: along Snake River, 28 Aug 1937, Christ & Ward 8848 (NY). Oneida Co.: Preston

- Whitney Hills, 24 Aug 1909, Smith 2033 (F, RM, UTC). Owyhee Co.: Silver City, 13 Jul 1910, Macbride 356 (DS, GH, NEB, NY, RM, US, WS). Teton Co.: Tetonia, 14 Jul 1934, Christ 5444 (NY). Twin Falls Co.: Shoshone Ranger Station, 14 Aug 1938, Gierisch 814 (UTC). Washington Co.: Spring Creek, 16 Aug 1941, Davis 4162 (UC, WS).

MONTANA: Beaverhead Co.: "Madison Co.", Monida, 4 Sep 1899, Nelson (DS, GH, NDG, NEB, NY, POM, RM, US, WTU). Big Horn Co.: 17.5 mi NW Hardin, 6 Jun 1956, Scharff s.n. (GH). Carter Co.: Box Elder Creek, 6 Aug 1934, Rose 385 (MONTU, WS). Cascade Co.: Great Falls, 27 Aug 1891, Williams 155 (NY, US). Custer Co.: U.S. Range Livestock Experiment Station, 14 Sep 1932, Kennedy K-64 (RM). Danials Co.: 3 mi W Scobey, 18 Jul 1973, Stephens 67979 (NY). Dawson Co.: Colgate, near Glendive, 5 Sep 1892, Sandberg et al. 1004 (CS, DS, MO, NY, POM). Deer Lodge Co.: Anaconda, 12 Sep 1906, Blankinship 716 (F, MO, MONT, NEB, POM, RM, UC, US). Fallen Co.: 10 mi N Baker, 26 Jun 1968, Stephens 23324 (GH). Fergus Co.: Missouri River bottom, 31 May 1979, Ramsden & Lackschewitz 409 (MONTU). Gallatin Co.: Bozeman, 10 Aug 1941, Booth s.n. (MONT, WTU). Glacier Co.: Midvale, along railroad, 3 Sep 1901, Umback 580 (NY). Granite Co.: 2 mi above Stony Creek, 9 Aug 1933, Hitchcock (CAS, DS, LL, MONT, POM, RM). Hill Co.: 1.3 mi E Box Elder, w/o date, Anderson et al. 5/2052 (WTU). Jefferson Co.: Benton Gulch Ranger Station, 30 Jul 1915, Cramer 108 (RM). Lewis and Clark Co.: Helena, 2 Sep 1889, Kelsey s.n. (DS, NY, POM). Liberty Co.: 12 mi NW Chester, 15 Jun 1952, Booth 52348 (WTU). Madison Co.: Ruby Range, 21 Aug 1982, Rosentreter 10291 (MONTU, NY). Missoula Co.: Bitterroot Mts, MacClay Mtn., 30 Sep 1976, Lackschewitz 7162 (MONTU, NY, WTU). Park Co.: 9 mi NW Wilsall, 28 Aug 1916, Suksdorf 145 (DS, GH, MO, MONTU, NY, OSU, RM, RSA, UTC, WS, WTU). Phillips Co.: S of Coulee, 12 Jan 1978, Lackschewitz 8137 (MONTU, NY). Powder Bay: Fort Howe, 31 Aug 1974, Bromenschenk 3 (MONTU). Powder Co.: 10 mi NE Helmville, 1 Jul 1948, Hitchcock 17865 (RM, RSA, UC, WS, WTU). Richland Co.: SE of Poplar, 29 Sep 1979, Lackschewitz 9290 (MONTU). Ravalli Co.: 3 mi N Sula, 19 Aug 1945, Hitchcock & Muhlick 13732 (CAS, DS, GH, NY, POM, RM, UC, WS, WTU). Rosebud Co.: 2 mi S Birney, 27 Jul 1957, Bennett (DS, F, NY, UC). Sheridan Co.: Westby, 22 Jun 1927, Larsen 33 (GH, MO, PHIL, RM). Silver Bow Co.: Little Basin, 15 Aug 1936, Casich 298 (MONTU). Sweet Grass Co.: Greyclif, 27-30 Aug 1913, Eggleston 9901 (GH, US). Teton Co.: 9 mi S Choteau, 21 Aug 1931, Howell 7890 (CAS). Toole Co.: Shelby, 26 Jul 1981, Taylor 30875 (NY). Whetland Co.: 2 mi W Hedgesville, Aug 1934, Hitchcock 2430 (CAS, MONTU, RSA, WTU).

NEBRASKA: Webster Co.: Red Cloud, 3 Sep 1903, Bates 3069 (GH). Sioux Co.: sandy prairies, Aug-Sep 1927, Kramer 170 (NEB, numerous sheets and presumably representing several populations, some of these labeled 170a, the latter approaching var. nebraskana).

NEVADA: Churchill Co.: 1 mi W Carroll Summit, 31 Aug 1937, Goodner & Hemming 1313 (UTC). Clark Co.: Charleston Mts, Kyle Canyon, South slope, 2200 m, 15 Aug 1939, Clokey 8574 (LL, NY, UTC, WS); 8592 (GH, UTC, UC, WS) - Most collections from the upper slopes in the Charleston Mts. show some gene flow from the lower elevation var. leucanthemifolia. Douglas Co.: 2 mi E Tahoe Junction, 1 Aug 1939, Mason 12187 (ARIZ, UC, WS, WTU). Elko Co.: Ruby Mts., Cass House Park, 1 Aug 1981, Tiehm & Williams 6757 (CAS, NY, RSA, UTC). Esmeralda Co.: Middle Creek, White Mts., 12 Aug 1938, Jaeger s.n. (POM). Eureka Co.: 8 mi W Carlin, 24 Jun 1960, Passey et al. 8 (TEX, UTC). Humboldt Co.: Santa Rosa Range, Hinkey Summit, 20 Jul 1961, Constance 3732 (ARIZ, NY, TEX, UC, UTC). Lander Co.: E of Austin, 27 Aug 1981, Semple 5733 (NY). Lincoln Co.: Wilson Creek Range, Mt. Wilson, 13 Sep 1983, Tiehm 8386 (BYU, NEB, NY, RSA, TEX). Lyon Co.: 2 mi SE Toll, 4 Sep 1937, Stackhouse 28 (RSA, UC). Mineral Co.: Wassuk Range, 4 mi below Laphan Meadows, 22 Jun 1944, Train (NY, UC, UTC). Nye Co.: Toquima Range, Pine Creek Canyon, 4 Aug 1964, Holmgren & Reveal 1524 (BYU, NY, UTC, WTU). Ormsby Co.: Snow Valley, 8 Aug 1902, Baker 1438 (GH, MO, NY, UC, US). Storey Co.: Virginia Range, Mt. Davidson, 23 Jul 1979, Larson 14 (NY, UTC). Washoe Co.: Calneva, Stateline, 15 Sep 1938, Rose 38271 (CAS, F, GH, MO, MONTU, NY, UC, US, UTC, WS). White Pine Co.: Ruby Mts., 9800 ft, Sherman Mountain, 4 Aug 1939, Hitchcock & Martin 5674 (DS, POM, RSA, UC, UTC) - high elevational forms; southern Shell Creek Range, 7000 ft, 11 Aug 1969, Holmgren & Bethers 3884 (ARIZ, NY, RSA, UC, UTC, WTU) - low elevational forms.

NORTH DAKOTA: Billings Co.: Medora, 19 Sep 1935, Stevens s.n. (RM, UC). Burke Co.: 2 mi N Wildwood Park, 10 Jun 1969, Hegstad 3435 (NEB). McKenzie Co.: 10 mi N Grassy Butte, 3 Sep 1968, Stephens 28683 (ARIZ, NY). Oliver Co.: Fort Clark, Sep 1860, Hayden s.n. (MO). Slope Co.: Marmarth, 20 Aug 1915, Moyer 723 (NY, RM). Williams Co.: Williston, 28 Jul 1906, Bell 405 (NY).

OREGON: Baker Co.: Sumpter-Whitney Road, 3 Aug 1976, Strickler 650 (RM). Crook Co.: 5 mi W Prineville, 10 Aug 1962, Dean 405 (ASU, DAV, DS, NY, OSC, RSA, UC, UTC, WS, WTU). Grant Co.: 7 mi S Seneca, 30 Jul 1953, Cronquist 7675 (GH, NY, UC). Harney Co.: Burns, 27 Aug 1913, Lawrence s.n. (OSC). Lake Co.: Devil's Garden, NE of Fort Rock, 21 Jul 1977, Crosby 1681 (OSC). Malheur Co.: E side of Trout Creek Mts., 1.2 mi from Little Wildhouse Creek Rd., 2 Jul 1981, Ertter 4338 (NY). Wallowa Co.: Wallowa Mts., Hurricane Creek, 25 Aug 1898, Cusick 2099 (F, GH, MO, NDG, UC, US). Wheeler Co.: 19 mi N Mitchell, 5 Jul 1942, Peck 21573 (OSC).

SOUTH DAKOTA: Bennett Co.: La Creek P.O., 12 Aug 1911, Visher 2252 (F, NY). Corson Co.: 3 mi W Mobridge, 12 Sep 1968, Stephens 29151 (GH, NY). Harding Co.: 16 mi NE Buffalo, 1 Sep 1968, Stephens 28560 (DS). Perkings: S fork of Grand River,

headwaters, 20 Aug 1928, Lee s.n. (RM). Stanley Co.: White River, Over 6154 (US).

