CONTRIBUTIONS

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NOTES REGARDING VARIABILITY OF THE ROSE MALLOWS

A. B. STOUT

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NOTES REGARDING VARIABILITY OF THE ROSE MALLOWS

A. B. STOUT

The swamp rose mallows usually classed as *Hibiscus Moscheutos* grow in abundance along the coastal region of the eastern United States, extending inland in somewhat scattered stations to Missouri. The tall vigorous growth of the plant with the production of numerous, large, gayly colored and conspicuous flowers makes it a noticeable and popularly well-known feature of the vegetation.

In regard to numbers, what may perhaps be considered as a climax development for the species is seen in marshes along the coast of southern New Jersey, especially in the vicinity of Sea Side. Here, a casual survey of the population of mallows will reveal marked variations. Especially is this the case in color of flowers which may range from white to a rather solid intense red with numerous grades of intermediate pinks and with various types of eye coloration combined variously with blade colors. One feature of this variation was recognized in the proposal of a new species by Britton (1903) which was named *Hibiscus oculiroseus*, and by the observation that hybridization between this and the ordinary pink-flowered form of *H. Moscheutos* results in an F_1 hybrid generation that is intermediate and which is of a form frequently seen in nature.

In 1912, at the suggestion of Dr. N. L. Britton, the writer began breeding experiments to determine various points regarding the polymorphism observed in *Hibiscus*. Living plants were obtained of various forms found in nature. Self-fertilized progenies were grown to determine what forms breed true, and cross-pollinations were made between various forms and between various well recognized species in the attempt to reveal clews as to their relationship and to the variability that may arise in nature by natural crossing.

These experiments have been prosecuted somewhat vigorously and as extensively as space in the experimental plots at the New York Botanical Garden would allow. The studies have revealed several facts that admit of a preliminary report at this time which may be of use to various observers in the field. The writer wishes to obtain as full information as possible regarding the regional and geographic variability of the species of *Hibiscus* growing in the eastern United States, especially of the two species *H. Moscheutos* and *H. oculiroseus*. Herbarium specimens are not very satisfactory for the identification of flower color, hence observations on this point should be made on living plants. In correspondence with persons who have very kindly made field observations for the writer, it had been a source of difficulty that there are no standard descriptions of forms. It is hoped that the following descriptions will be of use in this particular. More complete taxonomic descriptions of any that may be found to be species are reserved until later.

Hibiscus Moscheutos

The description of the general characteristics of this species may be given as presented in the second edition of the Illustrated Flora of the northern United States and Canada, by Britton and Brown.

"Erect, 4°–7° high, forming numerous cane-like stems from a perennial root. Leaves ovate or ovate-lanceolate, 3′–7′ long, cordate or obtuse at the base, acute or acuminate at the apex, the lower or sometimes all lobed at the middle, palmately veined, dentate or crenate, densely white stellate-pubescent beneath, green and glabrous or slightly stellate above; petioles 1′–5′ long; flowers 4′–7′ broad, pink, clustered on stout pedicels at the summits of the stems; peduncles often adnate to the petioles;

bractlets linear, not ciliate, shorter than the calyx; calyx-lobes ovate; capsule ovoid, 1′ long, glabrous or sparingly pubescent, abruptly short-pointed or blunt; seeds glabrous."

At the present time the cultures of *Hibiscus Moscheutos* grown at the New York Botanical Garden include several races which appear to breed true and which are sufficiently distinct to be readily identified. Unless specifically mentioned the characters agree closely with those of the species as described above. The color determinations were made with the aid of Ridgway's Color Standards and Nomenclature.

Race 1.—No red in foliage. Corolla-blades amaranth pink, except for an almost pure white area of a radius of about three eighths of an inch at base surrounding stamen column. Stamens of nearly equal length, those at base of column only slightly shorter. Pollen yellow. Stigmatic lobes broad. Pods blunt. The general character of this race is shown in the colored plate presented in the *National Geographic Magazine* 39: 597 and which, as it now seems, may be taken as a biological type of the species.

Race 2.—Like race 1, but with darker shade of coloration in petals.

Race 3.—Like race 1, but decidedly paler, the color being noticeable but of a very pale diffuse pink.

Race 4.—Like race 1, but with the white of the center extending out along the main veins nearly to the tips of the corolla-lobes in radiating streaks.

Race 5.—An *alba* form, nearly pure white; faintest suggestion of pink coloration in buds and occasionally in flowers. Pollen almost white, noticeably less yellow than in races 1–4.

Race 6.—An eyed form: Tyrian rose at base of petals for radius of about half an inch, the color extending out in veins into the blades which are chiefly a dead white. Pollen white. Considerable red pigmentation in stems and in the petioles, and veins of the leaves.

Race 7.—Red coloration decided in stems and in the petioles and veins of the leaves. Corolla fully colored, amaranth pink at tips of lobes, the color gradually becoming more intense until at the base of the stamen column it is almost Tyrian rose; color slightly more intense in veins of lobes; areas of color extending up stamen column and into stamens. Pollen yellow. Stigmatic lobes smaller than in forms 1–6. Pods decidedly beaked.

This form is undoubtedly sufficiently different from *Hibiscus Moscheutos* to be considered as a distinct species. In respect to flower color and shape of capsule especially, it is decidedly different from ordinary forms of the species. Thus far I have seen but one plant of this form growing wild. Two generations of self-fertilized offspring have bred true.

Various crosses have been made between several of the above forms. In general the F_1 generation in each case has been rather intermediate. An F_2 generation has been grown of the cross between Races 5 and 7; the characteristics of Race 7 predominated in the large majority of this generation.

What appears to be a dwarf race has been observed growing at Rockaway, Long Island. Mr. Norman Taylor reported the occurrence of dwarf plants at this locality. When the writer visited the locality in the autumn of 1916, the plants were not in bloom. The dwarf habit of growth was very decided. No plant was found that was over 26 inches tall, and these plants were evidently several years old. Twenty-five plants were transplanted to the experimental plots at the New York Botanical Garden for further observation.

Hibiscus oculiroseus

Britton (1903) proposed this name giving the rank of a species to the crimson-eyed *Hibiscus* then in cultivation and rather generally considered a variety of *H. Moscheutos*. The description by Britton and Brown (1913) is as follows:

"Similar to the preceding species (*H. Moscheutos*) in stems, foliage and pubescence, and about as high, the flowers about as large. Calyx-segments triangular-lanceolate, acute, nearly twice as long as wide; corolla white with a dark crimson center; capsule ovoid-conic, long-pointed."

The pedigreed cultures of this species grown at the New York Botanical Garden have bred quite true to the ovoid character of the pod. The color of the corolla-blades is a sea-foam yellow rather than white, and the eye is of Tyrian rose, which is a rather intense shade of red. There are further distinguishing characters in the small stigmatic lobes, which here are scarcely expanded ends of the divisions, and in the light yellow or almost white color of the pollen. There is also a considerable difference in the length of the various stamens, those at the base of the stamen-ring having shorter filaments, and there is considerable red in stems and foliage quite as in Races 6 and 7 of *Hibiscus Moscheutos* described above.

Some lines of descent have bred remarkably true to the above mentioned characters, but others have shown considerable variation in the color of the flowers, the tendency seeming to be toward decreased intensity of the eye area and to the development of pale diffuse colors in the blade. There has also been a pronounced tendency toward dwarfness, as has been discussed by the writer (Stout, 1915).

HYBRIDS BETWEEN *H. oculiroseus* AND *H. Moscheutos*.

Britton and Brown (1913) recognize a hybrid between these two species and note that it is intermediate in flower character. The writer has produced these hybrids in pedigreed cultures from seed obtained by controlled pollinations. The F_1 hybrids between the typical *oculiroseus* and *Moscheutos* (Races 1, 2 and 3) have flowers with an eye of less intense color than has *H. oculiroseus* combined with a pale pink blade. The stigmas, stamens and pod characters are rather intermediate. It may be noted that the beautifully colored illustration given in *Flore des Serres*, vol. 12, Plates 1233–1234, 1857, and there identified as *Hibiscus Moscheutos* is an exact representation of the F_1 hybrids of this cross. The F_2 generation breaks up into almost every conceivable grade of variation in regard to eye and blade colorations and to characteristics of stigma, stamens and pods.

F_1 plants of the cross between *H. oculiroseus* and *H. Moscheutos*, Race 5, are at first sight quite readily taken for *H. oculiroseus*, but a more careful examination shows that the eye is paler and the blades are dead white instead of pale sea-foam yellow. Plants of the F_2 generation of this cross have not yet bloomed.

The results obtained in pedigreed cultures indicate that various races exist within the species of *H. Moscheutos* and that hybridization among these and *H. oculiroseus* will result in increased variability.

There is considerable literature (no attempt will be made here to summarize the literature) which indicates that there is more or less marked geographic limitations or even isolation of various races and that other races than those here mentioned may exist. Thus the variability may be quite different at various stations throughout the range.

Very little is known regarding the range of *Hibiscus oculiroseus*. In some localities plants resembling this species seem to predominate. Rev. J. P. Otis (personal correspondence) finds this to be the case near Marshallton, Delaware. However, flowers of nine plants which he sent to the writer showed that none of these conformed to the type of the species: the eye was much paler and the corolla-blades were either of pinkish tinge or were white instead of sea-foam yellow. Although there are many plants somewhat resembling *H. oculiroseus* to be found along the coast southward from New York City, none that the writer has yet seen have agreed with the type of the species grown at the New York Botanical Garden.

With the exception of Race 7, all the races of *H. Moscheutos* thus far tested hybridize readily with *H. militaris* giving highly fertile F_1 progeny. The latter species is decidedly distinct from either *H. Moscheutos* or *H. oculiroseus* and has a range that is more exclusively inland. It would seem, however, that in many localities both *H. Moscheutos* and *H. militaris* are to be found and that in such regions natural hybridization may occur producing much variability. Dr. O. E. Jennings has informed the writer, in a letter, that the form of *H. Moscheutos* which grows at Presque Isle, Lake Erie, has prevailingly three-lobed leaves. Evidently the shape of the leaves is somewhat like that seen in *H. militaris*, a condition which has not been seen in any of the races of Moscheutos that the writer has seen along the coast.

It will greatly facilitate the writer's efforts to make a field survey of the rose mallows if persons who have opportunity will report observations on the characteristics and relative abundance of the particular form or forms that they find at various stations. The writer will be pleased to receive fresh leaves and flowers for comparison with the species and races now growing at the New York Botanical Garden. If branches with flower buds are cut a day before the flowers are to open, slightly dampened with water, and immediately wrapped in paper and enclosed in a pasteboard box, they will keep in rather good condition for several days. Herbarium specimens may be made and while not revealing much regarding flower colors these are excellent for a study of leaf and pod characters.

It is also planned to extend the cultures at the New York Botanical Garden to include as many as possible of the different races or species found in nature. Plants can be transplanted at, or soon after, the close of the flowering period; the stems can be cut away, most of the dirt shaken from the roots, and the plant wrapped in paper to prevent drying out and shipped as soon as is convenient. A large majority of plants thus treated have lived when transplanted to the experimental plots. If possible, however, three plants of a particular form should be sent to insure against possible death of some.

The writer will fully appreciate any cooperation which will facilitate the study of these interesting and variable species.

New York Botanical Garden

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CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 202

PHYTOGEOGRAPHICAL NOTES ON THE ROCKY MOUNTAIN REGION

VII. FORMATIONS IN THE SUBALPINE ZONE

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Phytogeographical notes on the Rocky Mountain Region VII. Formations in the Subalpine Zone

P. A. Rydberg

In my Phytogeographical Notes, I have tried to present the distribution of the Rocky Mountain phanerogams viewed from three different standpoints: (1) their zonal distribution, (2) their geographic (provincial) distribution, and (3) their formational distribution. In other words, I have classified the plants: (1) according to the life zone to which they belong; (2) according to their surface distribution, inside as well as outside the Rocky Mountain region; (3) according to the formation to which they belong, i. e., whether they are hydrophytes, or mesophytes, or xerophytes, or any subdivision of these. When I mention formation this should not be taken in a purely ecological sense. In the third paper of the series, "Formations in the Alpine Zone,"* I indicated that I treated the "Formations" purely from a phytogeographical standpoint, and have nowhere treated plant societies, and still two reviewers of my articles (both ecologists) have criticized me for not stating which were the characteristic, the most common, and the secondary species. To do this, when a whole mountain region is treated, is impossible, for in the same class of formations certain species may be the characteristic ones in one locality, while in another they may be only secondary or even lacking altogether.

As shown in the fourth and fifth papers of this series† the vegetation of the Subalpine Zone consists mostly of forests and grasslands. Especially in the Southern Rockies, where the mountain slopes are very steep, another formation is also common, namely, the rock-slides. Where the latter do not exist, the slopes are mostly covered by forest, while the hog-backs and valleys are grasslands.

A. FORESTS

As the forests evidently cover the larger area, they may be treated first. The forest trees are six: *Picea Engelmannii,*

* Bull. Torrey Club 41: 459–474. 1914.

† Bull. Torrey Club 42: 11–18; 629–632. 1915.

Populus tremuloides, Abies lasiocarpa, Pinus aristata, Pinus exilis, and *Pseudotsuga mucronata,* of which the last two really belong to the Montane Zone and extend into the lower part only of the Subalpine Zone. Their relative importance, size, and distribution have been treated before.*

The forest formations of the Subalpine Zone in the Rockies may be divided into more or less defined classes, according to the most characteristic trees found there.

1. SPRUCE-BALSAM FOREST

This formation in the Southern Rockies is mostly found on the northern slopes and along water courses. The predominant tree is the Engelmann spruce, *Picea Engelmannii.* Sometimes it is found in pure stand, sometimes mixed with the subalpine fir or balsam, *Abies lasiocarpa,* occasionally also with the aspen. In the lower part of the zone the red fir, *Pseudotsuga mucronata,* is often added. The following species constitute mainly the flora of the spruce-woods, though several more might be added, especially such as are characteristic of the aspen groves, and occasionally accompany the aspen into the coniferous woods.

The corresponding formation in the Northern Rockies resembles that of the Southern very closely, except that *Abies lasiocarpa* becomes more common on the western side, and on the western slope of the Bitter Root Mountains in places becomes the dominant tree. Lyall's larch, *Larix Lyallii,* and the alpine hemlock, *Hesperopeuce Mertensiana,* are added in the Bitter Root Mountains and the Selkirks, and the former in the main Rockies north of latitude 48° 30′. The red fir, *Pseudotsuga mucronata,* scarcely reaches the subalpine region in the Northern Rockies, but the lodge-pole pine, *Pinus Murrayana,* often enters the lower portion of the zone. As stated in a previous paper, *Picea Engelmannii* and *Abies lasiocarpa* are rare in the Big Horn Mountains, and there often the upper limit of the lodge-pole pine constitutes the timber line.

The undergrowth of the spruce-balsam forest in the Northern Rockies is similar to that of the Southern Rockies. Many of the plants are common to both regions, as seen from the following

* Bull. Torrey Club 42: 14–20.

list. The place of the plants limited to the Southern Rockies is taken by those enumerated below. Species in this and subsequent lists which are marked "†" are limited to the Bitter Root-Selkirk region while those marked "‡" are limited to the Canadian Rockies.

Common to the Southern and Northern Rockies

Trees

Picea Engelmannii
Abies lasiocarpa
(*Populus tremuloides*)
Pseudotsuga mucronata (lower portion of the zone only)

Shrubs

Sorbus scopulina
Lepargyrea canadensis
Pachystima myrsinites
Linnaea americana
Distegia involucrata
Gaultheria humifusa
Vaccinium caespitosum
" *oreophilum*
" *scoparium*

Herbs

Poa crocata
Bromus Richardsonii
Vagnera stellata
Disporum trachycarpum
Lysiella obtusata
Ophrys borealis
" *nephrophylla*
Cytherea bulbosa
Alsine baicalensis
Thalictrum sparsiflorum
Atragene tenuiloba
Parnassia fimbriata
Pectianthia pentandra
Ozomelis stauropetala
Micranthes arguta
Tium alpinum
Atelophragma elegans
Aragallus deflexus
Osmorrhiza obtusa
Ligusticum Porteri
Moneses uniflora
Pyrola chlorantha
" *minor*
" *secunda*
Polemonium delicatum
Pedicularis racemosa
Veronica serpyllifolia
Arnica cordifolia
" *Parryi*
" *pumila*

Restricted to the Southern Rockies

Herbs

Anticlea coloradensis
Limnorchis purpurascens
Aquilegia elegantula
Ozomelis stenopetala
" *Parryi*
Viola neomexicana

Conioselinum scopulorum
" *coloradense*
Androsace pinetorum
Castilleja confusa
Adoxa moschatellina
Valeriana ovata
Senecio amplectans

Restricted to the Northern Rockies

Shrubs

Ribes laxiflorum
‡ " *hudsonianum*
" *petiolare*
Azaliastrum albiflorum
Gaultheria ovatifolia
Chiogenes hispudula
Vaccinium occidentale
" *globulare*
Linnaea longiflora

Herbs

‡*Alsine borealis*
Aquilegia columbiana
" *formosa*
Dentaria rupicola
Parnassia palustris
" *Kotzebuei*
Heuchera glabra
†*Pectianthia Breweri*
‡*Ozomelis trifida*
Atelophragma Forwoodii
Aragallus foliolosus
†*Osmorrhiza Leibergii*
Ligusticum filicinum
Moneses reticulata
Pyrola uliginosa
Aster meritus

2. PINE SLOPES

The characteristic tree of this formation in the Southern Rockies is the bristle-cone pine, *Pinus aristata*, which occupies dry slopes and ridges especially on the southern side of the mountains. It seldom forms a dense forest. Occasionally *Picea Engelmannii* or *Populus tremuloides* has encroached on the pine slopes and then the woods are more dense. In the lower part of the zone the bristle-cone pine is often mixed with the limber pine, *Pinus flexilis*. As *Pinus aristata* seldom makes a close stand but grows scattered on the slopes, the undergrowth is mostly made up of the grass formations, either that of the mountain slopes or that of the hog-backs. Wherever the trees stand close the undergrowth contains more and more of the element found in the more open woods. Some of the more common species are: *Arenaria Fendleri, Arnica cordifolia, A. pumila, A. Parryi, Polemonium delicatum, Draba streptocarpa, D. aureiformis, Pseudocymopterus montanus, Solidago* *decumbens*, *Poa crocata*, *Festuca saximontana*, *Agropyron Scribneri*, and *Bromus Richardsonii*.

The general feature of the corresponding formation in the Northern Rockies is the same as that just described, but the principal tree of the Southern Rockies, *Pinus aristata*, is not found there. Its place is taken by *Pinus albicaulis*. This tree grows even more scattered and the undergrowth is composed of plants which are still more characteristic of the grass-covered hog-backs. Some of the plants found in the Southern Rockies, as for instance *Pseudocymopterus montanus*, are lacking. *Calamagrostis purpurascens* and *Agropyron latiglume* are rather common. So are also *Xerophyllum tenax* and *X. Douglasii* in places, especially west of the mountains.

3. Aspen groves

The aspen in the Southern Rockies grows mostly on more gentle slopes than the pines, both on the north and south sides of the mountains, especially where the ground is richer and moist. It often takes possession of the ground after the coniferous forest has been destroyed by fire or otherwise. Usually it grows in groves, but sometimes mixed with the spruce, balsam and pines, especially along the edges of woods.

The aspen is not so common in the Northern Rockies, and this is especially true of the Subalpine Zone. In the Montane Zone it grows usually mixed with other species of *Populus*, birches and alders, while in the Subalpine Zone it is found along the edges of the spruce woods, in company with alders and the mountain ash.

The following plants are characteristic of the aspen groves, or else have followed the aspens where they grow mixed with the other trees:

Common to the Southern and Northern Rockies

Trees

Populus tremuloides

Shrubs

Salix brachycarpa	*Distegia involucrata*
Sorbus scopulina	*Vaccinium scoparium*

Herbs

Poa crocata	*Bromus Richardsonii*

Bromus Pumpellianus
Agropyron violaceum
Carex Geyeri
" *Rossii*
" *brunnescens*
Allium brevistylum
Vagnera stellata
Iris missouriensis
Disporum trachycarpum
Coeloglossum bracteatum
Alsine baicalensis
Moehringia macrophylla
Atragene tenuiloba
Anemone globosa
Aquilegia caerulea
Arabis Drummondii
Sieversia arizonica
Lupinus parviflorus
" *pulcherrimus*
Tium alpinum
Atelophragma elegans
Chamaenerion latifolium
Osmorrhiza obtusa
Pyrola uliginosa
" *minor*
" *secunda*
Pedicularis racemosa
" *bracteata*
" *Grayi*
Veronica serpyllifolia
Campanula petiolata
Oreochrysum Parryi
Erigeron Coulteri
" *glabellus*
Anaphalis subalpina
Arnica Parryi
" *pumila*
Achillea lanulosa
Hieracium gracile
Aster Lindleyanus

Restricted to the Southern Rockies

Shrubs

Salix Wolfii
Ribes coloradense
Ribes Wolfii
Sambucus microbotrys

Herbs

Danthonia Parryi
Anticlea coloradensis
Limnorchis purpurascens
Aquilegia elegantula
Draba chrysantha
" *streptocarpa*
Viola neomexicana
Ligusticum Porteri
Pseudocymopterus montanus
Pseudocymopterus sylvaticus
Conioselinum scopulorum
" *coloradense*
Castilleja confusa
Polemonium foliosissimum
Valeriana purpurascens
Antennaria viscidula
Senecio amplectens
" *ambrosioides*

Restricted to the Northern Rockies

Shrubs

‡*Ribes hudsonianum*	*Ribes laxiflorum*
" *petiolare*	" *glandulosum*

Herbs

Aquilegia columbiana	*Hedysarum Mackenzii*
" *formosa*	†*Osmorrhiza Leibergii*
Aragallus foliolosus	*Pedicularis contorta*
Hedysarum sulphurascens	*Aster meritus*

4. COPSES AND BORDERS OF WOODS

Shrubberies in the Southern Rockies are not common outside of the willow bogs, and the plants gathered together under this heading do not form a distinct formation but a mixture from several, especially of those of the aspen groves, the willow bogs, and the meadows. It consists in reality of the zone of strife between the last one mentioned and the other two. It is therefore not necessary to give a full list of the plants, but only advisable to mention the more common ones.

Copses are more common in the Northern Rockies, especially along the subalpine brooks, where *Alnus sinuata* is the predominant species.

Common to the Southern and Northern Rockies

Shrubs

Salix brachycarpa	*Distegia involucrata*
Vaccinium scoparium	

Herbs

Phleum alpinum	" *Olneyi*
Calamagrostis canadensis	*Carex Geyeri*
" *Langsdorfii*	" *Rossii*
Deschampsia atropurpurea	" *brunnescens*
Elymus glaucus	*Veratrum speciosum*
Panicularia nervata	*Vagnera stellata*
" *pauciflora*	*Silene Menziesii*
Poa reflexa	*Moehringia macrophylla*
" *leptocoma*	*Draba nitida*

Fragaria bracteata
Castilleja rhexifolia
" *lanata*
Erigeron Coulteri
Antennaria anaphaloides
Arnica Parryi
Anaphalis subalpina

Restricted to the Southern Rockies

Shrubs

Salix Wolfii
Acer trifida (Utah)
Sambucus microbotrys

Herbs

Trisetum montanum
Capnoides brachycarpum
Drymocallis fissa
Lathyrus arizonicus
Ligusticella Eastwoodiae
Pseudocymopterus montanus
Oreochrysum Parryi
Cirsium oreophilum
" *Eatonii* (Utah)
" *griseum*

Restricted to the Northern Rockies

Shrubs

‡*Salix Hookeriana*
‡*Ribes glandulosum*
Ribes hudsonianum
Alnus sinuata

Herbs

Silene repens
" *oregana*
Aquilegia columbiana
Sieversia ciliata
Fragaria bracteata
Lupinus monticola
" *caespitosus*
Astragalus spicatus
Homalobus Bourgovii
Hedysarum sulphurescens
" *Mackenzii*
Chaemaenerion angustifolium
" *latifolium*
Senecio pseudaureus
Castilleja Tweedyi
" *lancifolia*

B. GRASSLANDS

The grasslands have been discussed in the fifth paper of the series,* and the grasses were there enumerated. I shall not repeat here the discussion, but merely list the species of plants which enter into the composition of these different formations.

* Bull. Torrey Club 42: 629–634. 1915.

I. MEADOWS

Common to the Southern and Northern Rockies

Muhlenbergia racemosa
" *comata*
Phleum pratense
" *alpinum*
Alopecurus aristulatus
" *occidentalis*
Agrostis asperifolia
" *hyemalis*
" *variabilis*
Calamagrostis Langsdorfii
" *canadensis*
Deschampsia atropurpurea
" *curtifolia*
" *caespitosa*
Trisetum subspicatum
" *majus*
Graphephorum muticum
Danthonia californica
" *intermedia*
Poa pratensis
" *reflexa*
" *leptocoma*
" *alpina*
" *Olneyi*
" *Vaseyana*
Panicularia nervata
" *pauciflora*
Hordeum jubatum
Carex pyrenaca
" *nigricans*
" *eburnea*
" *Preslii*
" *brunnescens*
" *capillaris*
" *albonigra*
" *Reynoldsii*
Carex nova
" *chalciolepis*
" *atrata*
Veratrum speciosum
Juncus parous
" *Mertensianus*
Juncoides parviflorum
" *intermedium*
Lloydia serotina
Bistorta bistortoides
" *linearifolia*
Alsine strictiflora
" *borealis*
" *longifolia*
" *calycantha*
Silene Douglasii
Anemone globosa
Ranunculus alismaefolius
" *micropetalus*
" *eximius*
" *alpeophilus*
" *Eschscholtzii*
Aquilegia caerulea
Aconitum columbianum
" *insigne*
Thlaspi glaucum
Arabis Drummondii
Clementsia rhodantha
Heuchera parviflora
Leptasea Hirculus
Potentilla filipes
" *diversifolia*
" *glaucophylla*
" *decurrens*
" *arachnoidea*
Fragaria glauca

Dasiphora fruticosa
Sieversia ciliata
Acomastylis turbinata
Viola bellidifolia
Primula angustifolia
" *Parryi*
Anthopogon elegans
Amarella scopulorum
" *plebeia*
" *strictiflora*
Dasystephana Romanzovii
Phlox Kelseyi
Myosotis alpestris
Veronica Wormskioldii
Valeriana edulis
Campanula petiolata
Solidago oreophila
Aster Canbyi
Erigeron elatior
" *flagellaris*
" *glabellus*
Erigeron jucundus
" *salsuginosus*
" *superbus*
Antennaria bracteosa
" *corymbosa*
" *microphylla*
" *rosea*
Rydbergia grandiflora
Arnica rhizomata
" *Rydbergii*
Senecio crassulus
" *perplexans*
" *atratus*
" *pseudaureus*
" *pauciflorus*
" *cymbalarioides*
Achillea lanulosa
" *subalpina*
Hieracium gracile
Taraxacum ammophilum
Agoseris aurantiaca

Restricted to the Southern Rockies

Muhlenbergia Wolfii
Agrostis melaleuca
Deschampsia alpicola
Graphephorum Wolfii
Poa callichroa
" *pudica*
" *occidentalis*
" *tricholepis*
Carex bella
" *epapillosa*
Veratrum tenuipetalum
Silene Hallii
Sophia purpurascens
Cheirinia oblanceolata
Draba streptocarpa
" *spectabilis*
Potentilla viridior
Aragallus Parryi
Anthopogon barbellatum
Mertensia pratensis
Besseya plantaginea
Castilleja brunnescens
Campanula Parryi
Pyrrocoma Clementis
Aster griseolus
Erigeron formosissimum
Rydbergia Brandegei
Dugaldia Hoopesii

Arnica macilenta
" *subplumosa*
Senecio pudicus
" *chloranthus*
" *lapathifolius*
Senecio anacletus
" *amplectans*
" *foliosus*
" *multicapitatus*
Agoseris graminifolia

Restricted to the Northern Rockies

Agrostis variabilis
Poa nervosa
Carex ablata
" *montanensis*
" *spectabilis*
Juncoides glabratum
Alsine crassifolia
Silene oregana
" *repens*
" *Douglasii*
‡*Pulsatilla occidentalis*
Ranunculus alismellus
" *saxicola*
" *Suksdorfii*
Aconitum ramosum
‡ " *delphinifolium*
Thlaspi californicum
Heuchera flabellifolia
" *ovalifolia*
Potentilla viridescens
" *glomerata*
" *Vreelandii*
" *flabellifolia*
" *virgultata*
Drymocallis pseudorupestris
Acomastylis sericea
Sieversia ciliata
Lupinus monticola
Trifolium Haydeni
Aragallus viscidulus
" *viscidus*
Epilobium latiusculum
† " *Drummondii*
" *oregonense*
" *anagallidifolium*
Dodecatheon uniflorum
Amarella anisosepala
Phlox alyssifolia
Mertensia paniculata
" *stenoloba*
Pentstemon fruticosum
" *crassifolium*
† " *Lyallii*
Castilleja lutea
" *pallescens*
Adenostegia ramosa
Euphrasia mollis
†*Campanula heterodoxa*
Erigeron politus
Antennaria umbrinella
Arnica tenuis
Senecio megocephalus
" *Hookeri*
" *lugens*
‡*Agoseris pumila*

2. Dry valleys and Benchlands*

Species marked "§" are found in more sandy places; those

* For description see Bull. Torrey Bot. Club **42**: 632. 1915.

marked " Utah " are restricted within the region of the Southern Rockies to the Wahsatch and Uintah Mountains of Utah.

Common to the Southern and Northern Rockies

Stipa Tweedyi
" *minor*
Poa crocata
" *longiligula*
" *lucida*
" *Buckleyana*
Bromus Porteri
" *Richardsonii*
" *polyanthos*
Agropyron violaceum
Elymus simplex
Carex Hepburnii
" *Engelmannii*
" *occidentalis*
" *obtusata*
" *rupestris*
" *Rossii*
Eriogonum flavum
" *umbellatum*
Cerastium scopulorum
" *strictum*
Alsinopsis Nuttallii (Utah)
Anemone globosa
Pulsatilla ludoviciana
Thlaspi californicum
" *glaucum*
Draba aureiformis
Ivesia Gordonii
Potentilla filipes
" *arachnoidea*
Dasiphora fruticosa
§*Gayophytum racemosum*
Phacelia heterophylla
Pentstemon procerus
Campanula petiolata
Leptodactylum pungens
Chrysopsis asperella
Macronema discoideum
Townsendia incana
Antennaria aprica
" *bracteosa*
" *corymbosa*
" *microphylla*
" *rosea*
Hymenopappus cinereus
Senecio Purshianus
Achillea lanulosa

Restricted to the Southern Rockies

Carex Egglestonii
Eriogonum arcuatum
" *chloranthum*
" *neglectum*
Cerastium variabile
§*Arenaria confusa*
" *globosa*
§*Alsinopsis macrantha*
Lesquerella montana
" *Wardii* (Utah)
Cheirinia lanceolata
Draba Parryi
" *streptocarpa*
" *spectabilis*
" *luteola*
" *brachystylis*

Geranium Pattersonii
Pseudopteryxia longiloba (Utah)
Pentstemon caespitosus
Chrysopsis alpicola
Geranium pumila
Erigeron flagellaris
Senecio Nelsonii
" *Jonesii* (Utah)

Restricted to the Northern Rockies

Eriogonum Piperi
" *polyphyllum*
" *heracleoides*
Spraguea multiceps
Arenaria lithophila
† " *salmonensis*
Arabis exilis
Cogswellia montana
Androsace septentrionalis
Phlox alyssifolia
Erigeron Tweedyi
Antennaria albescens
Lygodesmia juncea

3. Mountain slopes*

Common to the Southern and Northern Rockies

Carex pyrenaica
" *nigricans*
" *Geyeri*
" *pseudoscirpoidea*
" *chimaphila*
Juncus Drummondii
" *Parryi*
Juncoides spicatum
Lloydia serotina
Salix petrophila
" *saximontana*
Cerastium scopulorum
" *strictum*
Anemone globosa
Aquilegia coerulea
Draba nitida
" *crassifolia*
" *Parryi*
" *aureiformis*
" *aurea*
Arabis oblanceolata
" *oreophila* (Utah)
Rhodiola integrifolia
Lithophragma bulbifera
Heuchera flavescens
" *parviflora*
Micranthes arnoglossa
" *rhomboidea*
" *brachypus*
Spathularia Vreelandii
Ivesia Gordonii
Potentilla filipes
" *diversifolia*
" *glaucophylla*
" *divisa*
" *quinquefolia*
" *nivea*
" *saximontana*
Sibbaldia procumbens
Acomastylis turbinata
Homalobus humilis
Epilobium clavatum
" *anagallidifolium*
Angelica Rosei (Utah)

* For discussion see Bull. Torrey Club 42: 632. 1915.

Amarella scopulorum
" *plebeia*
Dasystephana affinis
Polemonium viscosum (Utah)
Phacelia heterophylla
" *alpina* (Utah)
" *sericea*
" *ciliosa*
Mertensia alpina
Pentstemon procerus
Synthyris pinnatifida (Utah)
" *laciniata* (Utah)
Castilleja occidentalis
Valeriana edulis
Campanula petiolata
Solidago ciliosa
" *oreophila*
Aster andinus
" *frondeus*
" *apricus*
Erigeron glabellus
Antennaria anaphaloides
" *aprica*
" *pulcherrima*
" *umbrinella*
Arnica Parryi
" *pumila*
Senecio Nelsonii
" *crocatus*
" *cymbalarioides*
Artemisia spithamaea
" *scopulorum*
" *saxicola*
Taraxacum scopulorum

Restricted to the Southern Rockies

Carex nubicola
Juncus Hallii
Erythronium parviflorum
Salix pseudolapponicum
Cerastium Earlei
" *variabile*
" *oreophilum*
Vahlbergilla Kingi (Utah)
" *montana*
Anemone zephyra
Aquilegia scopulorum
" *thalictrifolia*
Sophia purpurascens
Cheirinia oblanceolata
Draba chrysantha
" *streptocarpa*
" *spectabilis*
" *luteola*
Rhodiola polygama
Germania debilis (Utah)
Potentilla modesta (Utah)
" *tenerrima*
Trifolium Brandegei
" *Parryi*
Pseudocymopterus Tidestromii (Utah)
Angelica Grayi
Primula angustifolia
Polemonium confertum
" *mellitum*
" *Brandegei*
Leptodactylon Nuttallii
Dasystephana Parryi
Phacelia nervosa
Mertensia lateriflora
" *Bakeri*

Mertensia Parryi
Pentstemon stenosepalus
" *caespitosus*
Besseya alpina
" *plantaginea*
" *Ritteriana*
Castilleja puberula
Pedicularis Parryi
" *scopulorum*
Valeriana acutiloba
Solidago decumbens
Oreochrysum Parryi
Aster griseolus
Machaeranthera Pattersonii
Senecio fedifolius
" *petrocallis*
" *ambrosioides*
Artemisia Pattersonii
" *Parryi*
Agoseris agrestis

Restricted to the Northern Rockies

Xerophyllum tenax
" *Douglasii*
Erythronium obtusum
" *grandiflorum*
Salix Seemannii
" *cascadensis*
" *Fernaldii*
Arenaria lithophila
† " *salmonensis*
Silene Lyallii
" *multicaulis*
‡*Sophia sophioides*
Draba cana
Arabis Lyallii
Heuchera grossularifolia
" *flabellifolia*
Micranthes occidentalis
" *saximontana*
" *Rydbergii*
Spathularia Brunnoniana
Potentilla Vreelandii
" *perdisecta*
Drymocallis pseudorupestris
Acomastylis sericea
Sieversia ciliata
Lupinus caespitosus
Trifolium montanense
Cystium platytropis
Viola adunca
Bupleurum americanum
Amarella propinqua
Dasystephana calycosa
" *monticola*
Phacelia Lyallii
Mertensia paniculata
" *stenoloba*
" *Tweedyi*
Pentstemon montanus
" *pseudohumilis*
" *Tweedyi*
Pedicularis Hallii
Valeriana septentrionalis
Campanula heterodoxa
Oreostemma Haydeni
Townsendia Parryi
Antennaria lanata
‡*Artemisia arctica*
" *elatior*
Agoseris pumila

4. HOG-BACKS*

Common to the Southern and Northern Rockies

Carex Hepburnii
" *Engelmannii*
" *occidentalis*
" *phaenocephala*
" *obtusata*
" *rupestris*
" *Helleri*
" *Rossii*
Eriogonum arcuatum
" *flavum*
" *umbellatum*
Oreobroma pygmaea
Silene acaulis
Cerastium Behringianum
Alsinopsis Nuttallii
" *obtusiloba*
Anemone parviflora
" *tetonensis* (Utah)
" *Drummondii*
Pulsatilla ludoviciana
Smelowskia americana
" *lineariloba*
Draba ventrosa
" *oligosperma*
" *andina*
" *crassa*
" *luteola*
" *aurea*
Rhodiola integrifolia
Ivesia Gordonii
Potentilla divisa
" *nivea*
" *uniflora*
" *saximontana*
" *arachnoidea*
Sibbaldia procumbens
Dasiphora fruticosa var.
Trifolium nanum
Androsace carinata
Gilia globularis
Phlox depressa
" *caespitosa*
Eritrichium elongatum
" *argenteum*
Castilleja occidentalis
Erigeron compositus
" *melanocephalus*
" *simplex*
Antennaria aprica
" *media*
" *sedoides*
" *umbrinella*
Chaenactis alpina
Senecio Purshianus
Artemisia scopulorum
" *spithamaea*

Restricted to the Southern Rockies

Eriogonum chloranthum
" *neglectum*
Paronychia pulvinata
Arenaria Fendleri
Thlaspi coloradense
" *purpurascens*

* For discussion see Bull. Torrey Club 42: 633. 1915.

Lesquerella parvula
" *Wardii* (Utah)
Cheirinia nivalis
" *radiata*
" *amoena*
Draba sobolifera (Utah)
" *pectinata*
Ivesia utahensis (Utah)
Potentilla tenerrima
" *minutifolia*
" *paucijuga* (Utah)
Trifolium stenolobium
" *bracteolatum*
" *lividum*
" *dasyphyllum*
Aragallus Hallii
" *oreophilus* (Utah)
Oreoxis humilis
" *Bakeri*
" *alpina*
Phlox condensata
Synthyris pinnatifida
" *laciniata*
Chrysopsis alpicola
Erigeron glandulosus
" *pinnatisectus*
Senecio werneriaefolius
" *Holmii*
" *taraxacoides*
" *Soldanella*

Restricted to the Northern Rockies

Eriogonum Piperi
" *polyphyllum*
" *caespitosum*
" *pyrolaefolium*
Oreobroma minima
Anemone Drummondii
Aquilegia Jonesii
‡*Smelowskia lobata*
† " *ovalis*
Pilosella Richardsoniana
†*Draba eurocarpa*
" *densiflora*
" *lonchocarpa*
Arabis Lyallii
†*Phoenicaulis cheiranthoides*
Coniomitella Williamsii
Heuchera ovalifolia
potentilla brevifolia
" *Macounii*
" *wyomingensis*
" *ovina*
Trifolium scariosum
Aragallus alpicola
" *viscidus*
" *viscidulus*
Viola adunca
Pseudocymopterus bipinnatus
Bupleurum purpurascens
Douglasia montana
Phlox costata
" *diapensioides*
Synthyris dissecta
" *reniformis*
Townsendia Parryi
" *florifer*
Oreostemma Haydeni
Erigeron radicatus
" *Scribneri*
" *Tweedyi*
Antennaria acuta
" *mucronata*
" *pulvinata*
‡*Tonestus laceratus*

C. VARIOUS HYDROPHYTIC FORMATIONS

These consist of bogs, brook banks, lakes, ponds, and brooks. In the Subalpine Zone these contain few grasses and no trees. The bogs may be divided into sedge bogs, willow bogs and *Sphagnum* bogs.

I. SEDGE BOGS

The sedge bogs resemble those of the Alpine Zone. These have already been described in a previous paper.*

Common to the Southern and Northern Rockies

Alopecurus aristulatus
Calamagrostis Langsdorfii
Poa reflexa
Phleum alpinum
Panicularia pauciflora
Carex nigricans
" *gymnocrates*
" *disperma*
" *aurea*
" *brunnescens*
" *Reynoldsii*
" *nova*
" *bella*
" *aquatilis*
Scirpus pauciflorus
" *caespitosus*
Eriophorum angustifolium
" *gracile*
Juncus balticus montanus
" *triglumis*
" *castaneus*
" *Mertensianus*
Bistorta bistortoides
" *linearifolia*
" *vivipara*
Alsine longifolia
" *strictiflora*
Alsine laeta
" *crassifolia*
" *calycantha*
Thalictrum alpinus
Ranunculus affinis
Ranunculus eximius
Trollius albiflorus
Aconitum columbianum
Radicula alpina
Parnassia fimbriata
Micranthes arguta
Geum rivale
Epilobium ovatifolium
" *Drummondii*
" *wyomingense*
Hippurus vulgaris
Pyrola uliginosa
Primula Parryi
Anthopogon elegans
Amarella scopulina
" *strictiflora*
Dasystephana Romanzovii
Pleurogyne fontana
Swertia scopulina
" *congesta*
Myosotis alpestris
Veronica americana

* See Bull. Torrey Club 41: 471, 472, 1914.

Veronica Wormskjoldii
Elephantella groenlandica
Mimulus Langsdorfii
Senecio crassulus
Erigeron salsuginosus

Restricted to the Southern Rockies

Juncus parous
Ranunculus alismaefolius
" *micropetalus*
" *stenolobus*
Caltha rotundifolia
Aconitum Bakeri
" *insigne*
Radicula curvipes
" *Underwoodii*
Epilobium stramineum
Ligusticum Porteri
Senecio atratus
" *lapathifolius*

Restricted to the Northern Rockies

Alopecurus occidentalis
Poa leptocoma
Carex saxatilis
Eriophorum Scheucheri
" *Chamissonis*
‡ " *alpinus*
Tofieldia intermedia
Juncus Regelii
" *nevadensis*
Ranunculus alismellus
" *Suksdorfii*
" *Helleri*
Caltha leptosepala
Aconitum ramosum
‡ " *delphinifolium*
Cardamine umbellata
Cardamine acuminata
Parnassia palustris
" *Kotzebue*
Comarum palustre
Argentina subarctica
‡*Epilobium oregonense*
" *wyomingense*
" *latiusculum*
Pedicularis contorta
" *ctenophora*
" *lunata*
" *Hallii*
" *Canbyi*
" *bracteosa*
" *cystopteridifolia*
Petasites corymbosa

2. WILLOW BOGS

The characteristic vegetation of these consists of shrubby species of *Salix* and *Betula glandulosa*. The herbaceous flora contains most of the plants of the sedge bogs. The shrubs present are the following:

Southern Rockies

Salix Wolfii
" *brachycarpa*
Salix pseudolapponum
" *glaucops*

Salix chlorophylla	*Kalmia microphylla*
Betula glandulosa	*Distegia involucrata*
Phyllodoce empetriformis	

Northern Rockies

Salix Barkleyi	*Ledum glandulosum*
" *commutata*	†*Azaliastrum albiflorum*
" *Tweedyi*	*Phyllodoce glanduliflora*
" *pseudomyrsinites*	" *empetriformis*
" *chlorophylla*	*Andromeda polifolia*
Alnus sinuata	*Vaccinium uliginosum*

In the Canadian Rockies quite a number of subarctic willows and other shrubs are added to this flora. These species, which are listed below, grow either in the willow bogs proper or on wet mountain slopes.

Salix Hookeriana	*Salix arbusculoides*
" *myrtillifolia*	" *Seemannii*
" *alaxensis*	" *desertorum*
" *Barrettiana*	*Ledum groenlandicum*
" *Drummondiana*	*Vaccinium Vitis-Idaea*

3. SPHAGNUM BOGS

Sphagnum bogs are exceedingly rare in the Southern Rockies and of very limited extent. The phanerogamic flora, if any, is not different from that of the other bogs. In the northern part of the Northern Rockies, especially in Canada, they are more common. Here, as well as in the northern parts of Montana and Idaho, there are found several phanerogams characteristic of the Hudsonian Zone of the northeast. Among these may be mentioned:

Eriophorum angustifolium	*Rubus acaulis*
" *Chamissonis*	" *arcticus*
" *alpinum*	" *Chamaemorus*
Drosera rotundifolia	*Oxycoccus palustris*
" *longifolia*	*Pinguicula vulgaris*
Thalictrum alpinum	

4. Brook banks

Many of the brook banks are lined with willows and *Betula glandulosa* or with sedges. In such cases the flora is practically the same as that of the willow bogs or sedge bogs. In the subalpine regions of the Rockies, we find also another brook bank flora, consisting of herbaceous plants which are neither sedges nor grasses, and which are rarely found in the bogs proper. Brook banks of this type are found mostly where the slope is steep and the valley narrow, so that neither swamps nor grasslands could exist. The characteristic plants of these brook banks are mostly species of *Mertensia. Epilobium* and *Juncoides,* and where it is drier we find *Cirsium.*

Common to Southern and Northern Rockies

Poa reflexa
Panicularia nervata
Calamagrostis canadensis
Juncus balticus montanus
Juncoides parviflorum
" *spicatum*
Delphinium occidentale
Alsine longifolia
" *borealis*
Epilobium ovatum
Epilobium stramineum
" *wyomingense*
Mimulus Langsdorfii
Mertensia pratensis
" *ciliata*
" *viridula*
Veronica americana
Arnica rhizomata
Senecio triangularis

Restricted to the Southern Rockies

Juncoides subcapitatum
Delphinium Barbeyi
" *attenuatum*
Oxypolis Fendleri
Castilleja brunnescens
Cirsium Parryi
" *scopulorum*
" *oreophilum*

Restricted to the Northern Rockies

Poa leptocoma
Juncoides glabratum
‡*Anemone Richardsonii*
Mertensia paniculata
" *stenoloba*
Senecio saliens
Chamaenerion latifolium

In the more open places where the taller herbs have not crowded out the smaller ones, the flora consists of the following species:

Common to Southern and Northern Rockies

Poa alpina
Carex bella
" *calciolepis*
" *atrata*
Scirpus pauciflorus
Juncus triglumis
Juncoides spicatum
Alsine baicalensis
" *laeta*
Alsinopsis propinqua
Sagina saginodes
Ranunculus alpeophilus
Ranunculus Eschscholtzii
Saxifraga cernua
" *debilis*
Chrysosplenium tetrandum
Micranthes arnoglossa
Muscaria delicatula
Androsace subumbellata
" *filiformis*
Condrophylla americana
Pleurogyne fontana
Veronica Wormskjoldii

Restricted to the Southern Rockies

Alsine polygonoides
Condrophylla Fremontii

Restricted to the Northern Rockies

‡*Juncoides arcticum*
‡ " *hyperboreum*
‡ " *arcuatum*
Neiocrene parvifolia
Micranthes Lyallii
" *Brunnonianum*
Hemiera ranunculifolia
Epilobium saximontanum
" *anagallidifolium*
" *clavatum*
Romanzoffia sitchensis
" *Leibergii*

5. Lakes, ponds and brooks

The purely aquatic flora is not well represented in the Subalpine Zone. It contains practically the same species as are in the Alpine Zone with few additions from the Montane Zone.* The following species belong to this formation:

Common to the Southern and Northern Rockies

Sparganum minimum
" *angustifolium*
Potamogeton alpinus
Catabrosa aquatica
Carex aquatilis
Veronica americana
Utricularia vulgaris
" *minor*
Nymphaea polysepala
Hippuris vulgaris
Lemna gibba
" *minor*

* Compare discussion in Bull. Torrey Club **41**: 473, 474; **43**: 630.

Restricted to the Northern Rockies

Batrachium confervoides	*Lobelia Dortmanna*
Veronica scutellata	

D. MISCELLANEOUS FORMATIONS

1. Rock-slides

The rock-slides in the Subalpine Zone* resemble those in the Alpine Zone, and the flora is practically the same with a few additions, as shown by the following lists:

Common to the Southern and Northern Rockies

Selaginella densa	*Claytonia megarrhiza*
Oxyria digyna	*Macronema discoideum*

Restricted to the Southern Rockies

Allium Pikeanum	*Polemonium delicatum*
Aquilegia saximontana	*Pentstemon Hallii*
Telesonix Jamesii	" *Harbourii*
Heuchera Hallii	" *stenosepalus*
Ribes montigenum	*Syntheris plantaginea*
Viola biflora	*Machaeranthera Pattersoni*
Pseudopteryxia anisata	*Senecio Holmei*
Primula Parryi	" *Soldanella*
Polemonium Grayanum	" *Harbourii*
" *speciosum*	" *cathamoides*
" *confertum*	*Senecio invenustus*
" *Brandegei*	

Restricted to the Northern Rockies

Alsine americana	*Collomia debilis*
Telesonix heucheriforme	*Polemonium viscosum*
Ribes parvulum	*Hulsea carnosa*
Pseudopteryxia Hendersonii	*Senecio Fremontii*

2. Bare cliffs

The flora of the crevices of the bare cliffs is practically the same as that of similar habitats in the alpine region. The species there have already been listed but are again enumerated below.†

* See Bull. Torrey Club 41: 465. 1914.

† See Bull. Torrey Club 41: 466. 1914.

Common to the Southern and Northern Rockies

Chondrosea Aizoon
Leptasea austromontana
Antiphylla oppositifolia
Oxyria digyna

Restricted to the Southern Rockies

Anticlea coloradensis
Aquilegia saximontana
Polemonium pulcherrimum
Polemonium delicatum
Edwinia macrocalyx (Utah)
Senecio petrocallis

3. Talus

In many places, under the perpendicular cliffs, there have gathered rather steep slopes of talus. Where this consists of larger rocks, the flora is the same as that of the rock-slides, but where it consists of small fragments and especially where there is a certain moisture, this talus has been taken possession of by certain plants, which can be regarded as forming a distinct formation. The most common of these plants are:

Common to the Southern and Northern Rockies

Carex Geyeri
Juncus Drummondii
" *Parryi*
Alsine laeta
Anemone tetonensis
Epilobium alpinum
" *Hornemannii*

Restricted to the Southern Rockies

Anticlea coloradensis

Restricted to the Northern Rockies

Viola flavovirens

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THE FLORA OF THE AMERICAN VIRGIN ISLANDS

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THE FLORA OF THE AMERICAN VIRGIN ISLANDS

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New York Botanical Garden

The islands St. Thomas, St. Jan and St. Croix recently purchased by the United States from the kingdom of Denmark, are situated to the east and southeast of the island of Porto Rico. My interest in their flora was first aroused by the proximity of the Virgin Islands archipelago to Porto Rico, both the Porto Rican islands Culebra and Vieques being parts of the archipelago. I therefore took occasion in 1913, accompanied by Dr. J. N. Rose and with the help of Mrs. Britton, Miss Delia W. Marble, and Dr. J. A. Shafer, to explore St. Thomas and St. Jan quite thoroughly, and Dr. Rose made collections on St. Croix, while we were engaged in studying the cacti of the West Indies.[1] In 1901, I had made a brief visit to St. Croix, with Mr. John F. Cowell.[2]

The islands are all hilly, there being very little level land on either St. Thomas or St. Jan, but more on St. Croix. The rocks are mostly of plutonic origin, but there is some limestone on St. Croix and locally other stratified rocks occur. The highest elevation is about 500 meters (1,550 feet), on The Crown of St. Thomas.

There is but little natural forest remaining on any of the islands, and what there is is confined to the hilltops in a few places. Reforestation is the crying need of the new possession, and it will be highly discreditable to the United States if this subject is not immediately taken in hand. Most of the higher parts of all three islands are not available for any but forest products and the supply of wood for fuel needs to be increased and the rainfall conserved by a forest cover, for most of the rain now runs off immediately. This destruction of the forest has doubtless eliminated a good many species from the original flora of the islands.

The principal literature of the botany of the islands is as follows:[3]

H. West. "Bidrag til Beskrivelse over Ste Croix, med en kort udsigt over St. Thomas, St. Jean, Tortola, Spanishtown og Crabeneiland." Kiöbenhavn. Pp. 363. 1793. [German edition pp. 274, Copenhagen 1794.]

West enumerates and partly describes 542 species, of which 111 were culti-

[1] Jour. N. Y. Bot. Gard. **14**: 99–109.
[2] Jour. N. Y. Bot. Gard. **2**: 166.
[3] See also citations in the chapters on Hepaticae, Fungi and Algae.

vated, mainly of St. Croix, a few from St. Thomas and St. Jan. Some of the descriptions are by Vahl. A number of the plants listed have not been observed on St. Croix by subsequent collectors and some of them are obscure. The author was rector of a school at Christiansted. The book is very rare. I am indebted to The New York Public Library for a photostat copy.

André Pierre Ledru. "Voyage aux îles de Ténériffe, La Trinité, Saint-Thomas, Sainte Croix et Porto Ricco, exécuté par ordre du gouvernement français, depuis le 30 septembre 1796 jusqu' au 7 juin 1798, sous la direction du capitaine Baudin, pour faire des recherches et des collections relatives a l'histoire naturelle; contenant des observations sur le climat, le sol, la population, l'agriculture, les productions de ces îles, le caractère, les moeurs et le commerce de leurs habitants." Ouvrage accompagné de notes et d'additions par M. Sonnini. Avec une très belle carte gravée par J. B. Tardieu d'après Lopez. Paris. 2 vol. 1810.

Ledru was the botanist and Anselme Riedlé the gardener of an expedition sent out by the Paris Museum of Natural History 1796–1798. Unfortunately, many of the specimens attributed to St. Thomas were in all probability collected on Porto Rico. Many living plants were brought back to the Jardin des Plantes. The botanical parts of the report are general and not extensive.

D. F. L. de Schlechtendal. "Florula insulae Sti. Thomae Indiae occidentalis." Linnaea, **3**: 251–276; **4**: 78–93; **5**: 177–200, 682–688; **6**: 722–772. 1828–1831.

About 400 species are enumerated. The plants were collected by C. A. Ehrenberg, a merchant, in the years 1827 and 1828. The records are annotated and there are some descriptions.

Henry Krebs. "Catalogue of plants found on the island of St. Thomas, W. I." 1852. [In John P. Knox: A historical account of St. Thomas, W. I., with its rise and progress in commerce, missions and churches, climate and its adaptation to invalids, geological structure, natural history and botany. New York.]

Over 1,200 plants are enumerated alphabetically, including many in cultivation and some algae. Many of the records can not now be substantiated. Krebs had previously published an account of the geographic distribution of the Flora of St. Thomas.

J. P. Knox. "Catalogue des plantes qui naissent spontanément dans l'isle de Saint-Thomas." 1857. [Memorie della r. Acad. di Torino, II, **16**: lxxvi–lxxxix.]

This is essentially the same document as the preceding.

H. F. A. Eggers. "St. Croix's Flora." Vidensk. Meddel. Kjøbenhavn. Pp. 33–158. 1876.

Baron Eggers was a Danish official on St. Croix from 1869 to 1874, and made extensive botanical collections. He records 738 species, with annotations.

H. F. A. Eggers. "Flora of St. Croix and the Virgin Islands, West Indies." Bull. U. S. Nat. Mus. 13. Pp. 133. 1879.

Baron Eggers was in command of Danish troops on St. Thomas during most of the period between 1874 and 1887, and visited St. Jan. In this catalogue he enumerates 881 indigenous or naturalized species, with annotations, and also records many of the plants in cultivation.

H. F. A. Eggers. "Supplement til St. Croix's og Jomfruøernes Flora." Vidensk. Meddel. Kjøbenhavn, pp. 11–21. 1889.

This work contains additional records to those previously published by the author.

Otto Kuntze. "Um die Erde." Pp. 514. Leipzig. 1881.
Dr. Kuntze visited St. Thomas in 1874, at the beginning of his extensive travels.

Otto Kuntze. "Revisio Generum Plantarum" **1**: **2**: pp. 1009. Leipzig. 1891.
The author records specimens collected by him on St. Thomas in 1874.

F. Borgesen and Ove Paulsen. "Om Vegetationen paa de Dansk-Vestindiske Øer." Botan. Tidsskr. Kjøbenhavn, **22**: 1–114, *f.1–43*. 1898. [Reprint pp. 114.]
Mr. Borgesen visited the islands in 1892, and again in 1895–6, on his second trip accompanied by Mr. Paulsen. They made extensive collections, and listed six Spermatophytes as additions to the known flora. The document is mostly ecologic, and especially detailed as to the composition of the coastal vegetation. It was translated into French by Mlle. S. Eriksson and published in 1900 (Rev. Gen. de Bot. **12**: 99–107; 138–153; 224–245; 289–297; 344–354; 434–446; 489–510). [Reprint pp. 108.]

C. F. Millspaugh. "Plantae Utowanae." Field Col. Mus. Bot. **2**: 1–110; 113–135. *pl. 25*. 1900.
During the cruise of the yacht *Utowana*, December, 1898, to March, 1899, Dr. Millspaugh, botanist of the expedition, visited St. Thomas on January 17 and 18, 1899, and collected about 200 species, which are enumerated.

C. F. Millspaugh. "Flora of the Island of St. Croix." Field Col. Mus. Bot. **1**: 441–546. Map. 1902.
Annotated list of 1,029 species, based especially upon the large collections made in 1895, 1896 and 1897 by A. E. Ricksecker and Mrs. J. J. Ricksecker, with records taken from Baron Eggers Flora. Mr. Ricksecker published a list of the species collected by him, pp. 4, not dated [1896]. Dr. Millspaugh has a chapter upon the botanical history of St. Croix.

F. Borgesen. "Notes on the Shore Vegetation of the Danish West Indian Islands." Bot. Tidsskr. **29**: 201–259. *f.1–140*; *pl. 3–6*. 1909.
Mr. Borgesen made a third trip to the islands during the winter of 1905–1906, especially for algological studies. The paper is ecological, and supplementary to his earlier publications.

E. G. Britton. "Mosses of the Danish West Indies and Virgin Islands." Bull. Torr. Club **42**: 1–8. 1915.
Mrs. Britton lists, with annotations, 28 species of Mosses, including 3 described as new; four of the plants enumerated were found only on Tortola.

H. G. Brock, P. S. Smith, W. A. Tucker. "The Danish West Indies, their Resources and Commercial Importance." 1917.
The United States Department of Commerce has recently published as Special Agents Series 129 (pp. 68, *figs. 1–8*), a valuable document in which the vegetable products of commercial value are discussed.

There are a very large number of records of plants from the islands in taxonomic monographs and lists of species by many authors.

As a literary curiosity record may be made of a manuscript list of the plants of St. Thomas, undated, arranged upon the Linnaean system of classification, preserved in the library of the New York Botanical Garden, presented some years ago by the late Dr. T. F. Allen.

General comments upon the vegetation are to be found in several books of travel.

The earlier collections of botanical specimens are practically all to be found only in the herbaria of the Old World. Perhaps the oldest are those of Von Rohr and of Ryan, made about 1780, and preserved for the most part in the herbarium of the Botanical Museum at Copenhagen, where the most complete and extensive collections from these islands are to be found.

Prior to 1800 collections were made by L. C. M. Richard, Isert, West, Pflug, Ledru and Riedlé. During the nineteenth century the principal collectors were Benzon, Bertero, Ravn, Hornbeck, Ehrenberg, Breutel, Krebs, Oersted, Holton, Eggers, Krause, Warming, Borgesen, Paulsen, A. E. Ricksecker, Mrs. J. J. Ricksecker, Otto Kuntze and Millspaugh. Since 1900 collections have been made by N. L. Britton, Mrs. Britton, J. F. Cowell, Miss Marble, J. A. Shafer and J. N. Rose.

A collection made by Kirkman Finley in Trinidad was erroneously labeled as from St. Thomas, and many errors have been made in citing these specimens. A few plants collected by Kuntze in Porto Rico have been erroneously recorded as from St. Thomas, and many collected by Riedlé on Porto Rico have been similarly erroneously recorded. Conversely, some plants collected by Purdie on St. Thomas have been cited as Jamaican.

For the purposes of the following list of plants I have examined the literature and have studied the following series of specimens:

1. Duplicates of plants collected by Benzon, Hornbeck, Eggers and Paulsen, received by the New York Botanical Garden in exchange with the Copenhagen Botanical Museum.

2. The collection made by I. F. Holton on St. Thomas, preserved in the herbarium of Columbia University.

3. Dr. Otto Kuntze's St. Thomas plants, which came to the New York Botanical Garden as a part of his herbarium, presented by Mr. Andrew Carnegie.

4. The St. Croix collections made by Mr. Ricksecker and a portion of that made by Mrs. Ricksecker in the herbarium of the New York Botanical Garden and parts of the complete sets preserved in the herbarium of The Field Museum of Natural History.

5. Part of the St. Thomas collection made by Dr. Millspaugh.

6. The St. Croix collection made by Mr. Cowell and myself in 1900.

7. The collections made by Dr. Rose, assisted by Mr. Fitch and Mr. Russell on St. Croix in 1913.

8. The collection made on St. Thomas by Mrs. Britton and Miss Marble in 1913.

9. The collection made by Dr. Shafer and myself on St. Thomas, St. Jan and small adjacent islands in 1913.

Mrs. Britton has contributed the catalogue of the mosses, Dr. Evans that of the hepatics, and Professor Riddle that of the lichens.

Our knowledge of the fungi of the islands is but fragmentary and it is therefore deemed wise not to attempt an enumeration of them at this time; a mycological survey would doubtless reveal the presence of several hundred species. Dr. Howe has contributed a note on the algological collections and researches of Mr. Borgesen.

St. Thomas and St. Jan are two of the Virgin Islands, discovered by Columbus in 1493, and were so called to commemorate the young women who are fabled as having accompanied St. Ursula.

The Virgin Island group is usually regarded as composed of the following islands, proceeding from the west eastward, (1) Culebra, or Snake Island (Porto Rican); (2) St. Thomas, or San Thomé, and (3) St. John or San Jan; (4) Tortola, (5) Virgin Gorda, and (6) Anagada (British). Throughout this archipelago there are many islets and keys, and the marine views from the hills are among the most charming in America. If to the above mentioned larger islands we add (7) Jost Van Dyck, the next largest, a British island near Tortola, we have seven major Virgin Islands, eight if we include Vieques.

Tortola (British) is separated from St. Jan by little over a mile of water. The purchase from the Danish government thus brings our frontier close to that of the British Empire at another point.

Vieques, or Crab Island (Porto Rican), lies south of the axis of the archipelago, and is perhaps not properly a member of the Virgin Island group, although it is sometimes so considered.

These islands were originally inhabited by Arawak and Carib Indians. St. Thomas was colonized by the Dutch in 1657, passed to the British about 1667, and to the Danes in 1671, who have since held it, except for short occupations by the British. St. Jan was colonized by the Danes in 1684, and their occupancy has since been continuous. St. Croix, or Santa Cruz, was also discovered by Columbus in 1493 or early in 1494, colonized by both Dutch and English in 1625, passed soon to the Spanish, and next to the French in 1651. The Danish ownership dates from 1733. It is isolated in the sea, and not properly of the Virgin Island group; in clear weather, it can be seen from the hills of Porto Rico and from those of St. Thomas and St. Jan.

All three islands are oblong in shape, with the longer axes nearly east and west, the coast lines irregular. The hills of St. Thomas rise to about 1,500 feet; those of St. Jan are somewhat lower (about 1,260 feet), while the highest point on St. Croix (Mt. Eagle) is 1,164 feet. St. Croix is about 21 miles long, 6 miles wide, and has an area of about 84 square miles, being thus about one seventh larger than Staten Island, New York (72½ square miles). St. Thomas is 13 miles long, 4 miles wide, with an area, including its islets, of some 32 square miles; St. Jan is 9 miles long, about 5 miles wide, with an area, including its islets, of about 21 square miles. The total area of the three islands, including their contiguous islets, is thus about 138 square miles, or not quite twice that of Staten Island. The areas here used for St. Thomas and St. Jan are approximate, because the total area of the contiguous islets is not definitely recorded.

The harbor of Charlotte Amalia, coveted by commercial and naval interests, is the most striking coastal feature of the islands, indenting the southern coast of St. Thomas. It is something less than a mile in diameter, a little longer than wide, and is nearly enclosed by the hills, its mouth being approximately 900 feet wide. It is as safe an anchorage as any tropical harbor can be, and affords anchorage for as many vessels as would be at all likely to need it at any one time, in water which is up to 37 feet deep. It is not as spacious as Guantanamo Bay on the southeast coast of Cuba, but as a naval base, with the hills fortified, would immediately command the Virgin Passage.

Magen's Bay on the north side of St. Thomas, where a long peninsula juts out into the sea, and Coral Bay at the east and Cruz Bay at the west end of St. Jan, are also valuable harbors, and there are several other small harbors or coves. The so-called harbors at Christiansted and Frederiksted, St. Croix, are open roadsteads.

These islands, like Culebra, Tortola, and Virgin Gorda, are partly plutonic in origin, being partly composed of rocks which have solidified from a molten state. There is no present evidence of volcanic activity, as there is in the Leeward and the Windward Islands farther south, and there are no volcanic peaks. Conglomerate and other stratified rocks, supposed to be Cretaceous, also occur. They are evidently ancient, and show evidences of an enormous amount of erosion since their upheaval; they have not been geologically surveyed.

The soil, except that of some sand beaches and mangrove swamps and salt marshes, has directly resulted from the decay and erosion of the rocks; it is of good agricultural quality and locally deep, but on the steep slopes and hillsides it is meager, having been much washed away since the cutting away of the forests. There are not many sand beaches on St. Thomas or St. Jan, but there is a considerable area of beach on St. Croix. In sheltered coves and reaches with shallow water, the mangrove is forming land, as everywhere in similar situations on tropical coasts.

Along large portions of the coast lines, the rocks come directly to the sea, forming fine cliffs and headlands, often rising from deep water, and much of the coastal scenery is highly picturesque.

I have included records of the plants commonly cultivated either for their products or for ornament and interest, but have made no attempt to include the rarer or unusual garden plants. If the records by Krebs and Knox are correct, there was a greater variety of plants in gardens at the middle of the last century than at present.

In citing synonyms for the names of plants, I have given the original in cases where the species was first named in a genus other than the one in which it is now included, and I also have indicated the names used by previous authors dealing with plants of the islands, in so far as I have been able to refer them, but no attempt has been made to give complete synonymy.

I gratefully acknowledge aid from Mr. A. S. Hitchcock in the determination of some grasses and from Miss Margaret Slosson and Mr. W. R. Maxon for information regarding some ferns.

SPERMATOPHYTA

TYPHACEAE

TYPHA ANGUSTIFOLIA L. [*T. domingensis* Pers.; *T. angustifolia domingensis* Griseb.] Along rivulets and lagoons, St. Thomas; St. Jan; St. Croix.

PANDANACEAE

PANDANUS UTILIS Bory. [*P. odoratissimus* of Eggers.] Planted for ornament.

ZANNICHELLIACEAE

RUPPIA MARITIMA L. [*R. rostellata* of Eggers.] Shallow, brackish water, St. Thomas; Buck Island; St. Jan; St. Croix.

CYMODOCEACEAE

CYMODOCEA MANATORUM Aschers. Shallow, salt water, St. Croix; St. Thomas; St. Jan.

HALODULE WRIGHTII Aschers. Shallow, salt water, St. Thomas; St. Croix.

ALISMACEAE

ECHINODORUS CORDIFOLIUS (L.) Griseb. [*Alisma cordifolia* L.; *A. rostratum* Nutt.; *Echinodorus rostratus* Engelm.] Wet grounds, St. Thomas; St. Croix.

ELODEACEAE

HALOPHILA BAILLONIS Aschers. In salt water, St. Thomas.

HALOPHILA ASCHERSONII Ostenfeld. In salt water, St. Croix.

HYDROCHARITACEAE

THALASSIA TESTUDINUM Konig. In salt water, St. Thomas; St. Jan; St. Croix.

POACEAE

SACCHARUM OFFICINARUM L. Subspontaneous after cultivation, St. Croix, where it is extensively cultivated for sugar; grown in small patches on St. Thomas and St. Jan.

ANDROPOGON GLOMERATUS (Walt.) B. S. P. Doubtfully recorded from St. Thomas by Hackel.

ANDROPOGON BICORNIS L. [*Anatherum bicorne* Beauv.] On the high hills of St. Thomas and St. Jan.

ANDROPOGON LEUCOSTACHYUS H.B.K. St. Thomas.

ANDROPOGON JUNCIFOLIUS Desv. St. Croix.

ANDROPOGON CERIFERUS Hack. St. Thomas.

ANDROPOGON PANORMITANUS Parl. [*A. saccharoides* of Eggers; *A. Wrightii* of Millspaugh.] St. Croix.

ANDROPOGON SCHOENANTHUS L. Cultivated for perfume.

HETEROPOGON CONTORTUS (L.) Beauv. Krumbay, St. Thomas (according to Eggers).

HOLCUS SORGHUM L. [*H. saccharatus* L.; *Sorghum vulgare* Pers.; *Andropogon Sorghum* Brot.] Subspontaneous after cultivation, St. Croix; St. Thomas.

ANTHEPHORA HERMAPHRODITA (L.) Kuntze. [*Tripsacum hermaphroditum* L.; *Anthephora elegans* Schreb.; *A. villosa* Spreng.] Waste and cultivated grounds, St. Thomas; St. Croix.

NAZIA ALIENA (Spreng.) Scribn. [*Lappago aliena* Spreng.; *Nazia racemosa aliena* Scribn. & Smith; confused by authors with *Nazia racemosa* (L.) Kuntze = *Tragus racemosus* (L.) Haller.] Sandy fields, thickets and waste grounds, St. Thomas; St. Jan (according to Eggers); St. Croix.

VALOTA INSULARIS (L.) Chase.. [*Andropogon insularis* L.; *Panicum leucophaeum* H.B.K.; *P. insulare* Meyer; *Tricholaena insularis* Griseb.; *Syntherisma insularis* Millsp.] Dry soil, St. Thomas; St. Jan; St. Croix.

VALOTA EGGERSII (Hack.) Hitchc. & Chase. [*Panicum Eggersii* Hack.] St. Thomas. Endemic.

SYNTHERISMA DIGITATA (Sw.) Hitchc. [*Milium digitatum* Sw.; *Digitaria setigera* Roth; *D. horizontalis* Willd.; *Syntherisma setigera* Nash; *P. sanguinale vulgare* of Kuntze in part.] Fields, hills and cultivated grounds, St. Thomas; St. Croix.

SYNTHERISMA SANGUINALIS (L.) Dulac. [*Panicum sanguinale* L.; *Digitaria marginata* Link.] Fields, hills and cultivated grounds, St. Thomas; St. Jan; St. Croix.

SYNTHERISMA ISCHAEMUM (Schreb.) Nash. [*Panicum Ischaemum* Schreb.] St. Croix (according to Hitchcock & Chase).

The grass recorded by Eggers as *Digitaria filiformis* from Cowell Hill, St. Thomas, has not been further identified.

ERIOCHLOA PUNCTATA (L.) Desv. [*Milium punctatum* L.; *Helopus punctatus* Nees.] Moist grounds, St. Croix; St. Thomas.

ANASTROPHUS COMPRESSUS (Sw.) Schlecht. [*Milium compressum* Sw.; *Paspalum platycaulon* Poir; *P. compressum* Rasp.] Wet grounds, St. Thomas; St. Jan; St. Croix.

PASPALUM GLABRUM Poir. [*P. Helleri* Nash; *Panicum plantagineum* of Millspaugh; ? *P. Richardi* Steud.] Wet grounds, St. Thomas; St. Jan; St. Croix.

PASPALUM PLICATULUM Michx. [*P. undulatum* Poir.; *P. caespitosum* of Eggers, at least in part.] Hillside, Buck Island, St. Thomas; St. Croix (according to Eggers).

PASPALUM PANICULATUM L. [*P. hemisphaericum* Poir.] St. Thomas (according to Schlechtendal).

PASPALUM FIMBRIATUM H.B.K. Waste grounds and roadsides, St. Croix.

PASPALUM ORBICULATUM Poir. [*P. pusillum* Vent.] St. Thomas (Fluegge; according to Grisebach).

PASPALUM CONJUGATUM Berg. Grassy places, St. Thomas; St. Jan; St. Croix.

PASPALUM NOTATUM Fluegge. St. Thomas is the type locality of the species, but the plant has not been found there by recent collectors.

PASPALUM VIRGATUM L. St. Jan; St. Croix (according to West).

PASPALUM SECANS Hitchc. & Chase. Sandy soil, St. Croix.

PASPALUM DISTICHUM L. Wet grounds, St. Thomas; St. Croix.

PASPALUM VAGINATUM Sw. [*P. distichum vaginatum* Sw.] Wet grounds, St. Croix.

PASPALUM SPATHACEUM Desv., recorded as from St. Thomas by Schlechtendal, is a species not understood by modern botanists.

PASPALUM MOLLE Poir., described as from St. Thomas, is a species not understood by modern botanists.

PANICUM GEMINATUM Forsk. [*P. paspaloides* of Eggers and of Millspaugh; *P. brizoides* Lam., not L.; *Paspalum appressum* Lam.] Wet grounds, St. Thomas; St. Jan; St. Croix.

PANICUM BARBINODE Trin. [*P. molle* of Eggers.] Moist grounds, St. Croix.

PANICUM REPTANS L. [*P. grossarium* L.; *P. prostratum* Lam.; *P. prostratum pilosum* Eggers; *P. caespitosum* Sw.] Hillside thickets, St. Thomas; St. Jan; St. Croix.

PANICUM FASCICULATUM Sw. [*P. fuscum* Sw.; *P. fasciculatum fuscum* Griseb.; *P. fasciculatum flavescens* of Kuntze.] Banks, hillsides and thickets, St. Thomas; St. Jan; St. Croix.

PANICUM MILIACEUM L. Waste grounds, St. Croix.

PANICUM ADSPERSUM Trin. Hillside thicket, Bethania, St. Jan.

PANICUM CAYENNENSE Lam. St. Thomas (recorded with doubt by Schlechtendal).

PANICUM DIFFUSUM Sw. Rocky hillsides, St. Thomas; recorded from all three islands by Eggers and from St. Croix by Grisebach.

PANICUM MAXIMUM Jacq. [*P. jumentorum* Pers.; *P. polygamum* Sw.] Dry soil, St. Thomas; St. Jan; St. Croix.

PANICUM LAXUM Sw. Hillsides, St. Thomas.

PANICUM TRICHOIDES Sw. Barracks, St. Thomas (recorded by Eggers as *P. brevifolium* L.).

PANICUM GLUTINOSUM Sw. St. Croix (according to West).

LASIACIS DIVARICATA (L.) Hitchc. [*Panicum divaricatum* L.; *P. divaricatum glabrum* Kuntze.] Thickets and hillsides, St. Thomas; St. Jan; St. Croix.

LASIACIS HARRISII Nash. St. Jan.

LASIACIS SORGHOIDEA (Desvaux) Hitchc. & Chase. [*Panicum sorghoideum* Desvaux; *P. latifolium* of Millspaugh.] Thickets, St. Thomas; St. Croix.

LASIACIS LIGULATA Hitchc. & Chase. [*Panicum divaricatum puberulum* Griseb.] Shaded bank, St. Peter, St. Thomas.

ECHINOCHLOA COLONUM (L.) Link. [*Panicum colonum* L.] Grassy places, waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

OPLISMENUS HIRTELLUS (L.) Beauv. [*Panicum hirtellum* L.; *P. setarium* Lam.; *O. setarius* R. & S.; *Orthopogon setarius* Spreng.] Woodlands, St. Thomas; St. Jan; St. Croix.

CHAETOCHLOA GENICULATA (Lam.) Millsp. & Chase. [*Panicum geniculatum* Lam.; *P. imberbe* Poir.; *Setaria glauca imberbis* Griseb.; *S. glauca* of Eggers; *Chaetochloa glauca* of Millspaugh.] Woodlands, waste and cultivated grounds, St. Thomas; St. Croix; St. Jan.

CHAETOCHLOA SETOSA (Sw.) Scribn. [*Panicum setosum* Sw.; *Setaria setosa* Beauv.; *Panicum caudatum* Lam.; *Setaria setosa caudata* Griseb.; *Setaria macrostachya* of Schlechtendal.] Hillsides, St. Thomas; St. Croix; St. Jan.

CHAETOCHLOA RARIFLORA (Mikan) Hitchc. & Chase. [*Setaria rariflora* Mikan.] Hillsides, St. Thomas; St. Croix.

CENCHRUS ECHINATUS L. [*C. viridis* of Millspaugh; *C. echinatus brevisetus* Scribn.; *C. echinatus tribuloides* of Kuntze.] Fields and hillsides, St. Thomas; St. Jan; St. Croix.

CENCHRUS CAROLINIANUS Walt. St. Thomas (according to Hitchcock & Chase).

CENCHRUS VIRIDIS Spreng. Dry soil, St. Thomas.

STENOTAPHRUM SECUNDATUM (Walt.) Kuntze. [*Ischaemum secun-*

datum Walt.; *S. glabrum* Trin.; *S. americanum* Schrank.] Moist grounds, St. Thomas; St. Jan; St. Croix.

OLYRA LATIFOLIA L. Woodlands, St. Thomas; Cinnamon Bay, St. Jan (according to Eggers.)

PHARUS GLABER H.B.K. Woodlands, St. Thomas; St. Jan; St. Croix.

ORYZA SATIVA L. St. Thomas (according to Pilger).

ARISTIDA ADSCENSIONIS L. [*Aristida bromoides* H.B.K.; *A. stricta* Griseb., not Michx.; *A. americana* Pilger, not L.] Thickets and hillsides, St. Thomas; St. Jan; St. Croix.

ARISTIDA COGNATA Trin. & Rupr. [*A. Swartziana* Steud.] Hillsides, St. Thomas; St. Croix.

SPOROBOLUS VIRGINICUS (L.) Kunth. [*Agrostis virginica* L.] Saline soil, St. Thomas; St. Jan; St. Croix.

SPOROBOLUS BERTEROANUS (Trin.) Hitchc. & Chase. [*Vilfa Berteroana* Trin.; *Sporobolus angustus* Buckley.] Wet grounds, St. Jan; St. Croix.

SPOROBOLUS ARGUTUS (Nees) Kunth. [*S. domingensis* of Millspaugh; ? *S. littoralis* of Eggers.] Saline soil, St. Croix.

SPOROBOLUS INDICUS (L.) R. Br. [*Agrostis indica* L.; *Vilfa tenacissima* Kunth.] Dry soil, St. Thomas; St. Jan; St. Croix.

SPOROBOLUS MURALIS (Raddi) Hitchc. & Chase. [*Agrosticula muralis* Raddi; *S. minutiflorus* of Millspaugh.] Waste grounds and roadsides, St. Croix.

CAPRIOLA DACTYLON (L.) Kuntze. [*Panicum Dactylon* L.; *Cynodon Dactylon* Pers.] Dry soil, St. Thomas; St. Jan; St. Croix.

CHLORIS RADIATA (L.) Sw. [*Agrostis radiata* L.] Dry soil, St. Thomas; St. Jan (according to Eggers); St. Croix.

CHLORIS PARAGUAIENSIS Steud. [*C. barbata* Sw.; *C. ciliata* of Eggers.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

CHLORIS SAGRAEANA A. Rich. [*C. eleusinoides* Griseb.] St. Croix.

CHLORIS CILIATA Sw. Dry soil, St. Thomas; St. Croix.

BOUTELOUA AMERICANA (L.) Scribn. [*Aristida americana* L.; *Heterostega juncifolia* Desv.; *B. litigiosa* Lag.] Hillsides and banks, St. Thomas; St. Jan; St. Croix.

GYMNOPOGON FOLIOSUS (Willd.) Nees. [*Chloris foliosa* Willd.] St. Thomas.

ELEUSINE INDICA (L.) Gaertn. [*Cynosurus indicus* L.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

DACTYLOCTENIUM AEGYPTIUM (L.) Richt. [*Cynosurus aegyptius* L.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

LEPTOCHLOA FILIFORMIS (Lam.) Beauv. [*Festuca filiformis* Lam.;

L. mucronata (Michx.) Kunth; *L. mucronata multiflora* Eggers.] St. Croix, along ditches (according to Eggers).

LEPTOCHLOA VIRGATA (L.) Beauv. [*Cynosurus virgatus* L.; ? *L. virgata gracilis* Eggers; *Chloris poaeformis* H.B.K.] Moist or wet grounds, St. Thomas; St. Jan; St. Croix.

DIPLACHNE FASCICULARIS (Lam.) Beauv. [*Festuca fascicularis* Lam.; *Leptochloa fascicularis* A. Gray.] In a ditch, St. John's Estate, St. Croix.

PAPPOPHORUM ALOPECUROIDEUM Vahl. [*P. laguroideum* Schrad.] Rocky hillsides, St. Thomas; Buck Island, St. Thomas (according to Eggers).

ERAGROSTIS PILOSA (L.) Beauv. [*Poa pilosa* L.; *E. poaoides* of Grisebach.] Dry soil, St. Thomas; St. Croix.

ERAGROSTIS TEPHROSANTHUS Schultes. Dry soil, St. Thomas; St. Croix.

ERAGROSTIS CILIARIS (L.) Link. [*Poa ciliaris* L.; *E. ciliaris laxa* Kuntze.] Dry soil, St. Thomas; St. Jan; St. Croix.

ERAGROSTIS AMABILIS (L.) Wight & Arn. [*Eragrostis plumosa* Link.] Cultivated grounds, St. Jan.

ERAGROSTIS BARRELIERI Dav. [*E. minor* of Millspaugh; *E. poaoides* of Eggers.] Dry soil, St. Thomas (according to Eggers); St. Croix.

ERAGROSTIS ELLIOTTII S. Wats. Dry soil, St. Thomas.

UNIOLA VIRGATA (Poir.) Griseb. [*Poa virgata* Poir; *U. racemiflora* Trin.] Bolongo, St. Thomas; Little St. James Island, St. Jan.

ARTHROSTYLIDIUM CAPILLIFOLIUM Griseb. Flag Hill, St. Thomas; Battery, St. Jan.

BAMBOS VULGARIS Schrad. Naturalized in wet grounds, St. Thomas; St. Croix.

COIX LACRYMA-JOBI L. Cultivated for ornament.

ZEA MAYS L. Cultivated for food.

CYPERACEAE

KYLLINGA BREVIFOLIA Rottb. [*K. monocephala* Thunb. of Schlechtendal and of Eggers.] Moist, grassy places, St. Thomas; St. Jan; St. Croix.

KYLLINGA ODORATA Vahl. [*K. triceps* of Eggers; *K. odorata minor* Boeckl.] Moist, shaded banks, St. Thomas; St. Jan.

KYLLINGA PUMILA Michx. Moist grassy places, St. Thomas, collected by Riedlé (according to Clarke).

KYLLINGA PUNGENS Link. Midland, St. Croix.

CYPERUS ODORATUS L. [*C. polystachyus* R. Br.; *Pycraeus odoratus* Urban.] Crown, St. Thomas, at about 500 m. altitude (according to

Eggers). Not found by us on St. Thomas, but collected on Tortola at about the same elevation.

CYPERUS LAEVIGATUS L. [*C. laevigatus albidus* Eggers; *C. mucronatus* Rottb.; *Juncellus laevigatus* Clarke.] Wet grounds, St. Thomas; St. Croix.

CYPERUS SURINAMENSIS Rottb. Wet or moist grounds, St. Thomas.

CYPERUS OCHRACEUS Vahl. Moist grounds, St. Croix.

CYPERUS ELEGANS L. [*C. viscosus* Sw.] Wet saline grounds, St. Thomas; St. Jan; St. Croix.

CYPERUS SPHACELATUS Rottb. Pastures and hillsides, Signal Hill and Crown, St. Thomas.

CYPERUS COMPRESSUS L. Moist ground, Haven Sight, St. Thomas (according to Eggers). Not found by us on St. Thomas, but collected on Virgin Gorda, Vieques and Culebra.

CYPERUS DISTANS L. f. [*Cyperus Eggersii* of Millspaugh.] Pastures and ditches, Signal Hill and St. Peter, St. Thomas; Mt. Eagle, St. Croix.

CYPERUS ESCULENTUS L. [*C. esculentus macrostachyus* Boeckl.] St. Thomas (according to Clarke).

CYPERUS ARTICULATUS L. Wet grounds, St. Thomas; St. Croix.

CYPERUS ROTUNDUS L. [*C. Hydra* Michx.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

CYPERUS CAYENNENSIS (Lam.) Britton. [*Kyllinga cayennensis* Lam.; *Mariscus flavus* Vahl; *Cyperus flavus* Nees; *Cyperus flavomariscus* Griseb.; *Mariscus cayennensis* Urban.] Grassy places, St. Thomas; St. Croix.

CYPERUS GRANULARIS (Desf.) Britton. [*Mariscus gracilis* Vahl; *Kyllinga filiformis capillaris* Griseb.; *C. capillaris* of Millspaugh.] Sandy soil, near the coast, St. Croix.

CYPERUS TENUIS Sw. St. Croix (according to Clarke).

CYPERUS LIGULARIS L. [*Mariscus rufus* H.B.K.; *M. ligularis* Urban.] Moist, especially saline soil, St. Thomas; St. Jan; St. Croix.

CYPERUS CONFERTUS Sw. [*Mariscus confertus* Sw.] Hillsides and thickets, St. Thomas; St. Croix (according to Grisebach).

CYPERUS PURPURASCENS Vahl. Coastal rocks, Water Island, St. Thomas; St. Croix.

CYPERUS BRUNNEUS Sw. [*C. brizaeus* Vahl; *C. Ottonis* Boeckl.; *C. discolor* Boeckl.; *Mariscus brunneus* Clarke.] Coastal sands, St. Thomas; St. Jan; St. Croix.

CYPERUS FERAX L. C. Rich. [*C. pennatus* of Eggers; *C. flexuosus* Vahl; *C. odoratus* of Eggers; *Torulinium ferax* Urban; *C. Michauxianus* of Millspaugh.] Wet grounds, St. Thomas; St. Croix.

CYPERUS VAHLII (Nees) Steud. Moist soil on hills, St. Thomas; St. Jan.

CYPERUS FILIFORMIS Sw. [*Torulinium filiforme* Clarke; *C. unifolius* Boeckl.] Moist soil, St. Thomas; St. Croix.

CYPERUS FERRUGINEUS Poir. [*Pycraeus ferrugineus* Clarke] recorded from St. Thomas by Clarke on the evidence of a specimen in the herbarium of the British Museum, is probably an error in locality.

CYPERUS STRIGOSUS L. Recorded by Schlechtendal as found in a garded on St. Thomas, is probably an error in name.

ELEOCHARIS INTERSTINCTA (Vahl) R. & S. [*Scirpus interstinctus* Vahl.] Marshes, St. Thomas; St. Croix.

ELEOCHARIS MUTATA (Vahl) R. & S. [*Scirpus mutatus* Vahl; *E. cellulosa* of Millspaugh.] Wet grounds, St. Croix; St. Jan (according to Eggers).

ELEOCHARIS FLACCIDA (Spreng.) Urban. [*Scirpus flaccidus* Spreng. *E. ochreata* Nees.] Wet grounds, St. Thomas.

ELEOCHARIS CAPITATA (L.) R. Br. [*Scirpus capitatus* L.] Wet grounds, St. Thomas; St. Jan; St. Croix.

ELEOCHARIS RETROFLEXA (Poir.) Urban. [*Scirpus retroflexus* Poir.; *Eleocharis Chaetaria* R. & S.] Moist grounds, St. Thomas.

ELEOCHARIS MINIMA Kunth. Krumbay, St. Thomas (according to Clarke).

ELEOCHARIS NODULOSA (Roth) Schultes. [*Scirpus nodulosus* Roth.] Adventure, St. Croix (according to Eggers).

SCIRPUS SUBDISTCHUS Boeckl., described as from St. Thomas, has not been identified by subsequent botanists.

SCIRPUS ARTICULATUS (Kunth) Griseb. is recorded as from St. Croix by Kunth, presumably erroneously, it being an Old World species.

FIMBRISTYLIS DIPHYLLA (Retz.) Vahl. [*Scirpus diphyllus* Retz.; ? *S. dichotomus* of Schlechtendal; *Scirpus brizoides* Muhl.; *Fimbristylis polymorpha* Boeckl.] Grassy places, St. Thomas; St. Jan; St. Croix.

FIMBRISTYLIS FERRUGINEA (L.) Vahl. [*Scirpus ferrugineus* L.] Moist, saline soil, St. Thomas; St. Jan; St. Croix.

FIMBRISTYLIS SPADICEA (L.) Vahl. [*Scirpus spadiceus* L.] Moist soil near the coast, St. Thomas; St. Croix.

ABILDGAARDIA MONOSTACHYA (L.) Vahl. [*Cyperus monostachyus* L.; *Fimbristylis monostachya* Hassk.] Moist, shaded bank, Rosenberg, St. Jan.

DICHROMENA CILIATA Vahl. [*Rynchospora pura* Griseb.] Pastures and hillsides, Signal Hill and Crown, St. Thomas; Bordeaux, St. Jan.

Dichromena radicans Schl. & Cham. Shaded banks, St. Thomas.

Rynchospora Berterii (Spreng.) Clarke. [*Hypolytrum Berterii* Spreng.; *Rynchospora pusilla* (Sw.) Griseb., not *R. pusilla* Chapm.] Pastures, Signal Hill, St. Thomas (according to Eggers).

Rynchospora podosperma C. Wright. St. Thomas; a specimen in the Arnott Herbarium (according to Clarke).

Scleria distans Poir. St. Thomas (according to Clarke).

Scleria lithosperma (L.) Sw. [*Scirpus lithospermus* L.; *Scleria filiformis* Sw.] Rocky thickets, St. Thomas; St. Croix.

Scleria pterota Presl. [*Scleria pratensis* Nees; *S. communis* of Millspaugh.] Moist woodlands, St. Thomas; St. Jan; St. Croix.

Scleria scindens Nees. Forests, Signal Hill, St. Thomas.

ARECACEAE

Coccothrinax argentea (Lodd.) Sarg. [*C. sancti-thomae* Beccari; *C. Eggersiana* Beccari; *C. Eggersiana sanctae-crucis* Beccari; *Thrinax argentea* Lodd.; ? *T. parviflora* of Eggers.] Hillsides, Water Island and Flag Hill, St. Thomas; St. Jan; St. Croix.

Acrocomia aculeata (Jacq.) Lodd. [*Cocos aculeata* Jacq.] Hillside, St. Peter, St. Thomas.

Roystonea regia (H.B.K.) O. F. Cook. [? *Areca oleracea* of West; *Oreodoxa regia* H.B.K.; ? *O. oleracea* of Kuntze.] Wooded ravine, Tutu, St. Thomas; St. Croix. Planted for ornament.

Cocos nucifera L. Spontaneous after planting, especially in coastal sands, St. Thomas; St. Jan; St. Croix.

Sabal ——. Planted, Charlotte Amalia, St. Thomas.

Borassus flabellifer L. Recorded by West as found on St. Croix. An East Indian palm.

ARACEAE

Anthurium acaule (Jacq.) Schott. [*Pothos acaulis* Jacq.; *Anthurium Huegelii* of Eggers.] On rocks and trees in shaded situations, St. Thomas; St. Jan; St. Croix (according to Eggers).

Anthurium grandifolium (Jacq.) Kunth. [*Pothos grandifolia* Jacq.; *A. macrophyllum* of Eggers.] On rocks in woodlands, St. Thomas; St. Jan.

Anthurium cordatum (Willd.) D. Don. [*Pothos cordata* Willd.; ? *P. macrophyllum* of West.] On rocks in forests, St. Jan; St. Croix.

Anthurium Selloum C. Koch. On trees and rocks in forests, St. Jan.

Philodendron Krebsii Schott. [*P. hederaceum* of Eggers.] On trees in forests, Crown, St. Thomas.

PHILODENDRON OXYCARDIUM Schott. On trees in forests, St. Thomas.

PHILODENDRON GIGANTEUM Schott. On rocks in dense forests, Signal Hill and Crown, St. Thomas (according to Eggers).

DIEFFENBACHIA SEGUINE (Jacq.) Schott. [*Arum Seguine* Jacq.] Caret Bay, St. Thomas (according to Eggers).

CALADIUM BICOLOR (Ait.) Vent. [*Arum bicolor* Ait.; ? *C. smaragdinum* of Eggers.] St. Thomas (according to Urban). Cultivated on St. Croix.

XANTHOSOMA ATROVIRENS C. Koch. Cultivated and naturalized, St. Thomas; St. Croix (according to Eggers).

XANTHOSOMA SAGITTIFOLIUM (L.) Schott. [*Arum sagittifolium* L.; *Arum maculatum* of Millspaugh.] Naturalized after cultivation, St. Thomas; St. Croix. Cultivated for its roots.

XANTHOSOMA ? HASTATUM Eggers, recorded by Eggers as spontaneous after cultivation on all three islands, has not been identified. *Arum hastatum* Vahl, cited by Eggers as a synonym, is, an unpublished name, printed in West's Flora of St. Croix.

PISTIA STRATIOTES L. [*P. occidentalis* Blume.] Naturalized in gardens, St. Thomas (according to Eggers).

LEMNACEAE

LEMNA PERPUSILLA Torr. [*L. minor* Eggers; *L. paucicostata* Hegelm.] In still fresh water, St. Croix; St. Jan (according to Eggers).

BROMELIACEAE

BROMELIA PINGUIN L. Hillsides and thickets; used for hedges, St. Thomas; St. Croix; St. Jan.

WITTMACKIA LINGULATA (L.) Mez. [*Bromelia lingulata* L.; *Chevalliera lingulata* Griseb.] On trees and rocks on hills, St. Thomas; St. Jan.

PITCAIRNIA LATIFOLIA Sol. St. Croix (according to Mez).

PITCAIRNIA ANGUSTIFOLIA (Sw.) Redouté. [*Hepetis angustifolia* Sw.] On rocks, St. Thomas; St. Jan; St. Croix.

CATOPSIS NUTANS (Sw.) Griseb. On trees in forests, high hills of St. Thomas and St. Jan.

TILLANDSIA UTRICULATA L. On trees and rocks, St. Thomas; St. Croix.

TILLANDSIA FASCICULATA L. On trees in woodlands, St. Thomas; St. Jan.

TILLANDSIA RECURVATA L. On trees, St. Thomas; St. Jan; St. Croix.

Eggers records, in his supplementary list, another, undetermined *Tillandsia* from Adrian, St. Jan.

DENDROPOGON USNEOIDES (L.) Raf. [*Tillandsia usneoides* L.] On trees and shrubs, St. Thomas; St. Jan; St. Croix.

ANANAS ANANAS (L.) Cook & Collins. [*Bromelia Ananas* L.; *Ananas sativus* Lindl.] Cultivated for its fruit.

COMMELINACEAE

COMMELINA LONGICAULIS Jacq. [*C. cayennensis* L. C. Rich.; *C. communis* of West; *C. nudiflora* Clarke, not L.] Moist shaded situations, St. Thomas; St. Jan; St. Croix.

COMMELINA ELEGANS H.B.K. [*C. virginica* of Millspaugh and of Kuntze.] Moist grounds, St. Thomas; St. Croix.

CALLISIA REPENS L. Shaded situations, St. Thomas; St. Jan; St. Croix.

CALLISIA MONANDRA (Sw.) Schult. [*Tradescantia monandra* Sw.; *Callisia umbellulata* Lam.] Among shaded rocks, Signal Hill, St. Thomas (according to Eggers).

RHOEO DISCOLOR (L'Her.) Hance. [*Tradescantia discolor* L'Her.] Waste rocky places, St. Thomas; St. Jan; St. Croix.

ZEBRINA PENDULA Schnitzl. Lawns and cultivated grounds, St. Thomas; St. Croix. Naturalized.

PONTEDERIACEAE

PIAROPUS CRASSIPES (Mart.) Raf. [*Pontederia crassipes* Mart.; *Eichhornia crassipes* Solms; *E. azurea* of Millspaugh.] In water, St. Croix.

LILIACEAE

ALOE VERA L. [*Aloe vulgaris* Lam.; *A. perfoliata* of West.] On limestone and in fields, St. Thomas; St. Jan; St. Croix. Naturalized.

Cordyline guineensis (Jacq.) Britton. [*Aletris guineensis* Jacq.; *Sanseviera guineensis* Willd.] Hillsides, St. Thomas; St. Croix. Naturalized.

YUCCA ALOIFOLIA L. [*Y. Draconis* L.] Planted for ornament.

YUCCA GLORIOSA L., is recorded by Eggers as naturalized in gardens and near dwellings on St. Thomas and St. Croix. Planted for ornament.

ALLIUM PORRUM L. Cultivated for food.

ALLIUM CEPA L. Cultivated for food.

ALLIUM FISTULOSUM L. Cultivated for food.

ALLIUM SATIVUM L. Cultivated for food.

CONVALLARIACEAE

Asparagus officinalis L. Planted for food.

SMILACEAE

Smilax ilicifolia Kunth. [*S. havenensis* of Eggers.] Hillside thickets, St. Jan (?); St. Croix.

Smilax coriacea Spreng. [*S. subarmata* O. E. Schulz; *S. populnea* of Eggers.] Hillside thickets, St. Thomas; St. Croix.

Smilax rotundifolia L., cited by O. E. Schulz as from St. Croix, is an error in record or determination.

Smilax domingensis Willd., cited by A. de Candolle from St. Thomas, is an error in locality.

AMARYLLIDACEAE

Atamasco tubispatha (L'Her.) Maza. [*Amaryllis tubispatha* L'Her.; *Zephyranthes tubispatha* Herb.] In fields and near dwellings, St. Thomas; St. Croix; St. Jan (according to Eggers).

Atamasco rosea (Lindl.) Greene. [*Zephyranthes rosea* Lindl.; ? *Amaryllis Atamasco* of West.] Cultivated for ornament.

Crinum erubescens Ait. Along rivulets, St. Croix (according to Eggers); cultivated for ornament.

Crinum giganteum Andr. Cultivated for ornament.

Crinum longifolium Herb. Cultivated for ornament, St. Croix, and seemingly an escape (according to Millspaugh).

Hymenocallis declinata (Jacq.) Roem. [*Hymenocallis expansa* Herb.; *Pancratium caribaeum* of Eggers; *P. declinatum* Jacq.; ? *P. patens* of Schlechtendal; *H. caribaea* of Millspaugh.] Rocky coasts and hillsides, St. Thomas; St. Croix; St. Jan.

Hymenocallis caribaea (L.) Herb. [*Pancratium caribaeum* L.] Planted for ornament.

Hippeastrum puniceum (Lam.) Urban. [*Amaryllis puniceus* Lam.; *A. equestris* Ait.; *Hippeastrum equestre* Herb.] Rocky shores and hillsides, St. Thomas; St. Croix; St. Jan.

Agave sisalana Perrine. Persistent after cultivation, St. Croix. Cultivated for fiber.

Agave missionum Trelease. [*Agave americana* of Eggers in part; *A. sobolifera* and *A. Morrisii* of Eggers.] Hillsides, St. Thomas; St. Jan. Known otherwise on the other Virgin Islands and on Porto Rico.

Agave Eggersiana Trelease. [*A. americana* of West and of Eggers, in part, and of Millspaugh.] St. Croix. Endemic, but not definitely known in the wild state. Planted for ornament.

Furcraea tuberosa Ait. f. [*F. cubensis* of Eggers and of Millspaugh; *F. hexapetala* of Urban, in part.] Thickets, St. Thomas; St. Croix.

HYPOXIS DECUMBENS L. Grassy banks, St. Jan.

AMARYLLIS BELLADONNA L. Planted for ornament.

POLIANTHES TUBEROSA L. Planted for ornament.

DIOSCOREACEAE

DIOSCOREA PILOSIUSCULA Bert. Forests, high hills of St. Thomas; St. Jan.

DIOSCOREA ALATA L. Persistent after cultivation, St. Thomas; St. Croix; St. Jan.

DIOSCOREA SATIVA L. [*D. altissima* of Eggers, at least in part.] Persistent after cultivation, all islands (according to Eggers). Cultivated for its roots.

RAJANIA CORDATA L. [*R. pleironeura* Griseb.; *R. hastata* of Eggers.] Forests, hills of St. Thomas.

IRIDACEAE

Galatea bulbosa (Mill.) Britton. [*Sisyrinchium bulbosum* Mill.; *S. palmifolium* Cav.; *Cipura plicata* Griseb.; *Eleutherine plicata* Herb.] Valleys, St. Croix. Grown in flower gardens.

MUSACEAE

MUSA PARADISIACA L. Cultivated for its fruit.

MUSA SAPIENTUM L. Cultivated for its fruit.

ZINGIBERACEAE

ALPINIA OCCIDENTALIS Sw. [*Amomum sylvestre* of West; *Renealmia occidentalis* Sweet; *R. sylvestris* of Eggers.] Forests and shaded situations, Golden Rock, St. Croix; Signal Hill, St. Thomas.

ZINGIBER ZINGIBER (L.) Karst. [*Amomum Zingiber* L.; *Zingiber officinale* Rosc.] Spontaneous after cultivation. St. Thomas; St. Croix.

CURCUMA LONGA L. Cultivated for tumeric.

LANGUAS SPECIOSA (Wendl.) Small. [*Zerumbet speciosum* Wendl.; *Alpinia nutans* Rosc.] Planted for ornament.

CANNACEAE

CANNA INDICA L. Moist waste places, St. Thomas; St. Croix (according to Eggers). The plant may have been mistaken for *C. coccinea* Ait.

CANNA LAMBERTI Lindl. Naturalized in gardens, all islands (according to Eggers); escaped in places, St. Croix (according to Millspaugh).

CANNA EDULIS Ker. Cultivated for its tubers.

CANNA LUTEA Mill. Cultivated and escaped in gardens at Bassin, St. Croix (according to Millspaugh).

MARANTACEAE

MARANTA ARUNDINACEA L. [*Maranta indica* Tuss. of Millspaugh.] Escaped or spontaneous after cultivation, St. Thomas; St. Croix.

ORCHIDACEAE

HABENARIA MONORRHIZA (Sw.) Rchb. f. [*Orchis monorrhiza* Sw.; *Habenaria maculosa* of Eggers.] Hillsides, St. Thomas; St. Croix (according to Cogniaux.)

HABENARIA ALATA Hook. Signal Hill, St. Thomas.

VANILLA EGGERSII Rolfe. [*V. aphylla* Eggers, not Blume.] Thickets, St. Thomas.

Beadlea elata (Sw.) Small. [*Satyrium elatum* Sw.; *Spiranthes elata* L. C. Rich.] In leaf mould and on wet shaded banks on high hills, St. Thomas; St. Jan; St. Croix.

IBIDIUM TORTILE (Sw.) House. [*Satyrium tortile* Sw.; *Spiranthes tortilis* L. C. Rich.] Grassy hillsides, St. Thomas.

STENORRHYNCHUS LANCEOLATUS (Aubl.) Griseb. In clayey soil among rocks, Signal Hill, St. Thomas (according to Eggers.)

CRANICHIS MUSCOSA Sw. Woods between Crown and Signal Hill, St. Thomas.

PRESCOTTIA OLIGANTHA (Sw.) Lindl. [*Cranichis oligantha* Sw.; *Prescottia myosurus* Rchb. f.] Grassy fields and banks, hills of St. Thomas; shaded bank, Bordeaux, St. Jan.

PRESCOTTIA STACHYODES (Sw.) Lindl. [*Cranichis stychyodes* Sw.] Wooded hills, Bordeaux, St. Jan.

PONTHIEVA GLANDULOSA (Sims) R. Br. [*Neottia glandulosa* Sims.] Wet shaded banks, St. Thomas; St. Jan.

LIPARIS ELATA Lindl. Among rocks on high hills, St. Thomas.

LIPARIS EGGERSII Rchb. f. Bonne Résolution, St. Thomas. Perhaps not distinct from the preceding species.

POLYSTACHYA MINUTA (Aubl.) Britton. [*Epidendrum minutum* Aubl.; *Polystachya luteola* Hook.; *Cranichis luteola* Sw.] On rocks, walls and trees, Signal Hill and St. Peter, St. Thomas.

EPIDENDRUM PAPILIONACEUM Vahl. [*E. bifidum* Sw.; *E. papilionaceum grandiflorum* Cogn.] On small trees and shrubs, St. Thomas; St. Jan; St. Croix.

Epidendrum ciliare L. On shaded rocks and trees, St. Thomas; St. Jan; St. Croix.

Epidendrum cochleatum L. On trees, Mt. Eagle and Jacob's Peak, St. Croix (according to Eggers).

Epidendrum patens Sw. On rocks, Signal Hill, St. Thomas (acco ding to Eggers).

Epidendrum carinatum Vahl, of St. Croix, is a species unknown to modern botanists.

Tetramicra elegans (Hamilt.) Cogn. [*Cyrtopodium elegans* Hamilt.; *Epidendrum subaequale* Eggers.] Rocky hillsides, St. Thomas; St. Jan; St. Croix.

Brassavola cucullata (L.) R. Br. [*Epidendrum cucullatum* L.] On rocks, St. Thomas.

Ionopsis utricularioides (Sw.) Lindl. [*Epidendrum utricularioides* Sw.] St. Thomas (according to Cogniaux).

Oncidium Leiboldi Rchb. f. Flag Hill, St. Thomas (according to Cogniaux).

Oncidium variegatum Sw. On shrubs and trees, rarely on rocks, St. Thomas; St. Croix.

Oncidium intermedium Bertero. [*O. Lemonianum* Lindl.] Forests and thickets, rare, Picaria Peninsula and Fortuna, St. Thomas (according to Eggers).

CASUARINACEAE

Casuarina equisetifolia L. Planted; occasionally spontaneous on St. Thomas.

PIPERACEAE

Piper Amalago L. [*P. medium* Jacq.; *P. Sieberi* C. DC.] Woodlands and forests, St. Thomas; St. Jan; St. Croix.

Piper dilatatum L. C. Rich. [*Piper Bredermyeri* of Eggers and of Millspaugh.] Shaded valleys, St. Croix.

Piper blattarum Spreng. Forests, Crown and Signal Hill, St. Thomas (according to Eggers); known otherwise only from Porto Rico.

Piper reticulatum L. St. Croix (according to West).

Piper auritum Kunth, is recorded by C. de Candolle, with doubt, as collected on St. Thomas by Friedericksthal; the record is probably erroneous.

Piper tenuiflorum Vahl, St. Croix (according to West). A species not understood by modern botanists.

Piper incurvum Sieb., is recorded from St. Croix; the record is questioned by C. de Candolle.

PIPER RETROFRACTUM Vahl. Cultivated on St. Thomas.

POTOMORPHE PELTATA (L.) Miq. [*Piper peltatum* L.; *P. umbellatum* L.] Forests, shaded banks and along rivulets, St. Thomas; St. Croix.

PEPEROMIA GLABELLA (Sw.) A. Dietr. [*Piper glabellum* Sw.] On trees and rocks in forests, St. Thomas; St. Jan.

PEPEROMIA ALATA C. DC. [*P. cubana* of de Candolle, in part.] On trees, St. Croix.

PEPEROMIA PELLUCIDA (L.) H.B.K. [*Piper pellucidum* L.] On walls and in wet shade, St. Thomas; St. Jan; St. Croix; in forests, St. Croix (according to Eggers).

PEPEROMIA SCANDENS R. & P. is recorded by C. de Candolle as found by Friederichsthal on St. Thomas (Prodr. **16**[1]: 434, 1869); but in his description of West Indian Piperaceae (Urban Symb. Ant. **3**: 229. 1902), St. Thomas is not cited. The earlier record is, presumably, erroneous.

PEPEROMIA GUADALUPENSIS C. DC. [*Piper acuminatum* of West; *P. acuminata* of Eggers, in part.] St. Croix, according to de Candolle, collected by West; on rocks in forests, all islands (according to Eggers).

PEPEROMIA HAMILTONIANA Miquel. [*P. Hamiltoniana emarginula* C. DC.; *P. acuminata* of Millspaugh.] Shaded rocks, St. Croix.

PEPEROMIA MAGNOLIAEFOLIA (Jacq.) A. Dietr. [*Piper magnoliaefolium* Jacq.; ? *Piper obtusifolium* of West; *Peperomia obtusifolia* and *P. obtusifolia clusiaefolia* of Eggers.] In woodlands, St. Thomas; St. Croix.

PEPEROMIA HUMILIS (Vahl) A. Dietr. [*Piper humile* Vahl; *Peperomia Langsdorffii* Miq.; *P. polystachya* of Millspaugh.] Shaded rocks, St. Thomas; St. Jan; St. Croix.

PEPEROMIA MYRTIFOLIA (Vahl) A. Dietr. [*Piper myrtifolium* Vahl.] St. Croix, collected only by Pflug. Endemic.

PEPEROMIA POLYSTACHYA (Ait.) Miq. [*Piper polystachyon* Ait.] St. Croix (according to Hooker); among rocks in forests, all islands (according to Eggers). Perhaps not distinct from *P. humilis*.

PEPEROMIA RUPERTIANA C. DC.(?) Wet, shaded bank, Rosenberg, St. Jan. Determined from a barren specimen, and identification therefore doubtful.

SALICACEAE

SALIX CHILENSIS Molina. [*S. Humboldtiana* Willd.] In water, near Grove Place, St. Croix.

ULMACEAE

CELTIS TRINERVIA Lam. Forests and thickets, St. Thomas; St. Jan.

MOMISIA IGUANAEA (Jacq.) Rose & Standley. [*Rhamnus iguanaea* Jacq.; *Celtis aculeata* Sw.; *Celtis aculeata serrata* Eggers.] Thickets, St. Thomas; St. Jan; St. Croix.

TREMA MICRANTHUM (L.) Blume. [*Rhamnus micranthus* L.; *Celtis micrantha* Sw.; *Sponia micrantha* Dcne.] Woodlands, St. Thomas; St. Jan; St. Croix.

MORACEAE

CHLOROPHORA TINCTORIA (L.) Gaud. [*Morus tinctoria* L.; *Maclura tinctoria* D. Don.] Woodlands, St. Thomas; St. Jan (according to Eggers); St. Croix.

ARTOCARPUS INCISA L. f. Hillsides and valleys, naturalized and planted, St. Thomas; St. Jan; St. Croix.

FICUS URBANIANA Warburg. [*Ficus crassinervia* of Eggers in part, and of Millspaugh.] Woods, St. Croix. Sometimes planted.

FICUS CRASSINERVIA Desf. [*Ficus trigonata* of Eggers.] Forests, St. Thomas; St. Croix.

FICUS LAEVIGATA Vahl. [*Ficus lentiginosa* Vahl; *Ficus populnea* Willd.; *F. thomae* Miq.; *F. sancti-crucis* Miq.; *F. pedunculata* Vahl.] Forests, woodlands and hillsides, St. Thomas; St. Jan; St. Croix.

FICUS CARICA L. Planted for its fruit.

FICUS ELASTICA Roxb. Planted for shade and ornament.

CECROPIA PELTATA L. Forests and hillsides, St. Thomas; St. Jan; St. Croix.

URTICACEAE

URERA ELATA (Sw.) Griseb. [*Urtica elata* Sw.] Spring Garden, St. Croix, collected by West; Eggers records West's specimen as preserved in the Copenhagen herbarium.

URERA BACCIFERA (L.) Gaud. [*Urtica baccifera* L.] is cited by Eggers as recorded from St. Thomas by Weddell in de Candolle's Prodromus **16**^{1}: 93, but an examination of pages 93 and 94 of that work does not verify the citation, and the plant is otherwise unknown from these islands.

URTICA ELONGATA Vahl (St. Croix, West) is a species unknown to modern botanists.

FLEURYA AESTUANS (L.) Gaud. [*Urtica aestuans* L.] On rocks, walls and in forests, St. Thomas; St. Jan; St. Croix.

PILEA MICROPHYLLA (L.) Liebm. [*Parietaria microphylla* L.; *Adicea microphylla* Kuntze; *P. microphylla trianthemoides* and *succulenta* of Eggers; *Adicea microphylla trianthemoides* and *succulenta* of Millspaugh.] Rocky situations, St. Thomas; St. Jan; St. Croix.

PILEA TENERRIMA Miquel. Shaded banks, St. Jan.

PILEA RICHARDI Urban. St. Thomas, collected by L. C. Richard, the specimen preserved in the Copenhagen herbarium (according to Urban). Endemic.

PILEA INAEQUALIS (Juss.) Wedd. [*Urtica inaequalis* Juss.; *Adicea inaequalis* Kuntze.] On rocks in forests, Signal Hill and Crown, St. Thomas.

PILEA SANCTAE-CRUCIS Liebm. [*Adicea sanctae-crucis* Kuntze; *Pilea semidentata* of Eggers; *Pilea grandis* of Eggers.] Forests, St. Thomas; St. Jan; St. Croix.

PILEA NUMMULARIAEFOLIA (Sw.) Wedd. [*Urtica nummulariaefolia* Sw.; *Adicea nummulariaefolia* Kuntze.] Shaded situations, St. Thomas; St. Croix.

PILEA GRANDIFOLIA (L.) Blume. [*Pilea grandis* Wedd.] Recorded by de Candolle (Prodr. 16^1: 143) as from Jamaica and St. Thomas, is confined to Jamaica, where there is a parish of St. Thomas.

ROUSSELIA HUMILIS (Sw.) Urban. [*Urtica humilis* Sw.; *U. lappulacea* Sw.; *Rousselia lappulacea* Gaud.] Shaded situations, St. Thomas.

OLACACEAE

SCHOEPFIA SCHREBERI Gmelin. [*Codonium arborescens* Vahl; *S. arborescens* R. & S.] Woodlands, St. Thomas; St. Croix.

LORANTHACEAE

DENDROPEMON CARIBAEUS Krug & Urban. [*Loranthus emarginatus* of Eggers; *Phthirusa caribaea* Engler.] On trees, St. Thomas; St. Jan; St. Croix.

PHORADENDRON CHRYSOCARPUM Krug & Urban. [*Phoradendron flavens* of Eggers; *P. martinicense* of Millspaugh.] On trees, St. Thomas; St. Croix.

PHORADENDRON TRINERVIUM (Lam.) Griseb. is recorded by Trelease as represented in the Ventenat Herbarium by a specimen from St. Thomas; it is otherwise unknown from the islands.

PHORADENDRON RACEMOSUM (Aubl.) Krug & Urban. [*P. penninervium* O. Kuntze] is recorded by O. Kuntze as from St. Thomas, apparently erroneously; the specimen was probably from Porto Rico.

ARISTOLOCHIACEAE

ARISTOLOCHIA ODORATISSIMA L. Hillside thickets, St. Jan.

ARISTOLOCHIA TRILOBATA L. Thickets, St. Thomas; St. Jan; St. Croix (according to West).

ARISTOLOCHIA ANGUICIDA L. Thickets, St. Croix.

ARISTOLOCHIA RINGENS Vahl. Cultivated on St. Croix (according to West).

POLYGONACEAE

COCCOLOBIS KRUGII Lindau. Rocky Hills, Little St. James Island, St. Jan.

COCCOLOBIS PYRIFOLIA Desf. [*C. Kunthiana* Meissn.; *C. pyrifolia Jacquini* of Eggers.] St. Thomas (according to Lindau).

COCCOLOBIS OBTUSIFOLIA Jacq. [*C. microstachys* Willd.; *C. microstachya ovalifolia* Meissn.; *C. punctata microstachya* of Eggers; *C. punctata parvifolia* of Millspaugh.] Thickets, St. Thomas; St. Jan; St. Croix.

COCCOLOBIS KLOTZSCHIANA Meissn. St. Thomas and St. Croix (according to Lindau). Endemic. Perhaps not distinct from the preceding species.

COCCOLOBIS DIVERSIFOLIA Jacq. [*C. barbadensis* Jacq.; *C. punctata* of Eggers; *C. coronata* of Millspaugh.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

COCCOLOBIS LAURIFOLIA Jacq. [*C. leoganensis* of Eggers.] Thickets, St. Croix.

COCCOLOBIS RUGOSA Desf. St. Thomas (according to de Candolle, a specimen being preserved in the Delessert Herbarium); not known to be on St. Thomas at the present time but may have been there before the forests were cut away; known otherwise only from Porto Rico.

COCCOLOBIS UVIFERA (L.) Jacq. [*Polygonum Uvifera* L.; *C. leoganensis* Jacq.; *Uvifera leoganensis* Kuntze.] Coastal thickets and locally on hills, St. Thomas; St. Jan; St. Croix.

COCCOLOBIS VENOSA L. [*C. excoriata* L.; *C. nivea* Jacq.] Woods and hillsides, St. Thomas; St. Croix.

ANTIGONUM CINERASCENS M. & G. [*A. cordatum* of Eggers and of Millspaugh.] Roadsides, St. Thomas; cultivated for ornament, St. Thomas and St. Croix.

FAGOPYRUM FAGOPYRUM (L.) Karst. [*Polygonum Fagopyrum* L.] Planted for food.

RUMEX VESICARIUS L. Recorded by Eggers as cultivated.

MUHLENBECKIA PLATYCLADA (F. Muell.) Lindau. Planted for interest.

CHENOPODIACEAE

CHENOPODIUM MURALE L. Walls and waste grounds, St. Thomas; St. Croix.

CHENOPODIUM AMBROSIOIDES L. [? *C. cuneifolium* Vahl.] Walls and waste grounds, St. Thomas; St. Jan; St. Croix.

ATRIPLEX PENTANDRA (Jacq.) Standley. [*Axyris pentandra* Jacq.; *Atriplex cristata* H. & B.; *Obione cristata* Moq.] Coastal sands, St. Thomas; St. Jan; St. Croix.

SALICORNIA PERENNIS Mill. [*S. ambigua* Michx.] Salt marshes, St. Croix.

BETA VULGARIS L. Cultivated for food.

AMARANTHACEAE

CELOSIA NITIDA Vahl. [? *C. paniculata* of Schlechtendal.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

CELOSIA ARGENTEA L. [*C. margaritacea* L.] Waste and cultivated grounds, St. Thomas; St. Croix.

CELOSIA CRISTATA L. Planted for ornament.

CHAMISSOA ALTISSIMA (Jacq.) H.B.K. [*Achyranthes altissima* Jacq.; *Kokera paniculata* Kuntze.] Forests and thickets, St. Thomas; St. Croix.

AMARANTHUS DUBIUS Mart. [*A. tristis* Willd., not L.; *A. paniculatus* of Eggers and of Millspaugh.] Waste grounds, St. Thomas; St. Jan; St. Croix.

AMARANTHUS SPINOSUS L. Waste and cultivated grounds, St. Thomas; St. Croix.

AMARANTHUS CRASSIPES Schl. [*Scleropus amarantoides* Schrad.] Dry soil, waste and cultivated grounds, St. Thomas; St. Croix.

AMARANTHUS CAUDATUS L. St. Croix (according to West).

AMARANTHUS POLYGONOIDES L. [*Amblyogyne polygonoides* Raf.] Sandy soil, roadsides and waste grounds, St. Thomas; St. Croix.

AMARANTHUS GRACILIS Desf. [*Chenopodium caudatum* Jacq.; ? *Amaranthus oleraceus* of West; *Euxolus caudatus* Moq.; *E. oleraceus* of Eggers.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

AMARANTHUS GANGETICUS L. [*A. incomptus* Willd.; *A. tricolor* L.] Planted for ornament.

CENTROSTACHYS INDICA (L.) Standley. [*Achyranthes aspera indica* L.; *Achyranthes aspera obtusifolia* Griseb.; *A. aspera simplex* Millsp.] Waste and cultivated grounds, St. Thomas; St. Croix.

CENTROSTACHYS ASPERA (L.) Standley. [*Achyranthes aspera* L.; *A. argentea* Lam.] is recorded from the islands by Eggers, but I have seen no specimens nor find any other record; the plant occurs, however, on Tortola.

ACHYRANTHES POLYGONOIDES (L.) Lam. [*Gomphrena polygonoides* L.; *Alternanthera polygonoides* R. Br.; *Alternanthera paronychioides* St. Hil.] Waste grounds, St. Thomas.

ACHYRANTHES REPENS L. [*Alternanthera Achyrantha* R. Br.; *A. paronychioides* of Millspaugh.] Rocky waste places, St. Thomas; St. Croix.

ACHYRANTHES FICOIDEA (L.) Standley. [*Gomphrena ficoidea* L.;

Illecebrum ficoideum L.; *Alternanthera ficoidea* R. Br.] Moist places and on shores, St. Thomas.

ACHYRANTHES PORTORICENSIS (Kuntze) Standley. [*Alternanthera portoricensis* Kuntze.] Rocky hills, Little St. James Island, St. Jan.

GOMPHRENA GLOBOSA L. Subspontaneous after cultivation, St. Thomas; St. Croix.

IRESINE ANGUSTIFOLIA Euphr. [*I. elatior* L. C. Rich.] Thickets, and banks, St. Thomas; St. Croix.

PHILOXERUS VERMICULATUS (L.) R. Br. [*Illecebrum vermiculatum* L.; *Lithophila vermiculata* Uline; *Iresine vermicularis* Miq.] Saline soil along the coasts, St. Thomas; St. Croix.

LITHOPHILA MUSCOIDES Sw. Rocks on the shore, Judith's Fancy, St. Croix.

NYCTAGINACEAE

MIRABILIS JALAPA L. [*M. dichotoma* L.] Waste grounds, St. Thomas; St. Croix.

BOERHAAVEA ERECTA L. Waste and cultivated ground, St. Croix.

BOERHAAVEA COCCINEA Mill. [*B. paniculata* L. C. Rich.; *B. diffusa* Sw.; *B. decumbens* Vahl; *B. hirsuta* Willd.; *B. diffusa paniculata* Kuntze; *B. repens* of Millspaugh.] Dry soil, St. Thomas; St. Croix; St. Jan.

COMMICARPUS SCANDENS (L.) Standley. [*Boerhaavea scandens* L.] Rocky hillsides, St. Thomas.

PISONIA ACULEATA L. Hillsides, woods and thickets, St. Thomas; St. Croix.

PISONIA SUBCORDATA Sw. [*P. nigricans* of West.] Thickets and woods, St. Thomas; St. Croix.

TORRUBIA FRAGRANS (Dum.-Cours.) Standley. [*Pisonia fragrans* Dum.-Cours.; *Pisonia inermis* of Eggers, of Kuntze and of Millspaugh; ? *P. coccinea* of West.] Forests and thickets, St. Thomas; St. Croix.

BOUGAINVILLEA SPECTABILIS Willd. Cultivated for ornament.

EGGERSIA BUXIFOLIA Hook. f. [*Neea buxifolia* Heimerl.] Dry hillsides, St. Thomas; St. Jan.

BATIDACEAE

BATIS MARITIMA L. Shores of salt water lagoons, St. Thomas; St. Croix.

PHYTOLACCACEAE

RIVINA HUMILIS L. [*R. laevis* L.; *Tithonia humilis* Kuntze.] Dry, shaded situations, St. Thomas; St. Jan; St. Croix.

TRICHOSTIGMA OCTANDRUM (L.) H. Walt. [*Rivina octandra* L.; *Villamilla octandra* Hook. f.; *Rivina scandens* Mill.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

Petiveria alliacea L. Dry, shaded situations, St. Thomas; St. Jan; St. Croix.

Microtea debilis Sw. Waste grounds, St. Thomas; St. Croix.

AIZOACEAE

Mollugo verticillata L. Dry soil, Buck Island, St. Thomas;

Mollugo nudicaulis L. Rocky soil and banks, St. Thomas. St. Croix.

Sesuvium portulacastrum L. [*Halimus portulacastrum* Kuntze.] Saline soil, St. Thomas; St. Jan; St. Croix.

Trianthema portulacastrum L. [*T. monogynum* L.] Waste and rocky places. St. Thomas; St. Croix.

Cypselea humifusa Turp. Around a small fresh-water lagoon, Water Island, St. Thomas (according to Eggers).

PORTULACACEAE

Talinum triangulare (Jacq.) Willd. [*Portulaca triangularis* Jacq.] Rocky soil, St. Thomas; St. Croix.