UTAH: Beaver Co.: 26 mi N Manderfield Exit, IH 15, 13 Aug 1983, Sundberg 2067 (TEX). Cache Co.: 20 mi SE Logan, 6300 ft, 10 Aug 1985, Tuhy 2453 (BYU). Carbon Co.: Price, 5600 ft, 10 Sep 1927, Flowers 801 (BYU, LL) - approaches var. aristata. Daggett Co.: 4 mi S Manila, 6500 ft, 20 Jun 1979, Welsh et al. 35 (BYU). Davis Co.: above Hot Springs N of Salt Lake City, 20 Sep 1913, Garrett 2737 (LL). Duchesne Co.: Uinta Mts., 6 mi ENE Hanna, 8550 ft, 19 Oct 1979, Goodrich 13721 (BYU). Emery Co.: San Rafael Swell, 3 mi from Summit, 7450 ft, Harris 627 (BYU). Garfield Co.: 22 mi N Escalante, 9000 ft, 18 Aug 1965, Holmgren et al. 2537 (BYU, NY, TEX); Henry Mts., Penellen Pass, 7800 ft, 11 Aug 1976, Neese 2441 (BYU) - intermediate to var. aristata. Grand Co.: Hill Creek, ca Weaver Reservoir, 8170 ft, 3 Aug 1965, Holmgren et al. 2373 (BYU, NY, TEX). Iron Co.: ca 10 mi N Brian Head, 7000 ft, 8 Aug 1983, Gieschen 91 (TEX). Juab Co.: upper Trout Creek Canyon, 8000 ft, 6 Sep 1978, Foster 7349 (BYU). Kane Co.: 8 mi E Kanab, 5120 ft, 12 May 1977, Foster 3765 (BYU). Millard Co.: W of Fillmore, 3 mi E Clear Lake, 13 Aug 1983, Sundberg 2065 (TEX). Morgan Co.: ca 4 mi NNE Lost Creek Reservoir, 6900 ft, 17 Sep 1983, Thorne 3128 (BYU). Piute Co.: ca 4 mi W Marysville, 25 Jul 1971, Atwood 3017 (BYU). Rich Co.: Walton Canyon, 8000 ft, 17 Jul 1981, Thorne 1412 (BYU). Salt Lake Co.: ca 2 mi E Wasatch Blvd., Mill Creek Rd., 26 Sep 1982, Neese 12445 (BYU). Sanpete Co.: skyline drive E Fairview, 10,000 ft, 2 Aug 1977, Clark 2982 (BYU). Sevier Co.: 4 mi SE Monroe, 7000 ft, 18 Sep 1978, Henroid 11 (BYU). Summit Co.: Park City, 7400 ft, 21 Jul 1978, Keil K12910 (TEX). Toole Co.: Oquirrh Mts., Sharp Mt., 8600 ft, 2 Aug 1970, Holmgren & Holmgren 4641 (NY, TEX). Uintah Co.: 8 mi W Vernal, 22 Sep 1978, Neese (BYU). Utah Co.: Timpanoqos Cave Natl. Mon., 6 Aug 1983, Gieschen 80 (TEX). Wasatch Co.: W of Fruitland along highway 40, 10 Aug 1984, Sundberg & Lee 2593 (TEX). Washington Co.: Kolob, near reservoir, 3070 m, 5 Aug 1983, Higgins 14144 (BYU); summit of Beaverdam Mts., E slope 26 May 1978, Higgins 11913 (BYU) - this aproaches var. leucanthemifolia; Beaver Dam Wash, 800 m, 31 May 1985, Higgins 15517 (BYU) - collections more or less intermediate to var. leucanthemifolia; Pine Valley Mts., 6600 ft, 27 Jul 1968, Gentry & Jensen 2185 (ASU, DS, NY, RM, RSA, TEX, UTC, WS) - these approach var. ambigua; Zion Natl. Park, 5250 ft, 25 Sep 1982, Welsh 21392 (BYU) - more or less intermediate to var. aristata. Wayne Co.: 8 mi SSW Fish Lake, 8500 ft, 11 Aug 1977, Higgins 10571 (BYU).

WYOMING: Albany Co.: Jelm, 11 Aug 1900, Nelson (MO, NEB, NY, POM, RM, US). Big Horn Co.: Red Bank, 22 Jul 1901, Goodding 337 (NY, RM, US). Campbell Co.: Gillette, 1 Sep 1926, Nelson (GH, MO, NY, RM, UC). Carbon Co.: Rawlins, 31 Aug 1900, Nelson 8179 (GH, NY, POM, RM, US). Converse Co.: Douglas, 4 Oct 1903, Nelson 9004 (GH, NY, RM, UC). Crook Co.: Devil's Tower, 21 Aug 1981, Marriott 937 (RM). Fremont Co.: 14 mi SE Lander, 20 Jun 1965, Scott 437

(RM, UC). Goshen Co.: 11.5 mi NNE Lingle, 27 Sep 1978, Nelson 2439 (RM). Hot Springs Co.: 15 mi E Thermopolis, 2 Sep 1922, Payson 3111 (RM). Johnson Co.: Buffalo, Oct 1900, Tweedy 3094 (NY, RM, TEX, WS). Lincoln Co.: Jackson's Hole, 3 Aug 1920, Payson 2187 (CAS, GH, MO, NY, RM). Natrona Co.: Powder River, 22 Jun 1939, Craig 3501 (POM). Park Co.: Clark's Fork of the Yellowstone River, 25 Aug 1948, Witt 1386 (NY, RSA, WS, WTU). Sheridan Co.: Dayton, Sep 1899, Tweedy 2035 (NY). Sublette Co.: 15 mi NE Bondurant, 15 Aug 1922, Payson 3053 (F, GH, NY, OSU, PHIL, POM, US). Sweetwater Co.: Creston, 29 Aug 1897, Nelson 4271 (MO, NY, RM, US). Teton Co.: near Jenny Lake, 17 Sep 1941, Nelson 4976 (DS, GH, RM). Uinta Co.: Evanston, 28 Aug 1900, Nelson 8112 (BYU, GH, NY, POM, RM, US, UTC). Washakie Co.: 4 mi E Worland 25 Jun 1970, Watson 466 (TEX). Weston Co.: Upton, 31 Aug 1909, Nelson 9293 (RM, UC). Yellowstone Natl. Park: Yellowstone Lake, 13 Aug 1897, Rydberg & Bessey 5109 (NEB, NY, PHIL).

5b. MACHAERANTHERA CANESCENS var INCANA (Lindl.) A. Gray

Diplopappus incanus Lindl., Bot. Reg., t. 1693, 1834. Dieteria incana (Lindl.) T. & G., Fl. N. Amer. 2: 100. 1842. Machaeranthera canescens var. incana (Lindl.) A. Gray, Bot. Wilkes Exp. Phan. 2: 340. 1874. Machaeranthera canescens var tephrodes A. Gray, Syn. Fl. 1^2: 206. 1886. (Based upon Diplopappus incanus Lindl.). Machaeranthera incana (Lindl.) Greene, Pittonia 3: 62. 1896. Machaeranthera tephrodes (A. Gray) Greene, Pittonia 4: 24. 1899. Aster tephrodes (A. Gray) Blake, Contr. U. S. Natl. Herb. 25: 555. 1925. TYPE: U.S.A. Oregon: "Columbia river", described from seeds grown in London. 1830. Douglas s.n. (holotype BM; fragment GH!; isotype, microfiche, DC-G!).

Machaeranthera attenuata Howell, Fl. N. W. Amer. 1: 314. 1900. Aster attenuatus (Howell) Peck, Man. Pl. Ore. 724. 1941. TYPE: U.S.A. OREGON: Wasco Co., "On the sandy plains and banks near the Dalles", w/o date, T. Howell s.n. (lectotype ORE; photolectotypes F!, GH!, US!).

A weakly differentiated taxon differing from the var. canescens primarily by its strict erect habit and more numerous larger heads.

DISTRIBUTION (Fig. 3): Sandy or alluvial soils along the lower Snake River and associated tributaries primarily in Washington and adjacent Oregon but a few plants (or genes therefrom) spilling over into the border regions of Canada, Idaho and northern California. Flowering: (Jun) Jul-Oct.

This variety is largely restricted to sandy soils along streams and grades into var. canescens upslope to the southeast and into var. shastensis to the southwest. A few collections from California possess the habit of var. incana but otherwise appear to be intermediate with var. shastensis. Machaeranthera inornata, placed in synonymy under the latter becuase of its eradiate heads, is such a collection.

REPRESENTATIVE SPECIMENS: CANADA. British Colombia: Lake Okanagon, 15 Sep 1890, McCoy 8 (GH, NY).

UNITED STATES. CALIFORNIA: Siskiyou Co.: Dry land, Weed, 11 Sep 1910, Butler 1869 (MO, RM, UC, US) - populations in this region grade into var. shastensis.

IDAHO: Kootenai Co.: near Spokane Bridge in Kootenai County, 20 Aug 1892, Sandberg 912 (F, NDG, PHIL).

OREGON: Baker Co.: Pine Creek, near the Snake River, 13 Jul 1901, Cusick 2439a (WS). Deschutes Co.: N of Redmond, ca 2900 ft, 6 Aug 1917, Standley 1080 (DS, OSC). Gilliam Co.: junction of John Day and Columbia Rivers, 14 Aug 1941, Brenckle & Shinners s.n.

(RM). Hood River Co.: W of the Dalles, 8 mi W of Sherman Co. line, 5 Aug 1983, Sundberg 2029 (TEX). Jefferson Co.: Metolius, 17 Aug 1934, Jones 5733 (NY, WSU). Klamath Co.: dry slopes near old Fort Klamath, 13 Aug 1925, Thompson 308 (WTU). Morrow Co.: Boardman, 2 Sep 1941, Foerst s.n. (OSC). Sherman Co.: Grass Valley Canyon, 1 Oct 1938, Baker 1115 (RM). Umtilla Co.: near Ridge, 1000 ft, 6 Sep 1896, Brown (F, MO, NY, PHIL, RM, US). Union Co.: Sparta, 15 Oct 1897, Sheldon 9119 (GH, NY, RM, US). Wasco Co.: sandy soil, open pine woods, The Dalles, 15 Sep 1933, Jones 4238 (LL, UC, WTU).

WASHINGTON: Adams Co.: along road to Cunningham ca 2.5 mi N of junction with highway 26, 2 Aug 1983, Gieschen 76 (TEX). Asotin Co.: Anaconda Creek, 9 May 1926, St. John 4423 (WS) - an unusually shrubby form. Benton Co.: sand dune area, 12 Sep 1970, Langham 135 (WS, WTU). Chelan Co.: Lake Chelan, 16 Aug 1892, Lake & Hull s.n. (US, WS). Columbia Co.: Starbuck, 17 Sep 1893, Piper 1606 (F). Douglas Co.: near Wenatchee, 29 Sep 1945, Schallert 6981 (F). Ferry Co.: Keller Ferry, 10 Oct 1941, Gleason s.n. (WS). Franklin Co.: Connell, Jun 1903, Elmer s.n. (CAS). Garfield Co.: along Snake River, 4 mi W lower Granite Dam, 3 Aug 1983, Gieschen 77 (TEX). Grant Co.: Coulee City, 1 Sep 1892, Lake & Hull 691 (F, GH, MO, WS, WTU). Kittitas Co.: Ellensburg, 23 Aug 1898, Piper & Whited 854 (OSC, US, WS). Klickitat Co.: Columbus, 10 Jun 1886, Suksdorf 1560 (F, WS). Lincoln Co.: 5 mi E Odessa, 16 Aug 1919, Burrill s.n. (WS). Okanogan Co.: Loomiston, Aug 1897, Elmer 608 (NY, POM, US, WS). Spokane Co.: Spokane, 17 Aug 1892, Sandberg et al. 912 (CSU, DS, GH, MO, MONT, NY, POM). Stevens Co.: 7 mi N Hunter, 11 Aug 1949, Daubenmire 4942 (WS). Walla Walla Co.: Waitsburg, 11 Sep 1897, Horner 628 (GH, US, WS). Whitman Co.: Snake River Canyon, near La Folette Grade, 16 Oct 1920, St. John 3018 (LL, WS). Yakima Co.: Parker, 20 Sep 1935, Jones 8621 (MONT, WTU).

5c. MACHAERANTHERA CANESCENS var. SESSILIFLORA (Nutt.) B. L. Turner

Phytologia 60:78. 1986.

Dieteria sessiliflora Nutt., Trans. Amer. Phil. Soc., Ser. 2, 7: 301. 1840. Machaeranthera sessiliflora (Nutt.) Greene, Pittonia 3: 60. 1896. TYPE: U.S.A. IDAHO ?: "Denudated plains of the Rocky Mountains and Oregon", 1836. Nuttall s.n. (lectotype: BM; probable isolectotypes, GH!). The specimen at GH is labeled "Rocky Mts. E. slope". If the latter is a Nuttall collection it could only have been collected in southern Idaho during Nuttall's trans-continental expedition of 1836. I suspect that there are labeling errors with the GH specimen and perhaps others; these are discussed in more detail below.

Machaeranthera magna A. Nels., Bot. Gaz. 53: 227. 1912. TYPE: U.S.A. IDAHO: Canyon Co., Falk's Store, sandy river flats, 2200 ft, 5 Sep 1910, J. F. Macbride 729. (holotype RM!; isotypes DS!, F!, GH!, NEB!, NY!, RM!, US!, WS!, WTU!).

Differing from the var. canescens in its stiffly erect habit, glandular-viscid vestiture throughout, more numerous, mostly appressed, involucral bracts, and more numerous heads whigh tend to be sessile.

DISTRIBUTION: Southern Idaho along the Snake River in sandy or gravelly flats mostly from 800-1200 m. Flowering: Aug-Oct.

Most workers have ignored this name or else applied it to habitally similar-appearing populations from Nebraska. I have designated the latter as var. nebraskana in the present treatment. The latter is readily distinguished from var. sessiliflora by its merely canescent vestiture; the latter stands morphologically and geographically closest to the var. glabra with which it intergrades.

The var. sessiliflora occurs largely in sandy soils along the Snake River of Idaho but in mountainous regions to the north, southeast and southwest of the Snake River from about Burley in Cassia Co. to near Weiser in Washington Co., it intergrades with the var. canescens.

REPRESENTATIVE SPECIMENS: UNITED STATES. IDAHO: Ada Co.: Boise, 6 Sep 1911, Clark 315 (DS, F, GH, NY, POM, RM, US, WS). Adams Co.: 7 mi N Council, 20 Aug 1966 (CAS, DAV, DS, F, MONTU, NY, OSU, RM, RSA, TEX, UC, US, UTC, WS, WTU) - approaches var. canescens. Blaine Co.: Corral, Camas Prairie, 5700 ft, 15 Aug 1916, Macbride & Payson 3834 (CAS, DS, GH, NY, POM, RM, US). Boise Co.: 3 mi below Banks, N Fork Payette River, 27 Aug 1951, Kruckeberg 2849 (OSU, RM, RSA, UC, WS, WTU). Camas Co.: 10 mi W Hill City, 9 Sep 1938, Christ 9796 (NY). Canyon Co.: Falks Store, 1 Sep 1911, (DS, F, GH, NY, POM, RM, US). Elmore Co.: 8.4 mi W Hill City, 13 Aug 1976, Dziekanowiski et al. 2547 (MO, NY). Gem Co.: 2 mi S. Emmett, 11 Sep 1960, Munz 24285 (GH, RSA, UC). Idaho Co.: 1 mi NW Dixie, 27 Aug 1953, Baker 11173 (NY). Washington Co.: Nutmeg Mt., E Of Weiser, 28 Oct 1973, Ertter & Grimes 584/3 (NY).

5d. MACHAERANTHERA CANESCENS var. SHASTENSIS (A. Gray) B. L. Turner

Phytologia 60:79. 1986.

Machaeranthera shastensis A. Gray, Proc. Amer. Acad. Arts 6: 539. 1865. Aster shastensis (A. Gray) A. Gray, Bot. Calif. 1:

322. 1876. TYPE: U.S.A. CALIFORNIA: Siskiyou Co., Mt Shasta, 9000 ft, 1860-62, W. H. Brewer 1385 (holotype GH!; isotype US!).

Aster shastensis var. eradiatus A. Gray, Syn. Fl. 1^2: 174. 1884. Machaeranthera eradiata (A. Gray) Howell, Fl. N. W. Amer. 1: 314. 1900. Machaeranthera shastensis var. eradiata (A. Gray) Cronq. & Keck, Brittonia 9: 238. 1957. TYPE: U.S.A. CALIFORNIA: Siskiyou Co., Scott Mountains, ca 9000 ft, 22 Aug 1876, E. L. Greene 1000 (holotype GH!; isotype NDG!).

Aster inornatus Greene, Erythea 3: 119. 1895. Machaeranthera inornata (Greene) Greene, Pittonia 3: 62. 1896. TYPE: U.S.A. CALIFORNIA: Siskiyou Co., Yreka, [31 Aug] 1876, E. L. Greene s.n. [1038] (holotype CAS!; isotypes NDG!, F!, GH!, NY!). Information given in brackets is from the GH sheet.

Machaeranthera inops Nelson & Macbride, Bot. Gaz. 62: 148. 1916. TYPE: U.S.A. OREGON: Klamath Co., Crater Lake Region, "on Glacier Peak", 21 Aug 1902, F. A. Walpole 2288 (holotype US!).

Machaeranthera inops var. atrata Nelson & Macbride, Bot. Gaz. 62: 148. 1916. TYPE: U.S.A. OREGON. Klamath Co., Crater Lake National Park, "on firm pumice gravel at the summit of Llao Rock", 14 Sep 1902, F. V. Coville 1470 (holotype US!).

A weakly defined variety differing from var. canescens in having, usually, sterile or neuter ray florets, often reduced ligules (or the ray florets absent) and often the bracts of the involucre in 3-5 series. It grades into the var. canescens to the northeast and west, especially in Bend and Crook counties, Oregon where rayed and non-rayed populations may occur in close proximity. Intergrades also occur on the eastern side of Lake Tahoe where both neuter and pistillate ray florets may occur in the same area or, indeed, population.

In Siskiyou Co. California (about Weed) and in adjacent Klamath Co., Oregon and northward to Deschutes and Jefferson Counties var. shastensis intergrades at lower elevations with the more robust, stiffly erect, many-headed var. incana.

DISTRIBUTION (Fig. 3): Inner Montane Regions of Northern California and adjacent Oregon from 1500-3400 m, just extending into Nevada in the Lake Tahoe region. Flowering: Aug-Oct.

REPRESENTATIVE SPECIMENS: UNITED STATES. CALIFORNIA: Eldorado Co.: Upper Truckee Valey, 6500 ft, 24 Aug 1972, Smith 3488 (UC) - intergrades with var. canescens are common in this county. Glen Co.: Black Butte, 10 Aug 1943, Howell 19255 (CAS, DS, LL). Lake Co.: Hull Mt., along Horse Ridge, 2075 m, 26 Jul 1977, Strother 1283 (NY, RSA, TEX, UC). Lassen Co.: Manzanita Creek, Volcanic Natl. Park, 6700 ft, 6 Sep 1945, Rose 45259 (CAS, NY). Modoc Co.: South Mt., Devil's Garden, 5200 ft, 27 Aug 1935,

Wheeler 3924 (GH, LL, POM). Nevada Co.: Lower end of Donner Lake, 8 Aug 1902, Heller 7128 (BYU, DS, GH, MO, NY, POM, RM, UC, US). Placier Co.: E side Lake Tahoe, Aug 1863, Brewer 2152 (MO, UC). Plumas Co.: Lake Almanor, near P.G.E. dam, 15 Sep 1950, Balls, 15859 (CAS). Siskiyou Co.: 1 mi E Etna, Scott Valley, 19 Sep 1949, Tracy 18564 (RSA, UC, WSU). Tehama Co.: on serpentine, Tedoc Gap, ca 4500 ft, 21 Jul 1949, Hoffman 2833 (CAS, UC). Trinity Co.: 6 1/2 mi N Carrville, 24 Aug 1936, Howell 12716 (CAS, TEX).

NEVADA. Washoe Co.: Calneva, 6400 ft, 15 Sep 1938, Rose 38271 (CAS, F, GH, MO, MONT, NY, UC, US, WS) - population with neuter ray florets; Steamboat Hot Springs, 4600 ft, 25 Sep 1982, Tiehm & Williams 7589 (MO, NY, RSA, UTC) - population without ray florets.

OREGON. Crook Co.: Prineville-Bend road, desert, 3 Sep 1902, Cusick 3008 (DS, F, GH, MO, NY, POM, UC, US, WTU). Deschutes Co.: Lapine, 27 Aug 1941, Rose 41424 (CAS) - populations in this county show considerable intergradation into var. canescens or vice versa. Douglas Co.: near Diamond Lake, 7 Aug 1897, Coville & Applegate 467 (DS, GH, US). Jackson Co.: Siskiyou Mountains, Ashland Peak, 2 Sep 1958, Dennis s.n. (OSC). Josephine Co.: Big Red Mt., Ashland Area, on serpentine, 22 Aug 1949, Whittaker s.n. (WS). Klamath Co.: 4 mi S Crescent, 11 Aug 1953, Cronquist 7768 (CAS, DS, GH, MONTU, RSA, UTC, WS). Lake Co.: 20 mi N Fort Rock, 17 Jul 1927, Peck 15715 (OSC). Marion Co.: Sand Mt., 18 Aug 1957, Bellinger 32499 (OSC).

5e. MACHAERANTHERA CANESCENS var. LEUCANTHEMIFOLIA (Greene) Welsh

Great Basin Naturalist 43: 316. 1983.

Machaeranthera leucanthemifolia (Greene) Greene, Pittonia 3: 64. 1896. Aster leucanthemifolius Greene, Erythea 3: 119. 1895. TYPE: U.S.A. NEVADA. Esmeralda Co., Candelaria, 6000 ft, Jun 1886, W. H. Shockley 268 (holotype CAS!; isotypes DS!, US!).

Machaeranthera hiemalis A. Nels, Amer. J. Bot. 21: 580. 1934. U.S.A. CALIFORNIA. San Diego Co.: 'near Jacumba", Devils Canyon, 14 Mar 1930, A. Nelson 11190 (holotype, RM!, Sheet II (with 2 separate plants), so designated by Nelson; isotypes DS!, PHIL!, RM!)

REPRESENTATIVE SPECIMENS. UNITED STATES: CALIFORNIA. Inyo Co.: Deep Springs Valley at College, 5220 ft, 10 Aug 1983, Morefield 1654a (NY). Mono Co.: Sherwin Hill, 5750 ft, 3 Sep 1942, Alexander & Kellogg 3435 (CAS, LL, MO, NY, UC, UTC) - robust forms approaching var. canescens. San Bernardino Co: Clark Mountain, eastern part of County, 5000 ft, 15 Sep 1932, Munz 12858 (LL, MO, POM, UC).