Talinum paniculatum (Jacq.) Gaertn. [*Portulaca paniculata* Jacq.; *P. patens* Jacq.; *Talinum patens* Willd.] Rocky soil, St. Thomas; St. Jan; St. Croix.

Portulaca oleracea L. [*P. oleracea macrantha* and (?) *micrantha* Eggers.] Sunny situations, St. Thomas; St. Jan; St. Croix.

Portulaca pilosa L. Cultivated and waste grounds, St. Thomas; St. Croix.

Portulaca halimoides L. Sunny situations, St. Thomas; St. Jan; St. Croix.

Portulaca quadrifida L. Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Portulaca brasiliensis West, of St. Croix, is not described. The plant was probably one of the preceding species.

BASELLACEAE

Boussingaultia leptostachys Moq. [*B. baselloides* of Eggers.] Naturalized in gardens and cultivated, St. Thomas; St. Croix.

Basella rubra L. Cultivated on St. Croix.

ALSINACEAE

Drymaria cordata (L.) Willd. [*Holosteum cordatum* L.; *D. cordata diandra* Eggers.] Shaded moist places, St. Thomas; St. Croix.

NYMPHAEACEAE

Castalia ampla (DC.) Salisb. [*Nymphaea ampla* DC.; *N. ampla parvifolia* Eggers.] In rivulets and ponds, St. Croix.

MENISPERMACEAE

Cissampelos Pariera L. [*C. microcarpa* DC.] Woods and thickets, St. Thomas; St. Croix; St. Jan.

Hyperbaena laurifolia (Poir.) Urban. [*Cissampelos laurifolius* Poir.; *Cocculus laurifolius* of Eggers.] Woodlands, St. Thomas.

Hyperbaena domingensis (DC.) Benth. [*Cocculus domingensis* DC.] Forest, near St. Peter, St. Thomas (according to Eggers). The species is not accredited to St. Thomas by Urban (Symb. Ant. **1**: 306). Eggers's record probably refers to *H. laurifolia*.

ANNONACEAE

Oxandra laurifolia (Sw.) A. Rich. [*Uvaria laurifolia* Sw.; *U. excelsa* Vahl.] St. Croix (according to West).

Guatteria caribaea Urban. [*G. Ouregou* Griseb., not Dunal.] St. Thomas (according to Grisebach).

Annona muricata L. Woods and thickets, St. Thomas; St. Jan; St. Croix.

Annona palustris L. [*A. glabra* L.; *A. laurifolia* Dunal.] Borders of marshes and coastal thickets, St. Thomas; St. Croix.

Annona squamosa L. [*Annona cinerea* Dunal.] Woods, hillsides and thickets, St. Thomas; St. Jan; St. Croix.

Annona reticulata L. Woods and hillsides, St. Thomas; St. Jan; St. Croix.

Annona montana Macf. Fredericksted, St. Croix.

LAURACEAE

Hufelandia pendula (Sw.) Nees. [*Laurus pendula* Sw.; *H. thomae* Nees.] St. Thomas (DC. Prodr. **15**^{1}: 65); recorded from St. Thomas as collected by Riedlé (Mez, Jahrb. Bot. Gart. Berlin **5**: 21).

Acrodiclidium salicifolium (Sw.) Griseb. Forests, St. Thomas; St. Jan; St. Croix.

Persea Persea (L.) Cockerell. [*Laurus Persea* L.; *Persea americana* Mill.; *P. gratissima* Gaertn. f.] Spontaneous after planting, St. Thomas; St. Croix.

Phoebe cubensis Nees. [*P. antillana cubensis* Meissn.; *P. elongata* of Eggers.] St. Croix (West, according to DC. Prodr. **15**^{1}: 31, and also recorded by Mez).

OCOTEA LEUCOXYLON (Sw.) Mez. [*Laurus leucoxylon* Sw.; *Oreodaphne leucoxylon* Nees.] Forest, Signal Hill, St. Thomas.

OCOTEA FLORIBUNDA (Sw.) Mez. [*Laurus floribunda* Sw.] Wooded hillside, Bordeaux, St. Jan.

NECTANDRA ANTILLANA Meissn. Forests, St. Thomas.

NECTANDRA MEMBRANACEA (Sw.) Griseb. [*Laurus membranacea* Sw.] Dense forests, Signal Hill, St. Thomas; Will's Bay, St. Croix (according to Eggers).

NECTANDRA CORIACEA (Sw.) Griseb. [*Laurus coriacea* Sw.] Forests, St. Thomas; St. Jan; St. Croix.

LAURUS INDICA West, of St. Croix, is unknown to modern botanists.

LAURUS LONGIFOLIA Vahl, collected on St. Croix by West, is not further determined.

CINNAMOMUM ZEYLANICUM Blume is recorded by Eggers as naturalized in a few places in shaded valleys on St. Croix.

CASSYTHACEAE

CASSYTHA AMERICANA Nees. Coastal thickets, St. Thomas; St. Croix.

PAPAVERACEAE

ARGEMONE MEXICANA L. Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

CAPPARIDACEAE

CLEOME SPINOSA Jacq. [*C. pungens* Willd.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

CLEOME GYNANDRA L. [*C. pentaphylla* L.; *Gynandropsis pentaphylla* DC.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

CLEOME VISCOSA L. [*Polanisea icosandra* of Millspaugh.] Waste and cultivated grounds, St. Thomas; St. Croix.

CAPPARIS CYNOPHALLOPHORA L. [*C. jamaicensis* Jacq.; *C. torulosa* of West; *C. jamaicensis marginata* and *siliquosa* Eggers; ? *C. linearis* of West.] Thickets and hillsides, St. Thomas; St. Jan; St. Croix.

CAPPARIS INDICA (L.) Fawc. & Rend. [*Breynia indica* L.; *Capparis Breynia* Jacq.; *C. amygdalina* Lam.; *C. Grisebachii* of Millspaugh.] Thickets, woods and hillsides, St. Thomas; St. Jan; St. Croix.

CAPPARIS BADUCCA L. [*Capparis frondosa* Jacq.] Forests and hillsides, St. Thomas; St. Croix; St. Jan (according to Eggers).

CAPPARIS FLEXUOSA L. [*Capparis cynophallophora* of Eggers and of Millspaugh; *C. saligna* of West; *C. cynophallophora saligna* Eggers.] Woods, thickets and hillsides, St. Thomas; St. Jan; St. Croix.

CAPPARIS COCCOLOBIFOLIA Mart. [*C. cynophallophora latifolia* Griseb.] Thickets and hillsides, St. Thomas; St. Jan; St. Croix.

CAPPARIS PORTORICENSIS Urban. Hillside thicket between Bethania and Rosenberg, St. Jan.

CAPPARIS VERRUCOSA Jacq. St. Thomas (according to Grisebach); Virgin Islands (according to Eggers).

MORISONIA AMERICANA L. Wooded hillsides, St. Thomas; St. Jan; St. Croix (according to Eggers).

BRASSICACEAE

LEPIDIUM VIRGINICUM L. [*L. apetalum* of Millspaugh.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

LEPIDIUM SATIVUM L. Cultivated for condiment.

CAKILE LANCEOLATA (Willd.) O. E. Schulz. [*C. aequalis* L'Her.] Coastal sands and rocks, St. Thomas; St. Jan; St. Croix.

SINAPIS ARVENSIS L. Naturalized near Anguilla, St. Croix (according to Eggers).

BRASSICA INTEGRIFOLIA (West) O. E. Schulz. [*Sinapis integrifolia* West; *S. brassicata* Griseb., not L.; *S. juncea* of Millspaugh.] Waste and cultivated grounds, St. Thomas; St. Croix; St. Jan.

BRASSICA OLERACEA L. Cultivated for food.

BRASSICA CAMPESTRIS L. [*B. Rapa* L.] Cultivated for food.

SISYMBRIUM NASTURTIUM L. [*Nasturtium officinale* R. Br.] In rivulets, St. Thomas; St. Croix.

RAPHANUS RAPHANISTRUM L. Recorded by West.

RAPHANUS SATIVUS L. Cultivated for food.

KONIGA MARITIMA (L.) R. Br. [*Clypeola maritima* L.] Cultivated for ornament.

MORINGACEAE

MORINGA MORINGA (L.) Millsp. [*Guilandina Moringa* L.; *Hyperanthera Moringa* Vahl; *Moringa pterygosperma* Gaertn.] Roadsides and hillsides, St. Thomas; St. Jan; St. Croix.

CRASSULACEAE

BRYOPHYLLUM PINNATUM (Lam.) Kurz. [*Cotyledon pinnata* Lam.; *B. calycinum* Salisb.] Dry soil, St. Thomas; St. Jan; St. Croix.

ROSACEAE

A number of different kinds of roses are grown for ornament.

AMYGDALACEAE

CHRYSOBALANUS ICACO L. Woods, hillsides and thickets, St. Thomas; St. Jan; St. Croix.

MIMOSACEAE

INGA LAURINA (Sw.) Willd. [*Mimosa laurina* Sw.; *M. laurifolia* of West.] Woodlands and forests, St. Thomas; St. Jan; St. Croix.

PITHECOLOBIUM UNGUIS-CATI (L.) Mart. [*Mimosa unguis-cati* L.; *Inga Unguis-cati* Willd.; *P. Unguis-cati forfex* Griseb.] Thickets, hillsides and pastures, St. Thomas; St. Jan; St. Croix.

ENTEROLOBIUM SAMAN (Jacq.) Prain. [*Mimosa Saman* Jacq.; *Calliandra Saman* Griseb.; *Pithecolobium Saman* Benth.] Roadsides and near settlements, St. Thomas; St. Croix.

ALBIZZIA LEBBECK (L.) Benth. [*Mimosa Lebbeck* L.; *M. speciosa* Jacq.; *Acacia Lebbeck* Willd.] Fields and hillsides, St. Thomas; St. Croix.

Anneslia portoricensis (Jacq.) Britton. [*Mimosa portoricensis* Jacq.; *Calliandra portoricensis* Benth.] Forests, King's Hill, St. Jan.

Anneslia haematostoma (Bert.) Britton. [*Acacia haematomma* Bert.; *Calliandra haemotomma* Benth.] Flag Hill, St. Thomas.

Anneslia purpurea (L.) Britton. [*Calliandra purpurea* Benth.; *Mimosa purpurea* L.; *Inga purpurea* Willd.] Cultivated on St. Croix (according to West).

ACACIA NUDIFLORA Willd. Hillsides and woods, St. Thomas; St. Jan.

ACACIA RIPARIA H.B.K. [*A. sarmentosa* Griseb., not Desv.; *Mimosa paniculata* of West; *A. Westiana* DC.] Hillsides and thickets, St. Thomas; St. Jan; St. Croix (according to West).

ACACIA CATECHU Willd. [*Mimosa catechu* L. f.] Naturalized in shaded valleys, St. Croix.

ACACIA MACRACANTHA H. & B. [*Mimosa lutea* Houst.; *Acacia lutea* Hitchc., not Leavenw.; *A. macracantha glabrens* Eggers.] Hillsides and thickets, St. Thomas; St. Jan; St. Croix.

ACACIA TORTUOSA (L.) Willd. [*Mimosa tortuosa* L.] Hillsides, St. Thomas; St. Croix.

ACACIA ARABICA Willd., is planted for ornament, and is recorded by Eggers as naturalized near dwellings on St. Thomas and St. Croix.

VACHELLIA FARNESIANA (L.) W. & A. [*Mimosa Farnesiana* L.; *Acacia Farnesiana* Willd.] Hillsides and thickets, St. Thomas; St. Jan; St. Croix.

LEUCAENA GLAUCA (L.) Benth. [*Mimosa glauca* L.; *Acacia frondosa* Willd.] Fields and hillsides, St. Thomas; St. Jan; St. Croix.

MIMOSA PUDICA L. Fields and hillsides, St. Thomas; St. Croix.

MIMOSA CERATONIA L. [? *M. sensitiva* of West.] Hills and thickets, St. Thomas; St. Jan; ? St. Croix (according to West).

MIMOSA PIGRA L. [*M. asperata* L.] St. Thomas (according to Grisebach), who indicates that he saw a specimen from that island, but the plant has not been found there by recent collectors.

ACUAN VIRGATUM (L.) Medic. [*Mimosa virgata* L.; *Desmanthus virgatus* Willd.; *D. strictus* Bertol.; *D. virgatus strictus* Griseb.; *A. virgatus albiflorus* Kuntze.] Fields and hillsides, St. Thomas; St. Croix.

ACUAN DEPRESSUM (H. & B.) Kuntze. [*Desmanthus depressus* H. & B.] Hillsides, St. Thomas; St. Jan.

NEPTUNIA PUBESCENS Benth. Buck Island, St. Thomas (according to Eggers).

ADENANTHERA PAVONINA L. Naturalized, St. Thomas; St. Jan and St. Croix (according to Eggers); not seen by us on any of the islands, except as a planted tree.

CAESALPINACEAE

HYMENAEA COURBARIL L. Woods and hillsides, St. Thomas; St. Jan; St. Croix.

TAMARINDUS INDICA L. In various situations, St. Thomas; St. Jan; St. Croix. Planted for its fruit and for shade.

BAUHINIA TOMENTOSA L. Spontaneous after cultivation, waste grounds, St. Thomas; St. Croix.

BAUHINIA MONANDRA Kurz. [*B. Kappleri* Sagot; *B. Krugii* Urban.] Spontaneous after planting, St. Thomas; St. Croix.

BAUHINIA UNGULA Jacq., recorded by Grisebach as found on St. Thomas, is probably an error in record or determination.

CASSIA FISTULA L. Naturalized in shaded valleys, St. Croix (according to Eggers). Planted for shade and for its fruit.

CASSIA GRANDIS L. Naturalized on St. Thomas and St. Croix.

CASSIA QUINQUANGULATA L. C. Rich. [*C. bacillaris* of Eggers, of Kuntze and of Millspaugh.] Woods and thickets, St. Thomas.

CASSIA BICAPSULARIS L. Waste grounds and hillsides, St. Thomas; St. Jan; St. Croix.

CASSIA SIAMEA Lam. [*C. florida* Vahl.] Naturalized near towns, St. Thomas (according to Eggers). Planted for shade and ornament.

CASSIA OCCIDENTALIS L. [*C. planisiliqua* L.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

CASSIA TORA L. [*C. obtusifolia* L.] Waste and cultivated grounds, St. Thomas; St. Croix.

CASSIA POLYPHYLLA Jacq. [*C. biflora angustisiliqua* of Eggers.] Hillsides, St. Thomas; St. Croix.

CASSIA OBOVATA Collad. Naturalized on St. Thomas (according to Eggers).

CASSIA HIRSUTA L. Sugar Estate, St. Thomas (according to Eggers).

CASSIA ALATA L. Waste grounds, St. Thomas; St. Jan; St. Croix.

CASSIA AUGUSTIFOLIA Vahl. Planted on St. Croix (according to West).

CASSIA TRIFLORA Vahl, collected on St. Croix by Rohr, is "a doubtful species" according to Eggers; it is not the same as *Cassia triflora* Jacquin, a prior name.

CASSIA GRANDIS L. [*C. mollis* Vahl.] Planted for shade.

CHAMAECRISTA GRAMMICA (Spreng.) Pollard. [*Cassia grammica* Spreng.] Rocky soil, Little St. James Island, St. Jan.

CHAMAECRISTA SWARTZII (Wickstr.) Britton. [*Cassia Swartzii* Wickstr.; *C. glandulosa* of West; *Cassia glandulosa stricta* and *ramosa* of Eggers; *Chamaecrista glandulosa* and *C. glandulosa ramosa* of Millspaugh; *Chamaecrista complexa* Pollard; *Cassia Chamaecrista pubicaulis* Kuntze.] Fields and hillsides, St. Thomas; St. Jan; St. Croix.

CHAMAECRISTA CHAMAECRISTA (L.) Britton. [*Cassia Chamaecrista* L.; *Cassia nictitans* of Eggers and of Millspaugh; *C. diffusa* DC.] Dry, grassy situations, St. Thomas; St. Jan; St. Croix.

PARKINSONIA ACULEATA L. Coastal thickets, St. Thomas; St. Jan; St. Croix.

HAEMATOXYLON CAMPECHIANUM L. [*Sabinea florida* of Millspaugh.] Coastal thickets and hillsides, St. Thomas; St. Jan; St. Croix.

DELONIX REGIA (Bojer) Raf. [*Poinciana regia* Bojer.] Spontaneous after planting, St. Thomas; St. Croix.

GUILANDINA CRISTA (L.) Small. [*Caesalpinia Crista* L.; *Guilandina Bonducella* L.] Coastal sands, St. Thomas; St. Jan; St. Croix.

GUILANDINA DIVERGENS (Urban) Britton. [*Caesalpina divergens* Urban; *Guilandina Bonduc* of Schlechtendal and of Eggers.] Coastal thickets, St. Thomas; St. Jan; St. Croix.

GUILANDINA MELANOSPERMA Eggers. [*Caesalpinia melanosperma* Urban.] Coastal thickets, St. Croix.

CAESALPINIA CORIARIA Willd. [*Poinciana coriaria* Jacq.; *Lebidibia coriaria* Schl.] Hillsides, St. Thomas. Planted on St. Croix.

CAESALPINIA GILLIESII Wall. [*Poinciana Gilliesii* Hook.] Planted for ornament.

CAESALPINIA PUNCTATA Willd. Planted on St. Thomas.

CAESALPINIA SAPPAN L. Recorded by Krebs as planted on St. Thomas.

CAESALPINIA ELATA Sw. Attributed by Eggers to St. Croix, presumably erroneously.

POINCIANA PULCHERRIMA L. [*Caesalpinia pulcherrima* Sw.] Spontaneous after cultivation, St. Thomas; St. Croix.

KRAMERIACEAE

KRAMERIA IXINA L. [*K. Ishami* Millsp.] Dry rocky soil, Bovoni and Water Island, St. Thomas.

FABACEAE

MYROSPERMUM FRUTESCENS Jacq. Naturalized near dwellings, St. Croix (according to Eggers).

SOPHORA TOMENTOSA L. Coastal sands, St. Thomas; St. Croix.

CROTALARIA RETUSA L. Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

CROTALARIA JUNCEA L. Field at Bassin, St. Croix; recorded by West as cultivated prior to 1793.

CROTALARIA VERRUCOSA L. Waste and cultivated grounds, St. Thomas; St. Croix; St. Jan.

CROTALARIA INCANA L. Waste and cultivated grounds, St. Thomas; St. Croix.

CROTALARIA LOTIFOLIA L. Thickets and hillsides, St. Thomas; St. Jan; St. Croix.

CROTALARIA LABURNIFOLIA L. Cultivated on St. Croix (according to West).

INDIGOFERA SUFFRUTICOSA L. [*I. Anil* L.] Thickets and hillsides, St. Thomas; St. Jan; St. Croix.

INDIGOFERA GUATEMALENSIS Moç. & Sessé. St. Thomas.

INDIGOFERA TINCTORIA L. Thickets, St. Thomas; St. Jan; St. Croix (according to Eggers, who notes its former cultivation).

MEDICAGO SATIVA L. Planted on St. Croix.

PAROSELA DOMINGENSIS (DC.) Millsp. [*Dalea domingensis* DC.; *D. phymatodes* of Eggers.] Dry soil, St. Jan, collected only by Eggers.

CRACCA CINEREA (L.) Morong. [*Galega cinerea* L.; *G. littoralis* L.; *Tephrosia cinerea* Pers.; *Cracca villosa cinerea* Kuntze; *Tephrosia cinerea littoralis* of Eggers.] Dry sandy soil, St. Thomas; St. Jan; St. Croix.

CRACCA PURPUREA L. [*Galega purpurea* L.] Cultivated on St. Croix (according to West).

SABINEA FLORIDA (Vahl) DC. [*Robinia florida* Vahl.] Hillsides and thickets, St. Thomas; St. Jan.

BENTHAMANTHA CARIBAEA (Jacq.) Kuntze. [*Galega caribaea* Jacq.; *Cracca caribaea* Benth; *Brittonamra caribaea* Kuntze.] Thickets and hillsides, St. Thomas; St. Croix.

COURSETIA ARBOREA Griseb., recorded by Grisebach from St. Jean, is erroneously quoted by Eggers as from St. Jan. There is a place called St. Jean in French Guiana.

SESBAN SERICEA (Willd.) DC. [*Coronilla sericea* Willd.] Thickets, Flag Hill, St. Thomas.

Sesban Sesban (L.) Britton. [*Aeschynomene Sesban* L.] Planted on St. Croix.

AGATI GRANDIFLORA (L.) Desv. [*Aeschynomene grandiflora* L.; *Sesbania grandiflora* Pers.] Roadsides and near dwellings, naturalized St. Thomas; St. Jan; St. Croix.

PICTETIA ACULEATA (Vahl) Urban. [*Robinia aculeata* Vahl; *R. squamata* Vahl; *Aeschynomene aristata* Jacq.; *Pictetia squamata* DC.; *P. aristata* DC.] Woods, hillsides and thickets, St. Thomas; St. Jan; St. Croix.

AESCHYNOMENE AMERICANA L. [*Ae. americana depila* Millsp.] Grassy places, St. Thomas; St. Jan; St. Croix.

STYLOSANTHES HAMATA (L.) Taubert. [*Hedysarum hamatum* L.; *Stylosanthes procumbens* Sw.] Dry soil, St. Thomas; St. Croix; St. Jan.

STYLOSANTHES VISCOSA Sw., recorded by West from St. Croix. Eggers thought perhaps a mistake for the preceding species, which is probable.

ARACHIS HYPOGAEA L. Subspontaneous after cultivation, St. Thomas; St. Croix. Hardly persistent.

ZORNIA DIPHYLLA (L.) Pers. [*Hedysarum diphyllum* L.; *Z. reticulata* Smith.] Pastures, high hills of St. Thomas; St. Croix (according to de Candolle).

CODARIOCALYX GYRANS (L. f.) Hassk. [*Hedysarum gyrans* L. f.; *Desmodium gyrans* DC.] Planted for interest.

MEIBOMIA TRIFLORA (L.) Kuntze. [*Hedysarum triflorum* L.; *Desmodium triflorum* DC.; *Meibomia triflora pilosa* Kuntze.] Fields and moist grassy places, St. Thomas; St. Jan; St. Croix.

MEIBOMIA SUPINA (Sw.) Britton. [*Hedysarum supinum* Sw.; *H. incanum* Sw.; *Desmodium supinum* DC.; *D. incanum* DC.] Fields, hillsides, woods and thickets, St. Thomas; St. Jan; St. Croix.

MEIBOMIA AXILLARIS (Sw.) Kuntze. [*Hedysarum axillare* Sw.; *Desmodium axillare* DC.] Shaded banks and ravines, St. Croix.

MEIBOMIA MOLLIS (Vahl) Kuntze. [*Hedysarum molle* Vahl; *Desmodium molle* DC.] Grassy places, St. Thomas; St. Croix.

MEIBOMIA SPIRALIS (Sw.) Kuntze. [*Hedysarum spirale* Sw.; *Des-*

modium spirale DC.] Hillsides and banks, St. Thomas; St. Jan; St. Croix.

MEIBOMIA TORTUOSA (Sw.) Kuntze. [*Hedysarum tortuosum* Sw.; *Desmodium tortuosum* DC.] Banks, hillsides and thickets, St. Thomas; St. Croix.

MEIBOMIA SCORPIURUS (Sw.) Kuntze. [*Hedysarum scorpiurus* Sw.; *Desmodium scorpiurus* Desv.] Grassy places, St. Thomas (according to Grisebach); St. Croix (according to Eggers).

LOUREA VESPERTILIONIS (L.) Desv. [*Hedysarum vespertilionis* L.] Naturalized in gardens, St. Thomas; St. Croix (according to Eggers). Planted for ornament.

ALYSICARPUS NUMMULARIFOLIUS (L.) DC. [*Hedysarum nummularifolium* L.; *H. vaginale* L.; *Alysicarpus vaginalis* DC.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Ecastophyllum Ecastophyllum (L.) Britton. [*Hedysarum Ecastophyllum* L.; *Pterocarpus Ecastophyllum* of West; *Ecastophyllum Brownei* Pers.; *Dalbergia Ecastophyllum* Taubert.] Coastal thickets, St. Thomas; St. Jan; St. Croix.

DREPANOCARPUS LUNATUS (L. f.) Meyer. [*Pterocarpus lunatus* L. f.] Coastal thickets, St. Thomas; St. Croix (according to West and to Eggers).

ICHTHYOMETHIA PISCIPULA (L.) Hitchc. [*Erythrina Piscipula* L.; *Piscidia Erythrina* L.; *P. Piscipula* Sargent.] Thickets and woodlands, St. Thomas; St. Jan; St. Croix.

ANDIRA JAMAICENSIS (W. Wright) Urban. [*Geoffraea jamaicensis* (*inermis*) W. Wright; *G. inermis* Sw.; *Andira inermis* H.B.K.; *Vouacapoua americana* of Millspaugh.] Woods and along rivulets, St. Thomas; St. Jan; St. Croix.

ABRUS ABRUS (L.) W. F. Wight. [*Glycine Abrus* L.; *Abrus praecatorius* L.] Thickets and hedges, St. Thomas; St. Jan; St. Croix.

CLITORIA TERNATEA L. [*Ternatea vulgaris* H.B.K.] Thickets and hedges, St. Thomas; St. Jan; St. Croix.

BRADBURYA VIRGINIANA (L.) Kuntze. [*Clitoria virginiana* L.; *Centrosema virginianum* Benth.; *C. virginianum angustifolium* Griseb.] Banks, fields and hillsides, St. Thomas; St. Jan; St. Croix.

BRADBURYA PLUMIERI (Turp.) Kuntze. [*Clitoria Plumieri* Turp.; *Centrosema Plumieri* Benth.] Sugar Estate, St. Thomas.

TERAMNUS LABIALIS Spreng. [*T. uncinatus albiflorus* Eggers.] Thickets, St. Thomas; St. Jan; St. Croix.

ERYTHRINA CORALLODENDRON L. Hillsides, St. Thomas; St. Croix. Planted for shade and ornament.

ERYTHRINA HORRIDA Eggers. Hillside, Flag Hill, St. Thomas. Recorded from all three islands by Eggers.

MUCUNA PRURIENS (L.) DC. [*Dolichos pruriens* L.] Shaded valleys and rocky banks, St. Thomas; St. Croix.

GALACTIA DUBIA DC. [*G. tenuiflora* of Eggers, partly; *G. regularis* of Millspaugh; *G. dubia Ehrenbergii* Urban; *G. filiformis minor* + *villosa* f. *albida* Kuntze.] Hillsides and thickets, St. Thomas; St. Jan; St. Croix.

GALACTIA STRIATA (Jacq.) Urban. [*Glycine striata* Jacq.; *G. striata tomentosa* Urban; *G. filiformis* of Eggers; *G. tenuiflora* of Millspaugh.] Thickets, St. Thomas; St. Jan; St. Croix.

GALACTIA EGGERSII Urban. [*G. tenuiflora* of Eggers; *G. pendula* of Knox.] Hillside, Flag Hill, St. Thomas; Bordeaux, St. Jan. Endemic.

CANAVALI RUSIOSPERMA Urban. [*C. parviflora* of Eggers.] Forest, Signal Hill, St. Thomas.

CANAVALI ENSIFORMIS (L.) DC. [*Dolichos ensiformis* L.; *C. gladiata ensiformis* of Eggers.] Naturalized in provision grounds, Signal Hill, St. Thomas (according to Eggers). Cultivated for its seeds.

CANAVALI LINEATA (Thunb.) DC. [*Dolichos lineatus* Thunb.; *D. rotundifolius* Vahl; *Dolichos obtusifolius* Lam.; *Canavalia obtusifolia* DC.] Coastal sands, St. Thomas; St. Jan; St. Croix.

CAJAN CAJAN (L.) Millsp. [*Cytisus Cajan* L.; *Cajanus flavus* DC.; *Cajanus indicus* Spreng.] Spontaneous after cultivation, St. Thomas; St. Jan; St. Croix.

DOLICHOLUS RETICULATUS (Sw.) Millsp. [*Glycine reticulata* Sw.; *Rhynchosia reticulata* DC.; *R. reticulata latifolia* Kuntze.] Roadsides and thickets, St. Thomas; St. Jan; St. Croix.

DOLICHOLUS PHASEOLOIDES (Sw.) Kuntze. [*Glycine phaseoloides* Sw.; *Rhynchosia phaseoloides* DC.] Forest, Signal Hill, St. Thomas (according to Eggers).

DOLICHOLUS MINIMUS (L.) Medic. [*Dolichos minimus* L.; *Rhynchosia minima* DC.; *R. punctata* DC.; *R. minima lutea* Eggers; *D. minimus luteus* Millsp.] Banks, hillsides and thickets and in cultivated ground, St. Thomas; St. Jan; St. Croix.

PHASEOLUS LUNATUS L. Thickets, spontaneous after cultivation, St. Thomas; St. Jan; St. Croix.

PHASEOLUS VULGARIS L. Spontaneous after cultivation, St. Thomas; St. Jan; St. Croix.

PHASEOLUS LATHYROIDES L. [*P. semierectus* L.] Banks, fields and hillsides, St. Thomas; St. Jan; St. Croix.

PHASEOLUS ALATUS L., recorded from St. Croix by West, is not further determined.

VIGNA REPENS (L.) Kuntze. [*Dolichos repens* L.; ? *D. luteus* of

West; *Dolichos luteolus* Jacq.; *Vigna luteola* Benth.; *Bradburya pubescens* of Millspaugh, St. Thomas.] Moist thickets, St. Thomas; St. Jan; St. Croix.

VIGNA UNGUICULATA (L.) Walp. [*Dolichos unguiculatus* L.; *D. Catjang* L.; *Vigna Catjang* Walp.] Edge of a cornfield near Doily Hill, St. Croix; St. Thomas (according to Schlechtendal).

PACHYRRHIZUS EROSUS (L.) Urban. [*Dolichos erosus* L.; *Pachyrrhizus angulatus* L. C. Rich.] Hillside thickets, St. Thomas.

DOLICHOS LABLAB L. [*Lablab vulgaris* Savi; *Dolichos benghalensis* Jacq.; *Dolichos Lablab abliflorus* (DC.) Millsp.] Thickets and spontaneous after cultivation, St. Thomas; St. Jan; St. Croix.

DOLICHOS SPHAEROSPERMUS (L.) DC. [*Phaseolus sphaerospermus* L.] Cultivated for its seeds.

DOLICHOS SESQUIPEDALIS L. Cultivated for its seeds.

BROWNEA COCCINEA Jacq. Planted on St. Croix (according to West).

PISUM SATIVUM L. Cultivated for its seeds.

OXALIDACEAE

IONOXALIS INTERMEDIA (A. Rich.) Small. [*Oxalis intermedia* A. Rich.; *O. latifolia* of Millspaugh.] Cultivated grounds, St. Croix.

IONOXALIS MARTIANA (Zucc.) Small. [*Oxalis Martiana* Zucc.] Shaded banks, St. Thomas; cultivated grounds, St. Croix.

XANTHOXALIS CORNICULATA (L.) Small. [*Oxalis corniculata* L.; *O. corniculata microphylla* of Eggers.] Dry soil, St. Thomas; St. Jan; St. Croix.

GERANIACEAE

Pelargoniums are cultivated for ornament.

BALSAMINACEAE

IMPATIENS BALSAMINA L. [*Balsamina hortensis* Desp.] Grown in flower gardens.

ERYTHROXYLACEAE

ERYTHROXYLON BREVIPES DC. [*E. ovatum* of Eggers, of Millspaugh, and of Kuntze; *E. areolatum* of West.] Hillsides and thickets, St. Thomas; St. Croix.

ERYTHROXYLON AREOLATUM L. is doubtfully attributed to St. Thomas by O. E. Schulz.

ZYGOPHYLLACEAE

GUAIACUM OFFICINALE L. Woods and thickets, St. Thomas; formerly on St. Croix and St. Jan. Nearly exterminated. Planted on St. Thomas.

TRIBULUS CISTOIDES L. [*T. terrester cistoides* Oliver.] Dry soil, St. Croix.

KALLSTROEMIA MAXIMA (L.) T. & G. [*Tribulus maximus* L.] Waste and cultivated grounds, St. Thomas; St. Croix; St. Jan.

RUTACEAE

ZANTHOXYLUM PUNCTATUM Vahl. [*Fagara trifoliata* Sw.; *Tobinia punctata* Griseb.] Thickets and banks, St. Croix.

ZANTHOXYLUM THOMASIANUM Krug & Urban. [? *Tobinia spinosa* of Eggers.] Forest, Flag Hill, St. Thomas; St. Jan. Endemic.

ZANTHOXYLUM SPINIFEX (Jacq.) DC. [*Fagara spinifex* Jacq.; *F. tragodes* of West; *Zanthoxylum microphyllum* Desv.] Thickets, St. Croix.

ZANTHOXYLUM MONOPHYLLUM (Lam.) P. Wilson. [*Fagara monophylla* Lam.; *Zanthoxylum simplicifolium* Vahl; *Z. Ochroxylum* DC.] Hillsides, woods and thickets, St. Thomas; St. Jan; St. Croix.

ZANTHOXYLUM MARTINICENSE (Lam.) DC. [*Fagara martinicensis* Lam.; *Zanthoxylum Clava-Herculis* of Eggers.] Woods and hillsides, St. Thomas; St. Jan; St. Croix.

ZANTHOXYLUM FLAVUM Vahl. [*Fagara flava* Krug & Urban.] Bordeaux Hills, St. Jan, nearly extinct (according to Eggers). Not found by us on St. Jan in 1913.

PILOCARPUS RACEMOSUS Vahl. Forest, King's Hill, St. Jan.

AMYRIS ELEMIFERA L. [*A. maritima* Jacq.; *A. sylvatica* of Eggers.] Woods and thickets, St. Thomas; St. Jan; St. Croix (according to Eggers).

CHALCAS EXOTICA (L.) Millsp. [*Murraya exotica* L.] Spontaneous after cultivation, St. Thomas; St. Croix.

TRIPHASIA TRIFOLIA (Burm. f.) P. Wilson. [*Limonia trifolia* Burm. f.; *T. trifoliata* (L.) DC.] Spontaneous after cultivation, naturalized in thickets, St. Thomas; St. Jan; St. Croix.

CITRUS MEDICA L. Recorded by Eggers as naturalized in gardens.

CITRUS LIMA Lunan. [*C. medica Limonum* of Eggers; *C. Limetta* Wight.] Woodlands and thickets, naturalized, St. Thomas; St. Jan; St. Croix.

CITRUS AURANTIUM L. Occasionally spontaneous after planting, St. Thomas; St. Croix.

CITRUS VULGARIS Risso. [*C. Bigaradia* Loisel.; *C. Aurantium bigaradia* Griseb.] Occasionally spontaneous after planting, St. Thomas; St. Croix.

CITRUS DECUMANA L. Planted for its fruit.

CITRUS BUXIFOLIA Poir. Planted for its fruit (according to Eggers).

Clausena Wampi Blanco. [*Cookia punctata* Sonn.] Planted for shade.

SURIANACEAE

Suriana maritima L. Coastal sands, St. Thomas; St. Jan; St. Croix.

SIMAROUBACEAE

Quassia amara L. Naturalized in and about gardens, St. Thomas; St. Croix. Planted for shade.

Castelaria Nicholsoni (Hook.) Small. [*Castela Nicholsoni* Hook.; *C. erecta* of Eggers and of Millspaugh.] Thickets, St. Croix.

Aeschrion antillana (Eggers) Small. [*Rhus antillana* Eggers; *Quassia excelsa* of West; *Picrasma antillana* Urban; *Picraena excelsa* of Eggers and of Millspaugh.] Forests, St. Thomas; St. Jan; St. Croix.

BURSERACEAE

Elaphrium Simaruba (L.) Rose. [*Pistacia Simaruba* L.; *Bursera gummifera* L.; *Bursera Simaruba* Sargent.] Woods and hills, St. Thomas; St. Jan; St. Croix.

Tetragastris balsamifera (Sw.) Kuntze. [*Hedwigia balsamifera* Sw.; ? *Icica altissima* of West.] St. Croix (according to West).

MELIACEAE

Swietenia Mahagoni Jacq. Hillsides and valleys, St. Thomas; St. Croix. Often planted; perhaps not native.

Melia Azedarach L. Roadsides; occasional in woods, St. Thomas; St. Jan; St. Croix.

Trichilia hirta L. [*T. spondioides* Jacq.] Woods, thickets and hillsides, St. Thomas; St. Jan; St. Croix.

Trichilia Wawrana antillana C. DC., described as from St. Croix from a specimen in the Copenhagen herbarium, is otherwise unknown.

Guarea trichilioides L., was recorded by West from St. Croix, but the record was questioned by Eggers. It is abundant in Porto Rico.

MALPIGHIACEAE

Hiraea faginea (Sw.) Ndz. [*H. faginea glandulifera* Ndz.], recorded by Niedenzu from St. Thomas, is probably an error in locality.

Banisteria purpurea L. [*Heteropteris purpurea* H.B.K.; *H. parvifolia* DC.] Thickets and hillsides, St. Thomas; St. Jan; St. Croix.

BANISTERIA LAURIFOLIA L. [*Heteropteris laurifolia* A. Juss.; *B. laurifolia antillana* Ndz., *B. lancifolia* of West.] St. Croix (according to Niedenzu).

STIGMAPHYLLON LINGULATUM (Poir.) Small. [*Triopteris lingulata* Poir.; *Banisteria periplocifolia* Desf.; *Stigmaphyllon periplocifolium* A. Juss.; *S. Sagraeanum* of Millspaugh.] Thickets and hillsides, St. Thomas; St. Jan; St. Croix.

STIGMAPHYLLON CORDIFOLIUM Ndz. St. Thomas (according to Niedenzu).

STIGMAPHYLLON CILIATUM (Lam.) A. Juss., recorded by Niedenzu from St. Thomas, as collected by Finlay, was really from Trinidad.

STIGMAPHYLLON TOMENTOSUM (Desf.) Ndz. [*Banisteria tomentosa* Desf.] Royiers, St. Jan (according to Niedenzu).

SPACHEA LITTORALIS A. Juss., recorded by A. Jussieu as collected by Finlay on St. Thomas, was from Trinidad.

THRYALLIS GLAUCA (Cav.) Kuntze. [*Galphimia glauca* Cav.; *G. gracilis* Bartl.] Roadsides and about dwellings, naturalized, St. Thomas; St. Croix.

TETRAPTERIS INAEQUALIS Cav. St. Croix (according to Niedenzu).

MALPIGHIA FUCATA Ker. [*M. fucata elliptica* Ndz.] St. Croix (according to Eggers).

MALPIGHIA GLABRA L. [*M. glabra antillana* Urban & Ndz.] Thickets, St. Thomas; St. Croix (according to Eggers and to Niedenzu).

MALPIGHIA PUNICIFOLIA L. [*M. punicifolia vulgaris* and *lancifolia* Ndz.; *M. glabra* of Millspaugh.] Hillsides and thickets, St. Thomas; St. Croix.

MALPIGHIA LINEARIS Jacq. [*M. angustifolia* L.; *M. angustifolia oblongata* Ndz.; ? *M. urens lanceolata* Eggers.] Hillside thickets, Water Island, St. Thomas; St. Jan.

MALPIGHIA BIFLORA Poir. [*M. oxycocca Grisebachiana* Ndz.] St. Croix (according to Niedenzu).

MALPIGHIA PALLENS Small. [*M. urens* of Millspaugh? and of Eggers.] Thickets along sandy beaches, St. Croix. Endemic.

MALPIGHIA INFESTISSIMA (A. Juss.) Rich. [*M. urens* of West; *M. urens infestissima* A. Juss.; *M. Cnide* of Eggers.] Hillside thickets, Water Island, St. Thomas; St. Jan. Also on Vieques and Culebra. Endemic. St. Thomas is the type locality.

BUNCHOSIA GLANDULOSA (Cav.) DC. [*Malpighia glandulosa* Cav.; *M. Swartziana* of Eggers.] Thickets, St. Thomas; St. Jan; St. Croix.

BYRSONIMA SPICATA (Cav.) DC. [*B. coriacea* of Millspaugh.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

BYRSONIMA CUNEATA (Turcz.) P. Wilson. [*B. lucida* DC.] St. Thomas (according to de Candolle, and cited also by Niedenzu).

BYRSONIMA MARTINICENSIS Krug & Urban. St. Croix (according to Small).

POLYGALACEAE

POLYGALA ANGUSTIFOLIA H.B.K. Thickets, southern side of St. Thomas.

SECURIDACA BROWNEI Griseb. [*S. scandens* West.] Naturalized around Christiansted, St. Croix, and on St. Thomas (according to Eggers).

SECURIDACA ERECTA L. Dry soil, St. Croix; St. Thomas (according to de Candolle).

EUPHORBIACEAE

SAVIA SESSILIFLORA (Sw.) Willd. [*Croton sessiliflorum* Sw.] Thickets and hillsides, St. Thomas; St. Jan; St. Croix.

Asterandra grandifolia (L.) Britton. [*Phyllanthus grandifolius* L.] St. Thomas (according to Urban).

PHYLLANTHUS NIRURI L. Waste and cultivated grounds, St. Thomas; St. Croix.

PHYLLANTHUS ACUMINATUS Vahl is accredited to St. Thomas by Mueller (DC. Prodr. 15^2: 381) who records a specimen in the Candollean herbarium, but the shrub is not known to inhabit St. Thomas now.

CICCA DISTICHA L. [*Phyllanthus distichus* Muell. Arg.] Spontaneous after planting, St. Thomas; St. Jan; St. Croix.

MARGARITARIA NOBILIS L. f. [*Phyllanthus nobilis* Muell. Arg.; *Cicca antillana* A. Juss.; *P. nobilis antillanus* Muell. Arg.] Forests, St. Thomas; St. Jan; St. Croix (according to Eggers).

SECURINEGA ACIDOTHAMNUS (Griseb.) Muell. Arg. [? *Adelia Acidoton* of West; *Flueggea Acidothamnus* Griseb.] Thickets, St. Thomas; Little St. James Island, St. Jan; eastern St. Croix (according to Eggers).

DRYPETES GLAUCA Vahl. St. Croix (according to Eggers).

CROTON ASTROITES Dryand. [*C. phlomoides* Pers.] Thickets, St. Thomas; St. Jan; St. Croix.

CROTON BETULINUS Vahl. Thickets, St. Thomas; St. Jan; St. Croix.

CROTON FLAVENS L. [*C. balsamifer* Jacq.; *C. flavens rigidus* Muell. Arg.; *Oxydestes flavens* Kuntze.] Thickets, St. Thomas; St. Jan; St. Croix.

CROTON DISCOLOR Willd. Rocky thickets, St. Thomas; St. Croix.

CROTON LOBATUS L. [*Oxydectes lobata* Kuntze.] Waste and cultivated grounds, St. Thomas; St. Croix; St. Jan.

CROTON HUMILIS L. Hillside thickets, St. Thomas.

CROTON GLANDULOSUS L. St. Croix (according to Urban).

Croton ovalifolius Vahl. [*Oxydectes ovalifolia* Kuntze.] Hillsides, St. Thomas; St. Jan; St. Croix.

Croton hastatus West, of St. Croix (hyponym) is not identified.

An arboreus Croton, not found in flower, occurred on Flag Hill, St. Thomas, according to Eggers.

Ditaxis fasciculata Vahl. [*Argyrothamnia fasciculata* Muell. Arg.] Thickets, St. Thomas; St. Jan; St. Croix.

Argythamnia candicans Sw. Thickets and hillsides, St. Thomas; St. Jan; St. Croix.

Ricinella Ricinella (L.) Britton. [*Adelia Ricinella* L.; *R. pedunculosa* Muell. Arg.] Hillsides and thickets, St. Thomas; St. Jan; St. Croix.

Acalypha portoricensis Muell. Arg. Rocky slopes, St. Croix.

Acalypha chamaedrifolia (Lam.) Muell. Arg. [*Croton chamaedrifolius* Lam.; *Acalypha reptans* Sw.; *A. corchorifolia* Willd.; *A. chamaedrifolia genuina* and *brevipes* of Eggers.] Rocky soil, St. Thomas; St. Croix.

Acalypha polystachya Jacq. St. Thomas (according to Eggers). The record is probably an error in determination.

Tragia volubilis L. Thickets, banks and hillsides, St. Thomas; St. Jan; St. Croix.

Dalechampia scandens L. Thickets, St. Thomas; St. Jan; St. Croix.

Ricinus communis L. Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Aleurites moluccana (L.) Willd. [*Jatropha moluccana* L.] Roadsides and near dwellings, St. Thomas; St. Croix.

Jatropha Curcas L. Hillsides and near dwellings, St. Thomas; St. Jan; St. Croix.

Jatropha gossypifolia L. [*Adenoropium gossypifolium* Pohl; *J. gossypifolia staphisagriaefolia* and *elegans* of Eggers.] In dry soil, fields and hillsides, St. Thomas; St. Jan; St. Croix.

Jatropha multifida L. Roadsides and planted in gardens, St. Thomas; St. Croix.

Jatropha panduraefolia Andr. Planted for ornament.

Manihot Manihot (L.) Cockerell. [*Jatropha Manihot* L.] Spontaneous or persistent after cultivation, St. Thomas; St. Jan; St. Croix.

Sapium Laurocerasus Desf. [*Excoecaria Laurocerasus* Muell. Arg.; ? *E. Laurocerasus laurifolia* of Eggers.] A high tree in forests, Cinnamon Bay, St. Jan, not seen flowering (according to Eggers). Otherwise known only from Porto Rico.

Hippomane Mancinella L. Coastal woods, St. Thomas; St. Croix.

Gymnanthes lucida Sw. [*Sebastiana lucida* Muell. Arg.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

Hura crepitans L. Woods, roadsides and near dwellings, St. Thomas; St. Jan; St. Croix.

Chamaesyce Vahlii (Willd.) P. Wilson. [*Euphorbia Vahlii* Willd.] Rocky hills, Little St. James Island, St. Jan.

Chamaesyce buxifolia (Lam.) Small. [*Euphorbia buxifolia* Lam.; *E. glabrata* Sw.] Coastal sands, St. Thomas; St. Jan; St. Croix.

Chamaesyce articulata (Aubl.) Britton. [*Euphorbia articulata* Aubl.; *E. linearis* Retz.; *E. linearis heterophylla* Kuntze.] Coastal rocks, St. Thomas; St. Jan; St. Croix (according to Retzius and reported by Eggers).

Chamaesyce hirta (L.) Millsp. [*Euphorbia hirta* L.; *E. pilulifera* L.; *E. pilulifera procumbens* Boiss.] Roadsides, banks and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Chamaesyce hypericifolia (L.) Millsp. [*Euphorbia hypericifolia* L.; *E. hypericifolia hyssopifolia* of Eggers.] Fields, banks and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Chamaesyce serpens (H.B.K.) Small. [*Euphorbia serpens* H.B.K.] Dry soil, St. Thomas.

Chamaesyce prostrata (Ait.) Small. [*Euphorbia prostrata* Ait.; ? *E. Chamaesyce* of West.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Chamaesyce brasiliensis (Lam.) Small. [*Euphorbia brasiliensis* Lam.] Grassy places near Charlotte Amalia, St. Thomas, determined by Millspaugh.

Euphorbia thymifolia Burm. is recorded by Eggers from all the islands, but has not been found on any of them by other collectors, and his determination of the species is therefore doubted.

Aklema petiolaris (Sims.) Millsp. [*Euphorbia petiolaris* Sims.; ? *E. cotinifolia* of West and of Schlechtendal.] Hillsides and thickets, St. Thomas; St. Jan; doubtfully recorded from St. Croix.

Poinsettia heterophylla (L.) Kl. & Garcke. [*Euphorbia heterophylla* L.; *E. heterophylla linifolia* Kuntze.] Dry rocky situations, St. Thomas.

Poinsettia cyathophora (Murr.) S. Brown. [*Euphorbia cyathophora* Murr.; *E. heterophylla cyathophora* Griseb.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Poinsettia Oerstediana Kl. & Garcke. [*Euphorbia geniculata* of Eggers; *Euphorbia Oerstediana* Boiss.] Grassy places, St. Thomas; St. Croix.

Poinsettia pulcherrima (Willd.) Graham. [*Euphorbia pulcherrima* Willd.] Planted for ornament.

EUPHORBIA NERIIFOLIA L. Planted for ornament.

EUPHORBIA SPLENDENS Bojer. Planted for ornament.

EUPHORBIA ANTIQUORUM L. Cultivated (according to Eggers).

PEDILANTHUS TITHYMALOIDES (L.) Poit. [*Euphorbia tithymaloides* L.] Persistent after cultivation, St. Thomas. Grown in flower gardens.

PEDILANTHUS PADIFOLIUS (L.) Poit. [*Euphorbia tithymaloides padifolia* L.] Thickets in dry stony ground, St. Croix.

PEDILANTHUS ANGUSTIFOLIUS Poit. Thickets and hillsides, St. Thomas; St. Jan.

CODIAEUM VARIEGATUM Blume. Planted for ornament.

BUXACEAE

TRICERA VAHLII (Baill.) Britton. [*Buxus Vahlii* Baill.; *Tricera laevigata sanctae-crucis* Eggers.] On limestone, Stony Ground, St. Croix. Known otherwise only on Porto Rico.

MANGIFERA INDICA L. Spontaneous after planting, St. Thomas; St. Jan; St. Croix.

ANACARDIUM OCCIDENTALE L. Woods, hillsides and along roads, St. Thomas; St. Jan; St. Croix.

SPONDIAS PURPUREA L. Spontaneous after planting, St. Thomas; St. Jan; St. Croix.

SPONDIAS MOMBIN L. [*Spondias lutea* L.] Woods, hills and roadsides, St. Thomas; St. Jan; St. Croix.

SPONDIAS DULCIS Forst. f. Cultivated on St. Croix.

COMOCLADIA DODONAEA (L.) Urban. [*Ilex Dodonaea* L.; *Comocladia ilicifolia* Sw.] Rocky coastal thickets, St. Thomas; St. Jan; St. Croix.

CELASTRACEAE

MAYTENUS ELLIPTICA (Lam.) Krug & Urban. [*Senacia elliptica* Lam.; *Rhamnus laevigatus* Vahl; *Ceanothus laevigatus* DC.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

MAYTENUS CYMOSA Krug & Urban. [*M. elaeodendroides* of Eggers.] Thickets, St. Thomas; St. Croix. Known otherwise only from Vieques. Endemic.

RHACOMA CROSSOPETALON L. [*Myginda pallens* Sw.; *M. latifolia* Vahl, not Sw.] Thickets, St. Thomas; St. Jan; St. Croix.

MYGINDA LATIFOLIA (Sw.) Urban. [*Myginda latifolia* Sw.] Thickets, St. Thomas.

SCHAEFFERIA FRUTESENS Jacq. [*S. completa* Sw.] Thickets, St. Thomas; St. Jan; St. Croix.

ELAEODENDRON XYLOCARPUM (Vahl) Urban. [*Cassine xylocarpa*

Vent.; *Celastrus polygamus* Vahl; *Rhamnus polygamus* West.] Coastal thickets, St. Thomas; St. Jan; St. Croix.

HIPPOCRATEACEAE

Hippocratea volubilis L. is doubtfully accredited to St. Thomas by Urban (Symb. Ant. **4**: 367).

SAPINDACEAE

Serjania polyphylla (L.) Schum. [*Paullinia polyphylla* L.; *S. lucida* Schum.; *Paullinia curassavica* of West.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

Paullinia pinnata L. St. Thomas (according to Radlkofer).

Dr. Millspaugh records *Paullinia frutescens glabrescens* (L.) Radlk. from Midland, St. Croix, as perhaps cultivated.

Cardiospermum Halicacabum L. Banks and thickets, spontaneous after cultivation, St. Thomas; St. Croix.

Cardiospermum microcarpum H.B.K. Thickets, St. Thomas; St. Jan; St. Croix.

Cardiospermum corindum L. Hillsides, St. Croix.

Cardiospermum bipinnatum West, is not known to modern botanists.

Allophylus occidentalis (Sw.) Radlk. [*Schmeidelia occidentalis* Sw.] Forests, St. Croix.

Sapindus Saponaria L. [*S. inaequalis* DC.] Forests, St. Thomas; St. Jan; St. Croix.

Melicocca bijuga L. Hillsides, woods and along roads, St. Thomas; St. Jan; St. Croix. Planted and naturalized.

Cupania triquetra A. Rich. [*C. fulva* of Eggers.] Woods and hills, St. Thomas; St. Jan.

Blighia sapida Koen. Planted for its fruit.

DODONAEACEAE

Dodonaea viscosa L. Coastal thickets, St. Thomas; St. Croix.

RHAMNACEAE

Krugiodendron ferreum (Vahl) Urban. [*Rhamnus ferreus* Vahl; *Ceanothus ferreus* DC.; *Condalia ferrea* Griseb.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

Reynosia uncinata Urban. [*R. mucronata* of Eggers.] Coastal thickets near Tague Bay, St. Croix.

Reynosia Guama Urban. [*R. latifolia* of Eggers.] Hillside thickets, St. Thomas; St. Jan. Endemic.

SARCOMPHALUS RETICULATUS (Vahl) Urban. [*Paliurus reticulatus* Vahl; *Zizyphus reticulatus* Vahl.] Thickets, Fair Plain, St. Croix.

COLUBRINA COLUBRINA (Jacq.) Millsp. [*Rhamnus Colubrina* Jacq.; *Colubrina ferruginosa* Brongn.] Coastal thickets and hillsides, St. Thomas; St. Jan; St. Croix.

COLUBRINA RECLINATA (L'Her.) Brongn. [*Rhamnus reclinatus* L'Her.; *R. ellipticus* Sw.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

GOUANIA LUPULOIDES (L.) Urban. [*Banisteria lupuloides* L.; *Gouania domingensis* L.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

ZIZYPHUS JUJUBA (L.) Lam. [*Rhamnus Jujuba* L.] Planted for its fruit.

RHAMNUS GLABRATUS West. A species not understood by modern botanists.

VITACEAE

VITIS TILIIFOLIA H. & B. [*V. caribaea* DC.] Forests, St. Thomas.

VITIS VINIFERA L. Planted for its fruit.

CISSUS SICYOIDES L. Woods, walls and thickets, St. Thomas; St. Jan; St. Croix.

CISSUS TRIFOLIATA L. [*C. acida* L.] Dry thickets, St. Thomas; St. Jan; St. Croix.

CISSUS CAUSTICA Tuss. [*C. trifoliata* of Eggers and of Millspaugh.] On trees and rocks, St. Thomas; St. Croix.

CISSUS OBOVATA Vahl. St. Croix. Known otherwise from St. Martin and eastern Porto Rico.

TILIACEAE

CORCHORUS ACUTANGULUS L. Waste and cultivated grounds, St. Thomas; St. Croix.

CORCHORUS SILIQUOSUS L. Thickets, fields, waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

CORCHORUS HIRTUS L. Gardens and roadsides, St. Thomas and St. Croix (according to Eggers).

CORCHORUS HIRSUTUS L. Coastal thickets and hillsides, St. Thomas; St. Jan; St. Croix.

TRIUMFETTA EXCISA Urban. Bassin yard, St. Croix. Known otherwise only from Porto Rico.

TRIUMFETTA RHOMBOIDEA Jacq. Thickets, St. Croix.

TRIUMFETTA SEMITRILOBA Jacq. [*T. althaeoides* Lam.; *T. semitriloba havanensis* Millsp.] Woods, banks and thickets, St. Thomas; St. Jan; St. Croix.

TRIUMFETTA LAPPULA L. Thickets, St. Thomas; St. Jan; St. Croix.

SLOANEA DENTATA L. Planted on St. Croix (according to West).

MALVACEAE

ABUTILON UMBELLATUM (L.) Sweet. [*Sida umbellata* L.] Rocky thickets and hillsides, St. Thomas; St. Jan; St. Croix.

ABUTILON HIRTUM (Lam.) Sweet. [*Sida hirta* Lam.; *Abutilon indicum hirtum* Griseb.; *A. graveolens* of Millspaugh.] Waste and cultivated grounds, St. Thomas; St. Croix.

ABUTILON INDICUM (L.). Sweet. [*Sida indica* L.; *A. subpapyraceum* Hochreutiner.] Sandy waste grounds, St. Thomas; St. Croix.

ABUTILON LIGNOSUM A. Rich. St. Thomas and St. Croix (according to Eggers).

GAYOIDES CRISPUM (L.) Small. [*Sida crispa* L.; *Abutilon crispum* Medic.] Sandy soil, St. Thomas.

WISSADULA AMPLISSIMA (L.) R. E. Fries. [*Sida amplissima* L.; ? *Abutilon periplocifolium albicans* of Eggers; *Sida hernandioides* L'Her.; *W. hernandioides* Garcke.] Banks and thickets, St. Jan; St. Croix.

WISSADULA PERIPLOCIFOLIA (L.) Griseb. [*Sida periplocifolia* L.; *Abutilon periplocifolium* Don.] Fields and hillsides, St. Croix.

MALVASTRUM COROMANDELIANUM (L.) Garcke. [*Malva coromandeliana* L.; *M. americana* L.; *M. tricuspidata* Ait.; *Malvastrum tricuspidatum* A. Gray.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

MALVASTRUM SPICATUM (L.) A. Gray. [*Malva spicata* L.] Hillsides, waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

SIDA CILIARIS L. Dry, grassy and rocky situations, St. Thomas; St. Jan; St. Croix.

SIDA ERECTA Macf. Dry soil, St. Croix.

SIDA SPINOSA L. [*S. angustifolia* Lam.; (?) *S. spinosa polycarpa* Eggers; *S. retusa* of Millspaugh.] Banks, fields and cultivated grounds, St. Thomas; St. Jan; St. Croix.

SIDA GLOMERATA Cav. Banks and thickets, St. Thomas; St. Jan.

SIDA CARPINIFOLIA L. f. [*S. carpinifolia acuta* Millsp.; *S. carpinifolia antillana* Millsp.; (?) *S. carpinifolia brevicuspidata* Eggers.] Banks, fields, woods and thickets, St. Thomas; St. Jan; St. Croix.

SIDA RHOMBIFOLIA L. [*S. rhombifolia retusa* of Eggers.] Banks, fields, waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

SIDA PROCUMBENS Sw. [*S. pilosa* Cav.; *S. supina* Sw.] Roadsides, St. Croix.

SIDA CORDIFOLIA L. [*S. althaeifolia* Sw.; *S. cordifolia althaeifolia* of Millspaugh.] Banks, fields and thickets, St. Thomas; St. Jan; St. Croix.

SIDA HUMILIS Cav. [*Sida supina* of Millspaugh, St. Thomas; *Sida supina glabra* of Millspaugh and of Eggers.] Banks, fields, and thickets, St. Thomas; St. Jan; St. Croix.

SIDA GLABRA Mill. [*S. ulmifolia* Cav.; *S. arguta* Sw.] Banks, fields and thickets, St. Thomas; St. Croix.

SIDA GLUTINOSA Commers. [*S. nervosa* DC.; (?) *S. nervosa viscosa* Eggers.] Hillsides and thickets, St. Thomas; St. Jan; St. Croix.

SIDA ACUMINATA DC. [*S. acuminata macrophylla* Schl. and *microphylla* Schl.] Hillsides, St. Thomas; St. Croix.

SIDA EGGERSII E. G. Baker. St. Thomas, apparently (Eggers, Suppl. 14). Otherwise known only from Tortola and Culebra. Endemic.

SIDA JAMAICENSIS L. [*S. tristis* Schl.] Fields and hillsides, St. Thomas; St. Jan; St. Croix.

BASTARDIA VISCOSA (L.) H.B.K. [*Sida viscosa* L.] Dry fields, hills and thickets, St. Thomas; St. Jan; St. Croix.

MALACHRA CAPITATA L. [*M. palmata* Moench.] Dry soil, St. Croix.

MALACHRA ALCEIFOLIA Jacq. [*M. rotundifolia* Schrank.] Thickets, waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

MALCHRA FASCIATA Jacq. [*M. radiata* Griseb., not L.; (?) *M. urens* of Eggers.] Waste grounds, St. Thomas.

URENA LOBATA L. [*U. americana* L. f.; *U. reticulata* Cav.; *U. lobata americana* Guerke.] Fields, woods, hillsides and cultivated grounds, St. Thomas; St. Jan; St. Croix.

URENA SINUATA L. St. Thomas (according to Guerke).

PAVONIA SPINIFEX (L.) Cav. [*Hibiscus spinifex* L.] Thickets, waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

MALACHE SCABRA B. Vogel. [*Pavonia spicata* Cav.; *Althaea racemosa* Sw.; *P. racemosa* Sw.] Mangrove swamps, St. Croix (according to Eggers).

PARITI TILIACEUM (L.) A. Juss. [*Hibiscus tiliaceus* L.] Coastal woods, St. Thomas; St. Jan; St. Croix (according to West).

HIBISCUS BRASILIENSIS L. [*H. phoeniceus* Jacq.] Hillsides and thickets, St. Thomas; St. Croix.

HIBISCUS CLYPEATUS L. St. Croix (according to West).

HIBISCUS VITIFOLIUS L. Thickets and waste grounds, St. Thomas; St. Croix.

HIBISCUS SABDARIFFA L. Spontaneous after cultivation, St. Thomas; St. Croix.

HIBISCUS ROSA-SINENSIS L. Spontaneous after cultivation, St. Thomas. Planted for ornament.

Hibiscus mutabilis L. Planted for ornament.

Cienfuegosia heterophylla (Vent) Garcke. [*Fugosia heterophylla*; *Kosteletzkya pentasperma* of Eggers.] Moist soil, St. Thomas.

Abelmoschus esculentus (L.) Moench. [*Hibiscus esculentus* L.] Spontaneous after cultivation, St. Thomas; St. Jan; St. Croix.

Thespesia populnea (L.) Soland. [*Hibiscus populneus* L.] Coastal woods and thickets, St. Thomas; St. Jan; St. Croix. Commonly planted.

Gossypium barbadense L. Thickets and hillsides, spontaneous after cultivation, St. Thomas; St. Croix.

Gossypium vitifolium Lam. is recorded by Schlechtendal as naturalized in St. Thomas; Eggers suggests it may formerly have been cultivated there.

Althaea rosea Cav. Planted for ornament.

BOMBACACEAE

Ceiba pentandra (L.) Gaertn. [*Bombax pentandrum* L.; *B. heptaphyllum* of West; *Eriodendron anfractuosum* DC.] Hills, forests and roadsides, St. Thomas; St. Jan; St. Croix.

Adansonia digitata L. Naturalized in wooded valleys, St. Croix (according to Eggers). Planted for shade on St. Thomas and St. Croix.

Quararibaea turbinata (Sw.) Poir. [*Myrodia turbinata* Sw.] Woods, St. Jan; Spring Garden, St. Croix (according to West).

Pachira alba Walp. Planted, St. Thomas.

Pachira aquatica Aubl. [*Carolinea princeps* L. f.] Planted, St. Croix.

STERCULIACEAE

Melochia nodiflora Sw. [*Riedleia nodiflora* DC.] Hillsides, banks and thickets, St. Thomas; St. Jan; St. Croix.

Moluchia pyramidata (L.) Britton. [*Melochia pyramidata* L.] Grassy places, waste and cultivated grounds, St. Thomas (according to West); St. Croix.

Moluchia tomentosa (L.) Britton. [*Melochia tomentosa* L.] Hillsides and thickets, St. Thomas; St. Jan; St. Croix.

Waltheria americana L. [*W. indica* L.] Fields, banks and hillsides, St. Thomas; St. Jan; St. Croix.

Ayenia pusilla L. Thickets and hillsides, St. Thomas; St. Jan; St. Croix.

Theobroma Cacao L. Naturalized in shaded valleys, St. Croix (according to Eggers). Planted for its seeds.

Guazuma Guazuma (L.) Cockerell. [*Theobroma Guazuma* L.;

Guazuma ulmifolia Lam.; *G. tomentosa* H.B.K.] Fields, woods and roadsides, St. Thomas; St. Croix.

HELICTERES JAMAICENSIS Jacq. Thickets, St. Thomas; St. Jan; St. Croix.

DILLENIACEAE

DAVILLA RUGOSA Poir. is recorded by Grisebach from the island St. Thomas, and also from St. Thomas-in-the-Vale, Jamaica. It occurs in the Jamaica parish, but is not known on our island.

OCHNACEAE

OURATEA LITTORALIS Urban. [*Gomphia nitida* of Eggers.] Coastal thickets, St. Thomas. Known otherwise only from Porto Rico.

TERNSTROEMIACEAE

Taonabo peduncularis (DC.) Britton. [*Ternstroemia peduncularis* DC.; *T. elliptica* of West and of Eggers.] Forests, Bordeaux Hill, St. Jan; Maroon Hill, St. Croix.

CLUSIACEAE

MAMMEA AMERICANA L. Forests, hills and roadsides, St. Thomas; St. Jan; St. Croix. Much planted.

CALOPHYLLUM CALABA Jacq. Forests, roadsides and valleys, St. Thomas; St. Croix.

CLUSIA ROSEA Jacq. [? *C. alba* of West.] Hillsides and forests, St. Thomas; St. Jan; St. Croix (according to West and to Eggers).

TAMARICACEAE

TAMARIX INDICA Willd. Planted for ornament.

BIXACEAE

BIXA ORELLANA L. Spontaneous after planting, St. Thomas; St. Croix. Grown for the dye stuff annato.

CANELLACEAE

CANELLA WINTERANA (L.) Gaertn. [*Laurus Winterana* L.; *Canella alba* Murr.] Woods and thickets, St. Thomas; St. Jan; St. Croix (according to Eggers).

VIOLACEAE

Calceolaria linearifolia (Vahl) Britton. [*Viola linearifolia* Vahl; *Hybanthus linearifolius* Urban; *Ionidium strictum* Vent.] Rocky thickets, Water Island, St. Thomas; St. Croix.

FLACOURTIACEAE

PROCKIA CRUCIS L. [*Trilix crucis* Griseb.] Forests, St. Thomas; St. Jan (according to Eggers); St. Croix.

MYROXYLON BUXIFOLIUM (A. Gray) Krug & Urban. [*Xylosma buxifolium* A. Gray; *Drypetes laevigata* of Eggers.] Cinnamon Gut, St. Jan; St. Croix (according to Urban).

MYROXYLON NITIDUM (Hell.) Kuntze [*Xylosma nitidum* A. Gray], is recorded by Eggers as naturalized on St. Thomas. It is endemic in Jamaica.

SAMYDA SPINULOSA Vent. [*S. glabrata* Grisebach and of Eggers, not Sw.] Thickets, Crown, St. Thomas (according to Eggers). Otherwise known only from Porto Rico.

SAMYDA DODECANDRA Jacq. [*S. serrulata* L.] Thickets, St. Thomas; St. Jan; St. Croix.

CASEARIA GUIANENSIS (Aubl.) Urban. [*Iroucana guianensis* Aubl.; *Casearia ramiflora* Vahl; *C. hirta* of Millspaugh; *C. nitida* of Kuntze.] Woods and thickets, St. Thomas; St. Croix; St. Jan.

CASEARIA DECANDRA Jacq. [*C. parvifolia* Willd.; *Samyda decandra* Jacq.; *C. parvifolia microcarpa* Eggers.] Woods and thickets, St. Thomas; St. Jan; St. Croix (according to Eggers).

CASEARIA ARBOREA (L. C. Rich) Urban. [*Samyda arborea* L. C. Rich; *C. stipularis* Vent.] St. Thomas, collected by O. Kuntze, whose specimen is so labelled by him; Urban (Symb. Ant. **7**: 75) indicates, however, that it may have come from Porto Rico.

CASEARIA SYLVESTRIS Sw. [*Samyda parviflora* L. not Loefl.] Woods, hills and thickets, St. Thomas; St. Jan; St. Croix.

TURNERACEAE

TURNERA DIFFUSA Willd. [*T. microphylla* Desv.; *T. parviflora* of Eggers.] Coastal thickets, St. Thomas; St. Jan; St. Croix.

TURNERA ULMIFOLIA L. [*T. ulmifolia acuta* Urban; *T. angustifolia* Mill.] Hillsides and waste grounds, St. Thomas; St. Jan; St. Croix.

PIRIQUETA VISCOSA Griseb. Hillside thickets, St. Thomas.

PASSIFLORACEAE

PASSIFLORA PALLIDA L. [*P. suberosa* L.; *P. hirsuta* L.; *P. minima* L.; *P. parviflora* Sw.; *P. peltata* Cav.] Hillsides, banks and thickets, St. Thomas; St. Jan; St. Croix.

PASSIFLORA FOETIDA L. Banks, waste and cultivated grounds, St. Thomas; St. Croix.

PASSIFLORA MULTIFLORA L. Thickets, St. Thomas (according to Masters); St. Jan.

PASSIFLORA RUBRA L. Woods and thickets, St. Thomas; St. Jan; St. Croix (according to Eggers).

PASSIFLORA LAURIFOLIA L. Forests and thickets, St. Thomas; St Jan; St. Croix. Perhaps not indigenous; much planted.

PASSIFLORA INCARNATA L., recorded from St. Croix by West, must be an error in determination.

PASSIFLORA QUADRANGULARIS L. Planted for its fruit.

PASSIFLORA MALIFORMIS L. Planted for its fruit.

CARICACEAE

CARICA PAPAYA L. Spontaneous after cultivation, St. Thomas; St. Croix. Much planted.

BEGONIACEAE

Several kinds of Begonias are grown as garden flowers.

BEGONIA HUMILIS Ait., attributed to St. Thomas by A. de Candolle as collected by Finlay, was really from Trinidad.

CACTACEAE

HYLOCEREUS TRIGONUS (Haw.) Safford. [*Cereus trigonus* Haw.; *C. triangularis* of West and of Eggers.] On trees and rocks in forests and valleys, St. Thomas; St. Jan.

HYLOCEREUS UNDATUS (Haw.) Britton & Rose. [*Cereus undatus* Haw.; *Cereus triangularis* of authors.] Persistent after cultivation, St. Thomas; St. Croix.

SELENICEREUS GRANDIFLORUS (L.) Britton & Rose. [*Cereus grandiflorus* L.] Persistent after cultivation, St. Thomas; St. Croix.

SELENICEREUS PTERANTHUS (Link & Otto) Britton & Rose. [*Cereus nycticalis* Link.] Recorded by Millspaugh as naturalized on stone walls of a neglected garden at Bassin, St. Croix.

CEPHALOCEREUS ROYENI (L.) Britton & Rose. [*Cactus Royeni* L.; *C. peruvianus* of West; *Cereus floccosus* Otto; *Pilocereus Fouchianus* Weber; *Cereus armatus* Otto.] Dry rocky hillsides, St. Thomas; St. Jan; St. Croix.

CEPHALOCEREUS NOBILIS (Haw.) Britton & Rose. [*Cereus nobilis* Haw.; *Cereus strictus* DC.] Persistent after cultivation, St. Thomas.

ACANTHOCEREUS PENTAGONUS (L.) Britton & Rose. [*Cactus pentagonus* L.] Persistent after planting, St. Thomas; St. Croix.

CACTUS INTORTUS Mill. [*C. Melocactus* of West; *Melocactus communis* of Eggers; *M. atrosanguineus* Link & Otto.] Coastal hills and cliffs, St. Thomas; St. Jan; St. Croix.

CORYPHANTHA NIVOSA (Link) Britton. [*Mamillaria nivosa* Link.]

Rocky slopes and cliffs, Buck Island and Flat Cays, St. Thomas; St. Jan and Little St. James Island, St. Jan.

OPUNTIA RUBESCENS Salm-Dyck. [*O. catacantha* Link & Otto; *O. spinosissima* and *tuberculata* of Eggers.] Coastal hills, St. Thomas; St. Jan; St. Croix. The spineless or nearly spineless race is commonly planted for interest, and occurs wild on Little St. James Island, St. Jan, and on Culebra.

OPUNTIA REPENS Bello. [*Cactus curassavicus* of West; *O. curassavica* of Eggers and of Millspaugh.] Dry fields and hillsides, St. Thomas; St. Jan; St. Croix.

Opuntia antillana Britton & Rose, spec. nov.

Plant depressed, ascending or nearly prostrate, often forming clumps 1 m. broad, seldom more than 4 dm. high. Joints obovate or oblong-obovate, 2 dm. long or less, green, glabrous, readily detached; leaves conic-subulate, 2–3 mm. long; areoles large, 2–3 cm. apart, brown-woolly; spines mostly 3–6 at each areole, subulate, rather stout, terete, 1–6 cm. long, yellow fading gray or nearly white; glochids many, yellow; flowers about 7 cm. broad; petals obtuse, bright yellow or fading reddish; fruit red-purple, about 4 cm. long.

Rocky and sandy soil, St. Thomas, St. Croix, also on Tortola, Porto Rico, Hispaniola, and St. Kitts. Type specimen collected on St. Kitts (*Rose, Fitch & Russell 3230*).

OPUNTIA DILLENII (Ker.) Haw. [*Cactus Dillenii* Ker.; *Cactus Opuntia* of West; *O. Tuna* of Eggers and of Millspaugh; *O. horrida* Salm-Dyck.] Banks, fields and hills, St. Thomas; St. Jan; St. Croix. A hybrid with *O. rubescens* was observed on Buck Island, St. Thomas.

OPUNTIA TRIACANTHA (Willd.) DC. [*Cactus triacanthus* Willd.] Coastal rocks, Buck Island, St. Thomas.

NOPALEA COCHENILLIFERA (L.) Salm-Dyck. [*Cactus cochenillifer* L.; *Opuntia coccinellifera* Mill.] Persistent or spontaneous after cultivation; recorded by Eggers as occurring on limestone, St. Thomas; St. Croix.

PERESKIA PERESKIA (L.) Karst. [*Cactus Pereskia* L.; *P. aculeata* Mill.] Spontaneous after cultivation, St. Thomas; St. Croix.

PERESKIA GRANDIFOLIA Haw. [*P. Bleo* of Eggers and of Millspaugh.] Spontaneous after cultivation, St. Thomas; St. Croix.

CEREUS NORTHUMBERLANDIA Lambert. [*C. lepidotus* Salm-Dyck.] Planted, St. Croix.

CEREUS HEXAGONUS (L.) Mill. [*C. peruvianus* (L.) Mill.] Planted (according to Eggers).

Other species of Cacti are occasionally cultivated for interest.

THYMELAEACEAE

DAPHNOPSIS CARIBAEA Griseb. [*Nectandra antillana* of Millspaugh.] Forests and hillsides, St. Thomas; St. Jan; St. Croix.

LYTHRACEAE

AMMANNIA COCCINEA Rottb. Moist ground, St. Thomas; St. Jan; St. Croix.

AMMANNIA LATIFOLIA L. [*A. sanguinolenta* Sw.] Moist ground, St. Thomas; St. Croix.

GINORIA ROHRII (Vahl) Koehne. [*Antherylium Rohrii* Vahl.] Coastal thickets, St. Thomas; St. Jan; St. Croix.

LAWSONIA INERMIS L. Spontaneous after cultivation, St. Thomas; St. Croix.

LAGERSTROEMIA INDICA L. Commonly planted for ornament.

PUNICACEAE

PUNICA GRANATUM L. [*P. nana* L.] Spontaneous after planting, St. Thomas; St. Jan; St. Croix. Grown for its fruit.

RHIZOPHORACEAE

RHIZOPHORA MANGLE L. Mangrove swamps, St. Thomas; St. Jan; St. Croix. Not very common.

COMBRETACEAE

TERMINALIA CATAPPA L. [*Buceras Catappa* Hitchc.] Hillsides, valleys, and commonly planted, St. Thomas; St. Jan; St. Croix.

CONOCARPUS ERECTA L. [*C. erecta procumbens* Jacq.] Coastal rocks and mangrove swamps, St. Thomas; St. Jan; St. Croix.

BUCIDA BUCERAS L. [*Buceras Buceras* Millsp.; *Myrobalanus Buceras* Kuntze.] Moist soil, mostly near the coasts, but occasional on hillsides, St. Thomas; St. Jan; St. Croix.

LAGUNCULARIA RACEMOSA (L.) Gaertn. [*Conocarpus racemosa* L.] Coastal swamps, St. Thomas; St. Jan; St. Croix.

QUISQUALIS INDICA L. is commonly cultivated as an ornamental vine.

MYRTACEAE

PSIDIUM GUAJAVA L. Thickets, hillsides, and commonly planted for its fruit, St. Thomas; St. Jan; St. Croix.

PSIDIUM AMPLEXICAULE Pers. [*P. cordatum* Sims.] Hillsides, St. Thomas; St. Jan; planted on St. Croix. Occurs also on Tortola. Apparently endemic in the Virgin Islands, although recorded from Nevis.

PSIDIUM AROMATICUM Knox, recorded from St. Thomas, is not identified.

AMOMIS CARYOPHYLLATA (Jacq.) Krug & Urban. [*Myrtus caryophyllata* Jacq.; *Myrtus acris* Sw.; *M. Pimenta* Ortega; ? *Pimenta vulgaris* of Eggers; *Pimenta acris* Kostel.; *A. caryophyllata grisea* Krug & Urban.] Hills and woods, St. Jan; St. Croix (according to Eggers).

MYRCIA PANICULATA (Jacq.) Krug & Urban. [*Eugenia paniculata* Jacq.; *E. acetosans* Poir.; *E. marginata* Pers.; *Myrtus coriacea* Vahl; *Myrcia coriacea* DC.; *M. coriacea Imrayana* Griseb.] Forests, St. Thomas; St. Jan; St. Croix.

MYRCIA SPLENDENS (Sw.) DC., doubtfully accredited to St. Thomas by Urban, as collected by Riedlé, probably was from Porto Rico, where it is abundant.

CALYPTRANTHES THOMASIANA Berg. Signal Hill, St. Thomas; Bordeaux, St. Jan. Endemic.

CALYPTRANTHES PALLENS (Poir.) Griseb. [*C. Chytraculia ovalis* Berg.; *C. Chytraculia zuzygium* Berg.; *Chytraculia pallens* Millsp.; *C. Chytraculia* of West.] Forests, rare, St. Thomas; St. Croix.

EUGENIA LIGUSTRINA (Sw.) Willd. [*Myrtus ligustrina* Sw.; *M. cerasina* Vahl.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

EUGENIA LANCEA Poir. [*E. ludibunda* Bert.; *E. virgultosa* of Eggers and of Millspaugh; *E. glabrata* of Eggers; *Myrcia thomasiana* DC.] Woods and thickets, St. Thomas; St. Croix.

EUGENIA MONTICOLA (Sw.) DC. [*Myrtus monticola* Sw.; *Eugenia Poiretii* Berg, not DC.; *E. foetida* West; *E. flavovirens* Berg.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

EUGENIA BUXIFOLIA (Sw.) Willd. [*Myrtus buxifolia* Sw.; *E. foetida* Poir.] Thickets, St. Thomas; St. Croix.

EUGENIA AXILLARIS (Sw.) Willd. [*Myrtus axillaris* Sw.] Thickets, St. Croix.

EUGENIA RHOMBEA (Berg) Krug & Urban. [*E. foetida rhombea* Berg.; *E. Poiretii* of Millspaugh; ? *E. pallens* of Eggers.] Coastal thickets, St. Thomas (according to Berg); St. Croix.

EUGENIA PROCERA (Sw.) Poir. [*Myrtus procera* Sw.; *M. cerasina* Vahl of Eggers.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

EUGENIA PSEUDOPSIDIUM Jacq. [*E. portoricensis* DC.; *E. thomasiana* Berg.] Forests and wooded valleys, St. Thomas; St. Jan; St. Croix.

EUGENIA CORDATA (Sw.) DC. [*Myrtus cordata* Sw.; *M. ramiflorus* Vahl; *E. sessiliflora* DC., not Vahl; *E. lateriflora* of Eggers.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

EUGENIA SESSILIFLORA Vahl. Hillsides, St. Thomas (according to Eggers); St. Croix. Endemic.

EUGENIA FLORIBUNDA West. Woods, hillsides and thickets, St. Thomas; St. Jan; St. Croix.

EUGENIA UNIFLORA L. Spontaneous after planting, St. Thomas; St. Croix. Grown for its fruit.

EUGENIA MICRANTHA Vahl, not DC., recorded from St. Croix by West, is not further determined (hyponym).

EUGENIA EMARGINATA Vahl, not DC., recorded from St. Croix by Vahl, is not further determined (hyponym).

EUGENIA PEDUNCULATA Raeusch. of St. Croix, is unknown to modern botanists.

ANAMOMIS FRAGRANS (Sw.) Griseb. [*Myrtus fragrans* Sw.; *Eugenia punctata* Vahl; *Anamomis punctata* Griseb.] St. Croix; forests, St. Jan (according to Eggers).

JAMBOS JAMBOS (L.) Millsp. [*Eugenia Jambos* L.; *Jambos vulgaris* DC.] Woods and valleys, naturalized, St. Thomas; St. Jan; St. Croix.

JAMBOS MALACCENSIS (L.) DC. [*Eugenia malaccensis* L.], planted for its fruit, was naturalized in shaded valleys, St. Croix (according to Eggers).

MYRTUS COMMUNIS L. Planted for ornament.

LECYTHIDACEAE

COUROUPITA GUIANENSIS Aubl. Planted for ornament and interest.

MELASTOMACEAE

TETRAZYGIA ANGUSTIFOLIA (Sw.) DC. [*Melastoma angustifolia* Sw.; *Miconia angustifolia* Griseb.] Hillside thickets, St. Thomas; St. Jan; St. Croix (according to Cogniaux).

TETRAZYGIA ELAEAGNOIDES (Sw.) DC. [*Melastoma elaeagnoides* Sw.] Forests and hillside thickets, St. Thomas; St. Jan; St. Croix.

MICONIA MACROPHYLLA (D. Don) Triana. [*Chitonia macrophylla* D. Don; *Diplochita serrulata* DC.] Wooded valleys, St. Thomas; St. Croix (according to Eggers and to Cogniaux).

MICONIA IMPETIOLARIS (Sw.) D. Don. [*Melastoma impetiolaris* Sw.] Forests, St. Croix (West); St. Thomas (according to Grisebach).

MICONIA LAEVIGATA (L.) DC. [*Melastoma laevigata* L.; *M. prasina* of Millspaugh, St. Thomas.] Woods and hillsides, St. Thomas; St. Jan; St. Croix.

MICONIA PRASINA (Sw.) DC., recorded by Naudin as collected on

St. Thomas by Riedlé, was probably from Porto Rico. It occurs on Tortola.

MICONIA STENOSTACHYA (Schr.) DC. [*Miconia argyrophylla* Benth., not DC.], recorded by Naudin and others as collected by Finlay on St. Thomas, was really from Trinidad.

MICONIA THOMASIANA DC. was not from St. Thomas, but from Porto Rico.

MICONIA ACINODENDRUM (L.) Triana. [*Melastoma acinodendrum* L.; *Tshudya berbiceana* Griseb.], recorded by Naudin and others as collected on St. Thomas by Finlay, was really from Trinidad; St. Croix (according to West).

MECRANIUM AMYGDALINUM (Desr.) C. Wright [*Cremanium amygdalinum* Griseb.], attributed to St. Thomas by Naudin, was from Hispaniola, collected by Poiteau.

CLIDEMIA SPICATA DC., is recorded by Cogniaux as collected on St. Thomas by Finlay, but the specimen was from Trinidad. Eggers erroneously records it from all three islands.

CLIDEMIA HIRTA (L.) D. Don, attributed to St. Thomas by Naudin as collected by Riedlé, was probably from Porto Rico.

CLIDEMIA RUBRA Mart, accredited to St. Thomas by Naudin and others as collected by Finlay, was really from Trinidad.

MOURIRIA DOMINGENSIS (Tuss.) Spach. [*Petaloma domingensis* Tuss.; *P. Mouriri* of West.] Borders of a stream, Spring Garden, St. Croix.

NEPSERA AQUATICA (Aubl.) Naud., recorded by Cogniaux as collected by Riedlé on St. Thomas, was probably from Porto Rico.

ONAGRACEAE

JUSSIAEA SUFFRUTICOSA L. [*J. angustifolia* Lam.; *J. octovalvis* Sw.; *J. suffruticosa ligustrifolia* of Eggers.] Wet grounds, St. Thomas; St. Jan; St. Croix.

JUSSIAEA ERECTA L. St. Croix (according to West).

ARALIACEAE

DENDROPANAX ARBOREA (L.) Dcne. & Pl. [*Sciadophyllum capitatum* of Eggers; *Aralia arborea* L.; *Gilibertia arborea* E. March.] Forests, hills of St. Thomas.

DIDYMOPANAX MICANS (Willd.) Krug & Urban. [*Aralia micans* Willd.; *Panax speciosum* of Eggers.] Forest, King's Hill and Bordeaux, St. Jan.

APIACEAE

ERYNGIUM FOETIDUM L. Moist grounds, Caret Bay, St. Thomas (according to Eggers).

CELERI GRAVEOLENS (L.) Britton. [*Apium graveolens* L.; *Peucedanum graveolens* Benth.] Persistent after cultivation, St. Croix. Grown for celery.

ANETHUM GRAVEOLENS L. Spontaneous after cultivation, St. Thomas; St. Croix.

PIMPINELLA ANISUM L. Spontaneous after cultivation, St. Croix. Grown for anise.

APIUM PETROSELINUM L. [*Petroselinum sativum* Hoffm.] Cultivated for food.

DAUCUS CAROTA L. Cultivated for food.

FOENICULUM FOENICULUM (L.) Karst. [*F. vulgare* Gaertn.] Cultivated for drug purposes.

CEREFOLIUM CEREFOLIUM (L.) Britton. [*Anthriscus Cerefolium* L.] Cultivated for flavoring.

ERICACEAE

XOLISMA RUBIGINOSA (Pers.) Small. [*Andromeda rubiginosa* Pers.; *Lyonia jamaicensis* of Eggers.] Bolongo, St. Thomas. Known otherwise only from Hispaniola.

THEOPHRASTACEAE

JACQUINIA BERTERII Spreng. [*J. Berterii retusa* Urban.] Thickets, St. Thomas; St. Jan; St. Croix (according to Mez).

JACQUINIA BARBASCO (Loefl.) Mez. [*Chrysophyllum Barbasco* Loefl.; *J. armillaris* Jacq.; *J. armillaris arborea* of Eggers.] Coastal thickets, St. Thomas; St. Jan; St. Croix.

MYRSINACEAE

ICACOREA GUADALUPENSIS (Duch.) Britton. [*Ardisia guadalupensis* Duch.; *A. coriacea* of West and of Eggers.] Forests and hills, St. Thomas; St. Jan; St. Croix.

STYLOGYNE LATERIFLORA (Sw.) Mez. [*Ardisia lateriflora* Sw.; *A. caribaea* Miquel.] St. Thomas (according to Eggers).

PLUMBAGINACEAE

PLUMBAGO SCANDENS L. [*P. scandens densiflora* Kuntze.] Banks, woods and thickets, St. Thomas; St. Jan; St. Croix.

PLUMBAGO CAPENSIS Thunb. Grown in gardens.

PLUMBAGO ZEYLANICA L. St. Croix (according to West).

SAPOTACEAE

SAPOTA ACHRAS Mill. [*Achras Sapota* L.] Forests, and commonly planted, St. Thomas; St. Jan; St. Croix.

LUCUMA MULTIFLORA A. DC. [*Achras multiflora* Vahl, according to Eggers.] Forests, St. Thomas; St. Croix.

SIDEROXYLON FOETIDISSIMUM Jacq. [*S. mastichodendron* Jacq.] Forests, St. Thomas; St. Jan; St. Croix.

DIPHOLIS SALICIFOLIA (L.) A. DC. [*Achras salicifolia* L.; *Bumelia salicifolia* Sw.] Forests and hillsides, St. Thomas; St. Jan; St. Croix.

BUMELIA OBOVATA (Lam.) A. DC. [*Sideroxylon obovatum* Lam.; *B. cuneata* Sw.] Coastal hillsides, shores and borders of marshes, St. Thomas; St. Jan; St. Croix.

CHRYSOPHYLLUM CAINITO L. St. Thomas; St. Croix, occasionally planted, perhaps spontaneous.

CHRYSOPHYLLUM EGGERSII Pierre. [*C. microphyllum* of Eggers; ? *C. oliviforme monopyrenum* of Eggers.] Woods and hillsides, St. Thomas; St. Jan; St. Croix. Endemic.

CHRYSOPHYLLUM PAUCIFLORUM Lam. [*C. glabrum* of Eggers and of Millspaugh; *C. pauciflorum nervosum* Pierre.] Forests and hillsides, St. Thomas; St. Jan; St. Croix. Otherwise known only from Porto Rico.

CHRYSOPHYLLUM BICOLOR Pierre. St. Thomas (according to Pierre and Urban); known otherwise only from Porto Rico.

MIMUSOPS NITIDA (Sessé & Moç.) Urban. [*Sapota Sideroxylon* of Eggers.] Forests, St. Jan. Determined from foliage only; its flowers and fruit have not been collected by botanists, and the identification is, therefore, uncertain.

MIMUSOPS ELENGI L. Planted, St. Thomas.

SYMPLOCACEAE

SYMPLOCOS MARTINICENSIS Jacq. Forest, Signal Hill, St. Thomas.

OLEACEAE

FORESTIERA SEGREGATA (Jacq.) Krug & Urban. [*Myrica segregata* Jacq.; *Forestiera porulosa* Poir; *F. porulosa Jacquinii* Eggers.] Thickets, St. Croix.

FORESTIERA EGGERSIANA Krug & Urban. Thickets, St. Thomas; St. Jan. Known otherwise only on Culebra, Vieques and Virgin Gorda, thus endemic in the Virgin Islands.

FORESTIERA RHAMNIFOLIA Griseb. [*Drypetes laevigata* of Millspaugh.] Bluffs of Salt River, St. Croix.

MAYEPAEA CARIBAEA (Jacq.) Kuntze. [*Chionanthus caribaea* Jacq.; *C. compacta* Sw.; *Linociera compacta* R. Br.] Forests, St. Thomas; St. Croix.

JASMINUM SAMBAC (L.) Soland. [*Nyctanthes Sambac* L.; *J. quinqueflorum* Heyne.] Spontaneous after planting, St. Croix.

Jasminum pubescens (Retz) Willd. [*Nyctanthes pubescens* Retz.] Spontaneous after planting, St. Thomas; St. Croix.

Jasminum grandiflorum L. [*J. officinale* of Millspaugh.] Spontaneous after planting, St. Thomas; St. Croix.

Jasminum officinale L. Planted for ornament.

Jasminum humile L. [*J. revolutum* Sims.] Planted for ornament.

Olea europaea L. Planted on St. Thomas.

LOGANIACEAE

Spigelia Anthelmia L. Moist or exsiccated situations, St. Thomas; St. Croix.

APOCYNACEAE

Allamanda cathartica L. Spontaneous after cultivation, St. Thomas.

Plumiera alba L. Coastal rocks and hills, St. Thomas; St. Jan; St. Croix.

Plumiera rubra L. [*P. obtusifolia* of Millspaugh.] Planted for ornament.

Plumiera obtusa L. St. Croix (according to West); naturalized in gardens (according to Eggers).

Catharanthus roseus (L.) D. Don. [*Vinca rosea* L.; *Lochnera rosea* Rchb.] Waste grounds, spontaneous after cultivation, and much planted for ornament, St. Thomas; St. Jan; St. Croix.

Tabernaemontana capensis L. Planted for ornament.

A species of *Tabernaemontana* was found in thickets at Frenchman's Bay, St. Thomas, according to Eggers, who, doubtfully, records it as *T. citrifolia*.

Rauwolfia tetraphylla L. [*R. nitida* Jacq.] Woods, hillsides and thickets, St. Thomas; St. Jan; St. Croix.

Rauwolfia Lamarckii A. DC. Hillsides and thickets, St. Thomas; St. Jan; St. Croix.

Cerbera Thevetia L. [*Thevetia Thevetia* Millsp.; *T. neriifolia* Juss.] Hillsides and thickets, St. Thomas; St. Jan; St. Croix.

Echites agglutinata Jacq. [*E. circinalis* Sw.] Forests and thickets, St. Thomas; St. Jan; St. Croix at Cane Bay (according to Eggers).

Urechites lutea (L.) Britton. [*Vinca lutea* L.; *Echites suberecta* Jacq.; *E. barbata* Desv.; *E. neriandra* Griseb.] Thickets, St. Thomas; St. Jan; St. Croix (according to Eggers).

Nerium Oleander L. Persistent after cultivation; planted for ornament; St. Thomas; St. Jan; St. Croix.

ASCLEPIADACEAE

ASCLEPIAS CURASSAVICA L. [*A. nivea curassavica* Kuntze.] Fields, hillsides and banks, St. Thomas; St. Jan; St. Croix.

ASCLEPIAS NIVEA L. Collected on St. Thomas by Krebs.

ASCLEPIAS FRUTICOSA L. Cultivated on St. Croix (according to West).

CALOTROPIS PROCERA (Ait.) Ait. f. [*Asclepias procera* Ait.] Fields and hillsides, St. Thomas; St. Jan; St. Croix. Naturalized.

METASTELMA PARVIFLORUM R. Br. [*M. Schlechtendalii* of Eggers and of Millspaugh.] Thickets, St. Thomas; St. Croix.

METASTELMA ALBIFLORUM Griseb. St. Thomas (according to Schlechter).

METASTELMA DECIPIENS Schlechter. St. Thomas (according to Schlechter).

METASTELMA GRISEBACHIANUM Schlechter. St. Thomas. Otherwise known only from Porto Rico.

METASTELMA DECAISNEANUM Schlechter. Hillsides, St. Thomas; St. Jan; St. Croix.

The above-listed species of *Metastelma* much resemble each other. It is possible that Schlechter has recognized too many species in the area.

OXYPETALUM CORDIFOLIUM (Vent) Schlechter. [*Gothofreda cordifolia* Vent.; *O. riparium* H.B.K.] St. Thomas (according to Schlechter).

PHILIBERTELLA CLAUSA (Jacq.) Vail. [*Asclepias viminalis* Sw.; *Sarcostemma Brownei* Meyer], recorded as from St. Thomas by West and by Eggers, has not been observed there by recent collectors.

FISCHERIA CRISPIFLORA (Sw.) Schltr. [*Cynanchum crispiflorum* Sw.; *F. scandens* DC.] Forests, Spring-gut, St. Croix (according to Eggers). Known otherwise only from Cuba and Jamaica; the determination is doubtful.

IBATIA MARITIMA (Jacq.) Dcne. [*Asclepias maritima* Jacq.; *Ibatia muricata* Griseb.] Rocky hillsides and thickets, St. Thomas; St. Jan; St. Croix.

HOYA CARNOSA (L. f.) R. Br. Cultivated for ornament.

STEPHANOTIS FLORIBUNDA A. Brongn. Cultivated for ornament.

CUSCUTACEAE

CUSCUTA AMERICANA L. On trees and shrubs, St. Thomas; St. Jan; St. Croix.

CONVOLVULACEAE

EVOLVULUS NUMMULARIUS L. Dry, shaded situations, St. Thomas; St. Jan; St. Croix.

Evolvulus glaber Spreng. [*E. mucronatus* Sw.] Moist, grassy situations, St. Thomas; St. Jan; St. Croix.

Evolvulus linifolius L. St. Thomas and St. Croix (according to Schlechtendal); moist localities, all islands (according to Eggers). Not found by us, and not known on Porto Rico.

Jacquemontia nodiflora (Desr.) G. Don. [*Convolvulus nodiflorus* Desr.; *C. albiflorus* West (hyponym).] Thickets, St. Thomas; St. Jan; St. Croix.

Jacquemontia jamaicensis (Jacq.) Hall. f. [*Convolvulus jamaicensis* Jacq.] Coastal thickets, St. Thomas; St. Croix.

Jacquemontia pentantha (Jacq.) G. Don. [*Convolvulus pentanthus* Jacq.; *C. violaceus* Vahl; *J. violacea* Choisy.] Thickets, St. Thomas; St. Jan; St. Croix.

Convolvulus matutinus West and C. venenatus West, described from St. Croix, are not further identified.

Thyella tamnifolia (L.) Raf. [*Ipomoea tamnifolia* L.; *Jacquemontia tamnifolia* Griseb.] Banks, hills and thickets, St. Thomas; St. Jan (according to Eggers); St. Croix.

Exogonium solanifolium (L.) Britton. [*Ipomoea solanifolia* L.; *I. filiformis* Jacq.; *Convolvulus filiformis* Desr.; *Exogonium filiforme* Choisy; *Ipomoea eustachiana* of Millspaugh.] Coastal thickets, St. Thomas; St. Croix.

Exogonium repandum (Jacq.) Choisy. [*Ipomoea repanda* Jacq.] Woods and forests, St. Thomas; St. Jan.

Exogonium arenarium Choisy. [*Ipomoea arenaria* Steud.; *I. Steudelii* Millsp.; *I. Eggersiana* Peter; *E. Eggersii* House.] Thickets, St. Thomas; St. Jan; St. Croix.

Ipomoea dissecta (Jacq.) Pers. [*Convolvulus dissectus* Jacq.; *Merremia dissecta* Hall. f.; *Operculina dissecta* House; *Ipomoea sinuata* Ort.] Thickets, fences and woods, St. Thomas; St. Jan; St. Croix.

Ipomoea aegyptia L. [*Convolvulus pentaphyllus* L.; *Ipomoea pentaphylla* Jacq.; *Merremia aegyptia* Urban.] Fields, fences and thickets, St. Thomas; St. Jan; St. Croix.

Ipomoea quinquefolia L. [*Merremia quinquefolia* Hall. f.] Thickets, St. Thomas; St. Croix.

Ipomoea polyanthes R. & S. [*Convolvulus umbellatus* L.; *Ipomoea umbellata* Meyer, not L.; *Merremia umbellata* Hall. f.; *Ipomoea mollicoma* Miq.; *Convolvulus sagittifer* H.B.K.] Fields, banks and thickets, St. Thomas; St. Jan; St. Croix.

Ipomoea Nil (L.) Roth. [*Convolvulus Nil* L.; *Pharbitis Nil* Choisy; *I. hederacea barbata* of Kuntze; ? *Convolvulus hederaceus* of Schlechtendal.] Banks, waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

IPOMOEA CATHARTICA Poir. [*Convolvulus acuminatus* Vahl; *Ipomoea acuminata* R. & S., not R. & P.; *Pharbitis cathartica* Choisy; *P. acuminata* Choisy.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

IPOMOEA ASARIFOLIA (Desr.) R. & S. [*Convolvulus asarifolius* Desr.] Danish Islands (according to Grisebach).

IPOMOEA PES-CAPRAE (L.) Roth. [*Convolvulus Pes-caprae* L.; *C. brasiliensis* L.; *C. maritimus* Lam.] Coastal sands, St. Thomas; St. Jan; St. Croix.

IPOMOEA STOLONIFERA (Cyr.) Poir. [*Convolvulus littoralis* L.; *C. arenarius* Vahl; *Ipomoea littoralis* Boiss.; *Convolvulus stoloniferus* Cyr.; *Ipomoea acetosaefolia* R. & S.] Coastal sands, St. Croix (according to West).

IPOMOEA HEPTAPHYLLA (Rottl. & Willd.) Voigt. [*Convolvulus heptaphyllus* Rottl. & Willd.; *Ipomoea pulchella* Griseb., not Roth.] St. Thomas (according to Urban).

IPOMOEA CARNEA Jacq. St. Croix (according to West).

IPOMOEA TRILOBA L. [*Convolvulus Sloanei* Spreng.; *I. parviflora* Vahl; *I. triloba eustachiana* of Eggers; *I. triloba quinqueloba* Kuntze.] Fields, banks and thickets, St. Thomas; St. Jan; St. Croix.

IPOMOEA TILIACEA (Willd.) Choisy. [*Convolvulus tiliaceus* Willd.; *C. fastigiatus* Roxb.; *I. fastigiata* Sweet; *I. Batatus fastigiata* Kuntze.] Thickets and hillsides, St. Thomas; St. Jan; St. Croix.

IPOMOEA BATATAS (L.) Lam. [*Convolvulus Batatas* L.; *Ipomoea pandurata cuspidata* Kuntze.] Persistent after cultivation, St. Thomas; St. Jan; St. Croix. Much planted for food.

IPOMOEA TRICOLOR Cav. [*I. violacea* Grisebach, and of Eggers and Millspaugh.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

IPOMOEA PURPUREA (L.) Lam. [*Convolvulus purpureus* L.] St. Croix (according to West). Planted for ornament.

IPOMOEA LEARII Paxton. Planted for ornament.

IPOMOEA PES-TIGRIDIS L. [*Convolvulus Pes-tigridis* L.] St. Thomas (according to Schlechtendal).

IPOMOEA HORSFALLIAE W. Hook. Planted for ornament.

IPOMOEA QUINQUEPARTITA (Vahl) R. & S. [*Convolvulus quinquepartitus* Vahl; *C. ovalifolius* West, not Vahl,] of St. Croix, is not further identified.

IPOMOEA LEUCANTHA Jacq., a South American species, is recorded by Eggers from St. Thomas and St. Croix.

OPERCULINA TRIQUETRA (Vahl) Hallier f. [*Convolvulus triqueter* Vahl; *Ipomoea triquetra* R. & S.] St. Thomas; St. Croix.

OPERCULINA TUBEROSA (L.) Meissn. [*Ipomoea tuberosa* L.] Forests, St. Thomas; St. Croix (according to Eggers).

Calonyction aculeatum (L.) House. [*Convolvulus aculeatus* L.; *Ipomoea Bona-nox* L.] Spontaneous after cultivation, St. Thomas. Planted for ornament.

Calonyction tuba (Schlecht.) Colla. [*Convolvulus tuba* Schlecht.; *Ipomoea tuba* G. Don.] Coastal thickets, St. Thomas; St. Jan; St. Croix.

Quamoclit Quamoclit (L.) Britton. [*Ipomoea Quamoclit* L.; *Quamoclit vulgaris* Choisy.] Banks, thickets and cultivated grounds, St. Thomas; St. Croix.

Quamoclit coccinea (L.) Moench. [*Ipomoea coccinea* L.; *I. hederaefolia* L.; *I. sanguinea* Vahl.] Banks, thickets and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Rivea tiliifolia (Desr.) Choisy. [*Convolvulus tiliifolius* Desr.; *Argyreia tiliifolia* Wright; *Convolvulus melanostictus* Schl.] Thickets, St. Thomas; St. Jan; St. Croix.

POLEMONIACEAE

Phlox Drummondii Hook. Grown in flower gardens.

HYDROPHYLLACEAE

Marilaunidium jamaicense (L.) Kuntze. [*Nama jamaicensis* L.; *Hydrolea jamaicensis* Vahl.] Dry, rocky situations, St. Thomas; St. Croix.

CORDIACEAE

Cerdana alliodora R. & P. [*Cordia Gerascanthus* Jacq., not L.; *C. Gerascanthus subcanescens* of Eggers.] Woods and forests, St. Thomas; St. Jan.

Sebesten Sebestena (L.) Britton. [*Cordia Sebestena* L.; *C. Ricksecker*i Millsp.] Coastal thickets, hillsides, and planted for ornament, St. Thomas; St. Jan; St. Croix.

Sebesten brachycalyx (Urban) Britton. [*Cordia Sebestena brachycalyx* Urban.] Rocky hillside, Buck Island, St. Thomas. Known otherwise only from Porto Rico.

Cordia alba (Jacq.) R. & S. [*Varronia alba* Jacq.] Thickets and hillsides, St. Thomas; St. Croix. Sometimes planted.

Cordia collococca L. [*C. micrantha* Sw.] Woods, forests and hills, St. Thomas; St. Jan; St. Croix.

Cordia nitida Vahl. [? *C. laevigata* of Schlechtendal.] Forests and hills, St. Thomas; St. Jan; St. Croix.

Cordia sulcata DC. [*C. macrophylla* R. & S.] Forests and hills, St. Thomas; St. Jan; St. Croix (according to West).

Varronia corymbosa (L.) Desv. [*Lantana corymbosa* L.; *Cordia* *ulmifolia* Juss.; *C. ulmifolia* and varieties of Eggers.] Thickets, fields and hillsides, St. Thomas; St. Jan; St. Croix.

VARRONIA ANGUSTIFOLIA West. [*Cordia angustifolia* R. & S.; *C. cylindrostachya* and varieties of Eggers; *C. cylindrostachya* of Millspaugh.] Hillsides and thickets, St. Thomas; St. Croix (type locality).

CORDIA MARTINICENSIS R. & S. is accredited to St. Croix by Grisebach (Fl. 481); the record probably refers to *V. angustifolia.*

VARRONIA GLOBOSA Jacq. [*Cordia globosa* H.B.K.]. Thickets, St. Thomas and St. Croix (according to West, Schlechtendal and Eggers).

BOURRERIA SUCCULENTA Jacq. [*Ehretia Bourreria* L.] Forests, hillsides and thickets, St. Thomas; St. Jan; St. Croix.

ROCHEFORTIA ACANTHOPHORA (DC.) Griseb. [*Ehretia acanthophora* DC.; (?) *Ehretia spinosa* Jacq.] Thickets, St. Thomas; St. Jan; St. Croix (according to West and to Eggers).

BORAGINACEAE

TOURNEFORTIA FILIFLORA Griseb. [*T. foetidissima* DC. and of Eggers, not L.] St. Jan (according to Eggers); St. Croix (according to West).

TOURNEFORTIA HIRSUTISSIMA L. Thickets, banks and hills, St. Thomas; St. Jan; St. Croix.

TOURNEFORTIA BICOLOR Sw. [*T. laevigata* Lam.] Among rocks, Crown, St. Thomas.

TOURNEFORTIA LAURIFOLIA Vent., attributed to St. Thomas by Ventenat and by de Candolle, is known to us only from Porto Rico.

TOURNEFORTIA VOLUBILIS L. Thickets, St. Thomas; St. Jan; St. Croix (according to Eggers).

TOURNEFORTIA MICROPHYLLA Bert. [*T. volubilis microphylla* DC.; *T. volubilis microcarpa* of Millspaugh.] Thickets, St. Thomas; St. Jan; St. Croix.

MALLOTONIA GNAPHALODES (L.) Britton. [*Heliotropium gnaphalodes* L.; *Tournefortia gnaphalodes* R. Br.] Coastal sands, St. Thomas; St. Jan; St. Croix.

HELIOTROPIUM CURASSAVICUM L. Saline soil, St. Thomas; St. Jan; St. Croix.

HELIOTROPIUM PARVIFLORUM L. Banks, hillsides, waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

HELIOTROPIUM INDICUM L. Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

HELIOTROPIUM TERNATUM Vahl. [*Heliotropium fruticosum* L., in part, and of Eggers and Millspaugh.] Rocky thickets and hillsides, St. Thomas; St. Jan; St. Croix.

HELIOTROPIUM PERUVIANUM L. Cultivated in flower gardens.

VERBENACEAE

LANTANA CAMARA L. [*L. scabrida* Ait.] Thickets and hillsides, St. Thomas; St. Jan; St. Croix.

LANTANA ACULEATA L. [*L. polyacantha* Schauer.] Waste grounds, St. Thomas; St. Croix.

LANTANA INVOLUCRATA L. [*L. odorata* L.; *Camara involucrata* Kuntze.] Thickets and hillsides. St. Thomas; St. Jan; St. Croix.

LANTANA RETICULATA Pers. Stony ground, King's Hill, St. Croix (according to Eggers).

LIPPIA REPTANS H.B.K. [*Lippia nodiflora* of Eggers and of Millspaugh.] Wet ground, St. Croix.

LIPPIA TRIPHYLLA (L'Her.) Kuntze. [*Aloysia citriodora* Ort.] Cultivated in gardens.

BOUCHEA PRISMATICA (L.) Kuntze. [*Verbena prismatica* L.; *B. Ehrenbergii* Cham.] Waste and cultivated grounds, St. Thomas; St. Croix.

VALERIANODES JAMAICENSIS (L.) Medic. [*Verbena jamaicensis* L.; *Stachytarpheta jamaicensis* Vahl; *Valerianodes jamaicensis indicus* Kuntze.] Fields, hills, banks and in cultivated grounds, St. Thomas; St. Jan; St. Croix.

VALERIANODES STRIGOSA (Vahl) Kuntze. [*Stachytarpheta strigosa* Vahl.] Thickets and hillsides, St. Thomas; St. Jan.

PRIVA LAPPULACEA (L.) Pers. [*Verbena lappulacea* L.; *V. mexicana* of West; *P. echinata* Juss.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

CITHAREXYLUM FRUTICOSUM L. [*C. cinereum* L.; *C. villosum* Jacq.] Woods, hills and thickets, St. Thomas; St. Jan; St. Croix.

CITHAREXYLUM SPINOSUM L. [*C. quadrangulare* Jacq.] Forests and slopes, St. Thomas; St. Croix. Planted for shade.

DURANTA ERECTA L. [*D. Plumieri* Jacq.; *D. Ellisia* Jacq.; ? *D. repens* L.] Thickets and hillsides, St. Thomas; St. Jan; St. Croix. Sometimes planted for ornament.

CALLICARPA RETICULATA Sw., accredited to St. Croix by West, is a little-known species of Jamaica; what plant West had in mind is not further recorded.

AEGIPHILA MARTINICENSIS Jacq. Forests, St. Thomas; St. Croix, common (according to Eggers).

PETITIA DOMINGENSIS Jacq. In forests, St. Croix, not common (according to Eggers).

VITEX DICARICATA Sw. Forests, St. Thomas; St. Jan; St. Croix (according to Eggers), and recorded from St. Croix by Swartz.

VITEX AGNUS-CASTUS L. Planted for ornament.

VOLKAMERIA ACULEATA L. [*Clerodendron aculeatum* Schlecht.; *C. aculeatum grandifolium* and *parvifolium* Kuntze; ? *C. longicollis* of Borgesen and Paulsen.] Thickets, St. Thomas; St. Jan; St. Croix.

CLERODENDRON FRAGRANS Vent. [*C. fragrans pleniflora* Schauer.] Waste grounds, St. Thomas.

SIPHONANTHUS INDICUS L. [*Clerodendron Siphonanthus* R. Br.] Woods near Grove Place and at Crequis, St. Croix. Apparently naturalized. Planted for ornament.

AVICENNIA NITIDA Jacq. [*A. tomentosa* Jacq.; *A. officinalis nitida* Kuntze.] Coastal swamps and lagoons, St. Thomas; St. Jan; St. Croix.

PETRAEA VOLUBILIS Jacq. Planted for ornament.

HOL MSKOLDIA SANGUINEA Retz. Planted for ornament.

VERBENA ICHAMAEDRIFOLIA Juss. Planted for ornament.

LAMIACEAE

LEONOTIS NEPETIFOLIA (L.) R. Br. [*Phlomis nepetifolia* L.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

LEONURUS SIBIRICUS L. Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

MOLUCCELLA LAEVIS L. St. Croix (according to West).

LEUCAS MARTINICENSIS (Jacq.) R. Br. [*Clinopodium martinicense* Jacq.] Waste and cultivated grounds, St. Croix.

SALVIA THOMASIANA Urban. [*S. tenella* of Schlechtendal and of Eggers.] St. Thomas. Endemic. Known only from a specimen collected long ago by Ehrenberg.

SALVIA OCCIDENTALIS Sw. [*S. occidentalis bicolor* Kuntze.] Banks, fields and thickets, St. Thomas; St. Jan; St. Croix.

SALVIA SEROTINA L. [*S. dominica* Sw.; *S. micrantha* Vahl.] Banks, fields and hillsides, St. Thomas; St. Jan; St. Croix.

SALVIA COCCINEA B. Juss. [*S. coccinea ciliata* Griseb.; *S. coccinea pseudococcinea* Kuntze.] Hillsides, waste and cultivated grounds, St. Thomas; St. Croix; St. Jan.

MENTHA AQUATICA L. Naturalized along rivulets, Caledonia, St. Croix, not seen flowering (according to Eggers). Perhaps, if the flowers were known, referable to some other species.

HYPTIS CAPITATA Jacq. [*Mesosphaerum capitatum* Kuntze.] Moist grounds, St. Thomas; St. Jan; St. Croix.

HYPTIS SUAVEOLENS (L.) Poir. [*Ballota suaveolens* L.; *Mesosphaerum suaveolens* Kuntze.] Thickets, waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Hyptis pectinata (L.) Poir. [*Nepeta pectinata* L.; *Mesosphaerum pectinatum* Kuntze.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Hyptis verticillata Jacq. [*Mesosphaerum verticillatum* Kuntze.] St. Thomas (according to Bentham and to Grisebach).

Coleus amboinicus Lour. Banks and hillsides, naturalized, St. Thomas; St. Jan (according to Eggers); St. Croix.

Ocimum micranthum Willd. Banks, fields and hillsides; St. Thomas; St. Jan; St. Croix.

Ocimum Basilicum L. Grown as a garden herb.

Rosmarinus officinalis L. Grown as a garden herb.

Thymus vulgaris L. Grown as a garden herb.

Origanum Majorana L. Grown as a garden herb.

SOLANACEAE

Physalis angulata L. [*P. ramosissima* Mill.; *P. Linkiana* Griseb., not Nees.] Fields, banks, waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Physalis pubescens L. [*P. angulata dubia* Kuntze.] Dry soil, waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Physalis turbinata Medic. Dry soil, St. Jan; St. Croix.

Physalis Eggersii O. E. Schulz. Water Island, St. Thomas. Endemic. A species known only from the type specimen. We searched Water Island for it in 1913, but could find nothing answering the description.

Physalis peruviana L., recorded by Eggers as found in fields at Rapoon, St. Thomas, prior to 1879, was, apparently, erroneously determined (see Schulz in Urban, Symb. Ant. **6**: 149).

Capsicum frutescens L. Roadsides and woods, St. Thomas; St. Jan; St. Croix.

Capsicum baccatum L. [*Capsicum annuum baccatum* Kuntze.] Thickets, banks and woods, St. Thomas; St. Jan; St. Croix (according to Eggers).

Capsicum annuum L. Cultivated for food.

Capsicum dulce Dunal. Cultivated for food.

Solanum lanceifolium Jacq. King's Hill, St. Jan.

Solanum jamaicense Mill. St. Thomas, collected by Richard (according to Poiret).

Solanum nigrum L. [*S. americanum* Mill.; *S. nigrum nodiflorum* A. Gray; *S. nodiflorum* Dunal, not Jacq.] Thickets, waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Solanum Seaforthianum Andr. Spontaneous after cultivation, St. Thomas; St. Croix. Planted for ornament.

SOLANUM VERBASCIFOLIUM L. Hillsides and thickets, St. Thomas; St. Jan; St. Croix.

SOLANUM CONOCARPUM L. C. Rich. Coral Bay, St. Jan. Endemic.

SOLANUM MUCRONATUM O. E. Schulz. St. Thomas; St. Jan; otherwise known only from Porto Rico.

SOLANUM MAMMOSUM L. Waste grounds, St. Croix.

SOLANUM PERSICIFOLIUM Dunal. [*S. persicifolium Belloi* O. E. Schulz; *S. persicifolium parvifolium* (Vahl) O. E. Schulz.] Hillsides and thickets, St. Thomas; St. Jan; St. Croix.

SOLANUM RACEMOSUM L. [*S. ignaeum* L.; *S. bahamense* of Eggers.] Thickets, St. Thomas; St. Jan; St. Croix.

SOLANUM TORVUM Sw. Hillsides, woods and waste grounds, St. Thomas; St. Jan; St. Croix.

SOLANUM POLYGAMUM Vahl. [*S. inclusum* and *S. inclusum albiflorum* of Eggers; *S. polygamum thomae* Kuntze; *S. hirtum* of Borgesen & Paulsen.] Thickets, St. Thomas; St. Jan; St. Croix.

SOLANUM ACULEATISSIMUM Jacq. Naturalized by mules from Montevideo at Frederiksted, St. Croix (according to Eggers).

SOLANUM TUBEROSUM L. Cultivated for food.

SOLANUM MELONGENA L. [*S. insanum* L.] Cultivated for food.

SOLANUM MACROCARPUM L. Cultivated on St. Croix (according to Schulz).

SOLANUM PSEUDOCAPSICUM L. Cultivated for its fruit.

LYCOPERSICUM LYCOPERSICUM (L.) Karst. [*Solanum Lycopersicum* L.; *Lycopersicum esculentum* Mill.; *L. cerasiforme* Dunal.] Spontaneous after cultivation for food, St. Thomas; St. Jan; St. Croix.

DATURA STRAMONIUM L. [*Datura Tatula* L.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

DATURA METEL L. Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

DATURA FASTUOSA L. Spontaneous after cultivation, St. Thomas; St. Jan; St. Croix.

DATURA SUAVEOLENS H. & B. Cultivated for ornament.

CESTRUM NOCTURNUM L. Forests, Rogiers and Joshee Gut, St. Jan (according to Eggers). Planted on St. Croix.

CESTRUM LAURIFOLIUM L'Her. [*C. diurnum* of West and of Eggers; *C. laurifolium neglectum* Kuntze.] Forests and thickets, St. Thomas; St. Jan; St. Croix.

CESTRUM ALTERNIFOLIUM (Jacq.) O. E. Schulz. [*Ixora alternifolia* Jacq.; *Cestrum vespertinum* L.] St. Thomas (according to O. E. Schulz).

NICOTIANA TABACUM L. Spontaneous after cultivation, St. Thomas; St. Jan; St. Croix.

BRUNFELSIA AMERICANA L. [*B. americana pubescens* Griseb.] Thickets and hillsides, St. Thomas; St. Jan; St. Croix. Sometimes planted for ornament.

Petunias are planted in gardens.

SCROPHULARIACEAE

MECARDONIA PROCUMBENS (Mill.) Small. [*Erinus procumbens* Mill.; *Herpestis chamaedryoides* H.B.K.; *Lindernia dianthera* Sw.; *Monniera dianthera* Millsp.] Wet grounds, St. Croix.

HERPESTIS STRICTA Schrad., accredited to St. Thomas by Bentham, according to Eggers, is probably an error in record.

BRAMIA MONNIERA (L.) Drake. [*Gratiola Monniera* L.; *Herpestis Monniera* H.B.K.; *Monniera Monniera* Britton; *M. calycina* Kuntze.] Wet sandy or muddy situations, St. Thomas; St. Jan; St. Croix.

CAPRARIA BIFLORA L. [*C. biflora pilosa* of Eggers.] Fields, banks, waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

VANDELLIA DIFFUSA L. St. Croix (according to Eggers).

SCOPARIA DULCIS L. [*Capraria dulcis* Kuntze.] Wet or moist situations and in cultivated grounds, St. Thomas; St. Jan; St. Croix.

RUSSELLIA EQUISETIFORMIS Schl. & Cham. [*R. juncea* Zucc.] Cultivated for ornament.

MAURANDYA BARCLAYANA Lindl. Cultivated for ornament.

BIGNONIACEAE

MACRODISCUS LACTIFLORUS (Vahl) Bureau. [*Bignonia lactiflora* Vahl; *Distictis lactiflora* DC.] Thickets and roadsides, St. Croix. Cultivated on St. Thomas (according to Eggers).

CYDISTA AEQUINOCTIALIS (L.) Miers. [*Bignonia aequinoctialis* L.; *B. spectabilis* Vahl.] Forests and thickets, St. Thomas; St. Jan; St. Croix.

BATOCYDIA UNGUIS (L.) Mart. [*Bignonia Unguis* L.] Forests, St. Thomas; St. Jan; St. Croix.

MACROCATALFA LONGISSIMA (Jacq.) Britton. St. Thomas (according to Grisebach). The record is probably erroneous.

TABEBUIA HETEROPHYLLA (DC.) Britton. [*Raputia* (?) *heterophylla* DC.; *Tecoma Berterii* of Eggers, not DC.; *Tecoma triphylla* of Kuntze; *Tecoma Leucoxylon* Mart.; *Tecoma pentaphylla Leucoxylon* Kuntze.] Dry thickets, especially near the coasts, St. Thomas; St. Jan.

TABEBUIA PALLIDA Miers. [*Bignonia pentaphylla* L.; *Tecoma pentaphylla* Juss., not *Tabebuia pentaphylla* Hemsl.; *T. Leucoxylon* of Eggers.] Forests and hills and much planted for shade, St. Thomas; St. Jan; St. Croix.

TECOMA STANS (L.) Juss. [*Bignonia stans* L.; *Stenolobium stans* Seem.; *Gelseminum stans* Kuntze.] Thickets and hillsides, St. Thomas; St. Jan; St. Croix. Sometimes planted for ornament.

TECOMARIA CAPENSIS (Thunb.) Spach. [*Bignonia capensis* Thunb.; *Tecoma capensis* Lindl.] Roadsides, St. Thomas. Planted for ornament, St. Thomas; St. Croix.

ENALLAGMA LATIFOLIA (Mill.) Small. [*Crescentia latifolia* Mill.; *Crescentia cucurbitina* L.; *C. cucurbitina heterophylla* Kuntze; *E. cucurbitina* Baill.] Forests near rivulets, St. Thomas; St. Jan; St. Croix.

CRESCENTIA CUJETE L. Forests, hillsides and much planted for its fruit, St. Thomas; St. Jan; St. Croix.

CRESCENTIA LINEARIFOLIA Miers. Collected by Oersted on St. Thomas (according to Miers); coastal hill, Lamosure, St. Jan.

PEDALIACEAE

SESAMUM ORIENTALE L. [*S. indicum* L.] Spontaneous after cultivation, St. Thomas. Cultivated for its seeds.

MARTYNIACEAE

MARTYNIA ANNUA L. [*M. diandra* Glox.] Waste and cultivated grounds, St. Thomas; St. Croix.

ACANTHACEAE

THUNBERGIA FRAGRANS Roxb. [*T. volubilis* Pers.] Hedges and thickets and along ditches, St. Thomas; St. Jan; St. Croix.

THUNBERGIA ALATA Bojer. Banks and waste grounds, St. Thomas. St. Jan; St. Croix. Planted for ornament.

BLECHUM BROWNEI Juss. [*B. Brownei subcordatum* and (?) *laxum* Kuntze.] Fields, banks, woods and thickets, St. Thomas; St. Jan; St. Croix.

RUELLIA TUBEROSA L. [*R. clandestina* L.] Grassy situations, St. Thomas; St. Jan; St. Croix.

RUELLIA COCCINEA (L.) Vahl. [*Barleria coccinea* L.; *Stemonacanthus coccineus* Griseb.] Thickets, St. Thomas; St. Jan; St. Croix.

RUELLIA STREPENS L., recorded by de Candolle as found on St. Croix by Isert, must be an error in locality; the specimen is preserved in the Willdenow herbarium.

GERARDIA TUBEROSA L. [*Stenandrium tuberosum* Urban; *S. rupestre* Nees.] Rocky woods and thickets, St. Thomas; St. Jan.

ANTHACANTHUS SPINOSUS (Jacq.) Nees. [*Justicia spinosa* Jacq.; *A. microphyllus* and *A. jamaicensis* of Eggers; *Jasminum coeruleum*

Kuntze.] Woods, hillsides and thickets, St. Thomas; St. Jan; St. Croix.

Anthacanthus acicularis (Sw.) Nees, attributed by West and by Lindau to St. Croix, is known to me only from Jamaica. [*Justicia acicularis* Sw.]

Odontonema nitidum (Jacq.) Kuntze. [*Justicia nitida* Jacq.; *Thyrsacanthus nitidus* Nees.] St. Thomas and St. Croix, at least formerly.

Drejerella mirabiloides (Lam.) Lindau. [*Justicia mirabiloides* Lam.; *Beleperone nemorosa* of Eggers.] Shaded situations, St. Thomas; St. Jan; St. Croix.

Diapedium assurgens (L.) Kuntze. [*Justicia assurgens* L.; *Dicliptera assurgens* Juss.] Banks, thickets and waste grounds, St. Thomas; St. Jan; St. Croix.