NEVADA. Churchill Co.: Burnt Cabin Spring, 6400 ft, 18 Aug 1940, Beach 1028 (CAS, DS, UTC). Clark Co.: Kyle Canyon, 1300 m, 28 May 1937, Clokey 7740 (ARIZ, CAS, DS, F, LL, MO, NDG, NY, RM, RSA, UC, US, UTC). Esmeralda Co.: between Fish Lake Valley and Basalt, 3 Sep 1926, Ferris 6682 (DS, POM). Lincoln Co.: 0.4 mi N Hiko, 3850 ft, 6 Jun 1980, Harrison & Thorne 13260 (BYU, CSU, NY). Mineral Co.: near Basalt, 23 Jul 1976, Reveal 4585 (MO, NY, TEX). Nye Co.: White River Valley, 53 km (airline) S of Lund, 1570 m, 18 Jun 1978, Holmgren 8987 (BYU, CSU, MONTU, NY, RM, UT, UTC, WTU). Washoe Co.: Truckee Pass, 440 ft, 15 Sep 1909, Heller 9960 (DS, GH, NY, PHIL) - robust plants approaching var. canescens.

OREGON. Harney Co.: 3.5 mi S of junction with Mickey Hot Springs Rd on Alvord Well Rd, 12 Jul 1979, Price s.n. (OSC).

UTAH. Beaver Co.: road to Pot Sum Pa Springs, 7 mi S highway 21, 29 Aug 1980, Welsh et al. 214731 (NY). Millard Co.: SW Millard Co., wash N of Paddock No. 2, Desert Exptl. Range, 5400 ft, 7 Jul 1967, Alder 3 (MO, RM, UT). Washington Co.: Beaverdam Mountains, Castle Cliffs, 1150 m, 23 Aug 1984, Welsch & Welsh 23061 (BYU).

5f. MACHAERANTHERA CANESCENS var. ZIEGLERI (Munz) B. L. Turner

Phytologia 60:79. 1986.

Machaeranthera canescens subsp. ziegleri Munz, Aliso 7: 65. 1969. TYPE: U.S.A. CALIFORNIA, Riverside Co., N side Santa Rosa Mt, 6500-7500 ft, 30 Sep 1968, Louis B. Ziegler s.n. (holotype RSA; isotype CAS!).

An isolated series of populations differing from typical var. canescens in having a much larger involucre and better-developed perennial roots.

DISTRIBUTION (Fig. 3): UNITED STATES. California: known only from Riverside Co. in the Santa Rosa Mountains where it occurs in dry conifer forests from 1400-2000 meters. Flowering: Jul-Oct.

This variety grades northward into the var. canescens (populations of which, along the eastern Sierra Nevada, also possess exceptionally large heads, presumably as a result of past introgression with the var. leucanthemifolia, to judge from the glandular vestiture intermixed with the canescent condition which often occurs in the plants of this region).

REPRESENTATIVE SPECIMENS: UNITED STATES. CALIFORNIA: Riverside Co.: dry ridge near Santa Rosa Peak, 7600 ft, 13 Aug 1938, Munz (CAS, POM, UC, UTC, WSU); summit of Santa Rosa Mountain, 8100 ft, 25 Jul 1949, Jaeger s.n. (RSA).

5g. MACHAERANTHERA CANESCENS var. AMBIGUA B. Turner

Phytologia 60:77. 1986. TYPE: UNITED STATES. ARIZONA: Coconino Co.: Flagstaff, 28 Aug 1922, H. Hanson A7 (holotype, TEX!, isotypes ARIZ!, F!, MO!, NEB!, NY!, OSU!, PHIL!, RM!, TEX!).

Machaeranthera oxylepis Greene, Pittonia 4: 25. 1899. TYPE: U.S.A. ARIZONA: Cochise Co., Apache Pass, Sep 1881, J. G. Lemmon s.n. (holotype NDG!). The holotype is perhaps a collection with a label error; several additional collections by Lemmon from Cochise Co., Sep 1881, were examined, but all were typical M. asteroides (except for an Aster sp., yet further suggesting a mixing of material under this label).

Machaeranthera scoparia Greene, Leafl. Bot. Observ. Crit. 2: 227. 1912. TYPE: U.S.A. ARIZONA: Coconino Co., NW of Turkey Tanks, 26 Aug 1911, Jardine & Hill s.n. (lectotype US!; isolectotype RM!). Specimens were not found in NDG; the US specimen has written on this, "Type specimen"; I take this to be the hand of E. L. Greene. The specimen at RM has a Forest Service number, 32679, stamped upon the label.

Machaeranthera angustifolia Woot. & Standl., Contr. U.S. Natl. Herb. 16: 188. 1913. Not M angustifolia Rydb. (1910). TYPE: U.S.A. NEW MEXICO: Guadalupe Co., Fort Smith to the Rio Grande, "probably in the Sandia Mountains", 1853, J. M. Bigelow s.n. (holotype US!; probable isotype NY!). The NY label has written it, "Hurrah Creek. Sept 25th" which Standley (1915) notes to be a stream in the northern part of Guadalupe Co.

Differing from var. canescens in its larger heads and appressed, merely pubescent involucral bracts and usually glabrous achenes (or nearly so).

DISTRIBUTION (Fig. 3): Mostly northcentral Arizona from 5000-8500 ft in pine forests, extending into northern New Mexico and adjacent Colorado where it grades into the var. canescens and possibly M. bigelovii. Flowering: Aug-Oct.

I have not chosen to adopt any of the specific names listed in the above synonymy since, to some extent, each poses a problem in typification.

In Utah there exists a series of populations on the Aquarius Plateau in Garfield Co. which I have called var. canescens which appear to be intermediate with var. ambigua, at least as to involucral characters, possessing larger involucres with mostly appressed, merely puberulent bracts (e.g., Rydberg & Carlton 7392, 7441, GH, NY; M. E. Jones 6001, US; Hreha 376, UTAH; etc.). These characters intergrade extensively with those of the var. canescens in this region and I have not seen any populations (or individuals) which I could unequivocally assign to the var. ambigua. In

Washington Co. Utah populations of the var. canescens in the Pine Valley Mountain also approach the var. ambigua (e.g. Gould 1383, ARIZ, CAS, GH, NDG, NY, UC).

Populations of var. ambigua in New Mexico are generally taller and have involucres which approach those of M. asteroides var. asteroides, i.e. involucral bracts with more subulate, reflexed apices. The type of M. angustifolia Woot. & Standl. applies to such plants.

REPRESENTATIVE SPECIMENS. UNITED STATES. ARIZONA: Apache Co.: 15 mi W Window Rock, 1 Sep 1962, Turner 4910 (TEX). Coconino Co.: 10 mi W Flagstaff, 14 Aug 1946, Parker et al. 6158 (ARIZ, DS, LL, US, UTC). Mohave Co.: Slopes about Pine Lake, near Hualapai Peak, 6 Sep 1969, Correll 37809 (LL). Navajo: just W of Heber on Payson road, 28 Aug 1973, Sexton s.n. (ASU). Yavapai Co.: Ash Fork, 5000 ft, 14 Jul 1983, Gieschen 84 (TEX).

COLORADO: Archuleta Co.: NW of Pagosa Springs, 7100 ft, 8 Sep 1924, Payson 1418 (RM). Huerfano Co.: La Veta, 7000 ft, 21 Aug 1897, Crandall 3216 (NY). La Plata Co.: 30 mi E Durango, 12 Oct 1952, Twisselmann 1576 (CAS) - cultivated from seed.

NEW MEXICO: Bernalillo Co.: highway 44, 0.3 mi below Sandia Peak Winter Sports Area, 8500 ft, 22 Aug 1983, Gieschen 115 (TEX). Catron Co.: 7 mi W Datil, 7450 ft, 3 Sep 1956, Barneby 12899 (CAS, NY). Los Alamos Co.: Water Canyon, 5 Jul 1978, Foxx & Tierney 3 (NMC). Mora Co.: Watrous, 1950 m, 27 Aug 1926, Arsene & Benedict 17404 (F, US). Rio Arriba Co.: near Dulce, 20 Aug 1911, Standley 8150 (US). Santa Fe Co.: W slope, Sangre de Cristo Mts., 7200 ft, 14 Aug 1963, Bennett s.n. (TEX). San Juan Co.: Crystal, 8 Jul 1972, Francke & Cazier s.n. (ASU). Taos Co.: 16 air miles NE Taos, 7400 ft, 19 Aug 1973 (ASU, BYU, DS, MONTU, NMC, NY, RSA, UT, UTC, WTU) - grades toward var. glabra. Valencia Co.: Zuni Mts., Zuni Canyon Road, 7440 ft, 7 Sep 1968, Riffle 853 (NMC).

5h. MACHAERANTHERA CANESCENS var GLABRA A. Gray

Machaeranthera canescens var. glabra A. Gray, Pl. Wright 1. 89. 1850. Machaeranthera canescens var. viridis A. Gray, Syn. Fl. 1^2: 206. 1884. TYPE. UNITED STATES. NEW MEXICO: Dona Ana Co., Rio Grande Valley at Presidio San Elizario on sand-bars, 22 Sep 1849, C. Wright 262 (field no. 1258). (lectotype, selected here, GH!; isolectotypes GH!, MO!, UC!). Gray cited at least two separate collection sites; in addition he combined 2 or more of Wright's field numbers. I have selected that sheet with Wright's field number 1258 on the label, the locality corresponding to the collection site as given by Shinners (1940). This is also the type for var. viridis: Gray apparantly renamed his original variety, annotating the sheet accordingly.

Machaeranthera linearis Greene, Bull. Torrey Bot. Cl. 24: 511. 1897. Aster linearis (Greene) Cory, Rhodora 38: 407. 1936. TYPE: U.S.A. NEW MEXICO. Dona Ana Co., Mesilla Valley, 3900 ft, 6 Sep 1897. E. O. Wooton 444 (lectotype NDG!; isolectotypes DS!, GH!, MO!, NMC!, NY!, POM!, RM!, UC!, US!).

Machaeranthera fremontii Rydb., Bull. Torrey Bot. Cl. 32: 123. 1905. TYPE: U.S.A. COLORADO: "Black Soil of river bottoms (Platte waters) among tall plants", according to Fremont's notes, 20 Jul 1844, Fremont 421 (holotype NY!).

Differing from the var. canescens in its stiffly erect habit, more numerous heads and usually more numerous ray florets, in addition the leaves tend to be glabrous above and below.

DISTRIBUTION: Mostly sandy soils from 1000 to 1800 m along the eastern edge of the Rocky Mountains from southern Wyoming to New Mexico and adjacent states; extending into northcentral Chihuahua, Mexico. Flowering Jul-Sep.

It grades along the Rocky Mountains into the var. canescens and possibly into M. bigelovii; in northwestern New Mexico it grades into the var. aristata. In northeastern Colorado it grades into the var. nebraskana, the latter being larger-headed with more reflexed involucral bracts.

REPRESENTATIVE SPECIMENS: MEXICO. Chihuahua: Chihuahua, sand dunes, 10-19 Oct 1935, Le Sueur 330 (CAS, UC, TEX).

UNITED STATES. ARIZONA: Apache Co.: on the mesa leading S out of Chinle toward highway 264, 8 Aug 1971, Halse 599 (ASU, LL, OSU, UNLV).