Justicia periplocifolia Jacq. [*J. reflexiflora* Vahl and var. *glandulosa* Eggers; *Ecbolium reflexiflorum* Kuntze.] Thickets, St. Thomas; St. Jan; St. Croix.

Justicia pectoralis Jacq. [*Dianthera pectoralis* Gmelin.] Waste and cultivated moist grounds, St. Thomas; St. Jan (according to Eggers); St. Croix.

Justicia sessilis Jacq. [*J. pauciflora* Vahl; *Dianthera sessilis* Gmelin; *Siphonoglossa sessilis* Oerst.] Thickets and hillsides, St. Thomas; St. Jan; St. Croix.

Justicia carthaginensis Jacq. Woodlands, hillsides and waste grounds, St. Thomas; St. Croix.

Justicia secunda Vahl. Thickets, St. Croix (according to Lindau).

Barleria lupulina Lindl. Waste grounds, St. Thomas; St. Jan.

Barleria hirsuta Jacq., recorded from St. Thomas by West, is a species unknown to modern botanists except from description and the published illustrations of Jacquin (Obs. 2: *pl. 32*; Icon. Pict. *pl. 172*); it has been referred to *Duggena spicata* of the Rubiaceae, but the description of its flowers does not apply to that plant.

Crossandra infundibuliformis (L.) Nees. Cultivated for ornament.

Graptophyllum pictum (L.) Griff. [*G. hortense* Nees.] Cultivated for ornament.

Pseuderanthemum bicolor (Schrank) Radlk. [*Justicia bicolor* Sims.] Cultivated for ornament.

Eranthemum nervosum R. Br. Cultivated for ornament.

Pachystachys coccinea Nees. Cultivated for ornament.

MYOPORACEAE

Bontia daphnoides L. Coastal thickets, St. Thomas; St. Jan; St. Croix at Turner's Hole (according to Eggers).

PLANTAGINACEAE

Plantago major L. [*P. major tropica* Griseb.] Waste grounds, St. Thomas; St. Croix.

RUBIACEAE

Oldenlandia corymbosa L. Waste places, Government House yard, St. Croix (according to Eggers).

Oldenlandia callitrichoides Griseb. Gregarious among stones, Government House, St. Croix (according to Eggers).

Rondeletia pilosa Sw. [*R. triflora* Vahl.] Thickets, St. Thomas; St. Jan; near Cave Bay, St. Croix (according to Eggers).

Exostema caribaeum (Jacq.) R. & S. [*Cinchona caribaea* Jacq.] Thickets and hillsides, St. Thomas; St. Jan; St. Croix.

Duggena spicata (Lam.) Standley. [*Lygistum spicatum* Lam.; *Gonzalia spicata* DC.; *Gonzalagunia spicata* Maza.] Grassy situations on high hills, St. Thomas; St. Jan.

Randia formosa (Jacq.) K. Schum. [*Mussaenda formosa* Jacq.; *Gardenia armata* Sw.; *Randia Mussaenda* DC.] Roadsides, St. Croix. Planted for ornament.

Randia aculeata L. [*R. latifolia* Lam.; *Gardenia Randia* Sw.; *R. aculeata mitis* of Eggers.] Thickets, woods and hillsides, St. Thomas; St. Jan; St. Croix.

Genipa americana L. Forests on the higher hills, St. Thomas; St. Jan.

Hamelia patens Jacq. Valleys and hillsides, St. Croix; St. Thomas (according to Eggers).

Hamelia axillaris Sw. [*H. lutea* Rohr.] Forests and wet thickets, St. Thomas; St. Croix.

Catesbaea melanocarpa Krug & Urban. [*C. parviflora* of Eggers, not Sw.] Thickets, Fair Plain, St. Croix (according to Eggers).

Guettarda scabra (L.) Lam. [*Matthiola scabra* L.; *G. rugosa* Sw.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

Guettarda parviflora Vahl. [*G. parvifolia* Sw.] Thickets, woods and hillsides, St. Thomas; St. Jan; St. Croix.

Guettarda elliptica Sw. Hillside near Charlotte Amalia, St. Thomas.

Stenostomum lucidum (Sw.) Gaertn. f. [*Laugeria lucida* Sw.; *Antirrhoea lucida* Hook.] Forests, St. Thomas; St. Croix.

ERITHALIS FRUTICOSA L. [*E. odorifera* Jacq.] Thickets along the coast, St. Thomas; St. Jan; St. Croix.

CHIOCOCCA ALBA (L.) Hitchc. [*Lonicera alba* L.; *C. racemosa* L.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

CHIONE VENOSA (Sw.) Urban. [*Jacquinia venosa* Sw.; *Chione glabra* DC.] In forests, rare, not seen flowering, Fair Plain, St. Croix and Soldier Bay, St. Thomas (according to Eggers). Found on Tortola, according to A. Richard.

SCOLOSANTHUS VERSICOLOR Vahl. Thickets, St. Thomas; St. Jan; St. Croix. Known otherwise only from Porto Rico and Vieques.

COFFEA ARABICA L. [*C. liberica* of Millspaugh.] Spontaneous after cultivation, St. Thomas; St. Jan; St. Croix. Cultivated for coffee.

IXORA FERREA (Jacq.) Benth. [*Sideroxyloides ferreum* Jacq.] Forests and rocky hill-tops; St. Thomas; St. Jan.

IXORA STRICTA Roxb. Planted for ornament.

IXORA BANDHUCA Roxb. Planted for ornament.

PSYCHOTRIA PINNULARIS Sessé & Moç. [*P. horizontalis* Griseb. and of Eggers and of Millspaugh, not Sw.] Thickets, St. Thomas; St. Jan; St. Croix.

PSYCHOTRIA UNDATA Jacq. [*P. glabrata* of Eggers.] Thickets, St. Thomas; St. Jan; St. Croix.

PSYCHOTRIA BROWNEI Spreng. [*C. asiatica* of West; *C. tenuifolia* of Millspaugh.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

PSYCHOTRIA TENUIFOLIA Sw. Thickets, Crown, St. Thomas (according to Eggers and cited also by Urban); St. Croix (according to West).

PSYCHOTRIA PUBESCENS Sw. St. Thomas (according to Urban).

PALICOUREA DOMINGENSIS (Jacq.) DC. [*Psychotria domingensis* Jacq.; *P. Pavetta* Sw.; *Palicourea Pavetta* DC.; *P. Pavetta rosea* Eggers.] Forests and thickets, St. Thomas; St. Jan; St. Croix.

GEOPHILA HERBACEA (Jacq.) K. Schum. [*Psychotria herbacea* Jacq.; *G. reniformis* C. & S.] In dense woods, Signal Hill and St. Peter, St. Thomas (according to Eggers); wooded hill, Bordeaux, St. Jan.

FARAMEA OCCIDENTALIS (L.) A. Rich. [*Ixora occidentalis* L.; *Faramea odoratissima* DC.] Forests and thickets, St. Thomas; St. Jan; St. Croix, at least formerly.

MORINDA CITRIFOLIA L. Roadsides and thickets, St. Thomas; St. Croix.

ERNODEA LITTORALIS Sw. Coastal sands, St. Thomas; St. Jan; St. Croix.

DIODIA RIGIDA C. & S. Dry soil, St. Thomas.

DIODIA MARITIMA Thonn. [*D. radicans* of Borgesen and Paulsen.] Coastal sands, Water Island, St. Thomas.

DIODIA SARMENTOSA Sw. St. Thomas (according to Schlechtendal).

BORRERIA LAEVIS (Lam.) Griseb. [*Spermacoce laevis* Lam.; *Borreria vaginata* Cham. & Schl.] Dry soil, St. Thomas; St. Jan; St. Croix.

BORRERIA OCIMOIDES (Burm. f.) DC. [*Spermacoce ocimoides* Burm. f.; *Borreria parviflora* Meyer.] Banks, fields, waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

BORRERIA VERTICILLATA (L.) Meyer. [*Spermacoce verticillata* L.; *B. stricta* DC., not Meyer.] Grassy places, St. Thomas; St. Croix (according to Eggers).

SPERMACOCE TENUIOR L. [*S. tenuior angustifolia* Eggers.] Banks, fields, waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

GARDENIA JASMINOIDES Ellis. [*G. florida* L.] Planted for ornament.

PORTLANDIA GRANDIFLORA L. Planted for ornament.

VANGUERIA EDULIS Vahl. [*Varanga edulis* Vahl] Cultivated on St. Croix (according to West).

CAPRIFOLIACEAE

LONICERA JAPONICA Thunb. Planted for ornament.

LONICERA CAPRIFOLIUM L. Cultivated (according to Eggers).

SAMBUCUS NIGRA L. Cultivated (according to Eggers).

CUCURBITACEAE

MELOTHRIA GUADALUPENSIS (Spreng) Cogn. [*Bryonia guadalupensis* Cogn.; *M. pervaga* Griseb.] Thickets, St. Thomas; St. Jan; St. Croix.

MELOTHRIA FLUMINENSIS Gardn. [*M. pendula* Meyer.] St. Croix (according to West and to Cogniaux).

CORALLOCARPUS EMETOCATHARTICUS (Gros.) Cogn. [*Doyerea emetocathartica* Grosourdy; *Anguria glomerata* Eggers; *Corallocarpus glomeratus* Cogn.] Forests, St. Thomas; St. Croix.

ANGURIA PLUMIERIANA Schl. [*A. trilobata* West and of Eggers.] St. Croix.

MOMORDICA CHARANTIA L. Hedges, fences and waste grounds, St. Thomas; St. Jan; St. Croix.

MOMORDICA BALSAMINA L. Cultivated for its fruit, St. Croix.

LUFFA CYLINDRICA (L.) Roemer. [*Momordica cylindrica* L.; ? *M. operculata* of West.] Spontaneous after cultivation, St. Thomas; St. C roix.

Luffa acutangula (L.) Roxb., accredited to St. Thomas by Cogniaux as collected by Finlay, was really from Trinidad.

Cucumis Anguria L. Fields and banks, St. Thomas; St. Jan; St. Croix.

Cucumis sativus L. Cultivated for its fruit.

Cucumis Melo L. Cultivated for its fruit.

Cucurbita Lagenaria L. [*Lagenaria vulgaris* Ser.; *L. vulgaris viscosa* Eggers; *L. Lagenaria* Cockerell.] Waste grounds, spontaneous after cultivation, St. Thomas; St. Croix. Cultivated for its fruit.

Cucurbita ficifolia Bouché is recorded by Millspaugh as escaped from cultivation on St. Croix.

Pepo moschata (Duch.) Britton. [*Cucurbita moschata* Duch.; *C. Pepo* of Eggers.] Spontaneous after cultivation, St. Thomas; St. Croix.

Cayaponia americana (Lam.) Cogn. [*Bryonia americana* Lam.; *B. ficifolia* Vahl; *Trianosperma graciliflora* Griseb.; *T. ficifolia* of Eggers; *Cayaponia graciliflorum* Griseb.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

Sechium edule (Jacq.) Sw. Cultivated for its fruit.

Citrullus Citrullus (L.) Karst. [*C. vulgaris* Schrad.] Cultivated for its fruit.

Coccinia cordifolia (L.) Cogn. [*Cephalandra indica* Naud.] Cultivated; recorded by Eggers as naturalized in shaded valleys, St. Croix.

LOBELIACEAE

Isotoma longiflora (L.) Presl. [*Lobelia longiflora* L.] Moist banks, fields and hillsides, St. Thomas; St. Jan; St. Croix (according to Eggers).

GOODENIACEAE

Scaevola Plumierii (L.) Vahl. [*Lobelia Plumierii* L.] Coastal sands, St. Thomas; St. Croix.

CICHORIACEAE

Sonchus oleraceus L. Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Lactuca intybacea Jacq. [*Brachyramphus intybaceus* DC.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Lactuca sativa L. Cultivated for salad.

AMBROSIACEAE

Xanthium longirostre Wallr. [*X. orientale* of Schlechtendal; *X. macrocarpum* of Eggers; *X. strumarium* of Millspaugh; *X. echi-*

natum of Urban.] Waste and cultivated grounds, St. Thomas; all islands (according to Eggers).

AMBROSIA CUMANENSIS H.B.K. [*A. artemisiaefolia trinitensis* Griseb.] Waste places, St. Croix (according to Eggers).

CARDUACEAE

STRUCHIUM SPARGANOPHORUM (L.) Kuntze. [*Ethulia sparganophora* L.; *Sparganophorus Vaillantii* Crantz.] Moist grounds, St. Thomas (according to Eggers).

VERNONIA SERICEA L. C. Rich. [*Lepidoploa phyllostachya* Cass.; *Vernonia arborescens Swartziana, Lessingiana* and *divaricata* of Eggers; *V. arborescens* of Schlechtendal and of Millspaugh; *V. phyllostachya* Gleason; *Cacalia arborescens Lessingiana* Kuntze.] Thickets, St. Thomas; St. Jan; St. Croix.

VERNONIA ALBICAULIS Pers. [*V. longifolia* Pers.; *V. Vahliana* Less.; *V. thomae* Benth.; *V. punctata* of Eggers and of Millspaugh; *Cacalia thomae* Kuntze; ? *Conyza fruticosa* of West.] Thickets, St. Thomas; St. Jan; St. Croix.

VERNONIA CINEREA (L.) Less. [*Conyza cinerea* L.] Waste and cultivated grounds, St. Thomas; St. Croix.

PIPTOCOMA RUFESCENS Cass. Thickets, Water Island, St. Thomas; St. Jan.

ELEPHANTOPUS MOLLIS H.B.K. [*E. tomentosus* of Millspaugh.] Banks, fields and hillsides, St. Thomas; St. Jan; St. Croix.

PSEUDELEPHANTOPUS SPICATUS (Juss.) Rohr. [*Elephantopus spicatus* Juss.; *Distreptus spicatus* Rohr.] Banks, fields, hillsides and cultivated grounds, St. Thomas; St. Jan; St. Croix.

AGERATUM CONYZOIDES L. [*Carelia conyzoides robusta* Kuntze.] Banks, fields and roadsides, St. Thomas; St. Jan; St. Croix.

EUPATORIUM MACROPHYLLUM L. [*Hebeclinium macrophyllum* DC.] Forests, St. Thomas; St. Croix (according to West and to Eggers).

EUPATORIUM ODORATUM L. [*E. conyzoides* Vahl.] Banks, hillsides and thickets, St. Thomas; St. Jan; St. Croix.

EUPATORIUM CUNEIFOLIUM Willd., cited by Eggers from DeCandolle (Prodr. 5: 177) as from St. Thomas, was not from our island St. Thomas.

EUPATORIUM ATRIPLICIFOLIUM Lam. [*E. repandum* Willd.; *Erigeron atriplicifolium* of Millspaugh.] Hillsides and coastal thickets, St. Thomas; St. Jan; St. Croix.

EUPATORIUM SINUATUM Lam. [*E. canescens* Vahl.] Rocky thickets, St. Thomas (according to DeCandolle); rocky hillsides, St. Jan; St. Croix.

EUPATORIUM TRIPLINERVE Vahl. [*E. Ayapana* Vent.] Cultivated on St. Croix.

EUPATORIUM CAPILLIFOLIUM (Lam.) Small. [*E. foeniculaceum* Willd.] Cultivated on St. Croix (according to Millspaugh).

MIKANIA CORDIFOLIA (L. f.) Willd. [*Cacalia cordifolia* L. f.; ? *Eupatorium denticulatum* of Schlechtendal; *Mikania gonoclada* DC.; *Willughbaea cordifolia* Kuntze; *W. gonoclada* Millsp.] Thickets, St. Thomas; St. Jan; St. Croix.

ERIGERON CUNEIFOLIUS DC. Grassy places and banks on the higher hills, St. Thomas; St. Jan.

ERIGERON SPATHULATUS Vahl. Grassy situations, St. Thomas; St. Jan; St. Croix.

LEPTILON PUSILLUM (Nutt.) Britton. [*Erigeron pusillum* Nutt.; *Erigeron canadense* of Schlechtendal and of Eggers; *Leptilon canadense* of Millspaugh.] Grassy places, waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

LEPTILON LINIFOLIUM (Willd.) Small. [*Erigeron linifolium* Willd.; *Conyza ambigua* DC.] Waste grounds, St. Thomas.

PLUCHEA PURPURASCENS (Sw.) DC. [*Conyza purpurascens* Sw.; *P. camphorata* of Millspaugh.] Wet grounds, St. Thomas; St. Croix.

PLUCHEA ODORATA (L.) Cass. [*Conyza odorata* L.; *C. carolinensis* Jacq.; *P. odorata normalis* Kuntze.] Thickets and hillsides and in cultivated grounds, St. Thomas; St. Jan; St. Croix.

BACCHARIS DIOICA Vahl. [*B. Vahlii* DC.] Coastal rocks, St. Croix.

EGLETES PROSTRATA (Sw.) Kuntze. [*Matricaria prostrata* Sw.; *Pyrethrum simplicifolium* Willd.; *E. domingensis* Cass.] Sandy shores, St. Thomas.

PTEROCAULON VIRGATUM (L.) DC. [*Gnaphalium virgatum* L.; *Conyza virgata* L.; *Pluchea virgata* Schl.] Hillsides and banks, St. Thomas; St. Jan; St. Croix.

NOCCA MOLLIS (Cav.) Jacq. [*Lagascea mollis* Jacq.] Waste grounds, St. Thomas.

MELAMPODIUM DIVARICATUM (L. C. Rich.) DC. [*Dysodium divaricatum* L. C. Rich.; *M. paludosum* H.B.K.] Ditches, St. Croix.

PARTHENIUM HYSTEROPHORUS L. Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

CRASSINA MULTIFLORA (L.) Kuntze. [*Zinnia multiflora* L.] Roadsides and banks, St. Thomas; St. Jan.

CRASSINA ELEGANS (Jacq.) Kuntze. Grown in flower gardens.

VERBESINA ALBA L. [*Eclipta alba* Hassk.; *E. punctata* L.; *E. erecta* L.] Wet grounds, St. Thomas; St. Jan; St. Croix.

ACANTHOSPERMUM HISPIDUM DC. [*A. humile* of Eggers.] Waste and cultivated grounds, St. Thomas; St. Croix.

Borrichia arborescens (L.) DC. [*Buphthalmum arborescens* L.; *B. argentea* DC.] Coastal rocks and sands, St. Thomas; St. Croix.

Wedelia trilobata (L.) Hitchc. [*Silphium trilobatum* L.; *W. carnosa* L. C. Rich.] Moist grounds, St. Thomas; St. Croix.

Wedelia calycina L. C. Rich. [*Buphthalmum helianthoides* of West.] Thickets, St. Thomas; St. Croix.

Wedelia parviflora L. C. Rich. [*W. buphthalmoides* of Eggers and of Millspaugh; *W. affinis* DC.; *W. acapulcensis* of Schlechtendal; *W. brachycarpa* of Millspaugh, St. Thomas; *Sereneum frutescens* of Kuntze.] Dry hills and thickets, St. Thomas; St. Jan.

Wedelia cruciana L. C. Rich. [*W. buphthalmoides* of Millspaugh.] Dry rocky soil, St. Croix. Endemic.

Eleutheranthera ruderalis (Sw.) Sch. Bip. [*Melampodium ruderale* Sw.; *Ogiera ruderalis* Griseb.; *Wedelia discoidea* Less.] Banks, fields and waste grounds, St. Thomas; St. Jan; St. Croix.

Melanthera canescens (Kuntze) O. E. Schulz. [*Amellus asper canescens* Kuntze; *M. Linnaei* of Schlechtendal; *M. deltoidea* of Eggers.] Hillsides and thickets, St. Thomas.

Tepion alatum (L.) Britton. [*Verbesina alata* L.] Waste and cultivated ground, St. Thomas; St. Croix.

Sclerocarpus africanus Jacq. Waste grounds, St. Thomas.

Synedrella nodiflora (L.) Gaertn. [*Verbesina nodiflora* L.; *Ucacou nodiflorum* Hitchc.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Bidens pilosa L. [*Coreopsis leucantha* L.; *B. leucantha* Willd.; *B. pilosa dubia* O. E. Schulz; ? *B. pilosa subbiternata* Kuntze.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Bidens cynapiifolia H.B.K. [*B. bipinnata* of West, of Eggers and of Millspaugh.] Waste and cultivated grounds, St. Thomas; St. Jan; St. Croix.

Cosmos caudatus H.B.K. [*Bidens Berteriana* Spreng.] Grassy fields, banks, and in waste grounds, St. Thomas; St. Jan; St. Croix.

Porophyllum Porophyllum (L.) Kuntze. [*Cacalia Porophyllum* L.; *Porophyllum ellipticum* Cass.] Waste grounds, St. Thomas.

Pectis humifusa Sw. [*P. serpyllifolia* Pers.] Stony banks, fields, and hillsides, St. Thomas; St. Jan; St. Croix.

Pectis linifolia L. [*Pectis punctata* Jacq.; *Pectidium punctatum* Less.] Rocky hillsides, banks and thickets, St. Thomas; St. Jan; St. Croix.

Pectis febrifuga H. van Hall. [*P. Swartziana* of Borgesen and Paulsen.] Grassy places, St. Thomas; St. Croix.

Neurolaena lobata (L.) R. Br. [*Conyza lobata* L.] Woodlands, St. Thomas.

Erechthites hieracifolia (L.) Raf. [*Senecio hieracifolius* L.; *E. praealta* Raf.; *E. hieracifolia cacalioides* of Eggers and of Kuntze.] Banks, fields, waste and cultivated grounds, St. Thomas; St. Croix.

Emilia sonchifolia (L.) DC. [*Cacalia sonchifolia* L.; *E. sonchifolia sagittata* of Kuntze.] Banks, fields, waste and cultivated grounds, St. Thomas; St. Croix; St. Jan.

Emilia sagittata (Vahl) DC. Grown in flower gardens.

Chaptalia nutans (L.) Polak. [*Tussilago nutans* L.; *Leria nutans* DC.] Woods and thickets, St. Thomas; St. Jan; St. Croix.

Chrysoganum dichotomum Vahl, of St. Croix, is unknown to me; it is certainly not a *Chrysoganum*.

Helianthus annuus L. Grown in gardens.

Chrysanthemum indicum L. [*Pyrethrum indicum* Cass.] Grown in gardens.

Aster chinensis L. Grown in gardens.

Tagetes patula L. Grown in gardens.

Tithonia tagetiflora Desf. [*T. speciosa* Hook.] Grown in gardens.

Georgina variabilis Willd. Grown in gardens (according to Eggers).

Tarchonanthus camphoratus L. Cultivated on St. Croix (according to Eggers).

PINACEAE

Thuja orientalis L. Planted for ornament.

Juniperus bermudiana L. Planted on St. Croix (according to West).

CYCADACEAE

Cycas revoluta Thunb. Planted for ornament.

PTERIDOPHYTA

CYATHEACEAE

Cyathea arborea (L.) J. E. Smith. [*Polypodium arboreum* L.; ? *C. Serra* of Kuhn.] Forests, high hills, St. Thomas.

POLYPODIACEAE

Dryopteris patens (Sw.) Kuntze. [*Polypodium patens* Sw.; *Aspidium patens* Sw.] Forests, high hills of St. Thomas; St. Croix.

Dryopteris oligophylla Maxon. [*Polypodium invisum* Sw.] St. Thomas (according to Christensen).

Dryopteris incisa (Sw.) Kuntze. [*Polypodium incisum* Sw.] St. Croix (West, according to Eggers).

DRYOPTERIS SPRENGELII (Kaulf.) Kuntze. [*Dryoteris Balbisii* Urban; *Polypodium Balbisii* Spreng.] St. Thomas (according to Kuhn).

DRYOPTERIS SERRA (Sw.) Kuntze. [*Polypodium serra* Sw.; *Tectaria incisa* Cav.; *Dryopteris serra incisa* Kuhn.] St. Thomas (according to Kuhn).

DRYOPTERIS MOLLIS (Jacq.) Hieron. [*Aspidium molle* Sw.] Forests, Signal Hill, St. Thomas; St. Jan; St. Croix (according to Millspaugh).

DRYOPTERIS TETRAGONA (Sw.) Urban. [*Polypodium tetragonum* Sw.] Forests, St. Thomas; St. Jan; St. Croix.

DRYOPTERIS POITEANA (Bory) Urban.]*Polypodium crenatum* Sw., not Forst; *Lastrea Poiteana* Bory.] St. Thomas and St. Croix (according to Eggers); St. Croix (according to West).

CYCLOPELTIS SEMICORDATA (Sw.) J. Smith. [*Polypodium semicordatum* Sw.; *Aspidium semicordatum* Sw.] Shaded localities, Virgin Islands (according to Eggers).

GYMNOPTERIS NICOTIANIFOLIA (Sw.) Presl. [*Acrostichum nicotianum* Sw.], attributed by Swartz to St. Thomas, was probably from Porto Rico.

NEPHROLEPIS EXALTATA (L.) Schott. [*Polypodium exaltatum* L.] Forests, St. Thomas; St. Croix. Cultivated on St. Croix (according to Millspaugh).

NEPHROLEPIS RIVULARIS (Vahl) Mett. [*Polypodium rivulare* Vahl.] St. Thomas (according to Kuhn).

NEPHROLEPIS BISERRATA (Sw.) Schott. [*Aspidium biserratum* Sw.; *Aspidium acutum* Schk.; *Nephrolepis acuta* Presl.; *Aspidium punctulatum* Sw.] Forests, St. Thomas (according to Eggers); St. Croix.

ODONTOSORIA ACULEATA (L.) J. Smith. [*Adiantum aculeatum* L.; *Davallia aculeata* J. E. Smith.] Pastures on high hills, St. Thomas.

ODONTOSORIA CLAVATA (L.) J. Smith, is doubtfully attributed to St. Thomas by Fée.

ASPLENIUM SERRATUM L. Forests, Signal Hill, St. Thomas.

ASPLENIUM PUMILUM Sw. Forests and wet banks, St. Thomas; St. Jan.

ASPLENIUM ABSCISSUM Willd. [*A. firmum* Kunze.] St. Thomas (according to Grisebach).

BLECHNUM OCCIDENTALE L. Banks, fields and forests, St. Thomas; St. Jan; St. Croix.

PITYOGRAMMA SULPHUREA (Sw.) Maxon. [*Gymnogramme sulphurea* Desv.]. Cultivated in gardens.

PITYOGRAMMA CALOMELANA (L.) Link. [*Acrostichum calomelanos* L.; *Gymnogramme calomelanos* Kaulf.; *G. calomelanos pumila* Eggers.] Banks, hills, walls and thickets, St. Thomas; St. Jan; St. Croix.

HEMIONITIS PALMATA L. Forests, wet banks and rocky thickets, St. Thomas; St. Jan; St. Croix.

DORYOPTERIS PEDATA (L.) Fée. [*Pteris pedata* L.] Forests and shaded banks, St. Thomas; St. Jan.

CHEILANTHES MICROPHYLLA Sw. [*Adiantum microphyllum* Sw.] Rocky slopes, St. Thomas; St. Croix (according to West and to Eggers).

ADIANTUM VILLOSUM L. Forests, St. Thomas; St. Croix.

ADIANTUM LATIFOLIUM Lam. [*A. denticulatum* Sw.; *A. intermedium* of Eggers; *A. obliquum intermedium* of Millspaugh.] Shaded banks, hills of St. Thomas.

ADIANTUM CRISTATUM L. [? *A. microphyllum* of Eggers.] Hillsides, St. Thomas.

ADIANTUM TENERUM Sw. Shaded banks and ravines on high hills, St. Thomas; St. Jan (according to Eggers); St. Croix.

ADIANTUM FRAGILE Sw. Thickets and walls, St. Thomas; St. Jan; St. Croix.

ADIANTUM FARLEYENSE Moore. Cultivated on St. Croix (*A. foliosum* of Millspaugh).

PYCNODORIA LONGIFOLIA (L.) Britton. [*Pteris longifolia* L.] Along rivulets in forests, St. Croix; in a water spout, St. Thomas.

PTERIS BIAURITA L. St. Thomas (according to Kuhn).

ANTROPHYUM LINEATUM (Sw.) Kaulf. [*Hemionitis lineata* Sw.] Forest, St. Peter, St. Thomas (according to Eggers).

PALTONIUM LANCEOLATUM (L.) Presl. [*Pteris lanceolata* L.; *Taenitis lanceolata* R. Br.; *Heteropteris lanceolata* Fée.] On rocks and trees in forests, St. Thomas; all islands (according to Eggers).

POLYPODIUM POLYPODIOIDES (L.) Hitchc. [*Acrostichum polypodioides* L.; *P. incanum* Sw.] On trees, St. Thomas; St. Jan; St. Croix (according to Eggers).

PHLEBODIUM AUREUM (L.) J. Sm. [*Polypodium aureum* L.] On trees and rocks, St. Thomas; St. Jan; St. Croix.

PHLEBODIUM AREOLATUM (H. & B.). J. Sm. [*Polypodium areolatum* H. & B.] On trees, St. Thomas; St. Jan.

LEPICYSTIS PILOSELLOIDES (L.) Diels. [*Polypodium piloselloides* L.] In forests among rocks, Signal Hill, St. Thomas.

PHYMATODES EXIGUUM (Hew.) Underw. [*Polypodium exiguum* Hew.; *P. serpens* Sw., not Forst.; *P. Swartzii* Baker.] On trees, Bordeaux, St. Jan; St. Croix.

CAMPYLONEURUM PHYLLITIDIS (L.) Presl. [*Polypodium Phyllitidis* L.; *P. Phyllitidis repens* of Eggers.] On rocks and trees in forests, St. Thomas; St. Jan; St. Croix.

CAMPYLONEURUM LATUM Moore. Shaded rocks, Bethania, St. Jan.

Acrostichum aureum L. [*Chrysodium vulgare* Fée.] Borders of marshes, St. Thomas; St. Croix.

OPHIOGLOSSACEAE

Ophioglossum reticulatum L. Grassy places among rocks, Crown, St. Thomas; shaded bank, Bordeaux, St. Jan.

LYCOPODIACEAE

Lycopodium cernuum L. Among rocks in higher hills, St. Thomas.

PSILOTACEAE

Psilotum nudum (L.) Griseb. [*Lycopodium nudum* L.; *P. triquetrum* Sw.] Shaded places among rocks, Signal Hill, St. Thomas; Bordeaux, St. Jan; Crequis, St. Croix.

BRYOPHYTA

MUSCI[4]

Dicranella longirostris (Schwaegr.) Mitten. [*Trematodon longirostris* Schwaegr.] St. Jan.

Leucoloma serrulatum Bridel. [*L. Riedlei* Besch.] On trees in wet woods, St. Thomas.

Octoblepharum albidum (L.) Hedw. [*Bryum albidum* L.] On roots of *Anthurium*, near Caret Bay, St. Thomas; St. Croix.

Fissidens kegelianus C. Muell. [*F. palmatus*—of various authors, not Swartz.] On banks, St. Thomas; St. Jan; St. Croix.

Fissidens elegans Bridel. On rocks and earth, St. Thomas; St. Jan.

Syrrhopodon flavescens C. Muell. On rotten wood, St. Jan.

Calymperes Richardi C. Muell. [*C. Breutelii* Besch.; *C. hexagonum* Besch.] On rocks and banks, St. Thomas.

Hymenostomum Breutelii (C. Muell.) Broth. [*Weisia Breutelii* C. Muell.; *Gymnostomum Breutelii* Br. & Sch.] On banks, St. Thomas; St. Jan; St. Croix.

Hyophila Tortula (Schwaegr.) Hampe. [*Gymnostomum Tortula* Schwaegr.] St. Croix.

Barbula agraria (Sw.) Hedw. [*Bryum agrarium* Sw.] On rocks, walls and earth, St. Thomas; St. Jan; St. Croix.

Barbula Cruegeri Lond. [*Hyophila uliginosa* E. G. Britton.] Bethania, St. Jan.

Phascum sessile E. G. Britton. On the ground, Cowell Point and Water Island, St. Thomas.

[4] Contributed by Elizabeth G. Britton.

Bryum Cruegeri Hampe. Bed of stream, Tutu, St. Thomas. Sterile.

Philonotis sphaerocarpa (Sw.) Bridel. [*Mnium sphaericarpum* Sw.] Moist banks, high hills of St. Thomas.

Philonotis tenella (C. Muell.) Jaeger. [*Bartramia tenella* C. Muell.] Wet banks, St. Jan.

Pireella cymbifolia (Sull.) Cardot. [*Pilotrichum cymbifolium* Sull.] On trees near Bethania, St. Jan.

Neckera disticha (Sw.) Hedw. [*Fontinalis disticha* Sw.] On trees, rarely on rocks, St. Peter, St. Thomas.

Neckera jamaicensis (Gmel.) E. G. Britton. [*Hypnum jamaicense* Gmel.] On trees, Bethania, St. Jan.

Callicostella Belangeriana (Besch.) Jaeger. [*Hookeria Belangeriana* Besch.] On stones, Bordeaux, St. Jan.

Stereophyllum leucostegum (Bridel) Mitten. [*Leskea leucostega* Bridel.] On wet or shaded rocks, St. Thomas; St. Jan.

Mittenothamnium diminutivum (Hampe) E. G. Britton. [*Hypnum diminutivum* Hampe.] On old wood, Bordeaux, St. Jan.

Taxithelium planum (Bridel) Mitten. [*Hypnum planum* Bridel.] Wet rocks, logs and tree-roots, St. Thomas; St. Jan.

Sematophyllum admistum (Sull.) Mitten. [*Hypnum admistum* Sull.] Shaded banks, stones and dead wood, St. Thomas; St. Jan.

Haplocladium microphyllum (Sw.) Broth. [*Hypnum microphyllum* Sw.] Shaded bank between Pearl and Bonne Resolution, St. Thomas.

Thuidium cymbifolium (Dz. & Mk.) Br. Jav. Shaded banks, St. Thomas.

Dendropogon rufescens Schimp., a Mexican species, has been credited to St. Thomas in Paris, Index, and accepted by Brotherus, but we have seen no specimens.

HEPATICAE OF ST. CROIX, ST. JAN, ST. THOMAS AND TORTOLA[5]

In the Synopsis Hepaticarum of Gottsche, Lindenberg and Nees von Esenbeck, published in 1844–47, three species of Hepaticae are listed from St. Croix, one from St. Jan, and one from St. Thomas. Another species, although listed from St. Kitts, was based in all probability on material from St. Jan. A seventh species has been listed from St. Jan by Stephani. These seven species, which are the only ones so far reported from the islands under discussion, deserve a few words of comment.

[5] Contributed by Alexander W. Evans, Yale University.

The first species, *Radula pallens* (Sw.) Dumort., is said to have been found "in St. Crucis insula," the record being based on a specimen in the Weber herbarium. This specimen was originally referred to *Jungermannia complanata* L. (*Radula complanata* Dumort.) by Weber,[6] but the later determination is probably correct.

The second species, *Lejeunea Montagnei* Gottsche, was based on material from the Mascarene Islands and is now regarded as a species of *Euosmolejeunea*. A specimen from St. Croix is listed in the Synopsis but is very problematical and would probably now be referred to some other species. Since the specimen in question has not been available for study, and since no later references to it are to be found in the literature, its status must be left in doubt.

The third species, *Lejeunea bethanica* Gottsche, is based on material collected by Breutel and is said to have come from "prope Bethaniam in Insula St. Christopheri." Many years later Stephani,[7] on the basis of a specimen in the Lindenberg herbarium at Vienna, quoted the species from St. Jan, referring it to the subgenus *Cheilo-Lejeunea*. Still later he apparently changed his ideas regarding the habitat of the plant, citing it from St. Kitts and redescribing it under the name *Cheilolejeunea bethanica* Steph.[8] In studying the Lejeuneae in the Lindenberg herbarium, the writer found two specimens labeled *Lejeunea bethanica*, both of which were collected by Breutel at Bethania, St. Jan. One of these is very fragmentary but is apparently referable to *Rectolejeunea phyllobola* (Nees & Mont.) Evans; the other, which is the specimen studied by Stephani, is (in the writer's opinion) referable to *Lejeunea* rather than to *Cheilolejeunea*. The species was originally described from a specimen in the Gottsche herbarium at Berlin, not available at the present time, and there is therefore a possibility that the actual type may have come from St. Kitts. The evidence, however, is against this view, and it seems permissible to assume that the specimen in the Lindenberg herbarium is identical with the type and that it formed a part of the same collection. Unfortunately *L. bethanica* has not again been collected on either St. Jan or St. Kitts.

The fourth species, *Lejeunea epiphyta* Gottsche, was described as "parasitans in *Lej. bethanica* in Insula St. Johannis prope Bethaniam (Breutel, Hb. G.)." This statement affords further proof that *L. bethanica* came from St. Jan. According to Stephani[9] the specimen of *L. epiphyta* in the Lindenberg herbarium should be referred to

[6] Prodr. Hist. Musc. Hepat. 59. 1815.
[7] Hedwigia **29**: 86. 1890.
[8] Sp. Hepat. **5**: 652. 1914.
[9] Hedwigia **29**: 90. 1890.

Lejeunea myriocarpa Nees & Mont., now *Cololejeunea myriocarpa* Evans.

The fifth species, *Anthoceros Breutelii* Gottsche, was said to have been collected near Friedensthal, St. Croix. This species, in 1858, was transferred by its author[10] to the genus *Notothylas*, where it is still retained. The following year Milde[11] showed that the type material of the species did not come from St. Croix but from the Corallberg, St. Jan. There is likewise a specimen from St. Jan in the Mitten herbarium, which is presumably a part of the original collection.

The sixth species, *Lejeunea linguaefolia* Tayl., was found "in Insula St. Thomas (Richard in Hb. Hk. a. 1814)." A specimen of this species in the Lindenberg herbarium is referred by Stephani[12] to *Brachiolejeunea corticalis* (Lehm. & Lindenb.) Schiffn., and the writer would make the same disposition of a specimen in the Mitten herbarium.[13] Recently, however, Stephani has apparently thrown doubt on the propriety of this reduction. In the fifth volume of his Species Hepaticarum (1912), on page 35, he includes *L. linguaefolia* among the species of *Ptychocoleus*, citing it as *Pt. linguaefolius* Steph., and adds that he has been unable to see the plant and that his diagnosis is simply a translation of the original description. On page 127, nevertheless, he again quotes *L. linguaefolia* among the synonyms of *B. corticalis*. Since Stephani's original reduction was based on the study of an actual specimen, the writer would regard *Pt. linguaefolius* as nothing more than an unnecessary synonym.

The seventh and last species, *Riccia Breutelii* Hampe, is described as new by Stephani in the first volume of his Species Hepaticarum (1898), on page 17, the habitat being given as "Insulae S'Kitts et S. Juan." Dr. Howe informs the writer that there is some question about the identity of the St. Kitts and St. Jan plants and it is therefore omitted from the following list, pending investigation of authentic material.

In February, 1913, a botanical exploration of the islands was carried on under the auspices of the New York Botanical Garden, the Carnegie Institution of Washington and the United States National Museum.[14] The Hepaticae collected by the various members of this expedition form the basis for the present report. The specimens from St. Thomas, unless otherwise noted, were collected by Mrs. Elizabeth G. Britton and Miss Delia W. Marble, those from St. Jan

[10] Bot. Zeit. **16** (Anhang): 21. 1858.
[11] Bot. Zeit. **17**: 50. 1859.
[12] Hedwigia **29**: 22. 1890.
[13] See Bull. Torrey Club **35**: 164. 1908.
[14] See Britton, N. L., Jour. N. Y. Bot. Gard. **14**: 99. 1913.

and Tortola by N. L. Britton and J. A. Shafer, and those from St. Croix by J. N. Rose. The report records also two specimens collected by C. H. Ostenfeld in 1914, one on St. Thomas and one on St. Jan.

1. RICCIA BRITTONII M. A. Howe.[15]

ST. THOMAS: on the ground, Water Island, *N. L. Britton, E. G. Britton & J. A. Shafer 148* (a much larger plant than the original).

2. PLAGIOCHILA LUDOVICIANA Sulliv.

ST. JAN: on wet rocks, Bethania, *360*. ST. THOMAS: on rocks, St. Peter, *1453*.

3. RADULA PALLENS (Sw.) Dumort.

ST. CROIX: without definite locality, collector unknown, cited in the Synopsis Hepaticarum.

4. COLOLEJEUNEA MYRIOCARPA (Nees & Mont.) Evans.

Lejeunea epiphyta Gottsche.

ST. CROIX: without definite locality. ST. JAN: near Bethania, *J. C. Breutel*. ST. THOMAS: on rotten wood, near Magin's Bay, *1317*. TORTOLA: on a rock, Road Town to High Bush, 325 m. alt., *786* (a trace only).

5. LEJEUNEA BETHANICA Gottsche.

Cheilolejeunea bethanica Steph.

ST. JAN: near Bethania, *J. C. Breutel*.

6. LEJEUNEA GLAUCESCENS Gottsche.

ST. THOMAS: on tree roots, Bonne Resolution, *441*.

7. LEJEUNEA MINUTILOBA Evans.

ST. THOMAS: St. Peter, *1251*, *1254*, *1255*; on stones, Crown, *1365* (type).

8. LEJEUNEA PILILOBA Spruce.

ST. CROIX: on bark of a tree, without definite locality. ST. JAN: at base of a tree, Rosenberg, 300 m. alt., *306*; on a shaded rock, Bordeaux, 350 m. alt., *571*. ST. THOMAS: on ridge north of Charlotte Amalia, *406*; Crown, *1365* (a trace only); on rotten wood, St. Peter, *1451*.

9. MICROLEJEUNEA LAETEVIRENS (Nees & Mont.) Evans.

ST. THOMAS: on *Anthurium* roots, Pearl to Bonne Resolution, *1340*; on fern roots, St. Peter, *1253*; on mountain behind Charlotte Amalia, *C. H. Ostenfeld 77*. TORTOLA: on a rock, Roadtown to High Bush, 325 m. alt., *786* (in part).

10. RECTOLEJEUNEA PHYLLOBOLA (Nees & Mont.) Evans.

ST. JAN: near Bethania, *J. C. Breutel* (specimen in the Lindenberg

[15] Determined by Marshall A. Howe.

herbarium, labeled *L. bethanica*); on *Clusia* roots, Bethania, *355*. St. Thomas: on roots of royal palm, Tutu, *423*. Tortola: on a rock, Roadtown to High Bush, 325 m. alt., *786* (in part); shaded rocks, High Bush, 375 m. alt., *815*.

11. Euosmolejeunea clausa (Nees & Mont.) Evans.
St. Thomas: shaded bank, Pearl to Bonne Resolution, *1339;* on the ground, St. Peter, *1455*.

12. Euosmolejeunea duriuscula (Nees) Evans.
St. Jan: shaded rocks, Bordeaux, 330 m. alt., *570*. St. Thomas: on rocks, St. Peter, *1452;* on rocks, Crown, *1454*.

13. Euosmolejeunea trifaria (Nees) Schiffn.
St. Thomas: on rocks, St. Peter, *1252;* on a rotten log, Crown, 450 m. alt., *1367*.

14. Taxilejeunea obtusangula (Spruce) Evans.
St. Jan: on a stone, Bordeaux, 400 m. alt., *582*.

15. Mastigolejeunea auriculata (Wils. & Hook.) Schiffn.
St. Jan: on a tree, Bethania to Rosenberg, *243;* on a wet rock, Bethania *356, 362;* on loose blocks, Little Cruz Bay, *C. H. Ostenfeld 391*. St. Thomas: on a rock, St. Peter, *1256;* on rocks in ravine below Tutu, *1290*.

16. Brachiolejeunea corticalis (Lehm. & Lindenb.) Schiffn.
Lejeunea linguaefolia Tayl.
Ptychocoleus linguaefolius Steph.
St. Thomas: without definite locality, *L. C. Richard*.

17. Frullania brasiliensis Raddi.
St. Jan: on wet rocks. Bethania, *363* (mostly, specimens without perianths and therefore somewhat doubtful).

18. Frullania Kunzei Lehm. & Lindenb.
St. Jan: on wet rocks, Bethania, *363* (a trace only); on rocks, Bordeaux, 300 m. alt., *550*.

19. Frullania squarrosa (R. Bl. & N.) Dumort.
St. Thomas: on rocks, ridge north of Charlotte Amalia, *407;* on rocks, Bonne Resolution, *440;* on rocks, Magin's Bay to Mafolie, *1313;* on rocks, Pearl to Bonne Resolution, *1338;* on a stone wall, Crown, 450 m. alt., *1364*.

20. Notothylas Breutelii Gottsche.
Anthoceros Breutelii Gottsche.
St. Jan: Corallberg, *J. C. Breutel* (type); without definite locality or collector's name (specimen in Mitten herbarium); Bordeaux, *528*. St. Thomas: on damp earth, Nisky, *N. L. Britton, E. G. Britton &*

D. W. Marble 76; hills north of Charlotte Amalia, *409;* on the ground, Magin's Bay to Mafolie, *1312*.

21. ANTHOCEROS PUNCTATUS L.
ST. THOMAS: in a mud hole, Crown, 450 m. alt., *1363*.

REPORT ON THE LICHENS OF ST. THOMAS AND ST. JAN[16]

The following report is based primarily upon a study of 90 numbers of lichens from St. Thomas and St. Jan Islands; from St. Thomas, 82 numbers collected by Dr. N. L. Britton, Mrs. E. G. Britton, and Miss Delia W. Marble, unless otherwise stated; from St. John, 8 numbers collected by Dr. N. L. Britton and Dr. J. A. Shafer. To these have been added a few species recorded by Nylander in Flora (**63**: 127. 1880) and two endemic species described by Mueller-Argau. Altogether, we have represented 30 genera with 69 species and varieties, of which three species and one variety are here described as new. The discussion of the characteristics of the lichen-flora will be confined to that of St. Thomas.

There is no peculiar element in the lichen-flora of St. Thomas comparable with the gelatinous rock-lichens of Mona Island (see Annals Missouri Bot. Gard. **2**: 35. 1915), or with the crustose and gelatinous rock-lichens of Bermuda (see Bull. Torrey Bot. Club **43**: 146–155. 1916). Such rock-lichens as occur on St. Thomas belong to widely distributed groups even where the actual species are more restricted in distribution. In fact the greater part of the lichen-flora is made up of species more or less common throughout the West Indies or even in the tropics of both hemispheres. It is probably safe to say that there are not more than half a dozen endemic species in St. Thomas. Of the three new species described in this paper, two occur elsewhere in the West Indies. The flora is comparatively rich in the variety of crustose bark-lichens, especially in the genera *Anthracothecium* with 5 species, *Arthonia* with 8 species, and *Opegrapha* with 5 species. It is rather surprising that only one *Graphis* and no *Trypethelium* should have been collected. On the whole the lichen-flora is rather commonplace. In the following list, stations outside of the Virgin Islands are noted for species, the range of which is limited or not well known.

LICHENS OF ST. THOMAS

1. DERMATOCARPON HEPATICUM (Ach.) Th. Fr. On soil, without definite locality, 151.

[16] Contributed by Lincoln W. Riddle, Wellesley College.

2. LEPTORAPHIS EPIDERMIDIS (Ach.) Th. Fr. On bark, Bordeaux, 1381.
3. PORINA DESQUAMESCENS Fée. Without data, 1288a.
4. PORINA NUCULA Ach. On *Erythrina*, St. Peter, 1444b, 1445.
5. PYRENULA LEUCOPLACA (Wallr.) Koerb. On bark, Smith's Bay, 1276a.
6. ANTHRACOTHECIUM BREUTELII Muell. Arg. Flora **68**: 339. 1885. On bark, without definite locality, collected by Breutel. Endemic.
7. ANTHRACOTHECIUM CANELLAE-ALBAE (Fée) Muell. Arg. On *Cephalocereus*, Smith's Bay, 1274a; on twigs of *Guettarda*, Crown, 450 m. altit., 1357. South America.
8. ANTHRACOTHECIUM LIBRICOLUM (Fée) Muell. Arg. On *Melicocca*, Tutu, 468a; on same, Smith's Bay, 1276, 1282; on *Erythrina*, St. Peter, 1444.
9. ANTHRACOTHECIUM OCHRACEOFLAVUM (Nyl.) Muell. Arg.

On bark of coconut palm, near Charlotte Amalia, 489; on *Trichilia*, Tutu, 467.

10. ANTHRACOTHECIUM PYRENULOIDES (Mont.) Muell. Arg. On bark, without definite locality, collected by Dr. Forel. Recorded by Nylander in Flora **63**: 127. 1880.
11. MELANOTHECA FOVEOLATA Muell. Arg. On bark, near Tutu, 1287. Cuba.
12. PARATHELIUM INDUTUM Nyl. On *Cephalocereus*, Smith's Bay, 1274; on bark, Bordeaux, 1382 in part. Porto Rico, Colombia.
13. PARMENTARIA ASTROIDEA Fée. On bark, Bordeaux, 1382 in part.
14. ARTHONIA ANEGADENSIS Riddle Mem. New York Bot. Gard. **6**: 579. 1916. On *Bontia*, Smith's Bay, 1286. Anegada.
15. ARTHONIA CONFERTA (Fée) Nyl. On *Plumeria*, Tutu, 1484.
16. ARTHONIA GREGARIA (Weig.) Koerb. On bark, Bordeaux, 1380.
17. ARTHONIA OCHRACEELLA Nyl. On bark of old fallen branch, Crown, 450 m. altit., 1362. Cuba.
18. ARTHONIA RUBELLA (Fée) Nyl. On *Melicocca*, Tutu, 468b.
19. ARTHONIA SUBRUBELLA Nyl. Collected by Dr. Forel. Recorded by Nylander in Flora **63**: 127. 1880.
20. ARTHONIA.[17] On *Guilandina*, Smith's Bay, 1281 p.p.
21. ARTHONIA. On *Plumeria*, Tutu, 463.
22. ARTHOTHELIUM MACROTHECUM (Fée) Mass. On mango, St. Peter, 1247.
23. **Opegrapha acicularis** Riddle **sp. nov.**

Thallus epiphloeodes crustaceus effusus determinatus nigrolimitatus, albidus

[17] There are included in this paper three species of *Arthonia* the determination of which it has not been possible to complete in the time at my disposal. L. W. R.

vel albo-cinerascens, tenuis laevis subcontinuus. Apothecia sessilia nuda ad 0.8 mm. lata, primum orbicularia suburceolata, margine crenato, dein orbicularia oblonga vel subdifformia, disco late aperto plano rugoso atrofusco, margine laciniato partim stellato-radiato nitido nigro; epithecio fusco; hymenio incolore, 120–130 μ altit.; hypothecio incolore; amphithecio sub lamina deficiente, cetero crasso nigro. Paraphyses firmae crassae ramosae haud connexae. Asci cylindrices, 8-spori. Sporae incolores aciculares rectae vel subflexuosae vel rarius contortae, 20–24-loculares, cellulis cylindricis, 60–100 x 2–3 μ.

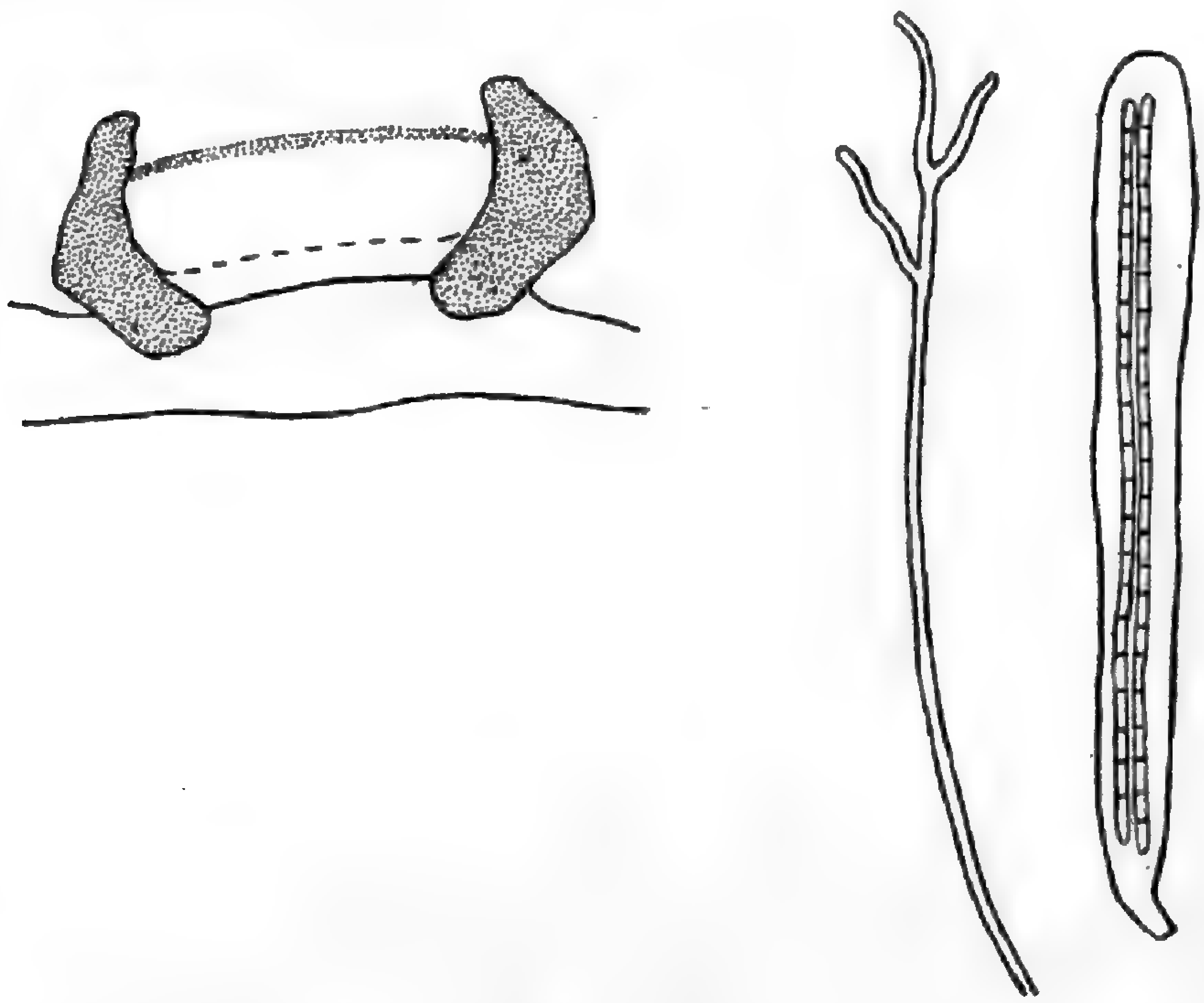

FIG. 1. *Opegrapha acicularis* Riddle. Vertical section of apothecium (stippling indicates dark coloration); paraphysis; ascus with two of the eight spores.

On bark of *Erythroxylon*, Punta Aguila, Porto Rico, collected by N. L. Britton, J. F. Cowell, and Stewardson Brown, Feb. 27, 1915, no. 4682 (**type**!). Also, on *Guilandina*, Smith's Bay, St. Thomas, 1276a, 1279; and on *Coccolobis*, Great Harbor Cay, Berry Islands, Bahamas, N. L. Britton and C. F. Millspaugh, no. 2545.

This is a striking and distinct species belonging to the section *Pleurothecium* of the genus *Opegrapha*. Externally it is easily recognizable by the marked tendency for the laciniate margin of the apothecia to spread out in a stellate manner. The spores resemble those of *Lecanactis myriadea* (Fée) Zahlbr. and of *Opegrapha pleistophragmoides* Nyl. But both of the species named have the black amphithecium complete at the base, and the spores are almost twice as thick.

24. OPEGRAPHA AGELAEA Fée. On *Crescentia*, Tutu, 462. Cuba, Colombia.

25. OPEGRAPHA ATRA Pers. On *Guilandina*, Smith's Bay, 1278a; on *Melicocca*, Smith's Bay, 1285.

26. Opegrapha Bonplandi Fée. On *Melicocca*, Magen's Bay, 1310; on bark, Mariendahl Road, 1476.
27. Opegrapha vulgata Ach. On *Melicocca*, Tutu, 468.
28. Graphis scripta (L.) Ach. On bark, Smith's Bay, 1277.
29. Phaeographis inusta (Ach.) Muell. Arg. On *Acacia*, near Charlotte Amalia, 486; on *Guilandina*, Smith's Bay, 1278; without locality, 464.
30. Chiodecton (Sect. Enterographa) sp. On *Erythrina*, St. Peter, 1445a.
31. Gyrostomum scyphuliferum (Ach.) Fr. On *Plumeria*, Tutu, 465; on *Acacia*, near Charlotte Amalia, 487, 494.
32. Bilimbia cuprea Massal. in Lotos (1856) 77.

    Lecidea cupreorosella Nyl. Mem. Soc. Sci. Nat. Cherb. **5**: 122. 1857.

    Biatora cupreorosella Tuck. Syn. N. A. Lich. **2**: 34. 1888.

    On old brick, St. Peter, 1442. Eastern United States, Europe.
33. Bacidia albescens (Arn.) Zwackn. On *Erythrina*, St. Peter, 1445b.
34. Cladonia pityrea f. squamulifera Wainio. On rocks, slope of Crown, 1440.
35. Leptogium chloromelum (Sw.) Nyl. On bark, Cowell Point, 103, 172; on *Pisonia* roots, Water Island, 153.
36. Leptogium tremelloides (L. f.) S. F. Gray. On tree-trunk, Crown, 1361.
37. Leptogium tremelloides var. caesium (Ach.) Hue. On rock near Bonne Resolution, 447.
38. Lecanora cinereocarnea (Eschw.) Wainio. Without data, 23a; on *Guilandina*, Smith's Bay, 1281.
39. Lecanora granifera Ach. On bark, Mariendahl Road, 1476a.
40. **Lecania euthallina** Riddle **sp. nov.**

Thallus crustaceus uniformis effusus crassus rimoso-areolatus, areolis 0.2–0.4 mm. latis leviter convexis contiguis, cinereus vel sat pallide fuscescens; hypothallo nullo. Gonidia cystococcoidea. Apothecia 0.6 mm. (0.4–1.0 mm.) lata, numerosa partim caespitosa superficialia sat elevata regularia, disco concavo castaneo vel fusco-nigricante nudo, margine proprio tenue disco concolore, margine thallino integro vel demum crenulato crasso prominente thallo concolore; epithecio fulvo; hymenio et hypothecio incolore. Asci 8-spori. Sporae incolores oblongae biloculares haud placodiomorphae, 10–12 x 4–5 μ.

On rock, Tutu, St. Thomas, collected by Dr. N. L. Britton, Mrs. E. G. Britton, and Miss Delia W. Marble, Feb. 8–9, 1913, no. 469 (**type**!).

Lecania euthallina differs from *L. erysibe* (Ach.) Th. Fr. in the much better developed thallus (whence the specific name), it being compact, thicker, and more continuous. Furthermore, the apothecia are more concave, with the persistent thalline margin more conspicuous.

41. Parmelia cetrata f. subisidiosa Muell. Arg. On tree-trunk, Crown, 1441 in part. North Carolina, Florida, Cuba, Jamaica.
42. Parmelia conspersa (Ehrh.) Ach. On rocks, Crown, 450 m. altit., 1358.
43. Parmelia latissima var. cristifera (Taylor) Hue. On tree-trunk, St. Peter, 1249; on twig, Crown, 1441 in part.
44. Parmelia perlata (L.) Ach. On rocks, near Bonne Resolution, 446; on *Spondias*, Mandal, 1311.
45. Ramalina complanata (Sw.) Ach. Without data, 1356a.
46. Ramalina gracilis (Pers.) Nyl. On twigs of *Guettarda*, Crown, 450 m. altit., 1356.
47. **Blastenia nigrocincta** Riddle **sp. nov.**

Thallus crustaceus arcte adnatus sat crassus, ambitu subradiato-laciniatus effiguratusque, centro rimoso-areolatus, areolis 0.4–0.8 mm. latis leviter convexa primum contiguis demum hypothallo nigro dispersis, cinereo-albescens dein fumosus aut partim luridus. Apothecia 0.3–0.5 mm. lata, superficialia dispersa vel partim caespitosa nuda, disco plano vel leviter convexa ferrugineo-aurantiaco, margine proprio sat tenue persistente nigro nitido, margine thallino nullo; excipulo externe coeruleo-nigro interne incolore; epithecio ferrugineo; hymenio incolore; hypothecio pallide fuscescente. Asci 8-spori. Sporae incolores ellipsoideae biloculares placodiomorphae, loculis poro tenue confluentibus, 12–14 x 5–6 μ.

On rock, Tutu, St. Thomas, collected by Mrs. E. G. Britton and Miss Delia W. Marble, Feb. 8–9, 1913, no. 469a (**type**!). Also, on limestone, Montalva, Porto Rico, N. L. Britton, J. F. Cowell, and Stewardson Brown, March 2–4, 1915, no. 4810.

This species is distinct in the contrasting coloration of the black margin and the orange disk of the apothecia, a character which will serve to distinguish it on the one hand from species with similar thalline characters, such as *Bl. Forstroemiana* (Fr.) Muell. Arg.; and on the other hand from *Bl. ferruginea* (Huds.) Koerb., where the disk and margin are concolorous, and from *Blastenia peragrata* (Fée) Muell. Arg., where the margin is black, but the disk is aeruginous-brown.

48. **Caloplaca diplacia** (Ach.) Riddle **comb. nov.**

Lecanora Ach. Synop. Lich. 154. 1814.

On rock, near Charlotte Amalia, 493, 495, 1485 in part. Also recorded by Nylander in Flora **63**: 127. 1880. Apparently confined to the West Indies.

49. Caloplaca murorum (Hoffm.) Th. Fr. On rock, near Charlotte Amalia, 1485 in part.

50. **Caloplaca subsequestra** (Nyl.) Riddle **comb. nov.**
Lecanora Nyl. Flora **63**: 127. 1880.
On rocks, without definite locality, collected by Dr. Forel. Endemic.

51. BUELLIA DISCOLOR (Hepp) Koerb. On rock, Tutu, 469b; without definite locality, collected by Dr. Forel, according to Nylander (l. c.). Europe.

52. BUELLIA PARASEMA var. AERUGINESCENS (Nyl.) Muell. Arg. On coconut near Charlotte Amalia, 489a.

53. **Buellia prospersa** (Nyl.) Riddle **comb. nov.**
Lecidia Nyl. Flora **63**: 127. 1880.
On rocks, without definite locality, collected by Dr. Forel. Endemic.

54. PYXINE COCOES (Sw.) Nyl. On bark, near Bonne Resolution, 445; on *Melicocca*, Tutu, 466.

55. PYXINE COCOES var. ENDOXANTHA Muell. Arg. On *Guilandina*, Smith's Bay, 1280; on bark, Mariendahl Road, 1475.

56. PYXINE MEISSNERI Tuck. On coconut palm, without definite locality, collected by Dr. J. N. Rose, 3198.

57. PHYSCIA ALBA (Fée) Muell. Arg. On *Erythrina*, St. Peter, 1443.

58. PHYSCIA CAESIA (Hoffm.) Nyl. On rocks, without definite locality, collected by Dr. Forel. Recorded by Nyl. Flora **63**: 127. 1880.

59. PHYSCIA CRISPA (Pers.) Nyl. On *Elaphrium*, near Charlotte Amalia, 491; on roots, same locality, 492, 496; on *Melicocca*, Tutu, 461.

60. PHYSCIA EROSULA Nyl. Flora **63**: 127. 1880. Based on material growing on rocks, St. Thomas, without definite locality, collected by Dr. Forel. Doubtfully distinct from the widely distributed *Physcia tribacia* (Ach.) Tuck.

61. PHYSCIA PICTA (Sw.) Nyl. On rock, St. Peter, 1260; on coconut palm, collected by Dr. J. N. Rose, 3197.

62. PHYSCIA SPECIOSA (Wulf.) Nyl. On rocks, near Charlotte Amalia, 405; on bark, St. Peter, 1248, 1250.

LICHENS OF ST. JAN

1. PYRENULA MAMILLANA (Ach.) Trev. On bark of *Icacorea*, Bordeaux, 597.

2. MELANOTHECA ACHARIANA Fée. On *Inga*, Bordeaux, 598. Cuba, Venezuela.

3. MYCOPORELLUM ELLIPTICUM Muell. Arg. Flora **72**: 508. 1889. On bark, without definite locality, collected by Levier, no. 113. Endemic.

4. ARTHONIA. On bark, Bordeaux, 577.
5. ARTHOTHELIUM MACROTHECUM (Fée) Mass. On *Icacorea*, Bordeaux, 540.
6. **Graphina nitidescens** (Nyl.) Riddle **comb. nov.**
   Fissurina Nyl. Lich. Japon. 108. 1890.
   On *Nectandra*, Bordeaux, 581. Florida, Cuba, Porto Rico.
7. OPEGRAPHA VULGATA Ach. On *Maytenus*, Little St. James Island, N. L. Britton & J. N. Rose, 1405.
8. **Leptogium marginellum** var. **isidiosellum** Riddle **var. nov.**

Thallus isidiis tenuibus dense tectus; ceterus ut in forma typica apothecia nulla.

On wet rock, road to Rosenberg, N. L. Britton & J. A. Shafer, Feb. 5–7, 1913, no. 276 (**type**!).

The fringed apothecia being such a characteristic feature of *Leptogium marginellum*, it is only after some hesitation that this material has been placed here. The texture and the wrinkling of the thallus is in exact agreement, however, with typical specimens. And the relation of this variety to the species is strictly comparable with the conditions in *L. tremelloides*, abundantly fruiting in the tropics, and its variety *caesium*, with isidia but very rarely fruiting; and with *L. phyllocarpum* and its variety *isidiosellum*.

9. PARMELIA TINCTORUM Despr. On tree-trunk, Bordeaux, 567.

The following lichens are recorded in "Le Végétation des Antilles Danoises" by F. Børgesen & Ove Paulsen in Revue Générale de Botanique **12**: 507, 508. 1900.

STICTA WEIGELII (Ach.) Wainio. St. Croix; St. Thomas.
GRAPHIS SCRIPTA (L.) Ach. St. Croix.
LECIDEA BUELLIANA Muell. Arg. St. Croix.
PERTUSARIA WULFENII (DC.) Fr. St. Croix.
PARMELIA PERLATA (L.) Ach. St. Thomas; St. Jan.
PARMELIA TINCTORUM Despr. [*P. coralloides* Mey. et Flot.] St. Croix.
PHYSCIA INTEGRATA Nyl. St. Jan.
RINODINA sp. St. Croix.
VERRUCARIA sp. St. Croix.
ARTHONIA RADIATA (Pers.) Ach. St. Croix.
SCHIZOXYLON sp. St. Thomas.

FUNGI

During our exploration of St. Thomas and St. Jan in 1913, about 25 species of fungi were obtained, and Dr. Rose collected four others on St. Croix; manuscript record has been made of these.

Twenty species collected by Mr. Ricksecker on St. Croix are listed by Dr. Millspaugh in his "Flora of the Island of St. Croix," as determined by J. B. Ellis and F. D. Kelsey.[18]

Thirty-one species brought by various collectors to Copenhagen, determined by E. Rostrop, are recorded by Børgesen and Paulsen in their "Végétation des Antilles Danoises."

Seven species, collected on St. Thomas during the voyage of the "Challenger," are listed by M. J. Berkeley in Journal of the Linnean Society **14**: 352.

These records duplicate each other considerably, indicating a known fungus flora of somewhat over fifty species only. Inasmuch as there must be several hundred species on the islands, a list of fungi is deferred for further mycological field work.

Algae[19]

"The Marine Algae of the Danish West Indies" is the title of a work, now appearing in parts, in which Dr. F. Børgesen, of Copenhagen, is carefully describing and adequately illustrating the seaweeds of these islands. His adoption of the English language in this work makes it immediately serviceable to American students. Volume 1, including the Chlorophyceae (Green Algae) and Phaeophyceae (Brown Algae), was published in 1913 and 1914, and, at the date of writing, the first 240 pages of Volume 2, dealing with the Rhodophyceae (Red Algae) have appeared. Other papers of importance, dealing with the algae of the Danish West Indies, are the following:

Borgesen, F. A Contribution to the Knowledge of the Marine Alga Vegetation on the Coasts of the Danish West Indian Islands. Bot. Tidssk. **23**: 49–57. Figs. 1–4. 1900.

—— Et Bidrag til Kundskaben om Algevegetationen ved Kysterne af Dansk Vestindien. Bot. Tidssk. **23**: 58–60. 1900. [An abstract, in Danish, of the foregoing article.]

—— Contributions à la connaissance du genre *Siphonocladus* Schmitz. Overs. K. Danske Vidensk. Selsk. Forh. **1905**: 259–291. Figs. 1–13. 1905.

—— An Ecological and Systematic Account of the Caulerpas of the Danish West Indies. K. Danske Vidensk. Selsk. Skr. VII. **4**: 337–392. Figs. 1–31. 1907.

—— The Dasycladaceae of the Danish West Indies. Bot. Tidsskr. **28**: 271–283. Figs. 1-9. 22 My 1908.

—— The Species of *Avrainvillea* Hitherto Found on the Shores of the Danish West Indies. Vidensk. Medd. Naturh. Foren. København **1908**: 27–44. pl. 33. Je 1908.

—— Some New or Little-known West Indian Florideae. Bot. Tidssk. **30**: 1–19. pls. 1, 2, Figs. 1–11. 23 O 1909; II. Bot. Tidssk. **30**: 177–207. Figs. 1–20. 9 D 1910.

—— Some Chlorophyceae from the Danish West Indies. Bot. Tidssk. **31**: 127–152. Figs. 1–13. 1911; II. Bot. Tidssk. **32**: 241–273. Figs. 1–17. 1912.

[18] The new species were described in Bull. Torr. Club **24**: 207–209. 1897.

[19] Contributed by Dr. Marshall A. Howe.

—— The Algal Vegetation of the Lagoons in the Danish West Indies. Biol. Arbejd. tilegn. Eug. Warming. 41–45. Figs. 1–9. 1911.

—— Two Crustaceous Brown Algae from the Danish West Indies. Nuova Notarisia 23: 123–129. Figs. 1–3. 1912.

—— The Species of *Sargassum* Found along the Coasts of the Danish West Indies, with Remarks upon the Floating Forms of the Sargasso Sea. 1–20. Figs. 1–8. 1914. [No. 32 of a Mindeskrift for Japetus Steenstrup.]

Cleve, Peter Theodor. Diatoms from the West Indian Archipelago. [Virgin Islands and St. Bartholomew.] Bih. Svens. Vet. Akad. Handl. 5^8: 1–22 pl. 1–5. 1878. Annot. list.

Dickie, George. Marine Algae Collected at St. Thomas during the Expedition of H. M. S. "Challenger." Jour. Linn. Soc. Bot. **14**: 312–313. 17 O 1874. List.

Millspaugh, C. F. Flora of the Island of St. Croix. Field Col. Mus. Bot. **1**: 441–546. 1902. On pp. 467, 468 is a list of 17 species of marine algae, determined by Professor W. G. Furlow.

Vahl, M. Endeel Kryptogamiske Planter fra St. Croix. Skrivt. Naturh. Selsk. 5^2: 29–47. 1802.

ENDEMIC SPECIES

The approximate number of species native to the islands as recorded, excluding fungi and algae, is 1,052, as follows:

Spermatophyta	890
Pteridophyta	41
Bryophyta	46
Lichenes	75
	1,052

The numbers of Spermatophyta and Pteridophyta are not likely to be increased by further exploration, but there are probably some more Bryophyta and many more lichens to be obtained. As we know the flora at the present time, the following 27 species are endemic, at least to the Virgin Island group as a whole.

Valota Eggersii (Hack.) Hitchc. & Chase
Agave Eggersiana Trelease
Peperomia myrtifolia (Vahl) A. Dietr.
Pilea Richardi Urban
Coccolobis Klotzchiana Meissn.
Zanthoxylum thomasianum Krug & Urban
Galactia Eggersii Urban
Malpighia pallens Small
Malpighia infestissima (Juss.) Rich.
Maytenus cymosa Krug & Urban
Reynosia Guama Urban
Sida Eggersii E. G. Baker
Psidium amplexicaule Pers.
Calyptranthes thomasiana Berg.

Eugenia sessiliflora Vahl
Chrysophyllum Eggersii Pierre
Forestiera Eggersiana Krug & Urban
Salvia thomasiana Urban
Physalis Eggersii O. E. Schulz
Solanum conocarpum L. C. Rich.
Wedelia cruciana L. C. Rich.
Phascum sessile E. G. Britton
Anthracothecium Breutelii Muell. Arg.
Lecania euthallina Riddle
Caloplaca subsequestra (Nyl.) Riddle
Buellia prospersa (Nyl.) Riddle
Mycoporellum ellipticum Muell. Arg.

The endemic elements are, then, only about 2.6 percent. of the native flora. A few other species are almost endemic, being otherwise known only on Porto Rico or on some other neighboring island. There are a few endemic species known on Tortola, and one on Anagada, but if the native species of these two islands, additional to those of St. Thomas, St. Jan and St. Croix, were taken into account, the percentage of endemism would not be increased.

Porto Rico, with a very much greater area and much higher mountains, has about 13 percent of its species of Spermatophyta and Pteridophyta endemic.

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 204

FURTHER NOTES ON THE STRUCTURAL DIMORPHISM OF SEXUAL AND TETRASPORIC PLANTS IN THE GENUS GALAXAURA

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FURTHER NOTES ON THE STRUCTURAL DIMORPHISM OF SEXUAL AND TETRASPORIC PLANTS IN THE GENUS GALAXAURA

MARSHALL A. HOWE

The New York Botanical Garden

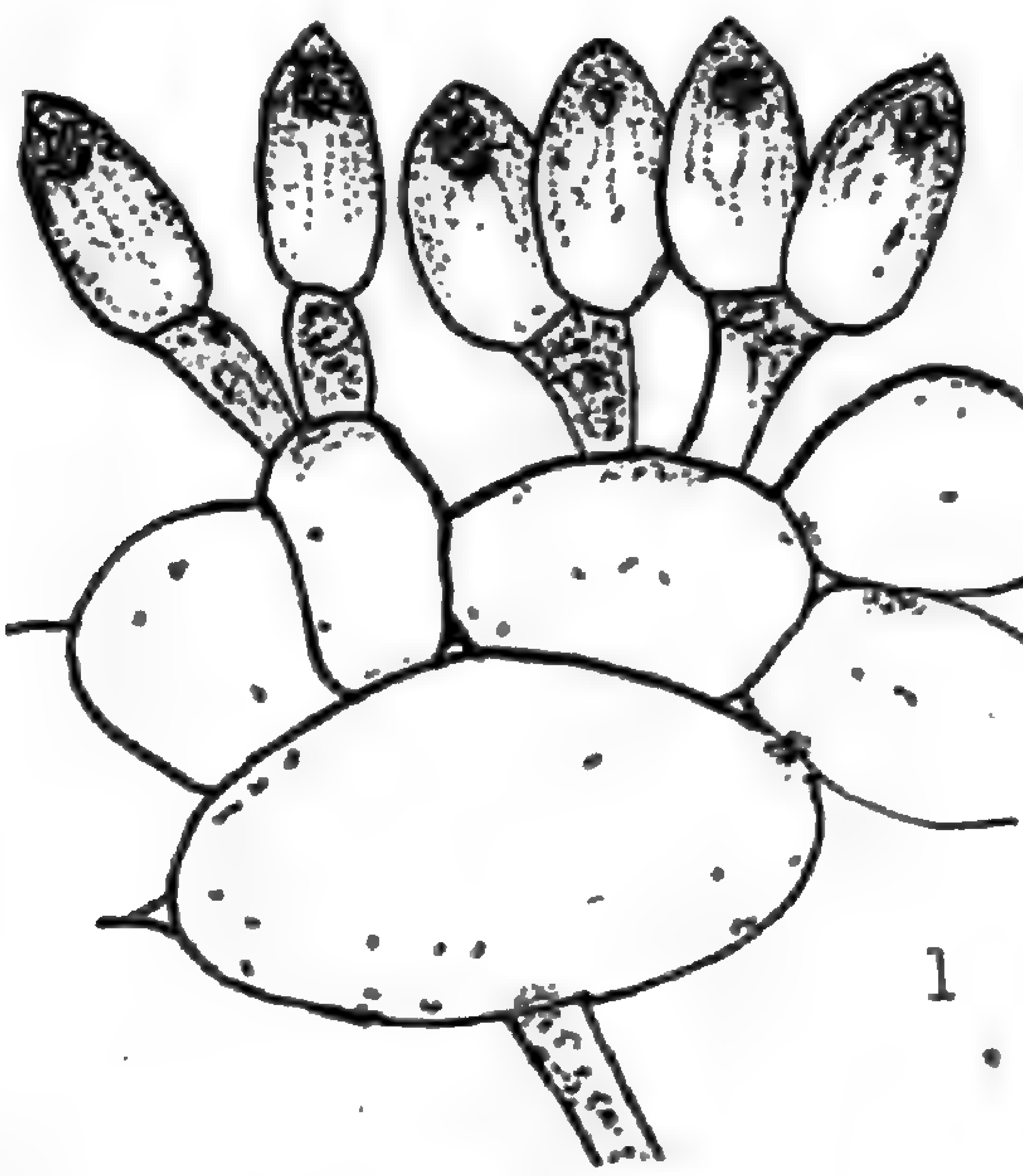
At the meeting of the Botanical Society of America, held at Columbia University in December, 1916, the writer presented a short paper, since published,[1] in which evidence was brought forward to show that *Galaxaura obtusata*, a calcified red alga of the family Chaetangiaceae, presents itself in two forms of the same general habit, but differing markedly and constantly in the microscopic structure of the cortex. In the one, the middle layer of the cortex consists chiefly of large chambers, more or less filled with lime in the natural condition, while in the other the chambers are comparatively small and the cortex is pseudoparenchymatous throughout. There are also other differences in the form and relations of the cortex cells, as pointed out in the paper to which reference has been made. In a monograph of the genus *Galaxaura*, published by Kjellman in 1900,[2] these characters were made the basis of two groups of species, denominated by him the "Cameratae" and the "Spissae." In the recently published paper, the present writer drew attention to the facts that plants showing the "Cameratae" and "Spissae" structure are commonly collected together throughout the West Indian region, that they show the same or parallel variations in external habit, that they can not, in fact, be separated without a microscopic examination, and that, whenever reproductive organs can be found, the plants of the "Cameratae" structure are always tetrasporic, while those of the "Spissae" structure are always antheridial or cystocarpic. The writer therefore expressed the conviction "that the 'Spissae' and 'Cameratae' characters, first accurately pointed out by Kjellman, do not offer a proper basis for subgeneric groupings of species as supposed by him," but merely distinguish the sexual and tetrasporic phases in the life-cycle of a single species.

Since reading and publishing the short paper to which reference

[1] Structural dimorphism of sexual and tetrasporic plants of *Galaxaura obtusata*. Bull. Torrey Club 43: 621–624. 10 Ja 1917.

[2] Kjellman, F. R. Om Floridé-slägtet *Galaxaura*, dess organografi och systematik. Kongl. Sv. Vet.-Akad. Handl. 33[1]: 1–109. *pl. 1–26.* 1900.

has been made, the writer has been investigating some of the other sections of *Galaxaura* as proposed or recognized by Kjellman in his monograph of the genus and as accepted without question by writers on the red algae during the past seventeen years, and grounds have been found for believing that a similar relation exists between several other pairs of groups hitherto considered to be independent. The



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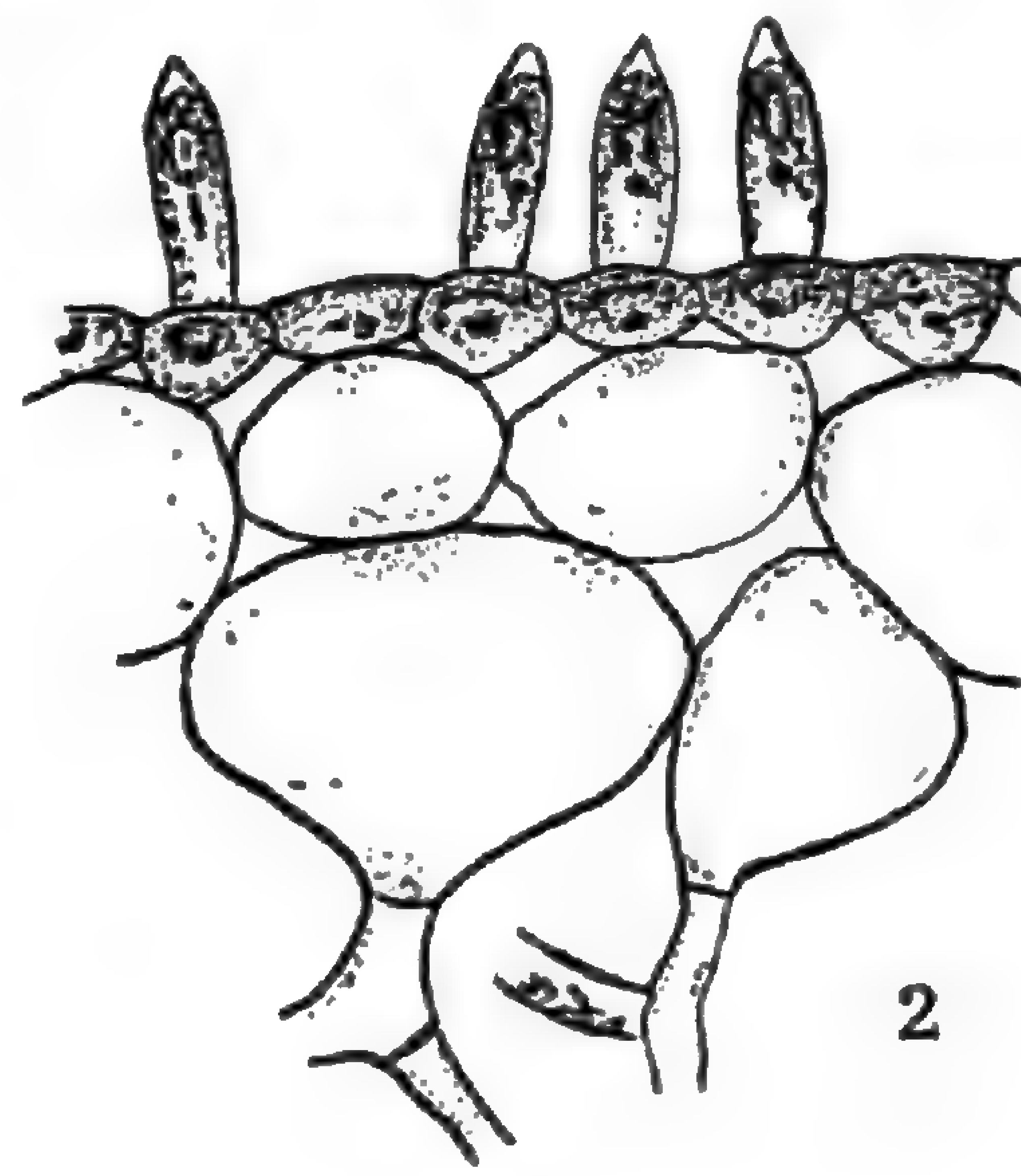

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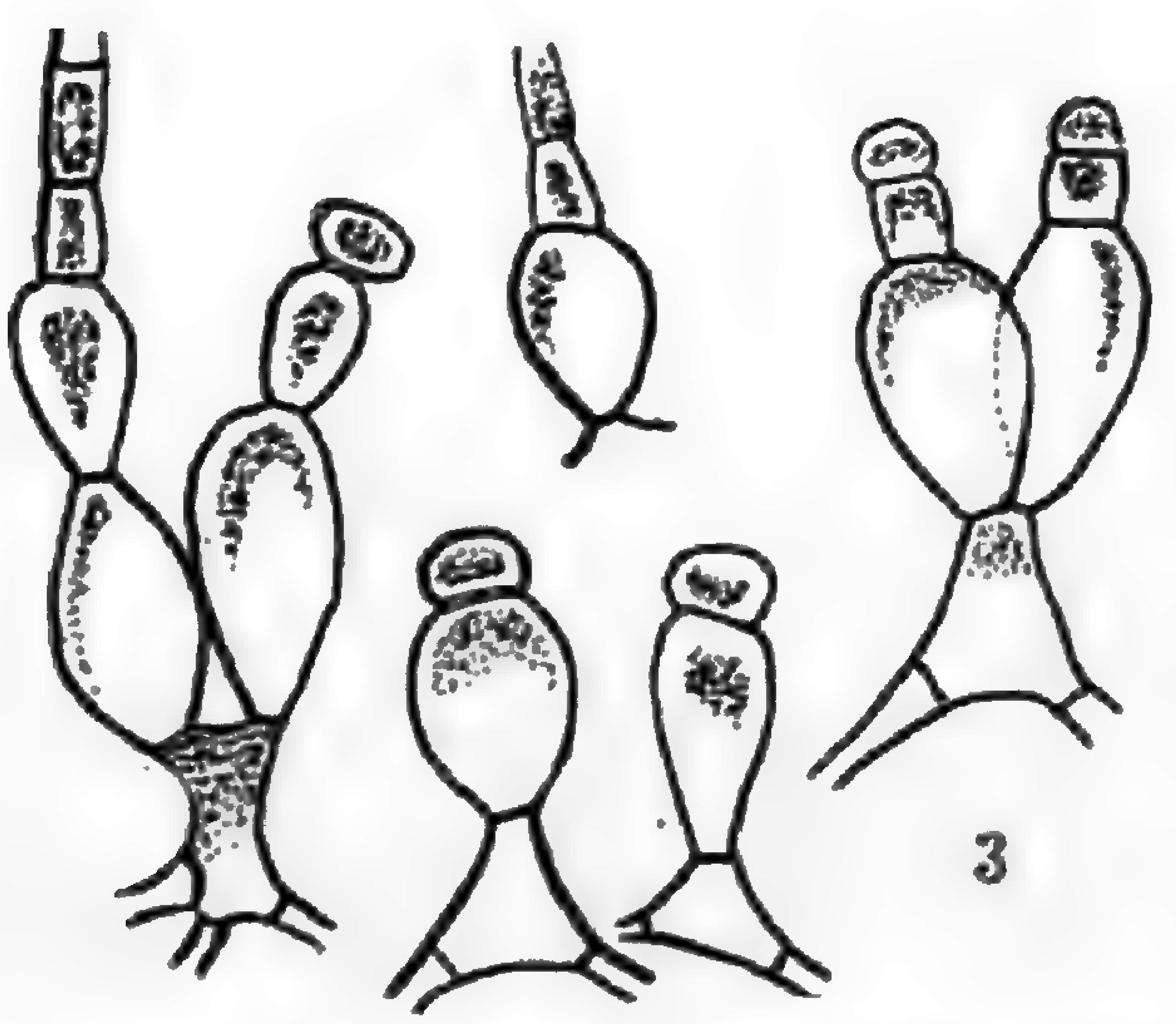

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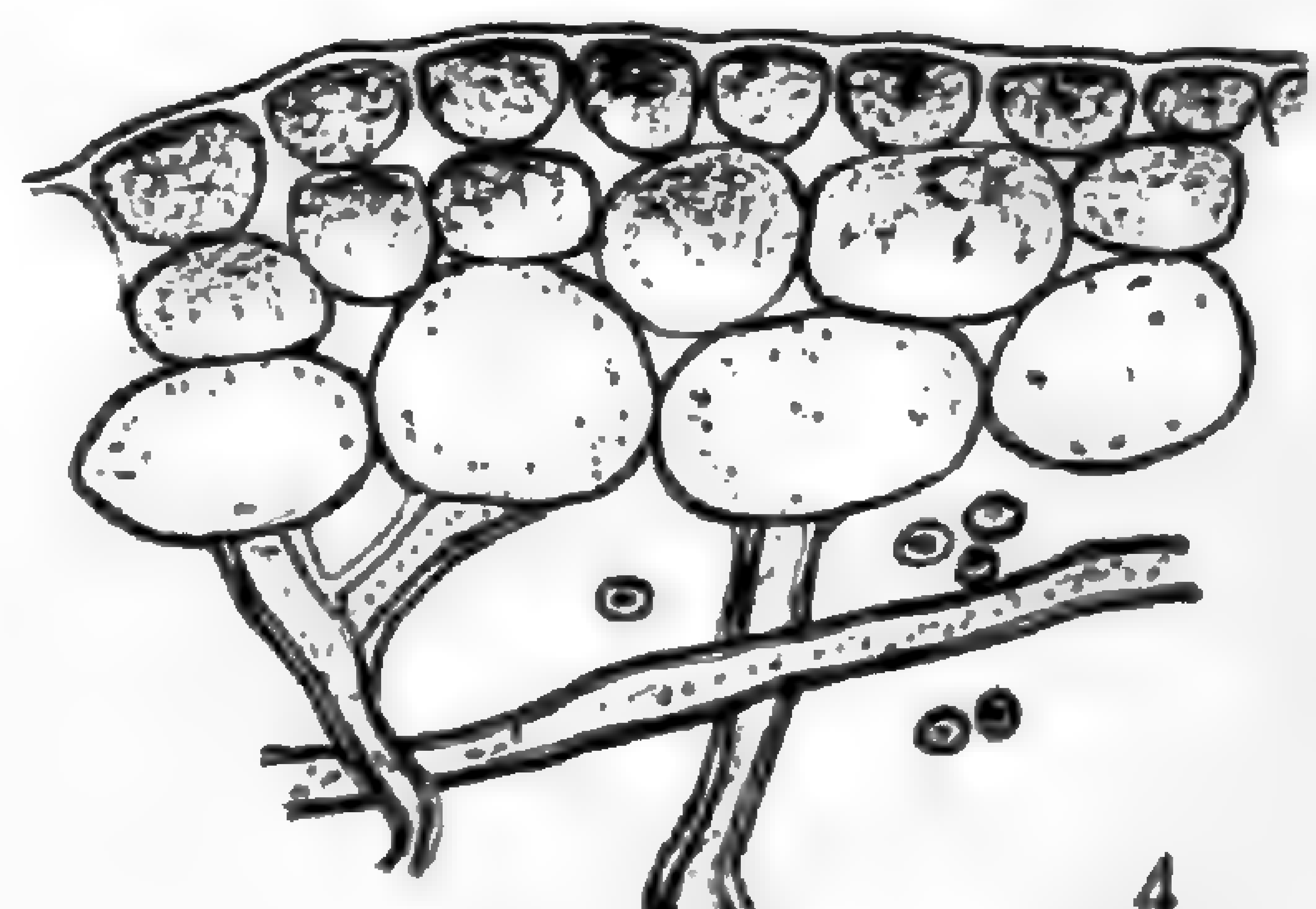

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FIG. 1. Cortex of a tetrasporic plant of *Galaxaura marginata* (Ell. & Soland.) Lamour., in section, illustrating the cortex structure of the section "Brachycladia"; enlarged about 210 diameters. (After Børgesen.)

FIG. 2. Cortex of antheridial plant of *Galaxaura marginata* (Ell. & Soland.) Lamour., in section, illustrating the cortex structure of Kjellman's section "Vepreculae," enlarged about 300 diameters. (After Børgesen, under name *Galaxaura occidentalis* Børg.)

FIG. 3. Figures showing the essentially free filaments, short and long (bases only of the long), constituting the cortex of *Galaxaura flagelliformis* Kjellm., and illustrating the cortex structure of Kjellman's section "Rhodura"; enlarged about 154 diameters. (After Kjellman.)

FIG. 4. Cortex of *Galaxaura squalida* Kjellm., in section, illustrating the cortex structure of the section "Microthoë"; enlarged 210 diameters. (After Børgesen.)

evidence associating the groups "Vepreculae" and "Brachycladia" seems particularly convincing. The name "Vepreculae" was given by Kjellman to a "section" of the genus in 1900. "Brachycladia" was proposed by Sonder as a separate genus in 1853 and is recognized as an independent genus by De-Toni in his "Sylloge Algarum," though by Kjellman it is properly considered to represent a section of *Galaxaura*. In the "Brachycladia" group, the cortex is essentially filamentous, as to its two outer layers at least (TEXT-FIGURE 1), and the cells separate easily after decalcification, though forming a more or less coherent epidermis in the natural calcified condition. The outermost or superficial cells are usually oval or ellipsoid and obtuse or apiculate. In plants of the section "Vepreculae," the cortex (TEXT-FIGURE 2) may be said to be parenchymatous or pseudoparenchymatous rather than filamentous. The epidermis here consists of cells that are firmly united both before and after decalcification and these cells have their longest axis parallel to the general surface instead of at right angles to it. In some parts of the thallus, especially at the edges of the flattened branches, the surface shows few or numerous, scattered or crowded, blunt or apiculate, papilla-like cells, which are probably homologous with the outermost or epidermal cells in the "Brachycladia" section, though they do not here form the epidermis, the firmly united epidermal cells of the "Vepreculae" section being probably homologous with the widely spaced subepidermal stalk-cells of the "Brachycladia" section. Now, an examination of a wide series of plants of the "Brachycladia" structure from the West Indies, as well as an examination of the type material of nearly all of the species from various parts of the world referred to this section by Kjellman, indicates that whenever reproductive organs are found, the plants of this group are always tetrasporic, and, in the same way, plants showing the "Vepreculae" structure are always antheridial or cystocarpic. Moreover, in the West Indies, at least, the writer's personal experience in collecting shows that plants of these two types of cortex-structure often occur together and that they show the same or parallel variations in external habit. They resemble each other very much in size and habit (PLATE III; PLATE IV, FIGURE 1), but may usually be distinguished under a hand-lens, if not at sight, by differences in the texture of the epidermis, that of the "Vepreculae" being more compact and parenchymatous and often more smooth and shiny. Of the occurrence of these two forms together, three cases may be cited: In one collection (no. 6515) of 40 plants, all believed referable to *Galaxaura marginata*, found growing together just below low-water mark near Guantanamo Bay, Cuba, 26 have been examined microscopically and of these 26, 13 were of the "Brachycladia" structure and tetrasporic, 7 were of the "Vepreculae" structure and cystocarpic, 5 were of the "Vepreculae" structure and antheridial, and 1 was of the "Vepreculae" structure and apparently sterile. Of 9 plants (no. 6966) found growing together at the mouth of Guanica Harbor, Porto Rico, 6 were of the "Vepreculae" structure, 2 of them being obviously antheridial, and 3 were of the "Brachycladia" structure, 2 of them obviously tetrasporic. Of 5 specimens (no. 7468) found near low-water mark on Muertos Island, Porto Rico, 2 were of the "Brachycladia" structure and tetrasporic, and 3 were of the "Vepreculae" structure, 1 being cystocarpic, 1 antheridial, and 1 apparently sterile. In some cases, a considerable series of specimens, all of one group, has been collected, but in collecting the red algae it often happens, as is well known, that the plants found at one time and place may be either all tetrasporic or all sexual. Without waiting for the results of cultural experiments which might furnish absolutely complete proofs of the suggested genetic continuity, it seems to the writer that the evidence is overwhelming that the so-called species of the Kjellman's "Vepreculae" section are simply the sexual phases of the species of the "Brachycladia" section. It is of interest to note that Børgesen, in a recent instalment of his admirable series of papers on "The Marine Algae of the West Indies,"[3] relying upon the sectional distinctions proposed by Kjellman, appears to have described and figured the antheridial plant (sect. "Vepreculae") of *Galaxaura marginata* (Ell. & Sol.) Lamour. as a new species under the name *Galaxaura occidentalis* Børg., taking the tetrasporic plant (sect. "Brachycladia") to be the true *G. marginata*.[4]

When we come to examine the alleged species of some of the other sections of the genus *Galaxaura*, as monographed by Kjellman, we find strong evidences of other correlations similar to those already described for the Cameratae-Spissae and Brachycladia-Vepreculae groups. In Kjellman's section "Rhodura," the peripheral elements of the thallus are so manifestly and predominantly filamentous (TEXT-FIGURE 3) that there is little ground for using the term "cortex" in connection with these plants, yet there is commonly a

[3] 2: 109–113. *f. 118–123.* 1916.

[4] The original of the *Corallina marginata* of Ellis and Solander (Nat. Hist. Zooph. 115. *pl. 22. f. 6.* 1786) was from the Bahama Islands, and, like most of the Ellis and Solander types, it is not certainly known to be now in existence. However, there is, in the herbarium of the Royal Botanic Gardens at Kew, an old fragment, inscribed in the hand of Lamouroux:

Galaxaura marginata
Corallina .... Sol. et Ell.
Bahame

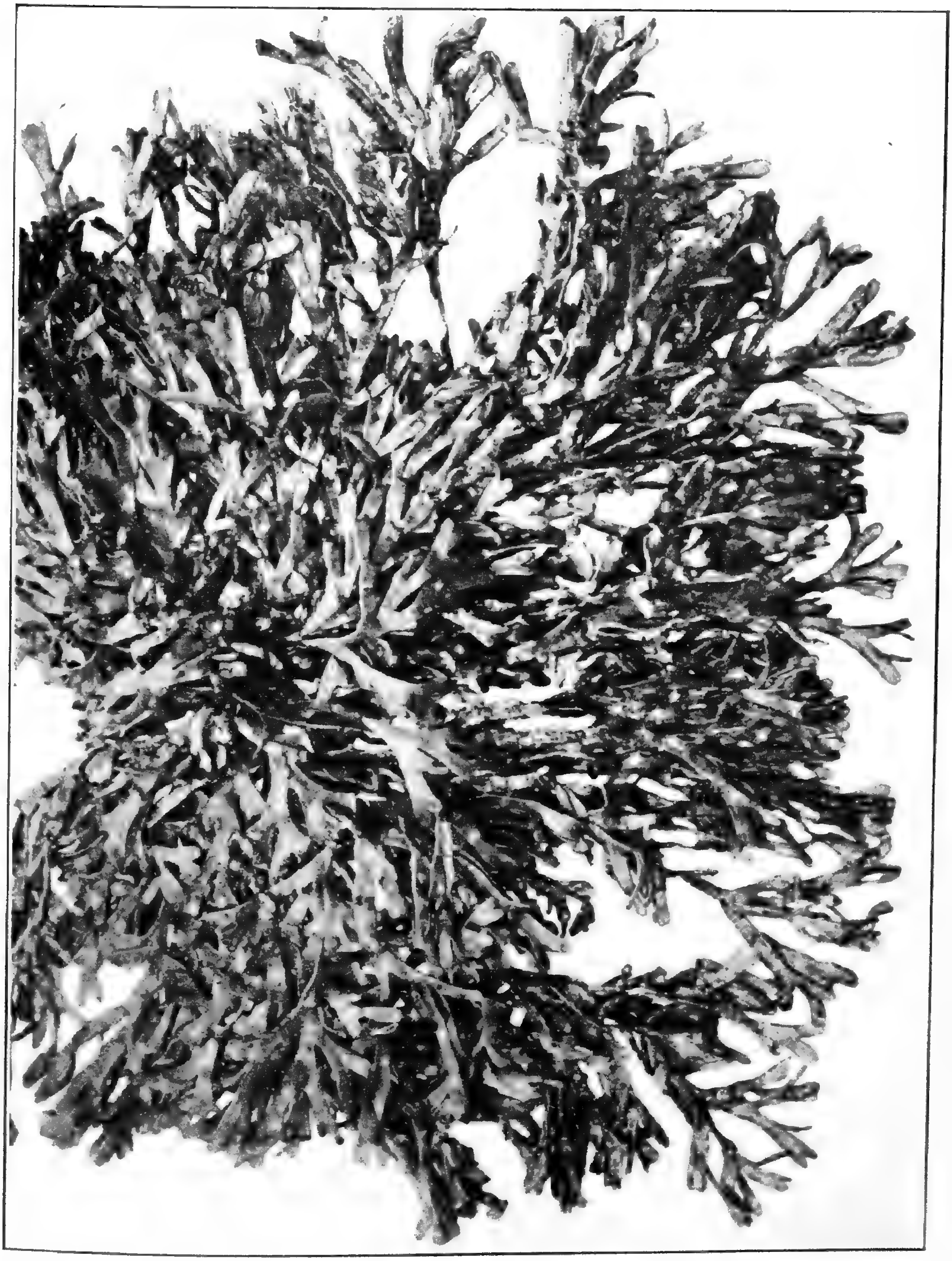
which may or may not represent an authentic bit from the Ellis collection. This is antheridial and has the "Vepreculae" structure.

dimorphism in these peripheral assimilatory filaments, one set being long and another short, and the short ones, more or less even-topped, may sometimes be said to form a loose cortex. Whenever reproductive organs are found on plants of the "Rhodura" section, they are always tetrasporangia, never antheridia or cystocarps. In the section "Microthoë," one finds a firm, compact, pseudoparenchymatous cortex—usually firm and coherent, even after decalcification (TEXT-FIGURE 4). In some of the species or forms belonging in this section, the smooth firm epidermis bears, in certain parts of the thallus, numerous long assimilatory filaments, and, when these are particularly abundant, plants of the section "Microthoë" may look much like those of the section "Rhodura," but, generally speaking, it may be said that the firm smooth cortex of plants of the "Microthoë" section and the rough shaggy exterior of plants of the "Rhodura" section give them a very different appearance and it is no wonder that they have been considered not only as different species but also as members of different sections of the genus. But members of the "Microthoë" section, except when apparently sterile, are always either antheridial or cystocarpic—never tetrasporic—just as members of the "Rhodura" section are always tetrasporic and never sexual. And plants of the "Microthoë" section and those of the "Rhodura" section grow often so closely associated—often intertangled in the same tuft—that it seems to be a fair inference that they represent phases in the development of one and the same species. Two plants from a collection (no. 1859) of about 100 specimens made by the writer near Santurce, Porto Rico, in 1903, are shown on PLATE IV. Not all of the material in this collection has been examined microscopically, but, roughly speaking, about 80 of the 100 have the "Rhodura" structure, some of them being obviously tetrasporic and others apparently sterile; and about 20 of the 100 are of the "Microthoë" structure, some of them being obviously antheridial or cystocarpic and others apparently sterile. These plants of the "Rhodura" section appear to represent a condition of what Kjellman described as a new species under the name *Galaxaura flagelliformis*, though usually less "flagelliform" than Kjellman's original; the plants of the "Microthoë" section represent what Kjellman described as a new species under the name *Galaxaura squalida*. The two forms, as shown in FIGURES 2 and 3 (PLATE IV), differ much in habit, yet, if we consider only the lower part of the *Galaxaura squalida*, where the cortex is more or less covered with free assimilative filaments, it looks a good deal like the shaggy tetrasporic plant, *G. flagelliformis*. These Porto Rican specimens lying under the no. 1859 were collected by the writer in his less experienced and less critical days and were put together under one field number as representing a single species, as in all probability they do, even though the current system of classification would require us to put them not only in different species-covers, but also in different sections of the genus. Likewise, in Bermuda, these two forms, *Galaxaura flagelliformis* and *G. squalida*, occur and in one instance, at least, they have been placed together under one field number by F. S. Collins (8486 in herb. N. Y. Bot. Gard.).

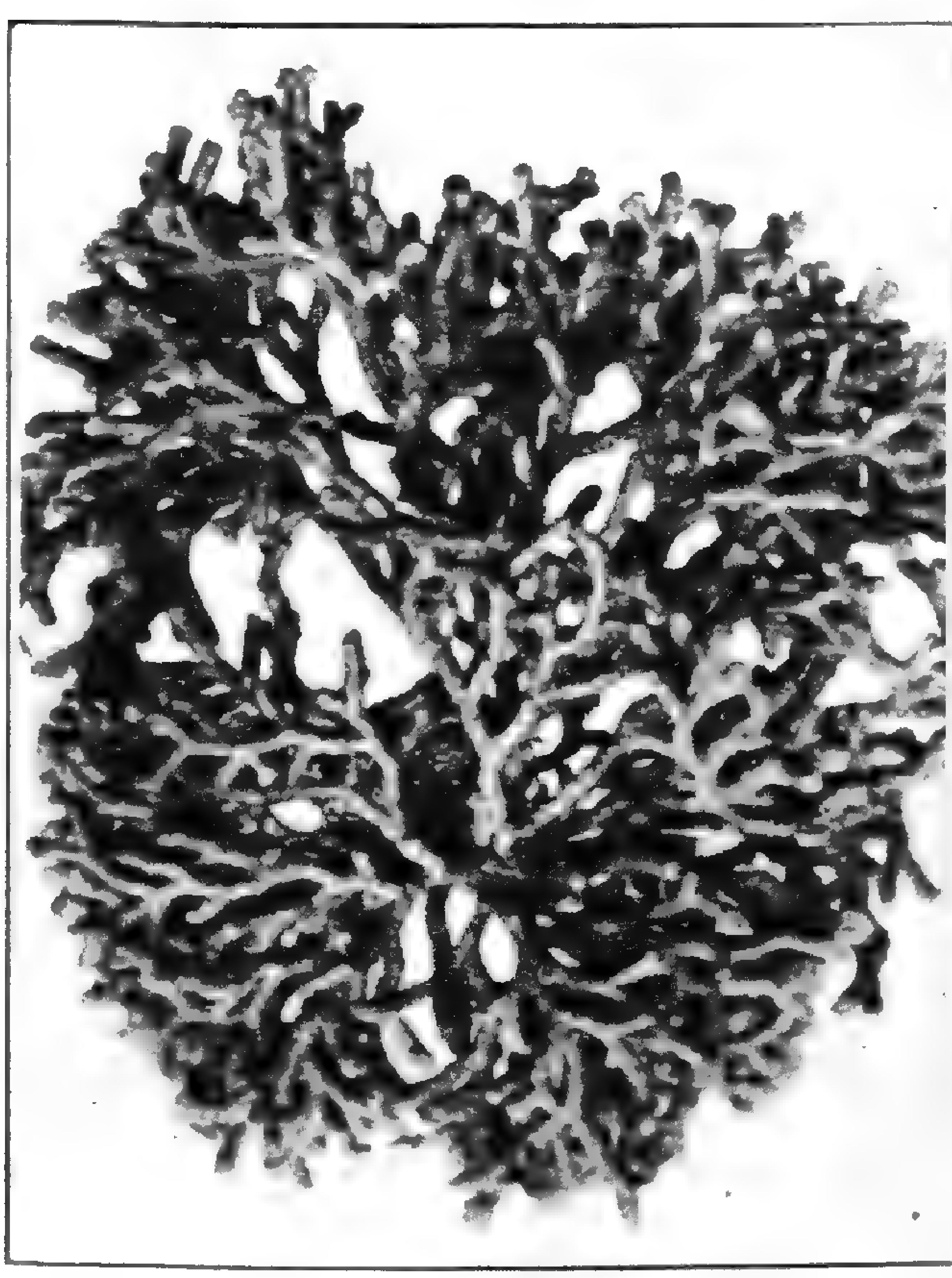
In a similar way, *Galaxaura subverticillata* Kjellm., a tetrasporic plant representing the section "Rhodura," and *G. rugosa* (Ell. & Sol.) Lamour., a sexual plant representing the section "Microthoë," are, in all probability, phases in the life-cycle of one and the same species. As instances of their occurrence together may be mentioned the writer's no. 2042 (Santurce, Porto Rico), in which the two, the *G. subverticillata* with young tetrasporangia and the *G. rugosa* with cystocarps, were found intertangled in the same tuft; the writer's nos. 7470 (*G. subverticillata*) and 7469 (*G. rugosa*), growing close together and sometimes intermingled, near the low-water line on Muertos Island (Caja de Muertos), Porto Rico; the writer's no. 4909a, *G. subverticillata*, tetrasporic, occurring with or near no. 4911, *G. rugosa*, cystocarpic, and other forms of *Galaxaura* at Montego Bay, Jamaica. It must be confessed, however, that *G. subverticillata* occurs also with sexual plants that agree more closely with *G. squalida* than with *G. rugosa* and that just as the lines of distinction between *G. flagelliformis* and *G. subverticillata* often seem vague and uncertain, so also do *G. squalida* and *G. rugosa* appear to intergrade.

The plants included by Kjellman in his section "Eugalaxaura" appear to be all sexual, never tetrasporic. The cortex is here smooth and firm, much as in the section "Microthoë," but the epidermal cells are commonly smaller, the cortex dissolves into its constituent filaments more readily on decalcification, the thallus is more distinctly jointed, and free superficial assimilatory filaments are of less frequent occurrence. The tetrasporic phases of the "Eugalaxaura" forms are apparently to be found in the section "Rhodura," this section supplying the tetrasporic conditions for both the section "Microthoë" and the section "Eugalaxaura." From size and association (at Santurce, Porto Rico, and elsewhere) more than from any similarity in habit (for the two are, as a rule, strikingly different in habit), the writer believes that *Galaxaura cylindrica* (Ell. & Sol.) Lamour. of the section "Eugalaxaura" finds its tetrasporic phase in *G. lapidescens* (Ell. & Sol.) Lamour., of the section "Rhodura," as this species has been recently limited and defined by Børgesen.[5] And, with less assurance, it may

[5] Mar. Alg. Dan. W. I. **2**: 95–99. *f. 102–104.* 1916.



HOWE: GALAXAURA MARGINATA (ELL. & SOLAND.) LAMOUR. (ANTHERIDIAL, SECTION "VEPRECULAE.")



HOWE: 1. GALAXAURA MARGINATA (ELL. & SOLAND.) LAMOUR. (TETRASPORIC, SECTION "BRACHYCLADIA.")

2. GALAXAURA FLAGELLIFORMIS KJELLM. (SECTION "RHODURA.")

3. GALAXAURA SQUALIDA KJELLM. (SECTION "MICROTHOË.")

be surmised that *Galaxaura oblongata* (Ell. & Sol.) Lamour.[6] has its tetrasporic condition in *G. comans* Kjellm. And just as the line of demarkation between *Galaxaura oblongata* and *G. cylindrica* seems a little uncertain and arbitrary, so also is the line of separation between *G. comans* and *G. lapidescens*. Where there is so much difference in habit as there is between the "Rhodura" forms on the one hand and the "Microthoë" and "Eugalaxaura" forms on the other, there is manifestly more need for a cultural demonstration of their correlation as alternating generations than there is in the case of the Cameratae-Spissae and Brachycladia-Vepreculae groups, where the two phases have the same outward appearance. But while experimental demonstration or further observations in the field may be desirable for a precise correlation of the "Rhodura" forms, the existing evidence that these "Rhodura" forms represent tetrasporic phases of "Microthoë" and "Eugalaxaura" forms seems convincing.

EXPLANATION OF PLATES III AND IV

Plate III

Photograph of a formalin-preserved antheridial specimen of *Galaxaura marginata* (Ell. & Soland.) Lamour., representing Kjellman's section "Vepreculae." Specimen from San Juan, Porto Rico (*Howe 2304*); natural size.

Plate IV

Fig. 1. Photograph of a formalin-preserved tetrasporic specimen of *Galaxaura marginata* (Ell. & Soland.) Lamour., representing the section "Brachycladia." Specimen from San Juan, Porto Rico (*Howe 2304*); natural size.

Fig. 2. Photograph of a formalin-preserved specimen representing a form of *Galaxaura flagelliformis* Kjellm. and belonging in Kjellman's section "Rhodura." Specimen from Santurce, Porto Rico (*Howe 1859a*); natural size.

Fig. 3. Photograph of a formalin-preserved specimen of *Galaxaura squalida* Kjellm. Specimen from Santurce, Porto Rico (*Howe 1859b*); natural size.

[6] *Galaxaura fragilis* of Kjellman and of Børgesen; not *Dichotomaria fragilis* Lamarck, the type specimen of which in herb. Mus. Paris. appears to have the structure of the "Spissae" group.

CONTRIBUTIONS FROM THE NEW YORK
BOTANICAL GARDEN—No. 205

OBSERVATIONS ON TULIPS

A. B. STOUT

NEW YORK
1917

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OBSERVATIONS ON TULIPS

1. Blind Tulips

The term "blind" is quite generally and popularly applied to tulip plants that do not produce flowers but which have been grown from bulbs of such size that flowers would be expected. In such plants there is at least some development of the flower stalk and the leaves formed are attached directly to this stalk.

In this sense blind tulips are quite distinct from plants having a scale leaf only, as is most common of plants grown from bulbs of small size. This distinction is well illustrated in Nos. 3 and 4 of Plate 38. The plant shown in No. 3 had a flower stalk bearing three leaves, but the uppermost portion of the stem with the flower bud failed to develop and is represented by a withered dead stub. The tulip was blind. In No. 4 no flower stem developed and the leaf formed was an extension of a bulb scale; growing points of the flower stems had remained in a rudimentary condition and were still enclosed in the bulb.

Three stages or degrees of blindness are illustrated in Plate 37. In No. 1 four stem leaves were formed and only the part of the flower stalk above the leaves was aborted. In No. 2 only two stem leaves were formed; the dead portion here included some of the leaves. In No. 3 all the leaves but the lowest were included in the dead portion. In all three plants the lower part of the stem was present and in all three the shrivelled dead apex was in evidence as shown. The occurrence of such blind tulips is not infrequent, and when blind tulips are present in noticeable numbers in display beds the results are decidedly disappointing.

During the past two years blind tulips have been numerous in the plantings grown at the New York Botanical Garden. This has afforded opportunity for observations of the occurrence of blind tulips among various varieties and of some of the conditions under which they developed. Experiments conducted to ascertain what the subsequent performance of blind plants may be have given some very definite results.

In the autumn of 1914 a special planting of large numbers of tulips was made at the New York Botanical Garden in the conservatory court of range 1 as described by Nash.*

The varieties Cottage Maid, La Reine, Rose Grisdelin, Crimson King, Chrysolora and Grand Duc were represented in the plantings, involving a total of about 20,000 bulbs. Practically every bulb produced a plant with a bloom all combining to give color effects of unusual beauty which attracted considerable attention.

At the close of the period of vegetative growth of the leaves, the bulbs were dug, spread out on the floor of a basement until "dry," then sorted according to size, placed in bags and kept in a cool dry semi-dark basement until the planting in the following autumn. All varieties were treated in the same manner. The largest of these bulbs were selected for planting in the following autumn and usually these supplied about half the number originally planted. To complete the plantings new bulbs were purchased. Some changes in the color scheme were made which necessitated the purchase of bulbs of other varieties. No bulbs of Cottage Maid were planted in the conservatory court in 1915, but a larger number of Rose Grisdelin were planted.

In the following spring (1916) large numbers of the varieties Cottage Maid and Rose Grisdelin came blind, but no other varieties were blind. In the majority of cases the full complement of leaves were formed quite as shown in No. 1 of Plate 37. As this was the first experience at the Garden with the occurrence of considerable numbers of blind tulips, it was deemed desirable

* George V. Nash. Display of tulips. Jour. N. Y. Bot. Gard. 15: 89-90. April, 1915.

Blind tulips. No. 1 is a plant of Rose Grisdelin, Nos. 2 and 3 are Chrysolora.

to make special study of the subsequent performance of these particular blind bulbs. For purposes of special study 35 bulbs of each of the two varieties were carefully dug from the ground. Each plant was taken separately, the old dead outer scales were removed, and the sister bulbs which could be readily separated were individually weighed, graded according to size and numbered. In the autumn all were planted in beds in the experimental plots. All other bulbs of these varieties were treated in the manner of the previous year and the largest bulbs were replanted in display beds.

The relative performance of these two lots of bulbs in the following spring (1917) is of special interest. Of the 35 "first" or largest bulbs of Rose Grisdelin planted in the experimental plots, 34 produced large flowers and one died; of the 35 first bulbs of Cottage Maid, 28 produced fine blooms, 2 were blind, 1 produced a scale leaf only, and 4 died. The performance of these bulbs from plants blind in the previous year was excellent. In contrast to this, however, scarcely a flower was produced by the other bulbs of these blind stocks which were planted in the display beds.

Furthermore, in 1917, blind tulips appeared among several varieties that had bloomed fully in 1916. Chrysolora, of largest selected bulbs of stock blooming perfectly in 1915 and 1916, came almost completely blind. In one bed of 500 plants about 50 per cent. were blind, but the plants that bloomed produced excellent flowers. In the conservatory court, in two beds having a total of 1,100 bulbs, only one bulb produced a flower. The blindness was for the most part of an extreme type. In nearly all cases but one leaf developed, as shown in No. 3 of Plate 37. Occasionally two leaves were formed as is shown in No. 2. Of the variety Crimson King about two thirds of 700 bulbs were blind, but in these all the leaves developed. Of the variety La Triumphante, of some 2,000 plants from selected bulbs only 10 bloomed. Although blind plants were very numerous in those varieties other varieties which had been handled in quite the same manner bloomed excellently. La Reine and Grand Duc especially gave excellent and almost perfect records.

The observations made indicate clearly that it is difficult to attribute blindness of tulips to any one cause. The experiments with Rose Grisdelin and Cottage Maid prove that blind tulips may bloom excellently in the following year: they are hence not necessarily "run down" or "run out" bulbs. In fact all the blind tulips noted above were grown from large selected bulbs that could not be considered "run out."

The possibility of fungous infection as a condition involved in blindness has been considered. Various saprophytic fungi may be found on the dead remnants of flowers and stems and on the dead outer scales of bulbs. These evidently are not directly injurious to the plants. Examination of a large number of blind tulips in 1916 failed to reveal any traces of truly parasitic fungi. In 1917, however, a sclerotium-forming fungus was found, which is clearly parasitic, at least in the outer scales. Its action and the masses or crusts of sclerotia (compact, rounded or bead-like masses of tissue of the fungus) are shown in No. 1 of Plate 37. It appears that this fungus has not been previously reported in America, but that it has been known to be destructive of bulbs in Europe.

The marked difference in performance of the two lots of bulbs of Rose Grisdelin and Cottage Maid—those used in special experiment and those planted in display beds—suggests that some aspect of treatment such as drying out, storage, planting, etc., may influence stages of growth and thus be concerned with the development of blindness. But different varieties have performed differently under quite identical conditions of treatment and climate. Undoubtedly the critical stages in the development, maturity and rest period of tulips are not only much influenced by treatment, but are somewhat different for various varieties.

2. Relation of Weight of Bulb to Blooming

If a single large bulb of the tulip be planted in the autumn and allowed to bloom in the following spring, and then dug up and examined, it will be seen that the basal portion of the plant, with rare exceptions, readily separates into from two to five or more bulbs. These bulbs, which may be called sister bulbs, are of different sizes; one is usually of large size, and the others grade to bulbs of the size of a kernel of popcorn.

The experiment mentioned above in connection with the discussion of blind tulips was also planned to determine the performance of sister bulbs of different sizes and especially those of the smaller sizes. The weights of the various sister bulbs (each set graded according to weight) and the subsequent performance of these bulbs for the two varieties tested are indicated in the following table:

	1st Bulb	2d Bulb	3d Bulb	4th Bulb	5th Bulb
Rose Grisdelin:					
Weight in grams	19–40	3–13	1–10	0.5–4.0	0.5–3.0
Number of bulbs	35	35	33	18	6
" blooming	34	28	12	3	2
" blind	0	0	6	0	0
" with scale leaf	0	3	7	9	2
" dead	1	4	8	6	2
Cottage Maid:					
Weight	11–29	1–13	1– 4	0.5– 2	0.5–1.0
Number of bulbs	35	29	13	5	1
" blooming	28	12	0	0	0
" blind	2	0	0	0	1
" with scale leaf	1	12	9	2	0
" dead	4	5	4	3	1

It will be noted from the weights given that bulbs of Rose Grisdelin made a more vigorous growth than did those of Cottage Maid. This is indicated by the greater weight of first bulbs, the greater number of sister bulbs, and, of course, the greater total weight.

The performance of bulbs of smaller sizes of Rose Grisdelin is of special interest. Of the 35 second bulbs, the largest of which weighed only 13 grams, 28 bloomed; of 33 bulbs of third rank, weighing from 1 to 10 grams, 12 bloomed; of the 18 of third rank 3 bloomed, and out of 6 of fifth rank 2 bloomed. *Bulbs weighing as little as 2.5 grams (a gram equals 0.035 ounce) produced flowers.* Flowers from bulbs of smallest sizes were small and often poorly developed. The flowers of bulbs of second rank were nearly always fine flowers, but were somewhat smaller than flowers of first bulbs, the stems were slightly shorter and more slender and the leaves were somewhat smaller. The difference in the growth of first and second bulbs is well shown in Nos. 1 and 2 of Plate 38.

Occasionally the first bulbs produced two flowers, as is shown in No. 1; this was due to the blooming of a small bulb, which at the time of planting was situated within the outer scales of the first bulb. Such flowers were always of small size.

The four plants shown in Plate 38 were grown from sister bulbs weighing 29.5, 5.45, 2.75, and 1.7 grams. This series was photographed to illustrate the principal types of growth observed. Nos. 1 and 2 show the relative size and vigor of the growth from first and second bulbs. No. 3 shows a blind tulip and No. 4 shows the development of a scale leaf only.

The blooming of bulbs of Cottage Maid was less pronounced than in Rose Grisdelin. Fewer second bulbs bloomed and no bulbs of smaller size bloomed.

As would perhaps be expected, the greater proportion of bulbs that died or that developed a scale leaf only was among bulbs of smaller sizes. The total number of blind bulbs was low—6 of Rose Grisdelin among third bulbs and 2 of Cottage Maid among first bulbs.

It may be said that in planting for special display one would scarcely ever select any bulbs of the size of the second bulbs used in the experiment. Probably no bulbs of smaller size than the first bulbs would be sold for planting by any commercial dealer.

The practical methods of increasing stock depends on the vegetative multiplication of bulbs giving sister bulbs of various sizes and the subsequent growth of the smaller of these bulbs without their blooming or splitting up into smaller bulbs until bulbs of large size are formed. It would seem that the blooming of bulbs of smaller size is undesirable in that it may retard the development of bulbs of second rank to the size of first rank. On account of the smaller size of the flowers produced and the somewhat greater uncertainty that flowers will be produced, it is scarcely practicable to select any but largest or first bulbs for planting. It is planned to determine the further performance of the bulbs of second and lower ranks which produced flowers in the experiment.

A. B. Stout

Showing growth made by four "sister" bulbs of a blind plant of the variety Rose Grisdelin. Illustrating principal types of growth observed.

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—NO. 206

REVISION OF THE NORTH AMERICAN SPECIES OF ENCALYPTA

DOROTHY COKER

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN THE FACULTY OF PURE SCIENCE, COLUMBIA UNIVERSITY

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Revision of the North American species of Encalypta

DOROTHY COKER

(WITH PLATES, 13 AND 14)

The family Encalyptaceae, of which there is only one genus, *Encalypta*, is closely related to the Pottiaceae, because of the twisted and crisped habit of its leaves when dry, the small, thick-walled, very papillose cells of the upper portion of the leaves, and the large hyaline cells at the base. The costa also is strong and often excurrent. The genus is noted for the great diversity in the structure of its peristome, ranging from double, with several remarkable variations, to single or absent.

Hedwig (**4**, p. 88), in 1782, based the genus *Leersia* on two species, *Bryum pulvinatum* and *B. extinctorium*, referring the latter to its Linnean synonym (see p. 103 in the descriptions of figures 19 and 24). Of these two species *Bryum pulvinatum*, which is a *Grimmia*, precedes *B. extinctorium;* and since *Grimmia*, according to Ehrhart (**6**, p. 176), antedates *Leersia* by one year, the name *Leersia* has been discarded. Hence, the adoption of the name *Encalypta* Schreb., 1791 (**9**, p. 759), instead of *Leersia* Hedw., 1782, is due to the fact that *Leersia*, which in reality antedates *Encalypta*, was originally used by Hedwig to include *Grimmia*. Subsequently Hedwig, in 1801 (**12**, pp. 60–63), accepted the name *Encalypta* in place of *Leersia*.

Following the older authors, Lesquereux and James (**32**, pp. 180–184) placed *Encalypta* under the Orthotrichaceae, and Schimper (**28**, pp. 307–340) with the Grimmiaceae; Lindberg (**30**, p. 26) and Braithwaite (**33**, pp. 279–287) adopted *Leersia* for *Encalypta*, referring it, as a subfamily, to the Tortulaceae, because of the leaf-characteristics. Limpricht (**32**, pp. 102–123) and Dixon (**40**, pp. 227–231) agree in recognizing the Encalyptaceae as distinct from the Pottiaceae, but Dixon places it under the subgroup Aplolepideae and Limpricht uses the terms Haplolepideae and Diplolepideae only in the specific descriptions. Loeske (**48**, p. 100) rejects Lindberg's usage of *Leersia* under the Tortulaceae and also the placing by Brotherus (**44**, pp. 436–439) of the Encalypteae as a subfamily of the Pottiaceae, and agrees with Fleischer (**46**, p. xiii), who places them under a new group, the Heterolepideae, because the peristome varies from the Haplolepideae to the Diplolepideae, stating that they should be treated as a separate family.

In 1904 Paris Index (**45**, pp. 119–126) listed 30 species, of which 18 were recorded for North America. According to Brotherus, in 1902 (**44**, pp. 436–439), there were 35 species, of which 21 were recorded for the whole of America, 14 being endemic and 18 occurring north of Mexico. We* have reduced this number to 8 by careful comparison of original and authentic specimens and by studying the types whenever possible, having seen type specimens of *E. longipes*, *E. Macounii*, and *E. Selwyni* from the Austin and Mitten Herbaria, and authentic material of *E. alaskana*, *E. leiocarpa*, *E. subspathulata*, *E. cucullata*, *E. subbrevicolla*, and *E. labradorica* from the Macoun collections. The accompanying lists and synonymy show the changes that have been made. Only one species remains doubtful, *E. lacera* Ren. & Card. (**38**, p. 91); it was described in a footnote to their check list of North American mosses from specimens collected in Oregon by L. F. Henderson, and no specimens have been obtainable.

Chronological list of the North American species of Encalypta†

1753. *E. extinctoria* (L.) Sw. Disp. Musc. Suec. 24. 1799.

1782. *E. laciniata* (Hedw.) Lindb. Acta Soc. Sci. Fenn. **10**: 267. 1872.

1788. *E. contorta* (Wulf.) Lindb. Oefv. K. Vet. Akad. Foerh. **20**: 396. 1863.

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* The responsibility for these reductions rests largely with Mrs. Britton.

† Adapted from Brotherus (**44**) and Paris Index (**45**).

1805. *E. alpina* Smith; Sowerby, Engl. Bot. *pl. 1419.* 1805.
1811. *E. rhabdocarpa* Schwaegr. Suppl. **1**: 56. *pl. 16.* 1811.
1827. *E. apophysata* Nees & Hornsch. Bryol. Germ. **2**: 49. *pl. 15, f. 5.* 1827.
1832. *E. procera* Bruch, Abh. Akad. München. **1**: 283. *pl. 11.* 1832.
1849. *E. mexicana* C. Müll. Syn. **1**: 516. 1849.
1865. *E. longipes* Mitt. Jour. Linn. Soc. **8**: 29. *pl. 5.* 1865.
1877. *E. Macouni* Aust. Bot. Gaz. **2**: 97. 1877.
1877. *E. Selwyni* Aust. Bot. Gaz. **2**: 109. 1877.
1889. *E. leiocarpa* Kindb. Bull. Torrey Club **17**: 275. 1889.
1892. *E. subspathulata* C. Müll. & Kindb.; Macoun, Cat. Can. Pl. 6: 93. 1892.
1892. *E. leiomitra* (Kindb.) Kindb.; Macoun, Cat. Can. Pl. 6: 94. 1892.
1892. *E. cucullata* C. Müll. & Kindb.; Macoun, Cat. Can. Pl. 6: 96. 1892.
1892. *E. alaskana* Kindb.; Macoun, Cat. Can. Pl. 6: 269. 1892.
1892. *E. lacera* Ren. & Card. Rev. Bryol. **19**: 91. 1892.
1897. *E. subbrevicolla* Kindb. Eur. & N. Am. Bryin. **2**: 295. 1897.
1897. *E. labradorica* Kindb. Eur. & N. Am. Bryin. **2**: 295. 1897.

Arrangement of the North American species of Encalypta*

§ 1. PYROMITRIUM (Wallr.) Kindb.

1. *E. alpina* Smith (*E. commutata* Nees & Hornsch.).

§ 2. XANTHOPUS Kindb.

2. *E. ciliata* (Hedw.) Hoffm. = *E. laciniata* (Hedw.) Lindb.
3. *E. Macounii* Aust. = *E. apophysata* Nees & Hornsch.
4. *E. alaskana* Kindb. = *E. laciniata*.

§ 3. RHABDOTHECA Kindb.

5. *E. vulgaris* (Hedw.) Hoffm. = *E. extinctoria* (L.) Sw.
6. *E. rhabdocarpa* Schwaegr. (including *E. leiomitra* Kindb.).
7. *E. lacera* Ren. & Card. = *E. rhabdocarpa*?
8. *E. subspathulata* C. Müll. & Kindb. = *E. rhabdocarpa*.
9. *E. mexicana* C. Müll. = *E. laciniata*.

* Adapted from Kindberg (**42**, pp. 292–297) and Brotherus (**44**, pp. 436–439).

§ 4. DIPLOLEPIS Kindb.

10. *E. longipes* Mitt. = *E. procera.*
11. *E. leiocarpa* Kindb. = *E. apophysata.*
12. *E. subbrevicolla* Kindb. = *E. brevicolla* Bruch.
13. *E. labradorica* Kindb. = *E. extinctoria.*

§ 5. STREPTOTHECA Kindb.

14. *E. contorta* (Wulf.) Lindb. (*E. streptocarpa* Hedw.).
15. *E. cucullata* C. Müll. & Kindb. = *E. procera* + *E. extinctoria.*
16. *E. procera* Bruch.
17. *E. Selwyni* Aust. = *E. procera.*

ENCALYPTA Schreb. Genera **2**: 759. 1791

Leersia Hedw. Fundam. **2**: 88, in part. 1782

Plants growing in dense compact cushions or mixed with other cespitose mosses; stems usually low and crowded, seldom more than 4 cm. high; branches usually simple and sub-apical, erect, the leaves uniformly spaced; leaves usually curled and twisted when dry, spreading above when moist, from an erect clasping oblong base, seldom more than 6 mm. long by 1.5 mm. broad; costa stout, either ending below the apex or excurrent into a subulate or mucronate point, cross-section of costa usually papillose above on both faces, with a large dorsal band of stereid cells and several upper layers of large ducts in 3–4 rows, the upper epidermal cells with thick walls and smaller papillae; cells of the upper part of the leaf-blade deeper than wide with clusters of prominent, minute papillae, those of the lower part of blade larger, oblong and usually without papillae, except in one species (*E. apophysata*) which has them on the short end walls; margins entire, flat or slightly recurved, rarely undulate. Perichaetial leaves generally smaller, more acuminate and often subulate.

Monoicous, or in one exception (*E. contorta*) dioicous; sometimes sterile and frequently propagating by elongated septate brood-bodies; the antheridia in small lateral axillary buds; archegonia terminal, vaginule enlarged, cylindric and often ochreate; seta usually elongate, smooth except in *E. streptocarpa*, seldom more than 1–2 cm., rarely 3 cm., long (*E. longipes*), usually twisted; calyptra large, 0.5–1 cm., completely covering the capsule to the base, cylindric and glossy, smooth or papillose at apex, sometimes slightly papillose over the entire surface, ragged or fringed at base; lid (operculum) large, never equalling the urn (theca), long-rostrate; peristome originating at or below the mouth; simple (haplolepideous) or compound (diplolepideous), sometimes lacking; preperistome sometimes present; annulus simple or compound; teeth varying in length, usually papillose or striate, entire or split along the median line, rarely more or less united and attached to the endostome by a hyaline membrane, sometimes nodose or with short intermediate cilia; walls of the urn (theca) either smooth or striate, striae sometimes visible only after sporosis, sometimes spirally twisted or deeply grooved; neck (column) short, stomatose, or the stomata scattered along the wall; spores smooth or rough, usually maturing in spring or summer, variable in size.

Type species, *Bryum extinctorium* L.

The genus divides itself naturally into two groups or sections: § 1. *Haplolepideae*, with the peristome single or absent, and § 2. *Diplolepideae*, with the peristome double and variable.

In § 1 are included 4 species that are found in Europe and North America: *E. alpina*, *E. extinctoria*, *E. laciniata*, and *E. rhabdocarpa*, the last two approaching the *Diplolepideae* by having a preperistome.

In § 2 are included 4 species, also common to Europe and North America: *E. apophysata*, *E. brevicolla*, *E. procera*, and *E. contorta;* of these *E. contorta* has not yet been found fruiting on this continent.

Key to species

§ 1. HAPLOLEPIDEAE. Peristome simple or lacking; teeth, when present, short, lanceolate; capsule not twisted.
- Capsule striate, or becoming so when old.
  - Calyptra lacerate at base, nearly smooth at apex.
    - Peristome only occasionally found. Walls of cells at base of leaves thickened. — 1. *E. extinctoria.*
    - Peristome usually present, often with preperistome. Walls of cells at base of leaves not thickened. — 2. *E. rhabdocarpa.*
- Capsule smooth.
  - Calyptra lacerate at base but not fringed. Peristome never present, spores papillose. — 3. *E. alpina.*
  - Calyptra with a persistent or fugacious fringe of larger cells. Peristome usually present, deeply inserted. — 4. *E. laciniata.*

§ 2. DIPLOLEPIDEAE. Peristome double, teeth usually long and slender; endostome more or less adherent to the teeth.
- Capsule smooth, calyptra fringed or lacerate.
  - Teeth perforate or split along median line. Basal cells of leaves with short walls papillose. — 5. *E. apophysata.*

Teeth more or less united in pairs, unequal in length.
Basal cells of leaves not papillose. 6. *E. brevicolla.*
Capsule striate and spirally twisted, calyptra lacerate.
Monoicous, seta smooth, spores 15–25 μ; leaves slightly toothed at base. 7. *E. procera.*
Dioicous, seta slightly papillose, spores 8–12 μ, leaves entire. 8. *E. contorta.*

§ 1. Haplolepideae

1. ENCALYPTA EXTINCTORIA (L.) Sw. Disp. Musc. Suec. 24. 1799
Bryum extinctorium L. Sp. Pl. 1116. 1753.
Leersia extinctoria Hedw. Fundam. **2**: 88. 1782.
Leersia marginata Hedw. Fundam. **2**: 103. 1782.
Leersia vulgaris Hedw. Descr. **1**: 46. 1787.
Encalypta vulgaris Hoffm. Deuts. Fl. **2**: 27. 1796.
Encalypta cucullata C. Müll. & Kindb.; Macoun, Cat. Can. Pl. 6: 96, in part. 1892.
Encalypta extinctoria subsp. *tenella* Kindb.; Röll, Hedwigia **35**: 65. 1896.

Plants small, about 0.5–1 cm. high; leaves up to 4 mm. long, 1 mm. wide; apical blade lingulate, apex cucullate contracted to an abrupt point; costa ending below the apex, smooth on both faces except slightly toothed at tip on back; margins plane, erose above; papillose cells 12–14μ long; cells of hyaline base oblong, up to 55μ long by 15μ wide, walls brown, slightly thickened at ends, with 7–8 rows of long narrow cells at margin; perichaetial leaves shorter and blunt at apex, usually carinate when moist. Monoicous; vaginule about 1.5 mm. long; seta 5–8 mm., red brown, not twisted; calyptra entire or ragged at base, slightly papillose at apex; lid about 1.5 mm. long; capsule 2–3 mm. long by 1 mm. wide, cylindric, smooth when young, ribbed when old; annulus simple, narrow; mouth marked by an irregular, broken row of 1–2 quadrate, small, thickened cells; urn with the stomata sparsely scattered over the entire surface; neck short, red, without stomata; peristome, when present, of simple fugacious teeth; spores rough with large rounded papillae, 24–32μ, maturing in early spring.

TYPE LOCALITY: European.

DISTRIBUTION: On rocks and earth in the Rocky Mountains, from British Columbia to Colorado, and South Dakota; western states from Nevada to California. Also Eurasia and Australasia, according to Paris Index (45).

ILLUSTRATIONS: Dill. Hist. Musc. *pl. 45. f.* 8. 1741 (as *Bryum*); Hedw. Descr. **1**: *pl. 18.* 1787 (as *Leersia*); Bryol. Eur. *pl. 199.* 1838 (as *E. vulgaris*).

EXSICCATAE: Macoun, Can. Musci *491* (as *E. cucullata*); Holz. Musci Acro. Bor. Am. *214*. 1906.

1a. ENCALYPTA EXTINCTORIA APICULATA Wahl. Fl. Lapp. 344. 1812

Costa usually excurrent into a short hair-point; capsule when mature striate and somewhat ribbed.

DISTRIBUTION: Colorado, Montana, and Assiniboia. Also Europe.

1b. ENCALYPTA EXTINCTORIA MUTICA Brid. Musc. Recent. Suppl. 4: 28. 1819

Costa disappearing far below the blunt apex; mature capsule ribbed.

DISTRIBUTION: Colorado to British Columbia. Also Europe.

2. ENCALYPTA RHABDOCARPA Schwaegr. Suppl. 1: 56. 1811

Leersia rhabdocarpa Lindb. Musci Scand. 26. 1879.

Encalypta rhabdocarpa var. *leiomitra* Kindb. Ottawa Nat. 4: 61. 1890.

Encalypta subspathulata C. Müll. & Kindb.; Macoun, Cat. Can. Pl. 6: 93. 1892.

Encalypta leiomitra Kindb.; Macoun, Cat. Can. Pl. 6: 94. 1892.

Plants 1.5–2 cm. high; leaves 3–4 mm. by 0.66–1 mm. wide, lingulate, flat and spreading when moist; costa extending beyond the suddenly contracted apex of leaf into a long mucronate hair-point or ending below the apex, papillose on back below the middle and on the upper surface above the middle of the leaf; margin plane; papillose cells, hexagonal, diameter 15–20μ; cells of hyaline base, irregular, not papillose, 24–48μ long by 24μ wide; walls orange, not thickened, with a distinct marginal border of 6–8 rows of cells, 60μ long by 6–10μ wide; perichaetial leaves smaller and tapering to a hair-point. Monoicous; seta 6–8 mm., orange, not twisted; calyptra entire or ragged at base, papillose at apex and sometimes to about the middle; lid about 2 mm.; capsule 2–3 mm. long by 1 mm. wide, cylindric, striate, each ridge of about 5–6 rows of cells; annulus simple; rim of the mouth marked by 2–3 rows of small brown quadrate cells; stomata numerous, scattered throughout the entire surface of the urn; neck short, red, deeply wrinkled with large loose cells; peristome usually present, single, of 16 red, finely striate, papillose teeth, with 4–5 segments, and occasionally with a narrow lateral preperistome covering 1–2 segments at base of the teeth; spores 40–50μ in diameter, very rough with large granular warts, ripe in late spring.

According to Limpricht (39, p. 115. *f. 245, 246*) there is great variation in the peristomes of this species. However, we have not found any peristome to correspond with his *f. 246* in American specimens.

TYPE LOCALITY: European.

DISTRIBUTION: Arctic America, Greenland, Labrador to Quebec and northern New York, Rocky Mountains from Montana to New Mexico, Pacific Coast ranges from Washington to California. Also Europe and Asia.

ILLUSTRATIONS: Schwaegr. Suppl. 1: *pl. 16.* 1811; Bryol. Eur. *pl. 205.* 1838.

EXSICCATAE: Drummond, Musci Am. *50, 51* in part; also *52.* 1828. Sull. & Lesq. Musci Bor. Am. *112.* 1856; ed. 2. *166.* 1865; Macoun, Can. Musci *131, 421* (as *E. subspathulata*).

E. leiomitra differs from *E. rhabdocarpa* only in that the apex of the calyptra is nearly smooth.

E. subspathulata is undoubtedly *E. rhabdocarpa*, but all of the older capsules are badly infected by fungi and filled with hyphae.

2a. ENCALYPTA RHABDOCARPA PILIFERA (Funck) Nees & Hornsch. Bryol. Germ. 2: 41. 1827

Encalypta pilifera Funck, in Sturm, Deuts. Fl. 17: *pl. 5.* 1819.
Leersia extinctoria var. *pilifera* Lindb. Musc. Scand. 20. 1879.

Leaves somewhat broader and more ovate; costa excurrent into a long toothed hair; peristome perfect.

DISTRIBUTION: Fraser River Valley, Canada. Also Europe.

ILLUSTRATION: Sturm, Deuts. Fl. 17: *pl. 5.*

2b. ENCALYPTA RHABDOCARPA MICROSTOMA Breidler; Limpr. Laubm. 2: 115. 1895

Capsule narrowing to a small mouth. Lid small, extended into a long point; peristome perfect or rudimentary. A parallel form to *E. laciniata microstoma*.

DISTRIBUTION: Alpine regions of the Rocky Mountains. Also Europe.

3. ENCALYPTA ALPINA Smith; Sowerby, Engl. Bot. *pl. 1419.* 1 F 1805

Encalypta affinis Hedw. f. Weber & Mohr's Beitr. 1: 121. Mr 1805.

Encalypta commutata Nees & Hornsch. Bryol. Germ. **2**: 46. 1827.
Leersia alpina Lindb. Musci Scand. 20. 1879.

Plants 4–6 cm. high; leaves 3–4 mm. by 1 mm. subspatulate, carinate; apex cucullate when moist; costa excurrent into a long hair-point or ending below the apex, smooth except for a few teeth just below the apex of leaf; margin plane; upper cells hexagonal, 12μ–16μ, not densely papillose; cells of hyaline base 32μ–48μ long by 16μ wide, walls not thickened, becoming narrower and longer toward the margin; perichaetial leaves smaller and tapering to a long hair point. Monoicous; vaginule about 1 mm. long; seta 7–9 mm. long, orange, seldom twisted; calyptra laciniate at base, very slightly papillose at apex; lid 1.5 mm. long; annulus of 2–3 rows of cells; capsule 2–3 mm. long by 0.75 mm. wide, cylindric, smooth when young, appearing striate when old; mouth marked by 1–2 rows of small red-brown quadrate cells often irregularly broken; neck short, wrinkled, stomatose; peristome none; spores 25μ–35μ, warty, often flattened and irregular, ripe in late summer.

TYPE LOCALITY: European.

DISTRIBUTION: Alpine regions of the Rocky Mountains from Colorado to Washington; Alaska and Greenland. Also Europe and Asia.

ILLUSTRATIONS: Sowerby, Engl. Bot. *pl. 1419.* 1805; Weber & Mohr's Beitr. **1**: *pl. 4.* 1805; Schwaegr. Suppl. **1**: *pl. 16.* 1811 (as *E. affinis*); Bryol. Eur. *pl. 198.* 1838.

EXSICCATAE: Drummond, Musci Am. *49.* 1828 (as *E. affinis*).

4. ENCALYPTA LACINIATA (Hedw.) Lindb. Acta Soc. Sc. Fenn. **10**: 267. 1872

Bryum extinctorium var. β. L. Sp. Pl. 1116. 1753 (see Dillen, **1**, p. 349; also Druce & Vines, **47**, p. 210).
Leersia laciniata Hedw. Fundam. **2**: 103. *pl. 5, f. 24a.* 1782.
Leersia ciliata Hedw. Descr. **1**: 49. 1787.
Encalypta ciliata Hoffm. Deuts. Fl. **2**: 27. 1796.
Encalypta mexicana C. Müll. Syn. **1**: 516. 1849.
Encalypta alaskana Kindb.; Macoun, Cat. Can. Pl. 6: 269. 1892.

Plants growing on wet limestone rocks; about 1–3 cm. high; leaves carinate when moist, up to 5 mm. long, to about 1.3 mm. wide; apical blade elliptic or lingulate, suddenly contracted to a short mucronate point; costa thick, tapering into the short finely serrulate tip or ending below the apex, slightly toothed on the back; margins revolute below the middle, above entire or erose with truncate, minutely papillose cells up to 13–24μ in diameter; cells of the hyaline base not papillose, oblong, up to 60μ long by 13–21μ wide, becoming narrower toward the margin, the basal cells with brown walls; perichætial leaves slightly smaller. Monoicous; seta yellow to brown, 5–10 mm. high; calyptra broadening at base into a deep regular fringe of larger cells, smooth or slightly roughened at apex; lid beaked, up to 2 mm. long; annulus present, of one row of cuneate cells; capsule 3–5 mm. long by 1 mm. wide, cylindric, smooth; mouth narrow bordered by 3–5 rows of smaller thickened cells; urn with numerous large stomata from the middle to the neck; peristome deeply inserted, single; teeth lanceolate with 5–7 joints, which are longitudinally papillose inside and occasionally with a darker colored preperistome partially covering the basal segments; spores up to 37μ in diameter, with radiating stellate lines, maturing in summer.

TYPE LOCALITY: European.

DISTRIBUTION: Alpine and mountain regions; Eastern States from Maine to northern New York; North Central States from Michigan to Wisconsin, Minnesota; Rocky Mountains from Montana to New Mexico; west coast from Washington to California; British America from Ontario to British Columbia. Also Europe, Asia, Africa and Australia.

ILLUSTRATIONS: Dill. Hist. Musc. *pl. 45. f. 9.* 1741; Hedw, Descr. 1. *pl. 19.* 1787; Bryol. Eur. *pl. 200.* 1838.

EXSICCATAE: Drummond. Musci Am. *50.* 1828; Sull. & Lesq. Musci Bor. Am. *111.* 1856; ed. 2. *165.* 1865; Austin, Musci Ap. *174.* 1870; Macoun, Can. Musci *132* (as *E. ciliata*), and *133* (as *E. Macounii*); Allen, Mosses of Cascade Mts. Wash. *45*; Holz. Musci Acro. Bor. Am. *213.* 1906; Pringle, Plantae Mexicanae *10547* (as *E. mexicana*).

4*a*. **Encalypta laciniata microstoma** (Schimp.) comb. nov.

Encalypta ciliata var. *microstoma* Schimp. Coroll. Bryol. Eur. 38. 1855.

Seta only 3–6 mm. high; calyptra with brown fringe; capsule narrowing to a small mouth. Neck somewhat longer and running down into the seta; peristome smaller, irregular, often lacking; spores very finely papillose, less transparent, and the radiating lines less distinct; ripe in August.

DISTRIBUTION: Northern New York and in the alpine regions of the Rocky Mountains. Also Europe and Asia.

Diplolepideae

5. ENCALYPTA APOPHYSATA Nees & Hornsch. Bryol. Germ. **2:** 49. 1827

Encalypta Macounii Aust. Bot. Gaz. **2**: 97. 1877.
Encalypta leiocarpa Kindb. Bull. Torrey Club **17**: 273. 1890.

Plants 1.5–2 cm. high; leaves 3–4 mm. long by 1 mm. wide, carinate, lingulate; costa ending in the blunt apex or rarely excurrent into a short mucronate point, densely papillose on both surfaces with coarse spinose teeth on dorsal apex; margins revolute above; cells of upper blade 8–10μ, irregular, those of the hyaline base 50–60μ long by 8–10μ wide with the end walls thickened, with papillose projections; perichaetial leaves slightly broader. Monoicous. Seta 10–12 mm. long, smooth; calyptra 6–7 mm. long by 1 mm. wide, very scabrous at apex, papillose over the entire surface, basal fringe sometimes fugacious, cells of fringe narrow; lid about 2 mm. high; capsule 2–3 mm. long by 0.5 mm. wide, not striate, neck apophysate when dry or when wet long and tapering; annulus of 2–3 rows of cells, more or less persistent; mouth bordered by 3–4 rows of small thick-walled hexagonal cells; peristome obscurely double; teeth slender, very papillose, perforate, rarely bifid, inner peristome white, papillose, adhering closely and almost invisibly to the outer; spores 18–24μ, finely papillose, maturing in summer.

TYPE LOCALITY: European.

DISTRIBUTION: Rocky Mountains of British Columbia to Montana; and (according to Paris Index) Scoresby Straits, Arctic America. Also Europe and Asia.

ILLUSTRATIONS: Bryol. Eur. *pl. 201.* 1838; Limpricht, Laubm. **2**: *f. 247.* 1891.

EXSICCATAE: None. Drummond, Musci Am. *50*, is *E. laciniata;* so are many of the specimens cited in Macoun's Catalogue (**37**) for *E. Macounii.* The American specimens of this species seem to have the leaves more often blunt than is usual in the European ones, though Limpricht (**39**) describes them as *obtuse* or *short-pointed.* The type specimens of *E. Macounii* in Austin's herbarium are immature and no spores were formed, but in all other characters they agree with *E: apophysata.* The description of *E. leiocarpa* is erroneous in two important characters, for the calyptra is fringed and the peristome is double.

6. ENCALYPTA BREVICOLLA (B. S. G.) Bruch; C. Müll. Syn. 1: 519. 1849

Encalypta longicolla var. *brevicolla* B. S. G. Bryol. Eur. (4:) Encalypta 12. 1838.

Encalypta labradorica Kindb. Eur. & N. Am. Bryin. **2**: 295. 1897.

Encalypta subbrevicolla Kindb. Eur. & N. Am. Bryin **2**: 295. 1897.

Plants 1–1.5 cm. high; leaves 4–5 mm. long by 1 mm. wide, subacuminate, carinate; costa excurrent into long colorless hair-point, sometimes toothed at the base of awn, papillose on both surfaces; margins plane; upper cells of blade 12–16μ in diameter, irregular; those at the hyaline base 40–48μ long by about 16μ wide, becoming narrower and colorless at the smooth margins; walls orange-colored, slightly thickened at ends; perichaetial leaves slightly shorter and broader. Monoicous; seta 1 cm. long, smooth, red; calyptra 5 mm. long by 1 mm. wide, very scabrous at the apex, papillose over the entire surface, lacerate at base; lid 2–2.25 mm. high, with a red border; capsule about 3 mm. long by 1 mm. wide, not striate; neck short, stomatose, with large basal cells; annulus none; mouth bordered by 4–5 rows of small, thick-walled, quadrate cells; peristome double, deeply inserted; teeth .8 mm. high, irregularly broken and branched, usually united in pairs at base and perforate above, papillose; inner peristome similar and attached to the outer, median segments longer than the lateral ones; spores 28–32μ, very rough.

TYPE LOCALITY: European.

DISTRIBUTION: Labrador and, according to Paris Index, the eastern coast of Greenland. Also Europe.

ILLUSTRATIONS: Bryol. Eur. *pl. 202, β.* 1838.

EXSICCATAE: None.

7. ENCALYPTA PROCERA Bruch, Abh. Akad. München. **1**: 283. 1832

Encalypta longipes Mitt. Jour. Linn. Soc. **8**: 29. 1865.

Encalypta Selwyni Aust. Bot. Gaz. **2**: 109. 1877.

Leersia procera Lindb. Musci Scand. 20. 1879.

Leersia Selwyni E. G. Britton, Bull. Torrey Club **18**: 50. 1891.

Encalypta cucullata C. Müll. & Kindb.; Macoun, Cat. Can. Pl. 6: 96, in part. 1892.

Plants 2–4 cm. high; leaves more or less spreading when dry, 5–6 mm. long by 1 mm. wide; apical blade subspathulate, apex blunt; costa ending below apex, papillose on upper surface, scabrous on back; margin revolute above; upper cells 12–16μ in diameter, round; those of the hyaline base, 48–60μ long by 12–16μ wide;

walls deep orange, thickened at ends, basal margin slightly serrate; with 3–4 rows of narrow cells, walls colorless and ends unthickened; perichaetial leaves acuminate, tapering, with the costa percurrent into a long hair-point. Monoicous; seta about 1.5–2 cm., smooth, purple shading to orange above; calyptra 6–7 mm. long by 1.5 mm. wide, papillose at apex, very slightly so over the entire surface, lacerate at base but without differentiation of cells; lid 2 mm., marked by ragged broken cells at base; capsule 3–4 mm. long by 0.4 mm. wide, cylindric, slightly striate when young, marked when old by 8 striae, spirally twisted once or twice around the capsule; annulus large, compound; mouth bordered by 2 rows of small thick-walled quadrate cells; neck short, stomatose; peristome double, teeth about 0.5 mm. long, narrow, red, smooth or papillose, basal segments of teeth united and perforated; endostome papillose, orange, as long as the teeth, attached to a papillose basal membrane, the segments alternating with short cilia; spores 15–25μ, smooth, granular inside.

TYPE LOCALITY: European.

DISTRIBUTION: On earth in crevices of rocks and on banks; Ontario to British Columbia and Alaska; the Rocky Mountains of Idaho and Montana; Greenland. Also northern Europe and Asia.

ILLUSTRATIONS: Abh. Akad. Münch. **1**: *pl. 2.* 1832; Bryol. Eur. *pl. 205.* 1838; Mitt. Jour. Linn. Soc. **8**: *pl. 5.* 1865 (as *E. longipes*).

EXSICCATAE: Drummond, Musci Am. *48.* 1828 (as *E. streptocarpa*); Macoun, Can. Musci *134* (as *E. Selwyni*), 474 (as *E. longipes*), *491* in part (as *E. cucullata*), and *565* (as *E. procera*).

8. ENCALYPTA CONTORTA (Wulf.) Lindb. Oefv. Sv. Vet.-Akad. Förh. **20**: 396. 1863

Bryum contortum Wulf.; Jacq. Coll. **2**: 236. 1788.

Encalypta streptocarpa Hedw. Sp. Musc. 62. 1801.

Leersia contorta Lindb. Musci Scand. 19. 1879.

Plants 2–4 cm. high; leaves spreading when dry, 5–6 mm. long by 1.5 mm. wide; apical blade lingulate, carinate; apex tapering to the blunt point; costa ending below the apex, very papillose on both surfaces, scabrous on back at basal portion; margins plane; upper cells 12–16μ in diameter, round, those of the hyaline base, 40–48μ long by 16μ wide, not papillose; walls deep orange, slightly thickened at angles, basal margins bordered by 2–3 rows of long narrow cells; perichaetial leaves 2–3 mm., more acuminate. Dioicous. Seta about 1.5–2 cm. long, slightly papillose, purple; calyptra 8–10 mm. long by 1 mm. wide, brown, lacerate at base, very rough at apex, entire surface slightly papillose; lid 1.5 mm. long; capsule 4–5 mm. by 2–3 mm. wide, larger at base, deeply grooved with 8 striae, which are spirally twisted 2–3 times around the capsule; annulus large, compound, persistent; mouth bordered by 2–3 rows of small thick-walled quadrate cells; neck short, stomatose, red; peristome double; teeth long, narrow, orange-colored, very papillose; endostome with 32 paler papillose segments, one half the length of teeth, united at base by a thin papillose membrane; spores 8–12μ, smooth, irregular, ripe in early summer.

TYPE LOCALITY: European.

DISTRIBUTION: On limestone rock, sand and earth in temperate and alpine regions of Canada and Ontario to the Rocky Mountains; Eastern States from Vermont to Virginia; Central States from Ohio to Minnesota; Colorado and California, according to Paris Index. Also Europe and Asia. Fruit plentiful in Europe but not yet found in North America.

ILLUSTRATIONS: Hedw. Sp. Musc. *pl. 10.* 1801 (as *Encalypta streptocarpa*); Bryol. Eur. *pl. 204.* 1838.

EXSICCATAE: Sull. Musci Allegh. *152.* 1845; Aust. Musci App. *175.* 1870; Macoun, Can. Musci *135;* Holz. Musci Acro. Bor. Am. *141.* 1904.

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Description of plates 13 and 14

PLATE 13

A. ENCALYPTA EXTINCTORIA (L.) Sw. 1. Plant, natural size. 2. Single plant, enlarged. 3. Various forms of leaves. 4. Base of leaf showing hyaline cells with border. 5. Apex of leaf showing smaller papillose cells. 6. Capsule enlarged. 7. Calyptra with rough apex. 8. Rough spores.

B. ENCALYPTA RHABDOCARPA Schwaegr. 1. Plants, about natural size. 2. Forms of leaves. 3. Smooth basal cells. 4. Apical papillose cells. 5. Ribbed capsule. 6. Calyptra with rough apex. 7. Peristome showing basal preperistome. 8. Rough spores.

C. ENCALYPTA ALPINA Smith. 1. Plants, natural size. 2. Forms of leaves. 3. Basal cells. 4. Apex with subulate awn. 5. Capsule. 6. Calyptra. 7. Portion of capsule walls showing ragged rim of mouth and one stoma. 8. Rough spores.

D. ENCALYPTA LACINIATA (Hedw.) Lindb. 1. Plants, about natural size. 2. Leaves. 3. Basal cells and border. 4. Apex with mucronate point. 5. Capsule. 6. Fringed calyptra. 7. Basal portion enlarged. 8. Rough peristome, and rim of capsule. 9. Smooth, stellate spores.

PLATE 14

A. ENCALYPTA APOPHYSATA Nees & Hornsch. 1. Plants, natural size. 2. Leaves. 3. Basal cells, with papillose transverse walls. 4. Apical cells. 5. Capsule. 6. Papillose calyptra. 7. Base of same, fringed. 8. Double peristome, the inner more or less attached to the outer. 9. Rough spores.

B. ENCALYPTA BREVICOLLA Bruch. 1. Plants. 2. Leaves. 3. Cells of base. 4. Cells of apex. 5. Capsule. 6. Papillose calyptra. 7. Double papillose peristome, the inner more or less branched. 8. Rough spore.

C. ENCALYPTA PROCERA Bruch. 1. Plant. 2. Stem and perichaetial leaves. 3. Smooth basal cells. 4. Papillose apical cells. 5. Twisted capsule. 6. Papillose ragged calyptra. 7. Double peristome, the inner perforate at base. 8. Fragment of annulus. 9. Smooth spores.

D. ENCALYPTA CONTORTA (Wulf.) Lindb. 1. Plants. 2. Leaf. 3. Basal cells. 4. Apical cells. 5. Twisted capsule. 6. Papillose and ragged calyptra. 7. Double peristome more or less united with intermediate cilia. 8. Smooth spores.

A. ENCALYPTA EXTINCTORIA (L.) SW.
B. ENCALYPTA RHABDOCARPA SCHWAEGR.
C. ENCALYPTA ALPINA SMITH
D. ENCALYPTA LACINIATA (HEDW.) LINDB.

A. ENCALYPTA APOPHYSATA NEES & HORNSCH.
B. ENCALYPTA BREVICOLLA BRUCH
C. ENCALYPTA PROCERA BRUCH
D. ENCALYPTA CONTORTA (WULF.) LINDB.

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—NO. 207

NOTES ON PLANTS OF THE SOUTHERN UNITED STATES IV

FRANCIS W. PENNELL

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Notes on plants of the southern United States—IV

Francis W. Pennell

THE GENUS CROTONOPSIS

In 1803 Michaux published in his "Flora Boreali-Americana" a new genus of plants to which, from its evident likeness to *Croton*, he gave the name of *Crotonopsis*. The genus has been maintained continuously from that time, although twice have attempts been made to rechristen it. In 1826 Sprengel, without comment, proposed to substitute *Friesia*, and twelve years later Rafinesque, remarking that "the name previously given was absurd and incorrect," announced his *Leptemon*. According to current rules of nomenclature *Crotonopsis* must be held.

Michaux collected *Crotonopsis* twice, and, in the plate which accompanies the description of his species *C. linearis*, he fortunately figured both the specimens obtained. The drawing to the left hand shows a low plant with lanceolate or elliptic-lanceolate leaves and with fruits few and axillary, that to the right is of a side-branch of a taller plant with narrower longer leaves and with conspicuously elongated spikes. Two localities are cited in the text, Long-bay, Carolina, and the Illinois region. From evidence to be presented it is clear that two species are illustrated, and, from the form of its leaves, that to the right is the one entitled to the name *C. linearis*. Fortunately it is also that from the locality first cited. True *C. linearis* Michx. is a plant restricted to the Coastal Plain of the southeastern states.

[The Bulletin for November (45: 433–476, *pl. 13–15*) was issued November 15, 1918.]

In 1805, but two years later, Willdenow added a second species, *Crotonopsis elliptica*. His plant is stated to differ from the linear-leaved *C. linearis* Michx. in its leaves being elliptic, rounded to each end, and in its spikes being shorter. Evidently *C. elliptica* is our oldest name for the widely-ranging northern and inland species. As this plant extends to the Gulf coast, incidentally overlapping the range of *C. linearis*, the type-region, "Carolina," is well within its normal range.

The later history of the genus may be briefly sketched. Pursh in 1814 combined both species, though as varieties, in one, his *C. argentea*. Nearly to the close of the past century the genus was uniformly considered monotypic. But in 1895 Nash, from a single collection from Florida, added a second species, *C. spinosa*. As a matter of fact he was actually recharacterizing Michaux's *C. linearis*, laying primary emphasis upon newly discovered features of the fruit.

Spikes short, of but one or two fruits. Staminate flowers less than 1 mm. in diameter; filaments shorter than the sepals, and but little longer than the anthers. Fruit ovoid, with an evident median vein on each side; scale-like hairs on fruit with broad brown disk, umbonate to tuberculate-raised, even occasionally into a short spine, and with its margin of relatively uniform closely appressed white rays. Leaves lanceolate to ovate-lanceolate, 1.5–3 cm. long; stellate hairs on upper surface with long rays which overlap those of adjoining hairs. Plant usually 1–5 dm. tall. 1. *C. elliptica*.

Spikes longer, slender, of three to six fruits. Staminate flowers more than 1 mm. in diameter; filaments longer than the sepals, and much longer than the anthers. Fruit ellipsoid, without evident vein on the side; scale-like hairs on fruit with minute disk, which is usually raised into a decided tubercle or spine, and with long irregular stellate not closely appressed slightly brownish rays. Leaves lanceolate-linear, 2–4 cm. long; stellate hairs on upper surface with short rays which do not overlap those of adjoining hairs. Plant usually 4–8 dm. tall. 2. *C. linearis*.

1. CROTONOPSIS ELLIPTICA Willd.

Crotonopsis elliptica Willd. Sp. Pl. 4: 380. 1805. "Habitat in Carolina."

Crotonopsis argentea elliptica Pursh, Fl. Am. Sept. 1: 206. 1814.

Dry sandy soil, Connecticut to northern Florida, west to eastern Kansas and central Texas; northward in or near the Coastal Plain, southward mostly inland, on granitic rocks of the Piedmont and southern Appalachian regions. Numerous specimens seen. The most southwestern studied are from sandy post-oak woods, Sheridan, Colorado County, Texas, my number *5533*, and are unique in that the plants were uniformly 7–8 dm. tall, and the fruit relatively large and somewhat brownish instead of being nearly black.

2. CROTONOPSIS LINEARIS Michx.

Crotonopsis linearis Michx. Fl. Bor. Am. 2: 186. *pl. 46* p.p. 1803. "*Hab.* in maritimis Carolinae, juxta *Long-Bay*, et in regione Illinoensi." Two plants figured. One is a plant with lanceolate-linear leaves and slender spikes, the other with lanceolate to ovate-lanceolate leaves and flowers one to two together. As Illinois specimen certainly the latter, and as the former is known in the maritime region of Carolina, and is the plant to which the name *linearis* better applies, this is selected as the type.

Crotonopsis argentea Pursh, Fl. Am. Sept. 1: 206. 1814. Consists of two varieties; name is here applied to first.

Crotonopsis argentea linearis Pursh, *l. c.*

Friesia argentea Spreng. Syst. 3: 850. 1826. Without citation of Pursh.

Leptemon lineare Raf. Sylva Tellur. 67. 1838.

Crotonopsis spinosa Nash, Bull. Torrey Club 22: 157. 1895. "Collected by Mr. W. T. Swingle [*1397a*] at Dunellon [Florida], July 24 [1894]." Type seen in the herbarium of Columbia University at the New York Botanical Garden.

Dry sandy soil, in the Coastal Plain, South Carolina to central Florida and eastern Texas, extending inland near the Mississippi River to southern Illinois and southeastern Missouri, and in Texas to Dallas.

SOUTH CAROLINA. Beaufort: Bluffton, *Mellichamp* (M). Charleston: Mt. Pleasant, *L. R. Gibbes* (Y).

GEORGIA. Lowndes: Olympia, *R. M. Harper 1593* (M, U, Y). Mitchell: *R. M. Harper 1168* (M, U, Y).

FLORIDA. Baker: Macclenay, *L. H. Lighthipe 586* (Y). Brevard: Melbourne, *Curtiss 5715* (M, U, Y). Escambia: Pensacola, *J. M. Macfarlane* (P). Hillsboro: Tampa, *A. P. Garber* (U). Jefferson: *Hitchcock* (M). Lake: Eustis, *Nash 1971* (M, U, Y). Leon: Tallahassee, *N. K. Berg* (Y). Marion: Dunnellon, *Swingle 1397a* (U, Y). Orange: *A. Fredholm 5389* (Y). Pinellas: Ozona, *F. L. Lewton* (Y). St. John: St. Augustine, *M. C. Reynolds* (P). Sumter: Wildwood, *H. J. Webber* (M). Suwanee: Live Oak, *Curtiss 6897* (M, U, Y).

MISSISSIPPI. Oktibbeha: Starkville, *S. M. Tracy* (M).

ILLINOIS. Mason: "sandy barrens," *E. Hall* (M).

MISSOURI. Dunklin: Campbell, *Bush* (M). Stoddard: *Bush 124* (Y).

TEXAS. Dallas: Dallas, *Reverchon 869* (M, Y), *3177* (M), *4366* (M, U). Waller: Hempstead, *E. Hall 575* p.p. (M, U, Y).

MISCELLANEOUS RECORDS

HYPERICUM OPACUM T. & G.

Collected in flower August 15, 1912, in moist long-leaf pineland, Ozone Park, St. Tammany Parish, Louisiana, my number *4216*.

LECHEA LEGGETTII Britton & Hollick

Collected in fruit August 14, 1912, in dry open long-leaf pineland, Abita Springs, St. Tammany Parish, Louisiana, my number *4162*. Wide-spread through the southeastern states, reaching Florida and Louisiana.

RHEXIA LUTEA Walt.

Collected in fruit August 14, 1912, in moist long-leaf pineland, Abita Springs, Louisiana, my number *4198*.

RHEXIA NASHII Small

Collected in flower August 16, 1912, moist sandy soil near Mandeville, St. Tammany Parish, Louisiana, my number *4239*. Through the long-leaf pineland of the Coastal Plain, North Carolina to Florida and Louisiana. When seen living, readily distinguished from *R. mariana* L. by its flowers, the petals of which are much larger, 18–25 mm. long, and deep purple-pink.

Rhexia interior Pennell, nom. nov.

Rhexia latifolia Bush, Rhodora 13: 167. 1911. Not *Rhexia latifolia* Aubl. Pl. Gui. 1: 336. 1775. Aublet's plant is not retained in the genus *Rhexia* as today understood, a fact which under the Vienna Code permits the repetition of the same specific name.

Collected in fruit September 8, 1913, moist shady soil, west of Sapulpa, Creek County, Oklahoma, my number *5389*.

The following key to the species of *Rhexia* is offered:

Anthers relatively short, oblong, straight, not spurred at base.
  Petals yellow. Leaves lanceolate. 1. *R. lutea* Walt.
  Petals pink-purple. Leaves ovate.
    Hypanthium glabrous. Upper surface of the leaves hirsute. 2. *R. petiolata* Walt.
    Hypanthium glandular-hirsute. Upper surface of the leaves glabrous. 3. *R. serrulata* Nutt.
Anthers longer, linear, curved, spurred at the base.
  Anther-sacs very slightly spurred. Petals less than 10 mm. long, white. 4. *R. parviflora* Chapm.
  Anther-sacs evidently spurred. Petals more than 10 mm. long, pale pink (or white in *R. lanceolata*) to pink-purple.
    Leaves membranous, green; lateral nerves not close to the margin; upper surface of some or all leaves hirsute. Hypanthium glandular-hirsute to glabrous.
      Apex of hypanthium not lanose. Calyx-lobes less than one-third length of hypanthium.
        Stem obscurely if at all winged, internodes conspicuously hirsute.
          Leaves narrowed at base. Neck of hypanthium equaling or but slightly shorter than the body.
        Petals pale-pink to white, 10–15 mm. long. Buds with sepal-tips mostly spreading-recurved.
          Leaves elliptic-ovate to lanceolate, all evidently three-veined, mostly over 2 cm. long, the lower with a more or less petiolar base.
            Leaves elliptic-ovate, on evident petioles 3–4 mm. long. Petals about 10 mm. long. 5. *R. delicatula* Small.
            Leaves lanceolate to elliptic-lanceolate, on ill-defined petioles. Petals 12–15 mm. long. 6. *R. mariana* L.
          Leaves narrowly-lanceolate to linear, only the main stem-leaves if any three-veined, mostly less than 2 cm. long, sessile. Petals 10–12 mm. long. 7. *R. lanceolata* Walt.
        Petals deep purple-pink. Buds with sepal-tips mostly ascending-appressed.
          Petals 18–25 mm. long. Hypanthium 10–14 mm. long, its neck equaling the body. Stem obscurely angled.
            Leaves linear, sparsely hirsute, lateral nerves obscure. 8. *R. cubensis* Griseb.

Leaves lanceolate, conspicuously hirsute, lateral nerves prominent. 9. *R. Nashii* Small.

Petals 10–14 mm. long. Hypanthium 7–8 mm. long, its neck slightly shorter than the body. Stem relatively sharply angled. 10. *R. interior* Pennell.

Stem conspicuously wing-angled, the internodes sparsely hirsute to glabrous. Leaves rounded at base, the upper clasping. Neck of hypanthium much shorter than the body. Petals deep purple-pink.

Internodes of stem sparsely hirsute. Leaves ovate. Hypanthium hirsute. 11. *R. virginica* L.

Internodes of stem glabrous. Leaves ovate-lanceolate. Hypanthium sparsely glandular-pubescent to glabrous. 12. *R. stricta* Pursh.

Apex of hypanthium lanose with glandless yellow hairs. Calyx-lobes more than one-half length of hypanthium. 13. *R. aristosa* Britton.

Leaves firm, glaucescent, lateral nerves following closely the margin of the blade; upper surface glabrous. Hypanthium densely glandular-pubescent. 14. *R. Alifanus* Walt.

RAIMANNIA DRUMMONDII (Hook.) Rose

Collected in flower October 12, 1912; beachs and, Sullivan Island, Charleston County, South Carolina, my number *4857*. Extensively spreading from Texas along the coastal dunes of the southeastern states.

MYRIOPHYLLUM PROSERPINACOIDES Gill.

Pool in long-leaf pine-land, Mandeville, St. Tammany Parish, Lousiana, my number *4205*. Established also in ditches at Houma, Terre Bonne Parish. Naturalized from Chile.

CONTRIBUTIONS FROM THE NEW YORK
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NOTES ON PLANTS OF THE SOUTHERN UNITED STATES
V

FRANCIS W. PENNELL

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Notes on plants of the southern United States—V

FRANCIS W. PENNELL

KALMIELLA HIRSUTA (Walt.) Small

Sandy scrub-land, between Theodore and Hollanders Island, Mobile County, Alabama, September 3, 1912, *Pennell 4513*.

POLYCODIUM FLORIBUNDUM (Nutt.) Greene

Open pine-land, Biloxi, Harrison County, Mississippi, August 28, 1912, *Pennell 4405*.

SABATIA ELLIOTTII Steud.

Moist scrub-land, between Theodore and Hollanders Island, September 3, 1912, *Pennell 4512*.

Dasystephana tenuifolia (Raf.) Pennell, comb. nov.

Diploma tenuifolia Raf. Fl. Tell. **3**: 27. 1837. "Florida . . . seen in the herb. of Torrey." The type, labeled in Rafinesque's handwriting "G. tenufolia Raf. Monog.," is in the Columbia University Herbarium at the New York Botanical Garden. It bears data of collection, "Florida, Mr. Croom, 1832, flowers white."

In the American Journal of Science for October, 1833 (**25**: 69), H. B. Croom records "Gentiana alba (White flowered Gentian)" as growing in "wet pine woods" in Middle Florida, a region defined as "that tract of country which lies between the Suwanee River on the east, and the Apalachicola on the west." His "observations were chiefly made . . . about twenty miles west of Tallahassee, about thirty miles from the Gulf of Mexico, in latitude about 30° 30′." The plant was seen in bloom January 1–5, 1833, and must certainly be the same species as the plant sent Dr. Torrey.

Dasystephana tenuifolia is most nearly allied to *D. Porphyrio* (Gmel.) Small, long known as *Gentiana angustifolia* Michx. Rafinesque briefly distinguishes the two by certain features, the most obvious of which is the white corolla of the southern plant. Southern botanical authors treating of the Carolina flora, describe the blue-flowered species, but Chapman, working on the Gulf coast, knew only the white-blooming low-growing plant. A brief contrast of the two would be:

Plant 3–5 dm. tall. Corolla deep-blue within. Stamens and pistil about equaling the tube of the corolla. Stigmas spreading, 3–4 mm. long. Sandy pine-lands, New Jersey to South Carolina. 1. *D. Porphyrio.*

Plant 1–2.5 dm. tall. Corolla white within. Stamens and pistil only about one half the length of the corolla-tube. Stigmas slightly spreading, about 1 mm. long. Low pine barrens, West Florida. 2. *D. tenuifolia.*

Beside the type nearly all the specimens of *D. tenuifolia* seen are from the Chapman Herbarium, and his No. 467b, collected November 2, 1884, and distributed by the Biltmore Herbarium, may be cited. The only specimens of recent collecting which have come to my notice were obtained by Dr. G. C. Fisher at Red Bay, Walter County, Florida, in January, 1917. The same observer has found the plant at Sanborn in Wakulla County. These definite localities enable us to predict the occurrence of the species throughout the low moist pine-lands between Apalachee Bay and Escambia Bay.

Acerates hirtella Pennell, sp. nov.

? *Oligoron longifolium hirsutum* Raf. New Fl. Am. 4: 60. 1838. No locality given, but description of pedicels as long-hirsute suggests, though it over-emphasizes, a feature of the plant here considered.

Stem 6–10 dm. tall, stout, strongly puberulent in lines above. Leaves scattered, numerous, rather crowded, lanceolate-linear, 9–17 cm. long, 0.6–1.4 cm. wide, scabro-puberulent above and on the veins beneath. Peduncles stout, less than 3 cm. long, scabro-hirtellous. Umbels four to twelve, twenty-five to one hundred flowered. Pedicels 12–15 mm. long, hirtellous with spreading hairs. Flowers 8–8.5 mm. long. Sepals 2 mm. long, lanceolate-acuminate, hirtellous on the back. Petals 5 mm. long, lanceolate, greenish yellow, sometimes slightly purple-tinged on back toward apex, crenulate at apex. Column 0.5–0.7 mm. long. Hoods entire, rounded, one half to two thirds the length of the anthers. Anthers acute, each with two wings which are angled above the middle. Follicles erect on reflexed fruiting pedicels, 10 cm. long, lanceolate, short-caudate, hirtellous-pubescent. Seeds obovoid, flat, 8 mm. long. Coma silvery, 35 mm. long.

TYPE: dry soil, east of Carthage, Jasper County, Missouri, *F. W. Pennell 5372*, in the herbarium of the University of Pennsylvania.

Wet to dry prairies, northern Illinois to eastern Kansas, and in "swamps" in Michigan. Probably extends to Oklahoma, as Nuttall collected it on the "Red River." This is the plant of the Mississippi Valley which has been merged with the Coastal Plain *A. floridana* (Lam.) A. S. Hitchc., and the following numbers are characteristic, *H. S. Reynolds 28, Agnes Chase 1439, J. R. Gardner 563, B. F. Bush 244, A. S. Hitchcock 763*.

The key below contrasts these two species:

Puberulence finely cinereous. Pedicels finely puberulent with incurved hairs. Hoods two thirds to three fourths the length of the anthers. Seeds 9–10 mm. long, dark-brown. Leaves not crowded, narrowly to broadly linear, glabrate. Flowers 7 mm. long. Petals strongly purple externally toward apex, with a narrow white border. Umbels one to six, ten to thirty-flowered, on peduncles reaching 3–9 cm. long. Capsule about 11 cm. long, narrowly lanceolate, long-caudate, finely appressed-puberulent. 1. *A. floridana*.

Puberulence more densely cinereous. Pedicels pubescent with spreading hairs. Hoods one half to two thirds the length of the anthers. Seeds 8 mm. long, cinnamon. Leaves crowded, broadly linear, scabrous to the touch. Flowers 8–8.5 mm. long. Petals greenish, sometimes slightly greenish externally toward apex, with a broader white border. Umbels four to twelve, twenty-five- to one hundred-flowered, on peduncles not over 3 cm. long. Capsule lanceolate, short-caudate, 10 cm. long, hirtellous-pubescent. 2. *A. hirtella*.

EVOLVULUS SERICEUS Sw.

Two forms were collected together on black calcareous soil, Edwards Plateau, northwest of New Braunfels, Comal County, Texas, September 14, 1913, *Pennell 5440, 5442*. No. 5440, with broader densely white-lanate leaves, bore blue corollas; No. 5442, with narrower leaves, strigose-lanate beneath, bore pale blue corollas. The latter is nearer the typical form of the West Indies.

PHLOX FLORIDANA Benth.

Dry sandy pine-land, east of Mississippi City, Harrison County, Mississippi, August 27, 1912, *Pennell 4353*.

EUPLOCA RACEMOSA Rose & Standley

Dry sandy oak-land, west of Sheridan, Colorado County, Texas, September 21, 1913, *Pennell 5516.* This agrees closely with the description of the species of western Texas. It is probably most readily distinguished from *E. convolvulacea* Nutt. by its narrower leaves, lanceolate or nearly so in the specimens seen. Other Texan collections to be referred here are: San Antonio, *E. Palmer 889;* western Texas, *S. B. Buckley.*

VERBENA VENOSA Gill. & Hook.

Moist soil, Mandeville, St. Tammany Parish, Louisiana, August 15, 1912, *Pennell 4204;* moist soil, Catalpa, West Feliciana Parish, August 24, 1912, *Pennell 4332.* Introduced from South America; reported from Houston, Texas, and previously collected in Louisiana in Plaquemines Parish, *A. B. Langlois 49.*

MONARDA PUNCTATA L.

The species is widespread and abundant through most of the Coastal Plain of the southeastern states, occurring inland in the southern Appalachians and westward to Sapulpa, Creek County, Oklahoma, *Pennell 5390.* Two geographical subspecies, which seem worthy of recognition, may be distinguished from the typical form of the species and from each other by the following key:

Leaves lanceolate to ovate-lanceolate, their blades obviously wider proximally and with definite petioles. Corolla conspicuously spotted.
- Stem finely appressed-pubescent. — 1. *M. punctata.*
- Stem pubescent with spreading hairs. — 1a. *M. punctata villicaulis.*

Leaves linear-lanceolate, obscurely petioled. Corolla not or scarcely spotted. — 1b. *M. punctata immaculata.*

1*a*. **Monarda punctata villicaulis** Pennell, subsp. nov.

Stem pubescent with spreading hairs. Plant usually stouter than in the typical form.

TYPE: dry sandy open soil, Clarke, Lake County, Indiana, collected in flower August 22, 1915, *F. W. Pennell 6412;* in the herbarium of the New York Botanical Garden.

Sandy soil, northern Indiana and northern Illinois; far isolated from the typical species of the Coastal Plain. Other collections seen are:

INDIANA. Kosciusko: Winona, *C. C. Deam 1494;* Lake: Whitings, *N. L. Britton.*

ILLINOIS. Cook: Hyde Park, *A. Chase 1166* (sand near lake); Pullman (Y).

1*b*. **Monarda punctata immaculata** Pennell, subsp. nov.

Stem pubescent with fine reflexed appressed hairs. Leaves linear-lanceolate, obscurely petioled. Corolla not or scarcely spotted.

TYPE: sandy soil, Aloe, Victoria County, Texas, collected in flower September 8, 1913, *F. W. Pennell 5494;* in the herbarium of the University of Pennsylvania; iso-type in the herbarium of the New York Botanical Garden.

Also seen from Texas, without locality, collected by Charles Wright.

CLINOPODIUM COCCINEUM (Nutt.) Kuntze

Dry sandy pine-land, Biloxi, Harrison County, Mississippi, August 27, 1912, *Pennell 4372;* also Mississippi City, Harrison County, *Pennell 4355.*

Dry sandy ridges in the longleaf pine-land, southern Georgia and northern Florida to southern Mississippi.

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INTERSEXES IN PLANTAGO LANCEOLATA

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(WITH PLATES XII, XIII)

A. B. STOUT

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(WITH PLATES XII, XIII)

Through the resent researches of Goldschmidt (11, 12, 13), Banta (1), Whitman, Riddle, and their associates (see especially summaries by Riddle 22, 23), and Lillie (17, 18), the facts of intersexualism have acquired a significance which must be considered by any theory of sexuality and sex determination. These new studies show that in widely separated groups of animals which are usually dioecious various grades and degrees of maleness and femaleness in a single individual are common. Judged as entire individuals, such "intersexes" or "sex intergrades" may be predominately male or female, or there may be various grades in the relative development of maleness and femaleness, giving in some cases at least functional hermaphrodites. Along with these there may be individuals that are only male or female. An individual sex organ may start development as of one sex and change to the other, or there may be a decidedly simultaneous development of male and female sex organs, as in the fully functional hermaphrodite. The more remote secondary sex characters also exhibit characteristics of maleness, femaleness, or various grades of modifications that are intermediate.

Such development of intersexuality in forms usually considered as dioecious is evidence that even in dioecious forms sex is not necessarily determined at fertilization, and that sex is not alternative and irreversible for an individual or even for a sex organ. The data are particularly suggestive of the probability that sex differentiation in dioecious forms and in hermaphrodite forms is essentially the same process, and thus that sex determination is on the same fundamental basis in both plants (which are prevailingly hermaphrodite) and animals (which are prevailingly dioecious).

In plants the most intimate association of the two sporophytic sex organs is seen in the so-called perfect flowers. The opposite extreme is seen in dioecious species. Various grades of sexuality intermediate between these two are seen in species classed as monoecious and polygamous, most striking of which are the numerous instances where all grades of sexuality are to be seen among the various flowers produced by a single individual. DARWIN (7) presents an excellent summary of these cases as evidence that "various hermaphrodite plants have become or are becoming dioecious by many and exceedingly small steps" (p. 181). DARWIN was not directly concerned with the problem of sex determination. He was seeking to discover methods and principles of evolution. In his discussion of sex heteromorphism he places much emphasis on the law of compensation in the utilization of the energy at the disposal of plants, and thus gives recognition to a metabolic theory of sex determination in so far as it relates to the development of the floral organs.

There has been no special dispute over the very obvious fact that the condition of hermaphroditism indicates that sex differentiation may arise through somatic differentiation. According to the sex chromosome theory, however, sex in dioecious species is assumed to be determined qualitatively in reduction divisions and in fertilization, and that the two sexes are hence alternative and represent fundamentally irreversible conditions. In developing this theory, however, little attention has been paid to hermaphrodites, and in view of their predominance in plants the theory cannot be regarded as expressing any broad biological law.

The recent investigations of GOLDSCHMIDT, BANTA, RIDDLE, and LILLIE show that the sex of dioecious species is not necessarily irreversible. This is especially striking, as to demonstration in pedigreed cultures, in the results obtained by BANTA. By means of parthenogenetic reproduction he propagated races from females of *Simocephalus vetulus* for 130 generations, getting nothing but female individuals, only to have the femaleness break up in the 131st generation, giving males, females, hermaphrodites, and many grades of intersexes.

Turning to plants, we have such striking cases of changes of sex combined with conditions of intersexuality as are recently reported by DAVEY and GIBSON (8). They have studied the sex of the bog myrtle or sweet gale (*Myrica Gale*). This plant is a small shrub which grows abundantly in swamps and heaths in Europe, Asia, and the northern part of North America. The species is described as strictly dioecious, and until 1901 no observations that it is ever otherwise have apparently been recorded. DAVEY and GIBSON find that in the peat moors of England there are everywhere present intersexes, or, as they call them, "mixed plants" of many gradations. Judged as a whole, the plants present every gradation of intersexes between dioecism, monoecism, and hermaphroditism. The variations seen in the various catkins on a single plant include the entire range, and all the grades may appear among the flowers of a single catkin. Furthermore, a study of individual plants for a series of years shows that changes of sex from year to year occur. Plants entirely female in 1913 were entirely male in 1914. Plants female in 1913 were mixed in 1914, entirely or nearly all male in 1915, and again female in 1916.

DAVEY and GIBSON point out that the changes in sex seen in *Myrica Gale* indicate that sex determination is here in some way associated with environmental conditions. In regard to this they state as follows:

> The conditions which naturally suggest themselves are moisture, temperature, and light (with their influence on nutrition), and also the previous state of a plant as regards the production of fruit. Since the staminate flowers are developed early in the season preceding that in which they flower, while the pistillate catkins develop much later, it is possible that conditions accelerating or retarding the development of catkin buds may influence the proportions of the two kinds (pp. 150–151).

The facts reported for *Myrica Gale* are striking and suggest that similar conditions may already be present or may spontaneously arise in other species now considered as dioecious.

Intersexes in Plantago lanceolata

This species is a native of Europe and Asia. It has been introduced into America, where it has spread from the Atlantic to the Pacific, through Canada, and southward in the United States to Florida. It is well known as a vigorously growing species which in many sections has become a troublesome weed.

Standard botanical treatments describe this species as having only perfect flowers. For over 50 years, however, sex polymorphism has been recognized as present in the species. The tendency has been to group the individuals in 3 classes (LUDWIG **19**), most recently designated by BARTLETT (**2**) as (1) first form hermaphrodite, (2) second form hermaphrodite, and (3) female. CORRENS (**4**), however, groups plants of this species grown from seed collected near Leipzig, Germany, into 5 classes, in two of which there was variation in single spikes (*a*) from hermaphrodite flowers to flowers with imperfectly developed stamens (±☿), and (*b*) from more or less perfect flowers to flowers only female (±☿ and ♀). In thus making these classes recognition is given by CORRENS to variations in sex organs which include various grades of gynomonoecism already observed in this species by SCHULZ (**24**).

The difficulty of making any adequate classification, expressed in some degree by CORRENS (**4**) and by BARTLETT (**3**), has been very apparent from the observations which the writer has made. In 1912 BARTLETT very kindly supplied me with plants which he classed under the 3 forms just noted. Seed progenies have been grown and observations made of plants growing wild in the fields in and about the New York Botanical Garden, where *P. lanceolata* is exceedingly abundant. Study of this material reveals that there is present a wide range of variations in the development of sporophytic sex organs, which in its general aspects is quite identical with the phenomenon of intersexualism especially described by GOLDSCHMIDT, BANTA, and by DAVEY and GIBSON.

DESCRIPTION OF THE THREE FORMS

Flowers typical of the forms most generally recognized may first be described, as illustrating the two extremes and one intermediate. The flower drawn for a plant was in all cases selected from the middle portion of a spike, and was typical of a large number of flowers in bloom. The flower was placed on a glass slide, a large cover glass was placed over it to bring the various parts into somewhat the same plane, measurement was made of the flower parts under very low magnification by ocular micrometer, and all parts were then drawn to scale. Stamens and spores were measured and drawn under higher magnifications.

FIRST FORM HERMAPHRODITE (figs. 1–3, 49, 50).—This term has been applied by BARTLETT (2) to plants whose flowers very uniformly show most complete development of stamens. The filaments are usually twice as long as the pistils. The anthers are large and well developed and white in color. In face view when freshly dehisced (fig. 2) they measure about 2 mm. in length by 1.5 mm. in width. The corolla lobes are well developed, with blades strongly reflexed when anthesis is complete.

The pollen of numerous plants of this form was examined microscopically and rather extensive germination tests were made.[1] Perfect grains are almost spherical, with thin smooth walls and granular contents. There is much variation in the size of grains that appear to be perfect, the smallest being about one-third the diameter of the largest. There is also a considerable number of obviously imperfect grains with shrunken shriveled walls that are either empty or have hyaline contents. Such grains do not swell up when placed in water or in various media used in testing germination. Impotent grains frequently constitute 25 per cent of the pollen of a microscopical mount. They have always been found present to some extent.

After a rather extended series of experiments it was found that the pollen of this form germinates well in sugar-agar media. The most uniformly favorable results were obtained with a medium of 15 per cent sugar to which 3 per cent agar was added. Good germination was also obtained in 15–1 and 15–5 solutions. The largest tubes observed measured 3.1 mm. in length. Even in the case of the most complete germination not all the spores with granular contents germinated. No shriveled and hyaline spores germinated, but some of the smallest of the apparently perfect spores germinated. Some granular spores of all the sizes failed to germinate. A series of countings was made for a plant

[1] In the various studies of the germinations of pollen reported in this paper the writer has been assisted by Lieut. M. V. REED, a former student and scholar at the New York Botanical Garden, and by Miss HELENE M. BOAS, laboratory assistant, for whose efficient aid and cooperation acknowledgment is here made.

whose pollen germinated most completely. Of 1003 pollen grains placed in 15–1 and 15–3 sugar-agar media, 147 grains (about 15 per cent) had failed to germinate at the end of 24 hours, and of these about half were shrunken and hyaline.

Data regarding the ability to produce seed are of interest in bearing on the condition of femaleness in intersexes. This is a point of particular interest in respect to plants classed as hermaphrodites. LUDWIG (**19**) reports that the reduction in stamens seen in female plants of *Plantago* is associated with increased fruitfulness. I have made special observations on 3 plants of the first form. In 1916 all of these failed to set any seed to controlled self-pollination. In 1917 two of these failed to produce seed to free open pollination; the third plant was isolated with a pistillate plant. Day after day pollen of the hermaphrodite was very generously shaken over stigmas of both plants. The female plant produced an abundance of seed, while not a seed developed on the other. It is possible that physiological self- and cross-incompatibilities may be operating here (STOUT **25**), but the various grades of impotence and intersexuality seen in stamens of plants of this species suggest that the failure to set seed when pollinated with viable pollen may involve impotence of pistils. It is readily observed in the field that many plants fail completely to set seed; although pistils are present they may be incapable of functioning. Such plants classified as of first form are functionally male only. In the highly developed stamens and impotent pistils these plants may be considered as representing the extreme of maleness seen in this species. Some first form plants, however, produce seed in abundance.

SECOND FORM HERMAPHRODITE (figs. 4–6, 53).—Plants most typical of this class, as thus designated by BARTLETT (**2**), are especially to be distinguished from the first form by the stamens, which have shorter filaments and slender yellowish-green anthers. In most cases the anthers do not dehisce. There is no excessive development of sterile tissue in the stamens. Pollen grains are numerous, but the largest are only about half the diameter of the largest of the first form; but poor and shrunken grains appear to be no more numerous. Attempts to germinate the pollen have been unsuccessful. Pollen grains have been removed from anthers of various ages, anthers have been artificially dried to various stages of dryness before pollen was removed, and many kinds of media have been employed. In extensive tests of pollen from 4 different plants during 2 years of bloom only one germinating grain was found, and this may have been accidentally introduced from another plant.

Accurate tests of the ability to set seed have not been made for plants that are best classed with this form. From the evidence at hand it appears that the pistils are very frequently functional, so that the plants most typical of this class are functionally female.

It will be noted later that the flowers of numerous plants which would ordinarily be classed with this form are found upon more careful examination to present somewhat decided differences indicative of various grades of maleness.

FEMALE OR PISTILLATE FORM (figs. 7–10, 58).—Plants that may be grouped in this class have flowers with rudimentary and rather reduced stamens, the tips of which only slightly or not at all protrude above the corolla. There is much variation, however, in the development of the stamens in such flowers. Frequently there is a differentiation of filaments and anthers as shown in fig. 8, and in cases even some traces of the 4 anther sacs. In other cases the stamens are more foliose, with no trace of anthers, as shown in fig. 10.

Numerous plants with this general type of stamen have what may be termed "closed" flowers; that is, the corolla lobes do not spread out and become reflexed, and when the flowers are fully developed they appear as shown in figs. 7 and 9, a condition decidedly in contrast to the reflexed corollas seen in such flowers as shown in figs. 1 and 4. Such a reduction of corolla in pistillate plants has long been recognized in gynodioecious species, and such a condition was recognized for *P. lanceolata* in the early observations made by DARWIN (**7**, p. 307) and LUDWIG (**19**, p. 322). Examination of such flowers shows that the blade portion of the petals is well developed, but that the part below the blade is shortened and often crumpled; the corolla lobes, therefore, are not pushed up above the calyx lobes. The writer has examined at least 100 plants with this closed corolla type of flowers. In every case the stamens were scarcely or not at all exserted and were completely composed of sterile tissue.

Thus far all plants that I have seen which had completely sterile non-exserted stamens also had closed flowers; but the pistillate form as described by BARTLETT also includes plants with corollas fully developed and reflexed, and such a flower is figured by him (**2**, fig. 3) as illustrating a typical pistillate flower. Various plants with expanded petals and completely sterile or indehiscent stamens are potentially only females. The rudimentary development of stamens and the character of the corolla may be regarded as extreme cases of loss of maleness, and the character of the corolla may be considered as a secondary sex character associated with femaleness and appearing when maleness is most completely lacking.

From general observations of plants in the field and in a greenhouse, and from such controlled pollination as have been made, it appears that plants of this pistillate type are highly productive of seed. A few plants, however, have set no seed when exposed to favorable conditions for free cross-pollination, which suggests that the pistils of some of the pistillate plants may be impotent.

These descriptions refer to the types of flowers that characterize the 3 forms most generally recognized, and into which attempts have been made to classify all individuals. Both CORRENS (**4**) and BARTLETT (**3**), however, recognized that it was somewhat difficult to thus place all individuals observed by them. Such a difficulty has been very apparent in respect to the material studied by the writer. The variations present almost every grade of intermediates between the two extremes described, and seem to involve a series of sex intergrades or intersexes. The character of flowers may be quite uniform for a plant as a whole, or there may be a wide range of intersexuality among the different flowers of a single spike, or even among the various stamens of a single flower. Flowers typical for some of these may be described and arbitrarily numbered as follows:

INTERSEXES WITH FLOWERS UNIFORM

No. 11 (figs. 11, 12, 50).—The relative lengths of pistils and stamens in the flowers of this plant are quite as in the first form. The general appearance of the spikes in full bloom is quite similar (fig. 50), but the anthers are noticeably smaller and more narrow, and they are slightly greenish-yellow in color. Many anthers do not dehisce, and after 2 or 3 days they turn brown. A high percentage of pollen is impotent, but the size of the apparently good grains ranges quite as for the first form.

No. 13 (figs. 13, 14).—The stamens produced by this plant are somewhat smaller than those of the first form. They are slightly greenish-yellow, but are fully dehiscent. A large proportion of pollen was impotent, but a few well formed grains as large as the largest of the first form were found. Tests of pollen germination in 15–1, 15–3, and 15–5 sugar-agar media gave germination in about 3 per cent of the grains. The tubes made a feeble growth and the longest obtained measured only 0.08 mm.

No. 15 (figs. 15, 17).—Pistils of this plant are normally longer than the stamens when both are fully developed. The filaments are only slightly shorter than in the first form; the anthers are decidedly smaller, but all are white and fully dehiscent. A large proportion of the pollen is impotent, but normal grains of large size are abundant. The pistils produced by this plant were among the longest observed on any plant, except for the abnormally elongated pistils (fig. 56) which appear in plants under certain conditions.

No. 18 (figs. 18, 19).—The stamens and pistils in flowers of this plant are of nearly equal length. Nearly half of the apical portion of the stamens is composed of a sterile blade. The small anther sacs, however, are well developed and fully dehiscent. Scarcely a shriveled pollen grain was found, the grains being very uniformly of large size and a high percentage of them being viable. In this plant the amount of sterile tissue in stamens is decidedly more than that seen in nos. 1, 11–17, but there is better development of such sporogenous tissue as is formed.

No. 20 (figs. 20–22, 54).—At the time when the pistils were receptive the flowers of this plant appeared as shown in fig 20, with the lobes of the corolla scarcely expanding and the large anthers scarcely protruding. Several days later, when the stigmas were beginning to shrivel, the corolla was slightly expanded (fig. 21). The anthers are large, but there is marked inequality in size of the 2 pairs. The pair next to the insertion of the filament is uniformly the larger and overlaps somewhat the smaller pair, so that in face view an anther appears as in fig. 22. Dehiscence is somewhat irregular and is confined to the apex, so that few spores are shed. The anthers persist until all the flowers in a spike bloom. In old anthers the microspores are dry and shriveled, but in fresh anthers they are mostly of large size and appear to be normal; but no germination was obtained in cultures.

No. 23 (figs. 23, 24).—A plant with short crinkled filaments and extremely narrow and pale green anthers. Most anthers dehisce fully. Very few microspores are plump and have granular contents. The range of size of grains is quite as for the first form, but no germination was obtained in cultures.

No. 25 (figs. 25–27).—This plant resembles a second form hermaphrodite. The stamens, however, are decidedly shorter, the anthers are somewhat of the same shape but dehisce regularly, and the microspores range to a larger size quite as for the first form. About 20 per cent of the pollen grains tested germinated, but in all cases the tubes made only a very feeble growth.

No. 28 (figs. 28, 29).—The stamens produced by this plant have short and crinkled filaments with decidedly green anthers. The apical half of the anthers is composed of a sterile green blade, and the anther sacs are much reduced in size and are not dehiscent. At least 75 per cent of the pollen grains that are produced are of large size and are plump with granular contents. In 3 cultures of pollen removed from fully developed anthers 6 grains germinated and the best developed tube was 0.60 mm. in length.

No. 30 (figs. 30, 31).—In general appearance the stamens produced by this plant resemble those of the second form; the anthers are greenish yellow but the filaments are shorter. There is a marked peculiarity, however, in the development of anther sacs not observed thus far on any other plant. When anthers are fully extended their appearance suggests dehiscence, but an examination at earlier stages of development shows that the 4 anther sacs develop as thin platelike and chiefly indehiscent structures, with only a few scattering thin areas of sporogenous tissue.

No. 32 (figs. 32, 33).—The stamens of this plant protrude only slightly above the throat of the corolla. The general shape of the anthers is maintained, but the anthers are wholly or nearly wholly sterile, and there are only slight irregularities on the surface suggestive of any differentiation of anther sacs.

Nos. 34 and 35.—Numerous plants are to be found having stamens with no trace of sporogenous tissue or even of anther differentiation. When such rudimentary stamens are short, they may be entirely or nearly inclosed within the corolla as previously described for certain plants classed as pistillate (figs. 9, 10). In many cases, however, the stamens are more extended and take on the character of leaves, both as to general shape and color. One of the cases best developed in this direction is illustrated in fig. 34. In fig. 35 the foliose stamens were of nearly uniform width and were much recurved.

Summary.—It is difficult to arrange or classify the flowers typical of individual plants, such as described, in any fully consistent series. Various types of flower and various grades of development of stamens are to be recognized, and it is evident that as arranged in descriptions and in plates the flowers of nos. 11–32 comprise a series which presents a quite continuous gradation between such extremes as shown in figs. 1 and 7. Stamens decrease noticeably in length of filaments, in size, in shape, and in dehiscence of anthers, in the relative amount of tissue that is sporogenous, and in the total number and viability of microspores produced. Complete absence of sporogenous tissue is seen in no. 32, almost complete absence of such tissue is seen in no. 30, and indehiscence is complete in no. 28, giving plants that can function only as females. Reduction in size of anthers and of the amount of sporogenous tissue, however, does not necessarily involve also a decrease in size and viability of the spores which are produced, as is shown in no. 18. Marked differences in viability of pollen are in evidence. Rarely was any germination observed in microspores artificially removed from indehiscent anthers. Very feeble germination was also obtained in tests of large sized grains from fully dehiscent anthers, as in no. 25. In many plants completely sterile stamens retain some suggestion of filaments and anthers in regard to the general form, but all traces of such differentiation may disappear, giving only foliose structures as shown in nos. 10, 34, and 35. In general, the various grades of development of stamens may well be regarded as indicating different grades of maleness.

In the case of all plants the flowers of which have here been described and illustrated, observations were made of flowers in numerous heads throughout at least one season of bloom. Some have been under observation for several years. At the extreme tip of the spikes in many plants there is a tendency for flowers to develop poorly; the pistils usually protrude, but the stamens are poorly formed and often flowers fail to open. This is the tendency to gynomonoecism especially emphasized by SCHULZ (24) and CORRENS (4). This tendency is evidently more marked in some plants than in others, but I am unable to make any classification on this basis. For the plants already discussed the flowers were very uniform for at least four-fifths of the spikes, as indicated in the spikes (excepting no. 55) shown in pl. 13.

GRADES OF INTERSEXUALISM

Variations in the development of stamens in the same flower or among sister flowers are frequent for many plants. In such cases there are various mixtures of different types of flowers and stamens. Some of these may be noted as follows:

No. 36 (fig. 36).—For this plant some stamens were nearly identical with those of the first form, while others were quite as in the second form. Differences in the length of stamens in a single flower were conspicuous. Some anthers failed completely to dehisce, while others dehisced fully. The greater portion of the pollen was impotent. Grains of large size were present and some of these from dehiscing anthers germinated well in cultures.

No. 37 (figs. 37, 38, 52).—As in the plant previously noted, there is much variation in the length of filaments among stamens of the same flower. Here, however, the anthers are all quite uniform in size and shape. A rather large portion of the apex is sterile, but the anther sacs dehisce fully, and about 50 per cent of the pollen which they contain appears to be normal. In tests, however, only grains of large size germinated, and the tubes from these made only a feeble growth.

No. 39 (figs. 39, 40).—Filaments are here not only of unequal length, but all are more or less twisted, and nearly all are expanded broadly at the base of the anthers. The upper portions of the anthers are leaflike. Anther sacs vary in number and in degree of development; all 4 may be in evidence, or there may be only 2 (fig. 40), but all are more or less rudimentary and none dehisce. Nearly 30 per cent of the microspores examined were granular and of large size. Of 3 cultures, only 2 grains germinated, and the best tube obtained was 0.35 mm. in length.

No. 41 (figs. 41–43).—In the stamens of this plant the anthers are reduced to irregularly sagittate-shaped leafy structures. Such structures are often composed only of sterile tissue; in some a mere nest of spores develops, but these spores are completely imbedded in sterile tissue. In no case was more than one such nest found in a stamen. Dissection of fully mature structures revealed that the microspores were represented by shriveled cells (fig. 43).

No. 44 (figs. 44, 45).—In this plant the stamens are somewhat more leaflike than those just described. Some are completely sterile, and usually one nest, but sometimes two, of sporogenous tissue may be present in a stamen. Only a few pollen grains appear normal when dissected out.

No. 46 (figs. 46, 47, 48, 56).—A wide range of variation is seen among the stamens produced by this plant. All stamens in a flower may be completely sterile and foliose, as in fig. 46, all may have quite well developed anthers with much good pollen, or all grades between these extremes may be present; 4 stamens from a single flower are shown in fig. 48, and illustrate very well this range. Flowers growing side by side and opening at the same date exhibit wide variations and a great mixture of types. In several plants under observation this was the condition in all spikes throughout the entire period of bloom. The general appearance of typical spikes from such plants is shown in nos. 55 and 56, but the wide range of stamen forms which are present is not clearly shown. The spikes shown in no. 56 also show the excessive growth which stigmas frequently make. It has been suggested that this occurs when pollination and fertilization have not been effected, and that successful pollination inhibits such growth. It is possible, however, that such growth is an indication of loss of femaleness. Studies are now in progress to determine especially the functional potentiality of pistils of plants for which this phenomenon is very general.

SUMMARY.—The flowers described and illustrated for plants 36–47 show that wide variations exist in the development of stamens among various flowers of a plant, or even among stamens of a single flower. The range is in some cases almost identical with the extremes seen for plants as wholes (nos. 1–35). This statement refers to the flowers produced in the lower two-thirds of the spikes. It may be noted that the range is greater for such a plant as no. 46 than for one like 36 or 37. This variation is not identical with the tendency for the last flowers of a spike to be different from earlier flowers. Here there is a marked mixture throughout the spikes.

NATURAL DISTRIBUTION

In the fields in and about the New York Botanical Garden *P. lanceolata* is so abundant that it often dominates the vegetation over a considerable area. Here plants that approach the first form are most numerous; female plants corresponding to the type described as nos. 7 and 9 are abundant; and there are thousands of plants which are in some degree intermediate between these extremes. Many plants with mixed flowers are to be found. With respect to vegetation characters and to general size and shape of spikes, extremely wide variations are everywhere in evidence.

The variations in flower forms noted by DARWIN for England, by LUDWIG and CORRENS for Germany, and by BARTLETT in the vicinity of Washington, D.C., indicate that much the same range of variation is to be seen over a wide geographical area. Undoubtedly many of the plants classed as intermediate gynomonoecious, especially by CORRENS, present a range of variations quite identical to those here described.

The wide geographical range of this species, and especially its recent rapid spread in America, give opportunity to observe to what extent there is geographic distribution of races possessing distinctive differences in sex heteromorphism.

Discussion

The term intersexuality, as especially applied by GOLDSCHMIDT to conditions of sex in *Lymantria dispar*, can with equal adequacy be applied to such sex variations as are evident in *Plantago lanceolata*.

It must be recognized that the significance of such variations is to be sought in the conception that there may be different degrees in the expression of maleness and femaleness. Cases of intersexuality afford material for the study of stages and degrees of sexuality and sex determination.

The observations reported for *P. lanceolata* refer almost entirely to maleness. The variations in development of the stamens, with their anthers and contents, are easily and directly to be observed. Evidences of marked variations in the development and functioning of the pistils are also in evidence, and further studies of femaleness are in progress.

It is very evident that there is a wide range of variation in the degree in which maleness is expressed. Measured by the amount of sporogenous tissue, there is every degree of sexual development between the highest grade seen and complete sterility. The size of the stamen as a whole and the size and shape of its various parts exhibit a series from the normal to extremely rudimentary structures. There are two forms in which this decrease in maleness is expressed. In one the stamens are greatly reduced in size; in the other they become foliose. The foliose character is seen first in the slight enlargements of the sterile tissue at the apex of the anther, as shown in figs. 19 and 29.

It is to be recognized that the impotence of one or the other of the sex organs involved in intersexuality is to be distinguished from sterility of the type classed as impotent (STOUT 25), which results very frequently from hybridization. In sterility of hybrids there is poor development of both sets of sex organs; stamens and pistils are both affected very uniformly, and the tendency is to give complete sterility. In intersexuality loss of sex development for one sex is not necessarily associated with similar loss in the expression of the other sex. In fact, the opposite condition is the normal one for such cases.

In *P. lanceolata* the so-called "first form" is very high in its grade of maleness, and it is in these plants apparently that seed production is noticeably low. As already stated, such plants may fail to set any seed. They have maleness well developed, but functional femaleness may be lost, although pistils are present. Likewise in the most marked cases of loss of maleness the degree of femaleness may be high, as is seen in the plants classed as females. DARWIN (7) reports that females in certain gynodioecious species (*Thymus serpyllum*, *T. vulgaris*, and *Satureia hortensis*) are much more productive of seed than the hermaphrodites, and that thus the species produces more seed than if all were hermaphrodites, a condition to which he attaches evolutionary significance in the formation and separation of the two sex forms. CORRENS (5), however, reports that the hermaphrodites of *S. hortensis* are more productive of fruit and seeds than the females.

If it is found that in *P. lanceolata* femaleness also varies in the degree of its expression, it is quite probable that increased maleness is correlated in the individual with decreased femaleness. Still it is also possible that the variations are such that both decreased maleness and femaleness may be present in the same individuals, that individuals may be intermediate for both, and that both maleness and femaleness may be well developed, giving full hermaphrodites. All these conditions, it appears, are represented in the groups of intersexes studied by GOLDSCHMIDT, BANTA, and by DAVEY and GIBSON. Such facts go far toward establishing the fundamental similarity between sex characters and every other class of structures as functional hereditary characters.

It is the tendency to a differential loss of one sex that distinguishes intersexuality from sterility (impotence) resulting from hybridization, and from that sterility ascribed to replacement of sexual reproduction by asexual means (GATES and GOODSPEED **9**), in both of which the tendency is to give a very uniform impotence of both sexes. A high degree of impotence is present in many plants regarded as pure species. JEFFREY (**14, 15, 16**) has recently emphasized the view that such sterility is to be considered as conclusive evidence of hybrid origin. Intersexuality, however, involves much impotence, and may very clearly develop in pure species through lability of the processes of sex determination.

At this point one may well inquire whether differences in sexuality somewhat akin to intersexuality may be present in species that are morphologically fully hermaphrodite, and in which no appreciable impotence of sex organs is in evidence. For example, DARWIN reports that plants of "the short-styled form of *Primula veris* produce more seed than the long-styled in the proportion of nearly four to three (**7**, p. 19), and that in *Lythrum Salicaria* (**6, 7**) the mid-styled form is potentially capable of higher seed production than plants or either of the other two forms. Judged on the basis of seed production, certain forms in heterostyled species appear to be more female than others. Sexuality of species as such is obviously more intense in some than in others if we are to judge by seed reproduction. Much variation in total seed production is seen among races and among individuals of a race. Such considerations raise many questions regarding the determination of potentiality of sex reproduction through production of seed, and most especially of the relations of vegetative to reproductive function. Undoubtedly much variation in maleness and femaleness exists in sex organs that are morphologically perfect. The sexual behavior of female pigeons has especially been studied by RIDDLE as an index of the degree to which femaleness is developed. He states (**22**, p. 341) that "females hatched from eggs laid earlier in the season are more masculine in their sex behavior than are their own full sisters hatched later in the season. *And several grades of females can be thus seriated according to season of hatching.*"

The existence of physiological incompatibilities (STOUT **25**) between sex organs that are fully formed, potentially functional, and of simultaneous development are especially well revealed in self-fertilization of numerous species that are homomorphic hermaphrodites. Judged by ability of sex organs to function together, both femaleness and maleness of sex organs are seen in such cases to be of various grades of intensity. Such cases reveal that grades of functional or physiological sexuality may be quite independent of morphological sexuality. The striking feature of incompatibilities, however, is that sex organs which are functionless in some relations are highly functional in certain other relations. For example, it is not complete loss of femaleness, but only a loss in relation to certain degrees or grades of maleness.

The conditions that exist in *Campanula carpatica* (PELLEW 21) are of special interest in indicating that variations in the relative development of sex organs and physiological incompatibilities may both operate in a single species. PELLEW finds that there is a wide range of variations from normal hermaphrodites to females quite as I have described in *P. lanceolata;* it is also reported that nearly all hermaphrodites are self-sterile (physiological incompatibility). The "self-sterile" hermaphrodites used in the experiments set seed to cross-pollination, but the extent to which self- and cross-incompatibilities may be operating among hermaphrodites and in crosses of hermaphrodites with females was not determined, and the studies do not reveal whether or not some plants classed as hermaphrodites may be impotent as to femaleness.

The inheritance of various grades of intersexes in *P. lanceolata* is a problem under investigation, and a discussion of the researches (CORRENS, BARTLETT, GOLDSCHMIDT, RIDDLE, PELLEW, etc.) bearing on this question therefore will not be made here.

It is quite clear that sex differentiation is to be considered as morphological and as physiological. Physiologically the essential and only index of sex in cells is the capacity for their fusion which culminates in the expression of that function by sex cells. It is in decided contrast to that property of asexuality which is seen in cell division and cell growth.

Morphological sexuality consists purely and solely of adaptations to facilitate the bringing into juxtaposition cells that are capable of fusion when juxtaposed. It may consist of (1) the more or less immediate modification of physical structure of the cells (in spermatogenesis and oogenesis) that are to fuse, and (2) of modifications of organs associated with the development of sex cells, either in the sporophyte or the gametophyte, or both. All of these latter are in reality secondary sex characters; true primary sex characters are to be considered as belonging to the cells that fuse, a view clearly stated by STRASBURGER (**26**).

The relationship between morphological and physiological sex differentiation is well shown in the flowering plants. We may take a hermaphrodite with perfect flowers as a type. Primarily such a plant is a spore-producing individual; it is a sporophyte in which heterospory is in evidence. The stamens bear microspores, the pistils bear macrospores. These spores are asexual in that they are not able to fuse. They are sexual, however, to the extent that sex is here already determined. Anatomical expression of maleness and femaleness here appears in sporophytic structures, and the particular sex of the future generations of cells in asexual descent is predetermined until the next fusion of sex cells or the development of a sporophyte through apogamy. The pollen grains grow into microgametophytes producing male sex cells or sperms. The macrospores grow into the macrogametophytes which produce the eggs. The alternation of generations is marked; the one is sporophytic; the other is gametophytic. But maleness can be traced back through the pollen tube, through pollen, beyond reduction divisions, to the beginning of somatic differentiation of stamens. Likewise femaleness can be traced to the beginning of the organogenesis of the pistil. These facts certainly justify the application of the terms male and female to structures that in their morphology are sporophytic. This view has frequently been criticized by those who emphasize the morphology of the alternation of generations (MACMILLAN **20**). Furthermore, it is to be noted that in the greater number of animals the gametophytic generation is omitted or perhaps to be considered as reduced to a single cell generation, and that here the conditions of maleness and femaleness are most essentially properties of individuals and structures that are wholly sporophytic.

It is clear that in the higher flowering plants maleness and femaleness are two series of morphological steps beginning in the development of stamens and pistils from cells of the closest somatic lineage. Any diploid or haploid nuclear organization can become either male or female according to whether its cell lineage leads through stamens or pistils. In this sense maleness and femaleness are acquired; they are conditions imposed upon cell organization rather than existing as separate inherent conditions; they begin in somatic differentiation that is fundamentally on the same basis as differentiation of stems, leaves, and sterile floral organs. Potentially maleness and femaleness (either morphological or physiological) reside in every cell of the sporophyte. The reduction divisions preceding the gametophytic divisions give the same range of nuclear organization to both kinds of spores.

It is such conditions, emphasized by the wide occurrence of hermaphrodites, that compel us to state the problems of sex determination in such questions as the following:

1. What physiological and chemical processes operate when sex differentiation appears and is initiated morphologically among organs which develop side by side from cells of the same somatic lineage?

2. Should we not regard dioecism as the suppression of maleness or femaleness in an individual as a whole (either in sporophytic or in gametophytic generations, or in both)?

We may note that intersexuality completely fills the gap between hermaphroditism and dioecism. In this respect the conditions in plants fully agree and supplement those reported in animals. Viewing all the evidence, we may at the present time make the following conclusions, which are in general harmony with the facts and the conclusions of GOLDSCHMIDT, BANTA, RIDDLE, and LILLIE: (1) Fundamentally maleness and femaleness reside in all somatic cells of all sporophytic individuals. (2) Maleness and femaleness are quantitative differentiations; there are all grades of intersexes. Maleness and femaleness are relative; there are all grades of compatibilities. (3) Sex determination, at least in hermaphrodites, is fundamentally a phenomenon of somatic differentiation that is ultimately associated with processes of growth, development, and interaction of tissues, and subject to modification or even complete determination by them.

The older conception of mystical properties of maleness and femaleness have given place to what are fundamentally metabolic theories of sex determination. The principal points of difference in the large number of theories, thus to be grouped, lie in questions regarding (1) time of determination, (2) whether the two sexes are two contrasted conditions or simply phases of the same general property, (3) to what extent sex development in the individual is an evolution or an epigenesis, and (4) to what extent a physical basis can be related to differences in the amount of chromatin present.

To DARWIN and many of his contemporaries the evolutionary and adaptational significance of variations in sex were points of principal interest. That such variations fundamentally involve physiological processes operating in the organism was of course recognized. The increased femaleness seen in females of certain gynodioecious species was considered by DARWIN as involving the principle of compensation; with decreased expenditure of energy in development of male organs there was a greater supply for development and function of female organs. The doctrine of conservation in expenditure for useless organs was likewise applied to the tendency to gynomonoecism as seen in such a species as *P. lanceolata* (LUDWIG **19**); the stamens in the uppermost flowers of a spike tend to be useless, and this was supposed to induce their elimination. The tendency to poor development of flowers at the tips of spikes, however, may be purely the result of food supply being diverted for use of lower flowers, and as such may be on quite a different physiological basis from the condition that makes an individual only female. The intimate association of many proterogynous flowers in a spike, however, may well give opportunity for changes in metabolic processes (RIDDLE) or influence of hormones (LILLIE).

A very interesting and suggestive conception which has frequently been proposed is embodied in the view that maleness is a "katabolic habit" of body (we may now add *of an organ*) induced by preponderance of waste over repair, and that femaleness is an "anabolic habit" induced by conditions favoring constructive processes (GEDDES and THOMSON 10).

The physical basis for different metabolic activity is to be sought in qualitative or quantitative differences; the same kind of substance may be involved quantitatively or different substances may be involved either qualitatively or quantitatively.

The recent theory of the sex chromosome is in one aspect a metabolic theory in which different amounts of chromatin material in the nucleus may be considered as affording a physical basis for quantitative and perhaps qualitative metabolic differences. The theory fails as a broad biological law in not applying to the conditions of hermaphroditism as already discussed, and also in assuming that in dioecious species there is a determination of sex at the time of fertilization that is exclusive for the zygote. As intersexuality reveals, sex in zygotes of dioecious species is not necessarily irreversible (see especially RIDDLE and LILLIE); and experimental work has shown (see especially RIDDLE) that the distribution of sexes among the offspring may be controlled in a measure which breaks up the chromosomal correlation.

Most noteworthy of the more recent experimental data bearing on the chemical nature of sex determination are the results of RIDDLE. He has shown that in the pigeon "the male sex is an expression of metabolism at a higher level, the female sex of metabolism at a lower or more conservative level" (**22**, p. 322). The chemical nature of the eggs produced by a single female mated with a male is found to be subject to change according to whether egg production is forced or otherwise, and sex can thus be controlled. The physical basis for differences in metabolic activity is to be found in changes in the chemical organization and relations of the food substances. That such changes can readily occur is quite in harmony with well known facts as to the chemical differences in metabolic substances produced by an organ under different conditions. In the case of sex control in the pigeons it appears that it is not the amount of one or more kinds of food substances, but the different chemical nature of them, induced by the condition of the mother, that leads to differences in metabolism which determine the sex of the offspring.

The development of perfect flowers in hermaphrodites shows that male and female organs may originate side by side. That stamens and pistils exhibit differences in nutritive and metabolic activities is obvious, most marked of which perhaps is the temporary nature of the stamens and the more permanent and vegetative nature of the ovary portion of the pistil. The life processes of the two develop along somewhat different lines, as the structure and physiology of the respective spores, gametophytes, and sex cells fully indicate. Such organic specificity is well known frequently to involve specific differences in chemical organization. This, however, is not indicative that the essential nature of fertilization processes is dependent on such differences.

There seems to be no exception to the rule that in perfect flowers the male organs constitute an outer and lower whorl, the primary anlagen of which are laid down slightly ahead of those for the female. Such a general mode of development it would seem must have special significance in respect to sex differentiation. Such conditions, however, are adaptive both to immediate and to more remote function of the parts involved. When conditions in monoecious forms are reviewed it is to be noted that when grouped in spikes and catkins the staminate flowers are as a rule about the pistillate, either when both are in a same catkin or when they are in different catkins. Here, however, direct adaptations for facilitating pollination are in evidence.

The phenomena of intersexuality in plants and animals indicate clearly that neither hermaphroditism nor dioecism are fixed conditions for species or for individuals as such. Maleness and femaleness are subject to much lability; they are even reversible; the physical and chemical substances involved are subject to modification in ontogeny. The factors in sex determination for the individual as a whole or for individual sex organs are highly variable. Such conditions give support to a metabolic and epigenetic theory of sex in so far as the nature of sex is revealed in the morphological differentiation of sex organs.

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EXPLANATION OF PLATES XII, XIII

PLATE XII

Flowers $\times 2.5$; stamens $\times 7.5$; microspores $\times 110$

FIGS. 1–3.—Flower, anther, and pollen of typical first form hermaphrodite.

FIGS. 4–6.—From typical second form hermaphrodite.

FIGS. 7–10.—Flowers, stamens, and petals of females of closed corolla type.

FIGS. 11–35.—From various intersexes each having flowers decidedly uniform.

FIGS. 36–48.—Illustrate various grades of intersexuality appearing among stamens and flowers produced by single individuals.

PLATE XIII

From photograph taken June 19, 1916, showing spikes at about one-half natural size.

FIG. 49.—Typical spike of first form hermaphrodite.

FIG. 50.—Spikes of plant no. 11; stamens differing slightly from those of first form hermaphrodite.

FIG. 51.—Spike of plant no. 37; all filaments short and of unequal lengths.

FIG. 52.—Spikes of typical second form hermaphrodite.

FIG. 53.—Three spikes from plant no. 39.

FIG. 54.—Spikes from plant no. 20; large non-dehiscent anthers conspicuous.

FIG. 55.—Spikes showing wide variation in character of stamens; many stamen forms present in flowers throughout entire spike; showing well reflexed corolla lobes.

FIG. 56.—Spikes of plant no. 46; flowers for drawings nos. 46, 47, and 48 taken from middle of spike at right; also showing elongated pistils as frequently developed.

FIG. 57.—Three spikes of various ages from female plant of closed corolla type; spike at right full of ripe seed.

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THE GENUS DESMATODON IN NORTH AMERICA

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The genus Desmatodon in North America

R. S. Williams

(with plate 11)

The work on this genus was mostly done some four or five years ago, but little has since occurred, so far as the author knows, to cause any important changes. Twelve species are here included in the genus as against thirteen in the Lesquereux & James Manual, but two of these thirteen species, *D. neomexicanus* and *D. nervosus* belong to *Tortula* while one other, *D. arenaceus*, is reduced to *D. obtusifolius*. This leaves ten of the Manual species, the two additions being *D. Sprengelii*, originally from Santo Domingo and discovered in Florida in 1916 by Dr. J. K. Small, and *D. stomatodontus* from Jalisco, Mexico.

Desmatodon Bushii Card. & Thér., from Missouri, belongs to *Tortula*, *fide* Brotherus; *D. Sartorii* (C. Müll.) Paris, from Mexico, is a *Leptodontium*; and *D. systylioides* Ren. & Card., from Newfoundland, a *Pottia*.

DESMATODON Brid. Musc. Recent. Suppl. **4**: 86. 1819

Plaubelia Brid. Bryol. Univ. **1**: 522. 1826.

Trichostomum § *Desmatodon* C. Müll. Syn. **1**: 588. 1849.

Didymodon § *Desmatodon* Kindb. Eur. & N. Am. Bryin. **2**: 273. 1897.

Dioicous or monoicous. Mostly alpine plants of medium or small size, usually growing in rather compact cushions on moist earth. Stems, mostly with central strand, simple or somewhat branching, closely leaved and more or less radiculose. Leaves erect-flexuous and appressed when dry; ovate and oblong to oblong-lanceolate or somewhat spatulate, concave, the margins flat, recurved or broadly incurved, entire or slightly serrulate in the upper part, sometimes colored or thickened, the apex mostly broadly acute, with costa vanishing below the apex, percurrent or excurrent into a short awn or elongate, nearly smooth hair-point. Costa in cross-section usually showing two or four guide-cells, one or two rows of large cells on the ventral side and on the dorsal side, a large stereid band, with outer cells more or less differentiated. Cells of upper part of leaf mostly quadrate to hexagonal, scarcely or not elongate, obscure, densely papillose on both sides or distinct and more or less mamillose; those of lower part of leaf, pale, smooth and elongate-hexagonal to rectangular. Perichaetial leaves usually not greatly differentiated. Seta erect, often strongly twisted. Capsule oblong to cylindric, erect or nodding and curved, with stomata mostly few, in the basal part, the columella often projecting above the rim; the lid conic to more or less beaked. Annulus compound, often persistent. Peristome densely papillose, the sixteen teeth (sometimes scarcely developed in *D. obtusifolius*) from a basilar membrane usually extending well above the annulus, mostly divided to near the base into two or three slender, erect or oblique forks, or the forks sometimes quite irregular and more or less united above. Calyptra cucullate, descending well below the lid.

Type species: *Dicranum latifolium* Hedw.

Capsule erect and symmetric or nearly so; leaf margin of one thickness of cells.
- Cells of upper part of leaf more or less densely papillose with variously shaped papillae.
  - Leaf-margins somewhat recurved and leaves hair-pointed (except in *D. latifolius muticus* which is distinguished from *D. obtusifolius* by the leaves with margins partly flat and twice as long, 2.5–3 mm., and by the spores, 20 μ instead of 8–10 μ); the older leaves without a distinct golden-brown border.
    - Monoicous.
      - Upper leaves with blade usually 2–3 mm. long.
        - More or less spatulate or oblong, the upper marginal cells mostly obscure and rough with numerous papillae. 1. *D. latifolius.*
        - Gradually tapering from below the middle to an acute point. 2. *D. suberectus.*
      - Upper leaves with blade 1.5 mm., or less, long, the upper marginal cells distinct with few or no papillae. 3. *D. Guepini.*
    - Dioicous; blade of leaf about 2.5 mm. long. 4. *D. plinthobius.*
  - Leaf-margins mostly strongly revolute all round and leaves not hair pointed. 5. *D. obtusifolius.*
  - Leaf-margins flat, the older leaves with a distinct, golden-brown border. 6. *D. Porteri.*
- Cells of upper part of leaf never papillose, distinct, mostly mamillose on one or both sides.
  - Median leaf-cells 15–20 μ and spores about 25 μ in diameter. 7. *D. systilius.*

Median leaf-cells and spores 8–10 μ, or less, in diameter.
Leaf-cells highly mamillose on the upper surface, mostly flat on under side, the leaves slightly serrulate toward apex.
Leaves oblong-lanceolate, acute; costa slightly excurrent. 8. *D. Garberi.*
Leaves oblong-linear, the apex broadly rounded or broadly acute; costa vanishing 2–3 cells below the leaf-apex. 9. *D. Sprengelii.*
Leaf-cells mamillose on both sides; margins of the leaf crenulate half way down or more. 10. *D. stomatodontus.*
Capsule nodding, more or less curved; leaf-margins thickened.
Cells of lid scarcely elongate, in erect rows. 11. *D. cernuus.*
Cells of lid a little above the base elongate in oblique rows. 12. *D. Laureri.*

1. DESMATODON LATIFOLIUS (Hedw.) Brid. Musc. Recent. Suppl. 4: 86. 1819

Dicranum latifolium Hedw. Descr. 1: 89. 1789.
Barbula latifolia Kindb. Eur. & N. Am. Bryin. 2: 252. 1897.

Autoicous, the male flower on a short stalk a little below the perichaetium with numerous club-shaped paraphyses surrounded by one or more broadly pointed, scarcely longer leaves: fertile plants in rather soft, green or brownish green tufts, reddish tomentose within; stems with central strand, erect, often branching, from a few mm. to 2 cm. high; upper stem-leaves more or less ovate or obovate to somewhat spatulate, the blade usually 2.5–3 mm. long and 1 mm. wide, mostly broadly acute, with costa nearly percurrent or excurrent into a terete, not quite smooth hair-point (or in var. *muticus* the hair-point lacking), the lower leaves smaller with costa vanishing below the apex; leaf-margins papillose, otherwise entire and more or less revolute on one or both sides; costa in cross-section showing mostly two large guide-cells, three or four cells nearly as large on ventral side, and on dorsal side a more or less distinct stereid band with two to four large outer cells; cells of upper part of leaf mostly square to short-rectangular, obscure with numerous round to oblong and c shaped papillae; perichaetial leaves scarcely differentiated; seta erect, twisted when dry, 1–1.5 cm. long; capsule erect, oblong to cylindric, 1–2 mm. long; annulus of one to three rows of cells, more or less persistent; peristome golden brown, densely papillose, the basal membrane extending well above the annulus, with teeth mostly split to near the base into two or rarely three slender, erect forks, or the forks sometimes united above and slit below; lid obliquely beaked, one third to one half the length of the rest of the capsule, the cells near the base not elongate, those further up broadly oblong, in erect rows; calyptra smooth, cucullate, descending well below the rim of capsule; spores papillose, rather irregular, the larger 20–24μ in diameter. [FIG. 1.]

TYPE LOCALITY: Sweden or Lapland.

DISTRIBUTION: Greenland; Gaspé coast of Canada to Unalaska and southward to California and New Mexico.

EXSICCATAE: Aust. Musci App. *123*.

ILLUSTRATION: Sull. Ic. Musc. Suppl. *23*.

The var. *glacialis* Schimp. is evidently not distinct from the var. *muticus* Brid.

2. DESMATODON SUBERECTUS (Hook.) Limpr. in Rab. Krypt.-Fl. 4[1]: 651. 1889

Tortula suberecta Hook. in Drummond, Musci Am. *145*. 1828.

Desmatodon obliquus B.S.G. Bryol. Eur. (18–20): Desmatodon 10. 1843.

Paroicous, the antheridia usually four or five with few, nearly filiform and somewhat longer paraphyses, in a cluster just below the archegonia: plants in rather dull green tufts with branching stems, 0.5–1 cm. high; leaves rather broadly ovate-lanceolate, the upper larger, 2–3 mm. long and 1 mm. wide, gradually tapering from below the middle to an acute apex and terminating in a nearly smooth awn usually less than 0.25 mm. long, the leaf margins crenulate-papillose and mostly recurved: costa stout, excurrent into the point, in cross-section mostly showing two large guide-cells, two rows of somewhat smaller cells on ventral side and on dorsal side a large stereid band with scarcely differentiated outer cells; cells in upper part of leaf from square to hexagonal, 12–16 μ in diameter, usually obscure with numerous, minute, often C-shaped papillae on both sides, those of lower part smooth, pale, mostly rectangular; perichaetial leaves scarcely differentiated; seta up to 18 mm. long; capsule oblong-cylindric, mostly slightly curved and nodding, about 2 mm. long without lid, the stomata in two rows near the base; annulus of one or two rows of small, persistent cells; peristome teeth sixteen, usually divided to near the base into two or three slender, papillose forks, or sometimes the forks more or less united, mostly twisted about half way round, from a basilar membrane extending well above the annulus and composed of very elongate cells with thick, projecting walls; lid high-conic, the cells just above the base elongate in very oblique rows; calyptra extending about half way down the capsule; spores rough, up to about 22 μ in diameter. [FIG. 2.]

TYPE LOCALITY: Rocky Mountains of British America.

DISTRIBUTION: Greenland; Beechey Island, Arctic America; the Canadian Rockies; also in Europe.

EXSICCATAE: Drummond, Musci Am. *145*.

ILLUSTRATION: B.S.G. Bryol. Eur. *pl. 136*.

3. DESMATODON GUEPINI B.S.G. Bryol. Eur. (18–20): Desmatodon 8. 1843

Trichostomum Guepini C. Müll. Syn. 1: 590. 1849.
Barbula Guepini Schimp. Syn. ed. 2, 197. 1876.
Tortula Guepini Broth. in E. & P. Nat. Pfl. 1^3: 430. 1902.

Autoicous, the two or three very small male flowers scattered along the stem and composed of four or five pale, ecostate, ovate, acute leaves, smooth or nearly so, the outer longer ones about 0.5 mm. long, enclosing three or four antheridia about 0.25 mm. long, with few or no paraphyses: fertile plants rather loosely cespitose, bud-like, 1–3 mm. high; the larger upper leaves ovate to somewhat spatulate, with blade 1–1.5 mm. long, the apex somewhat rounded or acute, the margins entire and revolute from near the apex almost to base and the costa mostly smooth on the back, excurrent into a nearly smooth point one fifth to one half the length of the blade; costa in cross-section showing mostly two guide-cells, four or five cells of about the same size in one row on the ventral side and on the dorsal side a thick stereid band with outer cells differentiated; leaf-cells rather obscure and densely papillose in upper part of leaf, more or less four to six sided, not or scarcely elongate, 14–16 μ wide, those of basal part smooth, pale, larger, more or less rectangular: outer perichaetial leaves not differentiated, the inner small, acutely pointed, with flat margins; seta erect, about 8 mm. long; capsule erect, oblong-cylindric, 1–1.5 mm. long without lid, the stomata in one row near the base; annulus narrow, persistent, of one or two rows of cells; peristome pale, densely papillose, of sixteen slightly oblique, narrow teeth mostly divided nearly to the base into two filiform forks from a basilar membrane extending well above the annulus; lid high-conic, its height about twice the basal diameter, the cells a little above the base elongate in nearly erect rows; spores nearly smooth, the larger 16μ in diameter; calyptra cucullate, descending about half way down the capsule. [FIG. 3.]

TYPE LOCALITY: France.

DISTRIBUTION: California and France.

ILLUSTRATION: B.S.G. Bryol. Eur. *pl. 133*.

4. DESMATODON PLINTHOBIUS Sull. & Lesq. Musci Bor. Am. *94*. 1856

Desmatodon neomexicanus Sull. & Lesq. Musci Bor. Am. *95*. 1856.

Dioicous, the male plants very similar to, and mixed with, the fertile tufts, the flowers terminal or lateral by innovations from just below the apex; the inner perigonial leaves short, acute, with pale, smooth cells extending two thirds way up the leaf, the antheridia often numerous, about 0.33 mm. long, with abundant, filiform paraphyses: fertile plants in compact cushions, with somewhat branching stems, 3–4 mm. or rarely 1 cm. high; leaves incurved-imbricate when dry, erect-spreading when moist, from oblong-lanceolate to narrowly lingulate with apex acute or rounded, those on lower stem with blade less than 1 mm. long with short point, on upper stem the blade up to 2.5 mm. long with a flexuous, smooth hair-point often of nearly equal length, the margins entire and mostly revolute from near the apex to below the middle; costa papillose on the back in upper part of leaf, in cross-section showing about four guide-cells with one or sometimes two rows of cells nearly as large on ventral side and on dorsal side a large stereid band with outer cells scarcely differentiated; cells of upper part of leaf obscure, somewhat four-sided, not elongate, about 8 μ wide, covered on both sides with very small, irregular, often C-shaped papillae, those of lower part rectangular, pale, smooth, up to 16 μ wide by 40 μ long; perichaetial leaves scarcely differentiated; seta erect, 6–12 mm. long; capsule oblong to nearly cylindric, erect, up to 3 mm. long without lid; the lid rather obtusely high-conic, 0.5–0.7 mm. long, the two or three basal rows of cells not elongate, those about one third above the base two or three times longer than wide, in slightly oblique rows; peristome teeth pale, densely papillose, erect, mostly very irregular, sometimes scarcely projecting above the annulus, or longer and quite regularly divided into two forks from a low basilar membrane; annulus large, two or three rows of cells in height; calyptra cucullate, long-beaked, descending about half way down the capsule; spores smooth, about 8 μ in diameter. [FIG. 4.]

TYPE LOCALITY: Charleston, South Carolina.

DISTRIBUTION: Pennsylvania to Alabama and westward to Missouri and Texas.

EXSICCATAE: Sull. & Lesq. Musci Bor. Am. *94*, *95* (as *D. neomexicanus*) and ed. 2, *123*; Aust. Musci App. *493*.

ILLUSTRATION: Sull. Ic. Musc. *pl. 30*.

5. DESMATODON OBTUSIFOLIUS (Schwaegr.) Jur. Laubm. Oesterr. Ung. 135. 1882

Barbula obtusifolia Schwaegr. Suppl. 1: 129. 1811.

Desmatodon oblongifolius Hook. in Drummond, Musci Am. *114*. 1828 (*nomen nudum*).

Tortula obtusifolia Schleich.; Broth. in E. & P. Nat. Pfl. 1^3: 430. 1902.

Desmatodon arenaceus Sull. in Gray, Man. ed. 2, 628. 1856.

Desmatodon ohioense Schimp. Syn. 159. 1860.

Desmatodon subtorquescens C. Müll. & Kindb.; Macoun, Cat. Can. Pl. 6: 48. 1892 (apparently).

Didymodon arenaceus Kindb. Eur. & N. Am. Bryin. 277. 1897.

Apparently dioicous, the male plant much like the fertile but the terminal flower forming a more distinct rosette, the perigonial leaves scarcely differentiated, enclosing ten to twelve oblong antheridia 0.2 mm. long with nearly filiform, slightly longer paraphyses (the European plants are said to become autoicous by the older male stems finally bearing archegonial flowers, a condition not observed in North American specimens): plants in compact cushions, 3–4 mm. to 1 cm. high, with stems more or less branching and radiculose at the base; leaves of lower stem very small, gradually larger upward, the upper 1–1.5 mm. long and 0.25–0.5 mm. wide, oblong-lingulate, broadly acute and somewhat apiculate or rounded and blunt at apex, the margin more or less revolute nearly all round and entire or slightly crenulate in the upper part; costa stout, vanishing a little below the apex or percurrent, smooth on the back or papillose in the upper part, in cross-section showing two to four guide-cells with one or two layers of somewhat smaller cells on the ventral side and on the dorsal side mostly a distinct stereid band with outer cells slightly or not differentiated; cells in upper part of leaf mostly obscure, densely papillose with partly C-shaped papillae, more or less four-sided, about 8 μ in diameter, those of lower part pale, smooth, about 12 μ wide and from nearly square to two or three times longer than wide; perichaetial leaves about like those of stem, the inner sometimes smaller; seta erect, up to 1 cm. long, often strongly twisted below to the left and above to the right; capsule nearly straight and erect, 2 mm. long, with stomata in one row in the short, scarcely distinct neck; peristome variable, pale to reddish brown, finely papillose throughout, the basilar membrane extending usually a little above the rim of the capsule and either bearing slightly oblique teeth once or twice divided into slender forks of unequal size or sometimes the teeth reduced to short irregular lobes, scarcely evident above the persistent annulus of about two rows of cells; lid high-conic or shortly beaked, the cells in slightly oblique rows and mostly elongate about half way up the lid; spores smooth, up to 10 μ in diameter; calyptra cucullate, descending to about the middle of capsule. [FIG. 5.]

TYPE LOCALITY: Switzerland.

DISTRIBUTION: New Brunswick to Vancouver Island and southward to Ohio, Missouri, Arizona, and California; also in Europe, Turkestan and Africa.

EXSICCATAE: Sull. & Lesq. Musci Bor. Am. *93*, *120*; Holz. Musci Acro. Bor. Am. *17*.

ILLUSTRATIONS: Schwaegr. Suppl. 1: *pl. 129*; B.S.G. Bryol. Eur. *pl. 133*. Sull. Ic. Musc. *pl. 29*.

6. DESMATODON PORTERI James in Aust. Musci App. *123*. 1870

Barbula subcarnifolia C. Müll. & Kindb.; Macoun, Cat. Can. Pl. 6: 52. 1892.

Dioicous, male plants rather smaller than the fertile and mixed in with them, the flowers terminal or lateral by innovations from just below the apex, with outer antheridial leaves about 1 mm. long, broadly ovate-lanceolate, acute, papillose in upper part and costate, the inner leaves much smaller, pale, smooth, enclosing quite numerous antheridia about 0.2 mm. long with nearly filiform paraphyses: fertile plants in compact tufts with stems usually 2–3 mm. high; leaves spreading, flexuous or somewhat incurved when dry, the upper about 2 mm. long, mostly broadly ovate-lanceolate, the apex acute, the margins flat and in the older leaves rather distinctly yellowish-bordered from a little below the apex to near the base with two or three rows of somewhat larger more elongate cells, less densely papillose than those within or often smooth; in the younger leaves this border is scarcely evident or appearing only as a paler margin; costa percurrent, papillose on the back, in cross-section showing about four guide-cells with a row of three or four cells of about equal size on ventral side and on dorsal side a large stereid band with outer cells differentiated; cells of upper part of leaf mostly very obscure with minute, often C-shaped papillae, the median cells not elongate, somewhat four-sided, about 8 μ in diameter, those in the border about one half way down mostly elongate; the cells of lower one third of leaf pale, smooth, shortly rectangular or elongate-hexagonal; perichaetial leaves slightly differentiated; seta erect, mostly 7–10 mm., rarely 13 mm. long; capsule erect, nearly straight and cylindric, about 2 mm. long without lid, with a conical more or less short-beaked lid 0.50–0.75 mm. long, the cells from a little above the base mostly oblong in slightly oblique rows; annulus large, persistent, of two or three rows of cells; peristome papillose, reddish or golden brown, the erect or nearly erect teeth from a basal membrane projecting a little above the annulus and irregularly divided into two or three forks, or the forks sometimes more or less united; spores smooth, about 8 μ in diameter; calyptra cucullate, long-beaked, extending one third way down the capsule. [FIG. 6.]

TYPE LOCALITY: Easton, Pennsylvania.

DISTRIBUTION: Gaspé coast, Quebec, and Point Pelee Island, Lake Erie, Ontario, to Pennsylvania, Ohio and Illinois.

EXSICCATAE: Aust. Musci App. *123*.

ILLUSTRATION: Sull. Ic. Musc. Suppl. *pl. 23*.

7. DESMATODON SYSTYLIUS B.S.G. Bryol. Eur. (18–20): Desmatodon, Suppl. I. I. 1843

Paroicous, the antheridia about 0.25 mm. long, in one or two pairs, without paraphyses, in the axils of the outer perichaetial leaves: plants cespitose, somewhat branching, usually 2–3 mm. high, often more or less bud-like; the upper stem leaves with blade about 1.5 mm. long and 1 mm. wide, broadly ovate, acute, the margins mostly flat and entire or slightly crenulate at apex and the costa excurrent into a nearly smooth, flexuous, hair-point of variable length; the costa in cross-section showing two guide-cells with two often larger cells on the ventral side and on the dorsal side a large stereid band with differentiated outer cells; cells of upper part of leaf from nearly square to rhomboidal or hexagonal, somewhat mamillose, the median 15–20 μ in diameter, in lower part mostly rather larger and elongate-hexagonal or short-rectangular; perichaetial leaves scarcely differentiated; seta erect, about 8 mm. long; capsule erect, oblong-cylindric, up to 2 mm. long without lid, the columella exserted, persistent, the stomata in about two rows near base; annulus persistent, of one or two rows of cells; peristome teeth reddish brown, papillose, mostly divided to near the base into two forks, erect from a rather low basal membrane; lid remaining more or less attached to the columella after separating from the annulus, obliquely short-beaked, the cells, except the three of four basal rows, elongate, in slightly oblique rows; calyptra cucullate, descending well down the capsule; spores rough, up to 25 μ in diameter. [FIG. 7.]

TYPE LOCALITY: Norway.

DISTRIBUTION: Greenland and Newfoundland to the Canadian Rocky Mountains and at the foot of Mount Dana, California; also in Europe.

ILLUSTRATION: B.S.G. Bryol. Eur. *pl. 131.*

8. DESMATODON GARBERI Lesq. & James, Man. 112. 1884

Hyophila fragilis Card. Rev. Bryol. **36**: 75. 1909.

Dioicous, the male plants very slender, with a rosette-like apical flower, the outer perigonial leaves scarcely differentiated, the inner shorter, ovate-acute, entire, costate, enclosing ten to fifteen antheridia about 0.3 mm. long, with filiform, somewhat longer paraphyses: fertile plants in compact cushions with slender, erect, mostly unbranched stems 5–6 mm. high and about 0.2 mm. in diameter with distinct central strand and few or no radicles above the base; stem leaves rather distant, incurved or somewhat crispate and subtubulose when dry, the upper 1–1.5 mm. long, oblong-lanceolate, acute, with margins incurved and entire or occasionally with a few small teeth near the apex, flat and entire below; costa stout, sometimes rough on the back in the upper part, percurrent, in cross-section showing two to four guide-cells with one or two rows of smaller cells on the ventral side and on the dorsal side a large stereid band with outer cells scarcely differentiated; cells of leaf distinct, more or less golden brown from apex to base of leaf, those of upper part highly mamillose on the ventral side, mostly nearly flat on the dorsal side, the median cells roundish, about 8 μ in diameter, the basal smooth and rather short-rectangular; perichaetial leaves scarcely differentiated or sometimes one or two very small inner leaves; seta erect, 5 mm. long; capsule somewhat fusiform, its greatest diameter a little below the middle, 1–1.3 mm. long without lid, the stomata in one row near the base; annulus of one or two rows of cells; teeth of peristome reddish brown, papillose, irregular, divided often nearly to base into two slender forks, from a papillose basilar membrane scarcely extending above the rim of capsule; lid nearly erect, conical, short-beaked, about one third the length of the capsule, the cells elongate in nearly erect rows; spores smooth, 6–8 μ in diameter, calyptra cucullate, extending well down the capsule, sometimes split upward to near the smooth apex. [FIG. 8.]

TYPE LOCALITY: Key West, Florida.

DISTRIBUTION: New Providence, Bahama Islands; Key West, Florida; and Yucatan, Mexico.

The specimens of *Hyophila fragilis* are not fruiting but they do not seem to differ from *D. Garberi* except perhaps in being a little more slender.

9. **Desmatodon Sprengelii** (Schwaegr.) comb. nov.

Barbula Sprengelii Schwaegr. Suppl. **2**[1]: 64. 1823.
Plaubelia tortuosa Brid. Bryol. Univ. **1**: 522. 1826.
Weisia Berteriana Spreng. Syst. Veg. **4**: 156. 1827.

Dioicous, the male flower terminal, the short, inner antheridial leaves closely surrounding about six large antheridia, one third mm. long, with few, filiform paraphyses: fertile plants low, in dusky green cushions with simple, slender stems mostly 4–5 mm. long; leaves on the stem below rather distant, gradually and slightly larger and more crowded toward the apex, incurved when dry, widely spreading when moist, the upper about 1 mm. long, oblong linear, with broad, somewhat rounded or broadly acute, slightly apiculate and serrulate apex, the margins from a little below the apex to the middle of leaf or farther, incurved and entire; costa stout, often slightly rough on the back near the apex and the ventral surface more or less mamillose, vanishing two or three cells below the apex of the leaf, in cross-section showing two or three guide-cells with an equal number of somewhat smaller cells on the ventral side and on the dorsal side a stereid band with outer cells differentiated; cells of upper part of leaf distinct, roundish-hexagonal, 6–7 μ in diameter, mamillose on the upper side, flat or nearly so on the under side, in about the lower fourth of leaf becoming square to short rectangular with colored, slightly thickened walls as in cells of upper leaf; perichaetial leaves mostly a little longer than those of the stem with a somewhat broader, loosely clasping base rather gradually narrowed to a not quite entire, more acute point; seta erect, about 4 mm. long; capsule erect, somewhat fusiform, about 1.5 mm. long without lid, the exothecal cells rather irregular, two to four times longer than broad, with thin walls, the stomata few, near the base; peristome reddish brown, the basal membrane extending about the height of the annulus above the rim, with 16 erect, quite irregular, finely papillose teeth of variable length either undivided or more or less divided along the median line; lid somewhat obliquely subulate, about two thirds the length of the rest of the capsule; spores about 8 μ in diameter, pale and smooth; calyptra cucullate, extending about half way down the capsule. [FIG. 9.]

TYPE LOCALITY: Hispaniola (Santo Domingo).

DISTRIBUTION: known only from Santo Domingo and Florida (Cape Sable, 1916, *J. K. Small*).

10. **Desmatodon stomatodontus** (Card.) comb. nov.

Hyophila stomatodonta Card. Rev. Bryol. **36**: 76. 1909.

Dioicous: plants with slender stems 4–8 mm. long; lower leaves minute, the larger crowded into a rosulate tuft at the apex of the stem, somewhat spatulate-oblong, flexuous with strongly inrolled margins when dry, more or less widely spreading when moist, about 1.5 mm. long, mostly obtuse and scarcely apiculate, the margins finely crenulate to below the middle; costa percurrent, 40 μ wide a little above the base, in cross-section showing two large guide-cells, three to four rather large cells above them and below a large stereid band with the outer cells differentiated; cells in upper part of leaf distinct, roundish to hexagonal, mamillose on both sides, 6–8 μ in diameter, in the lower leaf, square to short-rectangular and scarcely paler than above; one or two inner perichaetial leaves sometimes lanceolate, acute, with the costa scarcely percurrent; seta about 5 mm. long; capsule erect, cylindric, about 1.5 mm. long without lid, the exothecal cells mostly irregularly elongate, with thin walls, the median cells about 20 μ wide by 40–50 μ long; lid about one-half the length of the capsule, nearly erect, with cells a little above its base elongate in nearly erect rows; annulus large; peristome reddish brown, papillose, fragile, irregularly divided from some distance above the rim into slender forks extending about 150 μ above the rim; spores smooth, pale, 7–8 μ in diameter. [FIG. 10.]