COLORADO: Adams Co.: Brighton, 14 Sep 1908, Johnston 399A (NY). Arapahoe Co.: 0.2 mi SE of Juction of highways 83 and 70, 5550 ft, 18 Sep 1961, Brunquist B-173 (CSU). Archuleta Co.: ca 8 mi W Piedra, 22 Aug 1970, Watson 527 (MONTU, TEX). Boulder Co.: Valley near Boulder, 20 Aug 1906, Robbins 2580 (RM). Costilla Co.: sandy soil, Mumms farm, 3 mi SW of Fort Garland, 28 Aug 1956, Klinger s.n. (CSU). Denver Co.: prairies, Denver, 5300 ft, 5 Sep 1917, Clokey 2951 (CAS, F, GH, NY, RM, TEX, UC, US). El Paso Co.: Coral Bluffs, 17 mi E Colorado Springs, 17 Aug 1924, Bacigalupi 890 (DS, GH). Fremont Co.: w/o locality, 1872, Brandegee B523 (NY, UC). Jefferson Co.: Bear Creek area, E of Morrison, 5000 ft, 30 Aug 1972, Mooradian 72-467 (CSU). Larimer Co.: Ft. Collins, 5000 ft, 29 Sep 1894, Baker s.n. (MO, NY). Washington Co.: 3 mi S Otis, 26 Sep 1972, Stephens 62543 (NY). Weld Co.: 2.7 mi N Roggen, 29 Sep 1982, Wilken 13920 (BYU, CSU, NY, RM).

KANSAS: Hamilton Co.: 1 1/2 mi S Syracuse, 24 Sep 1970, Stephens 45721 (NY). Morton Co.: 5 mi N Elkhart, 1 Oct 1972, Stephens 62914 (NY).

NEW MEXICO: Bernalillo Co.: Alburquerque, sandy soils, 5129 ft, 6 Jul 1983, Gieschen 29, 30 (TEX). Colfax Co.: Chico rico Canyon, near Raton, 25 Aug 1900, Cockerall s.n. (NY). Dona Ana Co.: Mesilla Valley, 20 Sep 1907, Wooton & Standley 3200 (ARIZ, DS, F, MONT, OSU, RM, UC, US). Eddy Co.: Carlsbad, 10 Sep 1932, Whitehouse s.n. (TEX). Los Alamos Co.: Jemez Mts., Junction of Potrillo and Water Canyons, 6400 ft, 3 Sep 1974, Levin 417 (DAV). Luna Co.: 20 mi W Las Cruces, 30 Sep 1944, Barkley 14NM722 (TEX). McKinley Co.: 7 mi W Crownpoint, 8 Sep 1977, Spellenberg 4828 (NMC, NY). Otero Co.: 35 km N El Paso Tex along highway 54, 2 Oct 1978, Garcia 744 (CAS, DAV, TEX). Quay Co.: 2 mi N San Juan, 17 Sep 1952, Castetter 9392 (NMU). Rio Arriba Co.: ditch banks, Lybrooks, 29 Aug 1932, Nelson 283 (RM). Roosevelt Co.: sandy soil in oak shinnery, 4 mi SW Kenna, 25 Sep 1946, Whitehouse 17179 (NY, UC). Sandoval Co.: 18 mi N Albuquerque, 29 Aug 1974, Schultz 1313 (ARIZ, BYU, DAV, GH, NY, UT, UTC, WSU). San Juan Co.: floodplain of Chaco Wash, Chaco Canyon Natl. Monument, 31 Aug 1980, Betancourt s.n. (ARIZ) - most of the collections from this county tend to intergrade into var. aristata. Socorro Co.: Rio Grande basin, E of San Antonio, 17 Sep 1948, Dunn 4884 (NMU). Torrance Co.: Laguna del Perro, E of Willard, 6 Sep 1965, Barneby 13832 (CAS, NY). Union Co.: 2 mi SE Grenville, 26 Sep 1969, Correll 38015 (GH, LL, UC). Valencia Co.: 15.2 mi NW Pie Town, 8 Sep 1974, Schultz 1529 (NY, WTU).

TEXAS: El Paso Co.: Franklin Mountains, 30 Oct 1962, Correll 26529 (LL, UC). Hockley Co.: in open woods, 5 Sep 1927, Harris 94 (F, US). Hudspeth Co.: W of Sierra Blanca, 1 Oct 1946, Barkley 14T756 (F, MO, RM, RSA, TEX). Randall Co.: Lubbock, Sep 1929, Reed 3251 (US). Winkler Co.: 10 mi NE Kermit, 17 Oct 1970, Watson 571 (TEX).

WYOMING: Albany Co.: Laramie Hills, 21 Aug 1900, Nelson 8226 (GH, NEB, NY, POM, RM, US); Granite Canyon, 10 Sep 1932, Nelson 345 (RM, UC, WTU). Platte Co.: Hartville Junction, Sep 1904, Nelson 8966 (NY, RM). Laramie Co.: near Hillsdale, 28 Aug 1926, Heller 14316 (DS, F).

5i. MACHAERANTHERA CANESCENS var. NEBRASKANA B. L. Turner

Phytologia 60:78. 1986. TYPE: UNITED STATES. NEBRASKA: Sheridan Co.: 2 mi E Ellsworth, Sandhill prairie pasture on dry, loose sand, 27 Aug 1968, Steve Stephens 28307 (holotype, NY!; isotypes ARIZ!, DS!, GH!).

Differing from var. canescens in being taller and more stiffly erect with larger, 8-9 seriate, involucres (0.9-1.5 cm high) with generally more numerous ray florets (34-54).

DISTRIBUTION (Fig. 3): Sand hills of western Nebraska and perhaps just extending into the peripheral states. Flowering: Aug-Sep.

A very well-marked variety which Rydberg (1932) recognized, in part, as M. sessiliflora. The type of the latter, however, possesses a well-marked, cauline glandularity and was presumably collected by Nuttall in Idaho. This is treated as a variety of M. canescens in the present treatment (cf. below). The var. nebraskana intergrades westward and northward into the var. canescens; southward it grades into var. glabra.

The var. nebraskana, while widespread over the dune regions of western Nebraska, is nonetheless relatively rare at any give site. For example, I encountered the species along the highway between Gordon and Elliston Nebraska at only 3 sites (ca 14.6 mi, 23 mi, and 37 mi S of Gordon). At each of these the populations comprised 20-80 plants always on bare white sand on the back-side of relatively high dunes.

REPRESENTATIVE SPECIMENS: UNITED STATES. NEBRASKA: Box Butte Co.: Alliance, "arrow hill", 22 Aug 1909, Churchill s.n. (NEB). Cheyenne Co.: "prairies", Aug 1889, Smith s.n. (PHIL). Cherry Co.: 16 mi W Merriman, 23 Aug 1967, Stephens 17047 (DS, GH, NY, UC); sandhills between Duck and Rice Lakes, 22 Aug 1973, Churchill 2478 (MO, NEB). Dawes Co.: Chadron, 5 Sep 1899, Bates s.n. (NEB, NY); Chadron Creek Canyon, 6 Sep 1940, Toldstead (NEB). Garden Co.: w/o locality, 15 Jul 1911, Churchill s.n. (NEB). Hooker Co.: Middle Loop River near Mullen, Sep 1893, Rydberg 1721 (US). Logan Co.: 15 mi N Stapleton, 11 Sep 1970, Johnson 2883 (NY). Scotts Bluff: Wild Cat Range at Game Preserve, deep canyon, 28 Aug 1941, Tolstead 411483 (NEB, RM). Sheridan Co.: 13 mi N of Hay Springs, 10 Sep 1964, Nixon 240 (RM). Thomas Co.: near Plummer Ford, Dismal River, 23 Aug 1893, Rydberg 1734 (GH, NY).

SOUTH DAKOTA: Pennington Co.?: "Bad Lands", 1906, Skinner 317 (RM).

5j. MACHAERANTHERA CANESCENS var. ARISTATA (Eastwood) B. Turner

Phytologia 60:78. 1986. Aster canescens Pursh var. aristatus Eastwood, Proc. Calif. Acad. Sci., Ser. 2, 6: 296. 1896. TYPE: U.S.A. UTAH: San Juan Co., Willow Creek, 14 Jul 1895, A. Eastwood 45 (holotype CAS!).

Machaeranthera rigida Greene, Pittonia 4: 25. 1899. TYPE: U.S.A. ARIZONA. Navajo Co., "Kearn's [Keams] Canon", 20 Aug 1897, Zuck 41 (holotype NDG!).

Machaeranthera cichoriacea Greene, Leafl. Bot. Observ. Crit. 1: 148. 1905. Aster cichoriacea (Greene) Blake, Contr. U.S. Natl.

Herb. 25: 555. 1925. TYPE: U.S.A. COLORADO: Mesa Co., Bottom of canyon at Deer Run, 4700 ft, 25 Aug 1901, C. F. Baker 918 (holotype NDG!; isotypes MO!, NY!, POM!, US!).

Machaeranthera pulverulenta var vacans A. Nels., Bot. Gaz. 56: 70. 1913. M. canescens var. vacans (A. Nels.) Welsh, Great Basin Naturalist 43: 316. 1983. TYPE: U.S.A. UTAH. San Juan Co., Geyser Basin, "dry sandy park", 30 Jul 1912, E. P. Walker 360 (lectotype, selected here, RM!; isolectotypes GH!, NY!).

Differing from var. canescens in being more stiffly erect, taller, with more numerous florets and especially by the glandular-pubescent stems which are otherwise glabrous, or nearly so.

DISTRIBUTION (Fig. 3): Mostly sandy areas of Southeastern Utah and adjacent status (Colorado, New Mexico and Arizona) from 1000-2000 m in Juniperus-Artemisia associations. Flowering Aug-Sep.

The var. aristata intergrades westward and upslope, especially in Garfield and Wayne counties Utah, with the var. canescens. Plants seemingly intermediate between these variants include, among others, Cottam 6490, 9155 (UTAH) and Howell & True 44855 (CAS).

Collections from easternmost Colorado and adjacent Utah, including the types of M. cichoriacea and M. pulverulenta var. vacans, approach the var. canescens. Over most of its range the var. aristata is markedly glandular with little puberulence. Collections upslope (i.e. above 1800 m or so) on all sides of var. aristata tend to become minutely puberulent or canescent and less glandular (i.e., approach var. canescens). No doubt there has been periodic introgression between the two varieties. In northwestern New Mexico and adjacent Arizona var. aristata grades into var. glabra. The latter also occurs in sandy soils at about the same elevations as does var. aristata.

REPRESENTATIVE SPECIMENS: UNITED STATES. ARIZONA: Apache Co.: Canyon de Chelly National Monument, moist areas in canyon, 17 Sep 1955, Demaree 38419 (RSA). Coconino Co.: between Oraibi and Hotevilla, 5 Sep 1952, Deam 4122 (ARIZ, CAS). Mohave Co.: Arizona Strip District, Cottonwood Spring, 10 Sep 1980, Bundy 215 (ARIZ, BYU). Navajo Co.: Monument Valley, 14 Sep 1938, Eastwood & Howell 6647 (CAS, GH).