TYPE LOCALITY: State of Jalisco, Mexico.

DISTRIBUTION: known only from type locality.

11. DESMATODON CERNUUS (Hueb.) B.S.G. Bryol. Eur. (18–20): Desmatodon 8. 1843

Dermatodon cernuus Hueb. Musc. Germ. 117. 1833.

Cynodontium latifolium Schwaegr. Suppl. 1^1: 110. 1817 (not *Dicranum latifolium* Hedw. Desc. 1: 89. 1787).

Desmatodon camptothecius Kindb.; Macoun, Cat. Can. Pl. 6: 48. 1892.

Dermatodon camptothecius Kindb. Eur. & N. Am. Bryin. 2: 283. 1897.

Autoicous, the male flower just below the perichaetium, composed of several club-shaped, often long-stalked antheridia, with rather numerous, slightly club-shaped paraphyses, enclosed by two ovate-lanceolate, costate leaves about 1 mm. long, either entire or with one or two rather large teeth at the acute apex: plants in compact cushions with mostly simple stems from 3–4 mm. up to 2 cm. high; stem leaves more or less erect or flexuous and twisted when dry, from oblong-linear to oblong-spatulate, up to 3.5 mm. long by 1 mm. wide, acute, the margins toward apex flat and mostly not quite entire, of a single layer of cells, farther down more or less revolute on one or both sides and usually of a double layer of two to four rows of slightly colored cells; costa smooth on the back, mostly excurrent into a short awn, in cross-section showing two guide-cells, a single row of about three cells nearly as large on the ventral side and on the dorsal side a stereid band with the outer cells differentiated; cells of upper part somewhat rhomboidal to hexagonal, up to 20 μ wide by 25 μ long, rarely smooth or nearly so but mostly papillose on both sides; cells of lower part smooth, lax, pale, up to 30 μ wide by 140 μ long; perichaetial leaves scarcely differentiated; seta erect, 1.5–2 cm. long, yellow or finally reddish; capsule nodding to horizontal, somewhat curved-ovate, the mouth rather small and oblique, the few stomata in one row at the base; peristome reddish brown, densely papillose, the teeth mostly divided irregularly into two forks, one or both of which are more or less perforate or split in the lower part, the basilar membrane extending well above the rim; annulus persistent, of one to three rows of rather small cells; lid obliquely short-pointed, its height slightly exceeding its basal diameter, the cells in erect rows and scarcely elongate except in the point; calyptra cucullate, rather small, the apex smooth and dark colored; spores papillose, 30–50 μ in diameter. [FIG. 11.]

TYPE LOCALITY: Tyrol, Austria.

DISTRIBUTION: Gaspé coast, Quebec, to the Yukon River, and southward to Colorado.

EXSICCATAE: Macoun, Can. Musci *71, 604*.

ILLUSTRATIONS: Schwaegr. Suppl. 1^1: *pl. 28*; B.S.G. Bryol. Eur. *pl. 134*.

12. DESMATODON LAURERI (Schultz) B.S.G. Bryol. Eur. (18–20): Desmatodon 9. 1843

Trichostomum Laureri Schultz, Flora **10**: 163. 1827.

Tortula bryoides Hook. in Drummond, Musci Am. *135*. 1828.

Autoicous, the male flower sessile just below the perichaetium, of eight or ten more or less stalked antheridia about 0.5 mm. long, with abundant, often longer, club-shaped paraphyses, enclosed by two or three ovate, entire, somewhat acute leaves, with the costa vanishing just below the apex: plants in compact tufts from a few millimeters to 2 cm. high, with somewhat branching stems more or less tomentose below; the lower stem leaves ovate, the upper longer, more or less erect-flexuous and twisted when dry, nearly linear, the base often a little broader, 4 mm. long and 1 mm. wide, rarely 5.5 mm. long and 1.5 mm. wide, the point rounded or broadly acute and mostly apiculate by the shortly excurrent costa; leaf-margin, except near the flat and not quite entire apex, with a distinct, thickened and recurved border extending to near the base; costa papillose on the back to below the middle, in cross-section showing two or three guide-cells, usually a single layer of large cells on ventral side, but sometimes two layers, and on dorsal side a large stereid band with outer cells somewhat differentiated; cells of upper part finely papillose on both sides, rhomboidal to hexagonal, the median about 16 μ wide by 18–25 μ long, the basal cells, often 20 μ wide by 50–80 μ long, smooth and more or less tinged with golden brown: perichaetial leaves scarcely differentiated; seta somewhat flexuous, 8–15 mm. long; capsule nodding to horizontal, sometimes pendant, oblong, more or less curved, up to 2 mm. long without lid, the stomata in one row at the base; peristome reddish brown, the distantly articulate teeth often twisted almost once around and divided nearly to the base into two or three slender, terete, sometimes split or perforate forks or the forks sometimes united above; annulus persistent, of two or three rows of small cells; lid conic, short-pointed, the three or four basal rows of cells not elongate, those above elongate-rectangular, in very oblique rows; calyptra cucullate, extending about one half way down the capsule; spores papillose, 30–40 μ in diameter. [FIG. 12.]

TYPE LOCALITY: Tyrol, Austria.

DISTRIBUTION: Rocky Mountains of British America and Vancouver Island to Colorado; also in Greenland, Europe and Asia.

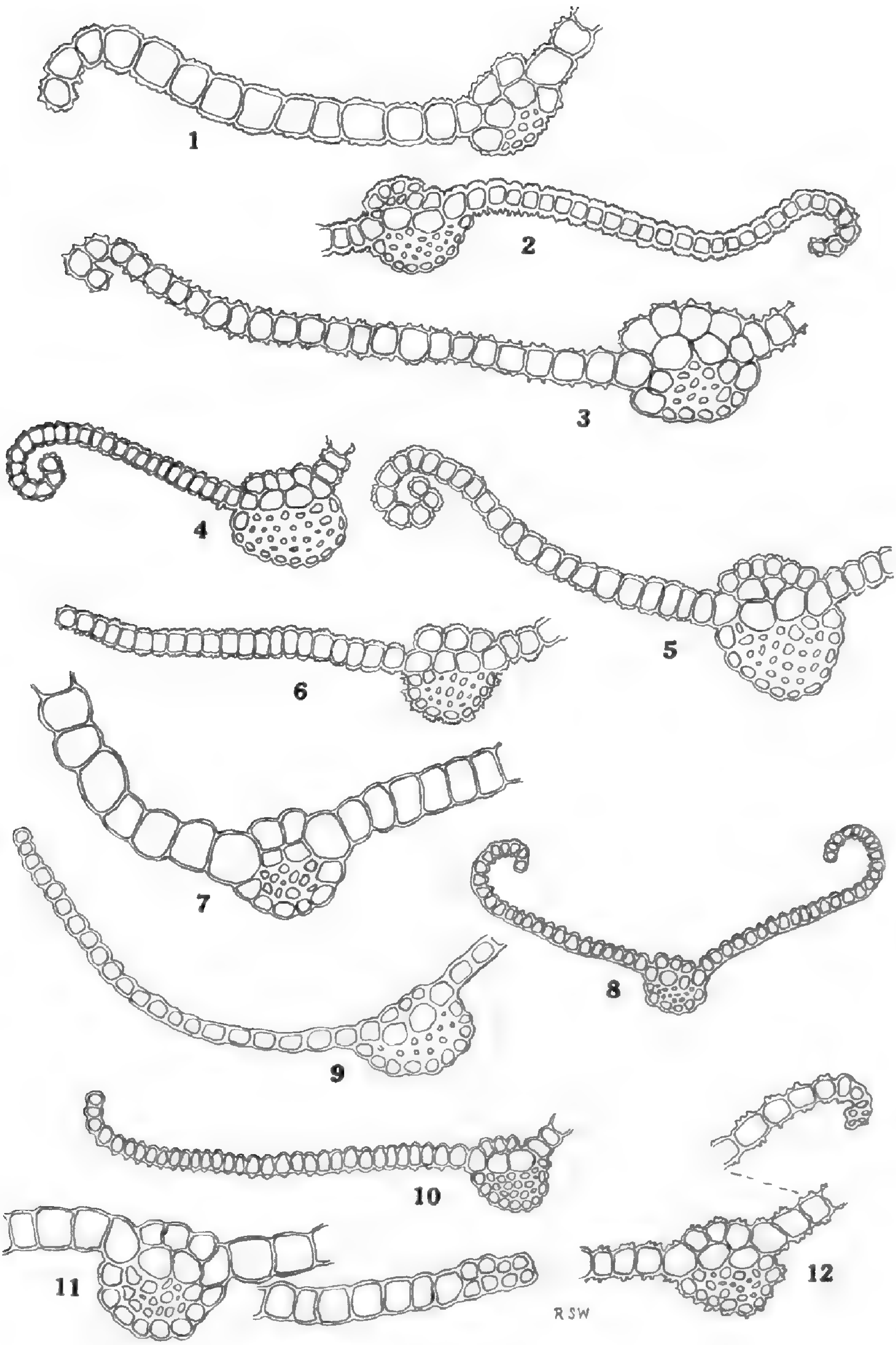
EXSICCATAE: Drummond, Musci Am. *135*.

ILLUSTRATION: B.S.G. Bryol. Eur. *pl. 135*.

Explanation of plate 11

Cross-sections of *Desmatodon* made about half way down the leaf.

FIG. 1. *Desmatodon latifolius* (Hedw.) Brid., from California, × 270.
FIG. 2. *Desmatodon suberectus* (Hook.) Limpr., from Canada, × 270.
FIG. 3. *Desmatodon Guepini* B. S. G., from California, × 270.
FIG. 4. *Desmatodon plinthobius* Sull. & Lesq., from South Carolina, × 270.
FIG. 5. *Desmatodon obtusifolius* (Schwaegr.) Jur., from Montana, × 270.
FIG. 6. *Desmatodon Porteri* James., from Pennsylvania, × 200.
FIG. 7. *Desmatodon systylius* B. S. G., from Labrador, × 270.
FIG. 8. *Desmatodon Garberi* Lesq. & James, from Florida, × 270.
FIG. 9. *Desmatodon Sprengelii* (Schwaegr.) R. S. Williams, from Santo Domingo, × 270.
FIG. 10. *Desmatodon stomatodontus* (Card.) R. S. Williams, from Mexico, × 350.
FIG. 11. *Desmatodon cernuus* (Hueb.) B. S. G., from Canada, × 270.
FIG. 12. *Desmatodon Laureri* (Schultz) B. S. G., from Colorado, × 270.



WILLIAMS: DESMATODON

CONTRIBUTIONS FROM THE NEW YORK
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PHYTOGEOGRAPHICAL NOTES ON THE ROCKY MOUNTAIN REGION

VIII. DISTRIBUTION OF THE MONTANE PLANTS

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Phytogeographical notes on the Rocky Mountain region VIII. Distribution of the Montane plants

P. A. RYDBERG

The Montane Zone or Pine Belt of the Rocky Mountain region includes approximately the areas between the altitudes of 2,500 and 3,000 m. in southern Colorado, between 1,800 and 2,500 m. in southern Montana, and between 1,200 and 1,800 m. in Alberta, where the Canadian Pacific Railroad crosses the mountains. A general description of the Zone has been given in a previous article.*

The Subalpine Zone of the Rockies comes in contact with the Hudsonian or Eastern Subarctic Zone along the foothills of the Rockies from the headwaters of the Peace River northward, and here the species of the East and of the Rockies more or less intermingle. But the relation between the Montane Zone of the Rockies and the Canadian or Eastern Boreal Zone is very different, for the latter, in its typical development, reaches its western limits in the region of the Lake of the Woods and Lake Winnipeg. The most representative species of the Canadian Zone, *Strobus Strobus* and *Pinus resinosa*, reach their northwestern limits in this region and it is only in the transition belt between the Canadian and Hudsonian Zones, which extends along the height of land between the Saskatchewan and Athabasca Rivers, that species of the Canadian Zone range farther west. This transition belt is characterized by mixed woods of *Pinus Banksiana*, belonging to the Canadian, and of spruces and larches belonging to the Hudsonian Zone. North of the upper Athabasca River and Beaver River practically the whole country is Hudsonian, while south of the northern branch of the Saskatchewan the prairies and the plains begin. These latter grassland formations belong to the Transition or Sub-boreal Zone.

The number of plants common to the Canadian Zone of the East and the Montane Zone of the Rockies is small, outside of

* See Bull. Torrey Club 42: 11-25. 1915.

the common transcontinental species that grow along the water-courses and species which are common to the Hudsonian-Subalpine Zone and the Canadian-Montane Zone. None of the conifers are common to the two regions, and among the trees which occur in common we find only a few species of *Salix*, *Populus*, and *Betula*. If we consider the relationship between the Montane plants of the Rockies and those of the Pacific Coast Mountains, however, we find the conditions quite different. The Cascade Mountains are directly connected with the Rockies in the north and there are several mountain chains interposed between the Cascades and the Rockies in British Columbia, separated from one another only by narrow river-valleys. The Montane Zone of the Cascades, therefore, is practically continuous with that of the Rocky Mountains, and the two regions have many plants in common, the leading conifers not excluded. Many of the Pacific species have emigrated into the Rocky Mountains, especially into the northern Rockies, and many Rocky Mountain species into the Cascades.

As has already been pointed out in earlier articles of mine, the Rockies may be divided into two principal parts, the Northern Rockies, extending from the Yukon Territory to northern Wyoming, and the Southern Rockies, of southern Wyoming, Colorado and northern New Mexico. Each of these main divisions may be subdivided, and the following districts may be distinguished:

Northern Rockies

1. Canadian Rockies
2. Main Range, Montana
3. Selkirk-Bitterroot District
4. Belt Mountains District
5. Yellowstone District
6. Sawtooth District
7. Big Horn District
8. Black Hills District

Southern Rockies

9. Main Range District
10. Uintah-Wasatch District
11. Sevier District
12. La Sal-Abajo District

The main range of the Northern Rockies north of Butte, Montana, is rather homogeneous and the change in the Montane flora seen in proceeding northward is rather gradual, although many of the high northern species found in the Canadian Rockies (District 1) are not found in Montana.

South of Butte the main range (District 2) becomes lower and less distinctly Montane until the neighborhood of Yellowstone Park is reached. Here it rises higher and the Alpine Zone is present in the Bear Tooth, Shoshone, Teton, Gros Ventre, and

Wind River Ranges. This region may be regarded as a distinct subdivision (District 5).

Numerous species belonging to the Cascade Mountains have invaded the Selkirk Mountains in British Columbia and the Bitter-root Mountains between Idaho and Montana, and the flora here has become more or less Pacific in its character. This region (District 3) includes also more or less the western slopes of the main range in British Columbia and northern Montana.

The mountains of Central Idaho, such as the Sawtooth, Salmon River, and other ranges (District 6) are characterized in the Montane Zone rather by the lack of many species found in the main range than by the introduction of any considerable new element. In the Submontane Zone, however, the character of the flora apparently is more like that of the mountains of the Great Basin than that of the main range, although the flora of this region is not so well known as might be desired.

The isolated mountains of central Montana, such as the Belt Mountains, the Snowy Mountains, the Crazy Mountains, and the Little Rocky Mountains, together with the Cypress Hills in Canada (District 4), being rather low, are characterized by a meagre Montane flora without any additional element. This can also be said of the Big Horn Mountains of Wyoming (District 7), although these are much higher and contain a few strictly endemic species.

The Black Hills of South Dakota and Wyoming are also to be counted as a subdivision of the Northern Rockies (District 8), although they contain quite a number of species belonging to the Southern Rockies as well as many belonging to the Canadian and Alleghanian Zones.

In the Southern Rockies the main range (District 9) includes all of the mountains in Colorado and northern New Mexico, together with the Sierra Madre, Medicine Bow, and Laramie Ranges in Wyoming. Only a few peaks of the latter reach the Montane Zone.

The Uintah and the northern part of the Wasatch Mountains in Utah (District 10), although geologically belonging to the Northern Rockies, have a flora closely resembling that of the Southern Rockies. In the Wasatch Mountains, however, there are found quite a number of species which have immigrated from the Northern Rockies or from the mountains of the Great Basin. The southern part of the Wasatch Mountains, including the Sevier Range, the Henry Mountains, and other ranges west of the Colorado of the West (District 11), have a flora characteristic of the Basin Mountains. The Montane flora consists to a great extent of species common to the Rockies, the Basin Mountains, and the Sierra Nevada. The La Sal and Abajo Mountains, in Southeastern Utah (District 12) have a mountain flora almost the same as that characteristic of the main range of the Southern Rockies in Colorado.

The plants of the Montane Zone of the Rocky Mountains may be classified in the following categories. These are practically the same as those in the Subalpine Zone, with, however, some modification.

I. Transcontinental Species.
II. Species common to the Rockies and the Canadian Zone of the East.
III. Species common to the Rockies and the Pacific Mountains.
IV. Endemic species.

I. **Transcontinental Species**

The transcontinental species, as well as most of those common to the Rockies and to the East, consist partly of forest species, most of which have migrated around the Saskatchewan Plains, partly of water, meadow, and thicket species which have followed the watercourses across the plains. The former consist to a great extent of species common to the Subalpine and Montane Zones in the Rockies and hence also to the Hudsonian and Canadian Zones of the East; the latter consist mostly of species found also in the Submontane and Transition (or Alleghanian) Zones. Many of the water and bog plants, however, are not found on the plains and hence must have followed the woods.

A. TRANSCONTINENTAL SPECIES RANGING THROUGHOUT THE ROCKIES

Here I have included species which are found in the main ranges of both the Northern and Southern Rockies. Many of these may be lacking in one or more of the districts or subdivisions, especially in Districts 8, 11, and 12, but some also in Districts 4, 6, and 7.

1. PLANTS WITH BOREAL-SYLVAN DISTRIBUTION

In this discussion the word "sylvan" applied to a plant does not mean that it grows only in the deep woods, but that its distribution has taken place in connection with the Northern Woods, and that it does not grow in the prairie or plains regions. The plant may be a forest species in the true sense or it may grow in open woods, thickets, or among rocks in more open places. The essential point is that its migration east or west has taken place around and north of the plains, and not across them along the water-courses. To this category belong the transcontinental trees and most of the shrubs. The most important of the former is the quaking aspen, *Populus tremuloides*, also found in the Subalpine Zone.

In this and subsequent lists, species which are marked "**" are rare in the Southern Rockies; those marked "†" attain their best development at higher altitudes and reach the Alpine zone; those marked "‡" develop best lower down and reach the plains; those followed by "(Eur.)" are found also in Europe and usually also in northern Asia. The nomenclature is that of the author's Flora.*

a. Forest species

Trees

Populus tremuloides
*Populus balsamifera***
Salix Bebbiana
*Betula papyrifera***

Shrubs

Juniperus sibirica (Eur.)
Dasiphora fruticosa (Eur.)
Chamaepericlymenum candense
Lepargyraea canadensis
Arctostaphylos Uva-ursi (Eur.)
Linnaea americana
Distegia involucrata

* Flora of The Rocky Mountains and Adjacent Plains. New York. 1917.

Herbs

Phleum alpinum (Eur.)	*Ramischia secunda* (Eur.)
Avena striata	*Monotropa uniflora*
Danthonia spicata	*Veronica serpyllifolia* (Eur.)
Poa compressa (Eur.)	*Galium boreale* (Eur.)
Allium sibiricum (Asia)	*Galium triflorum*
Lysiella obtusata	*Specularia perfoliata*
Peramium decipiens	*Botrychium Lunaria* (Eur.)
Cytherea bulbosa (Eur.)	*Botrychium virginianum* (Eur.)
Corallorrhiza multiflora	*Botrychium silaifolium***
Tium alpinum (Eur.)	*Filix bulbifera*
Chamaenerium spicatum (Eur.)	*Filix fragilis* (Eur.)
Heracleum lanatum	*Filix montana* (Eur.)
Moneses uniflora (Eur.)	*Polystichum Lonchitis*
Pyrola uliginosa	*Thelypteris Dryopteris* (Eur.)
*Pyrola asarifolia***	*Asplenium septentrionale* (Eur.)
Pyrola chlorantha (Eur.)	*Asplenium Trichomanes* (Eur.)
Pyrola elliptica	*Pteris aquilina* (Eur.)
Erxlebenia minor (Eur.)	*Cryptogramma acrostichoides*

b. Aquatic and bog species

The following water and bog plants probably reached the Rockies by the way of the Northern Woods:

Shrubs

Salix chlorophylla	*Betula glandulosa*

Herbs

Sparganium minimum (Eur.)	*Scirpus caespitosus* (Eur.)
Triglochin palustris (Eur.)	*Carex diandra* (Eur.)†
Calamagrostis Langsdorfii (Eur.)	*Carex gynocrates* (Eur.)
Deschampsia caespitosa	*Carex disperma* (Eur.)
Catabrosa aquatica (Eur.)	*Carex canescens* (Eur.)
Panicularia nervata	*Carex brunnescens* (Eur.)
Panicularia borealis	*Carex paupercula* (Eur.)
Panicularia septentrionalis	*Carex aquatilis* (Eur.)
Eriophorum angustifolium (Eur.)	*Bistorta vivipara* (Eur.)†
Scirpus pauciflorus (Eur.)	*Alsine borealis*

Sagina saginoides (Eur.)
Thalictrum alpinum (Eur.)†
Batrachium flaccidum (Eur.)
Ranunculus reptans
Cardamine pennsylvanica
Subularia aquatica (Eur.)
Epilobium alpinum (Eur.)†
Epilobium Hornemannii (Eur.)†
Mimulus moschatus
Limosella aquatica (Eur.)
Limosella tenuifolia (Eur.)
Veronica Wormskjoldii†
Elephantella groenlandica
Senecio pauciflorus
Lycopodium annotinum (Eur.)

c. Various mesophytes

A few plants which are neither aquatics nor forest species have invaded the Rockies from the north. These are species that grow among bushes, among rocks, or on hillsides.

Torresia odorata (Eur.)
Calamagrostis purpurascens
Poa crocata
Festuca rubra (Eur.)
Bromus ciliatus
Carex praticola
Carex concinna
Carex Halleri (Eur.)
Juncoides parviflorum (Eur.)
Juncoides intermedium
Juncoides spicatum (Eur.)†
Blitum capitatum (Eur.)
Moehringia latifolia (Eur.)
Moehringia macrophylla
Viola adunca

2. Plants with riparian or campestrian distribution

These plants have crossed the continent over the plains, following mostly the watercourses. All of them are found in the foothills also and most of them attain their best development on the plains and prairies.

a. Aquatic plants

Sparganium angustifolium‡
Potamogeton natans (Eur.)‡
Potamogeton alpinus (Eur.)‡
Potamogeton lucens (Eur.)‡
Potamogeton foliosus‡
Triglochin maritima (Eur.)
Alisma brevipes
Sagittaria latifolia‡
Phragmites Phragmites (Eur.)‡
Panicularia grandis‡
Eleocharis palustris (Eur.)‡
Eleocharis acicularis (Eur.)‡
Eriophorum gracile (Eur.)‡
Scirpus validus‡
Lemna trisulca (Eur.)‡
Lemna minor (Eur.)‡
Persicaria coccinea‡
Batrachium trichophyllum (Eur.)‡

Batrachium Drouetii (Eur.)‡
Ranunculus Purshii‡
Sisymbrium Nasturtium-aquaticum (Eur.)‡
Tillaeastrum aquaticum (Eur.)‡
Callitriche palustris (Eur.)‡
Callitriche autumnalis (Eur.)‡
Hippuris vulgaris (Eur.)‡
Sium cicutaefolium‡
Menyanthes trifoliata (Eur.)‡
Veronica americana‡
Utricularia vulgaris (Eur.)‡
Utricularia minor (Eur.)‡

b. Bog and wet meadow plants

Tree

Salix cordata

Herbs

Phalaris arundinacea (Eur.)‡
Alopecurus aristulatus‡
Calamagrostis elongata‡
Calamagrostis canadensis‡
Beckmannia erucaeformis‡
Carex leptalea (Eur.)
Carex aurea‡
Carex Buxbaumii (Eur.)‡
Carex lanuginosa
Carex viridula‡
Carex rostrata‡
Carex retrorsa‡
Rumex occidentalis
Rumex mexicanus
Ranunculus sceleratus (Eur.)
Halerpestes Cymbalaria‡
Argentina Anserina (Eur.)‡
Gnaphalium uliginosum (Eur.)
Equisetum arvense (Eur.)

c. Meadow plants

Agrostis hyemalis‡
Muhlenbergia Richardsonis
Poa annua (Eur.)‡
Poa triflora (Eur.)‡
Poa pratensis (Eur.)‡
Festuca octoflora‡
Hordeum jubatum‡
Carex stenophylla‡
Carex interior
Juncus bufonius (Eur.)‡
Polygonum ramosissimum‡
Capnodes aureum‡
Arabis ovata‡
Draba nemorosa‡
Viola nephrophylla‡
Viola septentrionalis‡
Artemisia biennis

To this category belong also some of the escaped cultivated plants and common weeds, such as

Phleum pratense (Eur.)‡
Dactylis glomerata (Eur.)‡
Syntherisma Ischaemum (Eur.)
Chenopodium Botrys (Eur.)‡
Bursa Bursa-pastoris (Eur.)‡
Carum Carui (Eur.)‡
Plantago major (Eur.)‡

d. Hillside plants

Panicum Huachucae
Ibidium strictum
Polygonum Douglasii
Bilderdykia Convolvulus (Eur.)
Pulsatilla ludoviciana

B. Transcontinental species restricted to the Northern Rockies

Nearly all of the transcontinental plants restricted in their distribution to the Northern Rockies are of boreal-sylvan distribution, whether they are forest species or not. In spreading across the continent, they have followed the northern woods around the plains north of the Saskatchewan and then south in the mountains. In some cases the species have not extended very far south—have not even entered the United States; in other words, their distribution in the Rockies is limited to District 1, the Canadian Rockies. Others have traveled farther south and invaded District 2, or even Districts 3 and 4. About one third have spread further south into District 5 and from there to Districts 6, 7 and 8. Two are even found in the Uintah-Wasatch District of the Southern Rockies.

1. Species reaching at least the Yellowstone District

a. Forest plants

Sabina horizontalis
Melica Smithii
Oryzopsis pungens
Carex Peckii
Streptopus amplexifolius
Rosa acicularis (Asia)
Osmorrhiza divaricata
Androsace septentrionalis (Eur.)
Valeriana septentrionalis
Aster major
Aster Lindleyanus
Youngia nana (Asia)†
Aspidium viride (Eur.)

b. Water and bog plants

Eriophorum Scheuchzeri (Eur.)†
Eriophorum Chamissonis (Eur.)†
Carex livida
Juncus Richardsonianus
Comarum palustre (Eur.)
Equisetum palustre (Eur.)
Equisetum fluviatile
Equisetum laevigatum

c. Cliff plant

Antiphylla oppositifolia (Eur.)†

Of these species *Oryzopsis pungens, Carex Peckii, Osmorrhiza divaricata* and *Juncus Richardsonianus* have extended their range into the Black Hills of South Dakota, and *Osmorrhiza divaricata* and *Youngia nana* into the Uintah Mountains of Utah.

2. Species reaching the Main Range in Montana or the Bitter-roots in Idaho, but not further south

a. Forest plants

Actaea rubra
Ribes Hudsonianum
Dryopteris Filix-mas (Eur.)
Dryopteris dilatata (Eur.)
Lycopodium obscurum (Eur.)
Lycopodium complanatum (Eur.)
Lycopodium clavatum (Eur.)
Lycopodium sitchense

b. Water and bog plants

Shrubs

Salix pedicellaris
Salix candida

Herbs

Rynchospora alba (Eur.)
Scirpus subterminalis
Scirpus atrocinctus
Carex vaginata (Eur.)
Carex limosa (Eur.)
Carex scirpoidea (Eur.)
Carex lacustris (Eur.)
Carex Crawfordii
Carex flava (Eur.)
Castalia Leibergii
Drosera rotundifolia (Eur.)
Drosera longifolia (Eur.)
Geum macrophyllum
Mertensia paniculata
Equisetum sylvaticum (Eur.)
Equisetum scirpoides (Eur.)
Lycopodium inundatum (Eur.)

Pellaea glabella, growing among exposed rocks, has a peculiar distribution. Though it is not found in the Southern Rockies it is found in the Black Hills and the hilly country of western Nebraska and reappears in eastern Kansas.

3. Species limited to the Canadian Rockies

a. Forest species

Carex aenea
Carex durifolia
Cypripedium passerinum
Lysias orbiculata
Ophrys convallarioides
Comandra livida
Coptis trifoliata (Eur.)
Thelypteris Phegopteris (Eur.)
Dryopteris fragrans (Eur.)
Woodsia glabella (Eur.)
Lycopodium alpinum (Eur.)

b. Water and bog plants

Herbs

Eriophorum callitrix (Eur.)
Eriophorum opacum (Eur.)
Scirpus pumilus†
Carex chordorrhiza
Carex militaris
Carex deflexa
Oxycoccus Oxycoccus (Eur.)
Oxycoccus macrocarpus

II. Species common to the Rockies and the Canadian Zone

The plants common to the Rockies and to the Canadian Zone of the East consist either of eastern species, whose ranges extend west into the Rockies, or of Rocky Mountain species which have invaded the East. The distribution of the former in the Rockies is very similar to that of the transcontinental species just treated. Some of them have followed the northern woods, others the watercourses across the plains. The distribution area of some reaches the Southern Rockies, while that of others stops in northern Wyoming, in northern Montana, or in the Canadian Rockies. Among the Rocky Mountain species which have emigrated east, some have reached the Lake Superior region, while others are found as far east as the Gaspé Peninsula of Quebec.

A. Eastern species, extending south into the Southern Rockies

1. Plants of boreal-sylvan distribution

a. Forest species

Oryzopsis asperifolia
Agrostis oreophila
Cinna latifolia (Eur.)
Carex Parryana†
Vagnera stellata
Coeloglossum bracteatum
Peramium ophoides
Corallorrhiza Corallorrhiza (Eur.)

Claytonia virginica
Ranunculus micranthus
Fragaria americana
Rubus pubescens
Viola Selkirkii
Viola renifolia
Viola canadensis
Circaea alpina (Eur.)
Aralia nudicaulis
Prunella vulgaris (Eur.)
Clinopodium vulgare (Eur.)
Pedicularis canadensis
Linnaea americana
Erigeron droebachiensis (Eur.)
Botrychium simplex (Eur.)
Botrychium neglectum (Eur.)
Cryptogramma Stelleri
Selaginella selaginoides

b. Water and bog plants

Alsine alpestris (Eur.)
Alsine crassifolia
Parnassia parviflora
Geum rivale (Eur.)
Viola palustris (Eur.)
Epilobium adenocaulon
Petasites sagittata
Nabalus racemosa
Lactuca spicata
Equisetum pratense (Eur.)

2. EASTERN PLANTS WITH RIPARIAN OR CAMPESTRIAN DISTRIBUTION

Muhlenbergia racemosa
Juncus Vaseyi
Carex lanuginosa
Urtica gracilis
Carex siccata
Thalictrum dasycarpum
Lepidium densiflorum†
Sullivantia Hapemanii
Vicia trifida
Vicia americana
Apocynum androsaemifolium
Macrocalyx Nyctelea‡
Plantago eriopoda‡
Rudbeckia hirta

Vitis riparia, *Juncus Torreyi*, and *Asplenium platyneuron*, eastern species, have reached the Southern Rockies in Colorado, but are not found in the Northern.

3. PLANTS OF THE GREAT PLAINS

Some of the plants of the Great Plains extend up into the Montane Zone. Although they do not belong to the Canadian or Alleghanian Zones of the eastern United States, they are immigrants from the East and may be included here.

Calamagrostis micrantha
Polygonum buxiforme
Xanthoxalis Bushii
Viola pedatifida
Anogra latifolia
Anogra coronopifolia
Plantago Purshii
Laciniaria punctata
Chrysopsis villosa
Solidago glaberrima
Equisetum variegatum

B. Eastern species, extending into the Northern Rockies only

1. Species reaching at least the Yellowstone Region

Carex Richardsonii
Carex eburnea
Heuchera hispida
Phaca americana
Hedysarum americanum

Of these, *Heuchera hispida* and *Phaca americana* even reach the Black Hills and western Nebraska.

2. Species extending only to Northern Montana or Idaho

Carex tenera
Carex pedunculata
Parnassia palustris (Eur.)
Mitella nuda
Chiogenes hispidula
Melampyrum lineare
Thelypteris Robertiana (Eur.)
Dryopteris cristata (Eur.)

3. Species limited to the Canadian Rockies

Trees

Picea canadensis
Picea mariana

Shrub

Salix pellita

Herbs

Carex atratiformis
Vagnera trifoliata
Coptidium lapponicum (Eur.)
Ribes glandulosum
Geum perincisum
Primula mistassinica
Petasites palmata
Pteretis nodulosa
Dryopteris intermedia

Of these, *Picea canadensis* and *Pteretis nodulosa* are found also in the Black Hills.

C. Rocky Mountain species which have emigrated eastward

The following plants have extended their ranges as far east as eastern Minnesota, western Ontario, upper Michigan or Hudson Bay.

Shrubs

Rosa Bourgeauiana
Amelanchier alnifolia

Herbs

Viola rugulosa
Monarda menthaefolia
Androsace subumbellata
Aster laevis
Aster Wilsonii
Solidago pulcherrima
Erigeron glabellus

Another species, *Dryas Drummondii*, has even reached the Gaspé Peninsula, Quebec.

III. Species common to the Rockies and the Pacific Mountains

A. Species found in both the Northern and Southern Rockies, as well as the Cascades and the Sierras

a. Forest species

Nearly all of the plants belonging in this category have passed from the Rockies to the Pacific Mountains, or vice versa, in the north where the two mountain systems are connected, and not across the Great Basin.

Trees

Pseudotsuga mucronata
Pinus Murrayana
Apinus flexilis
Salix Scouleriana

Shrubs

Odostemon Aquifolium
Ribes viscosissimum
Rubacer parviflorum
Echinopanax horridum
Pachystima Myrsinites
Gaultheria humifusa
Vaccinium scoparium

Herbs

Oryzopsis Bloomeri
Festuca subulata
Elymus glaucus
Carex Bolanderi
Carex athrostachya
Veratrum speciosum
Vagnera amplexicaulis
Vagnera lilacina
Trillium ovatum
Piperia unalaschensis
Ranunculus Douglasii
Ranunculus Bongardii
Actaea arguta
Thalictrum sparsiflorum
Aquilegia coerulea
Osmorrhiza obtusa
Pectianthia pentandra
Fragaria bracteata
Geranium viscosissimum
Geranium Richardsonii

Linum Lewisii
*Circaea pacifica**
Glycosma occidentalis
Chimaphila occidentalis
Pyrola picta
Pterospora Andromedea
Androsace filiformis (Asia)
Polemonium occidentale
Collinsia parviflora
Pedicularis racemosa
Achillea lanulosa
Artemisia frigida (Asia)
Arnica cordifolia
Senecio pseudaureus
Hieracium albiflorum
Athyrium alpestre (Eur.)
Athyrium cyclosorum (Eur.)
Cryptogramma densa
Polypodium hesperium

Cryptogramma densa, *Athyrium alpestre*, and *Osmorrhiza obtusa* reappear eastward on the Gaspé Peninsula, Quebec. When their distribution in Canada becomes better known, they may prove to belong among the transcontinental plants. *Thalictrum sparsiflorum* extends east to the Hudson Bay, *Elymus glaucus* to Upper Michigan, and *Collinsia parviflora* and *Achillea lanulosa* to western Ontario; *Echinopanax horridum* is found near the shores of Lake Superior.

b. Water and bog plants

In this class have also been included many plants of the wetter meadows and copses; in other words, the class consists of plants which probably have spread along the watercourses. This means, in this case, mostly along the Columbia River and its tributaries, for the Frazer River drains mostly the Cascades and other ranges west of the Rockies. Only the headwaters of this stream are in the Rocky Mountains, though north of the region here considered and mainly within the Subarctic Zone. The Colorado of the West runs for hundreds of miles in a deep canyon, does not touch the Sierras, and therefore can play practically no part in the distribution of the Montane plants.

Shrubs

Salix glaucops
Alnus tenuifolia
Kalmia microphylla

Herbs

Muhlenbergia comata‡
Muhlenbergia filiformis
Agrostis grandis
Agrostis asperifolia‡

Agrostis variabilis
Graphephorum Brandegei
Danthonia californica
Danthonia unispicata
Carex Raynoldsii
Carex tenuirostris
Carex simulata
Carex athrostachya
Carex Kelloggii
Lemna gibba (Eur.)
Juncus Mertensianus
Iris missouriensis
Polygonum Watsonii
Bistorta bistortoides†
Claytonia lanceolata
Crunocallis Chamissonis
Alsine strictiflora
Alsine laeta†
Alsine calycantha
Nymphaea polysepala
Thalictrum sparsiflorum (Asia)
Myosurus aristatus
Ranunculus Eschscholtzii
Campe americana‡
Parnassia fimbriata
Micranthes arguta
Geum oregonense
Vicia oregana‡
Vicia sparsiflora‡
Epilobium brevistylum
Epilobium occidentale
Amarella strictiflora
Mimulus Langsdorfii
Mimulus Lewisii‡
Pedicularis bracteosa
Galium subbiflorum
Aster occidentalis
Aster Burkei
Erigeron salsuginosus
Rudbeckia occidentalis
Senecio triangularis
Arnica longifolia
Agoseris elata

Of these, some have spread also to the East, as *Crunocallis Chamissonis* and *Galium subbiflorum* to Minnesota, *Linum Lewisii* to the Black Hills and Nebraska, *Alsine strictiflora* to Ontario, and *Thalictrum sparsiflorum* and *Alsine laeta* to Hudson Bay.

c. Various mesophytes

In this category are included plants that grow in open places, as dry meadows, table-land, hillsides and cliffs. Many of these grow also at lower altitudes; in the foothills and even on the plains. Many are also common to the mountain chains of the Great Basin.

Trees or shrubs

Cercocarpus ledifolius
Limnobotrya montigena

Herbs

Eriocoma hymenoides‡
Poa longiligula
Poa Sandbergii
Hesperochloa Kingii‡
Agropyron Smithii‡
Elymus condensatus‡
Carex Douglasii‡
Carex Hoodii
Carex phaeocephala†
Carex obtusata (Eur.)
Carex Rossii
Juncus longistylis
Juncoides comosum
Eriogonum stellatum
Eriogonum umbellatum
Eriogonum ovalifolum
Polygonum sawatchense
Sarcobatus vermiculatus‡
Eurotia lanata‡
Lewisia redeviva
Oreobroma pygmaea
Cerastium strictum (Eur.)
Arenaria congesta†
Arenaria Burkei‡
Anemone globosa
Draba lutea (Eur.)
Arabis retrofracta
Sedum stenosepalum
Lithophragma bulbifera
Lithophragma parviflora
Petrophytum caespitosum
Potentilla Bakeri
Potentilla diversifolia
Drymocallis glandulosa
Lupinus tenellus
Lupinus argenteus‡
Viola venosa
Viola linguaefolia
Epilobium paniculatum‡
Gayophytum intermedium
Gayophytum ramosissimum
Gayophytum racemosum
Oenothera Hookeri
Lavauxia flava
Leptodactylon pungens
Leptodactylon Nutallii
Gilia aggregata
Collomia linearis
Hydrophyllum capitatum
Lappula floribunda
Cryptantha Torreyana
Pentstemon procerus
Castilleja linariaefolia
Campanula petiolata
Macronema suffruticosum
Aster campestris
Antennaria rosea
Antennaria oblanceolata
Gymnolomia multiflora‡
Balsamorrhiza sagittata
Wyethia amplexicaulis
Helianthus petiolaris‡
Madia glomerata
Chaenactis Douglasii
Artemisia incompta
Artemisia tridentata‡
Arnica pedunculata
Arnica fulgens
Agoseris laciniata
Woodsia oregana
Woodsia scopulina

Of these *Eriocoma hymenoides*, *Juncus longistylis*, *Arabis retrofracta*, *Lithophragma bulbifera*, *L. parviflora*, *Petrophytum caespitosum*, *Drymocallis glandulosa*, *Epilobium paniculatum*, *Arnica pedunculata*, and *A. fulgens* extend as far east as South Dakota and Nebraska; *Gilia aggregata* extends to Minnesota, reappearing farther east on the Gaspé Peninsula; *Carex Rossii* and *Draba lutea* to upper Michigan; *Woodsia scopulina* and *W. oregana* are found on the Gaspé Peninsula.

B. Rocky mountain species found in both Southern and Northern Rockies, which have spread into the Cascades, but are not found in Sierra Nevada

a. Forest species

Tree

Picea Engelmannii

Shrubs

Sorbus scopulina
Rubus melanolasius

Herbs

Calamagrostis luxurians
Carex Geyeri
Ophrys nephrophylla
Razoumofskia americana
Razoumofskia Douglasii
Atragene columbiana
Ozomelis stauropetala
Conioselinum scopulorum
Ligusticum tenuifolium
Apocynum ambigens
Aster Geyeri
Erigeron macranthus
Erigeron speciosus
Erigeron conspicuus

b. Water and bog plants

Shrub

Salix exigua

Herbs

Poa leptocoma
Poa interior
Poa Olneyæ
Agrostis humilis
Agrostis idahoensis
Limnorchis stricta
Limnorchis borealis
Limnorchis viridiflora
Ibidium porrifolium
Alsine obtusa
Ranunculus alismaefolius
Ranunculus cardiophyllus‡
Trollius albiflorus
Delphinium multiflorum
Argentina argentea
Dodecatheon parviflorum
Castilleja exilis
Graphalium sulphurescens

Of these *Argentina argentea* extends east to South Dakota and *Ranunculus cardiophyllus* to eastern Saskatchewan.

c. Various mesophytes

Melica spectabilis
Melica bella
Bromus polyanthus
Carex nubicola
Carex pachystachya
Carex Geyeri
Carex filifolia‡
Carex scopulorum
Anticlea elegans
Juncus confusus
Allium Geyeri
Delphinium Nelsonii
Thlaspi Nuttallii
Draba nitida
Peritoma serrulatum
Leptasea austromontana
Potentilla Nuttallii
Drymocallis corymbosa
Sieversia grisea
Sieversia ciliata
Thermopsis montana
Lupinus caespitosus
Astragalus striatus
Astragalus goniatus
Viola vallicola
Phlox caespitosa
Gilia pulchella
Phacelia sericea
Castilleja lancifolia
Castilleja lauta
Castilleja hispida
Orthocarpus luteus
Coleosanthus grandiflorus
Aster apricus
Antennaria flavescens
Antennaria concinna
Atnennaria corymbosa
Antennaria pulcherrima
Antennaria anaphaloides
Artemisia Michauxiana
Artemisia cana‡
Artemisia arbuscula
Artemisia tripartita
Arnica Parryi
Arnica mollis
Arnica Rydbergii
Senecio serra
Selaginella densa

Of these, *Delphinium Nelsonii, Anticlea elegans, Juncus confusus*, and *Allium Geyeri* extend east to South Dakota or Nebraska, *Astragalus striatus* to Minnesota, and *A. goniatus* to Hudson Bay.

c. PACIFIC SPECIES, WHICH HAVE INVADED THE NORTHERN ROCKIES, BUT NOT THE SOUTHERN

1. SPECIES WHICH HAVE REACHED ONLY THE SELKIRK-BITTERROOT DISTRICT

a. Forest species

The species listed here have probably followed the mountain chains in their migration from the Pacific Mountains by the way of the Cascades and the Selkirks into the Rockies.

Trees

Strobus monticola
Larix occidentalis
Abies grandis
Tsuga heterophylla
Thuja plicata
Taxus brevifolia

Shrubs

Ribes nevadense
Rubus nivalis
Rubus spectabilis
Ceanothus prostratus
Azaliastrum albiflorum
Vaccinium parvifolium
Linnaea longiflora

Herbs

Carex laeviculmis
Unifolium dilatatum
Allium validum
Disporum oreganum
Clintonia uniflora
Piperia multiflora
Piperia elegans
Lysias Menziesii
Eburophyton Austinae
Cytherea occidentalis
Corallorrhiza Mertensiana
Trautvetteria grandis
Mitellastra caulescens
Pectianthia Breweri
Therophon majus
Chimaphila Menziesii
Castilleja pinetorum

b. Water and bog plants

These have probably followed the Columbia River and Frazer River and their tributaries up into the mountains.

Shrubs or trees

Salix Lemmoni
Salix sitchensis

Herbs

Agrostis foliosa
Calamagrostis Cusickii
Graphephorum muticum
Tofieldia occidentalis
Cardamine oligosperma
Lupinus polyphyllus
Trifolium longipes
Epilobum oregonense
Epilobum glaberrimum
Dodecatheon Jeffreyi
Anthopogon simplex
Mimulus nasutus
Mimulus primuloides
Mimulus Breweri
Polystichum munitum
Isoetes Howellii
Isoetes Nuttallii

C. Various mesophytes

These have probably spread along the foothills from the Cascades to the Selkirks and Bitterroots, or even across the Columbia Plains, as most of them are also found in the Submontane or Transition Zone.

Herbs

Stipa Thurberiana
Festuca viridula
Hordeum murinum (Eur.)
Carex concinnoides
Carex spectabilis
Carex Mertensii
Eriogonum pyrolaefolium
Delphinium depauperatum
Pulsatilla occidentalis
Arabis suffrutescens
Phoenocaulis cheiranthoides
Sedum Douglasii
Heterisia Mertensiana
Dasystephana oregana
Stenotus stenophyllus
Antennaria confinis
Balsamorrhiza deltoidea
Arnica Menziesii
Cheilanthes gracillima
Selaginella Wallacei

2. SPECIES WHICH HAVE CROSSED THE MAIN RANGE OF THE ROCKIES IN MONTANA AND ALBERTA

a. Forest species

Trees

Pinus ponderosa
Apinus albicaulis

Shrubs

Ribes laxiflorum
Rubus pedatus
Acer Douglasii

Herbs

Melica subulata	*Adenocaulon bicolor*
Aquilegia formosa	*Pyrola dentata*
Tiarella unifoliata	

b. Water and bog plants

Poa nervosa	*Viola Macloskeyi*
Naiocrene parvifolia	*Trifolium Beckwithii*

c. Various mesophytes

Carex Preslii	*Lupinus laxiflorus*
Xerophyllum tenax	*Phlox Douglasii*
Anemone Drummondii	*Pedicularis contorta*
Smelowskia ovalis	*Arnica diversifolia*
Arabis Lyallii	

Adenocoulon bicolor reappears on Lake Superior and *Trifolium Beckwithii* in eastern South Dakota.

3. Species which have reached the Yellowstone Park

a. Forest species

Calamagrostis Suksdorfii	*Kelloggia galioides*
Hypericum Scouleri	*Aster integrifolius*
Ozmorrhiza brevipes	*Antennaria racemosa*

b. Bog plants

Shrub

Salix Austinae

Herbs

Panicum thermale	*Alsine crispa*
Tofieldia intermedia	*Ranunculus alismellus*
Juncus nevadensis	*Cardamine Breweri*

c. Mesophytes

Stipa Elmeri	*Potentilla Blaschkeana*
Stipa oregonensis	*Potentilla glomerata*
Calamagrostis rubescens	*Fragaria platypetala*
Carex Jonesii	*Dasystephana calycosa*
Carex nervina	*Townsendia scapigera*‡
Carex luzulina	*Balsamorrhiza terebinthacea*‡

4. Species whose distribution extends even into the Uintah and Wasatch Mountains of Utah

a. Forest species

Shrubs

Vaccinium occidentale
Sambucus coerulea

Herbs

Aquilegia flavescens
Bicuculla uniflora
Apocynum pumilum

b. Water and bog plants

Shrub

Ledum glandulosum

Herbs

Ruppia pectinata
Limnia asarifolia
Limnia sibirica (Asia)
Limnia perfoliata
Alsinopsis occidentalis
Alsine brachypetala
Dodecatheon alpinum
Aster oreganus

c. Mesophytes

Agrostis Thurberiana
Arenaria Douglasii
Thalictrum occidentale
Paeonia Brownii
Thlaspi californicum
Draba oligosperma
Arabis Lemmonii
Lupinus leucophyllus
Gayophytum diffusum
Gayophytum pumilum
Lappula diffusa

D. Plants common to the Northern Rockies and the Cascades, but not found in the Southern Rockies or in Sierra Nevada

1. Species found as far south as the Yellowstone Park region

a. Forest shrubs

Spiraea densiflora
Spiraea lucida
Menziesia ferruginea
Menziesia glabella

b. Bog plants

Shrubs

Salix idahoensis
Salix Geyeriana
Alnus sinuata

Herbs

Agrostis oregonensis
Carex Piperi
Carex microptera
Caltha leptosepala
Lupinus Burkei
Epilobium delicatum
Angelica Lyallii
Dodecatheon conjugens
Aster Jessicae
Senecio subnudus
Botrychium Coulteri

c. Various mesophytes

Sitanion montaum
Elymus nitidus
Carex Tolmei
Eriogonum Piperi
Spraguea multiceps
Silene Lyallii
Silene oregana
Silene multicaulis
Thalictrum columbianum
Delphinium Nuttallianum
Arabis albertina
Lupinus leucopsis
Lupinus sericeus
Cordylophorum suffruticosum
Amarella anisosepala
Dasystephana monticola
Pentstemon crassifolius
Castilleja pallescens
Valeriana ceratophylla
Aster conspicuus
Antennaria flagellaris
Antennaria Howellii
Artemisia floccosa
Arnica gracilis
Senecio Howellii
Hieracium cynoglossoides

Lupinus sericeus and *Aster conspicuus* extend east to the Black Hills.

2. Species whose range extends even into the Uintah-Wasatch region

Juncus Regelii
Silene columbiana
Ranunculus limosus
Delphinium bicolor
Arabis rupestris
Arabis microphylla
Potentilla dichroa
Castilleja Tweedyi
Eucephalus elegans
Hieracium albertinum
Hieracium griseus
Gnaphalium proximum

3. Species found in the Main Range in Montana and Alberta but not farther south

Shrubs

Salix Fernaldii
Philadelphus Lewisii
Ribes petiolare
Rosa nutkana
Sorbus occidentalis
Vaccinium globulare
Luetkea pectinata

Herbs

Poa Vaseyochloa
Xerophyllum Douglasii
Juncoides glabratum
Erythronium grandiflorum
Eriogonum polyphyllum
Eriogonum depressum
Arenaria nardifolia (Asia)
Silene repens (Asia)
Atragene grosseserrata
Arabis Nuttallii
Arabis furcata
Heuchera glabra
Heuchera grossulariifolia
Micranthes aestivalis
Potentilla Drummondii
Epilobium luteum
Viola orbiculata
Valeriana Scouleri
Penstemon Lyallii
Dodecatheon cylindrocarpum
Dodecatheon viviparum
Castilleja Suksdorfii
Castilleja lutea
Antennaria Howellii
Antennaria luzuloides
Erigeron Howellii
Aster modestus
Aster diabolicus
Aster Sayianus
Achillea fusca
Cirsium Macounii
Selaginella montanensis

4. Cascade Mountain species which have emigrated into the Selkirk-Bitterroot region

Shrub

Salix commutata

Herbs

Alopecurus pallescens
Poa Cusickii
Agropyron lanceolatum
Elymus Howellii
Carex stenochlaena
Allium fibrillum
*Allium Cusickii**
Eriogonum thymoides
Claytonia chrysantha
Alsine washingtoniana
Arenaria cephaloidea
Aquilegia columbiana
Sedum Leibergii
Hemieva ranunculifolia

Aruncus acuminatus
Trifolium plumosum
Angelica Piperi
Osmorrhiza Leibergii
Osmorrhiza purpurea
Ligusticum Canbyi
Ligusticum Leibergii
Chamaepericlymenum unalaschense
Moneses reticulata
Pyrola bracteata
Oxycoccus intermedius
Pentstemon pinetorum
Veronica Cusickii
Synthyris major
Castilleja cervina
Razoumofskya Laricis
Valeriana sitchensis
Castilleja Vreelandii
Aster Cusickii
Balsamorrhiza Careyana
Saussurea americana
Lactuca multifida
Polystichum Andersoni
Thelypteris Oreopteris (Eur.)

E. PLANTS COMMON TO THE SOUTHERN ROCKIES AND THE SIERRA NEVADA

These plants have spread across the Great Basin, their seed being carried by birds or wind from mountain to mountain by way of the numerous though low parallel mountain chains within the Basin. Most of them are xerophytic, the rest mesophytic. Species in the following list marked "††" extend into the Submontane Zone; those marked "‡‡" are not found east of the Wasatch Mountains.

Trees

Pinus aristata
Abies concolor

Herbs

Elymus simplex††
Stipa speciosa‡‡††
Oryzopsis Webberi††
Muhlenbergia gracilis††
Poa Fendleriana
Carex fissuricola‡‡
Carex epapillosa‡‡
Rumex hymenosepalus††
Amaranthus Powellii
Quamoclidion multiflorum††
Oreobroma nevadensis
Erocallis triphylla
Alsine Jamesii
Lepidium montanum††
Heuchera rubescens‡‡††
Sericotheca glabrescens‡‡††
Drymocallis pumila‡‡
Trifolium Rusbyi‡‡
Phaca Hookeriana‡‡††
Hamosa calycosa‡‡††
Kentrophyta tegetaria‡‡
Hypericum formosum††

Viola Beckwithii‡‡
Viola Sheltoni
Microsteris micrantha††
Hydrophyllum alpestre‡‡
Macronema discoideum
Dugaldia Hoopesii††
Senecio filicifolius‡‡††
Polystichum scopulinum‡‡
Selaginella Watsoni‡‡
Selaginella Underwoodii

IV. **Endemic Rocky Mountain species**

As the endemic element of the montane plants is very large, consisting of about 1040 species, or over 53 per cent of the whole number, it is hardly practicable to list them all. I shall therefore merely give the number of species found in each category and mention specifically only a few in each class whose distribution is particularly characteristic or of special interest.

A. ENDEMIC PLANTS COMMON TO THE SOUTHERN AND NORTHERN ROCKIES

Many of the endemic plants are of wide distribution, their range extending from Colorado or northern New Mexico to Montana or even further north. To this category belong the following trees: *Pinus scopulorum*, *Populus angustifolia*, *Betula fontinalis*, and six species of *Salix* (three of these usually mere shrubs). Among the shrubs, *Sambucus melanocarpa*, *Ceanothus velutinus*, and *Svida instolonea* are the most common and most widely distributed. The category contains 6 trees, 12 shrubs, and 217 herbs, and if to these are added 7 grasses and 6 other herbs belonging to the plains and occasionally reaching the Montane Zone, the whole number of species is 248. Of these some extend outside of the Rocky Mountains, as for instance *Svida instolonea*, which reaches to Manitoba and Kansas, *Drymocallis fissa* the Black Hills, and *Scrophularia occidentalis* North Dakota and Oklohoma.

B. PLANTS ENDEMIC TO THE SOUTHERN ROCKIES ONLY

1. PLANTS FOUND BOTH IN THE MAIN RANGE AND IN THE UINTAH-WASATCH REGION

To this category belong two trees, *Picea pungens* and *Populus Wislizenii*, together with 13 shrubs and 197 herbs, or in all 212 species. Of these some are limited to the very southern slope of the Rockies and are in reality immigrants from the Upper Sonoran region, as for instance, *Populus Wislizenii, Grossularia leptantha, Blepharoneuron tricholepis, Calamagrostis scopulorum, Festuca arizonica* and *Fragaria ovalis.*

As I have stated elsewhere, the interchange of flora between the Southern Rockies and the Northern does not take place so much along the continental divide in central Wyoming as from the Wasatch Mountains, over the Bear River Mountains and the Tetons, to the Northern Rockies. Several southern species are found in the two intermediate ranges mentioned and several northern ones in the Wasatch. These southern species are as follows:

Shrub

Salix Wolfii

Herbs

Stipa Vaseyi
Rumex densiflorus
Ranunculus intertextus
Delphinium occidentale
Delphinium reticulatum
Cardamine cordifolia
Arabis divaricarpa
Potentilla filicaulis
Sidalcea neomexicana
Amarella monantha
Primula Parryi
Orthocarpus purpureo-albus
Penstemon subglaber
Penstemon Rydbergii
Aster Canbyi
Senecio perplexus
Senecio rapifolius
Senecio uintahensis
Cirsium Eatoni
Leontodon scopulorum

The following plants of the Southern Rockies extend into the Black Hills or western Nebraska.

Poa andina
Eriogonum pauciflorum
Arabis Fendleri
Draba auriformis
Saxifraga simulata
Potentilla propinqua
Opulaster monogynus
Ceanothus Fendleri
Cynomarathrum Nuttallii
Dodecatheon radicatum
Sambucus microbotrys
Thelesperma gracilis
Senecio spartioides
Senecio rapifolius

2. Plants found in the Main Range but not in the Uintah-Wasatch region

To this category belong nearly half of the endemic plants of the Southern Rockies. The list comprises 6 shrubs and 252 herbs, but no trees. Some of these are restricted to the southern slope only and may be considered as immigrants from the Upper Sonoran region. Among these are three of the four fernworts endemic to the Southern Rockies: *Cheilanthes Fendleri*, *Notholaena Fendleri*, and *Selaginella mutica*. A fourth fern, *Woodsia mexicana*, is also found in the Black Hills and in Minnesota, and ranges southward into Mexico.

3. Plants restricted to the Uintah-Wasatch region

This category comprises 7 shrubs and 71 herbs, but no trees. Many of these plants are also found in the mountains of the Great Basin. Some of them, as *Fendlerella utahensis*, *Chamaebatiaria Millefolium*, *Arctostaphylos platyphylla*, *Phaca serpens*, and *Phaca Sileriana* are evidently immigrants from the Upper Sonoran region.

There are 47 local endemics found in Wyoming and southeastern Idaho which occur nowhere else in the Rockies. Of these maybe one third should be counted as belonging to the southern Rockies. If so, the total number of endemics restricted to the southern Rockies would be about 560 species.

C. Plants endemic to the Northern Rockies only

1. Plants of general distribution within the Northern Rockies

Fully one-third of the endemic species of the Northern Rockies are of general distribution and extend as far south as the Yellowstone Park Region. Among these are included two trees, *Picea albertiana* and *Betula utahensis*, 4 shrubs and 102 herbs; altogether 108 species. Of these the following extend south into the Uintah-Wasatch region.

Juncus Tweedyi	*Delphinium bicolor*
Cardamine multifolia	*Aconitum divaricatum*
Ranunculus saxicola	*Draba andina*

Arabis oreophila
Arabis exilis
Micranthes Greenei
Potentilla ovina
Drymocallis foliosa
Trifolium scariosum
Angelica Roseana
Dodecatheon salinum‡
Swertia congesta
Synthyris laciniata
Orthocarpus Tolmiei
Aster amplifolius
Machaeranthera viscosa
Erigeron tenellum
Arnica arcana

The following reach the Black Hills:

Alsinopsis dawsonensis
Atelophragma glabriuscula
Atelophragma Forwoodii
Homalobus dispar
Aragallus villosus
Aragallus gracilis
Aragallus spicatus‡
Aster meritus
Cirsium Drummondii

2. Species found in Montana and northern Idaho and northward

This category contains one tree, *Betula subcordata*, two shrubs (*Vaccinium* sp.), and 31 herbs; altogether 34 species. Of these, *Aragallus splendens* extends eastward to Minnesota, *Vaccinium membranaceum* to upper Michigan, and *V. ovalifolium* to the Gaspé Peninsula.

3. Local species or species of very restricted range

The local species of Wyoming and eastern Idaho number 47 (of which perhaps one third should be accredited to the Southern Rockies while 6 are also found in the Uintahs or Wasatchs), those of Montana 19, those of western Idaho 14, those of the Black Hills 5, and those of the Canadian Rockies 22 (among the latter one tree, *Betula alaskana*, and three shrubs); in all, 107 local species. If all categories of endemic species are considered, the number restricted to the Northern Rockies includes altogether about 230 species, and the number endemic to the Rocky Mountains as a whole 1,040 species.

SUMMARY

Within the Montane Zone in the Rocky Mountains are found about 1900 species. Of these, approximately 50 per cent* are

* All percentage figures in the following paragraphs are computed with reference o the total number of species.

Montane plants in the restricted sense, i. e. plants which attain their best development within this zone. Of the rest, many reach their best development in the Subalpine Zone above, and many others in the Submontane Zone below. A few alpine plants are sometimes found as low as the Montane Zone and several species from the Great Plains or from the Sonoran Zone are occasionally found as high up.

Of the plants found in the Montane Zone, 245, or less than 13 per cent, are transcontinental, i. e. they are found both in the East and on the Pacific Slope, as well as in the Rockies; 176 of these, or 9 per cent of the total flora, are common to the Northern and Southern Rockies, another 1 per cent extend as far south as Wyoming, and 1 per cent are limited to the Canadian Rockies.

Besides the transcontinental plants, there are 84 species which are common to the East and the Rockies but have not reached the Pacific Slope. If to these are added a score of western plants which have emigrated eastward as far as the Great Lakes and Hudson Bay, some of them even to the Gaspé Peninsula, Quebec, there are in all about 350 species, or nearly 18½ per cent of the flora, which are common to the East and to the Rockies. The larger portion of these, 250 species or over 13 per cent, are found in both the Northern and Southern Rockies, and 100, or more than 5 per cent, in the Northern only. None of the Montane plants are common to the East and the Southern Rockies only.

The number of species common to the Rockies and the Pacific Mountains is much larger: if the transcontinental species are excluded, about 565, or nearly 30 per cent; or, if these are included nearly 43 per cent of all the plants found within the Montane Zone of the Rockies. Nearly 450 of the plants common to the Rockies and the Pacific Mountains (the transcontinental ones included), or nearly 24 per cent of the whole number are found in both the Northern and Southern Rockies; 350, or about 18 per cent, are found in the Northern Rockies but not in the Southern, and not quite 2 per cent occur in the Southern but not in the Northern Rockies. Of the species common to the Rockies and the Pacific Mountains (the transcontinental ones not included), about 300, or nearly 16 per cent, are found both in the Cascades and the Sierra Nevada; about 225, or nearly 12 per cent, are found in the

Cascades alone, and less than 2 per cent in the Sierra Nevada alone. If the transcontinental plants are added, the percentage for the plants found in both the Sierras and the Cascades and for those found in the Cascades alone would be increased to about 20 per cent of each. The ratio for those found in the Sierras alone would remain less than 2 per cent. This refers of course to the Montane plants only. In the Submontane region the ratio would be much greater.

The endemic element consists of 1,040 Montane plants or over 53 per cent of the whole number. Of these, 245 or nearly 13 per cent are common to the Northern and Southern Rockies, 560 or nearly 29 per cent being restricted to the Southern Rockies, and 230 or 12 per cent to the Northern. Of the latter about 10 per cent extend as far south as Northern Wyoming and 1 per cent are restricted to the Canadian Rockies. Of the species restricted to the Southern Rockies over 11 per cent are common to the Main Range in Wyoming, Colorado, and New Mexico and the Uintah-Wasatch region, while 13½ per cent are restricted to the former and nearly 4 per cent to the latter. Of those restricted to the Northern Rockies, 8 per cent are found in Northern Wyoming and a little over 1 per cent are restricted to the Canadian Rockies. If the flora of the Canadian Rockies were better known this latter number probably would be much larger. We must also remember that only the region south of latitude 55° is here considered.

It may also be of interest to see how the number of species found in the Southern and Northern Rockies would compare, if all categories of Montane plants are taken in consideration. There are over 40 per cent common to both, nearly 28 per cent restricted to the Southern Rockies and 32 per cent to the Northern. The species found in the Southern but not in the Northern Rockies consist almost wholly of endemic forms, less than 2 per cent being common to the Southern Rockies (and most of these found only in Utah) and the Sierra Nevada and 3 species only being Eastern nontranscontinentals. Those found in the Northern Rockies and not in the Southern consist of over 3 per cent transcontinental species, less than 2 per cent being common to the Northern Rockies and the Eastern Canadian Zone, nearly 15 per cent common to the former and the Pacific Mountains and 12 per cent endemics: altogether 32 per cent of all Montane species.

As stated before, the interchange of species between the two great divisions of the Rockies has taken place from the northern part of the Wasatch Mountains over the Bear River Mountains and the Teton Mountains to the Northern Rockies, or vice versa, rather than along the continental divide in central Wyoming. Among the Montane plants, I have listed 69 northern species, or over 3½ per cent of the total flora, which are found in the Wasatchs but nowhere else in the Southern Rockies, and 23 Southern species, or over 1 per cent, which are found in southern Idaho or in the Teton Mountains, and nowhere else in the Northern Rockies.

A good deal could also be said about the distribution of the plants in the Black Hills, a meeting place of plants from the Northern Rockies, the Southern Rockies, the Canadian and Alleghanian Zones of the East, and of the flora of the Great Plains, and I hope to take up this subject at some future time.

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SCROPHULARIACEAE OF THE LOCAL FLORA

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SCROPHULARIACEAE OF THE LOCAL FLORA. I

BY FRANCIS W. PENNELL

In commencing the systematic study of a family of plants for North America there is logic in studying first those species which occur in the eastern seaboard of the United States. These were the plants first known in detail, if not necessarily those earliest discovered, on this continent. From Massachusetts to Carolina we are on classic ground, and here the plant-life has been worked over so many times, and each species so often collected, that we may now speak with certainty of nearly all specific identities.

The present study is concerned with but a portion of this territory, the counties included within the local flora range, of the Torrey Botanical Club and of the Philadelphia Botanical Club. These combined include all of Connecticut; New York southeast of Columbia, Greene and Delaware counties inclusive; all of New Jersey; Pennsylvania southeast of Pike, Wayne, Lackawanna, Luzerne, Schuylkill, Lebanon, Dauphin and Lancaster counties inclusive; Newcastle county, Delaware; and Cecil county, Maryland. This area is in main part represented in the Torrey Club collection at the New York Botanical Garden, and the portion within approximately fifty miles of Philadelphia in the remarkably full and valuable collection of the Philadelphia Club at the Academy of Natural Sciences in that city. To both collections I have had free access, and the records below include data from these, the herbaria of Columbia University, the Brooklyn Botanic Garden, the University of Pennsylvania and several other institutions. To the curators of all I am appreciative.

Nearly all the species native or naturalized within the area of this study I have myself collected and of each made descriptions of fresh corollas, and noted other features to be gained only in the field. The importance of such work in taxonomic study needs emphasis.

In the present revision keys are given to the genera and species. These are detailed for points of definite contrast. These keys apply only to the species of our flora, and the warning must be made that the generic and tribal contrasts *may* be of little or no assistance beyond this territory. But just such keys as these are of most value to the local worker, and moreover it is by combining such analyses from various regions that we may hope ultimately to build more thorough family keys. An inductive process!

For each genus the type-species is stated. For each native species information of its type is stated, quoted from the original describer. This includes the statement of the particular specimen from which the first description was made and of the place of its collection. The later history of each name is traced. Extra-limital synonyms, even if the names have been current here, are not included except by brief mention. But all names ever proposed based upon plants occurring native in this area are supposed to be included.

With respect to distribution I should like to undertake a study for which the data at hand in our herbaria is not yet sufficient. Moreover my own observations have not as yet been sufficiently prolonged over this area. The counties best represented in herbaria are those of Connecticut; New York, from the Highlands southeastward, including all Long Island; New Jersey, with considerable gaps to the northwest; Pennsylvania southeast of the Blue Ridge; and northern Delaware. Northwest of the Highlands and of the Blue Ridge botanical collections have been few and scattered, the regions best known being the Pocono Plateau of Pennsylvania, and sections of Ulster, Greene and Delaware counties, New York.

Dr. Witmer Stone, in his Plants of southern New Jersey, has traced with a master-hand the distribution of vegetation for the Coastal Plain portion of that state. That regions of as sharp delimitation occur northward and westward, through the land of hills, of parallel mountain-areas with intervening trough-like valleys, of red soil derived from Triassic rock or of black soil from Ordovician limestone, of various soils derived from the ridges of shale, gneiss and sandstone, appears self-evident. In the northern portion of our territory glaciers, building lake and gravel habitats, have left us a new series of environmental conditions. Mr. Taylor's suggestive Flora does not attempt the detailed analysis of distribution which is demanded. I believe that the careful working-out of the ranges of the species of a few well-selected families of plants will give the knowledge we need for the dividing into phytogeographic areas of this varied inland—knowledge which will be nearly as definite as if multiplied by such a wealth of data as is presented by Dr. Stone. The problem is fascinating and it is with reluctance that I realize that the Scrophulariaceae have not yet been observed over a sufficient area or with sufficient thoroughness to warrant basing upon this study any contribution toward such a survey.

Our present study then attempts but these three goals: to present keys contrasting the genera and species of Scrophulariaceae in our flora, to make certain the nomenclature, and to give preliminary observations of distribution.

A. Corolla with the posterior lobes external in the bud. (Antirrhinoideae.)

B. Filaments five. Stigma capitate. Capsule septicidal. Sepals five, distinct.

C. Corolla rotate, slightly zygomorphic, its lobes much longer than the tube. Filaments all with fertile anthers. Leaves alternate. — I. VERBASCEAE.

1. *Verbascum*.

CC. Corolla tubular-campanulate, zygomorphic, its lobes shorter than the tube. Posterior filament without anther, the others didynamous. Leaves opposite. — II. CHELONEAE.

Corolla white, lavender or pink, pubescent or puberulent within, its anterior lobes projecting. Sterile filament slender, filiform, white.

Corolla membranous, white or lavender, puberulent or somewhat pubescent within over base of anterior lobes. Sterile filament as long as the others, pubescent on its posterior face. Anther-sacs distinct, glabrous or barbate with short hairs. Sepals lanceolate to ovate, acute to acuminate. Seeds wingless. Inflorescence compound, a raceme of cymosely branching lax flower-clusters. Stem-leaves clasping. 2. *Penstemon.*

Corolla semi-fleshy, white or rose, densely pubescent within over base of anterior lobes. Sterile filament much shorter than others, glabrous. Anther-sacs becoming confluent, densely lanose. Sepals ovate-orbicular, rounded. Seeds winged. Inflorescence simple, a spike-like raceme of single flowers on short several-bracted pedicels. Stem-leaves narrowed at base, short-petioled. 3. *Chelone.*

Corolla red-brown, glabrous within, its antero-lateral lobes vertically projecting, the anterior lobe deflexed. Sterile filament shorter than wide, two-lobed, yellow or red-brown. Inflorescence compound. 4. *Scrophularia.*

BB. Filaments four or two, the posterior one being lost.

C. Acaulescent. Corolla rotate, slightly zygomorphic, white or lavender-tinged. Capsule two-celled at base, septicidal. Stigma capitate. Small herb, spreading by stolons. III. LimosellEAE.
5. *Limosella.*

CC. Caulescent, with leaves mainly cauline. Corolla zygomorphic, the lobes shorter than the tube. Capsule two-celled throughout. Inflorescence simply racemose.

D. Leaves opposite. Corolla without a spur. Stigma of two usually plate-like lobes. Capsule septicidal, or somewhat loculicidal by a simple split down median line of carpel. IV. Gratioleae.

Corolla yellow or white, with throat four-angled, its orifice open; pubescent within at base of posterior lobes. Postero-lateral stamens perfect, antero-lateral reduced to sterile filaments or wanting. Several bractlets at base of the five distinct sepals. Capsule septicidal, or tardily slightly loculicidal. 6. *Gratiola.*

Corolla yellow or lavender-blue, with throat somewhat flattened into a horizontal plane, channeled beneath and arched posteriorly; pubescent within at base of anterior lobes. No bractlets below calyx.

Perfect stamens four, with slender straight filaments. Corolla 15–30 mm. long, its orifice nearly closed by the raised anterior lip; the posterior lobes rounded and nearly equaling anterior. Style without tubercle-like base. Capsule loculicidal, tardily somewhat septicidal. Sepals united over one-half length. 7. *Mimulus.*

Perfect stamens two; the antero-lateral filaments fused with corolla ridges, from near apex of which abruptly upcurving. Corolla lavender, 2–10 mm. long, its orifice open; the posterior lobes acute and shorter than the anterior, or else wanting. Style with white tubercle-like base. Capsule septicidal, the thin plate-like septum persisting.

Corolla 6–10 mm. long, with two posterior lobes developed. Postero-lateral stamens perfect, antero-lateral filaments without anthers. Sepals five, united at base. Plants erect or ascending, with leaves 1–3 cm. long. 8. *Ilysanthes.*

Corolla 2 mm. long, with two posterior lobes lost. Postero-lateral stamens lost, antero-lateral filaments with anthers. Sepals four (the posterior lost), united nearly four fifths their length. Plant repent, with leaves .3–.5 cm. long. 9. *Hemianthus.*

DD. Leaves alternate. Corolla with a spur at the base of the anterior petal. Stigma capitate. Capsule loculicidal, the septum with adjacent capsule-wall persisting, the remaining wall splitting irregularly. V. Antirrhineae

10. *Linaria.*

AA. Corolla with the anterior lobes external in the bud. (Rhinanthoideae.)

B. Stamens two, the postero-laterals present; the antero-laterals completely lost. Antero-lateral lobes of corolla external in bud. Not parasitic. Sepals four, the posterior lost. Posterior lobes of corolla completely fused. VI. Veroniceae.

Leaves whorled. Corolla white, its lobes shorter than the tube. Capsule acute, longer than broad, not flattened. Plant 10–20 dm. tall. 11. *Veronicastrum.*

Leaves opposite or alternate. Corolla blue, its lobes longer than the tube. Capsule acute to deeply notched, broader than long, flattened. Plants lower. 12. *Veronica.*

BB. Stamens four, didynamous, the antero-laterals usually slightly the longer. Usually parasitic on roots of other plants.

C. Sepals five, alike, more or less united. Corolla-lobes all somewhat distinct, the posterior spreading or broadly arched; anterior lobe external in bud. Stigma elongated. Capsule loculicidal, splitting through septum. VII. BUCHNEREAE.

Corolla yellow or pink, campanulate, with inflated throat and open orifice. Stamens all perfect, the anthers two-celled, lanose. Two stigmatic lines, one down each side of style-apex. Filaments and style nearly as long as the tube of the corolla. Capsule exserted from the calyx-tube. Calyx not bracted at base.

Corolla yellow. Capsule acute to acuminate. Leaves lanceolate to ovate, entire to bipinnatifid, petioled. Stem stout, over 4 dm. tall. Perennials or annuals. 13. *Aureolaria.*

Corolla pink, with red spots within on anterior side. Capsule rounded, with a mucro. Leaves filiform to lanceolate, entire or auriculate-lobed at base, sessile. Stem slender, usually lower. Annuals.

Stem ascending-scabrellous to glabrous. Leaves linear to filiform, entire. Pedicels over 1 mm. long. Calyx-lobes linear to subulate, slightly longer to usually much shorter than the tube. Corolla with two yellow lines within throat anteriorly. Anther-sacs of both pairs of stamens uniform. Capsule globose to globose-ovoid, 3–7 mm. long. Seeds closely reticulate. 14. *Agalinis.*

Stem retrorse-hispid. Leaves lanceolate, usually auriculate-lobed at base. Pedicels less than 1 mm. long. Calyx-lobes ovate, longer than the tube. Corolla without yellow lines within throat anteriorly. Anther-sacs of posterior pair of stamens shorter. Capsule broadly ovate, 10–13 mm. long. Seeds reticulate with raised ridges. 15. *Otophylla.*

Corolla purple-blue, salverform, the tube very narrow and densely pilose, the lobes widely spreading. Postero-lateral stamens becoming rudimentary, the antero-laterals with but one anther-sac. Stigmatic area over entire surface of style apex. Filaments and style less than one half length of corolla-tube. Capsule equaled by and enclosed within calyx-tube. Calyx bibracteolate at base. 16. *Buchnera.*

CC. Posterior sepal shorter or wanting. Corolla decidedly two-lipped, the posterior lobes united and arched nearly to apex, the anterior lobes usually shorter; anterior or one antero-lateral lobes external in bud. Stigma short, capitate. VIII. RHINANTHEAE.

Posterior sepal shorter than others. Capsule turgid, septicidal, only tardily slightly loculicidal. Seeds linear, flat, 2 mm. long. Calyx bibracteolate at base. 17. *Schwalbea.*

Posterior sepal wanting. Capsule flattened, loculicidal, splitting through septum. Calyx not bracted at base.

Corolla with posterior lobes projecting, not hooded at apex, the anterior lobes very short, thickened, deep-green. Seeds many, reticulate. Bracts foliaceous, distally scarlet. 18. *Castilleja.*

Corolla with posterior lobes arched, hooded at apex, the anterior lobes membranous, flat, colored. Seeds few, not reticulate. Bracts not colored.

Corolla yellow or pink throughout, the anterior lip not raised into a palate. Seeds more than two. Sepals of each side united nearly or quite to apex. Leaves crenate-serrate to bipinnatifid-lobed.

Corolla 12 mm. long. Anthers lanose. Capsule circular, equally two-celled, splitting on both posterior and anterior sides. Seeds 5 mm. long, circular, flat, broadly winged. Sepals as long as the capsule, on each side united nearly to apex. Leaves crenate-serrate. Annual. 19. *Rhinanthus.*

Corolla 15–20 mm. long. Anthers glabrous. Capsule ensiform, unequally two-celled, splitting only on posterior side. Seeds 1 mm. long, oblong, cylindric, not winged. Sepals less than one half length of capsule, on each side united to apex. Leaves bipinnatifid-lobed. Perennials. 20. *Pedicularis.*

Corolla white, the anterior lip raised into a yellow densely pubescent palate. Seeds maturing two to four to a capsule. Sepals united at base only, the two postero-laterals longer. Leaves lanceolate, entire or setaceous-toothed near base. 21. *Melampyrum.*

1. VERBASCUM L., Sp. Pl. 177. 1753

Type species, *V. Thapsus* L. of Europe.

Leaves glabrous. Stem above and calyx with simple glandular hairs. Corolla yellow or white. Filaments all densely lanose with knobbed purple hairs. Pedicels 10–15 mm. long. Capsule subglobose, glandular-puberulent. Seeds .8–.9 mm. long, dark-gray. 1. *V. Blattaria.*

Leaves, stem and calyx more or less pubescent with stellately-branched non-glandular hairs. Corollas always yellow. Filaments: three posterior lanose, two anterior sparingly lanose to glabrous, with filiform yellow hairs. Pedicels less than 10 mm. long. Capsules ovoid or oblong, stellate-pubescent. Seeds .4–.7 mm. long, brownish-gray.

Leaves dark and becoming glabrate above, whitened beneath, sessile or the lower petiolate, not decurrent. Pedicels reaching 10 mm. long, clustered three to twelve in an axil. Sepals linear, 2–2.5 mm. long, much shorter than the mature capsule. Corolla 18 mm. wide. Capsule 4 mm. long. Seeds 6–7 mm. long. 2. *V. Lychnitis.*

Leaves dull- or yellowish-green and permanently pubescent above, scarcely paler beneath, sessile, more or less decurrent. Pedicels reaching 5 mm. long, one to five in an axil. Sepals ovate, 6–8 mm. long, slightly shorter than to equaling the mature capsule. Corolla 20–35 mm. wide. Capsule 6–8 mm. long. Seeds .4–.5 mm. long.

Stem-leaves broadly ovate, strongly crenate, dull-green, moderately pubescent. Pedicels reaching 5 mm. long, three to five to an axil. Inflorescence interrupted. Corolla 30–35 mm. wide. 3. *V. phlomoides*

Stem-leaves lanceolate, finely crenate, yellowish-green, very densely pubescent. Inflorescence crowded. Pedicels very short to none, one to an axil. Corolla 20–22 mm. wide. 4. *V. Thapsus.*

1. VERBASCUM BLATTARIA L.

Flowering from mid-June to mid-August, fruiting from early July on.

Loam soil, cultivated fields, common throughout the area above the Fall-line, rarely recorded from the Coastal Plain. Naturalized from Eurasia.

2. VERBASCUM LYCHNITIS L.

Flowering from late June to August, fruiting from August on.

Loam soil, roadsides, local in the area above the Fall-line, especially near the cities. Naturalized from Eurasia.

3. VERBASCUM PHLOMOIDES L.

Collected in flower in July and August.

Probably sandy soil, cultivated fields; rare. Garden City, L. I.; Lindenwold, N. J. Adventitive from Eurasia.

4. VERBASCUM THAPSUS L.

Flowering from mid-July to late August, fruiting in August and September.

Mainly in loam soil, fields and roadsides; common throughout, mainly above the Fall-line. Naturalized from Eurasia.

2. PENSTEMON [Mitchell Schmidel, Icones Plantarum 2. 1762

Type species, *Chelone Penstemon* L., "Habitat in Virginia."

Corolla funnelform; throat tubular; lobes widely spreading; puberulent within. Leaves entire or the upper slightly serrulate, glabrous, under a lens evidently puncticulate. Seeds strongly ridge-angled. 1. *P. tubiflorus.*

Corolla with throat tubular near base, then abruptly inflated; pubescent within at base of anterior lobes. Leaves more or less denticulate, not evidently puncticulate under a lens. Seeds not strongly ridge-angled.

Corolla with throat inflated, its mouth open, not closed by the anterior lip. Sterile filament slightly to moderately densely bearded. Calyx-lobes ovate-lanceolate to lanceolate. Plants taller, glabrous to puberulent.

Corolla white, rather strongly inflated. Anther-sacs usually barbate. Stem glabrous or nearly so. 2. *P. Digitalis.*

Corolla light violet-purple, moderately inflated. Anther-sacs glabrous. Stem puberulent. 3. *P. Pentstemon.*

Corolla with throat scarcely inflated, its mouth closed by the anterior lip, which closes as a convex arc. Sterile filament very densely bearded. Calyx-lobes ovate. Plants lower, the stem pubescent or hirsute.

Corolla 15–20 mm. long, white with violet lines. Anther-sacs oval. Calyx-lobes obtuse to short-acuminate. Stem and leaves soft-canescent. Leaves lanceolate. 4. *P. pallidus.*

Corolla 23–28 mm. long, lavender-purple, unlined. Anther-sacs triangular-orbicular. Calyx-lobes acuminate to caudate. Stem and frequently midrib of leaves beneath more or less lanose-hirsute. Leaves lanceolate-attenuate. 5. *P. hirsutus.*

1. Penstemon tubiflorus Nutt.

Flowering in June.

Fields, seen only from Spring Valley, Rockland Co., N. Y. Introduced from the southwestern Mississippi Valley.

2. Penstemon digitalis Nutt.

Flowering from mid-June to early July, fruiting in late August and September.

Fields and meadows, frequent above Fall-line. Introduced from the southwestern Mississippi Valley.

3. Penstemon pentstemon (L.) MacMillan.

Flowering in June and July.

Fields and meadows, seen only from Rockland Co., New York and Bergen and Gloucester counties, New Jersey. Introduced from the South Atlantic states.

4. Penstemon pallidus Small, Fl. S. E. Un. St. 1060, 1337. 1903.

"Type, Bedford, N. Y., *Britton*, June, 1900, in Herb. N. Y. B. G." Type seen; also the plant re-collected and studied at the type-station.

Flowering from mid-May to late June.

Sandy or barren soil, occasional, mostly above the Fall-Line. Certainly introduced from the central Mississippi Valley.

5. Penstemon hirsutus (L.) Willd.

Chelone hirsuta L., Sp. Pl. 611. 1753. "Habitat in Virginia." Based upon Clayton n. 39 in the Gronovian Herbarium. The Linnean characterization certainly denotes the plant here considered.

Penstemon hirsutus (L.) Willd., Sp. Pl. 3: 227. 1800.

Flowering from late May to early July, fruiting from July on.

Dry fields, usually sandy, in potassic soil, occasional or local through the area above the Fall-line. Ranges from southern Vermont and southern Ontario to upland Virginia, Kentucky and southern Michigan.*

3. CHELONE L., Sp. Pl. 611. 1753

Type species, *C. glabra* L.

1. CHELONE GLABRA L., Sp. Pl. 611. 1753. "Habitat in Virginia, Canada." Based upon a plant grown in the Clifford garden in Holland.

Chlonanthes tomentosa Raf., New Fl. Am. 2: 20. 1837. "In the mts. of Virginia." Leaves tomentose or pubescent beneath; a condition of more frequent occurrence southward, specimens noted from Monmouth, Burlington and Camden counties, New Jersey, and frequently through southeastern Pennsylvania. Here treated as a form, **tomentosa** (Raf.) Pennell, forma nova.

Flowering from early August to early October, fruiting from mid-September on.

Moist loam to sandy woodland, in potassic soil, frequent to common throughout above the Fall-line; frequent or occasional through the Coastal Plain, outside of the Pine Barrens. The leaves tend to be narrower in the Coastal Plain. Ranges from Newfoundland to Manitoba, northern Florida and Kansas.

4. SCROPHULARIA L., Sp. Pl. 619. 1753

Type species, *S. nodosa* L., "Habitat in Europae succulentes."

Petioles stouter, evidently wing-margined. Leaves cuneate to truncate at base, coarsely serrate to dentate. Inflorescence narrowly elongate, 4–8 cm. wide, its branches rela-

* PAULOWNIA TOMENTOSA (Thunb.) Baill.

A tree with lavender flowers, is an occasional escape from cultivation to roadsides, railroad-banks and thickets. Adventive from eastern Asia.

tively stout. Calyx-lobes triangular-obtuse. Corolla 8–12 mm. long. Fertile filaments more evidently pulverulent. Sterile filament 1.8 mm. wide, yellow. Capsule pyramidal-acuminate, 5–10 mm. long. Seeds .8–1 mm. long, reticulate with transverse areas. Flowering in early summer. 1. *S. leporella.*

Petioles slender, scarcely margined. Leaves narrowed to cordate at base, more finely crenate-serrate. Inflorescence pyramidal, 5–18 cm. wide, its branches slender. Calyx-lobes more broadly rounded. Corolla 6–8 mm. long. Fertile filaments very finely pulverulent. Sterile filament 1 mm. wide, purple-brown. Capsule ovoid, acute, 4–7 mm. long. Seeds .5–.8 mm. long, plump, reticulate with more nearly hexagonal areas. Flowering in late summer. 2. *S. marilandica.*

SCROPHULARIA LEPORELLA Bickn. in Bull. Torr. Bot. Club 23: 317. 1896. "Common near New York City. . . . I have met with it within eight miles of the Connecticut line and in the Pocono region of eastern Pennsylvania." Specimen from Bronxville, Westchester Co., New York, collected by E. P. Bicknell June 15, 1895, seen in herbarium Columbia University at The New York Botanical Garden.

Only inconstantly to be distinguished from *S. occidentalis* (Rydb.) Bicknell of the Rocky Mountain and High Plains states by its leaves being less coarsely and more evenly serrate (in *occidentalis* frequently coarsely toothed at base), and the branches of the inflorescence being usually less stout and less densely glandular. Probably better considered as a geographic variety.

Flowering from mid-May to mid-July, fruiting from late June to late August.

Meadows and thickets, loam, in potassic soil, frequent throughout above the Fall-line; less frequent or occasional on Long Island, and in the Middle and Cape May district of New Jersey. Ranges from Quebec to Connecticut and Virginia, westward to North Dakota and Nebraska where it appears to pass into *S. occidentalis.*

2. SCROPHULARIA MARILANDICA L., Sp. Pl. 619. 1753. "Habitat in Virginia." Linné had no specimen in his herbarium in 1753, but his description is copied from Hortus Upsalensis 177. 1748. From the diagnosis there given, especially the mention of leaves cordate serrate, and of

petiole but very slightly decurrent, the plant of the Upsala Garden would appear to have been the species now considered.

Scrophularia lanceolata Pursh, Fl. Am. Sept. 2: 419. 1814. "In wet meadows and woods: Pennsylvania." Description apparently of this. The type of this should be verified, but the description of the petioles as not ciliate, and the lateness of the time of flowering would indicate that Pursh described as new the original *marilandica*.

Scrophularia nodosa marilandica (L.) A. Gray, Syn. Fl. N. Am. 2. I: 258. 1878.

Scrophularia nodosa lanceolata (Pursh) M. E. Jones, Contrib. West. Bot. 12: 67. 1908.

Flowering from late July to late September, fruiting from early August into October.

Open woodland, loam, in potassic soil, frequent or northward rare through the area above the Fall-line; occasional in western Long Island, and near the Delaware River in the Middle District of New Jersey. Ranges from Massachusetts and southern Ontario to Georgia, Arkansas and Nebraska.

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SCROPHULARIACEAE OF THE LOCAL FLORA. II

BY FRANCIS W. PENNELL

5. LIMOSELLA L. Sp. Pl. 631. 1753.

Type species, *L. aquatica* L., of Europe.

1. LIMOSELLA SUBULATA Ives in Trans. Phys. Med. Soc. N. Y. 1: 440. 1817. "First observed in 1816. . . It flourishes in great abundance in the Housatonic, and in most of the rivers which empty into Long Island Sound, within the range of the tide."

Ygramela (or *Limosella*) *maritima* Raf. Atl. Journ. 199. 1833. "Discovered this year in the wet sand of the sea islands of New Jersey." As a new genus, this was based upon specimens the flowers of which bore but two stamens. Certainly an abnormal form, as the plant of such situations has normally four stamens.

Flowering from late August to November, and soon ripening fruit.

Tide-water river-beaches, saline, brackish or fresh, and about borders of ponds, brackish or fresh, along the coast. Margins of ponds back of sand-dunes, growing inundated or somewhat emersed on the sandy coastward margin of these, Long Island and southward to Ocean County, New Jersey; on the sandy or gravelly flats between high and low tide, along the Housatonic, Hudson, Passaic, Delaware, and doubtless other rivers. The plants of the two environments differ slightly, as has been indicated in Torreya 19: 51. 1919. This species ranges from Labrador to Maryland.

6. GRATIOLA L. Sp. Pl. 17. 1753.

Type species, *G. officinalis* L., of Europe.

Corolla slightly exceeding calyx, externally glabrous. Capsule nearly pyramidal, acuminate. Pedicels very short. Stem pubescent with several-celled hairs. (*Pilosae.*) 1. *G. pilosa*

Corolla more than twice as long as the calyx, externally more or less puberulent. Capsule broader, acute to rounded. Pedicels longer. Stem glabrous or puberulent with one-celled hairs, these frequently gland-bearing.

Pedicels exceeding 10 mm. in length. Corolla within throat on posterior side densely pubescent with knobbed hairs. Capsule ovate, equaled or exceeded by the sepals. Seeds 3–5 mm. long, semi-globose to oblong.

Capsule 1–3 mm. long, exceeded by the sepals. Stem-leaves clasping by a broad base, usually at least the upper with resinous dots. Roots perennial, slender. Stoloniferous. (*Ramosae.*)

Corolla golden-yellow throughout. Capsule 3 mm. long, little exceeded by the sepals. Leaves lanceolate to nearly ovate, entire or distally obscurely denticulate, with blackish glandular dots.

Leaves linear to lanceolate, frequently denticulate distally, usually strongly puncticulate. Sepals obtusish to acute. 2. *G. aurea.*

Leaves lanceolate to nearly ovate, entire, obscurely puncticulate distally. Sepals very obtuse. 2a. *G. aurea obtusa.*

Corolla with throat dull-yellow, the lobes white. Capsule 2 mm. long, much exceeded by the sepals. Leaves ovate, serrate, the upper sometimes with sparse glandular dots. 3. *G. viscidula.*

Capsule 4–5 mm. long, about equaled by the sepals. Stem-leaves narrowed to a sessile or slightly clasping base, not resinous-dotted. Roots annual, the main root thick and giving off numerous fibers. Not stoloniferous. (*Neglectae.*) 4. *G. neglecta.*

Pedicels less than 5 mm. in length. Corolla within throat on posterior side pubescent with knobless hairs. Capsule globose, 5–6 mm. long, slightly exceeding the sepals. Seeds 7 mm. long, linear. Leaves and root as in *Neglectae.* (*Virginianae.*) 5. *G. virginiana.*

1. GRATIOLA PILOSA Michx. Fl. Bor. Am. 1: 7. 1803. "Hab. in Carolinae inferioris uliginosis." Description sufficiently distinctive.

Sophronanthe pilosa (Michx.) Small, Fl. S.E. Un. St. 1067, 1338. 1903.

Flowering mid-July to late September, and soon ripening fruit.

Moist sandy pineland, in potassic soil, Cape May District and locally in Camden County in the Middle District, of the Coastal Plain of southern New Jersey. Ranges from New Jersey to Florida and eastern Texas, in the Coastal Plain.

2. Gratiola aurea Pursh, Fl. Am. Sept. 1: 12. 1814. "In sandy wet places, in the pine-barrens of New England, New Jersey and Carolina . . . v. v.; v. s. in Herbario Banksiano." Description distinctive, here restricted to the northern first-mentioned plant.

Flowering from early June to late September, and soon ripening fruit. Apparently fruit is sparingly matured, the plant increasing mainly by stolons.

Wet sandy potassic soil, margins of ponds; frequent in the Coastal Plain of Long Island and New Jersey, especially in the Pine Barrens; occasional about lakes in the glaciated region above the Fall-line, at least at Lake Hopatcong, Morris Co., New Jersey. Ranges from Maine and eastern Ontario to Virginia.

2a. **Gratiola aurea obtusa** Pennell, var. nov.

Plant erect, 1.5 dm. tall. Leaves lanceolate to ovate, 1.5 cm. long, entire, obscurely puncticulate distally. Sepals 3 mm. long, very obtuse. Corolla 10–12 mm. long.

Type, gravelly shores of Delaware River, between high and low tide, Fish House, Camden Co., New Jersey, collected in flower, July 24, 1905, by Stewardson Brown; in herb. Academy of Natural Sciences of Philadelphia.

Gravelly or sandy shores of Delaware River, between tides, Mercer and Camden counties, New Jersey, and Philadelphia Co., Pennsylvania.

3. **Gratiola viscidula** Pennell, nom. nov.

Gratiola viscosa Schwein.; Le Conte in Ann. Lyc. N. Y. 1: 106. 1824. "Inhabits Virginia, and the upper parts of North Carolina." Apparently the plant now considered, although the description appears inaccurate in stating that the capsule is as long as the sepals. Not *G. viscosa* Hornem. Enum. Pl. Hort. Hafn. 19. 1807.

Flowering from mid-July to September, and soon ripening fruit.

Swales and swamps, along streams, in potassic soil, at a few stations in the Piedmont of northern Delaware. Ranges from Delaware to upland Georgia and eastern Tennessee.

4. Gratiola neglecta Torr. Cat. Pl. N. Y. 89. 1819. "Within thirty miles of the City of New York." In the herbarium of Columbia University are two sheets, probably representing but one collection, both labeled "*Gratiola virginica* Linn., Torr. Fl. N. Y., 2, p. 37." It is possible that one or both of these are Torrey's plants of *G. neglecta.* The latter was described as distinct from *G. virginiana* because of the lack of the rudimentary antero-lateral filaments. Five years later, in his Flora of the Northern States, Torrey was persuaded that this lack was true of *G. virginiana*, and on that account reduced his earlier species. Still later, in 1843, in his Flora of New York, he described such rudiments as present, and held as erroneous his previous observations. The truth, as confirmed by an extensive examination of fresh flowers, is that these rudiments may be small, or reduced to one, or altogether absent; all stages are to be found in the same colony. The name is here used for the species which has long been known as *G. virginiana.*

Conobea borealis Spreng. in Neue Entdeck. 3: 26. 1822. "Hab. in locis humidis prope Noveboracum. . . ." This is virtually a re-description of *Gratiola neglecta* Torr., although sufficient new matter is added to indicate that Sprengel must have seen a specimen of this. The change of generic classification is doubtless due to the discovery of sterile rudiments of the antero-lateral filaments.

Flowering from late May to late September, and soon ripening fruit.

Wet loam, woodland or open, in potassic soil, common above the Fall-line; and through the Middle District of the Coastal

Plain. Ranges from Maine and Quebec to British Columbia, southward to Georgia, Texas and California.

5. GRATIOLA VIRGINIANA L. Sp. Pl. 17. 1753. "Habitat in Virginia." Although Linné had specimens of the plants here called *G. neglecta* in his herbarium in 1753, his description is taken solely from Gron. Fl. Virg. 6, 1743, and so is based upon *Clayton 379*. This, as shown by Dr. S. F. Blake in Rhodora **20**: 65, 1918, is the plant which has been known as *G. sphaerocarpa* Ell.

Flowering from mid-May to September, and soon ripening fruit.

Wet loam, in shade, occasional in the Middle and Cape May Districts of the Coastal Plain of New Jersey, and below the Fall-line in Delaware. From Burlington, N. J. southward to Florida and Texas, extending inland to the southern Appalachians.

7. MIMULUS L. Sp. Pl. 634. 1753

Type species, *M. ringens* L.

Corolla yellow. Capsule dehiscent laterally, apex persistent and valves permanently attached to axial cell-wall. Seeds ellipsoid-orbicular. Stems pubescent. Species introduced. (*Simiolus* Greene.)

Corolla 12–20 mm. long. Leaves 3–4 cm. long. Stems loosely lanose, slender, lax. 1. *M. moschatus*.

Corolla 30–35 mm. long. Leaves 4–5 cm. long. Stems glabrous to finely glandular-pubescent, stout, erect. 2. *M. guttatus*.

Corolla lavender-violet. Capsule dehiscent laterally from very apex, and its valves splitting from the persistent axial cell-wall. Seeds oblong. Stems glabrous. Species native. (*Eumimulus*.)

Leaves ovate, petioled. Angles of stem slightly winged. Pedicels stout, in fruit 5–10 mm. long. Calyx-lobes setaceous-tipped, 1–2 mm. long. Corolla 35 mm. long. Seeds pale-yellow. 3. *M. alatus*.

Leaves lanceolate, clasping. Angles of stem not winged. Pedicels slender, in fruit 30–60 mm. long. Calyx-lobes lanceolate, 3–5 mm. long. Corolla 30 mm. long. Seeds brownish. 4. *M. ringens*.

1. MIMULUS MOSCHATUS Dougl.

Aquatic in running streamlets or in bogs; rare; seen only from Queens and Sullivan counties, New York and Lehigh County, Pennsylvania. Certainly an escape from cultivation on Long Island, but in the mountain habitats it appears as if native. A native of the Rocky Mountains, occurring eastward in northern Michigan, Newfoundland and northern New England.

2. MIMULUS GUTTATUS DC.

Meadows and along streams, rarely escaped from cultivation; seen from Litchfield County, Connecticut, and Delaware County, New York. Native of western North America.

3. MIMULUS ALATUS Ait. Hort. Kew. 2: 361. 1789. "Nat. of North America. Introd. 1783, by Mr. William Malcolm."

Flowering from late July to early September, and soon ripening fruit.

Shaded swamps and along streams, in potassic soil, frequent, becoming rare northward, through the area above the Fall-line; occasional in the Middle District of the Coastal Plain of New Jersey. Ranges from Connecticut to Ontario and Kansas, southward to Florida and Louisiana.

4. MIMULUS RINGENS L. Sp. Pl. 634. 1753. "Habitat in Virginia, Canada . . . Hort. ups. 176. t. 2." In the Hortus Upsalensis 176, pl. 1, 1748, Linné described and figured our plant.

Flowering from early July to mid-September, and soon ripening fruit.

Open swales and along streams, more rarely in shaded swamps, in potassic and calcareous soils, common throughout the area above the Fall-line, of more rare occurrence through the Middle District and Coast Strip of the Coastal Plain. Ranges from Nova Scotia to Alabama, Minnesota and Kansas.

8. ILYSANTHES Raf. Ann. Nat. 13. 1820

Type species, *I. riparia* Raf., of the Ohio valley.

Leaves 1–3 cm. long, obviously attenuate at base. Pedicels relatively stout, at least in fruit, shorter than the bracts. Sepals usually finely pubescent, usually about equaling the capsule.

Leaves lanceolate to ovate-lanceolate, usually only the lowermost obtuse. Fruiting pedicels 5–10 mm. long. Plant diffuse. . . . 1. *I. dubia.*

Leaves elliptic-oval, all obtuse. Fruiting pedicels 3–5 mm. long. Plant erect. — *1a. I. dubia inundata.*

Leaves .5–1.5 cm. long, rounded at base, or at least broadest much below the middle. Pedicels filiform, longer than the bracts. Sepals glabrous or nearly so, shorter than the capsule. — *2. I. inaequalis.*

1. Ilysanthes dubia (L.) Barnhart.

Gratiola dubia L. Sp. Pl. 17. 1753. "Habitat in Virginiae aquosis." Type, *Clayton 164*, identified by Dr. B. L. Robinson in Rhodora **10**: 67. 1908, as the species here considered.

Capraria gratioloides L. Syst. ed. X. 1117. 1759. Based upon *Gratiola dubia* L.

Ilysanthes gratioloides (L.) Benth. in DC. Prod. **10**: 419. 1846.

Lindernia gratioloides (L.) Lloyd & Fouc. Fl. Ouest Fr. ed. IV. 246. 1886.

Ilysanthes dubia (L.) Barnhart in Bull. Torr. Club **26**: 376. 1899.

Flowering from early July to October, and soon ripening fruit.

Swamps, in potassic soil, frequent above the Fall-line and in Middle and Cape May Districts of the Coastal Plain. Ranges from New Brunswick and Ontario to Florida and Texas.

1a. **Ilysanthes dubia inundata** Pennell, var. nov.

Plant erect, 1.5–2 dm. tall. Leaves elliptic-oval, obtuse, 1.5–2 cm. long Pedicels in fruit but 3–5 mm. long.

Type, sandy tidal flats of Delaware River above Delair, Camden Co., New Jersey, collected in fruit September 3, 1915, *Pennell 6496;* in herbarium New York Botanical Garden.

Tidal flats of Passaic River, New Jersey, of the Delaware River in New Jersey, Pennsylvania and Delaware. Also seen from along the Potomac River near Alexandria, Virginia.

2. **Ilysanthes inaequalis** (Walt.) Pennell, comb. nov.

Gratiola inaequalis Walt. Fl. Carol. 61. 1788. Probably from lower South Carolina, a district where the plant here considered is frequent. Identified by Michaux, Fl. Bor. Am. **1**: 7. 1803 as questionably his own *Gratiola* *anagallidea*, and by Elliott, Sketch Bot. S. C. & Ga **1**: 16. 1816, identified and carefully described under the name *Lindernia dilatata* Muhl. Both the latter specific names are synonyms of this.

Flowering from late June to late September, and soon ripening fruit.

Swamps, in potassic soil, frequent throughout the Coastal Plain excepting the Pine Barrens, and, occasionally extending somewhat above the Fall-line. Ranges from Massachusetts to Florida and Texas.

9. HEMIANTHUS Nutt. in Journ. Acad. Nat. Sci. Phila. **1**: 119. 1817.

Type species, *H. micranthemoides* Nutt.

1. **Hemianthus micranthus** (Pursh) Pennell, comb. nov.

Herpestis micrantha Pursh, Fl. Am. Sept. **2**: 418. 1814. "On the banks of rivers, at the edge of low water mark: Pennsylvania to Virginia." Described as with five-leaved calyx, but no other plant can possibly be intended.

Hemianthus micranthemoides Nutt. in Journ. Acad. Nat. Sci. Phila. **1**: 119. *pl. 6.* 1817. "Habitat on the gravelly banks of the Delaware, overflowed by the tide, near Kensington [Pennsylvania]." Type seen in the herbarium of the Academy of Natural Sciences.

Micranthemum micranthum (Pursh) Wood, Class-Book 525. 1861.

Micranthemum Nuttallii A. Gray, Man. Bot. N. Un. St. ed. V. 331. 1867. "*Hemianthus micranthemoides* Nutt. . . . Tidal muddy banks of the Delaware River, and southward." Typified by plant of Nuttall.

Micranthemum micranthemoides (Nutt.) Wettst. in Engl. & Prantl, Natür. Pflanzenfam. **4**^{3b}: 77. 1891.

Globifera micranthemoides (Nutt.) Kuntze, Rev. Gen. 461. 1891.

Flowering from early September to October, and soon ripening fruit.

Gravelly or sandy river-shores, between high and low tides, Delaware and Chesapeake drainage. Along the Delaware River in New Jersey, Pennsylvania and Delaware. Also along the Potomac River in Virginia.

10. LINARIA Mill. Gard. Dict. ed. IV. 1754

Type species, *Antirrhinum Linaria* L. of Europe.

Corolla, excluding spur, 15–18 mm. long, yellow; posterior lip arched over anterior; anterior lip forming a conspicuous protruding orange palate; spur tapering from a broad stout base. Capsule 10 mm. long, much exceeding the sepals. Style 8 mm. long. Seeds 1.7 mm. long, flattened and circularly broadly-winged. Stem 3–10 dm. tall, densely leafy; without sterile prostrate branches from the base.
(*Linaria*, sensu strictu.) 1. *L. Linaria.*

Corolla, excluding spur, 7–8 mm. long, blue; posterior lip erect; anterior lip broadly spreading, but not forming a definite raised palate; spur very slender throughout. Capsule 2 mm. long, equaling to slightly exceeding the sepals. Style .8 mm. long. Seeds .3–.4 mm. long, cylindric, prismatic-angled, not winged. Stem very slender, 2–8 dm. tall, less leafy; with sterile prostrate branches from base.
(*Leptoplectron*, sect. nov.) 2. *L. canadensis.*

1. LINARIA LINARIA (L.) Karst.

Linaria pensylvanica Scheele in Flora **26**: 586. 1843. "Aus Pensylvanien." Described as differing from *L. vulgaris* (= *L. Linaria*) by having the raceme axis and pedicels quite smooth instead of glandular-pubescent. *L. Linaria* varies freely between these two states.

Loam or sandy soil, fields and waste ground, common above the Fall-line, less common through the Coastal Plain. Naturalized from Eurasia.

2. LINARIA CANADENSIS (L.) Dum.-Cours.

Antirrhinum canadense L. Sp. Pl. 618. 1753. "Habitat in Virginia, Canada." Specimen in Linnean herbarium credited to Canada should be the type. This is probably a plant collected by Kalm, and as Kalm spent much time near Philadelphia, especially on Raccoon Creek, Gloucester Co., New Jersey, in a district where this plant is very common, his specimen is probably from there. In Kalm's Travels **1**: 358. 1770, this species is mentioned as if common at Raccoon. Moreover it is a plant of rare occurrence and obviously recent introduction in any part of Canada.

Linaria canadensis Dum.-Cours. Bot. Cult. **2**: 96. 1802. "Lieu. Le Canada, la Virginie." Doubtless based upon *Antirrhinum canadense* L.

Flowering from late April to October, and soon ripening fruit.

Open sandy potassic soil, frequently a weed; thoughout the Coastal Plain of Long Island and New Jersey, but likely introduced into the Pine Barrens; above the Fall-line occasionally introduced along railroad-tracks. Ranges from Massachusetts to Florida and Texas.* *Linaria canadensis* occurs occasionally in a pink-flowered form.

* The following plants are to be considered as scarcely established.

CYMBALARIA CYMBALARIA (L.) Wettst., from Eurasia, is occasional along roadsides, and elsewhere near old gardens.

KICKXIA ELATINE (L.) Dumort. and K. SPURIA (L.) Dumort., both from Eurasia, are occasionally seen, mostly on ballast.

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SCROPHULARIACEAE OF THE LOCAL FLORA. III

BY FRANCIS W. PENNELL

11. VERONICASTRUM Heister; Fabr. Enum. meth. pl. Hort. Helmstead. 111. 1759

Type species, *Veronica virginica* L.

1. VERONICASTRUM VIRGINICUM (L.) Farwell.

Veronica virginica L. Sp. Pl. 9. 1753. "Habitat in Virginia." Grown in the Clifford garden.

Veronicastrum album Moench, Meth. 437. 1794. "...... .... *Veronica virginica* L."

Calistachya alba Raf. in Med. Repos. N. Y. II. Hex. **5**: 352. 1808.

Based on *Veronica virginica* L. Type of *Calistachya* Raf., not *Callistachys* Vent., 1804.

Leptandra virginica (L.) Nutt. Gen. N. Am. Pl. **1**: 7. 1818. Type of *Leptandra* Nutt.

Eustachya alba (Raf.) Raf., Cat. 14. 1824. *Eustachya* Raf. in Am. Mo. Mag. 4: 190. 1819, was a new name for *Calistachya* Raf. Preoccupied by *Eustachys* Desv., 1810.

Leptandra alba Raf. Med. Fl. **2**: 21. 1830. "The true *V. virginica* of L. .... The most common species being found all over the United States."

Paederota virginica (L.) Torr., Fl. N. Y. **2**: 44. 1843.

Calistachya virginica (L.) Farwell in Mich. Acad. Sci. Rep. **17**: 176. 1915.

Veronicastrum virginicum (L.) Farwell, Drugg. Circ. **61**: 231. 1917.

Varying, in number of leaves in whorl (five, reducing to four or three), in inflorescence of one or several racemes, and in leaves from lanceolate to nearly ovate, pubescent to nearly or quite glabrous beneath.

Flowering from mid-July to early September, and soon ripening fruit.

Sandy or loam soil, swales and moist meadows, in potassic, magnesian and calcareous soils, frequent above the Fall-line; in western Long Island, and occasional in Middle district of New Jersey. Ranges from Connecticut and Ontario to Mississippi, Minnesota and Texas.

VERONICA L. Sp. Pl. 9. 1753

Type species, *Veronica officinalis* L., of Europe.

Flowers solitary, axillary, frequently approximating so as to form a terminal raceme. Leaves alternate through the inflorescence.

Filaments not exceeding the lobes of the corolla. Bracts leaf-like or slightly reduced. Plants less than 3 dm. tall.

Pedicels longer than the sepals, usually exceeding the bracts. Sepals ovate. Capsule turgid. Seeds few, 1.3–3 mm. long, convex-arched, roughened. Leaves petioled (rarely the uppermost sessile), primarily palmately 5–7 nerved, the midvein usually with some radiating pinnate veins; mainly alternate, the lower sometimes opposite.

Leaves broadly cordate, 3–5 lobed, the lobes rounded. Sepals broadly ovate, conspicuously ciliate. Capsule very turgid, scarcely notched at apex, only slightly 2-lobed. Seeds 2.5–3 mm. long, blackish. 1. *V. hederaefolia.*

Leaves ovate, serrate to dentate. Sepals more shortly ciliate. Capsule slightly flattened, deeply notched at apex, thus strongly two-lobed. Seeds 1.3–1.5 mm. long, brown.

Petals not exceeding the ovate sepals. Capsule-lobes rounded, the most distal point of each about midway between the style and the lateral margin. 2. *V. agrestis.*

Petals exceeding the narrowly ovate sepals. Capsule-lobes acutish, the most distal point of each near the lateral margin. 3. *V. Tournefortii.*

Pedicels shorter than sepals or bracts. Sepals linear to narrowly ovate. Capsules flattened. Seeds many, less than 1 mm. long, flat, smooth or nearly so. Leaves sessile (or the lower petioled), scarcely palmate; alternate only through the inflorescence.

Perennials. Repent, with ascending stems. Leaves oval or ovate, obscurely crenate. Inflorescence spike-like, restricted to the distal portion of the stem. Sepals ovate. Corolla blue or white, with deep-blue lines on posterior side. Capsule retuse or shallowly notched, glandular-pubescent.

Leaves prevailingly oval. Stems distally and pedicels minutely pubescent with appressed hairs. Corolla 2 mm. long, white, with blue lines on posterior side. 4. *V. serpyllifolia.*

Leaves prevailingly ovate. Stems distally and pedicels finely pubescent with mostly spreading hairs. Corolla 3 mm. long, blue on posterior side, anterior lobe nearly white; with deep-blue lines on posterior side. 5. *V. ruderalis.*

Annuals. Erect, much branched below. Most leaf-axils flower-bearing. Sepals lanceolate to linear. Capsule deeply notched.

Lower stem-leaves ovate, crenate-serrate, the lowermost frequently petioled. Corolla deep violet-blue. Capsule pubescent with slightly gland-tipped hairs. Plant pubescent with glandless hairs. 6. *V. arvensis.*

Lower stem-leaves oblanceolate, entire or distally remotely toothed, all sessile. Corolla whitish throughout. Capsule glabrous. Plant glabrous or with short gland-tipped hairs.

Stem glabrous. 7. *V. peregrina.*

Stem pubescent with gland-tipped hairs. — *7a. V. peregrina xalapensis.*

Filaments much exceeding the lobes of the corolla. Bracts linear, abruptly reduced from the lanceolate foliage-leaves. Plants 6–10 dm. tall. Perennial. — *8. V. longifolia.*

Flowers all in axillary small-bracted racemes. Leaves opposite throughout. Perennials.

Stem, pedicels, leaves and sepals pubescent. Capsules pubescent. Leaves oval or ovate, serrate to dentate. Plants of dry soil.

Leaves sessile or nearly so, ovate, dentate, the largest cordate at base. Sepals 4–5 mm. long, linear-lanceolate, exceeding the capsule. Capsule not glandular, its lobes broadly rounded. Ascending or erect.

Stem erect, 3–5 dm. tall. Leaves coarsely dentate. Racemes 30–60 flowered, the pedicels scarcely exceeding the bracts. Largest corolla-lobes ovate, 6 mm. long, violet. — *9. V. Teucrium.*

Stem ascending, 1–3 dm. tall. Leaves crenately dentate. Racemes 10–20 flowered, the pedicels much exceeding their bracts. Largest corolla-lobes nearly orbicular, 3.5–4 mm. long, violet-blue. — *10. V. Chamaedrys.*

Leaves oval, crenate-serrate, narrowed to a petiolar base. Sepals 2–3 mm. long, lanceolate, shorter than the capsule. Capsule glandular, the most distal point being near the lateral margin of each lobe. Extensively repent, at apex ascending. — *11. V. officinalis.*

Stem, pedicels, leaves and cepals glabrous (or in *V. glandifera* slightly pubescent with gland-tipped hairs). Capsules glabrous. Leaves oblong-ovate to linear, obscurely crenate-serrate to entire. Aquatics.

Capsule scarcely or not wider than long, and scarcely or not two-lobed. Sepals equaling the capsule. Leaves oblong-ovate to broadly lanceolate, obscurely crenate-serrate.

Leaves all petioled. Racemes usually 10–25 flowered. Plant emersed. — *12. V. americana.*

Leaves sessile and clasping (or only the upper or lowermost petioled). Racemes usually longer, 25–50 flowered. In deeper water, usually mostly submersed.

Stem distally, rachis and pedicels glabrous. Leaves oblong-ovate, mostly broadest about the middle, the lowest, especially if submersed, narrowing to a petiolar base. Capsule globose-ovoid, not or scarcely emarginate. 13. *V. Brittonii.*

Stem distally, rachis and pedicels sparsely pubescent with glands, borne upon jointed stalks. Leaves lanceolate, broadest near the base, the lowest submersed ones elongated-lanceolate, clasping. Capsule broad-globose, emarginate. 14. *V. glandifera.*

Capsule much wider than long, strongly two-lobed. Sepals shorter than the capsule. Leaves linear or nearly so, remotely setaceous-toothed to entire. 15. *V. scutellata.*

1. VERONICA HEDERAEFOLIA L.

Occasionally introduced into waste ands, mostly near cities. From Eurasia.

2. VERONICA AGRESTIS L.

Occasionally introduced into waste land, mostly near cities. From Eurasia.

3. VERONICA TOURNEFORTII C. C. Gmel.

Veronica precox Raf. Atl. Journ. 79. 1832. "Grown in the [Bartram's Botanic] Garden [near Philadelphia] from seeds received from a place unknown; but has spread all over the garden like a weed, and even is become spontaneous on the banks of the Schuylkill." Not *V. praecox* All., 1789.

Veronica diffusa Raf., New Fl. Am. 4: 38. 1838. "Native of ——— naturalized on the Schuylkill near Philadelphia." Re-naming of *V. precox* Raf.

Occasionally introduced into waste land. From Eurasia.

4. VERONICA SERPYLLIFOLIA L.

Common in moist grassy soil, meadows, fields and lawns. From Eurasia.

5. Veronica ruderalis Vahl, Enum. Pl. 1: 66. 1805. "Habitat in ruderatis versuris et humidis locis frigidis Peruviae." Type not seen nor verified, but specimens from Ecuador and those collected by the writer in Colombia show the identity of this with the plant here considered.

This is the plant identified in the seventh edition of Grays Manual as *Veronica humifusa* Dickson. This species, published in Trans. Linn. Soc. **2**: 288. 1794, and found by James Dickson on "very high mountains of Scotland," was described by him as a plant wholly prostrate, with cordate-subrotund minutely scabrous leaves which often occur in threes or fours, and with a short raceme of a few crowded flowers. Whatever this may be, it surely cannot be our plant.

Veronica ruderalis appears to be the most cosmopolitan species of the genus, and doubtless *V. serpyllifolia* must be considered as a Palaearctic derivative from it. It is a boreal or mountain species through Eurasia and the Americas. One European description which I have had no opportunity to see, that of *Veronica neglecta* F. W. Schmidt, Fl. Boem. **1**: **12**. 1794, may give a name which possibly must supersede ours. This is identified by Koch, Syn. Fl. Germ. & Helv. 529. 1837, as a larger ovate-leaved form of *V. serpyllifolia*. However in the fifth (Hallier's) edition of the Flora von Deutschland of Schlechtendahl and Others, **17**: 150, while this is similarly characterized, the glandular-pubescent plant is distinguished as var. *borealis* Laestad. So it would appear safer to consider *neglecta* as but a robust state of the appressed-pubescent *serpyllifolia*.

I agree with Prof. Fernald, in Rhodora **4**: 194. 1902, that "the evidence at hand indicates that this large-flowered variety is the only indigenous form of *V. serpyllifolia* in Northeastern America." I follow his later judgment as expressed in the Grays New Manual, and in Rhodora **13**: 124. 1911, in according this specific rank. However I see no basis for the decision of the new Gray that *serpyllifolia* is likewise indigenous. Its occurrence in North America is south of the region normally occupied by species common to both this continent and Europe.

Apparently this has been collected in our range by *C. F.*

Austin in Sullivan Co., New York in 1860. It was labeled by him "large form."

6. VERONICA ARVENSIS L.

Common in cultivated soil. From Eurasia.

7. VERONICA PEREGRINA L. Sp. Pl. 14. 1753. "Habitat in Europae hortis, arvisque." Described, as the specific name would suggest, from specimens of an introduced plant.

Certainly American in origin, but it is difficult or impossible to say of what portion of this hemisphere it is indigenous. An abundant weed in moist cultivated soil.

7a. **Veronica peregrina xalapensis** (H. B. K.) Pennell, comb. nov.

Veronica xalapensis H. B. K., Nov. Gen. et Sp. 2: 389. 1817. "Crescit in Regno Mexicano prope Xalapa (alt. 630 hex.), in nemoribus Liquidambaris Styraci-fluae."

Occasional in cultivated soil. In the western half of the continent this glandular-pubescent plant completely replaces true *peregrina*. In the east it is only occasionally seen, and that probably as an introduction. Intergradation to the species seems to be complete.

8. VERONICA LONGIFOLIA L.

Rare in waste land. From Eurasia.

9. VERONICA TEUCRIUM L.

Rare in grass or waste land. From Eurasia.

10. VERONICA CHAMAEDRYS L.

Occasional in grass land. From Eurasia.

11. VERONICA OFFICINALIS L.

Common in pasture fields and waste lands. In colonial times this was grown as a medicinal plant, and very early became established as if native. From Eurasia.

12. VERONICA AMERICANA Schwein.

Veronica Beccabunga americana Raf., Med. Fl. 2: 109. 1830. "It grows from Canada to Virginia and Kentucky, near water, brooks, &c."

Veronica americana Schwein.; Benth. in DC., Prod. 10: 468. 1846. "*Veronica americana* (Schweinitz! mss.)

. . . . In America boreali a Canada et Carolina usque ad flum. Oregon et in ins. Sitcha · · · (v. s.)" Specimen seen in herbarium of the Academy of Natural Sciences of Philadelphia, labeled "Bethl." [Bethlehem, Pennsylvania], collected by Schweinitz, may be of collection seen by Bentham.

Flowering from late May to mid-August, and soon ripening fruit.

Springheads in woodland, and along cool streams, in potassic soil, frequent throughout the area above the Fall-line; in northern and westernmost Long Island. Ranges from Quebec to Alaska, south to South Carolina, New Mexico and California.

13. **Veronica Brittonii** PORTER sp. nov.

Veronica Anagallis latifolia Britton in Bull. Torr. Bot. Club **12**: 49. 1885. "In the latter part of September, 1883, · · · near Mahwah, Bergen Co., New Jersey, I noticed [this] in a small stream which crosses the N. Y. L. E. & W. R. R., half a mile or so north of the station." Type seen in herbarium of Columbia University at the New York Botanical Garden.

Stem 3–9 dm. long, glabrous, succulent, hollow. Leaves oblong-ovate to oval, acute, crenate-serrate to nearly entire, 5–10 cm. long, 3–5 cm. wide, clasping, the lowest narrowed to a petiolar base. On autumnal shoots all the leaves are ovate and definitely petioled. Racemes axillary to the upper leaves, 6–12 cm. long, 40–60 flowered. Bracts narrowly lanceolate, 4–5 mm. long. Pedicels 3.5–4.5 mm. long, glabrous. Sepals 3–3.5 mm. long, lance-ovate, acute. Corolla 4 mm. long, with a few hairs within throat, pale-blue, paler anteriorly, with longitudinal reddish-violet lines. Capsule 3–3.5 mm. long, globose-ovoid, acutish. Seeds .4 mm. long, oval, yellow-brown.

Type, base of Marble Hill, above Phillipsburg, New Jersey, collected in flower and fruit June 24, 1892, *T. C. Porter*; in herbarium Columbia University at the New York Botanical Garden. This specimen shows the summer state. Specimens collected at the same station October 9, 1892, show excellently the autumnal condition.

In the herbarium of Columbia University is a manuscript description by Dr. Thomas C. Porter, the diagnosis of which includes such field knowledge as to make it worth quoting in full: "VERONICA BRITTONII, n. sp.

"(*V. Anagallis* L., var. *latifolia* Britton). Glabrous, perennial, growing in shallow, shaded rivulets. In its summer state (June), the stems are erect, simple or branching, 2 to 3 feet high, round, often half an inch in diameter, succulent, fistular, brittle; the leaves ovate or oblong-ovate, variable in size, 2 to 3 inches in length, more or less clasping at base, the lowest pair sometimes contracted into short petioles; racemes numerous, many-flowered. In its autumn-state (October), the stems are procumbent at base and rooting at the joints, rarely producing racemes of flowers; the leaves large, orbicular, 1½ to 2 inches in diameter, abruptly narrowed into broadly margined petioles, ½ to an inch long, shining, thickish when fresh, with prominent veins beneath, thin when dried, crenulate, those of the slender branches similar but much smaller, petioles of the uppermost very short or wanting. Inflorescence, fruit and seeds scarcely to be distinguished from those of *V. Anagallis* and *V. Beccabunga*; flowers pale blue, the three large lobes marked with reddish stripes; capsules orbiculate, acutish." Then follow citation of specimens from northeastern Pennsylvania and northwestern New Jersey, and considerable interesting comment.

From a series of letters of Dr. Porter to Dr. Britton, the history of the former's interest in this plant may be traced. It commenced with finding on October 1, 1891 at Pot Rock, near Easton, Pennsylvania, a colony of the autumnal petioled-leaved form. On the 5th he wrote of having visited a colony of the plant in "the little run beside the tavern above Pot Rock," a station whence in "in midsummer two or three years ago" he had obtained "a very different form." The plant was abundant, and exactly that of the first discovery. On the 12th, Dr. Porter was "fully convinced that this plant is genuine *V. Beccabunga*, L.," and accordingly sent a note for the *Torrey Bulletin* to urge this opinion. He had even convinced himself of its introduction from the Old World. But for us the most interesting paragraph of this note is that contrasting the autumnal state of this plant with *Veronica americana:*

"*Veronica Americana* Schwein., a nearly allied species, which has likewise petioled leaves, was growing with it in some places, but its procumbent, far less robust stems and its smaller, ovate or lance-ovate, sharply serrated leaves furnished a striking contrast. In seeing them thus together even an unpracticed eye could not have failed to distinguish the one from the other. Intermediate forms were wholly wanting, so that the conjecture that it either must be an abnormal growth of that species, or a new variety is wide of the mark."