COLORADO. Mesa Co.: Badger Wash Experimental Area, 5000 ft, 26 Jul 1973, Reid & Ranck s.n. (RM); Colorado National Monument, 6000 ft, 11 Sep 1968, Porter & Porter 10595 (RM). La Plata Co.: Hesperus, 1963, Jefferies 6 (CSU). Montezuma Co.: head of Spruce Canyon, Mesa Verde Natl. Park, 17 Sep 1947, Weber 3619 (CAS, CSU, RSA, TEX) - approaches var. canescens.

NEW MEXICO: San Juan Co.: ca 5 air mi SW Fruitland, 8 Sep 1983, Spellenberg 7577 (NMC, NY).

UTAH: Carbon Co.: 5 mi E Wellington, 5 Sep 1962, Welsh & Moore 1834 (BYU). Emery Co.: adjacent to Carbon-Emery Co. line, along Utah highway 10, S of Price, 3 Oct 1969, Welsh et al. 9474 (BYU, NY, UTC). Garfield Co.: 7 mi E on Poison Springs Road, 23 Aug 1977, Neese & White 4036 (BYU). Grand Co.: Colorado River, W of Moab, 3900 ft, 4 Sep 1968, Howell & True 44740 (CAS, NY). Kane Co.: ca 11 mi NNE of Kanab, 5 Oct 1982, Welsh 21437 (BYU, NY, RM). San Juan Co.: S of Needle Rock, Monument Valley, 8 Sep 1944, Holmgren 3800 (GH, NY, UC, UTC, WTU). Uintah Co.: 13 mi SE Vernal, 13 Sep 1982, Goodrich & Atwood 17979 (NY). Washington Co.: Pine Creek Canyon, 4800 ft, Zion National Park, 13 Sep 1968, Howell & True 45291 (CAS). Wayne Co.: Henry Mountains, Notom Road crossing of Pleasant Creek, 5000 ft, 17 Sep 1976, Neese 2606 (BYU).

LITERATURE CITED

Anderson, L. C., D. W. Kyhos, T. Mosquin, A. M. Powell, & P. H. Raven. 1974. Chromosome numbers in Compositae. IX. Haplopappus and other Astereae. Amer. J. Bot. 61: 665-671.

Cronquist, A. 1971. Note on Haplopappus gracilis and H. ravenii. Brittonia 23: 292.

Cronquist A. and D. D. Keck. 1957. A reconstruction of the genus Machaeranthera. Brittonia 9: 231-239.

DeJong, D. C. D. and E. K. Longpre. 1963. Chromosome studies in Mexican Compositae. Rhodora 65: 225-240.

Ewan, J. and N. Ewan. 1981. Biographical dictionary of Rocky Mountain naturalists. Bohn, Scheltema and Holkema, The Hague, Netherlands.

Granger, B. H. 1975. Arizona Place Names, Univ. of Arizona Press, Tucson.

Hall, H. M. 1928. The genus Haplopappus, a Phylogenetic Study of the Compositae. Carnegie Inst. Wash. Publ. no 389. viii + 391 pp.

Hartman, R. 1976. A conspectus of Machaeranthera (Compositae: Astereae) and a biosystematic study of the section Blepharodon. Doctoral Thesis, Univ. of Texas, Austin.

Jackson, R. C. 1959a. In: Documented chromosome numbers of plants. Madrono 15: 52.

Jackson, R. C. 1960a. In: Documented chromosome numbers of plants. Madrono 15: 219-221.

Jackson R. C. 1964b. Relationship of a 3-paired Haplopappus to H. gracilis and H. ravenii. Amer. J. Bot. 51: 685. (abstract).

Keil, D. and D. Pinkava. 1979. IOPB Chromosome number reports LXIII. Taxon 28: 265-279.

Morefield, J. and C. Schaack. 1985. In: Chromosome number reports LXXXVI. Taxon 34: 160-161.

Nesom, G. 1978. Machaeranthera odyssei (Compositae): a unique new species from Mexico. Syst. Bot. 3: 218-225.

Nesom, G. and B. Turner. 1987. Cladistic relationships of Machaeranthera (Asteraceae-Astereae) and related taxa. (In Prep.)

Pinkava, D. and D. Keil. 1977. Chromosome counts of Compositae from the United States and Mexico. Amer. J. Bot. 64: 680-686.

Powell, A. and S. Powell. 1977. Chromosome numbers of gypsophilic plant species of the Chihuahuan desert. Sida 7: 80-90.

Rydberg, P. 1932. Flora of the Prairies and Plains of Central North America. New York Bot. Gard., New York.

Semple, J. 1985. Chromosome number determinations in fam. Compositae Tribe Astereae. Rhodora 87: 517-527.

Shinners, L. 1940. Field notes for Charles Wright for 1849 and 1851-52. Typed manuscript, Univ. of Texas, Austin.

Shinners, L. 1950. Notes on Texas Compositae - V. Field & Lab. 18: 32-42.

Solbrig, O. T., L. C. Anderson, D. W. Kyhos, and P. H. Raven. 1969. Chromosome nubers in Compositae. VIII. Astereae III. Amer. J. Bot. 56: 348-353.

Solbrig, O. T., L. C. Anderson, D. W. Kyhos, P. H. Raven, and L. Rudenberg. 1964. Chromosome numbers in Compositae. V. Astereae II. Amer. J. Bot. 51: 513-519.

Standley, P. 1915. Flora of New Mexico. Contr. U.S. Natl. Herb. 19: 762.

Strother, J. L. 1972. Chromosome studies in western North American Compositae. Amer. J. Bot. 59: 242-247.

Turner, B., J. Beaman and H. Rock. 1961. Chromosome numbers in the Compositae. V. Mexican and Guatemalan species. Rhodora 63: 121-129.

Turner, B. and D. Flyr. 1966. Chromosome numbers in the Compositae. X. North American species. Amer. J. Bot. 53: 24-33.

Turner, B. and D. Horne. 1964. Taxonomy of Machaeranthera sect. Psilactis (Compositae-Astereae). Brittonia 16: 316-331.

Turner, B., M. Powell and R. King. 1962. Chromosome numbers in the Compositae. VI. Additional Mexican and Guatemalan species. Rhodora 64: 251-271.

Ward, D. 1984. Chromsome counts from New Mexico and Mexico. Phytologia 56: 55-57.

Ward, D. and R. Spellenberg. 1986. Chromosome counts of angiosperms of Western North America. Phytologia 61: 119-124.

Watson, T. 1973. Chromosome numbers in Compositae from the Southewestern United States. Southwestern Naturalist 18: 117-124.

SCLEROPOGON (GRAMINEAE), A MONOTYPIC GENUS WITH DISJUNCT DISTRIBUTION

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Abstract

Examination of herbarium specimens of *Scleropogon* from both North and South America, along with field work in southern Arizona, has confirmed the long-held view that the genus is monotypic. Our studies failed to substantiate the existence in southwestern U.S. and Mexico of a distinct entity, marked by a coherent suite of characters, that is specifically distinct from *Scleropogon brevifolius* as it exists in South America. *S. longisetus* Beetle is, therefore, reduced to synonymy.

The genus *Scleropogon* was established by Philippi (1870), based on material collected in the vicinity of Mendoza, near the border between Argentina and Chile. The type species is *S. brevifolius*. Until 1981, when A. A. Beetle described a second species, *Scleropogon* was considered to be monotypic, having a disjunct distribution with populations in both North and South America. The plants are diclinous, having unisexual flowers which may be borne on the same or different plants. Moreover, the staminate and pistillate spikelets are quite different, the lemmas of the former having short awns, or none, whereas the latter are long awned.

In describing his new species, *Scleropogon longisetus* (based on *Reeder & Reeder 3626* from Coahuila, Mexico) Beetle (1981) stated that it was confined to North America, in contrast to *S. brevifolius*, which occurs in both the Northern and Southern Hemispheres. He includes the following key:

"Dioecious, rhizomatous, the panicles scarcely exserted above the leaves, the awns 3—5 cm long, at maturity twisted and strongly recurved *Scleropogon brevifolius*

Monoecious, stoloniferous, the panicles well exserted above the leaves, the awns 5—15 cm long, twisted but not strongly recurved *Scleropogon longisetus*"

(Although in his key, Beetle gives the awn length for *S. brevifolius* as 3—5 cm, in his description it appears as "5—15 cm"!)

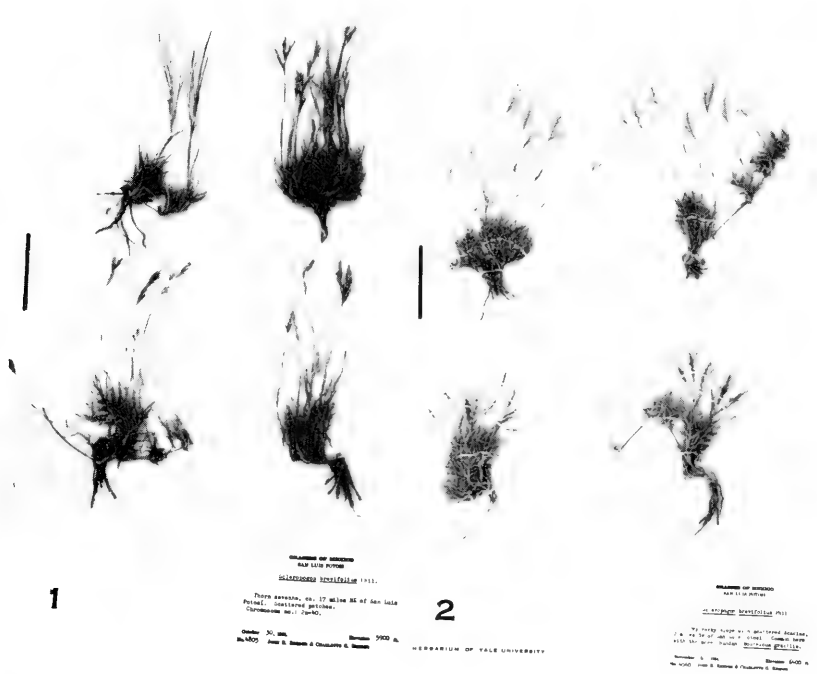
Botanists familiar with "dioecious" plant species will know that this condition is somewhat fragile. In a number of such grasses (e.g. *Buchloë, Opizia, Pringleochloa)* staminate and pistillate inflorescences may occur on the same plant within populations in which other plants of the same species bear either ♂ or ♀ flowers, but not both.

That the well-known and wide-ranging genus *Scleropogon*, considered to be monotypic since it was originally described, actually

consists of two clearly marked species (one dioecious and rhizomatous; the other monoecious and stoloniferous) is a concept that invites skepticism. Beetle's new species deserves critical re-examination, especially since the name *S. longisetus* has been taken up by Lehr & Pinkava (1982) in their Supplement to a Catalogue of the Flora of Arizona. They comment: *"Scleropogon longisetus* Beetle replaces *S. brevifolius* Phil. which is south of us." Those following Lehr's Catalogue (1978) and its supplements will quite logically conclude that the correct name for the common "Burro Grass" is *S. longisetus* and not *S. brevifolius,* as listed in all of our standard Floras and Manuals.