Flowering from late May to early October, and soon ripening fruit.

"Shallow shaded rivulets," through Piedmont Region above the Fall-line, western Connecticut to Northeastern Pennsylvania; reported by Porter from Franklin County, Pennsylvania, and seen from Keweenaw County, Michigan, collected July 8, 1915 by *O. A. Farwell 4005*.

CONNECTICUT.* Litchfield: North Canaan, *E. B. Harger 6238* (A).

NEW YORK. Greene: New Baltimore, *N. Taylor 1289* (Y). Queens: Flushing, *J. A. Bisky* (E, Y); Jamaica (Y). Rockland: Spring Valley (Y); Tappan, *W. H. Leggett* (Y).

NEW JERSEY. Bergen: Carlstadt (Y); Carlton Hill, *G. V. Nash 244* (Y); Mahwah (Y). Hunterdon: banks of Delaware River above Stockton, *C. S. Williamson* (A). Passaic: Passaic, *E. W. Berry* (Y). (P) Warren: Flatbrookville, (A); Manunka Chunk, Phillipsburg, *T. C. Porter* (A, Y).

PENNSYLVANIA. Northampton: Pot Rock, etc., near Easton, *T. C. Porter* (A, P, Y); Johnsonville (A); Martins Creek (A); Riverton (A).

14. **Veronica glandifera** Pennell sp. nov.

Flowering stem 3–9 dm. long, glabrous or distally glandular-pubescent. Leaves lanceolate, acuminate, more or less serrate,

* Localities for specimens seen are grouped by counties, and these listed in alphabetic sequence.

Herbaria cited: A. Academy of Natural Sciences, Philadelphia.
E. Brooklyn Botanic Garden, Brooklyn.
P. University of Pennsylvania, Philadelphia.
Y. New York Botanical Garden, New York.

7–10 cm. long, 1.2–2.5 cm. wide, all clasping, the lowest submersed ones elongated. Racemes axillary to the upper leaves, 10–20 cm. long, 30–60 flowered. Bracts narrowly lanceolate, 4–6 mm. long. Pedicels 3–6 mm. long, glandular-pubescent with scattered hairs. Sepals 3–4 mm. long, lanceolate, acute to acuminate. Corolla about 3 mm. long, not seen fresh. Capsule 2.5–3 mm. long, 3–3.5 mm. broad, broad-globose, emarginate. Seeds .4 mm. long, oval, yellow-brown.

Type, vicinity of Suffolk, Nansemond County, Virginia, collected in flower and fruit May 27, 1893. *N. L. Britton and J. K. Small:* in herbarium Columbia University at the New York Botanical Garden.

Flowering from late May to late July, and soon ripening fruit.

Shallow flowing streams, mainly in calcareous soil, through the lower Piedmont from the Delaware valley southwestward.* Ranges from New Jersey to North Carolina, Minnesota and Kentucky.

NEW JERSEY. Warren: Warrenville, *C. S. Williamson* (P).

PENNSYLVANIA. Bucks: Rockhill, *A. MacElwee* (A); Sellersville (A). CHESTER: West Chester, *W. Darlington* (A, Y). Lancaster: Dillerville Swamp, *J. K. Small* (Y). Montgomery: Conshohocken (A); Manayunk, Shannonville *J. Crawford* (A) Philadelphia: East Park (P) *I. C. Martindale* (A). Wayne Junction (A).

15. VERONICA SCUTELLATA L., Sp. Pl. 12. 1753. "Habitat in Europae inundatis."

Flowering from late May to September, and soon ripening fruit.

Swales and along streams, through the area above the Fall-line, becoming common northward. Ranges from Newfoundland to Yukon, south to Virginia, Wyoming and California; also through Eurasia.

* In the herbarium of the Charleston Museum, Charleston, South Carolina, is a sheet of *glandifera* bearing the inscription "Marl indicator!! Va. M. T." Dr. Barnhart identifies this comment as that of Michael Tuomey, a teacher in Virginia, who afterward became State Geologist of South Carolina, My only finding of this plant has been on limestone at Natural Bridge, Virginia, *Pennell 9802*.

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SCROPHULARIACEAE OF THE LOCAL FLORA. IV

BY FRANCIS W. PENNELL

13. AUREOLARIA Raf. New Fl. Amer. 2: 58. 1837

Type species, *A. villosa* Raf.

Annual. Stem, leaves and calyx with stalked or sessile glands. Leaves bipinnatifid, more or less pectinately cut. Calyx-lobes dentate to pectinate. Corolla externally glandular-pubescent, within pubescent over bases of the posterior lobes; more or less marked or tinged with purple-red. Anther-sacs 2.5–4 mm. long. Capsule ellipsoid, 9–12 mm. long, 1/2–2/3 enclosed in the calyx-tube, glandular-puberulent. Seeds .8 mm. long, not winged. Pedicels 10–28 mm. long. (*Panctenis* Raf.)

Stem closely pubescent above, not or scarcely glandular. Leaves puberulent, not or slightly glandular. Capsule narrowly ellipsoid, 9–11 mm. long.

Leaves 3–6 cm. long. Pedicels mostly shorter than to equaling the bracts. Stem (frequently) glandular-hirsute below. 1. *A. pedicularia.*

Leaves 1.5–2.5 cm. long. Pedicels longer than the bracts. Stem not glandular-hirsute below. 1a. *A. pedicularia caesariensis.*

Stem glandular-pubescent above with scattered glands. Leaves glandular-puberulent to pubescent. Capsule ellipsoid, 11–12 mm. long. 1b. *A. pedicularia intercedens.*

Perennials. Not glandular. Leaves entire to pinnately cut, and slightly bipinnatifid, though not pectinate. Corolla externally glabrous, within glabrous or diffused-pubescent; not marked or tinged with red-purple. Anther-sacs 4–6 mm. long. Capsule ovate to globose-ovate in outline, not enclosed within the calyx-tube, not glandular. Seeds 1.5–2.7 mm. long, broadly winged.

Pedicels 1.5–10 (–15) mm. long. (*Euaureolaria.*)

Capsule densely rusty-pubescent. Stem pubescent and leaves downy-pubescent. Pedicels 1.5–3 mm. long. 2. *A. virginica.*

Capsule glabrous. Stem glabrous and leaves glabrous or minutely puberulent on the upper surface. Pedicels 3 mm. long or longer.

Stem slender, not glaucous, rarely purplish. Petioles very short, less than 10 mm. long. Lower leaves lanceolate to ovate-lanceolate, widest below the middle, long-acuminate. Pedicels 3–8 mm. long. Corolla 30–35 mm. long. Seeds 1.5–1.7 mm. long. 3. *A. laevigata.*

Stem relatively stout, glaucous, frequently purple. Petioles mostly over 10 mm. long. Lower leaves ovate-lanceolate to ovate, widest about the middle, not long-acuminate. Pedicels 5–10 (–15) mm. long. Corolla 35–40 mm. long. Seeds 2–2.7 mm. long. 4. *A. flava.*

1. AUREOLARIA PEDICULARIA (L.) Raf.

Gerardia pedicularia L. Sp. Pl. 611. 1753. "Habitat in Virginia, Canada." Type not seen, but description sufficiently distinctive.

Panctenis pedicularia (L.) Raf. New Fl. Amer. **2**: 61. 1837. The specific name spelled by Rafinesque "pedicularis."

Aureolaria pedicularia (L.) Raf. l.c. 61. 1837.

Dasystoma pedicularia (L.) Benth. in DC. Prod. **10**: 521. 1846.

Agalinis pedicularia (L.) Blake in Rhodora **20**: 70. 1918.

Flowering from early August to late September, fruiting from September into November.

Dry oak-woodland, thin soil, sandy or rocky, occasional or local above Fall-line, more frequent southwestward; in the Coastal Plain of Long Island and New Jersey, passing into var. *caesariensis*. Northwestward the species passes into var. *intercedens*. Ranges, southward and westward mainly through its varieties, from western Maine to North Carolina and Minnesota.

1a. AUREOLARIA PEDICULARIA CAESARIENSIS Pennell in Bull. Torrey Club 40: 413. 1913. "Type, Atco, Camden Co., New Jersey, Sept. 7, 1911, *F. W. Pennell 3545* in Herb. University of Pennsylvania."

Sandy open woodland, Coastal Plain of Long Island and New Jersey, mainly in the Pine Barrens, where it replaces the species. Occurs northeastward to southeastern Massachusetts.

1b. **Aureolaria pedicularia intercedens** Pennell, var. nov.

Stem glandular-pubescent above, with spreading or recurved short hairs, scattered among which occur glands which are borne on stalks shorter than or longer than the pubescence. Leaves somewhat puberulent with short-stalked glands. Calyx-lobes 8–13 mm. long. Capsule 11–12 mm. long. Otherwise as in the species.

Type, Mt. Arlington, Morris Co., New Jersey, collected in flower August 26, 1906, *K. K. Mackenzie 2356;* in Herb. Missouri Botanical Garden.

Environment of the species, between which and the densely hirsute western *A. pedicularia ambigens* (Fernald) Farwell it forms a connected series of intergradations. Occasional in northern New Jersey and eastern Pennsylvania, to be expected with the species in our northwestern counties in New York.

2. AUREOLARIA VIRGINICA (L.) Pennell.

Rhinanthus virginicus L. Sp. Pl. 603. 1753. "Habitat in Virginia." As specimen in the Linnean Herbarium bears the handwriting of Linné the younger and so appears to have been a late addition, Gronovius's plant must be taken as the type. This is *Clayton 488*, recently identified by *Dr. S. F. Blake*, in Rhodora 20: 66. 1918, as the plant here considered. Our traditional applications of the names *virginica* and *flava* must be transposed.

Aureolaria villosa Raf. New Fl. Amer. 2: 59. 1837. No type locality given, nor type known to exist. Description sufficiently distinctive.

Dasystoma pubescens Benth. in DC. Prod. 10: 520. 1846. "In Americae sept. civitatibus orientalibus frequens." Type not verified, but description sufficiently distinctive.

Gerardia virginica (L.) Britton in Prelim. Cat. N. J. Pl. 40. 1888.

Dasystoma virginica (L.) Britton in Mem. Torr. Bot. Club **5**: 295. 1894.

Aureolaria virginica (L.) Pennell in Bull. Torr. Bot. Club **40**: 409. 1913.

Agalinis virginica (L.) Blake in Rhodora **20**: 71. 1918.

Flowering from early July to mid-August, fruiting from August to October.

Dry open oak-woods, usually sand or a sandy loam, frequent or common throughout our area, less general within the Pine Barrens. Ranges from New Hampshire to Florida, west to Michigan, Kentucky and Louisiana.

3. AUREOLARIA LAEVIGATA (Raf.) Raf.

Gerardia levigata Raf. Ann. Nat. 13. 1820. "It grows on the knob hills of Kentucky, the Cumberland mountains and the Alleghany." No type known to exist, unless it be a specimen in Herb. New York Botanical Garden, labeled in Rafinesque's handwriting, "Gerardia—n. sp.—Kentucky."

Aureolaria levigata (Raf.) Raf. New Fl. Amer. **2**: 59. 1837.

Dasystoma laevigata (Raf.) Chapm. Fl. S. Un. St. ed. II: 636. 1883.

Agalinis laevigata (Raf.) Blake in Rhodora **20**: 71. 1918.

Oak-woodland, usually rocky, along streams or on mountain-sides along the Susquehanna River in Lancaster Co., Pennsylvania. Ranges through the Appalachians from central Pennsylvania to South Carolina and Tennessee.

4. AUREOLARIA FLAVA (L.) Farwell.

Gerardia flava L. Sp. Pl. 610. 1753. "Habitat in Virginia, Canada." Specimen in Linnean Herbarium identified by Bentham; see in Comp. Bot. Mag. **1**: 198. 1836.

Gerardia glauca Eddy in Med. Repos. N. Y., IInd Hex. **5**: 126. 1807. Plandome, Long Island. *C. W. Eddy.* Type not seen nor known to exist, but description quite distinctive.

Gerardia quercifolia Pursh, Fl. Amer. Sept. 423. 1814. "On the banks of rivers, in rich shady places, Pensylvania to Carolina." Type not seen, but description distinctive.

Aureolaria glauca (Eddy) Raf. New Fl. Amer. **2**: 60. 1837.

Dasystoma quercifolia (Pursh) Benth. in DC. Prod. **10**: 520. 1846.

Dasystoma flava (L.) Wood, Class-Book 529. 1861. As to synonymy, not description, the latter applying to *Aureolaria virginica*.

Agalinis glauca (Eddy) Blake in Rhodora **20**: 71. 1918.

Aureolaria flava (L.) Farwell in Rep. Mich. Acad. Sci. **20**: 188. 1918.

Flowering from late August to late September, fruiting from September to November.

Dry to rather moist oak-woodland, usually on rocky hillsides, loam or sometimes in sandy soil, frequent or locally common through the counties above the Fall-line, especially toward the mountains; on northern Long Island, but rare in southern Long Island and very rare in the Coastal Plain of New Jersey. Including varieties, this species ranges from Maine to Florida, Illinois, Arkansas and Louisiana.

14. Agalinis Raf. New Fl. Amer. 2: 61. 1837

Type species, *A. palustris* Raf.

Corolla with lobes all spreading, pubescent within at base of posterior lobes.
- Seeds dark-brown. Plants tending to blacken in drying. Calyx-tube not evidently reticulate-venose.
  - Pedicels less than 12 mm. long. Inflorescence of normal racemes. Seed-coat with dark-brown ridges, between which are broad areas, paler and minutely reticulate.
    - Leaves and calyx-lobes obtuse to acutish. Anther-sacs obtuse to acutish. Plant fleshy, bushy-branched below, with elongated racemes above. Pedicels 5–12 mm. long. Corolla 12–17 mm. long. — 1. *A. maritima*.
    - Leaves and calyx-lobes acute to acuminate. Anther-sacs mucronate to minutely awned. Plants not fleshy, more uniformly branched. Pedicels rarely over 5 mm. long.

Calyx-lobes 4/5–7/8 the length of the tube, triangular-lanceolate to lanceolate. Corolla 12–20 (–23) mm. long. Stem 1–6 dm. tall. Anther-sacs somewhat pubescent to glabrous. 2. *A. pauperculа.*

Calyx-lobes 1/6–1/2 the length of the tube, triangular-lanceolate to subulate. Corolla 20–38 mm. long. Stem 3–12 dm. tall. Anther-sacs densely lanate.

Stem relatively stiffly branched, sparingly scabrellous. Calyx-lobes triangular-lanceolate to subulate. Corolla 20–38 mm. long. Leaves linear, 1–3 mm. wide. 3. *A. purpurea.*

Stem slender, virgately branched, glabrous. Calyx-lobes triangular-subulate to subulate. Corolla 20–25 mm. long. Leaves narrowly linear to almost filiform, .5–1 mm. wide. 4. *A. virgata.*

Pedicels 15–40 mm. long. Inflorescence a short raceme, one pedicel (by arrested growth of the rhachis) appearing terminal. Seed-coat with dark-brown ridges, between which are narrow scarcely paler areas. Corolla 18–25 mm. long. Leaves narrowly linear to filiform. 5. *A. Holmiana.*

Seeds yellowish-brown. Plants scarcely tending to bla ken in drying. Calyx-tube evidently reticulate-venose. Corolla 13–15 mm. long.

Calyx-tube campanulate, 3 mm. long, firmer in texture, 2/3–3/4 the length of the capsule, its lobes .5–1 mm. long, triangular-acuminate, not or scarcely callose. Seeds .4–.6 mm. long, strongly reticulate. Pedicels mostly 1–2 times the length of the bracts. Stem usually 1–4 dm. tall. 6. *A. acuta.*

Calyx-tube hemispheric, 2.5–3 mm. long, thinner in texture, 3/5–2/3 the length of the capsule, its lobes minute, .05–.2 (–.3) mm. long, strongly callose. Seeds .6–.8 mm. long, obscurely reticulate. Pedicels mostly 2–3 times the length of the bracts. Stem usually 2–5 dm. tall. 7. *A. decemloba.*

Corolla with the posterior lobes ascending-arched over the stamens and style, glabrous within at base of the posterior lobes. Racemes elongated, normal. Pedicels 12–27 mm. long. Seeds dark-brown. 8. *A. tenuifolia.*

1. Agalinis maritima (Raf.) Raf.

Gerardia maritima Raf. in Med. Repos. N. Y., IInd Hex. 5: 361. 1808. "Found in the islands of Egg-Harbour, in New Jersey." No type known to exist, but description quite distinctive. An unpublished plate of Rafinesque's is in the library of the New York Botanical Garden.

Gerardia purpurea crassifolia Pursh, Fl. Amer. Sept. 422. 1814. "In salt marshes, near New York." Type not seen, but description sufficiently distinctive.

Agalinis maritima (Raf.) Raf. New Fl. Amer. **2**: 62. 1837.

Flowering from mid-July to early September, fruiting September to October.

Salt marshes, along the Atlantic coast, Connecticut, New York and New Jersey. If separable from the much larger plant of the Southern and Gulf coast, our species ranges from Virginia northward to Maine, becoming progressively smaller and simpler northward.

2. Agalinis paupercula (A. Gray) Britton.

Gerardia purpurea paupercula A. Gray, Syn. Fl. N. Amer. II. **1**: 293. 1878. "Lower Canada to Saskatchewan and southward from coast of New England to Penn., N. Illinois and Wisconsin." Numerous specimens labeled by Gray seen, but none indicated as typical. In synonymy is mentioned the name *intermedia* Porter in herb., so selecting a type.

Gerardia paupercula (A. Gray) Britton in Mem. Torr. Bot. Club **5**: 295. 1894.

Agalinis paupercula (A. Gray) Britton in Britton & Brown, Ill. Fl. ed. II. **3**: 210. 1913.

Flowering from early August to September, fruiting September to October.

Moist soil, borders of lakes and in bogs, especially where sandy, in the glaciated region; through the area east of the Hudson River, occasional in Connecticut and northward in New York, very rare southward and on Long Island only at Lake Ronkonkoma; near Dingmans Ferry, Sussex Co., New Jersey (*W. M. Van Sickle* (E)), and doubtless occasional elsewhere in the glaciated region west of the Hudson, especially in New York. Ranges through glacial bog country from New Brunswick to Minnesota, but seems to be much more common in northern New England and in Michigan than through the intervening area. Along their lines of contact in southern New England, our area and in northern Indiana and Illinois, this intergrades somewhat with its obvious parent, *A. purpurea.*

3. AGALINIS PURPUREA (L.) Pennell.

Gerardia purpurea L. Sp. Pl. 610. 1753. "Habitat in Virginia, Canada." The Linnean diagnosis includes both long and short-pediceled plants, so could include all pink (="purple") flowered species. The first citation accompanied by a figure, Plukenet's "*Digitalis virginiana rubra, foliis & facie Antirrhini vulgaris,*" evidently the prevalent plant of the Atlantic seaboard now under consideration, is counted as the type.

Gerardia purpurea grandiflora Benth. in Comp. Bot. Mag. **1**: 208. 1836. "Hab. New Jersey." Type, labeled "New Jersey, *Torrey* 1834," seen in Kew Herbarium.

Agalinis palustris Raf. New Fl. Amer. **2**: 62. 1837. "Near marshes . . . . From New England to Carolina." Type not known to exist. Evidently intended for the prevalent plant of the Atlantic seaboard.

Agalinis longifolia Raf. l.c. 62. 1837. "Near streams New Jersey to Virginia." Type not known to exist. A smaller form.

Gerardia purpurea f. albiflora Britton in Bull. Torr. Bot. Club **17**: 125. 1890. New Jersey. An albino state. Plants with pure white corollas are occasional in any species of this genus.

Gerardia purpurea parvula Pennell in Proc. Acad. Nat. Sci. Phila. **62**: 572. 1911. "Serpentine, Wawa, Delaware county, Penna., *F. W. Pennell 2689,* coll. Sept. 25, 1910, in Herb. Acad. Nat. Sci. of Phila." The smaller-flowered depauperate plant characteristic of the Serpentine Barrens.

Agalinis purpurea (L.) Pennell in Bull. Torr. Bot. Club **40**: 126. 1913.

Aureolaria purpurea (L.) Farwell in Rep. Mich. Acad. Sci. **20**: 189. 1918.

Flowering from late August to mid-September, fruiting September to October.

Moist sandy soil, edges of salt-marsh, of lakes, or of rivers, in depressions among sand-dunes, or locally on barren magnesian loam in the Serpentine; abundant through the Coastal Plain of New Jersey and common in southern Long Island, in the Pine-Barrens replaced by *A. virgata;* above the Fall-line occasional near ponds and bogs of northern New Jersey, in the bogs of Lancaster Co., Pennsylvania, and in meadows and on dry grassy upland of the Serpentine Barrens of Delaware and Chester counties, Pennsylvania. Ranges from Massachusetts to Florida, Minnesota and Texas, mainly in the Coastal Plain or at low elevations inland.

4. AGALINIS VIRGATA Raf. New Fl. Amer. **2**: 62. 1837. "Glades of Pine woods in South New Jersey near Mullica Hill, &c." Type not known to exist.

Gerardia racemulosa Pennell in Torreya **11**: 15. 1911. "Type—Parkdale, Camden Co., N. J., *F. W. Pennell 2692* Coll. Sept. 27, 1910, in Herb. Acad. Nat. Sci. of Phila."

Flowering from September to mid-October, fruiting slightly later.

Moist sandy pine-barrens, or occasionally in open sand, in the Pine Barrens of Long Island (Great River, Suffolk Co., *E. P. Bicknell*) and of southern New Jersey. Ranges from Long Island to South Carolina, in the pine barrens of the Coastal Plain. An obvious derivative of *A. purpurea.*

5. AGALINIS HOLMIANA (Greene) Pennell.

Gerardia Holmiana Greene, Pittonia **4**: 52. 1899. "Plentiful in open pine and oak groves along Michigan Avenue south of the Soldiers' Home grounds near Brookland, D. C., collected by Mr. Holm and the writer, 20 Oct., 1898." No specimen of this date seen, but one in the herbarium of the New York Botanical Garden, of Dr. Greene's collecting, from Brookland, D. C., dated Oct. 16, 1898, may stand as the type. I have collected this plant at the type station.

Agalinis Holmiana (Greene) Pennell in Bull. Torr. Bot. Club **40**: 429. 1913.

Flowering early September to mid-October, fruiting slightly later.

Dry sandy pine-land, in the Coastal Plain. Occasional on Long Island, and common through the Pine Barrens of southern New Jersey. Ranges from Long Island to Alabama, through the Coastal Plain.

6. AGALINIS ACUTA Pennell in Bull. Torr. Bot. Club **42**: 338. 1915. "Type: dry sandy downs, Edgartown, Martha's Vineyard, Massachusetts, collected in flower September 12, 1901, *M. L. Fernald 45* in United States National Herbarium."

Flowering from late August to mid-September, fruiting September to October.

Dry sandy soil, sterile sandy loam, local in the Coastal Plain of Long Island, and known inland from Farmington, Hartford Co., Connecticut (*Bissell 14, 48, 439*). Abundant on the Hempstead Plains of Long Island, one of the most distinctive plants of that prairie.

7. AGALINIS DECEMLOBA (Greene) Pennell.

Gerardia decemloba Greene, Pittonia **4**: 51. 1899. "Plant not uncommon about Brookland, D. C., inhabiting grassy knolls and hillsides bordering on pine woods." A specimen in herb. New York Botanical Garden, collected by Dr. E. L. Greene at Brookland, D. C. in Oct., 1898, may stand as the type.

Agalinis decemloba (Greene) Pennell in Bull. Torr. Bot. Club **40**: 434. 1913.

Flowering from early September into October, fruiting late September an October.

Dry soil, sand or clay, in our area only in southern Lancaster Co., Pennsylvania. (New Texas and Wakefield.) Ranges from thence southwestward to northern Alabama, but with a distribution much broken, though, like the last, locally common.

8. AGALINIS TENUIFOLIA (Vahl) Raf.

Gerardia tenuifolia Vahl, Symb. Bot. **3**: 7. 1794. "Habitat in America septentrionali." Type in Herb. Universitetets Botaniske Museum, Copenhagen, Denmark, collected by *Von Rohren*, and said to be probably from Philadelphia, is identified by Dr. C. H. Ostenfeld as identical with my number *2681* from Secane, Delaware Co., Pennsylvania.

Agalinis tenuifolia (Vahl) Raf. New Fl. Amer. **2**: 64. 1837.

Gerardia tenuifolia f. *albiflora* Britton in Bull. Torr. Bot. Club **17**: 125. 1890. "Found by Mr. Leggett at South Amboy, and by Mr. Schuh at Rosemont, [New Jersey]." An albino state.

Aureolaria tenuifolia (Vahl) Farwell in Rep. Mich. Acad. Sci. **20**: 189. 1918.

Aureolaria tenuifolia albiflora (Britton) Farwell, l.c. 190. 1918.

Flowering from late August to early October, fruiting September and October.

Dry loam, or at times sandy soil, usually in open deciduous woodland, common throughout the area above the Fall-line; on northern Long Island; in the Coastal Plain of Long Island and New Jersey occasional, or frequent in heavy soils, not in the Pine Barrens. Ranges from Maine to Georgia, Louisiana, Michigan and Missouri, and in its varieties westward to North Dakota, Colorado and Texas.

15. OTOPHYLLA Benth. in DC. Prod. **10**: 512. 1846

Type species, *Gerardia auriculata* Michx.

(?) *Tomanthera* Raf., New Fl. Amer. **2**: 65. 1837. Type species, *T. lanceolata* Raf.

1. OTOPHYLLA AURICULATA (Michx.) Small.

Gerardia auriculata Michx. Fl. Bor. Amer. **2**: 20. 1803. "In pratis regionis Illinoensis." Type not verified, but description sufficiently distinctive.

Seymeria auriculata (Michx.) Spreng. Syst. **2**: 810. 1825.

(?) *Tomanthera lanceolata* Raf. New Fl. Amer. **2**: 66. 1837. "My specimen of Collins' herbarium was collected by Dr. Cleaver in New Jersey." The description of this is erroneous for our plant in describing the anther-sacs as unequal; actually they are alike in each stamen but those of the posterior stamens are smaller. However I am convinced that ours must be the plant of Rafinesque, and that such an error is due either to a lapse of memory in recording his observation or more likely to confusing in his dried specimen the sacs of two different stamens. This opinion is confirmed by Rafinesque's inclusion in his new genus of Michaux's plant. However for anything less than a certainty and for an untrue name it may be unwise to dispossess Bentham's well-chosen name.

Tomanthera auriculata (Michx.) Raf. l. c. 66. 1837.

Otophylla Michauxii Benth. in DC. Prod. **10**: 512. 1846. New name for *Gerardia auriculata* Michx.

Otophylla auriculata (Michx.) Small, Fl. S.E. Un. St. 1075, 1338. 1903.

Agalinis auriculata (Michx.) Blake in Rhodora **20**: 71. 1918.

Aureolaria auriculata (Michx.) Farwell in Rep. Mich. Acad. Sci. **20**: 189. 1918.

Flowering from late August to mid-September, fruiting September and October.

Old fields and railway banks, occasional in New Jersey and Pennsylvania. Certainly introduced from the prairies of the Mississippi Valley states.

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SCROPHULARIACEAE OF THE LOCAL FLORA. V

BY FRANCIS W. PENNELL

Concluded from November TORREYA

16. BUCHNERA L. Sp. Pl. 630. 1753

Type species, *B. americana* L.

1. BUCHNERA AMERICANA L. l.c. 630. 1753. "Habitat in Virginia, Canada." Based upon Gron., Fl. Virg. 74. 1743, typified by *Clayton 142* from Virginia. Type not verified, but description distinctive.

Flowering in July, fruiting in August and September.

Sandy or sterile loam soil, occasional in the Piedmont Region in the southwestern extremity of our area. Delaware County, Pennsylvania (Williamson School), Lancaster Co. (Pleasant Grove), and in Newcastle Co., Delaware (Centreville). Ranges from Pennsylvania to Florida, southern Ontario, Illinois and Louisiana.

17. SCHWALBEA L. Sp. Pl. 606. 1753

Type species, *S. americana* L.

1. SCHWALBEA AMERICANA L. l.c. 606. 1753. "Habitat in America septentrionali." Linné had in his herbarium no specimen of this, so that his species is based wholly upon Gron., Fl. Virg. 71. 1743, typified by *Clayton 33* from from Virginia. This from the description of the leaves as lanceolate and the plant as quite pubescent would appear to have been the species now considered.

Flowering from mid-June to early July, fruiting in September.

Sandy soil, usually rather damp, in pineland and about edges of salt-marsh, in the Coastal Plain of southern New Jersey and in central Delaware. Ranges from southeastern Massachusetts to Virginia, so is to be expected in eastern Long Island.

18. CASTILLEJA Mutis; L. f. Suppl. 293. 1781

Type species, *C. fissifolia* L. f., of Colombia

1. CASTILLEJA COCCINEA (L.) Spreng.

Bartsia coccinea L. Sp. Pl. 602. 1753. "Habitat in Virginia, Noveboraco . . . Hort. Cliff. 235." From L., Hort. Cliff. 325. 1737, "Crescit in Virginia, unde delatam communicavit DD. Gronovius," and from Gron., Fl. Virg. 69. 1743, "*Clayt.* n. 293." *Clayton 293*, the type, must be certainly the species here considered.

Rhinanthus coccineus (L.) Lam. Encyc. **2**: 60. 1786.

Euchroma coccinea (L.) Nutt. Gen. N. Am. Pl. **2**: 55. 1818. Type of the genus *Euchroma* Nutt.

Castilleja coccinea (L.) Spreng. Syst. **2**: 775. 1825.

Flowering from late April to early June, and soon ripening fruit.

Meadows and moist grassy slopes, loam or sandy loam, through the Piedmont Region, more frequent westward; in the Coastal Plain occasional in the Middle District of southern New Jersey. Ranges from Maine to Manitoba south to South Carolina and Kansas.

19. RHINANTHUS L. Sp. Pl. 603. 1753

Type species, *R. Crista-galli* L., of Europe

1. RHINANTHUS CRISTA-GALLI L.

Flowering in May and early June, fruiting in late June.

Fields and open places near Stratford, Connecticut. Probably introduced from Eurasia, although said to be native northeastward.

20. PEDICULARIS L. Sp. Pl. 607. 1753

Type species, *P. palustris* L., of Europe

Stem 6–8 dm. tall, glabrous. Leaves shallowly lobed, the sinuses narrow, the lobes with minute regular crenations. Bracts auriculate near base. Rachis of inflorescence glabrous. Fused sepals of each side terminating in a slightly enlarged crenate foliar tip, glabrous or with a very few long hairs near base. Corolla with truncate apex of posterior lobes without tooth-like processes. Capsule brown, scarcely exceeding calyx, slenderly beaked. Flowering in late summer. 1. *P. lanceolata.*

Stem 1–3 dm. tall, hirsute, especially above. Leaves deeply lobed, the sinuses broad, the lobes with more prominent irregular crenations. Bracts entire near base. Rachis of inflorescence lanate. Fused sepals of each side broadly acute, entire, pubescent along the veins. Corolla with apex of posterior lobes each with a tooth-like process. Capsule straw-colored, twice as long as the calyx, scarcely beaked. Flowering in spring. 2. *P. canadensis.*

1. PEDICULARIS LANCEOLATA Michx. Fl. Bor. Am. **2**: 18. 1803. "Hab. in regione Illinoensi [*A. Michaux*]." Type not verified, but description distinctive.

Pedicularis auriculata Sm. in Rees Cycl. **26**: 1813. "Sent by the Rev. Dr. Muhlenberg, from the neighborhood of Lancaster in Pennsylvania." Description distinctive.

Pedicularis pallida Banks; Pursh, Fl. Am. Sept. 424. 1814. "In a swamp near Kings-bridge, New York. . . . *Ph.* [= *Pursh*] . . . v.v.; v.s. in Herb. Banks." Description distinctive.

Flowering from late August to late September, fruiting late September and October.

Swales and moist meadows, loam soil, in the Piedmont region, more frequent southwestward; occasional in the Middle District of the Coastal Plain of southern New Jersey, extending nearly to Cape May. Ranges from Massachusetts to Manitoba, North Carolina and Nebraska.

2. PEDICULARIS CANADENSIS L. Mant. 86. 1767. "Habitat in America septentrionali. *Kalm.*" Description distinctive.

Pedicularis gladiata Michx. Fl. Bor. Amer. 2: 18. 1803. "Hab. in Pennsylvania [*A. Michaux*]." Description quite distinctive.

Flowering from late April to late May, fruiting in late May and early June.

Woodland, or on knolls in meadows, loam or sandy loam, common throughout above the Fall-Line; in the Coastal Plain frequent or occasional in Long Island and in the Middle District of southern New Jersey. Ranges from Nova Scotia to Manitoba, south to Florida and Texas.

21. MELAMPYRUM L., Sp. Pl. 605. 1753

Type species, *M. cristatum* L. of Europe

Main stem-leaves linear or lanceolate-linear. Bracts conspicuously fimbriate near base, with teeth frequently as long as the width of the blade. Capsules mostly 6–7 mm. long, curved and usually attenuate-beaked. Seeds 2–2.5 mm. long, brown to blackish.	1. *M. lineare.*
Main stem-leaves linear-lanceolate to nearly ovate. Bracts slightly or not fimbriate near base, the teeth shorter than the width of the blade. Capsules frequently larger, reaching 8–9 mm. long, slightly or not curved and less or not attenuate-beaked. Seeds often larger, reaching 3 mm. long, usually black.	1a. *M. lineare latifolium.*

1. MELAMPYRUM LINEARE Desr.; Lam. Encyc. 4: 22. 1796. "Rapportée de la Caroline par M. Fraser . . . (v.s.)" Description made from a very small and young plant, but certainly of the form here considered. Characterization of calyx as 5-toothed surely erroneous.

Flowering from mid-June to September, and soon ripening fruit.

Sandy soil, pineland and in open deciduous woodland, common throughout the Coastal Plain; inland occasional and mostly transitional to var. *latifolium*. Ranges from Massachusetts to North Carolina, and, including varieties, inland northward across the continent.

1a. MELAMPYRUM LINEARE LATIFOLIUM (Muhl.) Beauverd

Melampyrum americanum Michx. Fl. Bor. Amer. 2: 16. 1803. "Hab. a sinu Hudsonis ad montosam Carolinam. [*A. Michaux*]." Description evidently of the prevalent inland broader-leaved plant.

Melampyrum latifolium Muhl. [Cat. 57. 1813. *nomen nudum*]; Eaton, Man. Bot. N. & M. St. ed. II 316. 1818. From Muhlenberg's Catalog, the type station is in Delaware. Type not seen, but evidently is of the inland broader-leaved plant.

Melampyrum americanum latifolium (Muhl.) Eaton, l.c. ed. III. 350. 1822.

Melampyrum pratense americanum (Michx.) Benth. in DC. Prod. 10: 584. 1846.

Melampyrum lineare latifolium (Muhl.) Beauverd in Mem. Soc. Phys. Genève **38**: 474. 1916.

Melampyrum lineare americanum (Michx.) Beauverd, l.c. 476. 1916. Beauverd distinguishes *latifolium* with bracts broader, the lower entire, the upper entire or few-toothed, and the first flower placed at the third or fourth node, from *americanum* with bracts narrower, the lower entire or slightly toothed, the upper always toothed, and the first flower in the axil of the fourth to eighth node. His *americanum* is transitional from *latifolium* to *lineare* itself, from which he distinguishes both these varieties as having corolla whitish, tinged with purple, instead of pale-yellow, tinged with purple. The corolla of the species, as well of var. *latifolium* as I understand it, has the corolla white, posteriorly more or less tinged with red, especially in age, and only the palate yellow. His color distinction cannot be maintained, and I should consider the broadest, most entire-leaved plants as an extreme of this variety.

Flowering from late May to mid-August, and soon ripening fruit.

Dry open woods, in potassic soil, sandy or sterile, locally common on sandstone or shale ridges, etc., throughout the area above the Fall-line; in the Coastal Plain occasional on Long Island and in the Middle District of southern New Jersey. Intergrading to the species.

Local Specimens of the Author's Collecting

As my own collections illustrating our local species of Scrophulariaceae in part have already been, and in part are soon to be, distributed to various herbaria, it may be well here to present a summary of the numbers of these. The specimen numbers will be grouped by species and states. All are from the local flora as defined in the introduction to these studies.

Agalinis acuta (N. Y.) 5292, 6551, 6552, 9340, 10126.

Agalinis Holmiana (N. Y.) 10167. (N. J.) 1662, 2695, 3544, 3583, 3628, 6483, 9117.

Agalinis maritima (N. Y.) 9359. (N. J.) 1807, 2157.

Agalinis purpurea (N. Y.) 5291, 6549, 6647, 9366, 10146. (N. J.) 2602, 2603, 2604, 4004, 6492, 6524, 6637, 9294. (Pa.) 476, 750, 786, 838, 847, 1660, 2682, 2689, 3598, 3609, 5182, 5272, 8984.

Agalinis tenuifolia (Conn.) 8578. (N. Y.) 6651, 6698, 9226. (N. J.) 1664, 6534, 9870. (Pa.) 658, 837, 1642, 2681, 2688, 2690, 3543, 5289, 8906.

Agalinis virgata (N. J.) 2692, 2694, 3584, 3626, 3808, 6521, 6523, 9114.

Aureolaria flava (N. Y.) 5293, 8434, 9407. (N. J.) 8358. (Pa.) 3541, 3624, 5225, 5260, 5284, 5286, 6791.

Aureolaria pedicularia (N. Y.) 9225, 10171. (N. J.) 10040. (Pa.) 583, 991, 1948, 3542, 3559, 3585, 3589, 3625, 5192, 5226, 5261, 5262, 5265, 5288, 8831, 8860. (Del.) 1519. (Md.) 1619.

Aureolaria pedicularia caesariensis (N. J.) 1837, 3545, 3627, 6487, 9155.

Aureolaria pedicularia intercedens (Pa.) 676, 4982.

Aureolaria virginica (N. Y.) 5294, 6868, 8459. (N. J.) 3546, 3986, 6489, 7363, 7428, 8345, 9208. (Pa.) 337, 4985, 5021, 5067, 5227, 5259, 5283, 6503, 6793, 7850, 7912, 8847, 9412. (Del.) 7754. (Md.) 1615.

Castilleja coccinea (Pa.) 1290, 2034, 2772.

Chelone glabra (N. Y.) 6643, 6678, 6745, 6833, 6898, 8604, 9239, 9308, 9397, 9400. (N. J.) 6485, 6525, 6543, 9223, 9224. (Pa.) 6794.

Chelone glabra f. *tomentosa* (Pa.) 901, 6480, 8827, 8861, 8912.

Gratiola aurea (N. J.) 6500, 6527, 9929.

Gratiola aurea obtusa (N. J.) 9897.

Gratiola neglecta (Conn.) 8579. (N. Y.) 9930. (N. J.) 7367, 9445. (Pa.) 1495, 2822, 5013, 6477, 6994, 7256, 7861.

Gratiola pilosa (N. J.) 6486, 6491.

Gratiola virginiana (N. J.) 6495.

Hemianthus micranthus (N. J.) 6497.

Ilysanthes dubia (N. Y.) 6704 p.p., 8429. (N.J.) 6493. (Pa.) 6467, 6474 p.p., 8014, 8837.

Ilysanthes dubia inundata (N. J.) 6496.

Ilysanthes inaequalis (N. Y.) 6704 p.p. (N. J.) 3987, 6494, 6636. (Pa.) 6474 p.p.

Limosella subulata (N. J.) 6635.

Linaria canadensis (N. Y.) 7747, 10143. (N. J.) 6488, 6520, 6971, 6972, 8182, 9438, 10012, 10021, 10077. (Md.) 8882.

Linaria Linaria (N. Y.) 6699, 7014, 7679, 8710. (N. J.) 6526, 6548, 7408. (Pa.) 7303, 7968. (Md.) 8881.

Melampyrum lineare (N. J.) 3572, 3818, 3836, 6499, 6522, 6587, 8167, 9050. (Pa.) 1883, 6481.

Melampyrum lineare latifolium (N. Y.) 6795, 6798, 8440. (N. J.) 7429, 9219, 9460, 10010, 10054, 10118. (Pa.) 1561, 6501, 6795, 7880, 7956, 8852.

Mimulus alatus (N. Y.) 7683, 8209.

Mimulus ringens (N. Y.) 6550, 6642, 6683, 7636, 8687, 9190, 9305. (N. J.) 6537. (Pa.) 6472, 6476, 6502, 7857, 7889, 8028, 8842, 8958.

Otophylla auriculata (Pa.) 5229, 5230, 5285, 5290.

Pedicularis canadensis (N. Y.) 2386, 6761, 6823, 6905, 7153, 8433, 9951, 9968, 10141. (N. J.) 6974, 9995. (Pa.) 2612, 6792, 8753.

Pedicularis lanceolata (Pa.) 1839, 6469.

Penstemon Digitalis (N. Y.) 9423. (Pa.) 6471.

Penstemon hirsutus (N. J.) 7409. (Pa.) 3645, 6716, 7006.

Penstemon pallidus (N. Y.) 7130.

Schwalbea americana (N. J.) 9028, 10086.

Scrophularia leporella (N. Y.) 6790, 6888, 6910, 7732, 8323. (N.J.) 10098. (Pa.) 4993.

Scrophularia marilandica (N. Y.) 8220. (N. J.) 9904. (Pa.) 6468, 6504, 8108.

Verbascum Blattaria (N. J.) 7053. (Pa.) 6475, 7971.

Verbascum Lychnitis (Pa.) 6478.

Verbascum Thapsus (N. Y.) 6684, 8324, 8496. (Pa.) 6479, 7970.

Veronica americana (N. Y.) 6824, 6887, 7186, 7740. (N. J.) 6533, 9437. (Pa.) 5069, 7238.

Veronica arvensis (N. Y.) 6787, 6867. (N. J.) 7062, 9993. (Pa.) 6719, 6999, 7254.

Veronica Brittonii (N. J.) 10100.

Veronica Chamaedrys (N. Y.) 6768.

Veronica officinalis (N. Y.) 6880, 7023, 7118, 7623, 8423. (N. J.) 6528, 7414. (Pa.) 6718, 7965.

Veronica peregrina (Pa.) 6995.

Veronica scutellata (N. Y.) 6641.

Veronica serpyllifolia (N. Y.) 6788, 6830, 6911.

Veronica Tournefortii (Pa.) 6466.

Veronicastrum virginicum (N. Y.) 7731, 8697, 9851. (N. J.) 6529, 10104. (Pa.) 373, 4980, 4981, 6470, 7778, 8003, 8082, 9000, 9016.

Additions and Corrections

Page 111, line 19.—Delete word "persistent." The tubercle-like base of the style lasts but a short time after anthesis, not until the fruit is mature.

Page 111, last line.—VI. Veroniceae, not "Digitaleae."

Page 112, line 9.—Add word "usually" before "parasitic."

Page 112, line 19.—Add word "one" so as to read "Two stigmatic lines, one down each side of style-apex."

Page 112, line 22.—Add to characterization of genera contrasted with *Buchnera*, "Calyx not bracted at base."

Page 113, line 12.—Add to characterization of *Buchnera*, "Calyx bibracteolate at base."

Page 113, line 19.—Add to characterization of *Schwalbea:* "Calyx bibracteolate at base."

Page 113, line 22.—Add to characterization of genera contrasted with *Schwalbea*, "Calyx not bracted at base."

Page 114, line 10.—Add phrase "to four" so expression reads "Seeds maturing two to four to a capsule."

Page 152, line 13.—Add "*Linaria canadensis* occurs occasionally in a pink-flowered form."

Page 168.—13. *Veronica Brittonii* Porter and Page 170.—14. *Veronica glandifera* Pennell. It should have been stated that both these newly described species are segregates from the complex known as *Veronica* Anagallis-aquatica L. This name belongs to some one of several Palaeartic species, all of which differ from our plants.

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 213

TAXONOMIC STUDIES IN VERNONIA AND RELATED GENERA

HENRY ALLAN GLEASON

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Taxonomic studies in Vernonia and related genera

HENRY ALLAN GLEASON

In preparing the manuscript for the tribe Vernonieae, to be published in the North American Flora, several new species and varieties were recognized and a few nomenclatorial changes became necessary. One of the latter involves the erection of a new genus. Since the form of the North American Flora demands relatively concise descriptions and permits no critical discussion, the present paper is issued in advance.

A variety, in the opinion of the writer, represents a group which is not worthy of specific rank, yet demands recognition in the intensive study of a species. In general, varieties are not admitted into the North American Flora. Specific descriptions are drawn broadly enough to include all the varieties, while the varietal names are cited among the synonyms. The same treatment will be used for the varieties published here.

Although this paper and the manuscript for the North American Flora have been prepared at the New York Botanical Garden and are based primarily on the collections there, the writer has been greatly assisted by material from many American herbaria and takes this opportunity of expressing his thanks: to Mr. C. C. Deam and Mr. J. Lunell for material from their private herbaria; to those in authority at the University of California, the Field Columbian Museum, the University of Illinois, the Iowa Agricultural College, the University of Kentucky, the University of

Minnesota, the Ohio State University, and the University of Wisconsin for the loan of material; to the directors or curators of the Brooklyn Botanic Garden, the Gray Herbarium, the National Herbarium, the New England Botanical Club, and the Philadelphia Academy of Sciences for the facilities of their herbaria and libraries; to Dr. B. L. Robinson, Dr. J. M. Greenman, Mr. W. R. Maxon, and Mr. E. E. Watson for information, assistance, and criticism; and especially to the University of Michigan, where part of the work was done.

VERNONIA BORINQUENSIS Urban

In describing the species, Urban took as the type a form with hirsute achenes, resinous-dotted leaves, and short straight appressed hairs on the lower leaf surface. This is the commonest form in American herbaria. Urban's variety *Stahlii* covers a much rarer form with glabrous achenes and without resinous dots on the leaves. Two other forms also occur, which are deserving of varietal names.

Vernonia borinquensis resinosa var. nov.

Achenes glabrous; leaves conspicuously dotted with glands and resin on the lower surface: otherwise like the typical form of the species.

TYPE: *ex herb. E. W. D. Holway*, collected at Cayey, Porto Rico, January, 1911, and deposited in the herbarium of the New York Botanical Garden.

Vernonia borinquensis hirsuta var. nov.

Achenes hirsute; leaves densely sericeous-hirsute beneath with bent or curved hairs 2–4 mm. long, nearly or completely concealing the resinous dots; otherwise like the typical form of the species.

TYPE: *Britton, Stevens, & Hess 2471*, collected in a wooded valley, Rio de Maricao, Porto Rico, at an altitude of 500–600 meters, April 2, 1913, and deposited in the herbarium of the New York Botanical Garden. Field notes indicate that it is a vine, two meters long.

The species and its three varieties may be distinguished as follows:

Achenes hirsute; leaves with resinous dots or glandular pits on the lower surface.	
Pubescence of short, straight, appressed hairs seldom exceeding 0.5 mm. in length.	*V. borinquensis.*
Pubescence on the lower leaf-surface of bent or curved hairs 2–4 mm. long.	*V. borinquensis hirsuta.*
Achenes glabrous.	
Glands on the lower leaf-surface present.	*V. borinquensis resinosa.*
Glands on the lower leaf-surface none.	*V. borinquensis Stahlii*

VERNONIA SERICEA L. C. Rich.

Vernonia phyllostachya (Cass.) Gleason.

We are indebted to Ekman for the application of the correct name to this well-known species. Specimens in American herbaria show a great variation in the size, proportion, and density of pubescence of the leaves, without offering legitimate opportunity for the separation of varieties.

VERNONIA GNAPHALIIFOLIA Rich.

Until the last decade this species was poorly represented in American herbaria. The collections of the New York Botanical Garden now include an ample series of specimens, sufficient to give some idea of the range of variation within the species. On casual inspection, the specimens fall into two groups, characterized by wide and narrow leaves. The latter come from the provinces of Santa Clara, Camaguey, and Oriente, that is, from eastern Cuba; while the former are from Santa Clara, Havana, and Matanzas. The wide-leaved forms have leaves from 9 × 19 mm. to 21 × 51 mm., and the ratio of length to width varies from 2.1 to 3.4. The leaves of the narrow-leaved specimens range in size from 4 × 23 mm. to 14 × 61 mm., and their ratio from 3.2 to 5.7. They make accordingly a continuous series. In all cases the leaves are somewhat revolute and densely sericeous beneath. All specimens agree in the characters of inflorescence and flower-structure except one, *Shafer 2958*, from Holguin, Oriente, which lacks the resinous dots on the principal involucral scales.

Another specimen differs so much from the specific type that it may be described as a new variety.

Vernonia gnaphaliifolia platyphylla var. nov.

Leaf-blades broadly elliptic-ovate, less than twice as long as wide, flat, not revolute at the margin, closely and finely gray-tomentose beneath; otherwise resembling the typical form of the species.

TYPE: *Britton, Cowell, and Shafer 12,933*, collected at Ensenada de Mora, Oriente, March 26–29, 1912, and deposited in the herbarium of the New York Botanical Garden. It is described as a shrub, one meter high, and is the only broad-leaved representative of the species so far known from eastern Cuba. It is also the only specimen examined within the species without the revolute leaf-margin and with distinctly tomentose pubescence.

VERNONIA ICOSANTHA DC.

Ekman has pointed out the peculiar nomenclatorial confusion attached to this well-known species of the Lesser Antilles, and has chosen to apply to it the name *Vernonia arborescens* (L.) Sw. In describing *Conyza arborescens*, Linnaeus had before him not only the plate of Plumier, portraying the *Vernonia* of the Lesser Antilles, but also an actual specimen of a different species from Jamaica. A comparison of his text with the plate shows that the description could not have been taken from the plate alone, but was based primarily on the specimen. The latter accordingly becomes the type of the species and retains the specific name *arborescens*, and *V. icosantha* remains the first valid name for the species of Martinique and Guadeloupe.

Vernonia Shaferi sp. nov.

Stem shrubby, 1–2 m. high, the young branches closely cinereous-pubescent, becoming glabrate the second year; leaf-blades ovate-lanceolate or elliptic, the largest 4 × 12 cm., the upper much smaller, all acuminate, entire, acute at the base, dark green, minutely papillose-pubescent, and very sparsely resinous-dotted above, paler green but otherwise the same below; heads about eighteen-flowered, crowded in leafy secund cymes at the ends of the branches of the season; bracteal leaves oblong or oblong-ovate, acute, 5–10 mm. long; involucres broadly turbinate to campanulate, 6 mm. high, the scales rather closely imbricate, erect or appressed, narrowly oblong-lanceolate, acuminate, irregularly pubescent and ciliate, and usually resinous toward the tip; achenes hirsute; pappus white, its bristles 6.5–7 mm. long, the paleae very irregular in length, as much as 1.5–2 mm. long, minutely erect-ciliate; flowers white or pink.

TYPE: *Shafer 172*, collected in Montserrat, January 23, 1907, and deposited in the herbarium of the New York Botanical Garden. The same herbarium also contains sheets of three other collections made on the same expedition, *Shafer 589, 659*, and *661*.

This handsome species is obviously closely related to *V. longifolia* Pers., as shown by the shape and pubescence of the leaves, the inflorescence, and the character of the involucral scales. It is distinguished from that species at sight by the white pappus, as well as by the slightly larger heads, the much larger pappus-bristles, which are only 4–5 mm. long in *V. longifolia*, and the unusually long, barely ciliate paleae. It is a pleasure to name the species in honor of its first collector, the late John A. Shafer, who discovered several other interesting *Vernoniae* in the West Indies.

VERNONIA RACEMOSA Delp.

Vernonia racemosa Delp. Mem. Accad. Torino II. 14: 396. 1854.

Vernonia araripensis Gleason (in part), Bull. N. Y. Bot. Gard. 4: 181. 1906, not Gardn.

Vernonia sericea L. C. Rich. subsp. *racemosa* Ekman, Ark. Bot. 13^{15}: 85. 1914.

The two sheets in the herbarium of the New York Botanical Garden, which were referred by Ekman to *V. racemosa* as a subspecies of *V. sericea*, differ in certain features from *V. sericea*, with which they are not associated geographically, and agree better in general character with the linear-leaved species of Hispaniola and adjacent Cuba. The species-group *Arborescentes*, which includes *V. sericea*, has leaves of a broad type, not revolute, and comparatively few spreading cymes near the ends of the branches, producing a rather short and broad inflorescence. *V. racemosa* and its allied species have revolute, linear leaves and narrow, elongate inflorescences, composed of relatively short and few-headed cymes distributed over a considerable length of the axis. While this latter character is largely one of habit, the narrow revolute leaves afford a ready and accurate means of distinguishing it and its allies from the *Arborescentes*.

VERNONIA RIGIDA Sw.

Collected originally by Swartz in Jamaica in the middle of the eighteenth century, this excellent species has since been practically lost. Few botanists have examined Swartz's originals and as a result the name *V. rigida* has been applied by various collectors and students to several entirely different species. The genuine *V. rigida* was finally rediscovered by Wm. Harris at Upper Clarendon, Jamaica, December 27, 1917, and good specimens are now deposited in the herbaria of the Field Columbian Museum and the New York Botanical Garden. The species is obviously allied with the well-known Jamaican *V. acuminata* Less.

Vernonia Sagraeana angusticeps (Ekman) var. nov.

Vernonia angusticeps Ekman, Ark. Bot. **13**[15]: 14. 1914.

The sheet of *Wright 284*, on which the species of Ekman was based, in the Gray Herbarium agrees with the species in every particular except the small number (twelve) of flowers in the head and the consequently more nearly cylindrical involucre.

SPECIES-GROUP BUXIFOLIAE

In the mountains of Haiti and Santo Domingo occurs a group of three poorly known species of *Vernonia.* Only eight specimens have been examined in American herbaria by the writer, while Ekman mentions twelve in various European collections. One of these, the last to be described, is *V. Tuerckheimii* Urban, which seems to a well-marked and easily recognized species. Another is a form with small leaves, averaging only 7 × 12 mm., and a short, cylindrical or ellipsoid involucre 3–4 mm. in diameter, or spreading under pressure to 5 mm. For convenience this will be designated here as species A. The third, here referred to as species B, has leaves averaging 10 × 23 mm., and a turbinate or almost salviform involucre, spreading at its mouth to a width of 7–9 mm. even when not pressed. While the involucre of species A offers no noteworthy feature, that of species B is remarkable for its imbrication. It is composed of five vertical but gently spiral rows of scales, with ten to thirteen scales in each row, beautifully imbricated, and with the outer ones gradually reduced at the acuminate base of the head. Ekman had before him apparently only species A; at least he cites two collections which cover that species in the New York collection and fails to mention the peculiar involucre of species B, which is utterly unlike that of any other North American species. This species A is designated by him *V. buxifolia* (Cass.) Less., although he has not seen Cassini's type, and as a synonym he adds *V. domingensis* (Spreng.) DC., the type of which he has seen. These two names have been regarded as synonymous for over eighty years. The writer, in 1906, considered that species B was the true *V. buxifolia*, and described species A as new under the name *V. montana*. From this description and the cited specimen Ekman recognized that *V. montana* was co-specific with the plants which he had examined, and reduced *V. montana* to synonymy. At the same time he was unable to match Gleason's description of *V. buxifolia* (species B) with anything he had seen in European collections and decided that it was probably a new species. When he examined the New York material of these in 1914 he annotated the sheets of species A as genuine *V. buxifolia* and those of species B as "*V. buxifolia* forma."

Cassini described the involucre of *Lepidaploa buxifolia* as turbinate and regularly imbricated, with an assemblage of short rounded scales covering the summit of the peduncle at the base of the head. In this feature it can agree only with species B. De Candolle, in examining the type of Sprengel's *Proustia domingensis*, used terms which certainly apply to species B, but which do not emphasize the peculiar involucre. One can scarcely imagine that he would have passed by such a striking feature if the specimen had exhibited it. The writer is therefore convinced of the justice of maintaining *V. buxifolia* for species B, as he did in his revision in 1906. For species A, he must be guided by the negative evidence of De Candolle and the positive statement of Ekman in regard to *V. domingensis*, use that name for species A, and relegate his own *V. montana* to synonymy.

Vernonia morelana sp. nov.

A shrub 3–5 m. high, branching above; stems striate, closely gray-tomentose, becoming glabrate with age; leaf-blade firm, dull-green, ovate-oblong, 3 × 7.5 cm., on tomentose petioles 8mm.

long, entire or with a few low teeth, obtuse or rounded at the base and apex, closely scabrous-pubescent above, finely gray-tomentose beneath; upper and rameal leaves similar but smaller and more densely tomentose, those in the cymes broadly ovate to subrotund, 5–15 mm. long; cymes freely branching, forming a hemispheric cluster 2 dm. wide at the end of the branches; heads 21-flowered; involucre campanulate, 4–4.5 mm. high, its scales regularly imbricate, all appressed or barely spreading at the tip, outer and middle scales ovate to ovate-oblong, sharply acute or cuspidate, tomentose-ciliate and often puberulent on the back, inner scales lanceolate, sharply acute or subacuminate, 4 mm. long, nearly or quite glabrous; achenes thinly pubescent and densely resinous-glandular; pappus white or very pale tawny, the bristles 6 mm. long, the paleae narrow, 0.6–0.8 mm. long.

TYPE: *Pringle 7697*, collected by streams, Cuernavaca, Morelos, Mexico, altitude 5,000 feet, March 16, 1899, and deposited in the herbarium of the New York Botanical Garden.

While this species clearly resembles the other members of the species-group *Deppeanae* in leaf-habit, inflorescence, and pubescence, it is distinct in its glandular achene, a structure not observed elsewhere in the group. It resembles *V. canescens* H.B.K. in its white pappus, but differs in its pubescence and broader involucral scales. It approaches *V. Deppeana* Less. in its leaf-pubescence, but differs in its white pappus, sharper scales, larger involucre, and broader paleae. It is even more widely separated from the other species of the group.

Vernonia salamana sp. nov.

A shrub, 2–2.5 m. high, branching above; stem striate, thinly cinereous-pubescent or becoming glabrate; leaves thin but firm, pale olivaceous, the blades ovate-elliptic, 3 × 7 cm., undulate, entire or remotely denticulate with low teeth, obtuse or subacute, obtuse or rounded at base, distinctly pubescent or subtomentose above, finely pubescent beneath, especially on the prominent reticulated veins; petioles 4–8 mm. long, or the upper leaves nearly sessile; inflorescence of freely branched cymes, terminating the stem and the upper axillary branches and forming a large pyramidal panicle 2.5 dm. in diameter; rameal leaves similar to the cauline but smaller; cyme-branches leafless, straight, bearing three to six sessile, secund, 21-flowered heads; involucre broadly campanulate, 4–5 mm. high, its scales loosely but regularly imbricate, pale green with a darker spot near the tip, ciliate, puberulent on the back, obtuse to broadly rounded at the tip, the midvein becoming prominent near the apex and usually prolonged into a minute mucro; achene minutely pubescent on the ridges; pappus pale tawny, its bristles 4 mm. long, the paleae narrowly linear, about 0.4 mm. long.

TYPE: *Maxon & Hay 3385*, collected on dry plains near Salamá, Guatemala, January 22, 1905, and deposited in the herbarium of the New York Botanical Garden.

Vernonia salamana apparently finds its nearest relative in the well-known *V. patens* H.B.K., with which it agrees in its achenes, pappus, involucral scales, olivaceous leaves, and the finely pubescent lower leaf-surface. The shape of the leaf-blade is unlike that of *V. patens* and is closer to that of *V. Deppeana* Less. The pubescence on the upper side of the leaf and the prominent venation are distinctive.

VERNONIA MOLLIS H.B.K.

A plant collected by the Brothers Seler, number *3371*, has been identified by Hieronymus as *V. mollis* H.B.K. and distributed to American herbaria under that name. Ekman has considered the specimen as *V. canescens* H.B.K., to which it is obviously closely related, but from which it differs in the flat leaves and the tomentose lower leaf-surface, in its involucral scales, which are all subulate, and in its general habit. At the same time, it is doubtful if it is the true *V. mollis*. This is a Colombian species, described as having leaves sericeo-lanuginous beneath. This character is met with in certain Colombian specimens in the New York collections.

Vernonia ctenophora sp. nov.

Stem herbaceous, at least 4 dm. high, finely striate, thinly pubescent and resinous-dotted; leaves sessile or with petioles 2–4 mm. long; leaf-blades thin, ovate-lanceolate, entire, acuminate, obtuse or rounded at the base, as much as 5 cm. long by 2 cm. wide or the upper somewhat smaller, thinly puberulent and conspicuously glandular-dotted above, closely and finely gray-pubescent and resinous on the surface beneath and sparsely pubescent on the midrib and the obscure lateral veins; inflorescence of two or three elongated, erect, terminal or subterminal cymes; bracteal leaves resembling the cauline and progressively smaller, the upper only 15–20 mm. long; heads 20–35 mm. apart, sessile, 18–21-flowered; involucre campanulate, 6–7 mm. high, its scales irregularly but rather closely imbricate, the outer and middle with triangular-ovate or oblong appressed bases and long subulate tips, the inner linear-oblong, rather abruptly acuminate and most of them subulate-tipped, and all thinly pubescent with dark-colored hairs and sparsely resinous; achenes thinly pubescent, sharply ribbed, 1.5 mm. long; pappus white, its bristles 4 mm. long, prominently barbellate, the paleae little wider than the bristles, 0.6 mm. long, sharply ciliate with salient teeth.

TYPE: *E. A. Goldman 508*, collected at Apazota, Campeche, Mexico, December 30, 1900, and deposited in the United States National Herbarium as sheet 396871.

Vernonia ctenophora is a member of the species-group *Argyropappae*, as indicated by the resinous-dotted leaves and the long subulate involucral scales. Within the group it is most closely related to *V. hirsutivena* Gleason, from which it is distinguished by the conspicuously barbellate pappus bristles, the sharply ciliate and shorter paleae, the thinly pubescent involucre and achenes, the comparatively thin pubescence on the veins, and the numerous resin-dots on the upper surface of the leaf.

VERNONIA MISSURICA Raf.

Vernonia illinoensis Gleason, Bull. N. Y. Bot. Gard. **4**: 211. 1906.

Throughout its wide range, which is more extensive and covers more diverse environmental conditions than that of any other species in the United States, *V. missurica* exhibits a considerable variation in structure. This variation pertains chiefly to the inflorescence and leaf-pubescence and less to the characters of involucre and achene.

Judged from herbarium evidence and field experience, the species is best developed in Indiana, Illinois, and northern Missouri, where it is by all odds the most common species of the genus. Here the inflorescence is broad, freely branched, with many heads, and relatively flat, and the leaves are thinly but closely tomentose beneath with cinereous multilocular hairs which cover the surface and veins alike. Farther to the northeast, at the border of its range in Michigan and Ontario, the multilocular hairs on the leaf-surface are relatively fewer and usually replaced by short straight conical hairs. The leaves are smaller and proportionately narrower, and frequently with a basal taper. Because of these structures, the species is frequently mistaken for *V. altissima* Nutt., from which it may be distinguished by the resin-dots on the leaf, involucral scales, and achenes. This extreme form has been described by Daniels under the name *V. michiganensis*, and the same thing from Ontario appears in several herbaria under another unpublished name.

Throughout this whole region, from Michigan to Missouri, the plants exhibit generally rounded to subacute, purple involucral scales, imbricate in relatively few series, and a purple pappus. This is the form described by the writer as *V. illinoensis*.

West of this region the species is much less common, and the herbarium material has been collected in widely scattered localities as far south as southern Texas. In general, the collections from west of the Mississippi and south of the Missouri Rivers have a loose open inflorescence, sharper and frequently smaller involucral scales, imbricate in relatively many series, and frequently green instead of purple, and a pappus which soon becomes tawny in color when exposed to light. But these differences are not constant nor even coincident on the same plant, so that even well-marked varieties can not be accurately distinguished. Yet in four cases out of five the geographical origin can be correctly guessed merely by a glance at the involucre of the plant.

Another area in which a form of the species occurs is the coastal region of southern Mississippi and Alabama. Whether similar plants also occur in southern Louisiana and southeastern Texas is not known definitely, but the inference is that they do. This extreme southeastern form differs in certain features from the species, so that it is recognizable at a glance, and it may be described as a variety.

Vernonia missurica austroriparia var. nov.

Inflorescence more or less elongate, very loose, open, irregular, and few-headed; leaf-blades broadest distinctly above the middle, thinly tomentose beneath or merely pubescent; resinous glands on the leaves, scales, and achenes as in the typical form of the species.

TYPE: *Tracy 8015*, collected at Tensaw, Alabama, August 18, 1904, and deposited in the herbarium of the New York Botanical Garden. Other specimens are: *Tracy 6970* from Ocean Springs, Mississippi; *Tracy 4780* from Coopolis, Mississippi; and various specimens collected by Mohr at or near Mobile, Alabama. In some specimens the leaf-pubescence is reduced in amount until the leaf resembles that of *V. altissima*. Such plants have been included under this variety because of the size of the heads, the character of the involucre and inflorescence, and the presence of resin.

Vernonia aborigina sp. nov.

Stem herbaceous, stout, striate or ribbed, covered with a brown tomentum becoming thicker above; leaf-blades ovate-lanceolate, remotely denticulate with low ascending callous teeth, acuminate, narrowed below into an obtuse or rounded sessile or subsessile base, 8–15 cm. long, scabrous above with short papillose hairs, densely brown-tomentose beneath; inflorescence rather small and compact, 11–13 cm. wide and bearing relatively few (about 30) heads; bracteal leaves on the cyme-branches lance-oblong, 10–15 mm. long; heads large, in fruit about 12 mm. high, containing in the single head counted 68 flowers; involucre broadly rounded at the base, 7–8 mm. high, expanding to 16–18 mm. wide at maturity; involucral scales closely and regularly imbricated, the outer minute and triangular and all squarrose or recurved at the tip, acute, sparingly ciliate along the brown margin, resinous-glandular and thinly puberulent along the purple central two thirds, elsewhere green and glabrous, tipped with a rather prominent carinate midvein which is frequently prolonged into a short mucro; achenes 3.5 mm. long, olive in color, with low ridges and broad flat furrows, conspicuously glandular in the furrows, minutely and sparsely puberulent on the ridges; pappus-bristles reddish-tawny, almost plumose below, merely barbellate above, 7 mm. long, paleae as long as the diameter of the achene, narrowly linear, equaling in width or barely wider than the bristles.

The type was collected by P. H. Rolfs in Oklahoma, west of Fort Smith, Arkansas, August, 1891, and is deposited in the herbarium of Iowa Agricultural College as sheet number 32272. No other material has been examined.

The description of this new species is offered with considerable reluctance, because of the great variabilty of the western species and their known tendency to hybridize. In several features it differs from all other western species. The large heads, the unusual number of flowers in each head, the olive-colored, glandular achenes, and the reddish, conspicuously barbellate pappus distinguish it from all others. The squarrose scales separate it from all others except *V. Baldwini* Torr., the very narrow paleae from all except *V. interior* Small and the species-group *Fasciculatae.* It is to be hoped that further collecting in a somewhat neglected region may bring to light additional material.

Vernonia fasciculata nebraskensis var. nov.

Leaves shorter than in the typical form of the species, narrowly lanceolate, denticulate, acute, pale-green or yellowish green; heads closely crowded.

TYPE: *Rydberg 5400*, collected in Kearney County, Nebraska, July 14, 1900, and deposited in the herbarium of the New York Botanical Garden. Numerous other sheets occur in all larger herbaria; in fact, almost all of the Nebraska specimens labeled *V. fasciculata* are to be referred to this variety. The species proper occurs only along the Missouri River, so far as known to the writer, while the variety extends westward more than half the length of the state. Although the brief varietal description apparently offers but little evidence for the separation of a variety, nevertheless the Nebraska specimens in any large herbaria all look alike, all look different from the rest of the species, and can be separated at a glance even by a person not familiar with the genus, as the writer has been able to demonstrate.

VERNONIA ALTISSIMA PUBESCENS (Morris) Daniels

Inner involucral scales tipped with a short, straight, flat, erect, linear tip, not over 2 mm. long.

While Morris's variety was originally separated primarily by the character of the foliage, this is, as has been pointed out by Blake, due to some unusual pathological or teratological condition. The shape of the scales, on the other hand, is found as described above not only in Morris's type but in several other herbarium sheets from the Alleghenian region, from Pennsylvania and Ohio south to Alabama and South Carolina, and in isolated collections of Wilkinson from Mansfield, Ohio.

Vernonia altissima brevipappa var. nov.

Lower surface of the leaf-blades with a few multilocular hairs along the veins; paleae only 0.1–0.3 mm. long; otherwise as in the typical form of the species.

TYPE: collected by J. Schneck at Mt. Carmel, Illinois, August 13, 1891, and deposited in the herbarium of the University of Illinois.

Vernonia altissima laxa var. nov.

Heads smaller than in the species, 13–21-flowered; inflorescence broad, irregular, very loose and open; inner involucral scales often apiculate, the middle scales frequently sharply acute; resin-dots none; leaf and pubescence as in the typical form of the species.

TYPE: *Harper 1936*, collected at Newton, Georgia, August 19, 1903, and deposited in the herbarium of the New York Botanical Garden; duplicates of the type are in the Gray Herbarium and the herbarium of the Field Columbian Museum. Other specimens of this southern or coastal plain variety are *Tracy 8046* and *Eggleston 5142*.

Vernonia flaccidifolia angustifolia var. nov.

Leaves narrowly lanceolate, denticulate, only 1–2 cm. wide; otherwise as in the typical form of the species.

TYPE: *ex herb. Torrey*, collected in Alabama and deposited in the herbarium of Columbia University; another sheet in the New York collections is from Georgia, ex herb. Chapman.

Vernonia ovalifolia purpurea var. nov.

Leaves with numerous multilocular hairs on the veins of the lower surface, the upper leaves subtending the branches truncate on rounded at the sessile base; pappus purple; otherwise as in the typical form of the species.

TYPE: *F. S. & E. S. Earle 99*, collected at Auburn, Alabama, July 22, 1899, and deposited in the herbarium of the New York Botanical Garden.

Vernonia jucunda sp. nov.

Stem apparently herbaceous, at least 4 dm. high, erect, sparingly branched, densely villous when young, becoming floccose when older and glabrate at about 3 dm. from the summit, faintly striate and reddish brown under the pubescence; leaf-blades ovate-oblong, as much as 38 × 80 mm., narrowed toward the sessile base or into a short margined petiole, undulate and irregular at the entire margin or rarely with a few low salient teeth, frequently a little revolute, acute at the apex or short-acuminate into a small subulate tip, dark-green and rugose above with impressed veins and scabrous with papillose hairs or hair-bases, gray or nearly white beneath with a close fine tomentum; lateral veins prominent, ascending and straight almost to the leaf-margin; upper and bracteal leaves similar but smaller; heads five-flowered, in a sympodial raceme, standing opposite and a little (2–3 mm.) below a bracteal leaf which later bears secondary heads in its axil, primary heads eight to ten; involucre 8 mm. high, 2.5 mm. wide, with its stiff scales imbricate and appressed at the base and squarrose at the tip, lanceolate-oblong to ovate-oblong, broadest below or near the middle and long-acuminate into a subulate, glabrous, terete, callous tip, the outermost green, one-half the length of the purple inner ones, and all papillose-villous with erect hairs on the exposed portion; corolla apparently pale purple, its tube glabrous, not ampliate above, 5 mm. long, its lobes glabrous, 3 mm. long by 0.6 mm. wide, with parallel sides and triangular tip; filaments glabrous, attached at two thirds the height of the tube; anthers 2.8 mm. long, minutely rounded at the triangular tip, their obtuse bases 0.5 mm. long; style hairy along the upper 1.4 mm., its branches 1.4 mm. long, tapering, hairy on the outer side; achene 2.5 mm. long, shallowly ten-ribbed, pubescent with short erect hairs on the ridges; pappus-bristles pale tawny, 6.5 mm. long, barbellate; paleae linear-lanceolate, 1.0–1.1 mm. long by 0.09–0.18 mm. wide, trough-shaped and pubescent on the inner face.

TYPE: *Purpus 7060*, collected in the Sierra de Tonala of Chiapas, Mexico, October, 1913, and deposited in the herbarium of the University of California as number 173434. Other sheets of the same collection are in other American herbaria and agree in every particular with the type.

Vernonia jucunda is the first species of the section *Stenocephalum* to be discovered in North America. Other members of the section are South American; one species, probably undescribed, occurs in Colombia and a number in Brazil. The section is characterized by few-flowered heads set a short distance below the bracteal leaf, by an involucre constricted at the throat and composed of subulate, more or less squarrose scales, and by leaves which are usually revolute and tomentose beneath.

Among the many interesting plants collected by Charles Wright in Cuba, his number 2789, described by Grisebach as *Vernonia lepidota*, is one of the least known. Wright described it as a suffruticose plant, ascending on bushes to a height of about 3 meters, with purple flowers. The Gray Herbarium contains a large specimen which shows the foliar characters very well, but is too immature for a careful study of the floral structures, achenes, or pappus. Ekman examined three sheets of the same number in European herbaria, including Grisebach's type, and has published the first good description of its reproductive structures. A few of his observations have been verified at the Gray Herbarium. Ekman points out that its anthers and styles agree with those of the genus *Vernonia*, but that its pappus is entirely different. The inner pappus is composed of not more than seven flattened bristles, and the outer of scales which are coalescent into a cylindrical tube with lacerose margin. This feature alone is sufficient to warrant the erection of a genus for it, which may appropriately be named in Ekman's honor.

EKMANIA gen. nov.

Inflorescence a corymbiform cluster, freely branched and beset with petiolate bract-like leaves; heads homogamous, few-flowered; involucre of a few series of closely appressed scales; corolla glandular without; style and anthers as in *Vernonia*; achene glabrous, ten-ribbed; pappus biseriate, the outer of a cylindrical tube with lacerose margin, the inner of five to seven stout flattened bristles; stem and foliage lepidote.

Type species: *Vernonia lepidota* Griseb.

Ekmania lepidota (Griseb.) comb. nov.

Vernonia lepidota Griseb. Cat. Pl. Cub. 145. 1866.

Leaf-blades elliptic-oblong, the larger ones 3.5 × 8 cm., the upper smaller, thinly silvery-lepidote above, densely fulvous-lepidote beneath, entire, obtuse or subacute, prominently veined; the larger bracteal leaves petiolate, 10–13 mm. long and one-nerved, the others more crowded distally and gradually reduced in size to short subterete scales 2 mm. long, closely appressed to the involucre and distinguished from it chiefly by their lepidote pubescence; involucre 3 mm. high, its brown scales trough-shaped or boat-shaped, acute, pubescent or scurfy on the back.

Oliganthes Milleri (Johnston) comb. nov.

Vernonia Milleri Johnston, Proc. Am. Acad. **11**: 698. 1905.

The structure of the pappus of this little-known species from the island of Margarita indicates clearly its affinity with *Oliganthes* rather than with *Vernonia.*

Piptocoma rufescens latifolia var. nov.

Leaf-blade narrowly ovate or elliptic, two to three times as long as wide, broadly obtuse or rounded at the apex, abruptly narrowed at the base, its tomentum loose and thin; petiole 1 cm. long; involucre larger and its scales more tomentose than in the typical form of the species.

TYPE: *Britton, Britton & Shafer 104*, from a coastal thicket on Water Island, St. Thomas, January 31 to February 4, 1913, and deposited in the herbarium of the New York Botanical Garden; a second sheet in the same collection is *Britton & Shafer 845*, from a coastal thicket on Salt Island, Tortola.

The species of *Elephantopus* occurring in the southeastern United States have long been a difficult problem for taxonomists. *E. carolinianus* Willd. and *E. nudatus* Gray are quite distinct and have generally been recognized. Gray, in the Synoptical Flora, in 1886, combined *E. tomentosus* L. with *E. elatus* Bertol., and in general Bertolini's species was not recognized until 1901. Baker then regarded it as distinct and gave some valuable comparative measurements. While the difference in length of involucral scales and pappus is distinct in mature heads, it is not always reliable at earlier stages. Possibly for this reason, Baker's measurements have been neglected by recent authors, and Small has separated the two species chiefly on characters of leaf and pubescence, which are unfortunately exceedingly variable.

One diagnostic character has however been overlooked. In *E. tomentosus* the hairs on the midvein are generally reflexed, while on the leaf-surface proper many or all of the hairs point backward. In *E. elatus* the hairs of the midvein are longer and stiffer and point distinctly forward. Separated by this character, many specimens usually referred to *E. tomentosus* are found to belong to the other species, having also the short, heavily invested scales and short pappus ascribed by Baker to *E. elatus*, and only the leaf-shape of *E. tomentosus*. These may be described as a variety.

Elephantopus elatus intermedius var. nov.

Leaf-blade elliptic or oblong, abruptly narrowed to the base, less than three times as long as wide; stem comparatively short and sparingly branched; pappus sometimes as much as 5 mm. long.

TYPE: *Tracy 4741*, collected at Coopolis, Mississippi, September 8, 1898, and deposited in the herbarium of the New York Botanical Garden. The variety is represented in herbaria by numerous specimens, and is distributed from southern Mississippi east along the coastal plain to Georgia and south to Lee and Dade Counties in southern Florida.

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A BRIEF CONSPECTUS OF THE SPECIES OF KNEIFFIA, WITH THE CHARACTERIZATION OF A NEW ALLIED GENUS

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A brief conspectus of the species of Kneiffia, with the characterization of a new allied genus

FRANCIS W. PENNELL

It has recently been shown that the best-known specific name among our sundrops must be transferred from one species to another. While such a change is always peculiarly unfortunate, the desire for a definite nomenclature makes it unavoidable. In tradition the name "*fruticosa*" had been handed down as applying to the glandular-fruited element of the aggregate at first known by that name, whereas study of the Clayton Herbarium specimen upon which Linnaeus based the species showed that the name must be associated with the plant bearing on the capsule glandless incurved hairs.

Nomenclature should follow definite rules of procedure, but surely scientific truth may raise the question as to the advisability of continuing the name "*fruticosa*" for *any* species of a group of plants with herbaceous, strictly annual stems. May we not plead the right to reject a proved *nomen falsum?* Moreover, from this standpoint in freeing our most widely known *Kneiffia* from the *onus* of the word "*fruticosa*," Dr. Blake has hardly improved nomenclature—surely not in the opinion of our genetical friends—by the substitution of the name "*hybrida*." One of the incentives to the present study has been the hope of finding for this species some appropriate name.

Another incentive has been the desire to place correctly a plant characteristic of the restricted but most unique prairie near New York City, the Hempstead Plains. This plant, which seems amply distinct, appears below as *K. velutina*.

I present the results of this study with hesitation. Species-lines have not always been found clear, and in any genus so near to *Oenothera* one may expect the same tendency to split into incipient species. However, before this genus likewise is selected for intensive cultivation and study, it may be well, from the viewpoint of the taxonomist, to present an outline of its composition.

For this study I have examined specimens in the herbaria of the New York Botanical Garden, United States National Museum, Missouri Botanical Garden, Academy of Natural Sciences of Philadelphia, University of Pennsylvania and Charleston Museum.

Stem-leaves broadly linear to ovate. Bracts similar to the leaves, linear, longer than the capsules. Stigmas linear, conspicuous. Wings of capsule pronounced. — KNEIFFIA.

- Mature capsule clavate-linear, not stipitate.
  - Hypanthium 20–25 mm. long. Sepals with spreading-hirsute caudate tips, 2–4 mm. long. Petals 20–25 mm. long. Stem, leaves and capsules hirsute. — 1. *K. pratensis.*
  - Hypanthium 10–12 mm. long. Sepals with shorter tips, strigose or somewhat spreading-pubescent. Petals 15–18 mm. long. Stem, leaves and capsules ascending- or appressed-pubescent. — 2. *K. sessilis.*
- Mature capsule-body clavate to oblong, more or less stipitate.
  - Petals of earlier flowers 12–25 mm. long. Inflorescence when in fruit much less than one half height of plant.
    - Mature capsule-body decidedly clavate, pubescent with normally incurved glandless hairs, in Nos. 8 and 9 with some interspersed gland-tipped hairs.
      - Mature capsule-body about as wide as long, usually much shorter than the stipe.
        - Capsule with minute appressed hairs. Leaves broadly linear, strigillose to glabrous. Basal leaves narrowly oblanceolate. — 3. *K. subglobosa.*
        - Capsule hirsute-strigose. Leaves linear-lanceolate, densely silvery-silky. — 4. *K. arenicola.*
      - Mature capsule-body longer than wide, longer than, about equaling or sometimes shorter than the stipe. Basal leaves broadly lanceolate to ovate.
        - Stipe and capsule-body both pubescent with glandless hairs, the

stipe frequently equaling or sometimes exceeding the capsule-body.

Stipe of capsule in fruit equaling or somewhat exceeding the permanently pubescent body.

Plant erect. 5. *K. fruticosa.*

Plant diffusely spreading. 5a. *K. fruticosa humifusa.*

Stipe of capsule in fruit shorter than the body, which tends to become glabrate.

Main stem-leaves 7–9 cm. long, glabrate. Capsule-body pubescent with minute hairs. 6. *K. riparia.*

Main stem-leaves 3–6 cm. long, densely pubescent. Capsule-body pubescent with coarse hairs. 7. *K. brevistipata.*

Stipe pubescent with gland-bearing hairs; frequently also such are interspersed with the incurved glandless hairs of the capsule-body. Stipe always shorter than the capsule-body.

Leaves nearly linear, finely pubescent to glabrate, 5–9 cm. long. Capsule-body clavate. 8. *K. semiglandulosa.*

Leaves lanceolate, softly densely pubescent, 2–4 cm. long. Capsule-body clavate-oblong. 9. *K. velutina.*

Mature capsule-body oblong or nearly so, pubescent with short straight gland-tipped hairs, or becoming glabrate.

Main stem-leaves linear-lanceolate to lanceolate-ovate, scarcely paler beneath. Stem pubescent to rarely glabrous. Petals of earlier flowers 18–25 mm. long.

Stem sparsely pubescent to glabrous. Leaves lanceolate.

Stipe shorter than the capsule-body. 10. *K. tetragona.*

Stipe longer than the capsule-body. Leaves usually narrower. 10a. *K. tetragona longistipata*

Stem more or less hirsute. Leaves lanceolate-ovate. Inflorescence usually congested. 10b. *K. tetragona hybrida.*

Main stem-leaves lanceolate-ovate to ovate, glaucous beneath. Stems glabrous or rarely obscurely pubescent. Petals of earlier flowers 25–30 mm. long. 11. *K. glauca.*

Petals of earlier flowers 5–15 mm. long. Inflorescence in fruit usually over one half height of plant.

Capsule pubescent with incurved glandless hairs. Petals of earlier flowers 10–15 mm. long. Inflorescence erect from the first. 12. *K. Spachiana.*

Capsule sparsely pubescent with gland-tipped hairs. Petals of earlier flowers 5–10 mm. long. Young inflorescence nodding. 13. *K. perennis.*

Stem-leaves filiform-linear to filiform. Bracts deltoid-ovate to ovate, shorter than the capsules. Stigmas very short, scarcely appearing as lobes. Wings of capsule ridge-like. PENIOPHYLLUM.

KNEIFFIA Spach

Kneiffia Spach, Hist. Veg. **4**: 373. 1835.
Type species, *Oenothera glauca* Michx.

1. KNEIFFIA PRATENSIS Small

Kneiffia pratensis Small, Fl. SE. U. S. 842, 1335. 1903. "Type, Jefferson Co., Mo., *Eggert*, June 11, 1878, in Herb. N. Y. B. G." Type seen.

Kneiffia Sumstinei Jennings, Ann. Carnegie Mus. **3**: 480. *pl. 19.* 1906. "Dry upland field near Kittanning [Pennsylvania], D. R. Sumstine, June, 1905. Type specimens in the Pennsylvania Herbarium of the Carnegie Museum. Acc. No. 2905." Isotype seen in the herbarium of the New York Botanical Garden.

Oenothera pratensis Robinson, Rhodora **10**: 34. 1908.

Prairies and woods, Ohio to Wisconsin, Iowa and Arkansas; introduced near New York City, Pittsburgh and Washington.

2. **Kneiffia sessilis** Pennell, sp. nov.

Stem 3–4 dm. tall, pubescent with ascending hairs. Leaves 6–9 cm. long, acutish, densely strigose-pubescent with ascending hairs, in age somewhat glabrate. Bracts much exceeding the capsules. Hypanthium 10–12 mm. long. Sepals 15–16 mm. long, long-attenuate; tips more or less free in the bud. Petals triangular, 15–17 mm. long. Filaments less than one half the length of the petals. Anthers 6–7 mm. long, yellow. Stigmas becoming one half length of style. Capsule linear, at least 9 mm. long, densely pubescent with ascending to appressed hairs; not seen mature.

Type, L[ittle] R[ock], Ark[ansas], collected in flower June 2, 1885, *Dr. H. E. Hasse*; in the herbarium of the New York Botanical Garden.

Also "La. Hale," in the United States National Herbarium, with longer hypanthium, broader leaves and less dense pubescence apparently belongs to this species.

3. KNEIFFIA SUBGLOBOSA Small

Kneiffia subglobosa Small, Bull. Torrey Club **23**: 177. 1896. "North Carolina and Georgia." Type, "on the slopes or summit of Stone Mountain, De Kalb County, Georgia," collected in fruit September 6–12, 1894, *J. K. Small*, seen in the herbarium of Columbia University at the New York Botanical Garden; isotypes in the herbaria of the United States National Museum and the Missouri Botanical Garden. I have found no basis for the crediting of this species to North Carolina.

Open rocky slopes, over granite, central Georgia to central Alabama.

4. KNEIFFIA ARENICOLA Small

Kneiffia arenicola Small, Fl. SE. U. S. 842, 1335. 1903. "Type, Biltmore Herb., no. 5649d, in Herb. N. Y. B. G." Type, "sand hills, Augusta, Georgia," collected in fruit July 27, 1900, seen in the herbarium of the New York Botanical Garden; isotype in the United States National Herbarium.

Sand-hills and dry pine-barrens, in the Coastal Plain, South Carolina to southern Mississippi.

5. KNEIFFIA FRUTICOSA (L.) Raimann

Oenothera fruticosa L. Sp. Pl. 346. 1753. "*Habitat in* Virginia." Type, *Clayton 36*, is identified by Dr. S. F. Blake (Rhodora **20**: 51. 1918) as the plant here considered.

Oenothera florida Salisb. Prod. 278. 1798. New name for *O. fruticosa* L.

Oenothera linearis Michx. Fl. Bor. Amer. **1**: 225. 1803. "*Hab.* in Carolina superiore." Type not seen or verified.

Kneiffia angustifolia Spach, Nouv. Ann. Mus. Par. **4**: 367. 1835. "Habitat in Georgia, Carolina, et Virginia." Type not seen or verified.

Kneiffia linearis Spach, Hist. Veg. **4**: 376. 1835.

Kneiffia longipedicellata Small, Bull. Torrey Club **23**: 178. 1896. "West Virginia to North Carolina and Florida." Type, "Albemarle Co., Virginia," collected May 21, 1889, *W. C. Rives*, seen in the herbarium of Columbia University at the New York Botanical Garden.

Kneiffia fruticosa Raimann; Engler & Prantl, Nat. Pflanzenfam. 3^7: 214. 1893.

Oenothera longipedicellata Robinson, Rhodora **10**: 34. 1908.

Open soil, sandy or barren, mostly in the Coastal Plain although extending inland upon suitable soils (as in the serpentine barrens of southeastern Pennsylvania and eastern Maryland), Long Island to Florida, Missouri and Texas.

5a. **Kneiffia fruticosa humifusa** (Allen) Pennell, comb. nov.

Oenothera fruticosa humifusa Allen, Bull. Torrey Club **1**: 3. 1870. Type, "Montauk Point Long Island. [*T. F. Allen.*] July 1869," seen in the herbarium of Columbia University at the New York Botanical Garden.

Kneiffia linearis Alleni Britton, Mem. Torrey Club **5**: 235. 1894. Based on *Oenothera fruticosa humifusa* Allen.

Kneiffia Alleni Small, Bull. Torrey Club **23**: 177. 1894.

(?) *Oenothera linearis Eamesii* Robinson, Rhodora **10**: 34. 1908. "Sandy shore of a salt pond, Stratford, Connecticut, *E. H. Eames* (type hb. Gray)." Perhaps rather a form of the species, approaching *humifusa*.

(?) *Oenothera fruticosa Eamesii* Blake, Rhodora **20**: 50. 1918.

Sandy soil, eastern Long Island, New York, and perhaps on the Connecticut coast. Said to be of very distinct appearance and, locally near Montauk, to be extremely abundant. Specimens elsewhere along the coast approach the habit of this.

6. KNEIFFIA RIPARIA (Nutt.) Small

Oenothera riparia Nutt. Gen. N. Amer. Pl. 1: 247. 1818. "HAB. On the banks of Cape Fear river, Wilmington, North Carolina, in situations subject to inundation."

Kneiffia riparia Small, Fl. SE. U. S. 842. 1903.

Swamps along the Cape Fear River, near Wilmington, North Carolina. Little known, although recently re-collected by Dr. J. M. Macfarlane, C. S. Williamson, etc. Possibly not a distinct species.

7. **Kneiffia brevistipata** Pennell, sp. nov.

Stem 2–4 dm. tall, pubescent. Leaves 3–6 cm. long, linear-lanceolate, acutish, densely strigose-pubescent with ascending hairs, the young leaves very silky. Bracts slightly exceeding the capsules. Hypanthium 6–9 mm. long. Sepals 7–9 mm. long, acutish; tips not free in the bud. Petals triangular, 12–15 mm. long. Filaments about one half length of petals. Anthers 3–3.5 mm. long, yellow. Stigmas less than one half length of style. Capsule-body clavate-oblong, 5–6 mm. long; wings raised beyond ridges; pubescent, becoming glabrate, especially distally; on a stipe less than its own length.

Type, Poplarville, Mississippi, collected in flower and fruit, July 7, 1891, *S. M. Tracy 1681;* in the United States National Herbarium.

Dry pine ridges, southern Alabama to eastern Louisiana.

8. **Kneiffia semiglandulosa** Pennell, sp. nov.

Stem 3–6 dm. tall, finely pubescent, becoming glandular above, purple-red. Leaves 5–9 cm. long, lanceolate-linear, acutish, finely pubescent with ascending hairs to glabrate. Bracts much exceeding the capsules. Hypanthium 10–20 mm. long. Sepals 10–13 mm. long, acuminate; tips not or slightly free in the bud. Petals triangular, 15–25 mm. long. Filaments about one half length of petals. Anthers 5–6 mm. long, yellow. Stigmas less than one third length of style. Capsule-body clavate, 8–10 mm. long, wings exceeding the prominent ridges; finely pubescent with spreading gland-tipped, usually also with some incurved glandless, hairs, often glabrous or nearly so; on a stipe less than its own length.

Type, Biloxi, Mississippi, collected in flower April 21, 1891, *S. M. Tracy 5064*, in the United States National Herbarium.

Pine-land, West Florida to southern Mississippi; on ballast at Wilmington, North Carolina.

9. **Kneiffia velutina** Pennell, sp. nov.

Stem 2–4 dm. tall, pubescent. Leaves 2–4 cm. long, narrowly or broadly lanceolate, acute to acutish, densely soft-pubescent. Inflorescence less than one fourth height of plant. Bracts little exceeding, the upper shorter than the capsules. Hypanthium 9–12 mm. long. Sepals 10 mm. long, somewhat attenuate, so that buds are slightly caudate. Petals triangular, 15–20 mm. long. Filaments about one half length of petals. Anthers pale yellow. Stigmas about one third length of style. Capsule-body oblong, slightly clavate, 7–9 mm. long; the wings almost equaling width of body; pubescent with incurved hairs and, especially proximally, with some finer gland-tipped hairs.

Type, dry sandy soil, Garden City, Long Island, New York, collected in flower June 23, 1902, *F. A. Mulford;* in the herbarium of the New York Botanical Garden.

Dry sandy soil, apparently restricted to the Hempstead Plains of western Long Island, from which numerous collections have been seen.

10. **Kneiffia tetragona** (Roth) Pennell, comb. nov.

Oenothera tetragona Roth, Catalecta **2**: 39. 1800. A garden plant, for which an American origin is stated. No specimen seen but the full description would apply to the plant here considered.

Oenothera fruticosa ambigua Nutt. Gen. N. Amer. Pl. **1**: 247. 1818. "HAB. Common around Philadelphia."

Oenothera incana Nutt. *l. c.* 247. 1818. "HAB. In dry woods, Maryland.—Dr. W. C. Barton, *v. s.* in Herb. Barton."

Oenothera pilosella Raf. Ann. Nat. 15. 1820. "Indiana, near Evansville."

(?) *Oenothera canadensis* Goldie, Edinb. Phil. Jour. **6**: 325. 1822. "Island of Montreal." The size of flowers would indicate that this plant must be *K. tetragona.* Apparently far out of the normal range of the species (see Macoun, Cat. Canad. Pl. **1**: 172. 1883).

Oenothera ambigua Spreng. Syst. **2**: 229. 1825.

Oenothera serotina Sweet, Brit. Fl. Gard. **2**: *pl. 184.* 1826. A garden plant, of which no specimen seen.

Kneiffia suffruticosa Spach, Hist. Veg. **4**: 374. 1835. "Croît dans les Etats Unis, depuis la Géorgie jusqu' au Canada."

Kneiffia maculata Spach, *l. c.* 375. 1835. "*Oenothera serotina* Sweet. . . ."

Oenothera fruticosa phyllopus Hook. Bot. Mag. 64: sub *pl. 3545.* 1837. "Bot. Mag. t. 332."

Oenothera fruticosa incana Hook. *l. c.* sub *pl. 3545.* 1837.

Oenothera fruticosa hirsuta Nutt.; T. & G., Fl. N. Am. 1: 496. 1840.

Oenothera hybrida ambigua Blake, Rhodora **20**: 52. 1918.

Dry soil, barrens, etc., New York to Alabama, Tennessee and southern Michigan; the commonest *Kneiffia* of the Piedmont and Alleghanian floras.

10a. **Kneiffia tetragona longistipata** Pennell, var. nov.

Leaves linear-lanceolate. Stipe equaling capsule-body.

Type, woods near Clemson, Pickens County, South Carolina, collected in flower May 12, 1907, *H. D. House 3340;* in the herbarium of the New York Botanical Garden.

Piedmont Region, North Carolina to Georgia.

10b. **Kneiffia tetragona hybrida** (Michx.) Pennell, comb. nov.

Oenothera hybrida Michx. Fl. Bor. Amer. 1: 225. 1803. "*Hab.* in Carolina superiore."

Kneiffia floribunda Spach, Hist. Veg. **4**: 376. 1835. "Croît dans le midi des Etats-Unis."

Mountains of North Carolina, there nearly or quite replacing the typical form of the species. As examples may be cited: *Biltmore Herb. 669b; Heller 263;* and *Standley 5366.*

11. KNEIFFIA GLAUCA (Michx.) Spach

Oenothera glauca Michx. Fl. Bor. Amer. 1: 224. 1803. "*Hab.* in sylvis remotis et occidentalibus flumini *Mississipi* confinibus, versus regionem Illinoensium." Surely the plant here considered, although not known to occur so far west as the type station.

Oenothera Fraseri Pursh, Fl. Amer. Sept. **2**: 734. 1814. "In South Carolina *Fraser* . . . *v. v.* in *Hortis.*"

Kneiffia glauca Spach, Hist. Veg. **4**: 374. 1835.

Kneiffia Fraseri Spach, *l. c.* 375. 1835.

Oenothera fruticosa Fraseri Hook. Bot. Mag. 64. sub *pl. 3545.* 1837.

Oenothera fruticosa glauca Lév. Monog. Onothera 107. 1902.

Wooded mountain-slopes, southern Virginia to northern Georgia, eastern Tennessee and eastern Kentucky.

12. KNEIFFIA SPACHIANA (T. & G.) Small

Oenothera Spachiana T. & G., Fl. N. Am. 1: 498. 1840. "Texas, Drummond."

Kneiffia Spachiana Small, Bull. Torrey Club **23**: 179. 1896.

Oenothera fruticosa race *Spachiana* Lév. Monog. Onothera 106. 1902.

Sandy prairies, Kansas and northwestern Arkansas to Louisiana and Texas.

13. **Kneiffia perennis** (L.) Pennell, comb. nov.

Oenothera perennis L. Syst. ed. 10, 998. 1759. Canada.

Oenothera pumila L. Sp. Pl. ed. 2. 493. 1762. "Habitat in America septentrionali."

Oenothera chrysantha Michx. Fl. Bor. Amer. 1: 225. 1803. "*Hab.* a Quebec usque ad sinum *Hudsonis.*"

Oenothera pusilla Michx. *l. c.* 225. 1803. "*Hab.* in rupibus, ad lacus *Mistassins.*"

Kneiffia chrysantha Spach, Nouv. Ann. Mus. Par. **4**: 368. 1835.

Kneiffia Michauxii Spach, Ann. Sc. Nat. Bot. II. **4**: 167. 1835. Based on *Oenothera chrysantha* Michx.

Kneiffia pumila Spach, Hist. Veg. Phan. **4**: 377. 1835.

Oenothera pumila chrysantha Gordinier & Howe, Fl. Rensselaer Co., N. Y. 14. 1894. "Poestenkill, *Howe.*"

Oenothera pumila rectipilis Blake, Rhodora **19**: 110. 1917. "NEW BRUNSWICK: dryish rocky ground, Petit Rocher, Gloucester Co., 21 Aug. 1913, *Blake 5513* (TYPE in Gray Herb.)." The unusual state in which the pubescence is spreading may be considered as a form.

Dry fields, Nova Scotia and Quebec to Minnesota and North Carolina; northward to Hudson Bay; also on St. Pierre Island.

PENIOPHYLLUM* Pennell, gen. nov.

Slender glabrous herb, with virgately branched stem. Leaves of two forms, the basal petioled, ovate, less than 2 cm. long, the numerous stem-leaves scattered, filiform-linear to filiform, longer. Flowers in spikes terminal on the stem and branches. Bracts deltoid-ovate to ovate, shorter than the capsules. Sepals partially cohering, reflexing in two pieces. Petals about 4 mm. long, triangular. Filaments unequal, glabrous. Anthers oblong, glabrous. Style glabrous. Stigma broad, capitate, the four lobes scarcely or not distinguishable. Capsule 4–6 mm. long, ellipsoid, sharply 4-angled, not stipitate. Seeds angled, brown, 1 mm. long, irregularly clustered.

Type species, *Oenothera linifolia* Nutt.

1. **Peniophyllum linifolium** (Nutt.) Pennell, comb. nov.

Oenothera linifolia Nutt. Jour. Acad. Nat. Sci. Phila. **2**: 120. 1821. "Habitat. On the summits of arid hills and the shelvings of rocks, near the banks of the Arkansas [*T. Nuttall*]." Specimen, labeled "Arkansa, Nuttall," seen in herbarium of Columbia University at the New York Botanical Garden.

Kneiffia linifolia Spach, Nouv. Ann. Mus. Par. **4**: 368. 1835.

Kneiffia linearifolia Spach, Ann. Sc. Nat. Bot. II. **4**: 167. 1835. Based upon *Oenothera linifolia* Nutt.

Sandy soil, prairies and open woodland, southern Missouri and Kansas south to western Louisiana and eastern Texas; also on granite in central Georgia and central Alabama.

NEW YORK BOTANICAL GARDEN

* From πηνίον, thread, and φύλλον, leaf.

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TULIP DROPPERS

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Tulip Droppers

By A. B. Stout

DURING a single season of growth a tulip plant may burrow downward in the soil and thus bury its main bulb to a depth of several inches. Such a plant is shown in figure 1 of the accompanying plate. The cluster of roots, the portion of the stem from which they arose and the remnants of the old scale leaves at *c* indicate the level at which the base of the bulb sat during the preceding summer. Above this level a leaf extends upward into the air; below this level a hollow cylindrical column of tissue extends downward enclosing the bulb at its lower extremity.

The terms "dropper" and "sinker" have been applied by tulip growers to the part which thus carries the bulb to lower levels. It appears that the habit of forming droppers is common in wild species of tulips and especially during the growth of seedlings. Under ordinary methods of growing bulbs of garden varieties for display the formation of droppers appears to be somewhat infrequent. When droppers are observed for the first time by a gardener his interest is usually aroused which has led to occasional reports in various publications of the "discovery" of droppers in tulips.

Descriptions of the true nature of the droppers in *Tulipa* (and in other genera also) have appeared from time to time, but it has seemed desirable to describe in this journal some unusually fine droppers which the writer has found at the New York Botanical Garden.

The true nature of the dropper is revealed by a study of the stages in its development, and by an examination of its gross anatomy, and most especially of the distribution of the fibrovascular bundles or veins.

EXPLANATION OF PLATE

Figures *3a* to *3e* are magnified 3 diameters; Figure *3f*, $1\frac{1}{2}$ times; Figures *14* to *20* are purely schematic; all other figures are one-half the natural size.

Fig. 1. Tulip plant with dropper, and two daughter lateral bulbs at old level without droppers. Blade of leaf removed. Surface of soil indicated.

Fig. 2. Entire plant with dropper slit vertically showing bulb enclosed at base of the dropper.

Fig. 3. View showing surface of stem portion of dropper. Upper part of leaf removed.

Figures 3a to 3f. Cross sections of dropper shown in figure *3*, taken at points indicated. Shows distribution of fibrovascular bundles.

Fig. 4. Longitudinal section of a part of a dropper extending above and below old level.

Fig. 5. Longitudinal section of base of dropper and the enclosed bulb.

Fig. 6 and 7. View of a plant collected on March 22, showing a dropper in the early stages of downward growth, and also a small offset.

Fig. 8. Same with old bulb sectioned.

Fig. 9. Same with dropper also sectioned.

Fig. 10. Longitudinal section of a vegetative bulb early in spring. Upper part of vegetative leaf removed. Base of new bulb beginning to extend beyond the upper portion of the old bulb. Shows the normal eccentric radial growth of stem and the position of the bulb in the soil.

Fig. 11. Plant with dropper growing nearly horizontal to the surface of the soil.

Fig. 12. Diagram of a median vertical section of a vegetative bulb at the beginning of a season of growth.

Fig. 13. Same as figure *12* but at end of the season of growth. Shows relation of base of new bulb to stem of old bulb. Scales of old bulb are not shown.

Fig. 14. Representing condition of concentric radial growth and with uniform elongation of nodes (*A*, *B* and *C*) and internodes (*a* and *b*) most common in plants.

Fig. 15. Representing an increase in concentric radial growth of a node (*B*) and of the adjoining parts of internodes (*a* and *b*) over that of other nodes.

Fig. 16. Illustrating eccentric and downward radial growth of a node (*B*) and the correlated growth of the internode below.

Fig. 17. As in figure *16*, but with unequal elongation of internode below (*a*) which is greatest on the side of greatest eccentricity. This is the condition which regularly develops in the base of the new bulbs of vegetative tulip plants. Compare with figures *10* and *13*.

Fig. 18. Same as in Figure *17*, with also eccentric and unequal elongation of the internode (*b*) above.

Fig. 19. Same as above but more pronounced.

Fig. 20. Diagram of a young dropper of the tulip. Same as Figure *19* with also a coördinated growth of the leaf attached to node *B*. Region of active growth indicated by shading.

Fig. 21. Flowering bulb of tulip below, scale leaves attached to closely compacted nodes. Flower stem arising by marked symmetrical elongation of a few internodes (*a*, *b* and *c*). Green leaves attached to the nodes (*A*, *B* and *C*) not shown.

TULIP DROPPERS
FOR EXPLANATION, SEE PAGE 464

A longitudinal slit through a dropper (see fig. 2) shows that it is hollow throughout. The hollow within the leaf above the old level (*c*) is continued to the lower level and the bulb enclosed by the leaf is at the lower extremity. This condition is in marked contrast to that in a plant which has not buried its bulb. In the latter, as is shown in the longitudinal section of figure 10, the roots and stem mark the level of the old bulb, the base of the one green leaf encloses the main bud and this bud and the scales immediately surrounding it arise almost vertically from the stem of the bulb.

In the case of the plant shown in figure 2, there was but one main or stem bud; all the buds lateral to it and which were in the axils of the surrounding scales failed to develop. The plant kept its main growing bud but placed it at a lower level in the soil.

A series of cross sections of a dropper and of the part of the leaf immediately above shows the distribution of the fibrovascular bundles and thereby reveals the composition of the dropper and the mechanism which produces the burrowing bulb. The cross sections drawn for figures *3a* to *3f* were taken from the plant shown in figure 3 at the points indicated by the lettering. Immediately above the level of the old stem, the leaf forms a hollow cylinder containing a single ring of bundles. (See *3a* and *3b*.) At the level of the juncture of the leaf with the old stem the cross section appears as in figure *3c;* four of the bundles from the leaf connect directly with the stem. In the stem itself the bundles tend to form a ring in a solid core of tissue. The other bundles of the leaf continue on down in a direct course. Sections below this point, as at *d*, *e* and *f*, show that the arrangement of the bundles continues to be quite the same as at *c*.

The dropper is therefore part stem and part leaf. A segment is stem and a segment is leaf and the two are united to form the hollow cylindrical column. A part of the basal circumference of the leaf is attached to the stem of the plant at the upper level (*c*) and a part of the basal circumference of the same leaf is attached to the stem of the bulb at the lower level.

Between these two extremes the stem and the leaf join as contiguous parts of the entire cylinder. The stem part is characterized internally by its double row or ring of vascular bundles and it is noticeably thicker than the leaf portion. The general relation of the bundles is also well shown in such longitudinal sections as are given in figures *4* and *5*. On the exterior the stem segment of the dropper is somewhat ridged throughout its entire length as is indicated in figure *3* and in the drawings of the cross-sections at *c*, *d*, *e* and *f*.

The entire bulb of the ordinary non-burrowing plant of the tulip is somewhat radially asymmetrical and its basal and stem end stands usually at an angle of about 45° from the horizontal as is shown in figure 10. The roots arise in a crescent shaped area whose center is at the lowest point. The bases of the leaves and scales are hollow cylinders and are attached on a slant that corresponds to the inclination of the nodes. If a plant is to remain vegetative for a season and is not to produce a flower, one of its leaves develops as a green aerial leaf and the scales outside of this together with their nodes die. The stem segment from which the green leaf arises increases in diameter and forms the base of the new bulb which thus becomes of greater width than the old stem segments immediately below in which growth had ceased. But the radial growth of scales and stem segments of the new bulb is eccentric and is greatest toward the lower side. The new bulb, therefore, protrudes beyond and slightly below the part of the old stem of which it is an extension. This condition is readily revealed by a longitudinal section through a bulb (see fig. 10). The condition is shown diagrammatically in figures 13, 16, and 17. In this ordinary growth of vegetative tulips, however, there is scarcely any elongation of the segments between the leaves (the internodes) and the entire stem is composed almost entirely of nodes to which the leaves are attached.

The method of growth by which a bulb burrows to lower depths is a further development or modification of the processes which give the new bulb its eccentrically expanded base.

It should be noted that in the development of the dropper the relative positions of the old scales and their nodes are not disturbed. Neither are the relative positions of the scales and nodes within the new bulb changed in the least. The immediate contact of the green leaf to the bud which it encloses is unchanged at the lowest side, and the relation of this same leaf to the scales outside of it is unchanged at the outside at the upper level. In the development of the dropper of the tulip plant, therefore, the shape of the basal portion of the green leaf, the shape of its node, the shape of the internode immediately above, and that of the internode immediately below have become greatly distorted. No other parts are directly involved in the growth of the dropper.

The methods of growth here concerned may be compared to the more usual methods of growth seen in stems. Stems increase in diameter and also in length. When the radial growth is uniformly concentric and the elongation is quite the same for all nodes and internodes there is produced a symmetrical and gradually tapering cone-shaped stem, as is the rule in most shrubs and trees. This condition can be illustrated by the diagram of figure 14. When a tulip plant sends up a flowering stalk there is a marked elongation of internodes and the radial and longitudinal growth is decidedly uniform as is shown in figure 21. When a series of nodes and internodes grows to a diameter greater than that of the internodes behind them, as is represented in figure 15, such swollen stems as the tubers of the potato may result. When the radial growth of an internode is concentric but the elongation is not uniform the direction of the apex is changed; a result very commonly attained in plants of all sorts.

If there is a decided eccentric radial growth in a single node and in the parts of the internode below it, but a rather uniform elongation throughout, the result would be as represented in figure 16. But if at the same time there is unequal elongation of the internode below and its greatest elongation is on the side of the greatest radial growth of the node above, some such figure as is shown in 17 will result.

It is precisely this last mentioned method of growth that regularily occurs in the formation of a new bulb in a vegetative plant of the tulip (see figs. 10 and 13). The radial growth of all nodes and internodes is eccentric; the increase in diameter of the node of the green leaf is much greater than that which the node immediately below made. None of the internodes elongate much except the one directly below the green leaf and in this one the elongation is unequal and is coördinated with the eccentric growth of the node above. Viewed from below the surface of this, the internode is crescent shaped in outline and the form of the entire internode is that of an asymmetrically truncated cone. It is from its crescent shaped surface that the new crop of roots emerge.

If now the internode immediately above the leaf node also makes an unequal elongation coördinated with the growth of the leaf node, then the conditions which make a dropper are realized (see diagrams 18, 19 and 20). The excessive unequal elongation of the two internodes is on opposite sides of the same stem and these come to lie parallel to each other along the node which has made the extremely asymmetrically radial growth. The node and the internodes thus become drawn out into a long ribbon-like structure of stem tissue. The base of the green leaf remains attached at all points of the periphery of the node and its growth is so coördinated that no lesions result. The region of greatest active growth in the stem portion of the dropper lies just behind the bulb in the region indicated by the dotting in figure 20.

During the earlier part of the spring season of growth, about March 20 to 30 at the New York Botanical Garden, a plant which is burying its bulb appears as shown in figures 6, 7, 8 and 9. The apex of the dropper with the main bud enclosed protudes through an opening that it has forced through the surrounding scales which at this stage are still fleshy. In every instance thus far observed by the writer the dropper broke through the fleshy scales along the line of their juncture with the stem and emerged at the lowest point of position (see figs. 1, 2, 3, 6, 7, 8, 9 and 11).

The dropper is anchored at the old level by the roots of the plant and the pressure of the soil above on the old bulb. Its own downward growth exerts sufficient force to rupture the scales and to burrow down into the soil. At first the dropper is somewhat conical at its lower end. Most of the enlargement of the new bulb occurs after it reaches a lower level when it also assumes the shape and position characteristic of tulip bulbs.

As far as the writer's observations go, flowering bulbs and the bulbs immediately lateral to the main bud have not burrowed to lower levels. The burrowing bud has always been the main bud in a vegetative plant and it has been directly enclosed in the vegetative leaf whose base became a part of the dropper. Frequently small lateral bulbs form in the axils of the old scales as is shown in figure 1 at *c*. Cases where the lateral buds also developed into droppers have, however, been reported in certain species of tulips.

Droppers of the tulip are to be distinguished from the so-called offsets, a small one of which is shown in figures 6, 7 and 9. These offsets are lateral branches which develop from the stem at points outside of the living scales. They are evidently developed from adventitious buds or from axillary buds that have remained dormant for a time.

Occasionally a dropper does not grow vertically downward but grows somewhat horizontally or even upward. A drawing of such a plant is shown in figure 11. At the end of a season of growth the bulbs of such droppers may lie on one side or even be placed upside down. In such droppers the relative growth of the leaf and stem portions is irregular and not well coördinated.

Plantings have been made to study the occurrence of droppers and to test the influence of depth of planting on their development. Bulbs weighing from 2 to over 40 grams were sorted into grades by weight. A set of each grade was planted at depths of 2, 3, 4, and 6 inches. Nearly all of the larger bulbs bloomed and produced new lateral bulbs of several sizes while the bulbs of smaller sizes were, as a rule, vegetative only.

Not one of the bulbs of these special plantings developed a dropper.

In other plantings of tulips, of the smaller bulbs planted in autumn at a depth of two inches there has been an occasional dropper but usually its length was short. It is clear that vegetative bulbs planted at shallow depths in autumn do not regularly develop droppers at least in the first year of their growth. The ability to form droppers, which it seems is characteristic of seedling tulips, appears to be lost in the small bulbs of cultivated races propagated by vegetative multiplication.

At the New York Botanical Garden the best cases of droppers in the tulip have been found in beds whose bulbs have remained undisturbed for several years and in which the proportion of flowering plants was greatly decreased. They have been found in beds planted with bulbs of small size, but by far the greater number of such bulbs did not produce droppers.

The formation of droppers is also known for species of *Gagea*, a genus of bulbous plants indigenous to the old world, and for *Erythronium* of which the yellow adder's tongue is a well known species of the eastern United States.

The droppers of the Erythroniums have been described and figured in American botanical journals. They differ from the droppers of the tulip in that the vegetative leaf does not contribute to the structure. The dropper is formed from the part of the stem and from the scale next inside the vegetative leaf. Droppers also develop from lateral buds and the stem and leaf portions of these are more or less fused with the main dropper which thus appears to be branched.

The number of species whose seedlings or vegetative bulbs have the ability to burrow to lower levels by the formation of droppers is few. Most bulbous plants burrow to lower depths by means of contractile roots. The dropper is a highly specialized structure produced by the extremely asymmetrical but coördinated growth of a node and the two internodes adjacent to it.

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SOME APPLICATIONS OF THE QUADRAT METHOD

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Some applications of the quadrat method

HENRY ALLAN GLEASON

By the quadrat method in ecological phytogeography is meant the intensive study of the vegetation or environment of a limited and definitely circumscribed area, known as a quadrat, in order to gain a comprehensive knowledge of the vegetation as a whole. The development of the method is the direct outgrowth of a need which has been felt by every ecologist who has seriously attempted the study of vegetational units. While its use is of great value and leads frequently to generalizations which would otherwise be difficult or impossible, it is not complete in itself, and ecologists are unable to rely upon it alone as a means toward successful field work. Indeed, its use to the exclusion of all other methods has never been suggested. It does constitute, however, the only practicable means for the quantitative study of the association, and as such it forms an important adjunct to photography and verbal description, which were previously the only feasible means of presenting the structure of vegetation. It also plays an important part in the study of associational dynamics, as migration and succession, and environometry.

It is exceedingly difficult and in many cases impossible for a reader to form a clear mental picture of an association from a written description, as may be demonstrated by a perusal of any discussion of an otherwise unfamiliar type of vegetation. The value of a verbal description is always greatly enhanced by photography. There are certain physical limitations to the value of a general photograph, caused by the difficulties of field photography and the necessity of reducing the print to the usual compass of a page, so that a general view of an association seldom gives a sufficiently clear idea of the vegetation, since the component species are distinguishable only in the immediate foreground, if at all. A detailed photograph of a small part of the association, on the other hand, is frequently made with difficulty and it is often impossible to choose for illustration an isolated portion which is typical of the association as a whole. In the latter case, and in all cases of verbal description, the result unconsciously and unavoidably embodies the author's idea of the conditions, rather than the actual and impersonal facts, in that conspicuous species may be emphasized although possibly relatively unimportant, while important but comparatively inconspicuous species may be neglected. While the quadrat method is by no means a panacea for all these difficulties, its proper combination with verbal description and photography does much to aid the observer in securing a thorough knowledge of the association and in more satisfactorily expressing its structure in terms intelligible to his readers. The merit of the method lies not merely in the actual results which it affords but also in the deductions from and application of these results.

While quadrats may be of any chosen size, a single square meter is probably most frequently used. In the list quadrat, a simple list is prepared of the species included within it. In the count quadrat, the number of individuals of each species is also determined. Both of these are of value as a method, but are of little use in expressing results. For the latter purpose, the map quadrat is by far the most useful. A chart is prepared on a suitable scale, usually 1 to 10, and the location of each individual plant noted upon it. Other sorts of quadrats may be made for special purposes, concerning which reference may be made to the various works by Clements (1904, 1905).

The structure of a vegetational unit depends upon the species represented, determining the flora; on the relative number of individuals of each, determining by their form, size, and habit the appearance of the vegetation; and on the total number of individuals, determining the density of the vegetation.

The use of a chosen quadrat in representing this structure depends absolutely on the theory of the homogeneity of the association, which in turn depends on a number of factors (Gleason, 1917, p. 471). Given a uniform physical environment, the mere migration of some species over the whole area requires considerable time and interferes with the uniformity until it is accomplished, so that young associations are always less uniform than old ones, while in open associations migration may continue for a very long period. Minor differences in environment may lead to the predominance of certain species in favorable places, to the persistence of relics, or to the early appearance of pioneers of other associations. Uniformity can not be perfect, although the general tendency of vegetation (apart from the effect of disturbing physical factors) is always toward uniformity, and it is most nearly attained in old (climax) closed associations, where entrance of new species is prevented by vegetative control of the environment, or in associations of extreme environment, where a small group of adjusted species enjoy a monopoly of the area.

If the association were absolutely homogeneous, if the plant individuals of the different component species were as regularly distributed as water and alcohol in a mixture of the two liquids, all quadrats of appreciable size would be similar and any quadrat could be chosen to represent the vegetation. Since no association is perfectly uniform, any one quadrat may by its structure accentuate the variability instead of concealing it. The value of a single quadrat also depends on its size and on the number of species in the association. In communities of numerous species (75 or more), a meter quadrat seldom includes as many as fifteen of them and usually contains still fewer. In very open associations, a meter quadrat frequently includes but a single individual plant. In either case, the error is reduced by increasing the size of the quadrat, but this simultaneously increases the labor of charting and decreases the value of a photograph.

The single quadrat of small size, one to two meters square, is therefore essential for graphic illustration, either by photograph or map, and is undoubtedly of value also for experimental work, but it fails to give a fair representation of the whole association, and is of less value as a basis for written description or as a unit for intensive study in field work. To be sure, a suitable quadrat may be chosen, but the quadrat method itself, as ordinarily used, offers no aid in the selection of this typical area, so the actual choice invariably represents the observer's idea rather than the impersonal facts.

The chief value of the quadrat method lies in the results obtained from the study of many quadrats, chosen at random to avoid the personal element, scattered over an area wide enough to be representative of the whole association, of sufficient number to permit drawing logical conclusions, and of a size suitable to the character of the vegetation concerned. Several ecologists have devised statistical methods toward this end, which have been more or less successful. One of the earliest was Drude (1890), who described plants as social, gregarious, copious, or rare, depending on their number, their distribution, and their grouping. He also proposed the determination of the frequence of plants on a large scale by dividing an area into quadrats of 100 square kilometers. Pound and Clements (1898, 1900) adopted the same terminology in their first studies on the subject, but determined abundance within a single association by actual counts of the number of individuals in a quadrat 5 meters square, and investigated enough quadrats to warrant them in drawing averages. It is obvious, however, that averages from figures obtained in this way are not entirely trustworthy, since some species are mutually exclusive, while the averages might indicate that they normally grew together. Jaccard (1901) adopted the study of several adjacent quadrats as a method in his study of alpine vegetation, and developed the idea of the frequency index and the community coefficient. His results are, however, probably somewhat faulty, inasmuch as he used few quadrats in any one association and located them adjacent to one another. Harper (1917 and several other articles) has also attempted a statistical expression of car-window observations, which corresponds to some extent to the frequency index as here used. Raunkiaer (1909) used essentially the same method described here.

The present writer first attempted the use of statistical methods to determine and express the structure of vegetation in 1903 (1907). He improved his method somewhat in 1908 (1910) and adapted it to class work with students in 1910. In the summer of 1911 he began the intensive study of the quadrat method and its applications at the Biological Station of the University of Michigan, and during the following four summers obtained a long series of data upon which the present paper is based. The statistics used in TABLES I and II were secured from the aspen (*Populus tremuloides* and *P. grandidentata*) association.

In practice, the following method is adopted. The size of the quadrat to be used is determined first by the general character of the vegetation, using a small one, one square meter, for dense closed vegetation, and a larger one, two meters square, for open or irregular associations. The quadrats may be marked out by four stakes connected by a line of proper length, or they may be estimated by the eye with sufficient accuracy for all practical use. The optimum size can be ascertained after an examination of the preliminary results, and the survey can be repeated with a better size of quadrat if the first is unsatisfactory. The number to be counted depends upon the visible uniformity of the association, on the area covered by it and on the time available. If possible, one hundred are counted.

The first one is located anywhere. The others are located successively in a pre-decided relation to the first, thereby obviating any element of personal choice. Thus they may be in a straight line and separated by ten paces each, so that the whole strip of one hundred would be one kilometer long; or they may be in a square, but similarly separated, so that the area examined would be approximately 100 meters square; or any other arrangement of separate or contiguous quadrats may be used, depending upon the configuration of the association.

For the first quadrat, the species are listed and the figure 1 placed after each in a single vertical row. For the second, the figure 2 is placed after the 1 for all those species which occur also in the second quadrat, and new names followed by the figure 2 are added for the additional species. The process is continued to completion, when it is seen that some of the species occur in a majority of the quadrats and others in a few or only in one, and the common species are distinguished from the rare ones as the work proceeds.

At the conclusion of the count, the results are summarized and the ratio between the total number of quadrats and the number in which a particular species occurs is expressed as a percentage which is known as the *frequency index*, here abbreviated to *FI*. Thus, the frequency index of a common species may be as high as 100 and most associations show certain species with *FI* 90 or more, while others are as low as 1.

Obviously not every species of the association will appear in the counts. Some of the rarer ones will be missed completely. For example, during five years experience in the aspen association of northern Michigan, during which some thousands of quadrats have been counted by the writer or his students, *Cypripedium acaule*, a plant of great rarity in this habitat, has appeared but once in the quadrats. These rarer ones, while of the greatest interest to the systematist or the phytogeographer in their relation to plant distribution in general, as emphasized so interestingly by Fernald (1919), and to the ecologist through the evidence which they frequently offer concerning the past or future development of the association, are nevertheless of negligible value in formulating a verbal description of the association. But the important species all do occur, provided the number and location of the quadrats has been properly chosen with reference to the size and character of the association, as the writer has demonstrated frequently in his own work.

If the whole association were included in a single quadrat, the frequency index of each species would be 100 and would give no idea of the comparative value of the species. In general, if the quadrats are too large, the frequency indices are also large and tend to approximate near 100. Conversely, if they are too small the indices are also small, and tend to approximate near unity, while the number of omitted species tends to become large and may even include some of the more important ones. The optimum size is one in which there is a wide divergence in the indices, from 1 to 90 or even more, so that the variation is an indication of the relative importance of the species. This is illustrated in the first three columns of figures in TABLE I,* of which the second column, based on quadrats two meters square, presents probably the best series of indices.

* The frequency indices given in TABLE I are not considered typical of the aspen associationi n general. The association consists of a sparse growth of two species of aspen and the paper birch, alternating with treeless areas dominated by bracken fern. The 240 quadrats counted for this paper were located entirely within a treeless area, and do not take account of the conspicuous difference encountered in the shade, where *Melampyrum lineare* and *Diervilla Lonicera* are both abundant. Neither do they cover an extent wide enough to give a fair representation of the treeless areas in general, since these omit completely such relatively common species as *Vaccinium canadense*, *Panicum depauperatum*, *Oryzopsis pungens*, and *Convolvulus spithamaeus*.

Again, the number of quadrats counted determines the accuracy of the frequency index as an expression of the ecological value of each species. The results from a small series certainly can not express the actual conditions as well as those from a large

TABLE I

	F.I. in 15 quadrats of 16 square meters	*F.I.* in 60 quadrats of 4 square meters	*F.I.* in 240 quadrats of 1 square meter	*F.I.* in every fourth quadrat	*F.I.* in first 60 quadrats	*F.I.* in second 60 quadrats	*F.I.* in third 60 quadrats	*F.I.* in fourth 60 quadrats
Pteris aquilina	100	100	99	100	98	100	97	100
Vaccinium pennsylvanicum	100	82	71	70	82	78	97	27
Gaylussacia baccata	80	67	48	43	60	25	87	22
Aster laevis	100	68	29	30	37	30	23	27
Carex umbellata	87	53	24	33	57	20	7	13
Rhus glabra	73	55	23	25	33	15	3	40
Rumex Acetosella	80	40	21	28	7	33	33	12
Rubus allegheniensis	40	30	17	18	37	15	10	7
Panicum boreale	60	35	16	17	5	12	17	32
Danthonia spicata	40	22	15	13	2	48	3	7
Gaultheria procumbens	47	27	14	10	7	20	25	5
Gnaphalium decurrens	60	33	12	15	2	20	17	8
Populus grandidentata	53	32	11	10	0	10	8	25
Hieracium venosum	60	28	8	7	3	7	5	18
Erigeron canadensis	33	20	7	8	5	0	2	22
Panicum xanthophysum	20	13	6	3	0	2	0	23
Diervilla Lonicera	13	8	4	3	15	0	0	0
Solidago canadensis	33	8	2	2	2	0	3	5
Agrostis hyemalis	27	8	2	3	7	2	0	0
Lactuca canadensis	20	7	2	2	3	0	2	2
Poa compressa	13	5	1	2	2	3	0	0
Epigaea repens	20	5	1	0	0	0	3	2
Quercus rubra	13	3	1	3	2	0	2	0
Comandra umbellata	7	2	1	2	0	3	0	0
Amelanchier canadensis	7	2	0	0	0	2	0	0
Hieracium paniculatum	7	2	0	2	0	0	2	0
Pinus resinosa	7	2	0	0	0	0	0	2

series. Repeated tests have shown that 100 is a satisfactory number and that no valuable increase in accuracy is gained by increasing the number beyond that, while it eliminates all computation in determining the frequency index.

Experience has also shown that better results are obtained if the quadrats are not contiguous, but separated by some distance, so as to cover more thoroughly the whole area of the association. In small associations, where even contiguous quadrats cover most of the area, this treatment is not necessary. If plants were distributed absolutely at random over the association, that is, if the association were absolutely uniform throughout, separated quadrats would never be necessary. But plants are not distributed entirely at random. Each plant-parent gives rise to disseminules which occupy, roughly speaking, a circle about it, with a diameter depending upon the mobility of the disseminules. As early as 1903 the writer (1907, p. 159) was able to demonstrate these in his field work. As a check, the following data from 240 one-meter quadrats are offered. The 27 species have frequency indices ranging from 0 (1 quadrat only) to 99, based upon the whole series. If any fourth part of the series is taken as a basis, composed of 60 contiguous quadrats, as shown in the last four columns of TABLE I, the average discrepancy between the two series of indices is 6.8, or for the 15 commonest species 10.7, and the difference may be as high as 44 for a species which normally grows in patches. But if every fourth quadrat is taken as a basis, that is, 60 separated quadrats, as shown in column 4 of TABLE I, the greatest discrepancy is only 9 and the average only 1.9, or 2.7 for the commonest species. In other words, 60 quadrats well scattered give results practically as reliable as 240 contiguous ones.

From a list of the frequency indices, made from quadrats of suitable size and number, the species are arranged in order of their general distribution in the association, and any number of them may be segregated for further study as the most typical or commonest. Since the frequency index increases with the size of the quadrat, a quadrat of proper size may now be chosen which will normally include all the more important species as well as a number of the less important ones also. The size of this *major quadrat* may be determined in advance and, in field work with students, one of them assigned to each student for detailed study and description. Although every such major quadrat may not actually contain all the important species, the student may be assured that it is nevertheless a fair sample of the association as a whole. The value of setting a definite area before each student, in which he may do his more intensive work, will be at once apparent to every teacher who has tried to present this phase of ecology in the field. The method of determining the major quadrat will be discussed below.

The relative abundance of a species is a fair measure of its ability to maintain itself under the conditions of environment and competition prevalent within the association. Long-established species of an old association have frequently become diffused thoroughly over the whole area, and their abundance may be determined by counting, but recent immigrants into old associations or any species of young associations are not uniformly distributed. The number of individuals of such plants is therefore zero in those parts which they have not yet reached and is too high to show their relative adjustment in those parts which they have reached.

But there is a definite relation between the number of individuals of a species and its frequency index. If only one is present in the area covered by the quadrats, the frequency index naturally cannot exceed 1. If only two are present, it can not exceed 2 and may be only 1 if both happen to occur in the same quadrat. While it is possible for a species to be represented by a large number of individuals all of which occur in a single quadrat only, the chance of such a thing actually happening is very small indeed. Similarly, while 100 individuals might be so thoroughly distributed that they would occur one in each quadrat, there is again very slight probability of it. The mathematical possibilities are capable of solution according to the laws of probability and chance. If n plants are scattered at random over q quadrats, the probability of any one quadrat being occupied is expressed by the formula $1 - \left(1 - \frac{1}{q}\right)^n$. Thus for 2 plants in 5 quadrats $1 - \left(1 - \frac{1}{5}\right)^2 = 0.36 = FI\ 36$. Or for 65 plants in 100 quadrats $1 - \left(1 - \frac{1}{100}\right)^{65} = FI\ 48$. Or, conversely, FI 48 should indicate a total of 65 individuals within the 100 quadrats. But since plants are not distributed entirely at random, the actual number is therefore always greater than indicated by the mathematical formula, which may be expressed, when $q = 100$, as $n = \frac{\log (1 - FI)}{\log 0.99}$. Thus, *Pteris aquilina*, determined by actual count to have an average abundance of 4,400 in 100 quadrats, has FI 99, corresponding to a theoretical number of only 455 individuals. Obviously, the discrepancy between actual and theoretical number should be, and is, greatest in species of high frequency, *FI* 95 or more. It is not possible to draw any accurate conclusions as to the relation between theoretical and actual number of individuals, but in general, the theoretical number is one fifth to two thirds as large as the actual, and results any more accurate than this are probably of little or no value in ecological description.

The determination of the proper size of the major quadrat involves reducing the original series of quadrats to a smaller number of larger quadrats, thereby increasing the frequency index of selected species to 99 or more. With *FI* 99 or more for all the important species, it may be assumed that this quadrat is large enough to serve as a fair sample of the association.

In the original equation $1 - \left(1 - \frac{1}{q}\right)^n = FI$, substitute for q the number of quadrats actually counted, use for *FI* the index of the least common one of the important species, and solve for n. Substitute again the determined value for n and 99 for the original *FI* and solve for q. The equation is $1 - \frac{1}{q} = \sqrt[n]{.01}$ (presuming 100 quadrats were counted), from which q may be easily determined. For example, in a certain association, it is desired to determine a major quadrat which will probably contain all the species with *FI* 60 or more.

$$1 - \left(1 - \frac{1}{100}\right)^n = 60: \; n = 90$$

$$1 - \frac{1}{q} = \sqrt[90]{.01}: \; q = 20 \text{ (fractions omitted)}$$

That is, the original 100 quadrats redivided into 20 larger quadrats should show *FI* 99 or 100 for all species which originally had *FI* 60 or more; or the major quadrat should be five times as large as the original. The error concerned in computing the value of n, due to imperfect distribution of the species, does not affect this last equation, and experience has shown that it gives surprisingly good results. On the average, four major quadrats out of ve, the location of which is chosen at random, present all the important species for which they were computed.

Jaccard's *community coefficient* (*CC*) was designed to express by a number the degree of similarity between two areas of vegetation. His method is to divide the total number of species in both areas into the number common to both. Thus, two areas, each containing 30 species, of which 20 were common to the two, contain a total of 40 species, and the community coefficient is accordingly 50. Jaccard's method fails to take account of the much greater importance of some abundant species, and the resulting error of computation may be obviated, in part at least, by weighting each species with its frequency index. Referring to columns 5 and 6 of TABLE I, and weighting each species with its average index in both columns, the results, shown in TABLE II

TABLE II

	In first area only	Common to both areas	In second area only
Pteris aquilina		99	
Vaccinium pennsylvanicum		80	
Gaylussacia baccata		42.5	
Aster laevis		33.5	
Carex umbellata		38.5	
Rhus glabra		24	
Rumex Acetosella		20	
Rubus allegheniensis		26	
Panicum boreale		8.5	
Danthonia spicata		25	
Gaultheria procumbens		13.5	
Gnaphalium decurrens		11	
Populus grandidentata			5
Hieracium venosum		5	
Erigeron canadensis	2.5		
Panicum xanthophysum			1
Diervilla Lonicera	7.5		
Solidago canadensis	1		
Agrostis hyemalis		4.5	
Lactuca canadensis	1.5		
Poa compressa		2.5	
Quercus rubra	1		
Comandra umbellata			1.5
Amelanchier canadensis			1
	13.5	433.5	8.5

are obtained, from which the community coefficient of the two areas concerned is determined as 95, by dividing the sum of the three columns, 455.5, into the sum of the center column.

By Jaccard's method, giving equal weight to each species, 24 total species divided into 15 common species = *CC* 62.

This method, while doubtless better than the original one, is still deficient in allowing equal weight to such small slender plants as *Erigeron canadensis* and large bushy ones as *Gaylussacia baccata*. If each plant could be further weighted by a multiplier expressive of its size, a better index would doubtless be attained. In this particular case, for example, each plant of the latter species occupies probably 400 times as much ground space as the former. So far no serious attempt has been made to follow out this suggestion.

It is freely admitted that the expression "*FI* 55" means little to a person who has not already experienced its meaning by actual field work. But to such persons it does present at once an idea of the relative abundance of that particular species, and an idea much more accurate than any such general expression as *common, rare,* or *copious*. Students who have used the method adopt it into their scientific vocabulary and actually use it in their conversation, almost as freely as they refer to degrees of temperature. The writer has heard a student, describing the luxuriant growth of *Epilobium angustifolium* following a recent fire, state that it must have had "a frequency index at least 90," instead of resorting to the usual hyperbole to express great abundance, or, in alluding to a new station for a *Habenaria*, say "There was a good deal of it all through the woods: *FI* probably 5 or 10." And if such a student should read an account of an utterly unfamiliar vegetation in some remote part of the world, in which the frequency indices were given, he would at once have a relatively clear idea of the actual conditions.

Nevertheless, the quantitative study and description of vegetation are still in their infancy, and there is every opportunity for great improvement.

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FURTHER EXPERIMENTAL STUDIES ON SELF-INCOMPATIBILITY IN HERMAPHRODITE PLANTS

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FURTHER EXPERIMENTAL STUDIES ON SELF-INCOMPATIBILITY IN HERMAPHRODITE PLANTS.

By A. B. STOUT.

(With Plates III and IV.)

CONTENTS.

Experimental studies of the compatible and the incompatible relations of the sex organs (including germ cells) in the fertilization of hermaphrodites continue to yield evidence that these relations are highly fluctuating in the progeny of a single cross- or self-fertilized descent. There are all grades in the degree to which both self-compatibility and cross-compatibility may appear, and even the reciprocal matings of two hermaphrodites may give opposite results.

It is clear, as it has been since the time of Darwin at least, that within the species compatibility and fertility, both self and cross, is the rule, and represents the primitive condition, and that incompatibilities are the special cases. Cross-sterility within a species is a relatively rare phenomenon, often accompanied by morphological modifications in the sex organs such as dimorphism. Self-incompatibility is more common, and has evidently a selection or hereditary value which leads to its continuation and intensification whenever it appears.

The very wide distribution of homomorphic species showing self-incompatibilities (and also cross-incompatibilities to some degree) among the families of flowering plants (Gramineae, Liliaceae, Papaveraceae, Cruciferae, Rosaceae, Pomaceae, Amygdalaceae, Solanaceae, Scrophulariaceae, Cichoriaceae, and Compositae, for example) suggests that the condition has arisen many times independently, and may be one of fundamental significance. The generally accepted view that inbreeding and continued self-fertilization are of themselves injurious is certainly favoured by the evidence that self-incompatibility is so obviously a progressive character. The application of this doctrine in these cases is to some extent subject to experimental test, for it would seem that a species whose members exhibit wide variation in self-compatibility affords opportunity to test whether continued selfing is of itself injurious.

Furthermore the intensive study of the fertility of individuals that are feebly self-compatible gives positive evidence as to how the condition of self-sterility has arisen in species originally self-fertile. The marked fluctuation of the character in practically all self-sterile species is especially illuminating on this point.

In continuing my experimental studies (1916, 1917, 1918) of physiological incompatibilities further evidence has been obtained in support of the following general conclusions.

1. In all so-called self-incompatible species investigated, with the exception of *Raphanus sativus* and the dimorphic species *Linum grandiflorum* (which, however, have not been so extensively studied), self-incompatibility and self-compatibility are highly variable in their behaviour; although the variations are generally indiscriminate, there are cases of marked correlation with conditions of age or vegetative vigour operating during the period of bloom, giving such results as "end-season" and "mid-season" self-fertility.

2. There is evidence for considering that in some cases at least embryo abortion is due to physiological incompatibility.

3. The behaviour of further pedigreed progenies of self-compatible parentage in chicory shows that repeated selection does not eliminate the extreme fluctuations though tending toward the establishment and maintenance of highly self-fertile races.

4. Continued self-fertilization in chicory has not led to a decrease in the self-compatibility that exists in any given line and has not given general evidence of decrease in vegetative vigour.

5. All the results favour the view that incompatibilities arise primarily in the ontogenetic processes of physiological differentiation of sex organs, and are not determined by either individual stuffs or line stuffs of definite hereditary value. As far as general constitution is concerned similarity in parents favours fertility. In respect to the ontogenetic processes of sex differentiation the results may be taken as evidence that successful fertilization depends fundamentally on the element of similarity.

REVIEW OF THE MORE RECENT LITERATURE BEARING ON PHYSIOLOGICAL INCOMPATIBILITY IN FERTILIZATION.

The more recent report of studies with rye (Heribert-Nilsson, 1916) favours the doctrine that self-incompatibility is a relative quality rather than that any individual, or any race of this species, is absolutely self-incompatible. Heribert-Nilsson finds, in general agreement with previous investigators, that rye is decidedly self-sterile. Highly self-fertile and feebly self-fertile individuals are however to be found in any population, and he questions whether any plant of rye is really completely self-sterile.

The offspring of self-fertile plants were grown for a study of heredity. Three families were grown to the second generation (his I_3) and two were continued into the third generation. One family which was the largest in regard to the numbers grown and tested (8 plants in the second and 10 in the third generation) maintained a rather high grade of self-fertility, and all plants were self-fertile. The parent (I_1) was judged as 0·4 °/$_\circ$ self-fertile; the one plant of the I_2 was 79·8 °/$_\circ$ self-fertile in field isolation; the self-fertility of the 8 plants of the I_3 ranged from 10 to 68 °/$_\circ$ and that of the 10 plants of the I_4 ranged from 14·6 to 74·1 °/$_\circ$.

Certain lines of descent from self-fertile parentage did not breed true. For example one parent was 4·4 °/$_o$ self-fertile. The self-fertilities of the four progeny were 43·1 °/$_o$, 1·1 °/$_o$, 1·6 °/$_o$ and 0·0 °/$_o$. In the next generation three offspring of the plant 43·1 °/$_o$ self-fertile were all self-fertile (15·5 °/$_o$, 20·0 °/$_o$ and 11·8 °/$_o$), and the three offspring of the plant 1·1 °/$_o$ self-fertile were 0·7 °/$_o$, 0·5 °/$_o$ and 0·0 °/$_o$ self-fertile.

Heribert-Nilsson, none the less, concludes that these feebly self-fertile plants are really heterozygotes. When Heribert-Nilsson states that self-fertility is a recessive character in a simple mono-hybrid relationship with self-sterility, and that self-fertility segregates as a unit in heredity and is immediately constant, he contradicts his own data. His assumption of this simple Mendelian analysis is obviously on *a priori* grounds. The variations in degree of self-fertility in evidence are so great and the number of plants grown is so small that there is certainly no positive evidence that the relative physiological conditions of the sex organs are determined by line stuffs of specific and fixed hereditary values. Obviously the true conclusion is that rye plants are more or less heterozygous as to self-fertility, which is merely another way of saying that they are fluctuatingly variable in their self-compatibility.

Heribert-Nilsson finds evidences of degeneration in self-fertilized lines, both in the quality and viability of seed, and in the vegetative vigour of the offspring, but he questions whether this is due to the immediate physiological effects of selfing, or to an increase in homozygosity. It should be noted that he gives rather meagre data for the two series of sister plants of the I_4 which were most vigorous in vegetative growth. One series of five plants is described as "kraftig" but the self-fertility of its members was evidently not determined. Of another series of nine plants of which it is stated "die Mehrzahl recht kraftig" fertility was determined for only three, and these were all self-fertile (25·8 °/$_o$, 28·6 °/$_o$, 14·6 °/$_o$). It is, however, stated that all seeds of the I_4 were poorly developed, but it appears that the conditions of artificial isolation (glass tubes plugged with cotton) led to vigorous growth of fungi which covered the seeds as they were developing, and this may have been the real cause of the poor viability.

Marked anomalies in the appearance of incompatibilities are seen in the fact that one species may be highly self-fertile while another, but closely related species, may be self-sterile, and hybrids between such species may or may not be self-incompatible. Cases of this sort have been studied by Detjen (1916).

Eleven cultivated varieties directly derived from the blackberry and propagated vegetatively were found to be self-compatible, while of twelve varieties descended from the dewberry ten are self-incompatible. Wild plants of the blackberry (*Rubus villosus*) were found to be self-compatible. Thus it appears that *R. villosus* is a self-compatible species while *R. trivialis* is strongly self-incompatible.

Of the varieties known to be hybrids between these two species, three (McDonald, Sorsby and Spalding) are self-incompatible and one (Rathbun) is partially self-incompatible.

Further data are needed to determine fully whether the compatibility or incompatibility of the hybrid varieties is ever complete and absolute, but it is clear that the self-incompatibility characteristic of one parent appears in various degrees in the different individuals of the F_1. It is reported that the self-compatible plants when self-pollinated "produce apparently as good fruits as when cross-pollinated." In regard to cross-compatibility it is reported that most crosses give successful fertilization; evidently no decided cases of cross-incompatibility were found.

Detjen finds that, in addition to sterility from physiological incompatibility, certain hybrid varieties of the dewberry-blackberry cross are also more or less sterile from impotence of sex organs, as is common in inter-specific hybrids.

A most decided case of variation in sex relations has been reported by Sirks (1917) in the study of cross-incompatibilities in the hermaphrodite species *Verbascum phoeniceum*. Here the reciprocal crossing between pairs of plants gives all grades of opposite results in immediate fertility. In the extremes, both crossings may be highly and perhaps absolutely compatible, or they may be incompatible, or one may be compatible and the other incompatible. In the latter case using one plant as a male and the other as a female gives full compatibility; reversing the relation gives complete incompatibility. Furthermore there are many grades in the comparative fertility of reciprocal crossings between two plants.

This evidence agrees with that which the writer (1916) has presented for chicory, but Sirks' data are much more extensive and conclusive. It may be stated here that while Sirks has not reported on the self-compatibilities of *V. phoeniceum*, my own studies with this species, to be reported later, show that in my strains at least there appears to be no tendency for an end-season change in compatibility that might lead to different results if reciprocal matings were made at different times during the period of bloom.

These cases of difference in the compatibility of reciprocal matings point very clearly to a source of fluctuating variability by no means sufficiently recognized, and that is the complexity of the fertilization processes as revealed by cytological study. It may well make a difference which parent furnishes the male and which the female when we realize the possibility of variation offered in the complex processes of cytoplasmic fusion, nuclear fusion, pairing of homologous chromosomes and the arrangement of the pairs with reference to each other, to the nucleus, and to the cell as a whole.

Sirks recognizes that the conditions in *V. phoeniceum* indicate that "auto-incompatibilité" is a phenomenon of physiological sex differentiation which cannot be ascribed to fixed genotypic constitution nor to the inheritance of specific line stuffs. He suggests that the poor growth of pollen tubes very generally observed in cases of incompatibility may involve osmotropism.

Evidence that self-sterility is somewhat exclusive of, and more specific than, cross-sterility is given by Sutton (1918). The evidence of a wide range of variation in self-compatibility among the various cultivated (propagated asexually) varieties of plum, of cherry and of apple has been confirmed by studies of varieties commonly grown in England. Self-fertile, partially self-fertile and self-sterile varieties are reported in each of these quite as have been found by other investigators. Sutton finds, however, no evidence of cross-incompatibility between varieties except in crosses between the Jefferson variety and the Coe group of varieties of plums. She concludes that otherwise inter-varietal cross-fertility under field conditions depends solely on the production of plenty of pollen and on simultaneous blooming. The varieties of the cherry reported cross-incompatible by Gardner (1913) were not studied by Sutton.

Sutton's data show clearly that a distinction is to be made between fruitfulness involving only parthenocarpy, and fruitfulness with and dependent upon seed reproduction. In the case of the navel orange the size and quality of the carpels are quite independent of any process of fertilization, or even of parthenogenetic production of seed; the pistils however contain normal ovules, and when pollination occurs fertilization results and seeds are formed even in the accessory carpels (Shamel, 1918). Sutton finds in plums and cherries that well formed fruits usually contain well developed seeds; there is close correlation between fruitfulness and seed production, as perhaps is the rule in the great majority of seed plants. In the apple she finds that seedless fruits are frequent and that in some varieties seedlessness does not involve any decrease in the size of the fruit. In some varieties, however, there appears to be a decided inter-relation between fruit-development and seed-development as Ewert (1909) and Kraus (1915) have particularly pointed out. The relation between the conditions which lead to parthenocarpy and those which lead to bulbil formation for example is by no means clear. Evidently there are various types of parthenocarpy; in some cases it is apparently a purely vegetative phenomenon, in other cases pollination seems necessary for its initiation.

The conditions in the fruit-sterile (to self-pollination) and the seed-sterile (seedless) varieties of apple also raise some question as to the stage at which fertilization fails in these cases. Kraus is of the opinion that in self-sterile varieties generally the union of the proper nuclei within the embryo sac is apparently normal (Kraus, 1915, p. 554). If this be true then the incompatibilities come to their expression after fertilization, perhaps as embryo abortion. Ewert (1909) however holds that the more or less rudimentary seeds in the so-called seedless, and in the feebly self-fertile varieties, are largely, if not entirely, due to parthenogenesis. Sutton states that "the stage at which fertilization fails probably differs in various forms."

Recent papers by East and Park (1917), and by East (1918), extend considerably our knowledge of self- and cross-incompatibilities in certain species of *Nicotiana* and their hybrids, and decidedly modify previous statements of fact and theory for these species.

It now appears that *N. Forgetiana*, *N. alata*, *N. glutinosa*, *N. augustifolia*, and various of their hybrid offspring may be self-compatible to some degree and that cross-incompatibility may also be strongly in evidence. The variability of the relations, both self and cross, is hence much greater than was previously reported by East (1915), and in this general condition these species of *Nicotiana* are apparently not fundamentally different from other self-incompatible species.

East and Park also present very interesting evidence that sex compatibilities may show cyclic changes, becoming stronger with the full maturity of plants. They find a decided tendency for incompatibility, both self and cross, to appear during the period of vigorous bloom, and then to disappear near the end of the blooming period.

This indicates most clearly, as I have pointed out above, that incompatibilities, and especially self-incompatibilities, are acquired, and may, under special conditions, give way to the original primitive condition of full self-fertility. The whole set of conditions favours the conception that compatibility depends on similarity of gametes. Acquired differences which result in self-incompatibility have marked selective value only to the advantages in variability resulting from limiting sexual reproduction to crossing between individuals or races.

Further evidence of variability in the relations of incompatibility is seen in the fact that self-fertility is more pronounced in *N. alata* than it is in *N. Forgetiana*. It is interesting to note that East and Park consider that these conditions and differences can be so fully disregarded in judging heredity that each species can be called fully self-sterile, and be described as homozygous for a single unit factor (or possibly multiple factors) solely concerned with the hereditary transmission of self-incompatibility.

East and Park have made the most extensive studies of reciprocal crosses that have thus far been reported. Their facts show a considerable variation in the reciprocal relations of two individuals, but they believe that this is solely due to experimental error and to differences in maturity of the individuals, and that reciprocal matings should give the same results provided end-season conditions are not involved. They decide, therefore, that the condition of compatibility or incompatibility between sex organs (including the gametophytic generation) is determined for a plant as a whole rather than for sex organs as such. This view is decidedly at variance with the results which Sirks, and also the writer have found, as noted above.

East and Park consider that inbreeding or breeding from self-fertile plants increases the amount of cross-incompatibility; the marked or very general cross-incompatibility of a progeny being ascribed to increased homozygosity. This assumption seems to have some evidence in its support, but it has by no means been rigorously tested and adequately proven.

The point of view of East and Park is that incompatibilities, both self and cross, are not fundamentally phenomena of sex differentiation, but are properties of plants as wholes predetermined by line stuffs. The emphasis is placed on a Mendelian description in terms of hereditary units. They recognize that characters and factors representing them are very generally variable, but prefer to regard the marked variations in self-fertility as a "pseudo" fertility of no genetic significance and to assign the decided variation in the grouping of cross-incompatibilities to variations in linkage relations.

The available data on cross-incompatibilities in different species indicate marked variation in the group relations. East and Park report that the members of a seed progeny fall into classes which exhibit intra-class sterility but complete inter-class fertility. Thus if any two plants of a progeny are cross-sterile they will behave the same to a third plant. This rule does not agree with the relations reported by Correns (1912) for *Cardamine pratensis*, nor with the still different relations which Sirks reports for *Verbascum phoeniceum*.

East and Park give conclusive evidence that there is wide variation in the number of groups, and the number of individuals in the various groups within a seed progeny. For example, in one progeny of 53 plants there were three well defined groups of 22, 16 and 12 individuals; in another there were five groups of 8, 3, 4, 3 and 2 plants; another progeny of only 18 plants fell into six classes (4, 5, 3, 2, 2 and 2); another was composed of six classes of 4, 5, 7, 5, 3 and 3 plants; another showed marked inequality of four classes with 34, 11, 4 and 2 individuals per class. East and Park assume that these irregularities are due to variability in linkage relations. Their further assumption that the pollen grains of a plant all operate alike does not hold for many feebly compatible self- and cross-fertilizations that are operating periodically or indiscriminately. The variations in cross- and group-relations are quite in harmony with the wide variations that appear in the sex relations of the organs produced by individual plants.

PRESENTATION OF NEW DATA.

I. *Relation of vegetative vigour and maturity to variations in self-fertility and self-sterility.*

End-season fertility is one of the clearest evidences of the fluctuating nature of the relations of the sex organs in plants that are feebly self-incompatible. It indicates, as does also mid-season self-fertility, the cyclic nature of life processes, and supports the doctrine that sexuality is itself fundamentally a function of maturity.

In the experiments here reported controlled self-pollinations at frequent dates throughout the entire period of bloom were made. The evidence is clear that end-season fertility is comparatively rare, and is not a condition commonly operating in and characteristic of self-incompatible species. In the species in which it is found it occurs together with variations that operate from the first day of bloom.

Verbascum phoeniceum.

The habit of growth in this species is especially favourable for the study in question. Flowering begins when the plants are still in vigorous vegetative condition. The flowers are borne on loose racemes which make most of their growth after the first and lowermost flowers bloom. The rosette leaves begin to die during the flowering period, are usually dead at the end of the period of bloom, and the stems and their leaves, and often the whole plant, die at the maturity of fruit. The most terminal flowers usually fail to develop, obviously because of waning vigour. Flowering begins when the plant is in vigorous vegetative condition and continues during the gradual decline in vigour and the approach of death.

The entire main raceme can be enclosed in a semi-transparent "glassine" bag which can be shifted as the raceme elongates. Lateral branches which bloom somewhat later than the main stem may be treated likewise. In testing the plants pollinations were made at intervals of from 2 to 5 days, as conditions admitted, throughout the entire period of bloom. All pollinations were made by hand during the forenoon when corollas are not wilted and the freshly opened stamens contain much pollen. Flowers thus treated were properly tagged, and record made in a card file which was carried in the field. Forceps used in the manipulations were dipped in alcohol and the hands were washed in water after each plant was worked. Under such treatment plants highly self-fertile set fruit and seed throughout the entire period of bloom, and compatible crosses were likewise successful.

A series of 69 sister plants was grown in 1918 from seed of a cross between two self-sterile plants. These parent plants had shown themselves self-sterile throughout the first half of their period of bloom in the case of about 50 flowers self-pollinated under control. The seed was sown in January 1918 and the seedlings were grown in pots until May when planted in rows in the garden. Under this treatment flowering began in June. The periods of bloom ranged from 16 to 39 days. The number of flowers hand-pollinated per plant ranged from 45 to 244, and the total number of flowers hand-pollinated was 7703.

Two plants were highly self-compatible, 9 were feebly self-compatible and 58 were completely self-incompatible. The two first mentioned produced fine capsules from nearly every flower that was self-pollinated by hand (numbers were 58 and 183). In feebly or partially self-fertile plants, as a rule, a small proportion of flowers produced pods, and these were small and contained relatively few seeds; seven of these were feebly self-fertile from the first few days of bloom to the end of the blooming period.

For one plant, judged as partially self-fertile, pollinations were made on 14 different dates for a total of 244 flowers of the main and three lateral racemes. A total of 49 pods were produced and these were scattered over the racemes from the first to the very last of the flowers that were pollinated; many pods had no seed and the highest number for any pod was 18.

The following is the record for one (No. 8) of these self-fertile plants. The dates of pollination are given in italic, the number of self-pollinations that failed is indicated by roman, and the number of flowers that produced pods is given in bold face. The main raceme began bloom *June 6*, 2 flowers not pollinated; *8th*, 4 + **1**; *10th*, 9; *12th*, 4 + **2**; *13th*, 4 + **3**; *17th*, 12; *19th*, 8; *21st*, 4; *25th*, 3; *28th*, 3 which were the last on the main stem: for a large lateral branch from base of plant; began bloom *June 24th*; *25th*, 7 + **3**; *28th*, 11; *July 3rd*, 9 + **1**; *9th*, 10; *13th*, 6. The ninth plant classed as self-fertile produced 13 pods out of 26 flowers pollinated on first four dates, but gave not a pod in the 76 flowers self-pollinated on later dates.

Not a single pod was produced in the controlled self-pollinations by any of the 58 plants judged to be completely self-incompatible. As many as 288 flowers for a single plant were selfed and special effort was made to continue pollinations in one or more lateral branches as well as in the main branch until the last flower bloomed. One of these plants had a second period of bloom. The main stem and its immediate laterals bloomed from June 13 till Aug. 18. Later a branch arose from among the rosette leaves which bloomed from Sept. 14 until Oct. 4. The flowers on this branch were all self-sterile.

Every plant of this series was highly productive in pods when the flowers were subject to free open cross-pollination by insects. Numerous tests of the self-fertile plants by emasculation of flowers showed that parthenocarpic fruits and apogamous seeds were not formed.

Another series of 40 sister plants was grown from seed of a plant that was highly self-fertile from the first date of bloom.

Twenty-four of these plants were almost completely impotent as males but fully potent as females. The stamens were contabescent, not a single anther sac was observed to dehisce, and repeated examinations of the contents showed that at least 95 °/₀ of the pollen was shrivelled and empty. On three other plants, a few anthers were observed to dehisce partially, but in these the pollen was likewise largely impotent. All these plants produced corollas that opened normally, and every one produced large capsules with seed to free open cross-pollination. These plants exhibited a one-sided impotence identical with that observed in various species, such as in certain so-called self-sterile varieties of cultivated grapes and of the navel orange.

Twelve plants were fully potent both as males and females. They bloomed from 16 to 28 days, and controlled self-pollinations were made for from 20 to 64 flowers per plant. Five were completely self-incompatible, two were partially self-fertile, and five were highly self-compatible. The latter gave fine large pods in nearly every flower from the first to the very last to bloom. Of the partially self-compatible plants, one produced pods only on first two dates of selfing, and the others produced numerous but small pods indiscriminately throughout the period of bloom.

Summary. There was no evidence of "end-season" self-fertility in any of these plants. Plants were strongly or feebly self-fertile from the first flower that opened, and all plants completely self-incompatible during the first part of the blooming period remained thus to the end. In some cases of feeble self-fertility the self-fertility appeared to be confined to the early and mid-season period of bloom.

Eschscholtzia californica.

For the seed of this species the writer is indebted to Professor W. T. Horne, who collected it from individual plants growing wild on or near the campus of the University of California. Seeds of each of 5 plants were sown separately during March, 1918. All but three of the plants were grown in pots in a greenhouse. Flowers were enclosed in glassine bags and allowed to make autonomous self-pollination, a procedure that supplies an abundance of pollen to stigmas at a time when they are receptive to compatible cross-pollinations. The dehiscence of the stamens of individual flowers continues for several days, during which time the stigmatic branches of the pistil elongate, coil about among the stamens and become covered with pollen. Pollen and stigmas in this stage used in crossing most often give a rapid development of fruit and seeds.

Series 1. Twenty-nine sister plants bloomed from 15 to 58 days. From 5 to 15 flowers per plant, and a total of 236 flowers, were allowed to self-pollinate under bags. Special effort was made to include the last flowers that bloomed.

Seventeen plants were completely self-incompatible and did not even produce small pods. Four plants produced small pods in nearly all flowers selfed but all the pods were empty. Eight plants produced pods for nearly all flowers selfed, and some seeds were present. The total number of seeds per plant for these was as follows: 14, 10, 5, 3, 2, 2, 1, and 1. One of these gave 2 and 12 seeds in the second and third flower that opened, while the 8 selfed on later dates gave only empty pods. Another plant gave 1 and 4 seeds in the first and third flowers to open. Another gave 3 seeds for 1 flower, the next to the last to open. The others produced seed as noted in single pods for flowers that opened near the mid-season of bloom.

A plant of this series was planted in my home garden and allowed to bloom in the open. Under such treatment many more flowers are produced than when grown in pots. The plant bloomed from June 13 until Aug. 19. As many as 245 flowers were tagged for special observation. In the majority of cases no semblance of pods developed; in a small proportion, rudimentary pods about 2 cm. in length developed. The third flower to bloom produced a pod 3 cm. in length with 3 seeds; other pods from 2·5 to 3 cm. in length were produced for flowers opening on the following dates and contained seed as indicated: *June 30th*, 3 seeds; *July 1st*, 6 seeds; *2nd*, 5 seeds; *4th*, 2 seeds; *6th*, 1 seed; *8th*, 3 seeds; *12th*, 3 seeds. Many flowers opening on the same and on intervening dates produced no pods and seeds, and 143 tagged flowers selfed on 21 dates later than July 12, all failed to produce seed. This plant was repeatedly crossed with a plant of another series and proved to be highly productive of seed, giving from 70 to 101 seeds in capsules that were often 10 cm. in length.

Series 2. Forty-one plants descended from a single seed parent were grown in pots. They bloomed for periods of from 12 to 63 days. From 5 to 18 flowers per plant were self-pollinated under bags. The total of all flowers thus treated was 337. Fourteen plants were completely self-sterile and produced no pods; 15 produced small pods in nearly every flower but these contained no seeds or only shrivelled rudiments of seeds; 11 plants produced small sized pods (2 to 6 cm. in length) with only a few seeds; and 1 plant was highly self-fertile. The results for some of the 11 plants feebly self-fertile may be given.

One plant bloomed for 51 days; 18 flowers selfed produced 18 pods, none over 5 cm. long; 6 pods contained seeds as follows: 1, 2, 3, 2, 1, and 3, all in flowers that opened during first 28 days of bloom; no seeds were produced in 7 flowers self-pollinated during the last 23 days of bloom.

Another plant bloomed for 58 days, 8 flowers were selfed, all produced pods with seeds in 5 pods as follows: 1, 1, 3, 7, and 2, and in this case the first flower to open produced 1 seed and the very last 2 seeds.

One plant produced 2 seeds in each of the first 2 flowers to open but none in the 7 flowers tested later.

One plant gave 9 and 6 seeds in 2 pods from flowers that opened during the mid-period of bloom and none in flowers pollinated earlier or later.

The other seven of the partially self-fertile plants produced capsules and seeds as follows: 13 capsules, 1 seed; 11 capsules, two with 1 seed each; 6 capsules, one with 2 seeds; 13 capsules, 1 seed; 8 capsules, 1 seed; 8 capsules, 1 and 2 seeds; 5 capsules, 1 seed. In all of these the capsules bearing seed were from flowers that opened before the mid-date of bloom.

The single plant that was classed as highly self-fertile bloomed for 18 days and had only 6 flowers; three of these self-pollinated, gave fine pods bearing 26, (seed lost), and 15 seeds each. The first flower to open gave 26 seeds.

One plant of this series was grown in isolation in the field. It grew vigorously, made a spread of nearly 8 feet in diameter, began bloom on June 21st, and was still blooming on Nov. 6th when freezing temperatures occurred. During the latter part of July and the first week of August as many as 100 flowers opened each day. Insect visitors were abundant during most of the flowering period and carried much pollen from flower to flower, besides the autonomous fall of pollen to stigmas. The plant was examined at intervals of about every third day and during the earlier and later portions of the blooming period all flowers opening on those dates were tagged. During the height of bloom many of the flowers (up to 35 per day) were tagged. A total of 928 flowers were tagged and examined later, and at least as many more opened. Not a single ovary enlarged to a size of more than 1·5 cm. in length. The plant was completely self-sterile producing neither seeds nor empty pods. On four widely separated dates the plant was crossed with a plant of *Series* 1, and every pistil produced a fine large pod with many seeds.

Series 3. There were 43 plants in this series all of which were grown in pots. Periods of bloom varied from 28 to 69 days. The number of flowers self-pollinated per plant ranged from 6 to 25 and the total was 474. Thirty-six plants were completely self-sterile and did not produce pods. For 5 plants, empty pods of small size developed for flowers selfed. One plant gave a single pod with 6 seeds out of 18 flowers self-pollinated, a result that may be attributed to experimental error. Large fine pods with numerous seeds were frequently and very generally produced from flowers that bloomed in the open and were subject to cross-pollination by insects.

Series 4. The 46 sister plants of this series grown in pots bloomed for periods of 11 to 70 days. From 6 to 18 flowers per plant were selfed under bags, and the total for all such flowers was 513.

Thirty-two plants were completely self-sterile to the extent that pods were not formed. For 11 plants the pistils of flowers selfed enlarged somewhat and occasionally one was so much as 4 cm. in length, but all were either entirely empty or contained only shrivelled seeds.

Three plants produced seeds as well as pods. For 1 plant, only 1 pod had seed (the number was four) and this was of a flower that opened 24 days after first flower, and 20 days before last flower of the period of blooming. On another plant, 3 seeds from the first flower to open, and 3 seeds from a flower that opened near mid-season were all that developed for the 10 flowers selfed. A third plant produced 2 seeds for a flower that opened at mid-bloom while 7 selfed on later dates gave no seed.

One plant was grown in isolation in the field. It bloomed for 40 days, and 97 flowers in all were tagged for special observation. In these as in all other flowers no pods developed.

Series 5. Thirty-nine plants of this series were grown in pots. The periods of bloom ranged from 13 to 62 days. The flowers selfed under bags ranged from 4 to 13 per plant, and the total for all such flowers was 263. Twenty-nine plants were completely self-sterile forming no pods; 8 produced empty pods of small size; 2 plants produced seed as follows: for 1 plant 12 flowers were selfed and the first flower to open gave 3 seeds, all others produced empty pods: for another plant of 9 flowers that opened, 4 were selfed and these gave 6, 8, 7 and 8 seeds respectively.

Summary. In these five series the greater number of plants were completely self-sterile throughout the entire period of bloom. Self-compatible plants were in larger proportion in some series than in others. With only one exception the self-compatibility was feeble. It is clear that self-compatibility exhibited no tendency to develop as an "end season" fertility.

A most striking type of seed sterility was seen in the considerable number of plants that produced pods which were empty. In the feebly self-fertile plants, as a rule, the few good seeds that were developed were located in the upper end of the capsules. The considerable number of poor seed present both in pods containing few seeds, and in empty pods, suggests that incompatibility may operate after fertilization, producing embryo abortion. The results here obtained also suggest that some seedless pods may develop as a direct result of the stimulus of pollen tube growth, and more obviously that the size of pods bears a relation to the number of ovules fertilized.

Nicotiana Forgetiana Hyb. Hort.

Series 1. In 1917, the writer, assisted by Miss Helene Boas (now Mrs. Cecil Yampolsky), tested the self-compatibility of 58 plants of *N. Forgetiana* Hyb. Hort. Controlled self-pollinations were made by hand on successive dates using the same method employed for *Verbascum phoeniceum*, except that bags were shifted from branch to branch. In all cases the pollinations were begun during the first days of bloom.

On the basis of their self-compatibility and incompatibility these plants may be grouped in three classes.

(1) Eleven plants were highly self-fertile from the first day of controlled self-pollination. There were only 3 flowers out of 95 selfed that failed to produce pods. The capsules were large and well filled with seeds. As soon as it was found that a plant was self-fertile no further controlled pollinations were made.

(2) Eight plants were feebly self-compatible. Capsules were produced in relatively few of the selfed flowers, and these were small and contained few seeds. For 6 plants some pods developed in flowers of the first date of selfing; in the other 2 plants pods were formed from flowers of the second date of selfing. All these plants, however, were partially self-compatible during the first days of bloom.

(3) Thirty-nine plants were completely self-incompatible to all controlled selfings made, which were extended to well past the climax of bloom in all cases and for 10 plants the selfings were continued to the last date of bloom.

The plants of this series were grown from commercial seed and there was considerable variation in the colour of the flowers. Several conformed closely to the original description (Hemsley, 1905) of *N. Forgetiana*, but these were also plants whose flowers were of lighter and of darker shades of red, and there were green-flowered and white-flowered plants.

It may be noted here that no pure stock of this species was ever kept in culture from the original and only importation of seed obtained from a wild source. In reply to inquiry, the author learns the following by letter from the firm of Sanders of St Albans, England, who made the importation: "We never sold any of the original stock. We simply kept them for hybridizing purposes, afterwards selling the entire lot together with the seed. We had previously secured a batch of really fine new crosses with *N. affinis*, etc. resulting in a lovely set. When these plants were in full bloom in all the shades of rose, purple, white, pink and crimson the effect was magnificent. We did not continue with the growing of the Nicotianas but sold our stock. We regret very much having lost this remarkable species."

Series 2. A self-fertile plant of the 1917 crop which appeared to be identical with the original description of *N. Forgetiana* was the parent of 24 plants grown under field conditions. Guarded self-pollinations were made by hand at frequent dates from the first to the very last day of bloom.

Eleven plants were entirely self-incompatible. They bloomed for periods of from 22 to 65 days, and the total of all flowers selfed was 377.

One plant was judged as fully self-compatible. It produced fine pods in all flowers selfed on the first, second and fifth days of bloom. No controlled selfings were made thereafter.

The other 12 plants were partially or feebly self-compatible. The complete data for these would occupy much space, but as the results have a very special bearing on the variations in self-fertility they can be summarized, at least for several plants which are typical for the results.

One plant began blooming on July 27 and was still blooming on Nov. 6 when there was a heavy frost. A total of 80 flowers was selfed on twenty different dates. On the third day of bloom the fourth flower to open produced a pod with seeds; 2 pods developed from the 2 flowers that opened on the fourth day; one of 2 flowers selfed on the twelfth day developed a pod; 3 selfed on the seventeenth day gave pods; on Sept. 4th, 6 out of 10 flowers selfed gave pods, but on ten dates immediately preceding, self-pollinations of 27 flowers all failed. From Sept. 4 until the end of the season about half of the flowers selfed produced pods and seeds. In respect to the proportion of flowers which produced pods, the self-compatibility of this plant appeared to increase toward the end of the period of bloom. The plant was, however, somewhat self-compatible from the first.

Another plant bloomed from Aug. 29 until Oct. 24. Two small pods were obtained from two flowers selfed on the tenth day of bloom while 16 flowers selfed on five earlier dates entirely failed; 51 flowers selfed on seventeen later dates, and including several of the last to bloom, all failed.

For another plant, of 38 flowers selfed on eleven different dates, there were 10 pods of scattering dates from the first day of bloom.

A plant that bloomed for 80 days was tested in 45 flowers on eighteen dates. Only two small pods developed; one on the eighth, and one on the twenty-sixth day of bloom.

Another plant gave 10 pods at scattering dates from the fifth day of bloom to the last date, 55 days later.

A plant which bloomed for 63 days was tested in 51 flowers; two small pods were produced, one on second day of bloom and one on the thirtieth. Twenty-two flowers selfed on later dates failed.

The complete record for one plant may be here given with dates of pollinations, failures indicated by 0, and capsules by P. *Aug. 6th,* first flower, 0; *9th,* 0, 0; *12th,* 0; *14th,* 0, 0; *16th,* 0, 0, 0; *19th,* 0, 0; *21st,* 0, 0, P; *24th,* 0, 0; *Sept. 4th,* 0, 0; *6th,* 0, 0, 0, 0, 0, 0, 0, 0, P; *9th,* 0, 0, 0, 0, P; *11th,* 0, 0, P, P, P; *14th,* 0, 0, 0, 0, 0; *16th,* 0, P, P; *21st,* 0, 0; *24th,* 0, 0, 0, 0; *28th,* 0, 0, 0; *30th,* 0 and the last flower. This plant was feebly self-fertile but its self-compatibility was mid-seasonal rather than end-seasonal.

Six sister plants of this series were grown to maturity in pots in a greenhouse, a treatment which greatly reduces the number of branches and flowers. These plants bloomed for periods of 9 to 51 days. Four were completely self-incompatible. Two were feebly self-compatible. For one of these the record is as follows: *Aug. 10th,* began bloom, 0, 0; *14th,* 0, 0, 0; *16th,* 0, 0; *19th,* 0, 0; *22nd,* 0, 0, 0; *Sept. 3rd,* 0, 0, 0, P; *9th,* 0, 0, P; *11th,* 0, 0, P; *16th,* 0, P. This plant exhibited a good case of end-season self-fertility. Another plant bloomed for only eighteen days and produced but 10 flowers, 6 of which were selfed with the following results: *Sept. 3rd,* 0; *9th,* 0; *11th,* P; *16th,* P, P; *20th,* 0.

All the self-sterile plants produced fine pods for the greater number of flowers which bloomed in the open subject to cross-pollinations by insects and humming birds. Numerous tests for parthenocarpy and apogamy were made in self-fertile plants but in no case did pods form.

All plants of this series were remarkably uniform in general habit of growth and in flower colour. In all respects the plants seemed to conform closely to the characteristics of the original plants of *N. Forgetiana.*

Series 3. These plants were grown from selfed seed of a green-flowered plant which was highly self-compatible from the first day of bloom. Of the 13 plants grown in the field, 12 were highly self-compatible in every flower tested during the first five days of bloom; no later tests were made. One plant was completely self-incompatible; it bloomed for 58 days, was tested on twenty dates with a total of 64 flowers including some of the very last to flower.

Of 4 sister plants grown in the greenhouse, 3 were fully self-compatible and 1 was feebly self-compatible from the first day of bloom.

This series was very uniform in general habit of growth and in flower colour. The corollas were greenish white with the inner face becoming white with age.

Summary. The results show conclusively that there were plants fully self-compatible or completely self-incompatible throughout the entire period of bloom. The partially self-compatible plants were rather irregular in production of pods to selfing. Many were partially self-fertile from the first date of bloom and exhibited no decided change in this relation thereafter; in others the self-compatibility was most pronounced or was confined to the earlier part of the period of bloom, to the season of mid-bloom, or to the last part of the blooming period. The cases of decided end-season self-fertility were few, and constituted a small proportion of the partially self-compatible plants.

Brassica pekinensis.

Experiments with this species have given results which show that a few plants are highly self-fertile, but that the greater number are self-incompatible. At least some of the self-compatible plants exhibit several well defined stages or types of sterility in the succession of bloom: (1) flowers blast or fail to develop; (2) flower parts develop and open normally but abscission of pistil soon follows after self-pollination, or the pistils remain attached for a longer time but fail to develop into pods; (3) a period of fruit and seed production; (4) a period same as (2); and (5) failure of flowers to open normally or even their blasting as in (1). In self-incompatible plants the period of fruit and seed production to selfing is omitted. In certain plants stage (1) is omitted. In one self-fertile plant stage (5) was omitted in the main branches. The lateral branches which bloom later than the main ones usually omit certain of the earlier stages exhibited by the latter. The evidence seems conclusive that when compatible cross-pollination is made there is production of fruit and seed in any stage except (1) and (5). The highest degree of self-compatibility appears to develop during the mid-season of bloom.

During the latter part of the period of bloom (designated above as period 4) there is usually a poor development of pods and these may contain only partly formed seeds in which embryo abortion has taken place. This is evidently due to the rapid decline and death of the entire plant.

Raphanus sativus.

It can here be reported that some cultivated varieties of this species are decidedly self-incompatible. Nearly 50 plants of three varieties grown to maturity in a greenhouse have completely failed to produce pods to self-pollination. Of plants tested thus far only one has shown signs of self-fertility. It was grown in the field, bloomed from June 22 to July 13, and produced 223 flowers many of which were selfed by hand. Six small pods were produced, each containing from 1 to 2 seeds. All these were for flowers which opened during the mid-season of bloom. Further studies with varieties of the radish and also of the Chinese cabbage are in progress.

Lythrum Salicaria.

The marked sterility of this trimorphic species to self, to intra-form, and to inter-form illegitimate pollinations was noted by Darwin (1865). His experiments revealed, however, that self-fertility is somewhat in evidence especially in the mid-styled plants.

My own experiments with this species have thus far been confined chiefly to the growing of plants in isolation for the observation of seed production when subjected to free self-pollination by insects. The results thus far obtained show (1) that short-styled plants set very few pods; (2) that long-styled plants are feebly self-fertile and that (3) mid-styled plants are often decidedly self-fertile. One mid-styled plant grown under constant observation in my own garden has shown a decided increase in fertility at the end of the period of bloom. All other plants tested have shown quite a uniform degree of self-compatibility throughout the entire period of bloom.

End-season self-fertility in this species has to date been observed in only one plant. This condition seems to develop as an individual variation and not as a phenomenon characteristic of self-incompatible plants.

Linum grandiflorum.

Numerous tests for self-fertility have been made especially at the end of the period of bloom for both long- and short-styled plants of this species. Plants that made a vigorous growth in the field have been cut back, replanted in pots and grown during the winter in a greenhouse. Such plants bloomed profusely in isolation and hundreds of self-pollinations were made by hand. All self-pollinations have failed completely. The species appears to be completely self-incompatible. All intra-form crosses which were made failed, but there was always marked fertility in inter-form crosses. The relations in crosses were however not extensively tested.

Cichorium Intybus.

It should perhaps be stated here that the evidence already reported for wide variation in self-compatibility in this species does not involve a mingling of data collected at early and late periods of bloom, nor has there been any comparison between such data. An examination of the records for dates and periods of flowering shows that in no case have controlled pollinations been begun later than the tenth day after the first flower head opened, and that for 95 °/₀ of all plants studied pollinations were begun during the first three days of bloom and continued over an interval which seldom extended to the mid-date of bloom.

In the more robust races, and especially in the variety red-leaved Treviso, the period of blooming often continued until plants were killed by heavy frosts early in November. Toward the end of the period of bloom relatively few flower heads open, and these are rather scattered. During the latter part of September and in October many flower heads open irregularly and poorly, and when plants are killed by frost the seed in many heads is immature. I have therefore never made any pollinations of this species later than the 6th of September. It has been most convenient, and it has afforded a most uniform treatment as well, to begin pollinations within the first three days of bloom and to continue until about the tenth day. Especially for the plants of the variety red-leaved Treviso this covered but a small part of the period of bloom.

Controlled self-pollinations have been continued for a longer period than was the rule, in the case of certain plants found to be self-compatible and from which considerable seed for planting was desired. Seed production has been somewhat irregular but there has been no case of decided increase in self-fertility as the plant progressed in bloom. Cases showing the opposite condition have been found, but this was not known in time to make tests to determine if *all* seed production was not also decreased.

Efforts have been made to test for end-season fertility, especially in a line of red-leaved Treviso which has a somewhat shortened period of bloom. In 1918, 10 plants, the first to flower in each of two series, were thus studied. The plants that were completely self-incompatible during the first ten days of bloom, in tests of about 30 flower heads, remained completely self-sterile throughout. The only decided variation in fertility observed in self-fertile plants was in the direction of a decrease. Data may be given in detail for 4 plants which illustrate the results obtained.

Plant *R 12–11–59, no. 53.* A plant feebly self-compatible from the first day of blooming and judged to be 4 °/₀ self-compatible. Bloomed from July 11 to Aug. 21. The dates of pollinations and number of seed per head were :—*July 12th*, 0, 0, 0, 2, 4, 7 ; *16th*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 7, 8 ; *22nd*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2 ; *25th*, 0, 0, 0, 0, 9 ; *29th*, 0, 0, 0, 0, 1 ; *Aug. 2nd*, 0, 0, 0 ; *15th*, 0, 0, 0, 0, 2, 2. From Aug. 5th until the 21st few and scattered flower heads were produced and the branches were dying and becoming dry and brittle. The heads tagged for selfings were well distributed over the plant.

Plant *R 12–11–59, no. 2.* Bloomed from July 1 until Aug. 20. Record as follows :—*July 2nd*, 0, 5, 11 ; *5th*, 0, 3, 6 ; *8th*, 0, 0, 0, 0, 0, 1, 3, 8 ; *12th*, 0, 0, 0, 0, 0, 2, 4, 9 ; *16th*, 0, 0, 0, 0, 0, 0, 0, 0, 0 ; *Aug. 8th*, 0, 0, 0, 0, 0 ; *12th*, 0, 0, 0, 0, 1. These results seem to indicate that the plant was feebly self-compatible at first but less so later.

Plant *R 12–11–59, no. 6.* Bloomed from July 12 until Aug. 23. A completely self-incompatible plant. Dates and number of heads given :—*July 12th*, 2 ; *15th*, 15 ; *18th*, 5 ; *22nd*, 12 ; *25th*, 6 ; *29th*, 5 ; *Aug. 2nd*, 6 ; *5th*, 5 ; *7th*, 10 ; *8th*, 7 ; *9th*, 4 ; *17th*, 2 ; *19th*, 1. All heads failed completely as shown in fig. 1 of Plate III. There were no partially formed seeds.

Plant *R 12–11–49, no. 79.* A plant completely self-incompatible. All the pollinations here recorded were made by hand. Plant bloomed from June 21 until Aug. 13. Dates and number of heads selfed are as follows :—*June 21st*, 2 ; *24th*, 1 ; *26th*, 5 ; *28th*, 8 ; *July 2nd*, 10 ; *5th*, 5 ; *10th*, 6 ; *21st*, 5 ; *23rd*, 4 ; *26th*, 3 ; *Aug. 4th*, 8 ; *6th*, 3 ; *8th*, 1 ; *9th*, 1 ; *12th*, 1.

It is quite probable that a larger number of pollinations during the early portion of the period of bloom, or an extension of tests over a longer portion of the time of blooming, would show that plants judged as self-incompatible were somewhat feebly self-compatible. The tests made show that plants may be highly self-fertile, partially self-fertile, or completely self-sterile from the very first date of bloom. If end-season self-fertility does develop my results are in error in that plants classed as self-incompatible may later have become somewhat self-compatible. Apparently in chicory the entire range of variability in the self-fertility of individuals is seen during the first few days of the period of bloom.

II. *Evidence that self-incompatibility may lead to certain cases of embryo abortion.*

For plants of chicory that are fully self-incompatible only mere rudiments of achenes develop and the entire head which is selfed becomes shrivelled as is shown in 1, 2, and 3 of Plate III. The numbers 4, 5, and 6 of the same plate show the well filled heads containing seeds with embryos from flower heads of the same plant cross-pollinated on the same day that the heads of figs. 1 and 2 were selfed. The conditions here shown are typical of self-incompatibility, and are proof that (1) the sex-organs are potent and capable of functioning in certain relations and that (2) the plant is able to nourish embryos when there is compatible fertilization. It seems clear that embryo abortion of any sort, and especially that involving a condition of vegetative vigour, is not operating in such extreme cases of incompatibility.

For the feebly self-compatible plants, however, there is usually a rather graded series of more or less developed but empty achenes as is shown in 7 and 8 of Plate III. At *a* of no. 7, is a group of 14 mere rudiments of achenes, at *b* are 5 achenes of good size but entirely empty, and at *c* is one good achene with an embryo; these are all from a single head of a plant judged as feebly self-compatible. No. 8 shows a graded series of 16 empty achenes and four good seeds, two of which were crushed to determine if embryos were present.

No. 9 shows 11 good seed, 2 empty achenes which appear externally to be good seed, and 7 that are obviously shrivelled and empty.

Thus in the partially self-fertile plants there are usually present in those heads which have good seed some achenes which are considerably developed but which contain no embryos at maturity. Possibly the development of a few seeds has an influence on the phenospermic (using term of Goodspeed, 1915) development of certain others of the head which were not fertilized. It may be, however, that in some of these phenospermic achenes embryo abortion occurs as an expression of incompatibility after fertilization. This appears also to be the case for feebly self-fertile plants of *Eschscholtzia californica* as noted above. The ability of such plants to produce abundant seed to compatible cross-pollinations at the same time that phenospermic seeds are produced among heads selfed indicates that any embryo abortion which may occur is associated with incompatibilities rather than with inability of parent to nourish young embryos. It is to be recognized however that in chicory the development of the head as a whole may in large measure depend on the number of ovules fertilized properly, and that the development of the individual seeds in a head may thus be influenced by local relations. If such is the case, the effects would be most liable to appear in plants partially or feebly self-compatible.

Considerable cytological investigation has been directed to the study of these conditions in chicory, but at the moment of writing the observations are not conclusive as to the extent to which true embryo abortion may occur. The results, however, indicate that in plants fully self-incompatible there is complete failure in fertilization due to the poor growth of pollen tubes. In plants feebly self-fertile there appear to be various stages at which the processes of fertilization may fail.

III. *The heredity of self-compatibility in self-fertilized lines of descent in the variety red-leaved Treviso of Cichorium Intybus.*

The immediate parents of this generation were highly self-fertile plants which had descended from three generations of ancestry known to have been self-sterile at least during the early part of their period of bloom. The race had been kept in culture by rather close inbreeding. This generation therefore afforded material for the study of the heredity of self-fertility after it has arisen sporadically in an inbred variety.

The number of plants grown in the I_1, and also the I_2, was so large that it was impossible to test all of these by controlled hand pollination (described 1916, p. 362) as was done in previous studies with this species. The plants were tested by autonomous self-pollination. Flower heads were allowed to open and close under a bag. Such heads were appropriately tagged and allowed to continue development in the open. As a rule flower heads of chicory are open but a few hours during the forenoon; by midday they are closed never to open again, and the next day the corollas and styles fall. The entire afternoon can be devoted to shifting bags, and tagging heads. Bags need to remain enclosing a group of branches for only 24 hours. By beginning on the first or second day of bloom and shifting a bag about three times, about 30 flower heads per plant can readily be selfed during the first ten days of bloom.

The I_1 generation.

Tests for self-compatibility were made for 351 plants of the I_1 generation which were grown from the self-fertilized seed of 3 self-compatible plants. The presentation of data for all these plants would involve rather extended tables, hence complete data will here be given only for certain self-compatible plants which are fully representative of the results obtained, and illustrate the range in the percentages of self-compatibility. In the following tables dates of pollination and number of seed per head are given. The period of bloom is given for the I_2, but for the I_1 the last dates of blooming were not recorded. The percentage fertility for all plants of the I_1 and I_2 is based on the proportion of flowers (estimated at 20 per head) which produced seeds, and the percentages for the few self-fertile plants obtained previously are here also thus determined. A general summary showing distribution according to the degrees of self-fertility is given in Table IV (p. 115).

Series R 12–11– . The immediate parent of this series was one of evidently high self-fertility (1917, Table I). It was, however, the only one of 18 sister plants which was found to be self-compatible. Of this series 35 plants were self-incompatible and 26 were self-compatible. Data for 8 of the latter are given in Table I (p. 110).

Series R 10–8– . The 177 plants of this series were grown from the selfed seed of a plant (*R 10, no. 8*) whose self-compatibility is here estimated at 55 °/₀. This plant was the only one of 10 sisters to set seed to selfing. Of the series, 128 plants were completely self-incompatible and 49 were self-compatible. The fertilities ranged to 42 °/₀.

Series R 9–34– . The immediate parent (*R 9, no. 34*) was one of 25 sister plants three of which were self-compatible. Controlled self-pollinations were made on 113 of the progeny: 81 were self-sterile and 32 were self-fertile with fertilities ranging to 43 °/₀. In this series there were also 40 plants which were highly *impotent*, a condition discussed later.

The I_2 generation.

The number of plants tested for self-compatibility in this generation was 471. The number of flower heads tagged for autonomous selfing was 14,390; the average per plant was 30 flower heads or about 200

TABLE I.

Typical records for plants of three series of the I_1 generation from self-compatible parentage.

Pedigree	Date of first bloom	Dates of self-pollination. Number of seed per head	Fertility (per cent.)
R 12–11–			
No. 59	July 5	*July 5th*, 17, 18; *7th*, 11, 15, 18; *9th*, 3, 7, 12, 13; *10th*, 5, 6, 10, 16, 19, 20; *25th*, 3, 11, 14	·60
„ 51	June 29	*June 30th*, 9, 16, 22; *July 5th*, 15; *6th*, 5, 12, 14; *7th*, 7, 15, 18; *10th*, 2, 5, 5, 6, 7, 12, 13, 16	·56
„ 16	July 12	*July 13th*, 0, 3; *15th*, 0, 2, 11; *16th*, 6, 7, 12, 12, 13, 13, 20	·37
„ 49	July 5	*July 6th*, 11; *7th*, 2, 9, 9, 9, 10, 13, 14; *9th*, 6, 9, 10, 10, 12; *18th*, 0, 2, 2, 3, 8, 9, 9, 11; *20th*, 1, 5; *24th*, 2, 3, 4, 8; *25th*, 2, 4, 6, 7, 8, 9, 13	·35
„ 30	July 12	*July 13th*, 0, 0, 1, 8; *14th*, 0, 0, 2, 9; *16th*, 3, 7, 9, 11, 12	·24
„ 63	July 21	*July 23rd*, 0, 0, 0, 0, 0, 0, 0, 1, 5, 9, 11, 12; *25th*, 0, 9; *27th*, 0, 0, 2; *30th*, 0, 0, 0, 0, 0; *31st*, 0, 0, 0, 0, 0	·10
„ 18	July 10	*July 12th*, 0, 0, 0; *13th*, 0, 0, 0, 0, 2, 2; *14th*, 0, 0, 0, 0, 0, 3; *Aug. 6th*, 0, 0, 0, 0; *8th*, 0, 0, 0	·02
„ 25	July 20	*July 23rd*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 3; *25th*, 0, 0, 0, 0, 0; *27th*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1	·01
		18 other plants self-fertile 35 plants self-sterile Total flower-heads self-pollinated, 973	
R 10–8–			
No. 63	Aug. 4	*Aug. 6th*, 0, 2, 3, 3, 5, 7, 8, 9, 10, 13, 15, 16, 17, 17; *8th*, 0, 3, 7, 16	·42
„ 140	July 27	*July 30th*, 0, 0, 0, 0, 0, 3, 7, 7, 7, 7, 8, 9, 12; *Aug. 9th*, 0, 0, 0, 3, 4, 5, 7, 8, 18; *10th*, 0, 3, 3, 8, 13, 15, 16	·30
„ 37	July 29	*Aug. 1st*, 0, 0, 1, 1, 1, 1, 1, 4, 8; *3rd*, 0, 12, 12, 13, 15; *6th*, 0, 1, 3, 4, 9, 9, 14, 17	·29
„ 173	July 23	*July 25th*, 0, 0, 0, 0, 4, 10; *27th*, 0, 0, 0, 0, 0; *Aug. 8th*, 0, 0, 0, 1, 4, 6, 7, 10; *9th*, 0, 0, 0, 1, 2, 4, 5, 6, 7, 8, 11	·14
„ 20	July 21	*July 23rd*, 0, 0, 0, 0, 0; *27th*, 0, 0, 0, 0, 0, 0, 0, 3, 5, 6; *30th*, 0, 0, 0, 0, 1	·03
		44 other plants self-fertile 128 plants self-sterile Total flower heads, 1424	
R 9–34–			
No. 46	July 23	*July 25th*, 6, 10, 10, 15, 15; *30th*, 0, 0, 1, 6, 6, 6, 6; *Aug. 9th*, 0, 0, 2, 4, 6, 6, 7, 9, 13; *13th*, 3, 3, 7, 8, 8, 8, 9, 12, 12, 12, 14, 18; *15th*, 1, 1, 4, 5, 9, 9, 11, 12, 13, 14; *17th*, 0, 3, 4, 7, 8, 9, 10, 10, 10, 11, 12, 12	·38
„ 22	July 27	*July 30th*, 5, 9, 9, 10, 12, 14; *Aug. 1st*, 0, 0, 0, 0, 0, 2, 5; *11th*, 0, 0, 0, 0, 0, 2, 2, 6, 6; *6th*, 0, 0, 0, 0, 0, 12; *13th*, 0, 0, 0, 1, 2, 4, 5, 6, 6, 9, 11, 12, 13, 15, 16; *15th*, 0, 0, 1, 9, 10; *10th*, 0, 0, 3, 3, 5, 6, 8, 9, 9, 11	·23
„ 88	July 21	*July 23rd*, 0, 0, 0, 0, 0, 0, 2, 3, 8, 8; *25th*, 0, 0, 0, 0, 2, 3, 3, 4, 7, 8; *27th*, 0, 0, 0, 0, 0, 0, 1, 1, 1, 2, 2, 6	·10
„ 73	Aug. 19	*Aug. 20th*, 0, 0, 0, 0, 0, 4, 4; *22nd*, 0, 0, 0, 2, 3, 5; *24th*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2; *27th*, 0, 0, 0, 0, 0, 0, 5, 8	·05
„ 91	Aug. 13	*Aug. 14th*, 0, 0, 0; *15th*, 0, 0, 0, 0, 2, 4; *17th*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0; *20th*, 0, 0, 0, 0, 1	·01
		27 other plants self-fertile 81 plants self-sterile 40 plants impotent Total flower heads, 2643	

individual flowers. This generation descended from 6 of the I_1 generation and these in turn from 2 plants of the 1916 crop. The complete pedigree is given in Table IV and the records for typical plants of the two families of the I_2 generation are given in Tables II and III (pp. 112—113).

The family *R 10–8–* .

Series R 10–8–173– . The parent of this series (see Table I) was judged as 14 °/₀ self-compatible. Of the 84 seed planted, 66 germinated and 55 plants were grown to maturity and tested. Thirty-six plants were self-incompatible and 19 were self-compatible, a ratio of 2 to 1. The highest percentage of self-compatibility was 47 °/₀.

Series R 10–8–37– . The immediate parent was judged as 29 °/₀ self-compatible. Of its seed, 126 were planted; 86 seed germinated and 56 plants were grown to maturity and tested. Thirty-nine plants were self-compatible and 17 were self-incompatible, a ratio the inverse of that in the series above. The percentages of self-fertility for 4 plants were above 50 and there were 11 plants with a percentage higher than 25.

Series R 10–8–140– . The self-compatibility of the parent was judged to be 30 °/₀. Mice destroyed many seed after planting but 49 plants were grown and tested. Of these 32 were self-compatible.

The family *R 12–11–* .

Three series were grown in the I_2 of this family. The immediate parents were judged as 60, 37, and 35 °/₀ self-compatible from data presented in Table I.

Series R 12–11–59– . Of 175 seed planted, 155 germinated, of which 136 plants were grown and tested. Forty-two were self-incompatible and 94 were self-compatible. Three plants evidently feebly self-compatible were prematurely killed by pine mice; the individual fertilities of the others ranged to 59 °/₀ with distribution as shown in Table IV. Complete data for 3 plants of this series have already been given and discussed on page 106.

Series R 12–11–49– . The immediate parent was judged as 35 °/₀ self-fertile. Of the 210 seed planted, 136 germinated, and 131 plants were grown to maturity. Tests for self-fertility were made for 115 plants; 77 were self-incompatible and 38 were self-compatible to some degree. There was only one plant with a self-fertility above 25 °/₀.

Table III, in which the results for three of the self-fertile plants of this series are given, includes also certain special data. That for *No. 12*

TABLE II.

Typical records for plants of the family R 10–8– in the I_2 generation of self-compatible parentage.

Pedigree	Period of bloom	Dates of pollination. Number of seed per head	Fertility (per cent.)
R 10–8–173–			
No. 26	July 23—Oct. 15	*July 25th*, 0, 0, 0, 5, 12, 13, 14, 15, 18; *29th*, 0, 0, 6, 14, 15, 15, 15, 16, 17, 17; *Aug. 1st*, 5, 5, 5, 6, 9, 13	·47
,, 30	July 17—Oct. 12	*July 18th*, 0, 5; *25th*, 0, 1, 2, 2, 2, 2, 3, 3, 6, 6, 8; *29th*, 0, 5, 6, 6, 11, 11, 17; *Aug. 1st*, 0, 3, 5, 7, 9	·24
,, 35	July 22—Oct. 15	*July 25th*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 7, 7, 7, 9, 9, 9; *29th*, 0, 0, 0, 0, 0, 0, 0, 0, 2, 4, 7, 8	·12
,, 22	July 18—Oct. 10	*July 18th*, 0, 0; *20th*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 9; *24th*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 2, 1	·02
,, 1	July 27—Nov. 1	*July 29th*, 0, 0, 0, 0, 0, 0; *Aug. 1st*, 0, 0, 0, 0, 0, 0; *3rd*, 0, 0, 0, 0, 0; *6th*, 0, 0, 0, 0, 0, 0; *8th*, 0, 0, 0, 0, 0, 0, 0, 0	·00
		14 other plants self-fertile 36 ,, ,, self-sterile Total number flower heads selfed, 1526	
R 10–8–37–			
No. 85	July 24—Nov. 1	*July 26th*, 3, 9, 10, 14, 14, 14, 15, 15, 16, 16; *30th*, 0, 3, 4, 7, 7, 8, 8, 9, 10, 10, 11, 12, 13, 16, 20	·53
,, 71	July 15—Nov. 3	*July 16th*, 10, 10, 13, 14, 15, 15, 15; *23rd*, 1, 3, 3, 3, 4, 5, 7, 7, 7, 7, 8, 8, 9, 10, 10, 12, 13, 13, 13, 13, 13, 13, 14, 15, 20	·50
,, 28	July 26—Nov. 4	*July 26th*, 0, 1; *29th*, 0, 0, 0, 2, 3, 3, 4, 6; *Aug. 2nd*, 0, 0, 0, 1, 1, 1, 1, 1, 2, 2, 3, 3, 4, 5, 5	·09
,, 53	July 28—Nov. 1	*July 30th*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1; *Aug. 1st*, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 2, 2	·02
,, 25	July 25—Oct. 5	*July 26th*, 0, 0; *29th*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0; *Aug. 2nd*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0; *Aug. 5th*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0	·00
		34 other plants self-fertile 17 ,, ,, self-sterile Total number flower heads, 1555	
R 10–8–140–			
No. 19	July 27—Nov. 1	*July 31st*, 1, 3, 4, 4, 5, 6, 6, 7, 7, 11, 12, 15, 16, 17, 19; *Aug. 3rd*, 4, 9, 10, 10, 11, 13, 15, 15, 16, 16, 18	·52
,, 42	July 26—Nov. 6+	*July 28th*, 0, 0, 2, 7, 7, 10, 12, 15, 15; *31st*, 0, 0, 0, 0, 2, 5, 7, 7, 8, 11, 11, 12, 13, 13, 13, 16	·38
,, 31	July 18—Oct. 15	*July 18th*, 0, 2; *24th*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 2, 2, 3, 3, 3, 4, 4, 4, 5, 5, 6, 9; *27th*, 0, 0, 0, 0, 1, 3, 4; *31st* 0, 0, 2, 5, 6, 8	·10
,, 6	July 22—Nov. 6+	*July 24th*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2, 2, 7; *27th*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 3, 3, 3, 4, 6	·05
,, 2	July 17—Nov. 1	*July 18th*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0; *24th*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0; *27th*, 0, 0, 0, 0, 0, 0, 0; *31st*, 0, 0, 0, 0, 0	·00
		27 other plants self-fertile 17 ,, ,, self-sterile Total number flower heads, 1393	

TABLE III.

Typical records for plants of the family R–12–11– in the I_2 generation of self-compatible parentage.

Pedigree	Period of bloom	Dates of pollination. Number of seed per head	Fertility (per cent.)
R 12–11–59–			
No. 95	July 8—Sept. 4	*July 9th*, 5, 12, 19, 19; *12th*, 9, 10, 11, 11, 12, 14, 14, 14, 15, 15, 17, 18; *16th*, 4, 6, 8, 9, 10, 11, 13; *22nd*, 12, 13	·59
,, 4	July 10—Sept. 10	*July 12th*, 8/18, 14/18, 12/20, 13/21, 14/22, 17/24, 17/25, 18/26, 19/26; *17th*, 7/18, 7/18, 10/18, 1/19, 4/19, 6/20, 7/21, 11/22, 3/24, 16/26; *18th*, 1/18, 1/18, 3/18, 7/18, 1/19, 3/19, 6/19, 12/19, 15/20, 11/21, 14/22, 16/24; *22nd*, 9/16, 2/18, 15/18, 16/20, 16/20, 16/24	·41
,, 1	July 7—Sept. 2	*July 8th*, 0, 6/18, 4/19; *12th*, 0, 0, 0, 0, 2/16, 8/16, 2/17, 6/17, 9/17, 2/18, 9/18, 11/21; *16th*, 0, 0, 0, 3/16, 5/17, 5/18, 4/19, 5/19, 9/21; *22nd*, 0, 3/17, 12/17, 6/18, 13/19, 11/20; *25th*, 0, 0, 5/15, 12/16, 13/17, 5/18, 6/18, 7/18, 2/20	·23
		91 other plants self-fertile 42 plants self-sterile Total number flower heads selfed, 4034	
R 12–11–49–			
No. 12	July 10—Aug. 29	*July 11th*, 7/17, 13/18, 15/19, 6/20; *16th*, 7/16, 10/16, 11/16, 1/17, 6/17, 9/17, 12/17, 13/17, 14/17, 5/18, 8/18, 8/18, 10/18, 10/18, 12/18, 13/18, 13/18, 9/19, 13/19, 2/20, 9/20, 10/22	·49
,, 80	July 6—Sept. 12	*July 8th*, 0, 0, 0, 0; *11th*, 0, 0, 0, 0, 2, 5, 6, 9, 9, 10; *16th*, 0, 0, 3, 4, 5, 5, 5, 5, 6, 6, 6, 7, 8, 10, 10, 10, 12	·23
,, 33	July 16—Sept. 11	*July 16th*, 0, 0, 0, 0, 8; *18th* (hand), 0, 0, 0, 0, 0, 1, 4, 10; *20th* (hand), 0, 0, 1, 3, 3, 5, 8; *23rd*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 3, 3, 7, 8, 8, 10	·10
,, 50	July 8—Sept. 8	*July 8th*, 0, 0; *10th*, 0, 0, 0, 0, 0, 0, 0, 3, 4, 10; *15th*, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0; *23rd*, 0, 0, 0, 0, 0, 4; (*23rd*, cross-pollinated, 10/16, 12/16, 13/17, 12/18, 14/18, 14/18, 18/18, 15/19, 16/19, 16/19); *26th*, 0, 0, 0, 5, 10; *31st*, 0, 0, 0, 0, 0	·04
		34 other plants self-fertile 77 plants self-sterile Total flower heads selfed, 4106	
R 12–11–16–			
No. 37	July 13—Sept. 12	*July 15th*, 10/18, 13/18, 11/19, 15/22, 18/23, 14/24, 15/25; *16th*, 13/17, 13/18, 5/19, 7/20, 5/21, 17/22, 18/22, 10/23, 15/23, 18/23, 20/23, 20/23, 15/24, 23/24, 19/25, 24/25; *18th* (hand), 12/19, 14/19, 17/19, 7/21, 16/21, 20/21, 15/22, 19/24, 17/25, 20/25; *24th*, 13/18, 14/18, 12/19, 17/20, 16/21, 14/22, 19/23, 15/24	·75
,, 11	July 8—Sept. 4	*July 10th*, 9, 11, 12, 12, 14; *15th*, 4, 4, 5, 6, 7, 7, 7, 9, 11, 12, 12, 13, 14, 14, 14, 15, 18, 20; *19th*, 6, 8, 9, 12, 12, 15, 16; *24th*, 8, 11, 12, 12, 12, 14, 15	·56
,, 58	July 8—Sept. 10	*July 10th*, 2, 2, 10, 13, 15; *15th*, 1, 1, 3, 3, 3, 3, 4, 5, 5, 6, 8, 10, 11, 13, 13, 14, 15; *19th*, 1, 2, 4, 6, 8	·33
,, 60	July 5—Sept. 8	*July 8th*, 0, 0, 0, 0, 0, 5, 6, 6, 7, 9; *10th*, 0, 0, 0, 0, 0, 1, 3, 3, 5, 5, 8; *15th*, 0, 0, 0, 0, 0, 0, 0, 2, 3, 4	·11
		40 other plants self-fertile 16 plants self-sterile Total flower heads selfed, 1776	

gives the number of flowers per head expressed as a denominator and the number of seed obtained as the numerator of a fraction. (Such data show that the variations in number of seed per head are quite independent of the number of flowers per head.) Data for *No. 33* give comparative results of hand and autonomous self-pollination, which are typical of the evidence that careful self-pollination by hand does not increase self-fertility over autonomous selfing.

The data for *No. 50* include for comparison the results of the controlled cross-pollinations of 10 heads, and are quite typical of the abundant evidence obtained which shows that feebly self-compatible or strongly self-incompatible plants are highly productive of seed to compatible crosses made on the same dates of bloom.

Series R 12–11–16– . All of the 103 seed obtained from the self-pollinations of the parent were planted. Sixty-nine germinated, but possibly as many as 20 embryos had been injured at the time seed was examined to determine if embryos were present. Of the 60 plants tested for self-fertility, 16 were self-incompatible and 44 were self-compatible.

The data given for *No. 37* in Table III include results of self-pollinations by hand for 10 heads, and for all heads the numbers of flowers and seeds are expressed in the form of a fraction.

General summary. Table IV presents a grand summary of the various crops of the variety red-leaved Treviso with the pedigree indicated and the distribution of the individual fertilities given. As there shown the variety was kept in culture for the first three years (1914, 1915, 1916) by crossing self-incompatible plants. The first plant found to be self-fertile was one of the 1915 crop but it was very feebly self-fertile and the two offspring grown from its seed were self-incompatible. Among the 1916 crop grown from self-incompatible parentage, there were 11 plants which were self-fertile to some degree and of these 4 were highly self-fertile.

The subsequent generations descended from self-fertile plants, and the study of fertilities in them constitutes a test for the heredity of self-compatibility that arose sporadically after three generations of self-incompatible parentage. Three lines were grown in the I_1, and two families were continued into the I_2.

The proportion of plants that were self-fertile was decidedly increased in the I_1 and was still larger in the I_2. In both families of the I_2 there was also an extension in the range of self-fertilities.

The two families grown into the I_2 exhibit some differences in self-

TABLE IV. *Records of self-compatibility for families, lines of descent and series of the variety red-leaved Treviso.*

Record of Ancestry		Percentage self-fertility of		No. Plants			Record of Offspring	Distribution. Percentage fertility														
	Parentage	P_1	P_2	Total	Self-sterile	Self-fertile	Percentage self-fertile	1–5	–10	–15	–20	–25	–30	–35	–40	–45	–50	–55	–60	–65	–70	–75
1913	Com. seed	—	—	10	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1914	(19 × 27) of 1913	—	—	11	11	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1915	Ser. 1. (1 × 2) of 1914	—	—	10	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
,,	,, 4. (8 × 6) ,,	—	—	8	7	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
,,	,, 5. (8 × 2) ,,	—	—	20	20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1916	,, 6. Ser. 4, no. 21 ...	—	—	2	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
,,	,, 7. Ser. 1 8 × 5 5	—	—	10	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
,,	,, 8. ,, 4 1 × 5 8	—	—	19	18	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
,,	,, 9. ,, 5 1 × 5 6	—	—	25	22	3	—	—	?	—	—	—	—	—	—	1	—	—	1	—	—	—
,,	,, 10. ,, 4 12 × 5 9	—	—	10	9	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—
,,	,, 11. ,, 5 1 × 1 8	—	—	19	14	5	—	4	1	—	—	—	—	—	—	—	—	—	—	—	—	—
,,	,, 12. ,, 5 9 × 4 18	—	—	18	17	1	—	—	—	—	—	—	—	—	—	—	—	—	—	?	—	—
1917	I_1, Ser. 9–34–	56	—	113*	81	32	28	12	5	5	4	2	1	1	2	—	—	—	—	—	—	—
,,	,, ,, 10– 8–	55	—	177	128	49[2]	28	6	11	7	9	6	6	1	0	1	—	—	—	—	—	—
,,	,, ,, 12–11–	70?	—	61	35	26	43	6	7	1	1	2	0	2	4	0	1	0	2	—	—	—
Summary for I_1	... ...	—	—	**351**	**244**	**107**	**30**	**24**	**23**	**13**	**14**	**10**	**7**	**4**	**6**	**1**	**1**	**0**	**2**	—	—	—
1918	I_2, Ser. 10–8–173– ...	55	14	55	36	19	35	1	6	2	6	2	0	0	0	1	1	—	—	—	—	—
,,	,, ,, 10–8– 37– ...	55	29	56	17	39[1]	70	4	9	3	8	3	1	1	2	2	1	4	—	—	—	—
,,	,, ,, 10–8–140– ...	55	30	49	17	32	65	8	6	2	4	2	3	2	2	0	2	1	—	—	—	—
Summary for Fam. 10–8–	...	—	—	*160*	*70*	*90*	*56*	*13*	*21*	*7*	*18*	*7*	*4*	*3*	*4*	*3*	*4*	*5*	—	—	—	—
1918	I_2, Ser. 12–11–59– ...	70?	60	136	42	94[3]	69	15	13	15	13	9	12	3	4	4	1	1	1	—	—	—
,,	,, ,, 12–11–49– ...	70?	35	115	77	38	33	10	8	8	8	3	—	—	—	—	1	—	—	—	—	—
,,	,, ,, 12–11–16– ...	70?	37	60	16	44	70	1	4	4	5	5	7	7	2	0	3	1	2	1	1	1
Summary for Fam. 12–11–		—	—	*311*	*135*	*176*	*56*	*26*	*25*	*27*	*26*	*17*	*19*	*10*	*6*	*4*	*5*	*2*	*3*	*1*	*1*	*1*
Summary for I_2	... ...	—	—	**471**	**205**	**266**	**56**	**39**	**46**	**34**	**44**	**24**	**23**	**13**	**10**	**7**	**9**	**7**	**3**	**1**	**1**	**1**

[1] Percentage not determined for one, [2] for two, [3] for three self-fertile plants. * 40 other plants impotent not considered in percentages.

fertility. In the I_1, *Series 12–11* was more self-fertile both as to proportion of plants and range of self-fertilities. In the I_2, considering each family as a whole, there was no difference in the proportion of plants, but the ranges were higher for one series of the family *12–11–* .

Some irregularities are apparent in which the behaviour of offspring is not directly to be gauged by the degree of self-fertility of a parent. In the I_1 of family *10–8–* one series (*10–8–173*) gave a ratio of 2 self-sterile to 1 self-fertile while in the other series this ratio was reversed; the grades of self-fertility for the three immediate parents were almost identical and they all had the same ancestry preceding. In the I_2 of the family *12–11–*, the two series were obtained from parents of almost identical self-fertility; one of these (*12–11–49*) was of decidedly feeble self-fertility in comparison with the other (*12–11–16*).

IV. *Vegetative vigour and impotence in self-fertilized lines in the variety red-leaved Treviso of Cichorium Intybus.*

The various grades of seed development and embryo abortion in plants feebly self-compatible suggest strongly that individuals of various grades of vegetative growth may arise through various grades of compatibility in the fertilizations. The physiological basis for degeneracy in individuals or races may thus be sought, in part at least, in the comparative weak compatibility of the elements which unite in fertilization. That this is the case is also suggested by the evidence that inbreeding and continued self-fertilization is not of itself injurious.

The self-fertilized lines of descent in this variety of chicory were derived from a race that was kept in culture for three years by cross-fertilization of rather closely related plants. Undoubtedly the variety had previously been maintained largely by crossing, and it is a salad chicory that has been developed and maintained by selection for vigorous vegetative growth. Under such treatment there has been a constant selection of the offspring of highly compatible fertilizations and an elimination of weak individuals which in my culture have been given a chance for their complete development.

In the cross-fertilized stock of the first three years of culture there were occasional plants that exhibited signs of degeneracy. The leaves and branches were few and poorly developed, flower heads did not open fully, corollas were crumpled, and many anthers were dark coloured, contained few well-developed pollen grains and often did not dehisce. Such plants produced few seed to open cross-pollination. During the first few years in my culture plants of this variety ranged from $4\frac{1}{2}$ to $6\frac{1}{2}$ feet in height and were quite uniform in general appearance. The occasional degenerate plant was always one of the smaller plants. No controlled pollinations were made for such plants and they were not included with self-incompatible plants.

It has also been observed that abnormalities may be present in the pollen giving grains of noticeably large size. Cytological preparations show that these giant pollen grains are due to the incomplete separation of the four daughter cells that result from the reduction division. Quadripartition is arrested and a spore wall is formed about all four daughter nuclei. In some cases the giant grain is decidedly lobed. Such irregularities in the development of pollen have not been observed in other stocks (wild, Barbe de Capucin, and hybrid generations) in which examination of much pollen has been made. The proportion of giant grains has not been large and they have been found in largest numbers among highly self-compatible and incompatible plants indiscriminately. For many self-incompatible plants, giant grains were absent or rare. Thus it would seem that their development has no connection with incompatibilities, but is rather associated with the conditions of duplication and cohesion which are characteristic of this variety as described elsewhere (1918 b).

The three highly self-compatible plants selected as parents of the I_1 gave progenies that were decidedly different in regard to vegetative vigour and potentiality for seed production. One line of descent was decidedly degenerate, the others were highly vigorous in growth and in sex vigour.

1. *A degenerate line of descent.* One of the parent plants, *R 9 No. 34*, was $4\frac{3}{4}$ feet tall, well branched and exhibited no signs of degeneracy. Its main axis was strongly duplicated and there were lesions and considerable torsion quite as illustrated in a former paper on this type fasciation (see No. 9 of Plate XII, 1918 b). Giant pollen grains were frequent, but the plant was decidedly self-compatible and set abundant seed to open pollination.

The series (*R 9–34–*) grown from its seed was noticeably low in vegetative vigour. No plant was more than $5\frac{1}{2}$ feet tall; few were more than 5 feet; numerous plants were only from 3 to $4\frac{1}{2}$ feet in height and some were but 2 feet tall. Many plants produced very few seed to open pollination and some produced no seed at all. Such impotent plants, about 40 in number, were not included in the self-incompatible plants recorded for this series.

For the I_2 of this line the progeny of one plant, *R 9–34 No. 46,* were grown. This plant was the most highly self-compatible, and was one of the best developed plants of its series. The flower heads opened normally and the anthers dehisced properly. Of the 240 seed sown only 160 germinated. Many seedlings were poorly developed; 32 died within four weeks after germination; 18 others died before the crop was planted in the field.

Of the 111 plants grown in the field only three were over 4½ feet tall; 60 were from 8 inches to 3 feet in height when fully mature. Flower heads developed and opened poorly on nearly all plants.

At least 50 set no seed at all, and only 6 plants produced seed in considerable numbers. Giant pollen grains were found for 13 out of 30 plants whose pollen was examined. All plants were fasciated in some degree, and in the majority the duplication was strong with much torsion, but lesions were not frequent.

The series of the I_2 was characterized by extreme degeneracy in vegetative growth and sexual potentiality. This condition was more marked in the I_2 than in the I_1, both as to the degree to which individual plants were degenerate and as to the proportion of such plants.

2. *Families of marked vegetative vigour.* No case of degeneracy either in vegetative growth or in potency for seed production developed in the other two lines of descent of the I_1. The parents were well developed plants having slight or medium degrees of fasciation. One parent *R 10 No. 8,* shown in plate of a former paper (Stout 1917, Fig. 1), was one of the tallest and most vigorous plants grown to that date. The other parent (*R 12 No. 11*) was a smaller plant and bloomed for a shorter period.

All plants of both series were highly productive of seed to open pollination. Some irregular or giant pollen grains were found, but these were present for self-compatible and self-incompatible plants without discrimination. The series *10–8–* was taller in growth, and began bloom later but bloomed for a longer period than did series *12–11–* . Each series was rather uniform in itself and the differences between them were identical with those exhibited by their respective parents.

For the I_2 generation three series in each family were grown. In all, there were 471 plants whose self-compatibility was determined and 25 others whose fertility was not studied. Every plant produced flowers which appeared to be fully normal, all were highly productive of seed to open pollination, and all were of vigorous growth.

The differences in vegetative growth of these two families seen in the I_1 were continued into the I_2. Series *10–8–37* and *10–8–140* especially were of vigorous growth. Fifty of the 56 plants of series *10–8–37* were 6 or more feet tall and a few were 7 feet tall. The majority of the plants of *10–8–140* were from $5\frac{1}{2}$ to $6\frac{1}{4}$ feet tall. (See Plate IV at right with field label 26.) In these series were the largest, tallest and most vigorous plants that have thus far been grown in my cultures. The plants of series *10–8–173* were of somewhat smaller stature.

The three series of the I_2 of the family *12–11–* were remarkably uniform in habit of growth as is well shown in Plate IV. The height scarcely varied more than 6 inches. Some plants in each series began blooming in June and were about 10–15 days earlier in blooming than plants of the family *10–8–* .

Line breeding with self-fertilization for two generations has thus led to the isolation of families or lines differing in general vegetative vigour.

One line continued to the I_2 exhibited a decided degeneracy which became more marked in the I_2 than in the I_1. There may be some question as to whether this was due to some heritable factor of constitutional organization such for example as extreme conditions of fasciation, or whether a relation in sexual reproduction is operating as an immediate cause, as it appears to be in many degenerate hybrids and in the quite similar degeneratory offspring of certain illegitimate and weakly compatible matings reported in *Lythrum Salicaria* (Darwin 1869, 1877).

Two main lines maintained in both the I_1 and the I_2 a high degree of vegetative vigour and potential sex vigour, and one of these has seemed to gain in vegetative vigour over that of the parent stock. The uniformity of these differences here suggests that constitutional and heritable "factors" for size are present, and are not perceptibly influenced by such variations in self-compatibility as may have occurred in the rather highly self-compatible parents.

The readiness with which self-fertilized lines from parentage of high self-compatibility maintain a high degree of vegetative vigour is convincing evidence that self-fertilization is of itself not directly injurious and productive of degeneracy.

Discussion and Conclusion.

It seems clear that both self-fertility and cross-fertility within a species are original and primitive conditions as compared with self-incompatibility and cross-incompatibility. Further it seems clear that self-fertility is more primitive than cross-fertility just as hermaphroditism is obviously the more primitive condition out of which dioecism has developed. In hermaphrodites incompatibilities have arisen in species, and evidently are arising at the present time, through fluctuating variation in the physiological differentiation of the sex organs. These phenomena run parallel to the anatomical variations leading to intersexualism and dioecism.

The evidence supporting this general conclusion from my own studies and from the facts revealed by other recent studies as well may here be summarized under the following heads:

1. The indisputable evidence that compatibility and incompatibility in many species are highly variable both in expression and in heredity.

2. The evidence is conclusive that self-incompatibility is not always, if ever, induced by self-fertilization and inbreeding.

3. Variations, now recognized as phenomena of intersexualism, in morphological sex differentiation in species which are prevailingly hermaphrodite or dioecious, are quite analogous to variations in physiological differentiation.

4. The obvious conclusion is that sex differentiation and determination, and hence compatibility and incompatibility in hermaphrodites, are fundamentally of ontogenetic and biogenetic development.

1. The evidence is conclusive that in the various so-called self-incompatible homomorphic species there are individuals that are to some extent self-compatible, and that there is among these wide variability as to the number of sex organs that will function together. This is true at least of nearly all species whose self-fertility has been studied. The same general conditions are found in cases of cross-incompatibility within such species. Even reciprocals between pairs of plants may give opposite results.

As a rule feeble or partial compatibility manifests itself quite indiscriminately throughout the entire period of bloom. Marked cases of a periodic change in compatibility do occur such as end-season self-fertility (in *Nicotiana Forgetiana* Hyb. Hort. and in *Lythrum*

Salicaria) and mid-season self-fertility (in *Brassica pekinensis*) but from the evidence at hand these seem to be characteristic of certain individuals rather than a condition regularly present in the species. Such partial variations may be regarded as reversion to the more primitive condition. They exist along with other wide variations in the degree to which self-compatibility operates.

Not only is there variation in the number of sex organs that function together, but there appears to be considerable variation as to the stage to which processes of fertilization proceed, and also even in the vigour of the seed from fertilizations that are successful. Observations by many investigators confirm the fact that in some cases the pollen tubes make such feeble growth that fusion of gametes is not possible (see especially the recent account by East and Park, 1918). In the case of feebly self-fertile plants (chicory, California poppy, and perhaps the apple, show this very well) many poorly developed seeds stand as intermediates between the few good seeds and the mere rudiments, and suggest that some embryo abortion occurring in plants showing feeble self-compatibility may be due to certain grades of incompatibility.

As reported above in chicory, occasional plants and certain lines appear which exhibit decided degeneracy. One such family of chicory has been studied in detail. It showed grades of vegetative degeneracy, viability of seeds containing embryos was low, many plants were weak, small and short lived and many of those that lived were entirely impotent in respect to the development of stamens and pistils. Such conditions certainly suggest that the poor development of offspring may in such cases be an expression of compatibilities between the sex elements and may thus closely parallel the conditions of poor vegetative and sex vigour observed in certain, though of course not all, hybrids. The condition in this one family of chicory is quite like that reported by Darwin (1869, 1877) for the offspring of illegitimate crosses in the trimorphic species *Lythrum Salicaria*. Still it is to be recognized that we have no proof that degenerate plants or strains are more frequent in species which show self-incompatibility than in those that do not.

As reported above the heredity of self-compatibility and self-incompatibility has been specially studied in an inbred variety of chicory, and this problem had previously been studied (1918 a) in the progeny of inter-varietal crosses. The sporadically occurring self-compatible plants were made the beginning of selfed lines of descent, which in certain lines have been continued for three generations. The results obtained during the seven years, during which the self-fertility of over 2,000 plants was determined by controlled self-pollinations involving over 30,000 flower heads and about 600,000 individual flowers, show conclusively that self-compatible plants occur sporadically among the progeny of self-incompatible plants, and that self-incompatible plants continue to appear among the offspring of self-compatible plants. Either self-compatibility or self-incompatibility can arise from the other in a line of inbred or selfed progeny; in this sense the two conditions are reversible. Since this is the case, dominance or recessiveness of these characters cannot be adequately determined.

None the less there is a tendency to heritability in these characters. Self-fertile plants appear to constitute from 0 to 10 °/₀ of the progeny of self-sterile parents. The proportion of such plants immediately increases in the I_1; in this generation of the red-leaved Treviso numbering 351 plants (Table IV), 30 °/₀ of the plants were self-fertile to some degree. In other families the percentage was higher (Table VIII, 1918). The offspring of self-fertile plants are more likely to be self-fertile by a proportion of about 5 to 1. This proportion can be changed only slightly by the selection of parents of different degrees of self-fertility.

Certain lines and families appear to maintain somewhat different grades of self-fertility. This is most marked in respect to the range of individual self-fertility. All families agree in general behaviour as to regression, but some are more highly self-fertile than others. The character of self-compatibility is one of incomplete heredity; a self-fertilized line of descent does not breed true; in pedigreed lines of descent the characters self-fertility and self-sterility are reversible.

From the standpoint of a factorial description of the results obtained in chicory, several points are of significance. The spontaneous occurrence of self-compatible plants after several generations of self-sterile parentage suggests the phenomenon of mutation referable to single factors or to the recombination of modifying multiples. But submitted to the test of self-breeding the character of self-fertility does not breed true, hence any particular factors or combinations that may be assumed are not stable. The frequency distribution for fertilities suggests variation that is often interpreted in terms of multiple factors of quantitative and modifying values, and this is also suggested by the evidence that certain families exhibit somewhat different degrees of self-compatibility. Yet in all families there is marked regression to self-sterility. Perhaps the most significant fact from the standpoint of hereditary analysis is that the proportion of self-fertile to self-sterile plants in the progenies of self-fertile plants seems to fluctuate about a 1 : 1 ratio. This simulates a condition of so-called enforced hybridity or heterozygosity involving selective elimination of the homozygotes. In making such a ratio, however, many grades of self-fertility are classed together. The experimental evidence that such ever-sporting races of inbred lines of descent are really hybrids is often obtained by the very questionable method of crossing with some other race. Continued variability and reversibility of characters in inbred lines are best interpreted as marked deviations in quantitative values or potencies of the ultimate units which Mendelian analysis and description may give. In fact such variations are very generally recognized by students of heredity.

2. Incompatibilities do not arise in species as a condition induced by self-fertilization and inbreeding.

The question as to the cause of variability in the compatibilities in hermaphrodites, and of the origin of sexual incompatibilities and their significance in evolution, involves in some measure at least the more immediate question of their relation to inbreeding and cross-breeding, and of the relative fertility of hermaphrodites of self-bred and cross-bred parentage.

It seems necessary to reiterate that Darwin was consistent in his repeated interpretations that what he called self-sterility (the type due to physiological incompatibility) is an incidental and sporadic condition arising from the influence of environment on the constitution of the sex elements. He specifically rejected (1876, p. 345) the view that such a condition arises through physiological results of inbreeding, or that it involves a fundamental necessity for cross-fertilization. He did not consider that it is a condition acquired for the special advantage of preventing self-fertilization.

Darwin held that the physiological conditions operating in the self-sterile plant involve a lack of differentiation; the sex organs were considered to be too much alike in constitution. Most writers have sought to explain self-incompatibility on this basis; either on the basis of similarity of cytoplasmic constitution (Morgan, 1904, 1910), or of hereditary units of germ plasm either of direct influence (Correns, 1912), or of indirect influence (East, 1915), or of hereditary value in transmission but cytoplasmic in the immediate relations of fertilization (East and Park, 1918). East and Park have expressed the view that cross-incompatibilities at least are decidedly increased by inbreeding.

In considering the fertility of any stock one readily recognizes with Darwin (1876, p. 312) that there are involved (1) the production of perfectly formed sex organs and (2) the relative functioning of the organs formed. The latter is especially involved in what Darwin calls "relative fertility," the former is especially represented in "innate fertility." An extreme type of loss of relative fertility is seen in self- and cross-incompatibility of plants of such species as *Eschscholtzia californica, Nicotiana Forgetiana* and *Cichorium Intybus.*

In regard to the fertility of cross-bred stock we now have the statement of East and Park (1918, p. 527) that "neither Shull nor East has maintained that crossing increases fertility. The number of flowers and fruits is often increased but no data have appeared which indicate a decreased percentage of non-functional gametes." East, who has had wide experience in studies of inbred and cross-bred stock, thus considers that increased seed production observed in certain cross-bred progeny is due solely to an increase in the number of sex organs. If this be true it appears that heterosis, at least in species in which no compatibilities are already in evidence, does not influence compatibilities of sex organs and does not raise relative fertility, a conclusion fully reached by the more recent report by Jones (1918).

One may well hesitate therefore before assuming that any observed case of decreased productivity in selfed stock involves an actual loss in relative fertility. Such cases may involve solely the number of sex organs produced and the perfection of their development, as appears to be the condition in certain inbred strains of corn.

At the present time there is no direct or even conclusive indirect evidence that physiological incompatibility with selective fertilization (at least selective for definite hereditary units) and variations in relative fertilities arise in a species as a direct result of inbreeding and repeated self-fertilization. There is therefore some question regarding the validity of the old doctrine that there is a tendency inherent in hermaphrodites for the sex organs to be non-functional together simply because they are produced by a single individual and that foreign pollen is naturally prepotent. The accumulation of evidence that inbreeding is not necessarily injurious has lead to the view that decreased vegetative and reproductive vigour in inbred stock is due to an inherently weak constitution existing before inbreeding was begun (see especially Jones, 1918). This of course still leaves the question open as to the sources and causes of the cases of weak constitution which do appear in all sorts of species.

A question of special consideration is whether inbreeding and self-fertilization in species (homomorphic) in which incompatibilities are already in evidence lead to an increase of incompatibilities. According to a conception of multiple factors directly concerned with the transmission and expression of incompatibilities this must necessarily be a result in inbreeding or line-breeding. East and Park (1918) assume that this is true for cross-incompatibility. The evidence from chicory shows conclusively that repeated self-fertilization in line-breeding does not lead to an increase of self-incompatibility. The average self-fertility of a race may be maintained very uniformly under repeated self-fertilization. No tests for cross-incompatibility were made in those families of chicory for which new data are reported above. It may be stated, however, that all the self-incompatible plants produced an abundance of seed to open cross-pollination which could only have been between sister or closely related plants of the variety red-leaved Treviso.

Thus far the studies of self- and cross-incompatibilities have been in species in which the incompatibilities were already present as a character variable in constitutional or genetical value. No one has observed the origin of such a condition in a species. No one has produced such a condition experimentally. Numerous excellent studies have been made (see especially Kraus and Kraybill, 1918) of the influence of various conditions of nutrition on vegetative and reproductive vigour. Plants of highly self-fertile species have been rendered sterile and fruitless but in such cases the plant was fully sterile. It not only failed to set fruit to self-pollination but to all cross-pollination as well. The sterility was not relative, it was indiscriminate and absolute.

The evidence therefore that conditions of incompatibility are not directly induced by repeated self-fertilization, and are not to be ascribed to the condition of hermaphroditism as such, is further proof that variation is operating in the physiological sex differentiation of sex organs.

3. Variations in morphological sex differentiation, especially recognized as phenomena of intersexualism, occur frequently in species prevailingly either hermaphrodite or dioecious, and are quite analogous to those variations in physiological differentiation revealed by incompatibilities.

Concerning the relation between seed-sterility from incompatibility and sterility from various types of impotence there is much need of further information. In general the two classes are distinct. Incompatibility operates between sex organs either of the same hermaphrodite or of different individuals which are highly functional in certain relations. It is characteristic of self-incompatible and cross-incompatible plants that the respective sex organs may be fully developed and potent.

Many cases of pollen and embryo sac development are associated with hybridity. It is well known that hybrids exhibit all grades of vegetative vigour and sexual potency. Here the wide variations in either vegetative or sexual development, or in both, indicate that certain incompatible combinations of protoplasmic elements fail to give harmonious development of the zygote. In a few cases and especially where a character is vitally concerned with nutrition (as for example the non-chlorophyll condition) there is evidently a selective death of zygotes homozygous for this character (see Belling, 1918) but as a rule degeneration and impotence in hybrids seem to result from degrees of dissimilarity in the relative constitutional organization and development inherent in the respective parents.

It is to be recognized that various grades of impotence may develop in a good species through such variations in morphological sex differentiation as are described by the term intersexualism. Intersexualism differs from impotence in hybridity in that it exhibits a tendency to be one-sided. Indeed dioecism may be described as a complete one-sided and alternative impotence that has arisen out of hermaphroditism. Intersexualism may occur in all grades or degrees as is shown by Goldschmidt (1916, 1917), Banta (1916, 1918), and the writer (1919) and is of course a widespread developmental process leading to a complete sex differentiation of individuals as contrasted with the differentiation of sex organs in a single individual. In respect to specialization of the individual as a whole intersexualism is a period of progressive variation.

In intersexuality various grades of maleness and femaleness may develop for individuals as wholes, or for particular sex organs as such. What is perhaps the best analysis of such phenomena in Mendelian terms (by Goldschmidt) recognizes that the assumed factors involved are themselves variable, that maleness and femaleness are properties of all cells, that the factors for sex are the same as factors for general growth, and that these are subject to much variation in relative potency.

There is therefore a decided analogy between the variations in the physiological condition of sex organs as revealed by their relative functioning in incompatibilities and those variations in the development of sex organs that are recognized under the term intersexualism.

Sex differentiation is hence widely variable in both its morphological and its physiological aspects.

4. Sex-determination and sex-differentiation in hermaphrodites are fundamentally a process of ontogenetic development, and may occur at various stages in ontogeny.

In hermaphrodites maleness and femaleness are both qualities possessed by all cells. Any nuclear organization or combination resulting after reduction division can become male or female according to whether the cell lineage leads through stamens or pistils. The obvious differentiation of the two sexes, morphological and physiological, may begin in the development of entire branches, or of flowers as wholes, or of stamens and pistils of the same flower, and is at first strictly a somatic differentiation of like diploid cells. The sexual nature of these sporophytic structures is however seen in the intimate part which they play in the production and function of the haploid sex generation.

A self-incompatible plant is itself the result of a compatible fertilization. Cytoplasmic and nuclear elements of an egg and a sperm fuse to form a zygote highly vigorous and of high sexual potentiality, yet its sex organs fail to function together. The elements which were compatible in the fertilization and in the life of the resulting zygote became incompatible during ontogeny. Yet the incompatibility does not arise simply because of the element of constitutional similarity involved in hermaphroditism, nor because of sex-differentiation as such, for a sister plant with the same parentage and ancestry may be highly self-compatible.

Sexuality is a cyclic recurring condition which makes possible the fusion of cells and nuclei and the pairing of chromosomes. The incompatibilities exhibited in processes of fertilization are due to physiological properties that are acquired during sex differentiation.

Whether the most successful fertilization depends on some element or degree of similarity, or on some degree of dissimilarity, or on a proper balance of the two, it is clear that the behaviour of incompatibilities both self and cross gives no proof that unlikeness in the sex organs favours the union of gametes, or that some element of similarity leads to incompatibility.

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May 29, 1919.

EXPLANATION OF PLATES.

PLATE III.

All reproduced about twice natural size.

Nos. 1 and 2 are heads, and 3 the rudimentary achenes of a third head all resulting from self-pollination of a completely self-incompatible plant of chicory; Nos. 4 and 5 are heads, and 3 the fully developed achenes of a third head resulting from a compatible cross-pollination of same plant on the same date.

No. 7. Stages in development of achenes in a single head of a feebly self-compatible plant to self-pollination; at *a*, 14 merely rudimentary achenes; at *b*, 5 achenes of good size but containing no good embryos; at *c*, one seed with fully developed embryo.

No. 8. Series of stages quite as in No. 7.

No. 9. Achenes from a self-pollinated head of a plant strongly self-compatible. The greater number of achenes containing good embryos. No mere rudiments of achenes present.

PLATE IV.

View of chicory in experimental plot showing races of vigorous vegetative growth in the l_2 generation of self-fertilized descent. At the right, field label No. 26 marks the *Series 10–8–140*. To left of label 26 are four rows of two series of the family *12–11–*. To the extreme left may be seen bags on very tall plants of *Series 10–8–37*.

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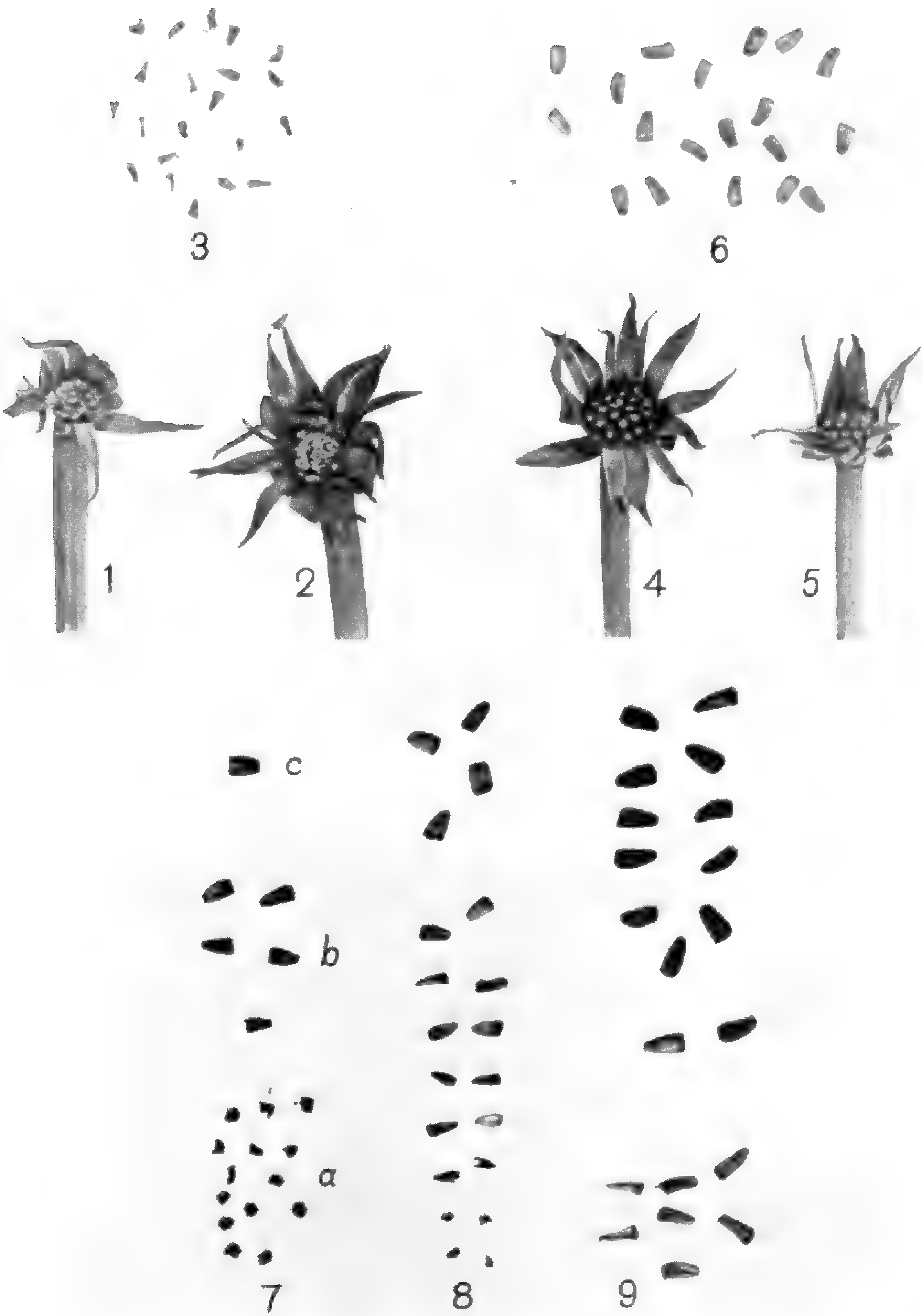
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OBSERVATIONS ON MONOSPORANGIAL DISCS IN THE GENUS LIAGORA

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Observations on monosporangial discs in the genus Liagora

MARSHALL A. HOWE

(WITH PLATE I AND FIVE TEXT-FIGURES)

The genus *Liagora* is a group of marine red algae of the family Nemalionaceae (Helminthocladiaceae). The species are confined to the warmer seas, where they show a preference for water that is normally agitated, ranging, however, from between the tide-lines on surf-beaten rocks down to a depth of at least one hundred feet. In the West Indian region, including Bermuda and southern Florida, the genus is represented by nine or ten species and one species is known to occur on the Californian coast. With the exception of one species, recently described from Bermuda by Collins & Hervey,* and one from the Mediterranean Sea, the plant body is more or less calcified, the amount of the lime and the way in which it is deposited being more or less characteristic of the various species. Under the compound microscope the thallus is seen to be of an obviously filamentous structure, both the structure and the often lubricous character of the plants when living sometimes calling to mind their fresh-water relatives of the genus *Batrachospermum*.

Most of the species of *Liagora* are consistently dioicous, others are consistently monoicous—characters that hitherto have been rarely ascertained or mentioned in the describing of species, probably because the antheridia are in some species very inconspicuous. The plants rarely seem to be sterile. Antheridia,

* Proc. Am. Acad. 53: 100. 1917.

procarps, or the subsequent cystocarps may nearly always be found, but the writer in examining some hundreds of specimens, has never seen anything that could be certainly interpreted as tetrasporangia or as a non-sexual alternating generation. In the older systematic works, it is either expressly stated that tetraspores in the genus *Liagora* are unknown or else silence is maintained on this point. In Schmitz's treatment of the genus in Engler & Prantl, Die natürlichen Pflanzenfamilien, we find, "Sporangien ungenügend bekannt, angeblich an knotig verdickten Stellen der oberen Thalluszweige aus den Endzellen der Rindfäden entwickelt und unregelmässig paarig geteilt." De-Toni, in his Sylloge Algarum, appears to have carried this statement over into Latin, omitting, however, to translate the "angeblich." Whether this statement by Schmitz rests upon his own personal observations or is based upon some previously published observation that has escaped the attention of the present writer is not clear. Oltmanns, in his Morphologie und Biologie der Algen, is apparently silent in regard to this matter.

In Kützing's Tabulae Phycologicae (**8**: 43. *pl. 90 I.* 1858) we find in his delineations of *Liagora Turneri* from the Red Sea a figure showing "Ein Gliederfaden, dessen eine Zelle sich zu einer Brutzelle erweitert, aus welcher sich die in *d. e. f. g. h. i.* dargestellten Knospen entwickeln, welche der Anfang der Seitensprossen sind." Structures evidently similar to those figured by Kützing occur in at least four of the West Indian species of *Liagora* (*L. ceranoides*, *L. valida*, *L. farinosa*, and *L. pinnata*), which often show small flat orbicular discs lying on the general surface of the plant or somewhat immersed among the assimilatory filaments. These discs are of a deeper red color than the main *Liagora* plant, they send down few or numerous roothairs from their ventral (proximal) surface in among the assimilatory filaments, and they bear on their dorsal (distal) surface a few sporangia, the contents of which remain undivided, so that they may referred to as monosporangia. Long, colorless, gelatinizing hairs may usually be seen, arising from this outer or dorsal surface. The disc is involved in mucus, the outer limits of which may be distinct or may be vague or imperceptible. Except in the youngest parts of the *Liagora*, this mucous envelope is more or less calcified. These monosporangium-bearing discs look at first sight very much like independent epi-endophytes. Their darker red color, their dorso-ventral rather than radial symmetry, and the lack of any obvious genetic continuity with the *Liagora* give plausibility to the very natural first impression that they are independent organisms or perhaps obligate epiphytes of various species of the genus *Liagora*. Another plausible *a priori* hypothesis would be that they result from the germination of carpospores and represent a non-sexual alternating phase in the life-history of the *Liagora*. But in support of this latter hypothesis, the present writer finds no direct evidence at all, and the fact that in *L. farinosa* these monosporangial discs are commonly more abundant on antheridial than on cystocarpic plants would seem to point to its improbability. The truth seems to be that these discs arise from gonidia, gemmae, or aplanospores, derived from the terminal or subterminal cells of the assimilatory filaments of the *Liagora*, as was the view of Kützing in regard to similar structures in *Liagora Turneri*. Kützing appears to be the only one who has previously alluded to these structures in print and his observations appear to have been overlooked or ignored by subsequent writers on the genus. These monosporangial discs are especially common in West Indian specimens of *Liagora ceranoides* Lamour. (*L. pulverulenta* Ag.) and *L. farinosa* Lamour. (*L. elongata* Zan.), occurring on both antheridial and cystocarpic plants. In *L. ceranoides*, the gemmae are unicellular or bicellular, terminal or subterminal, solitary or concatenate, but are most frequently derived from the terminal (distal) cells of the assimilatory filaments. The cell enlarges, its contents become deeper red, its walls become soft and mucous, and a new cell wall is laid down inside the old one (FIGS. 1 and 2). Sometimes the rejuvenated cell or aplanospore escapes from the old wall before germinating, but nearly always in this species, as in *L. valida* Harv., germination takes place, or at least begins, *in situ*. The original wall, however, becomes so tenuous that the aplanospore or young disc is very easily detached from its place of origin and even when it develops in its original position, the original walls dissolve so completely that it is usually very difficult to assure one's self of its genetic connection with the filament from which it was derived. Occasionally, the cell, with its original wall is abjointed as a one-celled gemma, but when abjointing occurs the subjacent cell commonly goes with it, the two together (FIGS. 7 and 8) constituting a two-celled gemma. In this case, the lower of the two cells seems not to divide but to persist as a finally inconspicuous stalk or appendage of the young disc, which results from divisions of the upper cell (FIG. 22). Very rarely (FIG. 28), one finds an irregular pluricellular gemma formed without obvious rejuvenescence or with rejuvenescence limited to one or two of its cells. Occasionally (FIG. 9) several consecutive

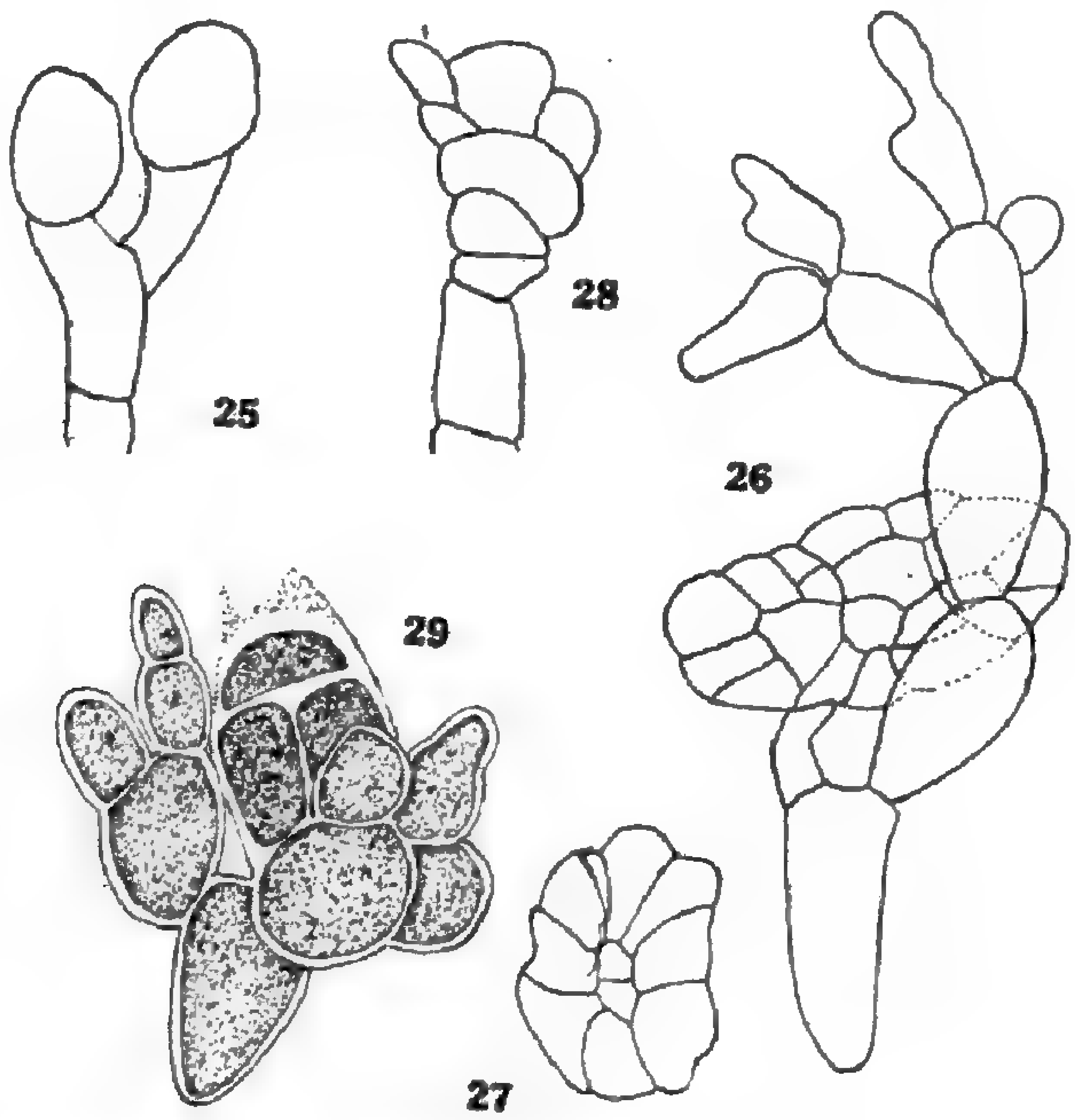


FIG. 25. Terminal cells of an assimilatory filament of *Liagora ceranoides* (No. *4778d*, from Montego Bay, Jamaica), showing enlargement and rounding of two of them preparatory to their division to form multicellular gemmae, which develop into monosporangium-bearing discs. × 510.

FIG. 26. A later stage, showing young disc, still attached, disc and stalk-cell together corresponding to a twice forked vegetative branch four cells long (No. *4778d*), × 620.

FIG. 27. Dorsal view of a young disc, slightly smaller than that shown in FIG. 26 (No. *4778d*). × 260.

FIG. 28. Apex of an assimilarity filament showing irregular division to form a gemma (No. *3141*, *L. ceranoides*, Gun Cay, Bahama Islands). × 620.

FIG. 29. A gemma in a three-celled stage, the original mother-cell wall gelatinizing at apex (No. *3141*). × 510.

cells of a filament are converted into aplanospores with evident rejuvenescence and with gelatinization of the original walls. The first divisions of the rejuvenated cell appear to occur in a variety of ways. Often (FIGS. 8 and 29) they suggest the "cruciate" or tripartite divisions of a tetrasporangium and structures of this character may have been responsible for the current somewhat vague and uncertain allusions to the existence of tetraspores in the genus *Liagora*. Occasionally the arrangement of the first segments of the young disc suggests that of the carpels of an orange, sometimes in apparent contravention of the usual rule that a cell divides in a plane perpendicular to its longest axis. When the young disc develops to a manifestly flattened form while still in its original orientation to the parent filament, it is seen (FIGS. 3, 4, and 6) that one of its edges is directed towards the filament, while the first root-hairs (FIGS. 5 and 22), ventral and central as regards the disc, are lateral in respect to the filament.

In *Liagora farinosa* Lamour. and *L. pinnata* Harv., the genetic connection of these discs with the *Liagora* is even more difficult to trace than in *L. ceranoides* and *L. valida*, owing, apparently, to the fact that the aplanospores are released from the more rigid mother-cell walls before germination, so that they do not germinate *in situ*. Hyaline, apparently unicellular hairs, usually several times as long as the diameter of the disc, arise from the dorsal surface and are probably always normally present in younger conditions at least, but owing to their delicacy and to their apparent readiness to dissolve into mucus, they are not always visible, especially in *L. ceranoides*, and they are not represented in our figures (FIGS. 6 and 18) of the disc in this species. The mature discs are suborbicular and are more or less similar in the four species of *Liagora* in which they have thus far been observed by the present writer, yet they show differences corresponding to the peculiarities of the species of which they constitute a part. In *L. ceranoides* and *L. valida*, the discs are softer, more mucous, and less compact than in *L. farinosa* and *L. pinnata*, in which the cells of the disc, like those of the assimilatory filaments of the main plant, have firmer, more rigid walls. In *L. valida*, the discs are thickened in the central part and often radiately unistratose towards the margins, while in *L. ceranoides* the discs give the impression of consisting of more than one layer of cells throughout. Fertile discs are mostly 90–230 μ broad (not including the mucous envelope), though in *L. farinosa*, the plants of which are commonly the largest of the four species named, they may occasionally reach a diameter of nearly 400 μ. The monosporangia are ellipsoid, ovoid, or obovoid, and are usually 13–26 μ long and 13–18 μ broad, measuring protoplasts only. To what these monosporangia give rise on germination has not been determined but there seems to be some ground for believing that they produce monosporangial discs like those from which they sprang. Species of *Liagora* offer a favorable matrix for the germination of various filamentous algae, including species of *Acrochaetium*, *Ceramium*, and other Rhodophyceae, and inferences that young sporelings associated with a *Liagora* represent stages in development of the *Liagora* itself demand rigorous confirmation, such as might be supplied by cultures or by the presence of a complete series of developmental stages. In this connection, however, it may be remarked that the almost constant association of *Acrochaetium*-like forms with various species of *Liagora* is a suspicious circumstance that deserves further investigation.