Beetle states (1981, p. 43): "Based on Reeder & Reeder 4607 from Chihuahua, Mexico, the chromosome count, 2n equals 40, for *longisetus* is the same as that for *S. brevifolius* (cf. Reeder, J. R. 1967 and 1968. Notes on Mexican Grasses VI and VIII, Bull. Torrey Botanical Club)." Referring to these two articles, one finds that the cited specimens (all under the name *Scleropogon brevifolius*) are *Reeder & Reeder 4528* in the earlier paper, and *R. & R. 4607* and *4805* in the later one. Beetle has referred *R. & R. 4607* to *S. longisetus,* and by inference clearly suggests that the other two (*4528* and *4805*) are good *S. brevifolius.* At ARIZ, a sheet of *R. & R. 4805* (Fig. 1) has four specimens: two bear only ♂ flowers, one only ♀ flowers, and the fourth is monoecious. All plants have stolons as well as rhizomatous bases. The inflorescences of the ♀ plants are exserted about 1.5 cm above the leaves, and the awns are from 2 to 6.5 cm in length. *R. & R. 4528* is from Crockett County, Texas, an area which Beetle indicates should be far north of the range of *S. brevifolius.* We have examined two sheets of this collection: one (ARIZ) has a single monoecious plant with short stolons, inflorescences exserted as much as 10.5 cm above the leaves, and awns up to 10 cm long. A YU specimen of the same number (on deposit at RM) has two plants, both of which are monoecious, obscurely stoloniferous, inflorescences exserted 8--10 cm, and awns mostly 6--9 cm long. Although Beetle implies that these specimens are *S. brevifolius*, they most closely fit his description of *S. longisetus.* One is led to wonder whether Beetle actually examined this material.

The following specimens (all *Reeder & Reeder* collections) were cited by Beetle as representing his new species, *S. longisetus: 2938, 3641, 4060, 4607, 4713.* Based on his protologue, these plants should be monoecious, stoloniferous, and have the ♀ inflorescences exserted well above the leaves. No. *2938* (ARIZ) fits his description reasonably well, but the others appear to have characters of both "species". A sheet of *4060* at YU (Fig. 2) has two ♂ and two ♀ plants in which the inflorescences are not exserted, or are borne only one cm above the leaves; at least some of the awns are strongly recurved, and none of them exceeds 5 cm in length. The ARIZ specimens of this number are essentially identical to those at YU. A specimen of *4607* at YU has the characters Beetle ascribed to *S. longisetus* except that it has a rhizomatous base, and some of the inflorescences are rather shortly exserted. A sheet of this same number at ARIZ has one ♂ ,



Figs. 1, 2. *Scleropogon* from Mexico. 1. *R. & R. 4805* (ARIZ) which Beetle implies is *S. brevifolius*. Note plant in upper right is monoecious, and that most plants have stolons. 2. *R. & R. 4060* (YU) cited by Beetle as *S. longisetus*. Note scarcely exserted inflorescences and short awns, some recurved. Scale line = 5 cm.

one ♀, and one monoecious plant; both of the pistillate and monoecious plants have rhizomatous bases, and the ♀ plant has an evident stolon. A sheet of *4713* at ARIZ has plants with ♀ inflorescences not, or but slightly exserted, and some of the awns are strongly recurved. The sheet of *4713* at YU has a ♂, a ♀, and a monoecious plant, the ♀ inflorescence is only shortly exserted, and some of the awns are clearly recurved. Finally, *3641* (ARIZ, YU) has ♂ and ♀ plants, the inflorescences scarcely exserted, and some of the awns are recurved. It seems clear that these specimens possess characteristics of both *Scleropogon brevifolius* and *S. longisetus*, and some (e. g. *R. & R. 3641*) most closely fit Beetle's description of the former! Examination of additional specimens from North America confirms the lack of consistent association of characters within each of the suites purportedly delimiting two species of *Scleropogon*.

Field studies of seven populations of *Scleropogon* in widely scattered areas in Cochise County, southern Arizona, during the late summer and fall of 1986 by one of us (Reeder) added significant information. In every stand examined there were separate colonies of ♂, ♀, and monoecious individuals. Plants exhibiting the latter condition may have separate culms bearing either a ♂ or a ♀ panicle, or an inflorescence might be a combination of ♂ and ♀ spikelets. In some cases, a spikelet was a mixture of ♂ and ♀ florets, the ♀ normally being borne toward the top of the spikelet. In all of these populations of *Scleropogon*, there was a preponderance of strictly pistillate plants. It is significant that late in the season, as the ♀ spikelets mature, the awns reflex markedly, a phenomenon observed in all areas visited. It should be remembered that Beetle indicated this to be an exclusive characteristic of South American *Scleropogon*. We found it to be a matter of maturity; it is clearly a generic character, not a specific one.

Although we hoped to see a large number of specimens of South American *Scleropogon* in order to compare them with those of our region, we were not particularly successful. We requested a loan of all South American material of this genus from US, but received only three sheets! Fortunately, one of those (*G. Covas 15053*) was from Mendoza, the type locality. Those specimens, plus one at ARIZ, were all we were able to assemble. Perusal of this meager sample, however, has been most enlightening and permits us, we believe, to make sound judgments regarding the validity of Beetle's *S. longisetus*, a taxon he indicates is confined to North America.

All of the South American material, according to Beetle, should be *Scleropogon brevifolius* and, perforce, be about one dm tall, strictly dioecious, rhizomatous, have inflorescences scarcely exceeding the leaves, and awns 3--5 cm in length. The plants from this area we were able to examine were at least 1.5 dm, most were about 2, and some were as much as 2.5 dm in height. *Bodenbender 8982* (US), from La Rioja, consists of three fragmentary plants: two ♂, and one monoecious with ♂ and ♀ flowers in the same inflorescence. The panicle of the monoecious plant is exserted ca. 12 cm above the leaves, and the awns are 3--5 cm long. All three of these fragments

Figs. 3--6. *Scleropogon* from South America (on left) and North America (on right). 3. *Covas 15053* (US) from Argentina. Note all plants are monoecious, have well-exserted inflorescences, and are stoloniferous. 4. *R. & R. 7962* (ARIZ) from Arizona, U.S.A.. Note strong rhizomatous base. 5. *Ruiz Leal 22098* (ARIZ) from Argentina. 6. *R. & R. 3626* (YU) from Mexico (type of *S. longisetus* Beetle). Note similarity of these last two specimens. Both have one ♀ and one monoecious plant, are stoloniferous, and the pistillate plants have long awns, some of which are recurved. Scale line = 5 cm.

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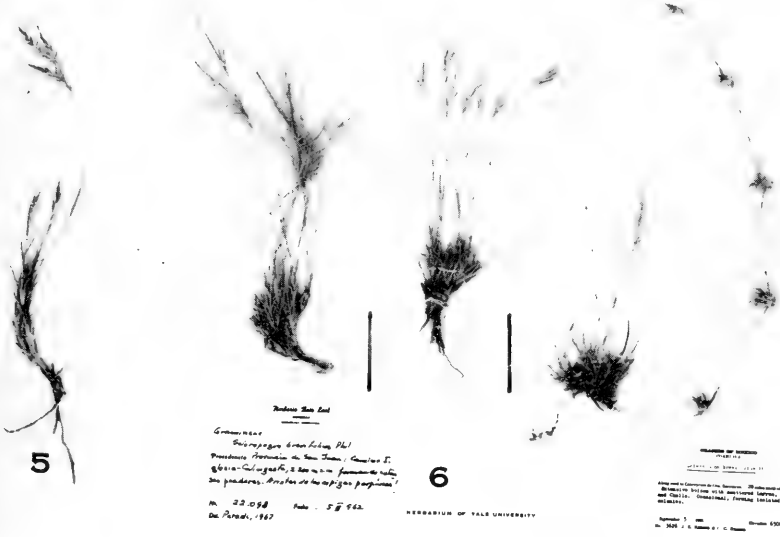

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are borne on stolons. A handwritten note on the label reads: "creeping like *Monanthochloë*!" *G. Covas 15053* (US), from Mendoza (the type locality) is unquestionably monoecious (Fig. 3). The sheet has eight plants, most of which have a stoloniferous base, and no rhizomes are evident. None of the inflorescences is either ♂ or ♀ , but ♂ and ♀ florets are borne in the same inflorescence, often in the same spikelet. The inflorescences are borne 10—12 cm above the leaves, and the awns are up to 6 cm long. *A. L. Cabrera 30110* (US) has only ♀ plants, some with stolons, in which the exsertion of the inflorescence varies from 3—9 cm. The awns are straight and mostly 6—9 (10) cm in length. Beetle characterized the South American plants (*S. brevifolius*) as lacking stolons and having "freely branching rhizomes." His new species, in contrast, is said to form elongate stolons, but lack rhizomes. We did not find plants of this genus to differ in these respects whether from the U.S.A. or from South America. All are stoloniferous, but none appears to form long branching rhizomes. Rhizomatous bases are characteristic of all, however, and it is not uncommon to find short rhizomes in plants from the U.S.A. *Reeder & Reeder 7962*, a staminate plant from Cochise Co., Arizona (Fig. 4), shows a more strongly developed rhizome than any we found among the South American plants examined.

Ruiz Leal 22098 (ARIZ) is strikingly similar to specimens from our area. It has two plants, one pistillate and the other monoecious (♂ and ♀ florets in the same inflorescence). Both plants have short basal stolons, well-exserted panicles (4—12 cm), and awns 4—10 cm long (Fig. 5). Compare this specimen with *R. & R. 3626* from Coahuila, Mexico, which Beetle designated as the type of his new species, *S. longisetus* (Fig. 6). In each case, the plants are monoecious, stoloniferous, have inflorescences borne well above the leaves, and the awns are widely spreading. An obvious difference is that the Mexican sheet shows a plant with a long stolon. We found this to be a variable character in all populations of *Scleropogon*. Presence or absence of stolons on herbarium specimen, and their length when present, is often a reflection of the care taken by the collector, and may not represent the plants' true characteristic.

It seems clear that plants of the genus *Scleropogon* from South America differ in no significant respect from those in southwestern U.S.A. and Mexico. Indeed, Beetle's characterization of *S. longisetus* describes quite accurately some Argentinian specimens we examined. We note that Pilger (1951) commented that plants of this genus may be monoecious, and illustrated a spikelet which is transitional with ♂ florets below and ♀ ones at the apex. Although it is not certain that Pilger was describing a South American specimen, the fact that his paper appears in an Argentinian journal is strongly suggestive.

Highly significant with respect to a clear understanding of *Scleropogon* in South America is the description and figure in Roig & Roig's (1971) treatment of the plants of Mendoza, the type locality for *S. brevifolius*. These authors describe the plants as perennial, monoecious or dioecious, with many-noded stolons which attain a

length of 40—50 cm and root at the nodes producing new plantlets. The panicles, they state, are masculine, feminine, or a mixture, and in the latter case the ♂ flowers are borne at the base. They give the awn length as 30 to 50 mm, and point out that a specimen (No. 10,352 in the Herbarium of Ruiż Leal) has some ♀ spikelets with 10 or 11 florets, and awns reaching a length of 110 mm. Their illustration (Fig. 17, p. 51) shows a plant one-half natural size with a long stolon and five flowering culms. Four of the culms bear ♀ panicles, and the fifth is wholly ♂. Clearly this plant is monoecious and stoloniferous and, according to Beetle, should not occur in South America. The panicles, when measured on the figure, are borne 3 to 4 cm above the leaves, but since the habit drawing depicts the plant one-half size, the actual length of the flowering culms would be 6 to 8 cm. Ruiz Leal (1972), in a popular Flora of the Mendoza area, also describes *Scleropogon* as being 10 to 20 cm tall and stoloniferous, the plants dioecious or monoecious. The inflorescences, he writes, are "muy superantes", staminate, pistillate, or a mixture. He indicates that the species is an important pasture grass and is known locally as "pasto de oveja" [sheep grass]. Indeed, in the original description, Philippi states that the plants are 15 to 20 cm tall, and that the awns attain a length of 108 mm. Unfortunately, there is no discussion of whether the plants are monoecious or dioecious, nor is there any mention of rhizomes or stolons.

It is quite evident that the studies reported here do not support the recognition of a second species of *Scleropogon*. We failed to substantiate the existence in southwestern U.S.A. and Mexico of a distinct entity marked by a coherent suite of character (stoloniferous vs strongly rhizomatous habit; monoecious vs strictly dioecious; long-exserted vs scarcely-exserted inflorescences; long-awned vs short-awned lemmas) that is separable from *S. brevifolius* as it exists in South America. Beetle's interpretation of *S. brevifolius* is quite inaccurate; his description of *S. longisetus* merely adds another synonym. The traditional concept of *Scleropogon* as a monotypic genus is clearly the correct one.

Although Beetle (1981) cited *Reeder & Reeder 3626* as the type of *Scleropogon longisetus*, he failed to indicate the herbarium in which the holotype is deposited. Among the specimens received on loan from RM was a specimen of *R. & R. 3626* in a folder marked "Type Specimen." There is no indication on the sheet, however, that this specimen is indeed the holotype, nor does the name *Scleropogon longisetus* appear on the label or on any annotation. The original determination by Reeder was *S. brevifolius*, and this remains the only name on the sheet. Since Beetle had a long association with the University of Wyoming, it is logical to assume that the above specimen is the one he studied and considered to be the type. The identity of the actual holotype remains, however, somewhat ambiguous. We therefore designate *Reeder & Reeder 3626* (YU), presently on deposit at RM, as lectotype of *S. longisetus* Beetle. The complete citation for the single species and its synonyms is given below:

Scleropogon brevifolius Philippi, Anal. Univ. Chile 36: 206. 1870. [Type from Mendoza, Argentina]

Lesourdia karwinskyana Fourn., Bull. Soc. Bot. France 27: 102. pl. 4, f. 12. 1880. [Type: Mexico, Tam., Cañon de las Minas, *Karwinsky 992*]

Lesourdia multiflora Fourn., Bull. Soc. Bot. France 27: 102. pl. 3, 4. 1880. [Type: Mexico, Tampico, *Bernier*]

Scleropogon karwinskyanus (Fourn.) Benth. ex S. Wats., Proc. Amer. Acad. Sci. 18: 181. 1883. (Based on *Lesourdia karwinskyana* Fourn.)

Scleropogon longisetus Beetle, Phytologia 49: 42. 1981. [Type: Mexico, Coah., *Reeder & Reeder 3626*]

Festuca macrostachya Torr. & Gray, U.S. Report Expl. Miss. Pacific 2(4): 177. 1855. nom. nud. Texas, Pecos. (staminate specimen)

Tricuspis monstra Munro ex Hemsley, Diag. Pl. Mex. 56. 1880. (as synonym of *Scleropogon brevifolius* Philippi)

IMPORTANT COLLECTIONS

When no collector is cited, the specimens are gatherings of *John R. Reeder & Charlotte G. Reeder*. A number followed by an asterisk (*) indicates a chromosome count of $2n = 40$.

USA: Texas: Crockett Co., 20 mi S of Big Lake, *4528** (ARIZ, YU). Arizona: Cochise Co., near mile marker 13, on Charleston Road, SW of Tombstone, *7878* [♂ & ♀ plants] (ARIZ); Whetstone Mt. area, Mine Canyon road, *7929* [♂ & ♀ plants], *7930* [monoecious] (ARIZ); 8 km E of Dragoon on Triangle T Road, *7933* [♂ & ♀ plants], *7934* [monoecious] (ARIZ); 6.5 km E of McNeal, *7946* [♂ & ♀ plants], *7947* [monoecious] (ARIZ); 5 km N of Ft. Bowie Trailhead, *7962* [♂ & ♀ plants], *7963* [monoecious] (ARIZ); ca. 7 km SW of San Pedro River crossing on Charleston Road, *7987* [♂ & ♀ plants], *7988* [monoecious] (ARIZ); along Rte. 80 S of St. David, just S of Curtis Road jct., *8001* [♂ & ♀ plants], *8002* [monoecious] (ARIZ).

MEXICO: Coahuila: 28 mi S of Saltillo, along road to Concepción del Oro, *3626* [Type of *S. longisetus* Beetle] (ARIZ, YU); 16 mi SE of Saltillo *3641* (ARIZ, YU). Chihuahua: ca. 5 mi SW of Jimenez, *4607** (ARIZ, YU). Zacatecas: ca. 40 mi N of Fresnillo, *4713* (ARIZ, YU). San Luis Potosí: ca. 15 mi NE of Cd. San Luis Potosí *2938* (ARIZ); 17 mi NE of Cd. San Luis Potosí *4805** (ARIZ); 2 mi SW of Cd. San Luis Potosí, *4060* (ARIZ, YU).

ARGENTINA: La Rioja, Cuesta de Amanao, "Creeping like Monanthochloë!", *Bodenbender 8982* (US); Mendoza, Las Heras, 10 km al N de Uspallata, *G. Covas 15053* (US); Prov. San Juan, Dept. Iglesia, Ruta a Chile, *A. L. Cabrera 30110* (US); Prov. San Juan, Camino Iglesia-Calingasta, *Ruiz Leal 22098* (ARIZ).

ACKNOWLEDGMENTS

Thanks are expressed to C. T. Mason, Jr. for providing space and facilities at ARIZ, to the Curators at RM and US for the loan of specimens, to Robert Ornduff for a copy of the original description of *Scleropogon brevifolius*, and to J. Abbott who provided the photographs. Charlotte Reeder's assistance with the field work and in the preparation of the manuscript is gratefully acknowledged.

LITERATURE CITED

Beetle, A. A. 1981. Noteworthy grasses from Mexico. IX. Phytologia 49: 33—43.

Lehr, J. H. 1978. A Catalogue of the Flora of Arizona. Phoenix, Arizona: Desert Botanical Garden. vi + 203 pp.

_____ & D. J. Pinkava 1982. A Catalogue of the Flora of Arizona. Supplement II. Jour. Arizona-Nevada Acad. Sci. 17: 19—26.

Philippi, R. A. 1870. Sertum mendocinum alterum, o sea, catalogo de las plantas recogidas cerca de Mendoza i en los caminos que conducen de Chile a esa ciudad. Anal. Univ. Chile 36: 159—212.

Pilger, R. 1951. Sobre el genero "Scleropogon" Phil. Revista Argentina Agron. 18: 46—53. [Spanish translation of: Pilger, R. 1940. Uber die Gattung *Scleropogon* Phil. Notizbl. Bot. Gart. Berlin-Dalhem 15(1): 15—22].

Reeder, J. R. 1967. Notes on Mexican grasses. VI. Miscellaneous chromosome numbers. Bull. Torrey Bot. Club 94: 1—17.

_____ 1968. Notes on Mexican grasses VIII. Miscellaneous chromosome numbers—2. Bull Torrey Bot. Club 95: 69—86.

Roig, F. A. & V. G. Roig 1971. Aportes al inventario de los recursos naturales renovables de la Provincia de Mendoza. 1. La Reserva Forestal de Nacuña. Anales del Instituto de Investigaciones de las Zonas Aridas y Semiaridas de La Provincia de Mendoza [Argentina]. Deserta I. (1970). 239 pp.

Ruiz Leal, A. 1972. Flora Popular Mendocina. Deserta 3: 1—296.

BOOK REVIEWS

Alma L. Moldenke

"FLORA HAWAIIENSIS: The New Illustrated Flora of the Hawaiian Islands" Book 6 by Otto Degener and Isa Degener, Waialua, Hawaii 26791, ca. 475 pp. 214 b/w pl. & 2 photo, author-published. 1986.

This new section of the definitive work on the native and naturalized flora of the Hawaiian Islands has just been released. It is bound in a firm 3-holed looseleaf volume so that the included material can be added to the previous volumes and arranged according to the owner's choice -- alphabetically, by family and genus, phylogenetically, etc. The senior author is well into his 90s, yet is fortunate to be able to continue recording and describing these fascinating plants now being exterminated so rapidly by unequal competition with adventives (both plant and animal), crops and cement. The various sections of this work can be ordered from him at the address given above, as can the "Naturalists South Pacific Expedition: Fiji" (1949). The authors have been our longtime admired friends whom we salute for their valuable and successful efforts in plant collecting and writing to help preserve what is left of the Hawaiian flora and to provide a record of what it was.

"FLOWERING PLANTS - Evolution Above The Species Level" by G. Ledyard Stebbins, xviii & 397 pp., 62 b/w fig. incl. 20 photo. & 14 tab. Belnap Press of Harvard University Press, Cambridge, Massachusetts 02138, 2nd printing. 1977. $30.00.

I have read this book carefully and with much interest as I had earlier read Cronquist's "The Evolution and Classification of Flowering Plants" (1968) and Takhtajan's "Flowering Plants: Origin and Dispersal" (1969). Throughout the present work Stebbins compares (usually) and contrasts (occasionally) his lifetime conclusions mainly with these and occasionally with other botanists' and evolutionists' theories. He postulates that ancestral angiosperms originated in a climate seasonal for the formation of flowers & seeds for strong selective processes for speeding up the reproductive cycle with rapid embryo, double fertilization and endosperm production probably in the Triassic or Jurassic, but now "believed to be completely extinct and not represented by any single order, living or fossil". They are postulated as having been low-growing shrubs with simple, stipulate, spirally arranged leaves; simple vascular woody stems; bisexual flowers in terminal, loose, leafy cymes, shortened floral axis, and undifferentiated perianth; stamens in bundles (=compound sporophylls), the pollen monocolpate; gynoecium carpels from infolded megasporophylls with terminal stigmas, no styles, and bitegumentary anatropous ovules; seeds with copious endosperm and dicot embryos. Stebbins urges future fossil, biochemical and comparative morphogenetic study for reliable answers as to how, where and when flowering plants arose.

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Articles dealing with research in all lines of botany and plant ecology, in any reasonable length, biographical sketches, and critical reviews and summaries of literature will be considered for publication.