In offering the above explanation of the origin of the peculiar monosporangium-bearing discs of certain species of *Liagora*, the writer realizes that he may be charged with having mistaken accidental contact for organic continuity. It would be easier, more conventional, and (*a priori*) more probable to regard the discs as independent or obligate epi-endophytes. Early in his acquaintance with them, the writer was at one time on the point of describing them as representing a new genus of uncertain family, but was deterred by observing that the character of the discs, particularly of their cells and cell walls varied according to the species on which they occurred, and that the discs were progressively older from base to apex of the *Liagora* thallus, the early stages being found only at the extreme apices. The chromatophores, too, seemed similar, except that those of the discs were more red than those of the vegetative cells of the *Liagora*, often as red as those of the carpospores. After much searching, indications that the discs could be traced back to certain cells of the *Liagora* thallus were observed, as shown in the accompanying figures. These observed evidences of direct continuity were not so numerous as the writer might wish and he knows of no analogy among other Rhodophyceae for the state of things here alleged to occur in *Liagora*. However, he believes the above explanation of the origin of the discs to be correct and ventures to publish his observations in the hope that some one more favorably situated, perhaps with access to living material, with facilities for cultural experiments, and with a taste for cytological investigations, may be able to confirm or disprove them. The possibility that the discs represent an obligate epi-endophyte with a boring parasitic spore deserves special consideration.

THE NEW YORK BOTANICAL GARDEN

Explanation of plate 1

The material from which the drawings on this plate were made was obtained from four species of *Liagora*, all collected by the writer at Montego Bay, Jamaica.

1. Terminal cells of an assimilatory filament of *Liagora ceranoides* (No. *4778d*), showing enlargement and rounding of two cells preparatory to their division to form discs. × 620. (The relations of the branches have been somewhat disturbed and distorted by manipulation)

2. Enlarged terminal cell of an assimilatory filament of *L. ceranoides* (No. *5034*), showing gelatinization of apical portion of wall of original cell and formation of new wall for the rejuvenated cell. × 620.

3. A young few-celled disc of *L. valida* (No. *4778c*), still connected by mucus with the filament from the terminal cell of which it has apparently originated. × 375.

4. A young disc of similar size but with more numerous and smaller cells, the disc p obably representing a branch of the filament against which it lies (No. *4778c*—*L. valida*). × 375.

5. A young disc showing its first root-hair and connected by mucus with the filament from the terminal cell of which it was apparently derived (No. *4778c*—*L. valida*). × 375.

6. A young disc in *L. ceranoides* (No. *5034*), with a mucus connection with the end of the filament from the terminal cell of which it was apparently derived. × 375.

7. A two-celled gemma in *L. ceranoides* (No. *4778d*) about to be abjointed. × 620

8. A later stage in the development of a similar gemma after detachment, the distal cell now divided into three cells and the proximal cell remaining undivided, forming a sort of stalk to the young disc (*L. ceranoides*, No. *4778d*). × 620.

9. The terminal portion of an assimilatory filament of *L. ceranoides* (No. *4778d*), showing the formation of several unicellular gemmae or aplanespores in a more or less concatenate series. × 510.

10. A supposed free aplanospore or unicellular gemma before its first division (*L. ceranoides*, No. *4778d*). Possibly, however, a spore from a monosporangium of a matured disc. × 510.

11. A young five-celled disc in which all of the divisions appear to have been lengthwise of the mother-cell, with the first root-hair originating from near one of the poles (No. *4778d*). × 510.

12. A young four-celled disc in which the first division appears to have been lengthwise of the mother cell, followed by the transverse division of one of the daughter-cells (No. *4778d*). × 510.

13. A later stage in the development of a disc, but showing a shorter root-hair (No. *4778d*). × 620.

14. An older stage, with long root-hair and with suggestion of a short stalk at one edge, indicating origin of the disc from a two-celled gemma as shown in Figures 7 and 8 (No. *4778d*). × 272.

15. Dorsal view of a young disc, suggesting discs of species of *Erythrotrichia* and *Erythrocladia* but apparently belonging in the present series (*L. valida*, No. *4778c*). × 510.

16. A later saucer-shaped stage, seen more or less edgewise, and showing three hairs springing from the dorsal surface in its thicker central part and one root-hair from its ventral surface (*L. valida*, No. *4778c*). × 272.

17. Dorsal view of a nearly mature disc with two monosporangia. The dorsal hairs have deliquesced or are so very inconspicuous that no attempt has been made to represent them. The dotted outer line indicates boundaries of the peripheral mucus or gelatinized outer walls. (*L. valida*, No. *4778c*). × 350.

18. An obliquely dorsal view of a mature disc with several monosporangia (*L. ceranoides*, No. *4778d*—edges of disc less monostromatic than in *L. valida*). × 272.

19. Escape of aplanospore from terminal cell of assimilatory filament of *L. farinosa* (No. *4775*). × 375.

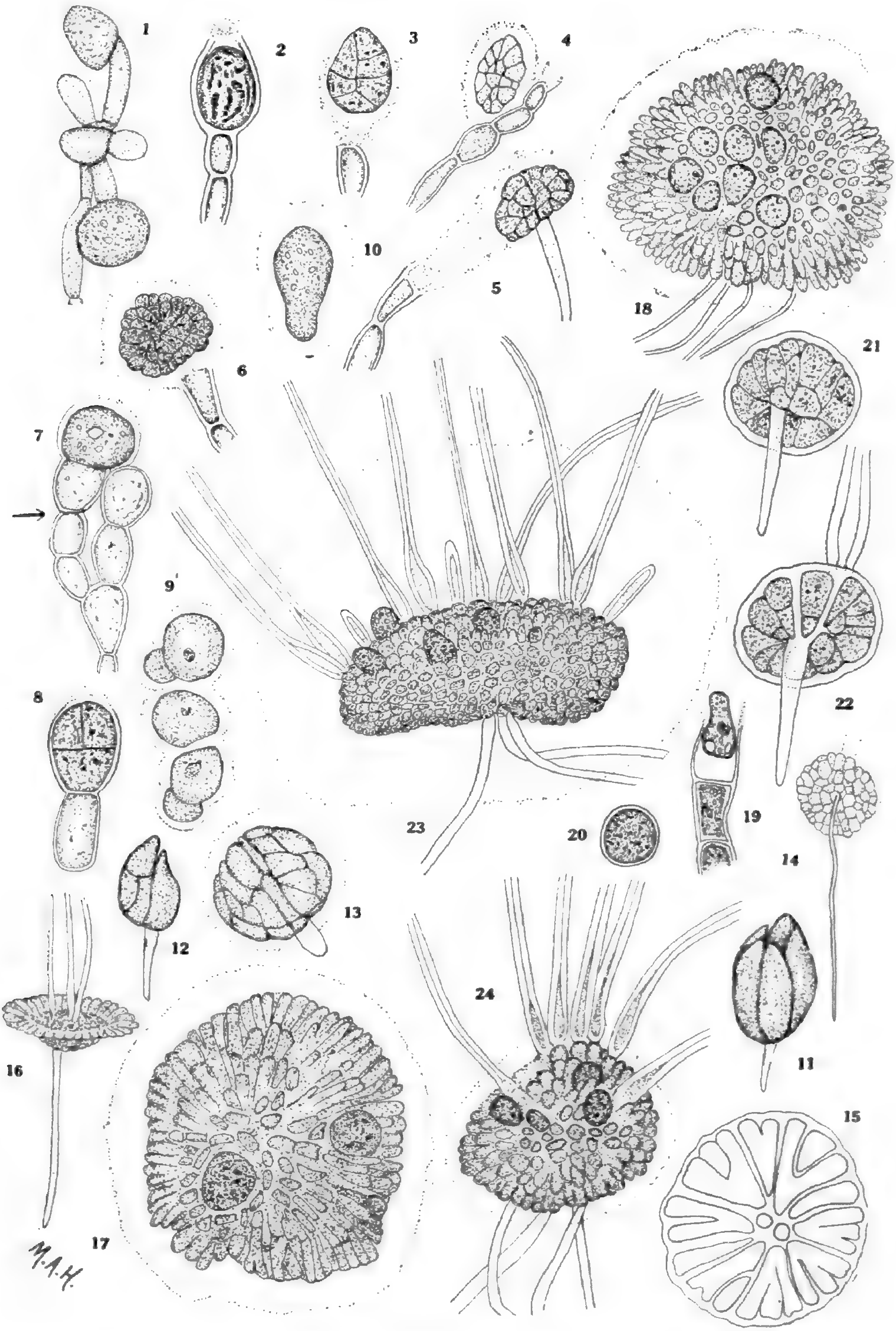
20. A free aplanospore from the same plant (No. *4775*). × 375.

21. A young disc of *L. farinosa* (No. *4775*) in ventral view, showing first root-hair. × 620.

22. Another young disc in obliquely ventral view (No. *4775*), showing base of first hair from dorsal surface and first root-hair. × 620.

23. A mature or nearly mature disc of *L. farinosa* (No. *4775*), in lateral view, showing the more or less protuberant monosporangia. The dotted line indicates the boundary of the mucus envelope, which, in the natural state, is lightly permeated with lime. Only about one third of the length of the dorsal hairs is shown. × 272.

24. Obliquely dorsal view of a mature or nearly mature disc of *L. pinnata* (No. *4776*), with monosporangia, etc. × 272.



HOWE: MONOSPORANGIAL DISCS IN LIAGORA

SMITHSONIAN INSTITUTION

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FROM THE

UNITED STATES NATIONAL HERBARIUM

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11

PREFACE.

The present number of the Contributions, by Dr. Francis W. Pennell, of the New York Botanical Garden, consists of an account of several genera of the family Scrophulariaceae as represented in the central Rocky Mountain States. It is based upon extensive field work carried on by the author in the region covered, and upon a critical study of material found in the larger American herbaria. The greater part of the paper relates to the genus *Pentstemon*, a large and difficult group containing many species which are among the most characteristic and attractive members of the Rocky Mountain flora. Because of the intensive character of the study, it has been possible to indicate with unusual precision the range, habitat, and period of flowering of most of the species, and for the same reason it has been found necessary to describe a considerable number of them as new.

FREDERICK V. COVILLE,
Curator of the United States National Herbarium.

CONTENTS.

SCROPHULARIACEAE OF THE CENTRAL ROCKY MOUNTAIN STATES.

By Francis W. Pennell.

INTRODUCTION.

The purpose of a series of papers, of which this is the first, is to present in summarized form our knowledge of the plants of the family Scrophulariaceae growing within the states of Wyoming, Colorado, and Utah, and in Idaho west to the 113th meridian. Within this area it is planned to consider all species, and to give for each its taxonomic history, its flowering season, and its distribution.

Eastward from these states occur the Black Hills, with a flora akin to that of the foothills of the Rocky Mountains, and southward from them a great expanse of high plains in all respects identical with the high plains of eastern Colorado. To include the former and a large portion of the latter, the area of this study has been extended eastward to the 100th meridian. From this additional territory—western Kansas, western Nebraska, and southwestern South Dakota—comparatively few specimens have been seen, and consequently the specimens here cited do not indicate with the same degree of completeness the distribution of the species. However, eastward the species of this family are few and mostly long known.

Within the large area of this study, an area except for slight irregularities on its northwestern boundaries rectangular in outline, occurs a considerable diversity of natural environment, but a much greater diversity of flora. The lower and vastly the larger portion consists of a flat or rolling tableland, sloping upward from our eastern frontier, the Platte River below North Platte at about 750 meters altitude, to about 2,130 meters altitude on the continental divide in southern Wyoming. Northward, westward, and southward occur various broad valleys and relative depressions. The most important are the valleys of the Powder, Tongue, and Bighorn rivers in northern Wyoming; of the Snake River in southeastern Idaho; the broad basin of the Great Salt Lake, itself about 1,300 meters in altitude, and the deserts westward; the valley of the Virgin River of southwestern Utah, at St. George but 840 meters above the sea; a large portion of the drainage of the Colorado River and its tributaries, the Green, the Grand, and the San Juan; and the valley of the Rio Grande in southern Colorado. This whole area impresses the traveler by its apparent botanical uniformity. It is throughout a country naturally arid; the gray dull growth of the sagebrush (*Artemisia*) is over the higher land, varied in the lowland with the somewhat livelier hues of the greasewood (*Sarcobatus*). Between the scattered plants bare earth is always visible, for sagebrush can not be said to "cover" or "clothe" the ground, nor does the greasewood hide the whiteness of the alkali in which it grows. Westward and southwestward the aridity increases; through much of central and southern and over enormous areas of western Utah the land is even without sagebrush—a desert almost or quite devoid of vegetation.

Through a land seemingly so uniform one would expect a uniform flora, but in *Penstemon*, the genus with which my studies have made me most familiar, precisely the opposite is the case. The high plains of the east have their distinctive species; others enter the valleys of northern Wyoming from the plains of Montana; different species occur on the "Red Desert," the valley of the Green River in southwestern Wyoming; in the North or Middle Park of northern Colorado; in the Grand or the Gunnison valleys of western Colorado; in the San Juan and Dolores valleys of southwestern Colorado; in the western drainage of the Colorado River from the base of the Uintas southward to northern Arizona; in the valley of the Virgin; in the Salt Lake Valley; and through the valley of the Snake River. No species of the lowland occurs over more than two or three of these regions. Ill-defined divisions within larger areas may be noted, as the valley of the Arkansas River from Pueblo to Las Animas counties, Colorado, and the valley of the Duchesne River in northeastern Utah. Evidently the factor controlling the development of species has been not diversity of valleys one from another, but simply the geographic isolation of each.

Throughout this dry country permanent watercourses are few, and their isolation when upon different river systems would seem far greater than that of the upland plains. Yet the few aquatic or wetland Scrophulariaceae are wide-ranging species, and occur in streams draining to the Atlantic and to the Pacific. Such are several species of *Mimulus* and *Veronica*. Doubtless the explanation of this seeming anomaly is that these species owe their distribution to the transporting agency of birds.

The surface of this plateau was summarized as level or rolling, and such also are the geologic strata; but eastward, and much more so westward, this surface is broken by steep escarpments, buttes, and bluffs which mark the edge of geologic formations, many of them geologic faults. It is also more evident westward that the streams, and temporary washes as well, have cut for themselves deep and precipitous chasms. The greatest of these are along the Colorado River, but in Utah such canyons occur along most of the lowland streams. The flora of the buttes and canyon walls brings down to the plateaus many species of the hills. Low, flat or slightly sloping table-topped ridges, whose steeper slopes are conspicuously covered by junipers, occur over much of this area, and many of the species which geographically are ascribed to certain valley plains grow only upon these "mesas."

From central Colorado, or in fact from central northern New Mexico, northward and westward, the basal plateau is broken by many mountain chains. All these are more or less isolated. Some are low ridges scarcely to be distinguished from the mesas except by their sharper contour, but some are among the highest mountains of the continent, having about their bases masses of foothills which themselves resemble mountains. From the viewpoint of plant distribution these mountains and the highlands about them may be grouped in three associations:

1. *Northern Rockies.*—These enter our region from the northwest and include all ranges north of the great "saddle" valley plateau of southern Wyoming. They include the ranges about Yellowstone Park, the Teton and Wind River ranges, and the outlying Bighorn Mountains.

2. *Southern or Colorado Rockies.*—These include all the intricate chains of mountains of Colorado, extending northward into the Medicine Bow Range of southeastern Wyoming, and including the outlying La Sal and Abajo mountains of southeastern Utah.

3. *Wasatch or Utah Rockies.*—These extend from the Bear River Range of southeastern Idaho southward across central Utah to the southwestern extremity of that State. Adjoining or somewhat outlying these to the east are the Uinta Mountains, extending to the Colorado line across northeastern Utah, and, farther south, the Henry Mountains. Dr. Rydberg includes the Wasatch in the Southern Rockies, but at least the *Penstemon* flora of each group is quite distinct.

While each of these mountain groups has its peculiar species, the parallelism of the vegetation upon each is most striking. This parallelism is dependent upon altitude, and much has been written concerning the zones of vegetation or life zones which may be recognized. From the sagebrush semidesert at the base one ascends to a scattered low growth of junipers and pinyons; then to a "chaparral" of shrubby, gnarled oaks; then to an open belt of conifers, largely of *Pinus scopulorum;* then to a denser forest of other pines and *Pseudotsuga*, with open groves of *Populus tremuloides*, the quaking aspen; next to a belt of spruce and fir; then out above the few stunted, highest growing individuals of these to the open alpine meadows and slopes. In this progress, corresponding to increased altitude, there is increased moisture. The alpine meadows are continually moist from more or less permanent snowdrifts, while here and lower on the slopes frequent showers occur in summer.

The foothills exist as a particularly wide and definite zone to the east of the Southern Rockies, and a peculiar flora of foothill species extends from Las Animas County, Colorado, to Albany County, Wyoming. The Black Hills of South Dakota are essentially a foothill region. Ranges of foothills, with a characteristic flora, running through southwestern Wyoming, southeastern Idaho, and northern Utah, connect the Northern with the Wasatch Rockies. In Utah and western Colorado many of the ranges are equivalent to the mountain foothills. In their flora the low mountains, the foothills, and the lower slopes of the main mountain chains are identical.

The different zonal treatments of the life of the Central Rocky Mountain States are based primarily upon the account and the classic map of Dr. C. Hart Merriam,[1] a map of the United States which, however, shows but little detail for this region. The work which Dr. Merriam then roughly outlined has, under his direction or stimulus, since been carried out in greater detail and made far more satisfactory by the United States Biological Survey. A series of state biological surveys has been begun, and for our area that for Colorado,[2] by Merritt Cary, was published in 1911, and that for Wyoming,[3] by the same author, in 1917. These contain excellent maps and interesting and pertinent text. His discussion is based upon personal field study, including practically every portion of these states and botanical even more than zoological evidence. The maps, slightly modified, as explained below, have been my best guide in expressing the zonal distribution of species.

In the plant distribution of the area covered by my study, Dr. Rydberg has been especially interested. In the Bulletin of the Torrey Botanical Club he is publishing a series of sketches of Rocky Mountain vegetation, zone by zone; but the paper which logically introduces these sketches and gives the author's delimitation of each zone is one published in the Memoirs of the New York Botanical Garden.[4] I am greatly indebted to this outline and to an unpublished

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[1] Life zones and crop zones of the United States, by C. Hart Merriam. U. S. Dept. Agr. Biol. Surv. Bull. **10**. 1898.

[2] A biological survey of Colorado, by Merritt Cary. U. S. Dept. Agr. N. Amer. Fauna **33**. 1911.

[3] Life zone investigations in Wyoming, by Merritt Cary. U. S. Dept. Agr. N. Amer. Fauna **42**. 1917.

[4] **6**: 477–499. 1916.

map by the same author. The map covers the entire area of my study, but it is not based upon so full a field acquaintance and does not attempt the detailed zonal delineation which makes Cary's map so valuable. However, in general terminology and broad limitation of zones I have followed it.

The terminology used by Rydberg is in accord with that used abroad, and its names have more appropriateness than have those of Merriam, followed by Cary. A third nomenclature has been evolved by Mr. Marcus E. Jones in his studies of Utah vegetation. Apparently, Jones has reached the same conclusions as to the belts of vegetation to be recognized, so that his names may be correlated readily with those in current use. The three systems of zonal nomenclature are:

Rydberg.	Merriam.	Jones.
Lower Sonoran.	Lower Sonoran.	Tropical.
Upper Sonoran.	Upper Sonoran.	Lower Temperate.
Submontane (Subboreal). [1]	Transition.	Middle Temperate.
Montane.	Canadian }	Upper Temperate.
Subalpine.	Hudsonian. }	
Alpine.	Alpine-Arctic.	Alpine.

The main point of divergence in which I follow Rydberg and not Merriam is in carrying the northern boundary of the Upper Sonoran Zone eastward and northeastward across the high plains following the divide between the Arkansas and Kansas river systems to the south, and the Platte drainage to the north. In the plains any zonal limit must be broad and more or less vague, but it certainly seems to accord better with *Penstemon* distribution to recognize from this line northward an area of Subboreal plains than it does to commence such an area in Montana. Slighter divergence from Cary's maps is in considering the Arkansas Valley above the Royal Gorge to be wholly Submontane (or Transition), with only some Upper Sonoran intrusion—at Salida I found only foothill Penstemons. The same treatment applies to the isolated Upper Sonoran areas or, as I view them, local Upper Sonoran intrusions into the Submontane Zone, above the canyon of the Grand River.

Of botanical collections made within this total area there have been many, and yet, such is the diversity of the flora that with collections much more ample than those of many areas of the same size eastward, our knowledge of the flora is still much less complete. The best known sections are the foothills of eastern Colorado, especially those easily reached from Denver, Boulder, Fort Collins, or Colorado

[1] "Subboreal" applies to the Great Plains, "Submontane" to the mountains and intermontane plateaus.

Springs, and the more or less immediate vicinity of Laramie, Wyoming, and of Salt Lake City, Utah, and Yellowstone Park.

At some time, from the early expeditions of James, Nuttall, and Frémont, to the present day of resident collectors, Osterhout, Ramaley, Nelson, Jones, and Garrett, nearly every natural region of this area has been visited by botanists. But most of the land is still practically unsettled, much is reached only with great difficulty, since railroad lines are far apart and mostly away from the mountains, and many sections have been visited but once or twice, and that at only one season of the year, so that even to-day, in spite of a century of collecting, it is evident that a great amount of further exploration needs to be done. The truth of this will appear after noting in the following revision the number of species which have been collected but once, but for which it is quite feasible to predict a natural range. Such is *Penstemon paysonii* of the Dolores Valley.

My own field work, of which primarily this revision is the outgrowth, was undertaken in the summer of 1915. The itinerary of the trip, listing only places for collecting, follows:

June 5–7. Pueblo, Pueblo County, Colorado.
8. North Cheyenne Canyon, El Paso County, Colorado.
9. Manitou, Garden of the Gods, El Paso County, Colorado.
10. Nob Hill, South Cheyenne Canyon, North Cheyenne Canyon, Bear Creek Canyon, El Paso County, Colorado.
11, 12. Palmer Lake, El Paso County, Colorado.
12. Aurora, Denver County, Colorado.
13. Golden, Morrison, Jefferson County, Colorado; Valverde, Denver County, Colorado.
14. Boulder, Marshall, Boulder County, Colorado.
15. Denver, Valverde, Denver County, Colorado.
16, 17. Windsor, Weld County, Colorado.
17. Horsetooth Mountain, Larimer County, Colorado.
18. Fort Collins, Owl Canyon, Larimer County, Colorado.
20. Laramie, Albany County, Wyoming.
21. Rawlins, Carbon County, Wyoming.
22. Wamsutter, Sweetwater County, Wyoming.
23. Point of Rocks, Sweetwater County, Wyoming.
24. Green River, Sweetwater County, Wyoming.
24, 26. Evanston, Uinta County, Wyoming.
26, 27. Echo, Summit County, Utah.
27, 28. Devils Slide, Morgan County, Utah.
29. Parleys Canyon, Salt Lake County, Utah.
30. Salt Lake City, Becks Hot Springs, Salt Lake County, Utah.

July 1. South Fork of Big Cottonwood Creek, Salt Lake County, Utah.
2. Emigration Canyon, Salt Lake County, Utah.
3. Along Madison River, along Gibbon River, Yellowstone National Park, Wyoming.
3, 4. Upper Geyser Basin, Yellowstone National Park, Wyoming.
5. West Thumb and near mouth of Yellowstone Lake, Yellowstone National Park, Wyoming.
6. Yellowstone Canyon, Hedges Peak, Yellowstone National Park, Wyoming.
7. Mammoth Hot Springs, Golden Gate, Swan Lake, Yellowstone National Park, Wyoming.
8. Near Gibbon Falls, Yellowstone National Park, Wyoming.
9. Ashton, Fremont County, Idaho.
10, 11. Pocatello, Bannock County, Idaho.
12. Big Cottonwood Canyon, Salt Lake County, Utah.
13–15. Silver Lake, Salt Lake County, Utah.
14. Little Cottonwood Canyon, Salt Lake County, Utah.
16, 17. Near mouth of Provo Canyon, Utah County, Utah.
17. Rock Canyon, Slide Canyon, Soldier Summit, Utah County, Utah.
18. Castle Gate, Helper, Price, Carbon County, Utah.
19–21. Glenwood Springs, Garfield County, Colorado.
22. Grand Junction, Mesa County, Colorado.
24. Ouray, Ouray County, Colorado.
25. Mount Abram, Ouray County, Colorado.
26. Ouray, Ouray County, Colorado.
27. Along Canyon Creek, along Sneffels Creek, Yankee Boy Basin, Ouray County, Colorado.
28. Along Horsethief Trail, east of Ouray, Ouray County, Colorado.
29, 30. Cimarron, Montrose County, Colorado.
30, 31. Sapinero, Gunnison County, Colorado.
31. Gunnison, Gunnison County, Colorado.

August 1. Near Gunnison River, west of Gunnison, Gunnison County, Colorado.
1, 2. Sargents, Saguache County, Colorado.
3. Salida, Chaffee County, Colorado; Canon City, Fremont County, Colorado.
4. Pueblo, Pueblo County, Colorado; Garden of the Gods, El Paso County, Colorado.
5. Pikes Peak, El Paso County, Colorado.

August 6. North Cheyenne Canyon, South Cheyenne Canyon, El Paso County, Colorado.
7. Near switch west of Arena, Jefferson County, Colorado.
8–10. Tolland, Gilpin County, Colorado.
11. Golden, Jefferson County, Colorado.
12. Valverde, Denver County, Colorado.
13, 14. Windsor, Weld County, Colorado.
17. Julesburg, Sedgwick County, Colorado; Ogallala, Keith County, Nebraska.
18. North Platte, Lincoln County, Nebraska.

To Prof. Ellsworth Bethel, of Denver, Colorado, with whom I collected June 13 to 15, to Mr. G. E. Osterhout, of Windsor, Colorado, with whom I collected June 16 to 18, July 20 to 28, and August 13 and 14, and to Prof. A. O. Garrett of Salt Lake City, Utah, with whom I collected June 29 to July 1, and July 12 to 15, I am under obligations for scientific assistance and unstinting hospitality.

Of all species of Scrophulariaceae seen collections were made, these at as many localities as possible. Duplicates were freely included and these have been distributed to leading herbaria. Descriptions of fresh flowers were made and field notes taken of other features. It would be difficult to overestimate the value of such records.

Since my return from the Rockies in August, 1915, much time has been devoted to the study of these Scrophulariaceae. At first I planned to consider little more than the species of the route traversed, extending my study to the northern limit now adopted, but definitely excluding the species of the southern tier of counties in Colorado and of southern and southwestern Utah. This southern country includes many species possessed in common with the northern portions of New Mexico and Arizona, and many or most of these do not reach the main line of the Denver & Rio Grande Railroad, along which I collected. But certain causes have led to the inclusion of these.

Rydberg's Flora of the Rocky Mountains, recently published, includes all species to the southern boundary of Colorado and Utah, and he had desired me to extend the range of this study to the same limit. Also, in asking from herbaria the loan of specimens, exclusive of southernmost Colorado and southern and western Utah, I have received in all cases full representation from these entire states. It has seemed appropriate, in view of the courtesy extended and the opportunity thus afforded, to make full use of these specimens. The study of this additional material has delayed the present report, but the chance to review the rich collections of Jones, Ward, Brandegee, and many others has made the delay worth while.

Specimens have been seen from most of our leading herbaria. The herbaria in which a given collection is to be found are indicated by the following letters:

A. Academy of Natural Sciences, Philadelphia.
B. University of Colorado.
D. State Museum, Denver, Colorado.
E. Brooklyn Botanic Garden.
F. Field Museum of Natural History.
H. Gray Herbarium.[1]
K. Royal Botanic Garden,[1] Kew, England.
M. Missouri Botanical Garden.
P. University of Pennsylvania.
R. Rocky Mountain Herbarium, University of Wyoming.
S. Stanford University.[1]
U. United States National Herbarium.
Y. New York Botanical Garden.
Z. New York State Museum.

To the custodians who have generously aided by lending material, I am much indebted.

Also, I have seen the herbarium of Prof. A. O. Garrett and the large herbarium of Mr. George E. Osterhout. The latter is of special value for the Colorado species. While I have not as yet seen the collection at the Gray Herbarium, through the kindness of Mr. J. Francis Macbride I have verified all types there. The type of *Penstemon petiolatus* T. S. Brandeg., at the University of California, has been critically examined at my request by Dr. H. M. Hall, formerly of that institution.

In the following account, keys to species are included and descriptions are provided for all species considered new. So far as possible all types have been verified. Full synonymy is given, but only for names of the area considered. The paragraph concerning distribution is primarily so restricted, and includes statements of environment; of altitude followed by that of life zone; of the province or physiographic natural region; of the actual surface distribution; and, in cases where the species occurs beyond the area considered, of its wider range. So far as the facts are known, statements of flowering seasons are made. These are compiled from records accompanying specimens seen, and not accepted from literature. By this process our information, while accurate, is obviously imperfect and will need many additions from future field observation.

Specimens are listed only from the area outlined. Under *Collinsia* and *Scrophularia*, genera with but one species each in our area, none are cited, although to afford a basis for the summary of the range

[1] Herbaria not seen, but to which duplicates of my specimens have been sent.

indicated, counties from which specimens have been seen are stated. Under *Chionophila*, a monotypic genus, no specimens are cited, but for a plant so local it is of interest to know the peaks upon which it occurs. For these genera the numbers of my own collections are given. Under *Penstemon*, a genus of many species and these much confused, it has been thought best fully to cite localities and specimens seen, the latter one to a county. All care has been taken to attribute localities to their proper county, but in this there is necessarily some possibility of error. The county is used as a logical, easily located unit of area. The name of each county is followed by a colon, and throughout county names are in alphabetical sequence.

SYSTEMATIC TREATMENT.

VERBASCUM L.

KEY TO THE SPECIES.

Leaves green, dentate, glabrous, not decurrent; stem (above) and calyx with simple glandular hairs; inflorescence lax; pedicels 10 to 15 mm. long; sepals lanceolate, 5 to 6 mm. long, much shorter than the capsule; corolla 25 to 30 mm. wide, yellow or white; filaments all densely lanose with knobbed purple hairs; capsule 7 to 8 mm. long, glandular-puberulent; seeds dark gray, 0.8 to 0.9 mm. long. **1. V. blattaria.**

Leaves yellowish green, finely crenate, decurrent; stem, leaves, and calyx densely woolly with stellate-branched nonglandular hairs; inflorescence densely crowded; pedicels very short or none; sepals ovate, 6 to 8 mm. long, slightly shorter than or equaling the capsule; corolla 20 to 22 mm. wide, always yellow; 3 posterior filaments lanose with filiform yellow hairs, the 2 anterior ones glabrous; capsule 6 to 8 mm. long, stellate-pubescent; seeds brownish gray, 0.4 to 0.5 mm. long.................................**2. V. thapsus.**

1. Verbascum blattaria L.

Fields and roadsides; rare (Boulder, Colorado, *Osterhout* 2462). Introduced from Europe.

2. Verbascum thapsus L.

Fields and roadsides; frequent (*Pennell* 5958, 6116). Introduced from Europe.

LINARIA L.

KEY TO THE SPECIES.

Corolla (excluding spur) 15 to 18 mm. long, yellow, the posterior lip arched over the anterior one, the anterior lip forming a conspicuous protruding orange palate, the spur tapering from a broad stout base; capsule 10 mm. long, much exceeding the sepals; style 8 mm. long; seeds 1.7 mm. long, flattened circularly and broadly winged; stem 30 to 100 cm. tall, densely leafy; young stems not prostrate.................................**1. L. linaria.**

Corolla (excluding spur) 14 to 17 mm. long, blue, the posterior lip erect, the anterior one broadly spreading but not forming a raised palate, the spur very slender throughout; capsule 2 to 3 mm. long, equaling or slightly exceeding the sepals; style 1 to 1.5 mm. long; seeds 0.3 to 0.4 mm. long, cylindric, obtusely prismatic-angled, not winged; stem slender, 20 to 80 cm. tall, less leafy young stems prostrate.................................**2. L. texana.**

1. Linaria linaria (L.) Karst.

Fields and roadsides; rare (Gunnison, Colorado, *Shear* 5074). Introduced from Europe.

2. Linaria texana Scheele.

Linaria texana Scheele, Linnaea **21**: 761. 1848. "Zwischen Houston und Austin (Texas) haufig: Römer." Type not seen or verified, but description evidently of the plant here characterized.

Occasional in sandy fields or along railroads, base of foothills of northeastern Colorado, at altitudes of 1,500 to 1,740 meters; possibly locally introduced; flowering in June.

COLORADO: Boulder: *Penard* 89. Jefferson: Golden, *Pennell* 6386. Larimer: Horsetooth Mountain, *Pennell* 5856.

Closely related to the eastern *L. canadensis* (L.) Dum.-Cours., but mostly distinguishable as follows:

Corolla of early flowers (excluding spur) 7 to 8 mm. long, the spur 2.4 mm. long; sepals linear-lanceolate, acuminate to subulate-tipped; seeds sharply prismatic, the angles thin, the faces smooth to somewhat tuberculate. Apparently native through the eastern Coastal Plain, Massachusetts to Florida and eastern Texas; Illinois, and likely introduced elsewhere northward and inland. **L. canadensis.**

Corolla of early flowers (excluding spur) 14 to 17 mm. long, the spur 5 to 9 mm. long; sepals lanceolate to ovate-lanceolate, obtusish to acute; seeds not sharply prismatic, the angles more or less rounded, the angles and faces densely tuberculate. From South Carolina, southwestern Missouri, Colorado, and Vancouver Island southward, within the tropics through the Cordilleras and Andes to Argentina and Chile. (*L. subandina* Diels is evidently a synonym. From Florida to Texas, and perhaps elsewhere, intermediates with *L. canadensis* occur.) .... **L. texana.**

COLLINSIA Nutt.

1. Collinsia parviflora Lindl.

Collinsia parviflora Lindl. Bot. Reg. **13:** *pl. 1082.* 1827. "Received by the Horticultural Society from Mr. David Douglas, in 1827, by whom it was found in the vicinity of the River Columbia." In account of *C. grandiflora* Lindl. (op. cit., *pl. 1107*), "We learn from [Mr. Douglas] that the species published at folio 1082 of the present volume is confined to the rocks in the vicinity of the ocean." Type station evidently near the mouth of the Columbia, probably near Fort Vancouver, Washington. Specimen in herbarium of Columbia University, New York Botanical Garden, labeled "N. West. Amer.," received by Torrey from Lindley, if not actually an isotype,[1] is certainly authentic.

Moist or dry, shady or open, loamy soil, gravelly or rocky, on banks and hillsides, at altitudes of (1,350) 1,500 to 2,850 meters; Submontane and Montane zones; flowering from mid-April to late August, depending upon latitude and altitude. Foothills and lower mountain slopes, descending into plateaus along canyon sides and river banks; throughout the area. British Columbia and Keeweenaw County, Michigan, to northern New Mexico and southern California.

SOUTH DAKOTA: Meade County.

[1] The word isotype is used to denote specimens of the type collection other than the type itself.

129510°—20——2

WYOMING: Albany (5875),[1] Carbon, Fremont, Laramie, Lincoln, Sheridan, Uinta (5911), and Weston counties. Yellowstone National Park (5993, 6005, 6017, 6026).
IDAHO: Bannock (6058) and Fremont (6051) counties.
COLORADO: Archuleta, Boulder (5829), Clear Creek, Delta, Denver (5836), Douglas, El Paso (5805, 5812), Fremont, Gilpin, Grand, Gunnison, Huerfano, Jefferson (5818), Larimer (5857), Montezuma, Montrose, and Pueblo counties.
UTAH: Beaver, Box Elder, Cache, Kane, Morgan (5946), Piute, Salt Lake (5981, 5982), Summit (5928, 5938), Utah, Washington, and Weber counties.

SCROPHULARIA L.

1. Scrophularia occidentalis (Rydb.) Bicknell.

Scrophularia nodosa occidentalis Rydb. Contr. U. S. Nat. Herb. **3**: 517. 1896. "Rapid City [South Dakota], altitude 1,000 m., July 25, [1892, *P. A. Rydberg*] (No. 914)." Isotype seen in herbarium of New York Botanical Garden.

Scrophularia occidentalis Bicknell, Bull. Torrey Club **23**: 315. 1896.

Moist soil, loam or sand, frequently gravelly or rocky, woodland, especially thickets along streams, more rarely in open, at altitudes of 1,350 to 2,700 (3,000) meters; Submontane (Subboreal) and Montane zones; flowering from early June to middle of August, depending upon latitude and altitude. Foothills and lower mountain slopes, descending into plateaus along canyon sides and river banks; throughout the area. A widespread species, apparently not distinct from *S. leporella* Bicknell of the Atlantic states.

SOUTH DAKOTA: Fall River and Pennington counties.
IDAHO: Bannock (6057) and Fremont (6047) counties.
COLORADO: Boulder (5832), Clear Creek, Denver (5837, 6391), El Paso (5778, 5783, 5809, 5815, 6336), Garfield (6161, 6171), Grand, Gunnison (6278, 6279), Huerfano, Jefferson (5819, 5824, 6388), La Plata, Larimer (5852, 5866), Montrose, Routt, Summit, and Weld counties.
UTAH: Box Elder, Cache, Morgan (5942), Salt Lake (5966, 5974, 5983, 6077), San Juan, Utah (6117, 6122, 6128), and Weber counties.

CHIONOPHILA Benth.

1. Chionophila jamesii Benth.

Chionophila jamesii Benth. in DC. Prodr. **10**: 331. 1846. "In montibus Scopulosis Americae borealis juxta nives perpetuas (James!) * * * (v. in herb. Torrey et Hook.)." Isotype seen in herbarium of New York Botanical Garden, doubtless from Pikes Peak.

Moist, gravelly slopes, above timber line, at altitudes of 3,600 to 4,200 meters; Alpine Zone; flowering from early July to late August. High mountains, Medicine Bow Mountains of southeastern Wyoming, southward through the Front Range of northeastern Colorado; on Pikes Peak; on the San Juan and Uncompahgre mountains of southwestern Colorado; doubtless through intervening ranges.

WYOMING: Albany: Medicine Bow Mountains.
COLORADO: Boulder: Arapahoe Peak; Longs Peak. Clear Creek: Berthoud Pass; Douglass Mountain; Grays Peak; Mount Flora; Mount Lincoln. El Paso: Pikes Peak (6330, 6335). Jackson: Ethel Peak. Larimer: Mountains above Beaver Creek; Estes Park; Longs Peak. Mineral: Near Pagosa Peak. Ouray: Mount Hayden. San Juan: Red Mountain. Summit: Mount Bartlett. County uncertain: Sawatch Range; Sierra Sangre de Cristo.

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[1] In *Collinsia*, *Scrophularia*, and *Chionophila* numbers refer to specimens of my own collecting.

PENSTEMON [Mitchell] Schmidel.[1]

KEY TO SECTIONS.

Anther sacs opening from the distal apex, throughout or partially; seeds grayish brown or brown, deepening to blackish, minutely or obsoletely reticulate.

Corolla scarlet, somewhat fleshy, the throat tubular. ELMIGERA (Reichenb.) Benth.

Corolla 25 to 30 mm. long, the posterior lobes 5 mm. long, united one-half their length, the anterior lobes scarcely spreading; anther sacs 2 mm. long, lanceolate, minutely puberulent, slightly united at base; seeds 2.5 mm. long, less sharply angled; leaves at base of stem obovate, those on the stem ovate, the upper ones rounded at base, the opposite leaves completely clasping the stem; thyrsus strict, the peduncles and pedicels short..**I. Centhranthifolii.**

Corolla 30 to 35 mm. long, the posterior lobes 8 to 12 mm. long, united two-thirds to three-fourths their length, the anterior lobes decurved-reflexed; anther sacs 1.5 to 2 mm. long, triangular-ovate, scarcely puberulent, broadly united at base; seeds 2 to 2.2 mm. long, sharply angled; leaves at base of stem lanceolate-oblong, those on the stem linear to lanceolate, narrowed at base and slightly clasping, the opposite leaves not meeting; thyrsus lax, the peduncles and pedicels longer..............................**II. Barbati.**

Corolla dull red, blue, purplish blue, or white, membranous, the throat usually wider.

Anther sacs glabrous to lanate; seeds merely angled; corolla throat terete or anteriorly flattened and ridged within. Inflorescence thyrsoid, rarely seeming racemose; leaves thin to succulent, not coriaceous; plants herbaceous to suffrutescent at base. EUPENSTEMON Benth.

Corolla throat rounded anteriorly; seeds brown, 1.5 to 5 mm. long; stems erect from base, not suffrutescent; plants probably biennial.

Corolla glandular-puberulent within, white or red.

Corolla red, the throat narrow; sterile filament glabrous; leaves entire; plants glabrous, glaucous.........................**III. Utahenses.**

Corolla white, the throat broad; sterile filament bearded; leaves frequently dentate; plants rough-puberulent, not glaucous...**IV. Albidi.**

Corolla not glandular-puberulent within, blue or purplish blue (except in *Spectabiles* and *Petiolati*).

Leaves broadly linear to orbicular.

Corolla throat nearly tubular, the posterior lobes united but slightly at base, the corolla scarcely 2-lipped. Plants cinereous-puberulent; corolla glabrous within.........................**V. Fremontiani.**

Corolla throat evidently inflated anteriorly, the posterior lobes united at least one-fourth their length, the corolla evidently 2-lipped.

Leaves relatively thin, not fleshy; plants scarcely or not glaucous (except in *Spectabiles* and *Petiolati*); sterile filament relatively slender, scarcely or but slightly enlarged distally; seeds 1.5 to 3.5 mm. long, finely and closely reticulate; posterior corolla lobes more arched, usually but slightly spreading.

Plants more or less densely puberulent or pubescent; corolla mostly purplish, the posterior lobes mostly less united, always for less than one-half their length; anther sacs always glabrous, the line of contact between the sacs relatively long. Sterile filament conspicuous, densely bearded with yellow or orange hairs; seeds more evidently reticulate.....................**VI. Cristati.**

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[1] C. C. Schmidel, Icones Plantarum 2. 1762. Type, from description and pre-Linnean citation, *Chelone pentstemon* L. This would establish the orthography "*Penstemon.*"

Plants glabrous or finely puberulent, rarely decidedly so; corolla mostly blue, the posterior lobes mostly more united, for one-third to usually over one-half their length; anther sacs glabrous to lanose, with short line of contact.

Stem leaves ovate to orbicular, dentate or serrate, glaucous; corolla (probably in ours) not blue.

Corolla 15 mm. long, scarcely inflated, strongly bearded within, apparently reddish; anther sacs short, semicircular; sterile filament not exserted, relatively short-bearded; leaves orbicular, dentate, the lower ones on conspicuous petioles, the upper ones distinct; plants cinereous-puberulent, glandular-pubescent in the inflorescence ..**VII. Petiolati.**

Corolla 25 to 30 mm. long, strongly inflated, slightly bearded within, "cream-white, and usually suffused or particolored with pink"; anther sacs ovate; sterile filament conspicuously exserted, bearded with long hairs; leaves ovate, serrate, the lowest somewhat petioled, the upper ones frequently connate; plants glabrous below, glandular-pubescent in the inflorescence.............**VIII. Spectabiles.**

Stem leaves linear to lance-ovate, entire, not or scarcely glaucous, the upper ones always distinct; corolla blue. Sterile filament bearded with short hairs or glabrous...........**IX. Glabri.**

Leaves relatively thick, more or less fleshy; plants strongly glaucous; sterile filament relatively broad, more or less enlarged distally (bearded with relatively short hairs); seeds 2.5 to 5 mm. long, more coarsely alveolate-reticulate; corolla lobes all widely spreading (posterior lobes united less than one-half their length). **X. Coerulei.**

Leaves filiform to narrowly linear.

Corolla 13 to 15 mm. long, the throat straight, inflated anteriorly, pubescent within over bases of the anterior lobes; sterile filament bearded; plants 10 to 30 cm. tall, the leaves more or less crowded at or near the base....................................**XI. Laricifolii.**

Corolla 15 to 20 mm. long, the throat decurved, narrow, not inflated, puberulent within over bases of all the lobes; sterile filament glabrous; plants 20 to 40 cm. tall, the leaves more scattered on the stem....................................**XII. Ambigui.**

Corolla throat flattened and 2-ridged within anteriorly; seeds grayish brown, 0.5 to 2 mm. long; stems usually depressed and more or less suffrutescent at base; plants probably all perennials.

Corolla white, glandular-puberulent within over bases of all the lobes; leaves coarsely sinuate-dentate................................**XIII. Deusti.**

Corolla blue or chocolate-purple, pubescent to lanose within over bases of the anterior lobes; leaves, at least the basal ones, entire or nearly so.

Corolla 8 to 22 mm. long, pale to deep blue, pubescent within over bases of the anterior lobes, these equaling or somewhat exceeding the posterior ones.

Corolla somewhat expanding, the posterior lobes more or less spreading; seeds pale toward the margin, lighter in shade, 0.5 to 2 mm. long; stems erect, diffuse-spreading only at base, not forming mats; plants finely puberulent or glabrous..............**XIV. Graciles.**

Corolla nearly tubular, the posterior lobes projecting; seeds uniformly dense, very dark, 1.5 to 2 mm. long; stems lower, diffuse-spreading partially or throughout, forming mats; plants more or less puberulent.................... ....**XV. Caespitosi.**

Corolla 25 to 30 mm. long, lavender-blue or chocolate-purple, lanose within over bases of the strongly projecting anterior lobes.
XVI. Whippleani

Anther sacs densely comose; seeds slightly wing-angled; corolla throat strongly flattened anteriorly and ridged within; inflorescence by reduction seemingly racemose; leaves coriaceous; plants shrubby, woody below. DASANTHERA (Raf.) Pennell [1]..................................**XVII. Fruticosi.**

Anther sacs opening partially by short confluent proximal slits, the anthers horseshoe-shaped; seeds pale gray, minutely honeycombed. Plants shrubby at base; corolla widely inflated, glabrous without and within; sterile filament glabrous. SACCANTHERA Benth.

Corolla scarlet-red, the throat nearly tubular, deeply 2-lipped, the posterior lobe projecting, the anterior ones strongly descending-recurved.
XVIII. Bridgesiani.

Corolla violet or blue, the throat inflated, shallowly 2-lipped, the lobes all spreading.
XIX. Heterophylli.

I. CENTRANTHIFOLII.

Stem glabrous; leaves glabrous or nearly so; sepals triangular-ovate, acute to acuminate, 3 to 5 mm. long..**1. P. eatoni.**

Stem and leaves finely pubescent or puberulent; sepals triangular-ovate to lanceolate, acute or more frequently long-acuminate, 3 to 7 mm. long.
1a. P. eatoni undosus.

II. BARBATI.

Anther sacs not lanate, more spreading; corolla throat relatively broad.

Corolla within the throat glabrous anteriorly or with a few white hairs; sepals mostly 3 to 5 mm. long..**2. P. torreyi.**

Corolla within throat lanate anteriorly with yellow hairs; sepals mostly 5 to 9 mm. long.

Stem and leaves glabrous; stem leaves linear or nearly so.......**3. P. barbatus.**

Stem and leaves puberulent; stem leaves broader than linear.
3a. P. barbatus puberulus.

Anther sacs more or less lanate, slightly thicker and more erect; corolla throat narrow.
4. P. trichander.

III. UTAHENSES.

A single species..**5. P. utahensis.**

IV. ALBIDI.

A single species..**6. P. albidus.**

V. FREMONTIANI.

Plants 40 to 80 cm. tall; basal and lower leaves obovate, emarginate, the upper leaves oblong-ovate; calyx lobes broadly ovate, abruptly short-caudate, with relatively conspicuous, erose, scarious margins; corolla 23 to 25 mm. long; sterile filament nearly or quite glabrous.................................**7. P. jonesii.**

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[1] *Dasanthera* Raf. Amer. Month. Mag. **2**: 267. 1818. Type species, *Gerardia fruticosa* Pursh.

Plants 10 to 30 cm. tall; basal and lower leaves oblanceolate to obovate, acutish, the upper leaves lanceolate; calyx lobes acute to acuminate, with narrow, scarcely erose, scarious margins; corolla 15 to 20 mm. long; sterile filament bearded.

Calyx lobes acute; anther sacs glabrous; sterile filament moderately bearded. **8. P. leptanthus.**

Calyx lobes acuminate; anther sacs barbate; sterile filament but slightly bearded. **9. P. fremontii.**

VI. CRISTATI.

Anther sacs opening nearly throughout, the line of contact of the sacs short; basal and lower leaves linear to linear-lanceolate; sterile filament densely bearded throughout with orange-golden hairs; seeds blackish.

Corolla 20 to 25 mm. long, much more than twice exceeding the sepals; stems relatively stout.......................................**10. P. auriberbis.**

Corolla 12 mm. long, much less than twice exceeding the sepals; stems slender. **11. P. parviflorus.**

Anther sacs opening throughout, the line of contact of the sacs longer; basal and lower leaves lanceolate to ovate; sterile filament bearded, especially distally, with yellow hairs; seeds brown.

Corolla throat moderately (i. e., less abruptly) inflated, slightly pubescent to glabrous within anteriorly, all the lobes spreading; anther sacs with moderate line of contact; sterile filament bearded with short hairs, rarely slightly exserted.

Inflorescence, stems (throughout), and calyx cinereous-puberulent but not glandular; plants 2 to 10 cm. tall; basal leaves 1.2 to 3 cm. long....**12. P. dolius.**

Inflorescence, stems (above), and calyx glandular-pubescent; plants taller; basal leaves 3 to 6 cm. long.

Basal leaves lanceolate; stem leaves narrowed to a clasping base; corolla 18 to 22 mm. long; anther sacs oblong-lanceolate, with medium line of contact; plants 8 to 16 cm. tall..........................**13. P. paysonii.**

Basal leaves ovate; stem leaves cordate-clasping at base; corolla 15 to 17 mm. long; anther sacs ovate, with longer line of contact; plants 10 to 40 cm. tall ....**14. P. moffatti.**

Corolla throat abruptly and strongly inflated, lanose within anteriorly, the posterior lobes arched and projecting forward (not spreading); anther sacs with long line of contact; sterile filament bearded with long hairs, usually exserted.

Corolla throat not contracted distally, the lobes one-fourth to one-third the total length; anther sacs with line of contact nearly equaling the length of each.

Corolla 20 to 35 mm. long, the throat very widely inflated, the lobes one-third the corolla length; basal leaves ovate, rough-puberulent, more or less lanate-pubescent; stem (above) and sepals white-lanate with gland-tipped hairs.

Stem leaves lanceolate, entire or nearly so; corolla 25 to 35 mm. long. **15. P. eriantherus.**

Stem leaves lanceolate-linear, more or less dentate with salient teeth; corolla 20 to 28 mm. long.................**15a. P. eriantherus saliens.**

Corolla 15 to 20 mm. long, the throat less inflated, the lobes one-fourth the corolla length; basal leaves lanceolate, roughish-puberulent to glabrate; stem (above) and sepals puberulent with gland-tipped hairs. **16. P. ophianthus.**

Corolla throat obviously contracted distally, the lobes one-fifth the corolla length; anther sacs with line of contact longer than the length of each. **17. P. cleburnei.**

VII. PETIOLATI.

A single species..**18. P. petiolatus.**

VIII. SPECTABILES

A single species.. **19. P. palmeri.**

IX. GLABRI

Anther sacs glabrous (or in *P. hallii* sometimes with a small tuft of hairs precisely at the summit of the filament).
  Anther sacs with relatively long line of contact, opening throughout.
    Corolla throat abruptly inflated and decurved at base; sterile filament short-bearded (very rarely glabrous); anther sacs with relatively long line of contact; sepals glandular-puberulent externally, with broad lacerate scarious margin. Plants 5 to 25 cm. tall........................... **20. P. hallii.**
    Corolla throat gradually much expanded from the base, not abruptly decurved; sterile filament glabrous (very rarely with a few hairs at apex); anther sacs with short line of contact; sepals glabrous externally, with or without a narrow entire scarious margin.
      Plants 5 to 10 cm. tall, puberulent; basal leaves 2 to 2.5 cm. long; stem leaves few; thyrsus of 1 or 2 1-flowered fascicles; sepals ovate, not or scarcely scarious-margined; corolla glabrous within................ **21. P. parvus.**
      Plants 40 to 90 cm. tall, glabrous; basal leaves 6 to 12 cm. long; stem leaves numerous; thyrsus of many several-flowered fascicles; sepals oblong-ovate, slightly scarious-margined; corolla glabrous or sparsely pubescent within anteriorly.... .... **22. P. unilateralis.**
  Anther sacs scarcely contiguous, the line of contact very short.
    Anther sacs opening throughout.
      Sepals narrowly ovate, more or less caudate-tipped, conspicuously scarious-margined, glabrous externally; lower stem leaves narrowly oblanceolate, sometimes 12 cm. long .... **23. P. magnus.**
      Sepals lanceolate-acuminate, not or obscurely scarious-margined, glandular-puberulent externally; lower stem leaves lanceolate, tapering distally, 4 to 10 cm. long.................................. **24. P. leiophyllus.**
    Anther sacs opening partially.
      Plants 40 to 70 cm. tall, glabrous throughout; sepals broadly ovate, more or less abruptly acuminate; corolla glabrous externally, the throat more inflated anteriorly; sterile filament slightly bearded ...... **25. P. laevis.**[1]
      Plants 20 to 35 cm. tall, cinereous-puberulent throughout; sepals ovate-acuminate; corolla glandular-puberulent externally, the throat less inflated anteriorly; sterile filament glabrous .... **26. P. wardii.**

Anther sacs hispid-pubescent to lanate on the sides, scarcely contiguous, the line of contact of the sacs very short.
  Anther sacs short-pubescent with relatively stiff hairs.
    Anther sacs opening throughout.
      Corolla 25 to 30 mm. long, the throat much inflated anteriorly and slightly narrowed to the orifice, the anterior lobes abruptly deflexed-spreading and pubescent or glabrous at base within; sepals not glandular-puberulent externally.
        Sepals 2 to 4 mm. long, nearly orbicular, with short acute or no tip; corolla pubescent or glabrous within .... **27. P. glaber.**
        Sepals 5 to 7 mm. long, mostly ovate, with more or less prolonged acuminate tip.

[1] For description of a related new species, *Penstemon tidestromii*, omitted in the key, see p. 379.

Sterile filament relatively slender, scarcely or not lobed at the apex, bearded near the apex with yellow hairs; corolla 23 to 30 (–33) mm. long, usually decidedly pubescent within; sepals with an acuminate tip nearly equaling or exceeding the body; stem glabrous or puberulent .... 28. P. alpinus.

Sterile filament relatively stout, frequently or mostly bilobate at the apex, glabrous (rarely with a few hairs at apex); corolla 30 to 40 mm. long, slightly pubescent or glabrous within; sepals with an acuminate tip shorter than the body; stem puberulent.......... 29. P. brandegei.

Corolla 15 to 25 (–30) mm. long, the throat inflated anteriorly and not narrowed to the orifice, the anterior lobes spreading and glabrous at the base within; sepals minutely and usually obscurely glandular-puberulent externally.

Corolla widening from a narrow basal tube; sepals ovate, with acuminate tip; plants 30 to 100 cm. tall.

Corolla 15 to 22 mm. long, the posterior lobes united less than one-half their length; sepals with a long acuminate tip........ 30. P. saxosorum.

Corolla (20–) 22 to 30 mm. long, the posterior lobes united over one-half their length; sepals with a short acuminate tip.... 31. P. subglaber.

Corolla gradually widening from a broad basal tube; sepals broadly ovate, acute; plants 10 to 20 cm. tall................ 32. P. uintahensis.

Anther sacs opening partially.

Corolla 27 to 30 mm. long, the throat slightly narrowed to the orifice; sepals broadly ovate to orbicular, with broad scarious denticulate margin and short acuminate tip; thyrsus strongly secund; stem leaves lanceolate, narrowed to slightly rounded at the base............ 33. P. cyaneus.

Corolla 20 to 30 mm. long, the throat not narrowed to the orifice; sepals lanceolate to ovate, with no or moderate scarious margin, acuminate-attenuate; thyrsus not strongly secund; stem leaves with a broader rounded base.

Corolla 20 to 25 mm. long; sepals attenuate-tipped, not or scarcely scarious-margined.

Stem leaves ovate, the largest 2 to 6 cm. wide; stem glabrous throughout or puberulent only near the base; capsules 9 to 12 mm. long.
34. P. cyananthus.

Stem leaves lanceolate, the largest mostly 1 to 1.5 cm. wide; stem more puberulent, frequently so nearly throughout; capsules 8 to 10 mm. long............................ 34a. P. cyananthus subglaber.

Corolla 25 to 30 mm. long; sepals shorter-tipped, decidedly scarious-margined; stem glabrous or puberulent........ 34b. P. cyananthus longiflorus.

Anther sacs lanate with flexuous white hairs.

Corolla deep blue, the throat obviously exceeding the basal tube; anther sacs less densely lanate; sterile filament more or less bearded (rarely glabrous in *P. strictus*); thyrsus strict, secund; pedicels relatively short; herbage brighter green, rarely glaucous.

Anther sacs lanate-pubescent with slender hairs, these shorter than or about equaling the width of the sac.

Anther sacs opening partially; pedicels and sepals somewhat glandular-puberulent.

Leaves lanceolate, the cauline ones narrowly so, mostly acuminate, the largest 6 to 10 cm. long; sepals with broad scarious margin, acuminate to an attentuate tip; corolla 20 to 30 mm. long.[1]

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[1] For description of a related new species, *Penstemon mensarum*, omitted in the key, see p. 380.

Sepals 8 to 9 mm. long, the margin finely denticulate distally and with an acuminate-attentuate tip, this nearly or quite equaling the sepal body; corolla 30 mm. long, the posterior lobes projecting; leaves lanceolate, the widest 0.9 to 1.1 cm. wide..**35. P. scariosus.**

Sepals 4 to 6 mm. long, the margin coarsely denticulate distally and with an acuminate tip, this much shorter than the sepal body; corolla 20 mm. long, the posterior lobes apparently more spreading; leaves linear-lanceolate, the widest 0.7 to 0.9 cm. wide. **36. P. garrettii.**

Leaves ovate to lanceolate, the cauline ones lanceolate, obtuse to acute, the largest ones 3 to 7 cm. long; sepals with obscure narrow scarious margin, acute; corolla 15 to 20 mm. long........**37. P. cyanocaulis.**

Anther sacs opening throughout; pedicels and sepals glabrous. Corolla 15 mm. long; plant 10 cm. tall..............................**38. P. caryi.**

Anther sacs lanate with tortuous hairs, these mostly much exceeding the width of the sac.

Sepals 7 to 10 mm. long, long-acuminate, with broad conspicuous scarious margin, slightly puberulent; corolla more widely expanded. **39. P. strictiformis.**

Sepals 3 to 5 mm. long, obtuse to acute (or short-acuminate), with narrow scarious margin, glabrous; corolla less widely expanded.

Basal leaves and stem (throughout) nearly or quite glabrous, usually not or but slightly glaucous; leaves mostly lanceolate, those of the stem frequently narrower.................................**40. P. strictus.**

Basal leaves and stem (at base or frequently throughout) puberulent, more commonly glaucous; leaves narrower, the basal ones narrowly lanceolate, the cauline ones linear.............**40a. P. strictus angustus.**

Corolla pale blue, the throat scarcely exceeding the relatively long basal tube; anther sacs densely lanate with long hairs; sterile filament glabrous; thyrsus lax, less secund; pedicels relatively long; herbage more glaucous. **41. P. comarrhenus.**

X. COERULEI.

Stamens and style included; anther sacs explanate.

Corolla 40 to 45 mm. long, glabrous within, the lobes slightly spreading; sterile filament closely short-bearded near the apex; capsule 20 to 25 mm. long, conspicuously acuminate..................................**42. P. grandiflorus.**

Corolla 10 to 25 mm. long, the lobes strongly spreading; sterile filament strongly bearded toward the apex; capsule 10 to 15 mm. long, acuminate.

Corolla 15 to 25 mm. long, lanate-pubescent within at base of the anterior lobes lavender-pink to lavender-blue; sterile filament very densely bearded.

Corolla (15–) 20 to 25 mm. long; sterile filament strongly enlarged distally, very densely bearded with golden hairs; stem leaves ovate, the upper ones acuminate, all firm to somewhat fleshy.

Sepals ovate-acuminate; sterile filament bristle-bearded to the apex; basal and stem leaves lanceolate to lance-ovate.

Thyrsus strongly secund, composed of relatively lax fascicles; flowers lavender-pink; leaves firm, very glaucous, scarcely veined.

Corolla 20 to 25 mm. long; stem leaves lanceolate to lance-ovate; plants tall......................................**43. P. secundiflorus.**

Corolla 15 to 20 mm. long; stem leaves narrower; plants smaller. **43a. P. secundiflorus lavendulus.**

Thyrsus not secund, composed of close fascicles; flowers bluish; leaves somewhat fleshy, slightly glaucous, evidently reticulate-veined.
44. P. osterhoutii.

Sepals broadly ovate, mostly acute; sterile filament more shortly bearded, much of the expanded white apex frequently glabrous; basal and stem leaves broadly obovate to elliptic-ovate....... **45. P. versicolor.**

Corolla 15 to 20 mm. long; sterile filament slightly enlarged distally, densely bearded with yellowish hairs; stem leaves ovate, the upper ones acuminate to rounded-mucronate, thickened-fleshy.

Corolla 18 to 20 mm. long; sterile filament relatively short-bearded.
46. P. lentus.

Corolla 15 to 18 mm. long; sterile filament relatively long-bearded.
47. P. pachyphyllus.

Corolla 10 to 25 mm. long, glabrous within (sometimes somewhat lanate-pubescent in *P. arenicola*), changing from pink to coerulean blue; sterile filament less densely bearded.

Corolla 25 mm. long; sterile filament slightly enlarged distally, slightly bearded near the apex; sepals lance-attenuate, 8 mm. long; stems in large clumps; lowest leaves linear, the upper ones lanceolate; bracts large, ovate-acuminate, the lower ones elongate.................... **48. P. haydeni.**

Corolla 10 to 20 mm. long; sterile filament obviously enlarged distally, more strongly bearded, especially toward the apex; sepals acute to acuminate, 4 to 8 mm. long; stems in small clumps; lowest leaves not conspicuously narrower than the upper ones; bracts not so conspicuously enlarged.

Sterile filament moderately enlarged distally, but not terminating in a broad white apex; seeds more than one-half as wide as long, dark brown; lower bracts more or less elongate, linear-lanceolate to lanceolate.

Leaves linear to lanceolate, acuminate; corolla 15 to 20 mm. long.

Bracts elongate, mostly gradually tapering from the base; corolla 15 to 18 mm. long, the lobes spreading less than 12 mm. wide; capsule narrowly ovate to ovate, mostly 7 to 8 mm. wide.
49. P. angustifolius.

Bracts less elongate, mostly abruptly contracted from the widened base; corolla usually nearly 20 mm. long, the lobes spreading 15 mm. wide; capsule more broadly ovate, about 10 mm. wide.
49a. P. angustifolius caudatus.

Leaves mostly oblanceolate, obtusely mucronate to short-acuminate; corolla 10 to 15 mm. long......................... **50. P. arenicola.**

Sterile filament expanded distally into a broad white apex; seeds less than or about one-half as wide as long, reddish brown; lower bracts not elongate, ovate.

Sepals lance-acuminate; capsule pale brown; seeds about 3 mm. long.
51. P. nitidus.

Sepals ovate, acutish to acute; capsule dark brown; seeds about 4 to 5 mm. long .... **45. P. versicolor**

Stamens and style conspicuously exserted; anther sacs approximate.
52. P. cyathophorus.

XI. LARICIFOLII.

Plants grayish-puberulent; leaves narrowly linear, more crowded on the lower part of the stem and on the basal branches arising from the elongate caudex; corolla throat strongly inflated.

Plants closely puberulent................................. **53. P. coloradoensis.**

Plants more loosely and strongly puberulent...... **53a. P. coloradoensis sileri.**

Plants essentially glabrous; leaves filiform or nearly so, closely tufted on abbreviated basal branches arising from the shortened caudex; corolla throat less inflated.

Corolla throat evidently inflated, 9 to 10 mm. long, evidently 2-lipped, the posterior lobes 4 to 7 mm. long, the lobes spreading to a breadth of 10 to 15 mm., "white"; anther sacs ovate-lanceolate; sterile filament densely bearded dorsally.. **54. P. exilifolius.**

Corolla throat slightly inflated, 10 to 12 mm. long, sligntly 2-lipped, the posterior lobes 3 to 4 mm. long, the lobes spreading to a breadth of less than 11 mm., light red-violet; anther sacs linear-lanceolate; sterile filament slightly to moderately bearded dorsally.............................. **55. P. laricifolius.**

XII. AMBIGUI.

A single species... **56. P. ambiguus.**

XIII. DEUSTI.

A single species... **57. P. deustus.**

XIV. GRACILES.

Corolla glabrous externally (rarely with a few glandless hairs distally).

Sepals triangular, slightly scarious but nearly entire below, one-third to two-fifths the length of the capsule. Thyrsus of lax fascicles; flowers more distinctly pediceled.. **58. P. watsoni.**

Sepals long-acuminate to caudate-tipped, conspicuously scarious and more or less erose-lacerate below, at least one-half the length of the capsule.

Corolla 8 to 10 mm. long, the throat 2 mm. wide.

Calyx glabrous externally.

Sepals with long caudate tip and with relatively slightly toothed scarious margin... **59. P. procerus.**

Sepals with short caudate tip and with relatively more lacerate scarious margin................................ **59a. P. procerus aberrans.**

Calyx pubescent externally.................. **59b. P. procerus pulvereus.**

Corolla 10 to 18 mm. long, the throat 2.5 to 4 mm. wide.

Corolla 10 to 14 mm. long, densely pubescent within, deep violet-blue; sepals with conspicuously broad, strongly lacerate margin below, and relatively shorter tip, always glabrous; thyrsus densely congested.. **60. P. rydbergii.**

Corolla 15 to 18 mm. long, slightly to moderately pubescent within, lighter violet-blue; sepals with narrower, less lacerate margin below, and relatively longer tip, pubescent or glabrous; thyrsus less densely congested. **61. P. aggregatus.**

Corolla glandular-puberulent externally.

Corolla pale to deep blue, the throat 1.8 to 4 mm. wide; capsule lance-ovate, 5 to 7 mm. long; plants erect, 10 to 80 cm. tall; thyrsus of many several-flowered axillary clusters.

Corolla deep or violet blue, slightly paler anteriorly, the throat less strongly ridged within anteriorly and not apparently inflated posteriorly, the posterior lobes abruptly spreading and but little exceeded by the anterior ones; plants ascending from creeping stems.

Corolla 15 to 20 mm. long; stem puberulent in lines. Blades of basal leaves over 3 cm. long.

Corolla 17 to 20 mm. long, deep blue, the throat slightly inflated; sepals 3.5 to 7 mm. long, with broad and more or less lacerate scarious margin; stem leaves nearly always entire; thyrsus more crowded; plants paler green.................................. **62. P. pseudoprocerus.**

Corolla 15 to 18 mm. long, violet-blue or blue, the throat more inflated; sepals 3 to 4 mm. long, with narrow, nearly entire, scarious margin; stem leaves frequently dentate; thyrsus lax; plants deeper green.
63. P. virens.

Corolla 8 to 12 mm. long; stem uniformly puberulent.

Plants greenish, minutely puberulent, 10 to 30 cm. tall; basal leaves ovate to broadly oval; stem leaves mostly oblong-lanceolate to oval-ovate; sepals lanceolate, two-thirds to three-fourths the length of the capsule.

Trailing subaerial rhizome-like stems much developed; blades of basal leaves ovate to broadly ovate, acute, 1.5 to 2.5 cm. long, 1 to 2 cm. wide; stem leaves mostly oval-ovate............**64. P. brevifolius.**

Trailing subaerial rhizome-like stems little developed; blades of basal leaves broadly ovate, obtuse (to acutish), 2 to 3 cm. long, 1.5 to 2.2 cm. wide; stem leaves mostly oblong-lanceolate..**65. P. obtusifolius.**

Plants grayish, evidently puberulent throughout, 20 to 40 cm. tall; basal leaves lanceolate to narrowly ovate; stem leaves lanceolate; sepals triangular to ovate-acuminate, about one-half the length of the capsule..**66. P. humilis.**

Corolla pale blue, decidedly paler anteriorly, the throat strongly ridged within anteriorly and abruptly and slightly inflated posteriorly, the posterior lobes projecting, spreading only at the apex, somewhat exceeded by the anterior ones; plants strictly erect.

Plant grayish-puberulent throughout. Rootstock slender, much branched and densely matted. Leaves entire..................**67. P. radicosus.**

Plants green, minutely puberulent or glabrous; rootstock stout, less branched and not matted.

Leaves entire; blades of basal leaves mostly 2 to 3 cm. long, those of the cauline ones lanceolate-linear and mostly shorter than the internodes; thyrsus lax, the lower peduncles ascending, mostly 2 to 4 cm. long, the pedicels over 5 mm. long....................**68. P. oliganthus.**

Leaves denticulate; blades of basal leaves mostly 3 to 5 cm. long, those of the cauline ones narrowly lanceolate and mostly longer than the internodes; thyrsus more strict, the lower peduncles erect, rarely 2 cm. long, the pedicels shorter..........................**69. P. gracilis.**

Corolla violet, the throat 5 to 6 mm. wide; capsule ovate, 8 to 9 mm. long; plants spreading in tufts, 10 cm. tall; thyrsus of few usually 1-flowered fascicles.
70. P. harbourii.

XV. CAESPITOSI.[1]

Leaves linear-lanceolate to obovate.

Leaves cinereous-whitened; plants little spreading.

Stems 15 to 20 cm. tall; calyx lobes not scarious, acutish, 3 to 5 mm. long; corolla 16 to 20 mm. long, the anterior lobes decidedly exceeding the posterior ones.
71. P. retrorsus.

Stems rarely 10 cm. tall; calyx lobes scarious-margined below, acuminate, dentate, 5 to 8 mm. long; corolla 15 to 17 mm. long, the anterior lobes scarcely exceeding the posterior ones........................**72. P. thompsoniae.**

Leaves light green; plants widely spreading, forming mats.

Corolla 20 to 25 mm. long, with broad tube, more deeply 2-lipped. Anterior corolla lip 5 to 7 mm. long...........................**73. P. crandallii.**

[1] Limitation of species of this group difficult and unsatisfactory. They need much more field study.

Corolla 15 to 20 mm. long, with narrow tube, less deeply 2-lipped.
Leaves glabrate; calyx lobes less puberulent, scarious-margined. Stems usually more ascending, sometimes 10 cm. tall.
Leaves obovate, obtusish; calyx lobes acute........**74. P. suffrutescens.**
Leaves lanceolate, acute or acutish; calyx lobes acuminate....**75. P. xylus.**
Leaves canescent; calyx lobes densely puberulent, not or scarcely scarious-margined.
Leaves narrowly oblanceolate to obovate, reaching 1 to 2 cm. long; branches more ascending at apex, frequently 3 to 4 cm. tall.
76. P. caespitosus.
Leaves spatulate-obovate, mostly shorter; plant with branches scarcely ascending..........................**76a. P. caespitosus perbrevis.**
Leaves linear or nearly so. Plants heathlike.
Corolla 16 to 18 mm. long.
Leaves canescent; calyx lobes densely puberulent, not or scarcely scarious-margined; corolla more pubescent within................**77. P. teucrioides.**
Leaves glabrous or nearly so; calyx lobes slightly puberulent, scarious-margined; corolla usually less pubescent within.................**78. P. glabrescens.**
Corolla 12 to 14 mm. long...**79. P. abietinus.**

XVI. WHIPPLEANI.

A single species...**80. P. whippleanus.**

XVII. FRUTICOSI.

Leaves ovate, dentate with spreading teeth, pubescent, 2 to 3 cm. long; sterile filament 0.25 to 0.5 mm. wide, slightly lanose or glabrous distally.
81. P. montanus.
Leaves lanceolate, slightly dentate or entire, glabrous, 3 to 6 cm. long; sterile filament 1 to 1.5 mm. wide, strongly lanose near the apex.........**82. P. fruticosus.**

XVIII. BRIDGESIANI.

A single species...**83. P. bridgesii.**

XIX. HETEROPHYLLI.

Anthers purple; seeds 1.5 to 2 mm. long; sepals lanceolate, 5 to 8 mm. long; leaves lanceolate to ovate, 3 to 5 cm. long, green; stems puberulent.
Corolla lavender-violet, 20 to 30 mm. long; anther sacs frequently more or less pubescent on the sides; leaves elliptic-ovate, 4 to 5 cm. long, usually conspicuously acuminate; plants 30 to 70 cm. tall..............**84. P. platyphyllus.**
Corolla violet-blue, 15 to 19 mm. long; anther sacs always glabrous on the sides; leaves lanceolate to oblanceolate, 3 to 5 cm. long, obtuse to acute or somewhat acuminate; plants 10 to 40 cm. tall.......................**85. P. leonardi.**
Anthers dark gray; seeds 2 to 3 mm. long; sepals rounded-ovate, 2 mm. long; leaves linear-lanceolate, 6 to 9 cm. long, glaucous; stems glabrous. Corolla violet, 25 to 30 mm. long; plants 60 to 80 cm. tall.......................**86. P. sepalulus.**

1. **Penstemon eatoni** A. Gray.

Penstemon eatoni A. Gray, Proc. Amer. Acad. **8**: 395. 1872. "Mr. Watson * * * in company with Professor Eaton, found it abundantly in Provo Canyon, Wasatch Mountains," Utah. Isotype, *S. Watson* 776, collected in July, 1869, at 1,800 meters altitude, seen in the herbarium of Columbia University, at the New York Botanical Garden.

Rocky ravines and mountain sides, in the open or among junipers, at altitudes of 1,500 to 2,600 (3,000) meters; Upper Sonoran and Submontane zones; flowering from late April to late July. Foothills and mesas, through the southern Wasatch region from Utah and Wasatch counties to Washington County, Utah, in the San Juan Valley of southwestern Colorado, and in northern Arizona. Southward probably passes into *P. eatoni undosus*.

COLORADO: Montezuma:[1] Mesa Verde, *Vreeland* (M).

UTAH: Beaver: Frisco (U, Y); Milford, *Rydberg & Carleton* 6301 (Y), 6303 (Y). Carbon: Castle Gate, *Pennell* 6137 (H, U, Y). Piute: Jugtown (near Marysvale), *Jones* 5405q (U). San Pete: Indianola, *Tidestrom* 2252 (U). Utah: American Fork Canyon; Provo, *Pennell* 6111 (A, D, S, Y), 6114 (Y), 6121 (F, M, P, R, Y); Thistle (M, U, Y). Wasatch: Midway, *Carleton & Garrett* 6709 (U, Y). Washington: Santa Clara Valley, *Jones* 5129a (M, U, Y); Springdale (U). Wayne: Bromide Mine, *Jones* 5695am (U).

1a. Penstemon eatoni undosus Jones.

Penstemon eatoni undosus Jones, Proc. Calif. Acad. II. **5**: 715. 1895. "[*M. E. Jones*] No. 5110ah. April 26, 1894, in red sand at St. George, Utah, 2,700° alt." Type seen in U. S. National Herbarium; isotype in herbarium of New York Botanical Garden.

This is the same as *P. coccinatus* Rydb., described from Arizona. Apparently more variable, at least in sepal length, than the species, and here distinguished solely by the pubescence. Perhaps a form rather than a variety, but it seems to have a different range.

"Among the junipers in gravelly soil"; doubtless in situations similar to those of *P. eatoni*, but known from altitudes of 810 to 1,650 meters; Upper Sonoran Zone; flowering from late April to mid-June. In the Colorado drainage, southwestern Colorado, southern Utah, and northern Arizona.

COLORADO: Montezuma: Mesa Verde, *Cary* 186 (U). Montrose: Naturita, *Payson* 333 (F, M, R).

UTAH: Grand: Court House Wash, *Eastwood* 6104 (Y). Kane: Johnson, *Jones* 5289u (U). Washington: St. George, *Jones* 5110ah (U, Y); Silver Reef (Y).

2. Penstemon torreyi Benth.

Penstemon torreyi Benth. in DC. Prodr. **10**: 324. 1846. "Versus montes Scopulosos (iter Long!) * * * (v. in herb. Torr.)." Type seen in herbarium of Columbia University at the New York Botanical Garden.

Penstemon barbatus torreyi A. Gray, Proc. Amer. Acad. **11**: 94. 1876.

Rocky sagebrush and wooded slopes, at altitudes of 1,800 to 3,000 meters; Submontane and Montane zones; flowering from mid-June to late August. Foothills, lower slopes of mountains, and on mesas, from Garfield, Lake, and Teller counties, central Colorado, southward into New Mexico; on both continental slopes.

COLORADO: Archuleta: La Pagosa, *Newberry* (U). Chaffee: Buena Vista; Salida, *Pennell* 6308 (Y). Costilla: Placer, *Shear* 3630 (Y). El Paso: Artists Glen, *Clements* 100 (M, U, Y); Bison Creek (F); Cascade; Mount Manitou (F); North Cheyenne Canyon (Y); Ute Pass (M, P). Fremont: Canon City, *Brandegee* 85 (M). Garfield: Glenwood Springs; Shoshone, *Pennell* 6160 (D, M, U, Y), 6163 (R, Y). Gunnison: Sapinero, *H. N. Wheeler* (B). Hinsdale: Lake City, *Newberry* (Y). Lake: Twin Lakes, *Porter* (A). La Plata: Rockwood, *Tweedy* 418 (U). Las Animas: Berwind (B); Stonewall, *Beckwith* 170 (Y); Trinidad (U, Y).

[1] In lists of exsiccatae names of counties are given in alphabetical sequence, and are each followed by a colon.

Mineral: Wagon Wheel Gap, *B. H. Smith* (A). Montrose: Cimarron, *Pennell* 6249 (F, Y). San Miguel: Norwood Hill, *Walker* 457 (R). Teller: Florissant, *Ramaley* 1374 (B).

3. Penstemon barbatus (Cav.) Roth.

Chelone barbata Cav. Icon. Pl. **3**: 22. *pl. 242.* 1794. "Habitat in Imperio Mexicano, unde nuperrime introducta in hortum Regium Pharmaceuticum * * * Floruit * * * 1794." Type not verified.

Penstemon barbatus Roth, Catal. Bot. **3**: 49. 1806.

Through central highlands of Mexico, apparently extending northward to southern Utah. Reported from an altitude of 864 meters.

UTAH: Washington: St. George, *Palmer* (F, Y).

3a. Penstemon barbatus puberulus A. Gray.

Penstemon barbatus puberulus A. Gray in Torr. U. S. & Mex. Bound. Bot. 114. 1859. "Guadalupe cañon [Arizona], May, 1851; *Thurber*." Type not verified, but evidently the plant here considered.

Arizona and apparently southern Utah. Probably a distinct species.

UTAH: Without locality: *Bishop* 154 (U).

4. Penstemon trichander (A. Gray) Rydb.

Penstemon barbatus trichander A. Gray, Proc. Amer. Acad. **11**: 94. 1876. "S. W. Colorado, T. S. Brandegee, in Hayden's Exploration, 1875." Isotype (no. 1119, "ex herb. J. H. Redfield") seen in herbarium of Academy of Natural Sciences of Philadelphia.

Penstemon trichander Rydb. Bull. Torrey Club **33**: 151. 1906.

Hillsides, at altitudes of 1,650 to 2,100 meters; probably Submontane Zone; flowering from mid-June to late July. Foothills and mesas, San Juan and Dolores valleys, southwestern Colorado and southeastern Utah.

COLORADO: Archuleta: La Pagosa (U); Piedra, *Baker* 597 (F, M, U, Y). La Plata: Durango, *Baker, Earle & Tracy* 513 (F, M, U, Y). Montezuma: Mesa Verde, *Vreeland* 877 (Y). Montrose: La Sal Creek, *Payson* 453 (M). San Miguel: Norwood Hill, *Walker* 457.1 (R).

UTAH: San Juan: Allen Canyon, southwest of Abajo Mountains, *Rydberg & Garrett* 9300 (U, Y), 9303 (Y).

5. Penstemon utahensis Eastw.

Penstemon utahensis Eastw. Zoe **4**: 124. (July) 1893. "It was collected between Hatch's Wash and Monticello [Utah], May 28, 1892." Isotypes, labeled "May, 1892," seen in herbarium of Missouri Botanical Garden and U. S. National Herbarium.

Penstemon confusus Jones, Zoe **4**: 280. (October) 1893. "Collected by me at Detroit, western Utah, May 26, 1891." Specimens collected by Jones at Detroit and labeled "June, 1891. *Pentstemon Parryi* Gray var. *imberbis* Jones," seen in herbarium of the Missouri Botanical Garden and U. S. National Herbarium. Description composite, of this red-flowered plant and of the blue-flowered *P. pachyphyllus* A. Gray. *P. utahensis*, as here understood, varies in size and acumination of sepals and in width of corolla tube, *P. confusus*, with large acute sepals and broad tube, representing the extreme variation from the type.

Penstemon eastwoodiae Heller, Muhlenbergia **1**: 4. 1900. New name for *P. utahensis* Eastw., not *P. glaber utahensis* S. Wats. 1871.

Dry sandy or gravelly slopes, at altitudes of 1,600 to 2,100 meters; Upper Sonoran and Submontane zones; flowering early May to mid-June. Foothills and lower mountains, southern Utah (from Sevier County southward) and northern Arizona.

UTAH: Garfield: Canyon above Tropic, *Jones* 5312ae (U). Iron: Cedar City, *Jones* 5204w (U). Kane: *Siler* (A). Millard: Detroit, *Jones* (M, U). Piute: Marysvale, *Jones* 5338aa (U), 5388p (U), 5410h[1] (U). San Juan: Between Hatchs Wash and Monticello, *Eastwood* (M, U). Sevier: Salina Canyon, *Jones* 5419d (U). Washington: Beaverdam Mountains, *Parry* 152 (A, F, M, Y); Silver Reef (U).

6. Penstemon albidus Nutt.

Penstemon albidus Nutt. Gen. Pl. **2:** 53. 1818. "Hab. On the plains of the Missouri, common, from the confluence of the River Platte to the Mountains." Type seen in herbarium of the Academy of Natural Sciences of Philadelphia.

Chelone albida Spreng. Syst. Veg. **2:** 813. 1825.

Sandy to stony or clayey prairies and low hills, in the open, known from altitudes of 900 to 1,830 (2,100) meters; Upper Sonoran and Subboreal zones; flowering from mid-May to early July. High plains, west to the base of the foothills of eastern Colorado and Wyoming. Manitoba to Kansas, eastern Colorado, and Montana.

SOUTH DAKOTA: Custer: Hermosa, *Rydberg* 920 (U). Fall River: Hot Springs, *Rydberg* 918 (U, Y). Meade: Fort Meade, *Forwood* 284 (U). Pennington: *Over* 1843 (U). Stanley: Cedar Pass (U); Fort Pierre, *Hayden* (Y). Washabaugh: Bear Creek (U); Eagle Nest Butte, *Over* 2084 (U).

NEBRASKA: Cherry: Fort Niobrara, *Wilcox* (Y). Deuel: *Rydberg* 278 (U). Hooker: Mullen, *Rydberg* 1316 (U). Keith: Ogallala, *Pennell* 6401 (H, M, Y). Lincoln: Hershey; North Platte, *Pennell* 6408 (Y). Sheridan: Hay Springs, *MacDougal* 38 (Y). Thomas: Halsey (P); Thedford, *Rydberg* 1316 (U).

KANSAS: Ford: Dodge City, *Ellis* (U, Y). Gove: *Hitchcock* 377a (U, Y). Hamilton: Syracuse, *Thompson* 83 (U). Logan: *Hitchcock* 377 (U, Y). Meade: Meade, *B. B. Smyth* 137 (U). Seward: *Carleton* 213 (U).

WYOMING: Crook: Sundance, *Nelson* 2241 (M). Goshen: Torrington, *Nelson* 8290 (M). Johnson: Buffalo, *Lothian* (R). Laramie: Cheyenne, *Ball* 1769 (U). Sheridan: Big Horn, *Tweedy* 2328 (Y).

COLORADO: Bent: Rule Creek; Las Animas, *Osterhout* 3917. Denver: Denver, *Pennell* 5844 (Y). Elbert: Bijou Basin, *Jones* 171 (B, F, Y). El Paso: Nob Hill, *Pennell* 5795 (Y). Kiowa: Eads, *Baker, Earle & Tracy* 813 (M, Y). Logan: Sterling, *Osterhout* 988 (Y). Prowers: 25 miles south of Lamar, *Osterhout* 5060. Sedgwick: Julesburg, *Pennell* 6398 (B, D, U, Y). Weld: Greeley, *Johnston* 281 (M); Pawnee Buttes (B).

7. Penstemon jonesii Pennell, sp. nov.

Stems several, 40 to 80 cm. tall, finely pubescent throughout with reflexed hairs; lowest leaves narrowed to petiole-like bases, the longest 7 to 9 cm. long, spatulate-oblanceolate to obovate, more or less deeply emarginate; lower stem leaves similar, the upper ovate, rounded-clasping, the bases of each pair meeting, finely pubescent throughout; thyrsus narrow, of 10 to 20 fascicles, each of 2 short axillary branches, their pedicels longer than the peduncle; sepals 3 to 4 mm. long, broadly ovate, abruptly short-caudate, with evident erose scarious margin, glabrous; corolla 23 to 25 mm. long, the tube gradually expanding into the cylindric throat, the two together 18 to 19 mm. long, 5 to 6 mm. wide, slightly inflated, rounded, the lobes 5 to 6 mm. long, the 2 posterior ones united and arched for three-fifths their length, the 3 anterior ones united two-fifths their length, all the free portions projecting forward, glabrous without and within, blue (not seen fresh); anther sacs divaricate, 2 to 2.2 mm. long, with short line of contact, each opening partially distally, the suture fimbri-

[1] "At the top of the grade between Marysvale and Monroe," probably in Sevier County.

olate, the sacs elsewhere with minutely puberulent surface; sterile filament included, flattened, scarcely enlarged distally, glabrous or with a few short hairs at apex; capsule ovate; glabrous (not seen mature).

Type in the U. S. National Herbarium, no. 260627, collected at Springdale, Utah, altitude 1,200 meters, in flower, May 17, 1894, by M. E. Jones, (no. 5250, in part; distributed as *P. glaber* Pursh). Another sheet of the same collection is the type of *P. laevis*, described below (p. 347).

At altitudes of 1,200 to 1,600 meters; Upper Sonoran Zone; flowering in May. Virgin and Kanab valleys, southwestern Utah.

UTAH: Kane: Kanab, *Jones* 5286x (M). Washington: Springdale, *Jones* 5250 (U).

8. Penstemon leptanthus Pennell, sp. nov.

Stems several, 15 to 25 cm. tall, below densely canescent-puberulent with reflexed hairs, above becoming glabrate, from a short branched caudex; leaves not thickened, dull pale green above and beneath, obscurely veined, entire, densely cinereous-puberulent, those at the base of the stem with lanceolate blades, these obtuse to acutish, 5 to 6 cm. long, gradually narrowed to margined petioles 1 to 2 cm. long, the leaves on the stem sessile (the bases of opposite leaves not meeting), acutish, the largest 3 to 5 cm. long, 0.5 to 0.9 cm. wide; thyrsus narrow, less than one-half the height of the plant, of about 9 fascicles, each of 2 axillary short branches, their pedicels shorter than the peduncle; sepals 3 mm. long, ovate, acute, obscurely or not ribbed, slightly scarious-margined and slightly erose, proximally nearly glabrous; corolla 13 to 15 mm. long, the tube and throat 11 to 12 mm. long, the throat slightly inflated and rounded ventrally, the 2 posterior lobes 2 to 3 mm. long, united and arched about one-fourth their length, projecting, the 3 anterior lobes 2 to 3 mm. long, united at base, slightly spreading, the corolla glabrous without and within, probably blue (not seen fresh); anther sacs divaricate, 1 mm. long, lanceolate-oblong, minutely puberulent, opening distally most of their length, the suture glabrous; sterile filament scarcely exserted, flat, scarcely enlarged distally, bearded on the posterior face, especially distally, with yellow hairs; capsule not seen.

Type in the U. S. National Herbarium, no. 146868 (in part), collected in central Utah, in flower, by L. F. Ward in 1875. This was probably part of Ward's no. 280, collected at Twelve Mile Creek Canyon, near Mayfield, Utah, June 28, 1875, although mounted with and bearing the label of Ward 546 from The Button, Aquarius Plateau, Utah (see remarks under *P. parvus*, p. 345). It was distributed as *P. acuminatus* Dougl.

9. Penstemon fremontii Torr. & Gray.

Penstemon fremontii Torr. & Gray; A. Gray, Proc. Amer. Acad. 6: 60. 1862. "On the Uinta plains, very abundant and in large patches. June 5, 1844." Type, collected by Frémont, seen in herbarium of Columbia University at the New York Botanical Garden.

Penstemon glaber fremontii Jones, Contr. West. Bot. 12: 62. 1908.

Dry butte sides and sagebrush draws, at altitudes of 1,800 to 2,100 meters; Upper Sonoran Zone; flowering from late May to late June. Red Desert of southwestern Wyoming and northwestern Colorado.

WYOMING: Sweetwater: Bitter Creek (R, Y); Red Desert, *Pennell* 5882 (Y); Steamboat Mountain (R); Wamsutter, *Pennell* 5884 (H, M, U, Y).

COLORADO: Rio Blanco: Meeker, *Osterhout* 2608 (Y). Routt: Hayden, *Osterhout* 5107, 5224.

10. Penstemon auriberbis Pennell, sp. nov.

Stems several, 10 to 20 cm. tall, below cinereous-puberulent with reflexed hairs, above spreading-pubescent with narrow-headed gland-tipped hairs; leaves linear to linear-lanceolate, the longest 4 to 10 cm. long, 0.2 to 0.7 cm. wide, those at the base of the stem narrowed to petiole-like bases, those of the stem sessile, rounded to narrowed at base, partly clasping, all finely canescent-puberulent, the upper leaves and bracts more or less glandular-pubescent; thyrsus narrow, of 3 to 6 fascicles, each composed of 2 short axillary branches, their pedicels shorter than or equaling the peduncle; sepals 8 mm. long, lanceolate, acuminate, glandular-pubescent; corolla 20 to 25 mm. long, the tube 4 to 5 mm. long, 3 to 3.5 mm. wide, the throat 8 to 10 mm. long, 8 to 9 mm. wide, much inflated and rounded, the lobes 8 to 10 mm. long, 8 mm. wide, the 2 posterior ones united and arched for one-half their length, the 3 anterior ones united slightly at base, all the free portions widely spreading, the corolla externally glandular-puberulent, within somewhat pubescent over the bases of the anterior lobes, purplish blue, not or faintly lined within the throat; anther sacs widely divaricate, 1.4 to 1.5 mm. long, lance-oblong, with short line of contact, pale, or violet-tinged on side, from distal apex opening nearly throughout, the suture fimbriolate; sterile filament 15 to 17 mm. long, more or less exserted, flattened, gradually enlarged distally, at times decurved at apex, densely bearded on the posterior face nearly to the base with orange-golden hairs; capsule 8 to 10 mm. long, ovate, acuminate, glabrous; seeds 2.5 to 3 mm. long, irregularly lanceolate-curved in outline, the angles obscure, the surface finely alveolate-reticulate, blackish brown.

Type in the herbarium of the New York Botanical Garden, collected on a dry sandy sagebrush slope, east of Fountain Creek, northeast of Pueblo, Pueblo County, Colorado, altitude about 1,400 meters, in flower, June 5, 1915, by F. W. Pennell (no. 5731).

This species has been identified as *P. jamesii* Benth., but examination of the type of that species, in Torrey's herbarium (Columbia University Herbarium) at the New York Botanical Garden, shows that his name should replace *P. similis* A. Nels. *P. similis* occurs on the Staked Plains of eastern New Mexico and northwestern Texas, and it was doubtless on these or in near-by western Oklahoma, while on the return route of Long's expedition, that Doctor James collected his plant. *P. jamesii* differs from *P. auriberbis* by having wider leaves, larger flowers, and anther sacs which dehisce throughout and have a broad line of contact.

Sandy or loam sagebrush slopes, at altitudes of 1,250 to 2,100 (2,200) meters; Upper Sonoran Zone; flowering mid-May to late June. High plains in the Arkansas Valley of southeastern Colorado.

Colorado: Costilla: Sangre de Cristo Creek, *Rydberg & Vreeland* 5635[1] (Y). El Paso: Fountain, *Redfield* 514 (M). Fremont: Canon City, *Pennell* 6312 (D, F, H, M, P, R, U, Y). Huerfano: Badito (Y); La Veta (Y); Walsenburg, *Rydberg & Vreeland* 5633 (R, Y). Las Animas: Barela, *T. A. Williams* (Y). Otero: Apishipa River; Rocky Ford, *Osterhout* 2084 (Y). Pueblo: Pueblo, *Pennell* 5731 (H, R, U, Y), 5733 (D, F, M, P, Y); Swallows (M, R, U, Y).

A hybrid with *P. angustifolius caudatus* (Heller) Rydb. was collected at Pueblo, *Pennell* 5733a (U, Y).

11. **Penstemon parviflorus** Pennell, sp. nov.

Stem 15 to 20 cm. tall, cinereous-puberulent with reflexed hairs, above spreading-pubescent with gland-tipped hairs; leaves linear to linear-lanceolate, the longest about 5 cm. long, 0.3 to 0.5 cm. wide, those at the base of the stem gradually narrowed to petiole-like bases, those of the stem sessile, gradually narrowed to base, partly clasping, canescent-puberulent, the upper leaves and bracts more or less glandular-pubescent; thyrsus narrow, of at least 6 loose fascicles, each composed of 2 axillary

[1] As this is only record from west of Sangre de Cristo Range, and as the collectors upon the same expedition collected extensively east of that range, it is probable that there has been some confusion of data.

branches, their pedicels shorter than the peduncle; sepals 8 mm. long, lanceolate, acuminate, glandular-pubescent; corolla 12 mm. long, the tube and throat 7 mm. long, about 4 mm. wide, much inflated and rounded, the lobes 4 to 5 mm. long, the 2 posterior ones united and arched one-third to one-half their length, the 3 anterior ones united slightly at base, their free portions spreading, the corolla externally glandular-puberulent, within pubescent over the bases of the anterior lobes, probably purplish blue (not seen fresh); anther sacs widely divaricate, 1 to 1.2 mm. long, with short line of contact, the suture fimbriolate, the surface elsewhere minutely puberulent; sterile filament about 5 to 6 mm. long, apparently included, flattened, enlarged distally, densely bearded on the posterior face nearly to the base with yellow hairs; capsule not seen.

Type in the U. S. National Herbarium, no. 215626, collected at Mancos, Montezuma County, Colorado, in flower, July, 1890, by Alice Eastwood. This was distributed as *P. jamesii* Benth.

Upper Sonoran Zone.

12. Penstemon dolius Jones, sp. nov.

Stems several, 2 to 12 cm. tall, from a short branched caudex, cinereous-puberulent throughout with reflexed hairs; leaves dull above, pale beneath, cinereous-puberulent, those at the base of the stem with lanceolate-ovate blades, these acute, 1.2 to 3 cm. long, narrowed into margined petioles 0.7 to 2 cm. long, the stem leaves sessile (opposite leaves not meeting around the stem), oblanceolate, obtusish to acute, the largest mostly 1.5 to 1 cm. long, 2 to 8 mm. wide; thyrsus narrow, over one-half the height of the plant, composed of 3 to 6 fascicles, each consisting of 2 short axillary branches; sepals 7 to 9 mm. long, linear-lanceolate, acuminate, obscurely or not ribbed, entire, not scarious-margined, densely puberulent; corolla 15 to 18 mm. long, the tube and throat 11 to 13 mm. long, the throat somewhat inflated and rounded ventrally, the 2 posterior lobes 2 to 5 mm. long, united and arched much less than one-half their length, the 3 anterior lobes 3 to 6 mm. long, all the free lobes widely spreading, the corolla externally sparsely glandular-puberulent, within slightly pubescent or glabrous over the bases of the anterior lobes, blue (not seen fresh); anther sacs widely divaricate, 0.8 to 0.9 mm. long, lance-oblong, minutely puberulent, distinct, with medium line of contact, opening throughout, the suture fimbriolate; sterile filament 8 to 10 mm. long, scarcely exserted, flat, slightly enlarged distally, moderately bearded, especially toward apex, with relatively (to *P. eriantherus*) short yellow hairs on the posterior face; capsule not seen.

Type in the U. S. National Herbarium, collected at Willow Springs, Nevada, in flower, June 5, 1891, by M. E. Jones. Isotypes in herbaria of the New York Botanical Garden and the Missouri Botanical Garden.

Probably dry sagebrush slopes, at altitudes of 1,500 to 1,650 meters; Upper Sonoran Zone; flowering mid-May to early June. Valley of Duchesne River, northeastern Utah, of the Sevier River in central Utah, and in eastern Nevada.

UTAH: Sevier: Red hills north of Redmond, *Eggleston* 11130 (U). Wasatch: Theodore to Myton, *Jones* (U, Y; this collection differs in its dwarf habit and more widely spreading corolla lobes, and only because of the variability in the corolla lobes of the type of *P. dolius* is it placed with this species).

In the Gray Herbarium are two specimens bearing data in the handwriting of Asa Gray, "S. Utah, Siler in litt.," determined by him as *P.* "*pumilus* var. *Thompsoniae.*" These are evidently an undescribed plant allied to *P. dolius* but which has the line of contact of the more puberulent anther sacs very short. The specimens are both incomplete, showing only the inflorescence.

Type in the U. S. National Herbarium, no. 327015, collected at Thurber, Utah, altitude 2,100 meters, in flower and fruit, August 1, 1894, by M. E. Jones (no. 5708; distributed as *P. moffatti* Eastw.). Isotypes in herbaria of Missouri Botanical Garden and New York Botanical Garden.

Dry mesas, at altitudes of 1,600 to 2,100 meters; Upper Sonoran Zone; flowering late May to late June. Colorado drainage of southwestern Colorado and southeastern Utah, southward into northern New Mexico and northern Arizona.

COLORADO: Montezuma: Mancos, *Baker, Earle & Tracy* 410 (F, M, U, Y). Montrose: Naturita, *Payson* 347 (F, M).

UTAH: Garfield: *Siler* (M). Wayne: Thurber, *Jones* 5708 (M, U, Y).

17. Penstemon cleburnei Jones.

Penstemon cleburnei Jones, Contr. West. Bot. **12**: 62. 1908. "This is common on the Green River Desert, Wyoming, at Granger and Green River, and appears to have been first collected since the time of Nuttall by Cleburne, June 27, 1875. It is also A. Nelson's no. 4716." Type (in Jones Herbarium) and specimen of Nuttall not seen, but description, and also specimen of A. Nelson, indicate the plant here considered.

Penstemon auricomus A. Nels.; Rydb. Bull. Torrey Club **36**: 688. 1909. "*Pentstemon jamesii* A. Nelson, Bull. Torrey Club **25**: 547. 1898" (as to description). "Recent collections * * * by the writer in the Red Desert of Wyoming in 1897 (no. 3052) and again in 1898 (no. 4716)." Isotype, *Nelson* 3052, collected at Green River, Sweetwater County, Wyoming, May 31, 1897, seen in herbarium of the New York Botanical Garden.

Stony hillsides, at altitudes of 1,800 to 2,000 meters; Upper Sonoran Zone; flowering from late May to late June. Red Desert of southwestern Wyoming.

WYOMING: Carbon: Fort Steele, *Nelson* 5384 (R). Sweetwater: Green River, *Nelson* 3052 (M, R, Y), 4716 (F, R), *Pennell* 5893 (Y).

18. Penstemon petiolatus T. S. Brandeg.

Penstemon petiolatus T. S. Brandeg. Bot. Gaz. **27**: 455. 1899. "Sheep mountain, Nevada, at 5,000 ft. altitude, *Dr. C. A. Purpus*, no. 6136." Isotype seen in herbarium of the New York Botanical Garden; also, through the courtesy of Dr. H. M. Hall, a fragment of the type from the University of California. The original description must be modified so as to denote a plant cinereous-puberulent throughout, somewhat glandular-pubescent on the stem above and on the inflorescence, and with a bearded sterile filament. The original collection consisted of plants past normal flower, but with old shriveled corollas still attached. The specimens of A. L. Siler cited below are certainly the same species, and are in full blossom. They show more clearly the glandular inflorescence and the bearded sterile filament, and apparently that the corolla is reddish.

"Crevices of limestone rock"; probably Upper Sonoran Zone; flowering in March. Beaverdam Mountains of southwestern Utah and mountains of southern Nevada.

UTAH: Washington: Beaverdam Mountains, *Siler* (A).

19. Penstemon palmeri A. Gray.

Penstemon palmeri A. Gray, Proc. Amer. Acad. **7**: 379. 1868. "Arizona, in Skull Valley, and on Rio Verde, near Fort Whipple, Drs. Elliott Coues and Edward Palmer."

At an altitude of about 2,400 meters; Upper Sonoran Zone; flowering in late June. Southwestern Utah and central Arizona to eastern California.

UTAH: Beaver: Frisco, *Jones* 1820 (F, U, Y). Kane: *Siler* (A).

20. Penstemon hallii A. Gray.

Penstemon hallii A. Gray, Proc. Amer. Acad. **6**: 70. 1862. "Rocky Mountains near Clear Creek [Colorado], etc., in the alpine region, coll. 1862, Parry, Hall and

Harbour: no. 388, distrib. Hall and Harbour." Isotypes seen in herbaria of the Academy of Natural Sciences of Philadelphia, Field Museum of Natural History, Missouri Botanical Garden, and Brooklyn Botanic Garden.

Rocky knolls, above timber line, at altitudes of 3,100 to 3,900 meters; Alpine Zone; flowering from early July to late August. High mountains, Front Range from Grays Peak southward, Sawatch Range, Pikes Peak, Sangre de Cristo Range, and San Juan and adjacent ranges, Colorado.

COLORADO: Chaffee: Mount Princeton, *Sheldon* 549 (U). Clear Creek: Grays Peak, *Patterson* 119 (F, M, U, Y); Mount McClellan (F). El Paso: Mount Garfield (Y); Pikes Peak, *Pennell* 6328 (D, R, Y). Lake: Mount Elbert, *W. A. Henry* (U). Park: Mountains north of Boreas (U); mountains above Como (Y); Horseshoe Mountain, *Coulter* (U, Y). San Juan: Engineer Mountain (F); Mineral Point (M); Needle Mountains (U); Silverton, *Tweedy* 167 (U). Summit: Argentine Pass, *Jones* 408 (B, Y). County uncertain: Sangre de Cristo Range, *Brandegee* 805 (M).

21. Penstemon parvus Pennell, sp. nov.

Stems several, 5 to 10 cm. tall, from a relatively long slender caudex, slender, puberulent, not glandular or glaucous; leaves green, not glaucous, obscurely veined, puberulent, those at the base of the stem with oblanceolate-obovate acutish blades, 2 to 2.5 cm. long and 4 to 5 mm. wide, narrowed into ill-defined petiole-like bases, those of the stem similar, smaller, with narrowed, slightly clasping base, becoming much reduced in the inflorescence; thyrsus narrow, probably secund, raceme-like, not over one-fourth the height of the plant, composed of 1 or 2 fascicles, each consisting of 1 or 2 axillary one-flowered branches (the flowers but 1 to 4); sepals 4 mm. long, ovate, acute, not veined, not or scarcely scarious-margined and erose-margined, sparsely and finely glandular-puberulent; corolla 20 mm. long, the tube and throat 14 mm. long, the tube narrow, the throat inflated and rounded ventrally, the 2 posterior lobes 6 mm. long, united and arched over one-half their length, probably projecting, the 3 anterior lobes slightly shorter, united at base, the free portions spreading; corolla externally glandular-puberulent, within glabrous, blue (not seen fresh); anther sacs widely divaricate, 1 mm. long, lance-ovate, distinct, opening from distal apex throughout, glabrous; sterile filament about equaling the anterior pair, slightly enlarging distally, glabrous; capsule not seen.

Type in the U. S. National Herbarium, no. 146868 (in part), collected at The Button, Aquarius Plateau (Garfield or Wayne County), Utah, altitude 3,400 to 3,500 meters, in flower, August 11, 1875, by L. F. Ward (no. 546); distributed as *P. acuminatus* Dougl.

Alpine Zone.

22. Penstemon unilateralis Rydb.

Penstemon unilateralis Rydb. Bull. Torrey Club **33**: 150. 1906. Based upon "*P. secundiflorus* A. Gray, Syn. Fl. **2**[1]: 263. 1878. Not *P. secundiflorus* Benth." Statement of type locality from Gray: "Mountains of Colorado, common at 8 or 9,000 feet." Specimens named by Gray seen; none designated as type, but name sufficiently definite.

Usually in gravelly soil, on hillsides and along streams, at altitudes of 1,400 to 2,800 (3,000) meters; Submontane and Montane zones; flowering from mid-June to late August. Foothills and lower slopes of mountains, descending usually along rivers into high plains northward, from southeastern Wyoming to southern Colorado, on both continental slopes.

WYOMING: Laramie: Cheyenne, *Nelson* 1997 (M).

COLORADO: Arapahoe: Littleton, *Eggleston* 11213 (U). Boulder: Boulder, *Pennell* 5845 (Y); Coal Creek; Eldorado Springs; Lyons (M); Sulphide (B, Y). Chaffee: Buena Vista, *Sheldon* (U, Y, Z); Granite (U); Mount Harvard (Y). Clear Creek:

Empire, *Patterson* 258 (A, F, M, P, Y); Georgetown (Y); Idaho Springs (Y) Costilla: Sangre de Cristo Creek, *Rydberg & Vreeland* 5631 (Y). Denver: Valverde, *Pennell* 5846 (Y). Douglas: *H. S. Smith* 5136 (Y); Elbert: Bijou Basin, *Jones* 155 (F). El Paso: Colorado Springs, *Shear* 4789 (U, Y); Garden of the Gods; Manitou (M, P, Y); Palmer Lake; South Cheyenne Canyon; Ute Pass (M). Fremont: Wilson Creek, *Brandegee* 419 (M). Gilpin: Central City (Y); Eldora to Baltimore, *Tweedy* 5714A (Y). Lake: Twin Lakes, *C. W. Derry* (F). Larimer: Dale Creek; Estes Park (M, U); Fort Collins, *Crandall* 1866 (Y); Laporte (Y); Pennocks (Y); Poudre Canyon (Y). Las Animas: Stonewall, *Beckwith* 157 (Y), 164 (Y); Trinidad (Y). Park: Como, *Shear* 4586 (Y); Webster Canyon (M). Teller: Florissant, *Ramaley* 1313 (B). Weld: Evans (Y); Windsor, *Pennell* 5863 (P, S, U, Y).

23. **Penstemon magnus** Pennell, sp. nov.

Stems several, 40 cm. tall, from a caudex, stout, glabrous, bluish glaucous; leaves light green, scarcely glabrous, obscurely veined, glabrous, those at the base of the stem with oblanceolate, obtusish to obtuse blades 7 to 8 cm. long, narrowed into scarcely defined petioles (bases of lowest leaves not meeting around stem), the largest leaves 12 cm. long and 1.4 cm. wide; thyrsus narrowly elongate, one-half the height of the plant, composed of 7 or 8 fascicles, each consisting of 2 short axillary branches, the pedicels equaling the peduncle; sepals 6 to 7 mm. long, narrowly ovate, acuminate, obscurely and finely ribbed, with white to pinkish, scarious, denticulate margin, glabrous; corolla about 25 to 27 mm. long, the tube and throat about 18 to 20 mm. long, the throat strongly inflated and rounded ventrally, the 2 posterior lobes about 6 to 7 mm. long, united and arched about one-half their length, the 3 anterior lobes slightly longer, united at base, the free portions widely spreading; corolla glabrous without and within, probably deep blue (not seen fresh); anther sacs divaricate, 2.3 to 2.5 mm. long, oblong, distinct, opening from the distal apex nearly throughout, glabrous (except for minute ciliation of suture); sterile filament shorter than the anterior pair, scarcely enlarged and slightly flattened distally, bearded on the posterior face distally with a few short yellow hairs; capsule 15 to 20 mm. long, ovate, acuminate, glabrous; seeds 3 to 4 mm. long, irregularly rectangular in outline, curved, the angles sharp, not winged, the surface very minutely alveolate-reticulate, dark brown, slightly glistening.

Type in the herbarium of the New York Botanical Garden, collected in low, open grounds, near Teller (North Park), Jackson County, Colorado, altitude 2,400 meters, in flower, July 30, 1884, by C. S. Sheldon (no. 90; distributed as *P. confertus caeruleo-purpureus* A. Gray).

Probably Montane Zone.

24. **Penstemon leiophyllus** Pennell, sp. nov.

Stems one or several, 15 to 60 cm. tall, from a short branched caudex, glabrous, glandular-puberulent in the inflorescence, slightly glaucous; leaves dull pale green, slightly glaucous, finely veined, acute, altogether 10 to 13 cm. long, 1.3 to 2 cm. wide, narrowed into petiole-like bases of about one-third the total length, the leaves of the stem smaller, clasping from a broadly rounded base (bases of opposite leaves meeting around stem), becoming reduced to small bracts through the inflorescence; thyrsus narrow, secund, less than one-half the height of the plant, composed of 5 to 15 fascicles, each consisting of 2 short axillary branches, their pedicels somewhat exceeding the peduncle; sepals 6 to 7 mm. long, lanceolate, acuminate, not veined, with obscure or no scarious margin, entire, glandular-puberulent; corolla 25 to 30 mm. long, the tube and throat 17 to 20 mm. long, the throat decidedly inflated and rounded ventrally, the 2 posterior lobes 8 to 10 mm. long, united and arched about two-thirds their length, projecting, the 3 anterior lobes equaling or exceeding the posterior ones, united at base, the free portions widely spreading; corolla externally glandular-puberulent, within glabrous, blue; anther cells distinct, opening distally throughout, glabrous; sterile filament nearly equaling the anterior pair, scarcely enlarging distally, flattened, slightly bearded to glabrous on the posterior face distally; capsule ovate, acuminate, glabrous (not seen mature).

Type in the U. S. National Herbarium, no. 260622, collected at Mammoth Creek, Utah, altitude 2,400 meters, in flower, September 10, 1894, by M. E. Jones (no. 6026b; distributed as *P. glaber utahensis* S. Wats.).

"Gravelly slopes," at altitudes of 2,100 to 2,700 meters; probably Submontane Zone; flowering in early September. Mountains of southwestern Utah.

UTAH: Garfield: Panguitch Lake, *Jones* 6015ar (U), 6015as (U); Mammoth Creek, *Jones* 6026b (U). Washington: Pine Valley Mountains, *Purpus* 6203 (U); St. George (M).

25. **Penstemon laevis** Pennell, sp. nov.

Stems one or several 40 to 70 cm. tall, from a short branched caudex, glabrous throughout, glaucous; leaves pale dull green, somewhat glaucous, obscurely veined, glabrous, those at the base of the stem with narrowly obovate to ovate, obtuse (at times retuse, with or without a mucro) blades, altogether 10 to 15 cm. long, 2 to 3 cm. wide, narrowed into petiole-like bases one-third the total length, the stem leaves similar, smaller, clasping from a more or less broadly rounded base (bases of opposite leaves nearly or quite meeting around stem), becoming reduced and bractlike through the inflorescence; thyrsus narrow, secund, about one-half the height of the plant, composed of 9 to 18 fascicles, each consisting of 2 short axillary branches, their pedicels probably exceeding the peduncle; sepals 4 to 7 mm. long, broadly ovate, more or less abruptly acuminate, not veined, with relatively broad erose-denticulate scarious margin, glabrous; corolla 20 to 30 mm. long, the tube and throat 14 to 20 mm. long, the throat decidedly inflated and rounded ventrally, the 2 posterior lobes 6 to 10 mm. long, united and arched one-half their length, projecting, the 3 anterior lobes nearly equaling the posterior ones, united at base, the free portions spreading; corolla glabrous without and within, blue (not seen fresh); anther sacs widely divaricate, 1.8 to 2 mm. long, oblong-lanceolate, distinct, opening distally three-fourths their length, minutely puberulent; sterile filament shorter than the anterior pair, scarcely enlarging distally, flattened, bearded with yellow hairs on the posterior face near the apex; capsule not seen.

Type in the U. S. National Herbarium, no. 260632, collected in red sand at Springdale, Washington County, Utah, altitude 1,200 meters, in flower, May 17, 1894, by M. E. Jones (no. 5250, in part; distributed as *P. glaber* Pursh).

"Red sand," at altitudes of 1,000 to 1,700 meters; Lower Sonoran and Upper Sonoran zones; flowering from middle to late May. Southwestern Utah.

UTAH: Kane: Johnson, *Jones* 5289y (U); Kanab, *Jones* 5289x (U). Washington: Near Canaan Ranch, *Jones* 5262, in part (M); Rockville, *Jones* 5224v (U); Springdale, *Jones* 5250 (M, U).

26. **Penstemon wardii** A. Gray.

Penstemon wardii A. Gray, Proc. Amer. Acad. **12:** 82. 1876. "Utah, near Glenwood, at 5,300 feet, L. F. Ward, in Powell's Expedition." Isotype, collected in flower, June 4, 1875, near Glenwood, Utah, at 1,560 meters altitude, *L. F. Ward* 162, seen in U. S. National Herbarium.

Penstemon glaber wardii Jones, Contr. West. Bot. **12:** 62. 1908.

At an altitude of about 1,600 meters; Upper Sonoran or Submontane Zone; flowering in mid-June. Sevier County, central Utah.

UTAH: Sevier: 4 miles up Salina Canyon, *Jones* 5419b (U).

27. Penstemon glaber Pursh.

Penstemon glaber Pursh, Fl. Amer. Sept. 738. 1814. "In upper Louisiana. *Bradbury.* * * * v. s. in Herb. Bradbury." According to Bradbury (Travels, 319) "Alluvia of the Missouri, above the Big Bend," South Dakota. Isotype, labeled "Louisiana. Bradbury," seen in herbarium of the Academy of Natural Sciences of Philadelphia.

Penstemon erianthera Nutt. (in Fraser's Cat. 1813, *nomen nudum*) Gen. Pl. **2**: 52. 1818. "P. glabra Pursh * * * Hab. In arid soils near the confluence of Shian [Cheyenne] River," South Dakota.

Penstemon gordoni Hook. in Curtis's Bot. Mag. **73**: *pl. 4319.* 1847. "For the opportunity of figuring this * * * species * * * I am indebted to Edward Leeds, Esq., of Manchester, who raised it from seeds given him by Mr. Shepherd of the Botanic Gardens, Liverpool, and which had been collected by Mr. Gordon in the valley of the Platte River, on the east side of the Rocky Mountains."

Gravelly or alluvial banks, at altitudes of 1,200 to 2,100 (3,150) meters; Subboreal (Submontane) Zone (probably rarely ascending to Alpine Zone); flowering from early June to early August. High plains and foothills in drainage of Missouri River, south to Albany County, Wyoming. North Dakota to western Nebraska and central Wyoming.

SOUTH DAKOTA: Custer: Custer, *Rydberg* 916, in part (U). Fall River: Edgemont, *Rydberg & Bessey* 4910 (F, Y). Lawrence: Deadwood, *Rydberg* 916, in part (Y); Nasby (Y); Spearfish Canyon (F). Meade: Fort Meade, *Forwood* 287 (U). Pennington: Rapid Creek, *Over* 1842 (U). County uncertain: "Hills of Shian River," *Geyer* 124 (U, Y).

NEBRASKA: Banner: Lawrence Fork, *Rydberg* 276 (U, Y). Dawes: Pine Ridge, *Webber* (Y). Morrill: West of Chimney Rock, *Engelmann* (M). Sioux: War Bonnet Canyon, *T. A. Williams* (Y).

WYOMING: Albany: McGill Ranch, *Nelson* 7457 (B). Crook: Devils Tower, *L. W. Carter* (Y); Sundance Mountain (F, M). Fremont: Birds Eye, *Nelson* 9352 (M, U, Y); North Fork of Wind River (U). Johnson: Mouth of Trabing Creek, *Willits* 408 (R). Niobrara: U L Ranch, *Knowlton* 152 (U, Y). Park: Needle Mountain, *Cary* 612 (U). Sheridan: Big Horn, *Tweedy* 2330 (Y), Dome Lake Road,[1] *Nelson* 8541 (R); headwaters of Tongue River (Y). Washakie: Head of Middle Fork of Powder River, *Goodding* 285 (F, M, Y). Weston: Stockade Beaver, *Nelson* 9487 (R).

28. Penstemon alpinus Torr.

Penstemon alpinus Torr. Ann. Lyc. N. Y. **1**: 35. 1824. "Hab. with the preceding ["On James (=Pikes) Peak, * * * 10,000 feet above the level of the ocean, near the region of perpetual snow," collected in July, 1820, by Dr. Edwin James]." Type seen in herbarium of Columbia University at the New York Botanical Garden. Name unfortunate, as plant rarely reaches timber line and grows mostly upon the lower mountain slopes and foothills. Although it does occur on the middle slopes of Pikes Peak, it would appear more probable that Doctor James, in making his habitat note, confused this plant with the truly alpine *P. hallii*, so abundant above timber line on Pikes Peak; or quite possibly Torrey simply assumed that this came from the same altitudes as the plants which precede it in his report. The type, in accordance with Torrey's description, is a quite glabrous plant.

Chelone alpina Spreng. Syst. Veg. **4**: Cur. Post. 235. 1827.

Penstemon glaber alpinus A. Gray, Proc. Amer. Acad. **6**: 60. 1862–3.

Penstemon riparius A. Nels. Bull. Torrey Club **25**: 379. 1898. "Collected at Laramie [Wyoming] by Mr. Elias Nelson, June 18, 1897, and fruited specimens later in the season. Type specimen in Herb. Univ. of Wyoming, no. 3185." Type seen in

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[1] Stem pubescent: forma **pubicaulis** Pennell.

Rocky Mountain Herbarium. Here maintained as a puberulent to pubescent form, *P. alpinus* forma **riparius** (A. Nels.) Pennell (indicated in the following lists by an asterisk).

Penstemon oreophilus Rydb. Bull. Torrey Club **31:** 642. 1905. "Colorado: Eldora to Baltimore, 1903, *Tweedy 5711* (type)." Type seen in herbarium of the New York Botanical Garden.

Species variable in size, pubescence, width of leaves, shape and length of calyx lobes, pubescence on anther sacs, etc., and possibly to be considered a subspecies of the much more stable *P. glaber*.

Gravelly soil, at altitudes of 1,350 to 3,000 (3,600) meters; Submontane and Montane zones, ascending to Alpine; flowering from early June to late August. River banks in the high plains, slopes of foothills, and mountains, southeastern Wyoming to central Colorado.

WYOMING: Albany: Chug Creek, *Nelson* 7309 (M, U, Y); Dunn Ranch (Y); Laramie,* *E. Nelson* 3185 (R, Y); Laramie Peak* (U); Prayers Crossing* (U); Sibylee* (Y). Carbon: Fort Steele (R); Medicine Bow, *Goodding* 39 (M, U). Goshen: Fort Laramie, *Nelson* 9194 (R).

COLORADO: Boulder: Allenspark (B, R); Crescent (B); Eldora,* *Robbins* 2391 (B, R); Nederland* (B); Pine Cliff* (B); St. Vrain Creek* (B); Sugarloaf Mountain* (B); Ward,* *Osterhout* (Y). Clear Creek: Bard Creek (F); Deer Creek* (F); near Empire,* *Patterson* 256 (Y); near Georgetown* (F). Denver: Military Park (M); Valverde, *Pennell* 5825 (M, Y), 5842 (F, H, R, S, Y). El Paso: Bald Mountain (Y); Cheyenne Mountain (Y); Colorado Springs,* *Jones* 973 (F); Crystal Park (M, U, Z); Green Mountain Falls (U, Z); Manitou (Y); North Cheyenne Canyon, (Y); Pikes Peak (*Pennell* 6338, near Mountain View), *Pennell* 6320 (D, K, Y), 6321 (P, Y); Quartz Ridge (Y); South Cheyenne Canyon (Y); Ute Pass (M). Fremont: *Brandegee* (M). Gilpin: Central City* (Y); Eldora to Baltimore (Y); Mammoth Gulch (B); Tolland, *Pennell* 6374 (Y),* 6374A (Y), 6376 Y). Jefferson: Bergen Park (M); Buffalo Creek Canyon, *Rusby* (Y); Golden, *Jones* 824 (B, Y); Morrison (A). Larimer: Estes Park*; Horsetooth Mountain,* *Cowen* 1807 (Y), 4201; Moraine Park*; Stove Prairie Hill* (Y). Saguache: Marshall Pass, *Baker* 869 (Y). Teller: Rosemont, *Blumer* (F). Weld: Evans, *Johnston* 641 (Y).

29. Penstemon brandegei Porter.

Penstemon cyananthus brandegei Porter; Port. & Coult. Syn. Fl. Colo. 91. 1874. "Sierra Mojado, Brandegee." Isotype seen in herbarium of the Missouri Botanical Garden. This differs from other specimens here associated with it in having the corolla more lanate within, and in having the sterile filament, at least in some flowers, bearded with a very few hairs. The name is here used for what is believed to be a definite species, although some specimens, including the type, appear to approach *P. alpinus*.

Penstemon brandegei Porter; Rydb. Mem. N. Y. Bot. Gard. **1:** 343. 1900. As to synonomy; description compounded of this and *P. cyaneus*.

Probably in environments similar to those preferred by *P. alpinus*, at altitudes of 1,800 to 2,400 meters; Submontane Zone; flowering from late June to late July. Probably foothills and lower mountain slopes, perhaps descending to high plains, southeastern Colorado and northeastern New Mexico, on the Atlantic slope.

COLORADO: Fremont: Canyon City, *Brandegee* 930 (M). Las Animas: Fisher Peak (Y); Trinidad, *Beckwith* 160 (Y), 162 (Y); Wootton (Y).

30. Penstenom saxosorum Pennell, sp. nov.

Stems several, 10 to 80 cm. tall, from a short branched caudex, slender, glabrous, not or scarcely glaucous; leaves green, not or scarcely glaucous, glabrous, those at the base of the stem with lanceolate, obscurely acute blades 5 to 7 cm. long, narrowed into indefinite petiole-like bases of nearly one-half the total length, those of the stem similar, narrowly to broadly lanceolate, clasping from a narrowed (or above widened) base, longer than the internodes, the largest 5 to 9 cm. long, 0.5 to 1.8 cm. wide; thyrsus narrowly elongate, strongly secund, nearly one-third the height of the plant, composed of 5 to 9 fascicles, each consisting of 2 short axillary branches, the longest pedicels equaling or exceeding the peduncle; sepals 5 to 7 mm. long, ovate, with a caudate tip sometimes nearly equaling the body, obscurely veined, with white to pinkish, scarious, more or less denticulate margin, finely glandular-puberulent; corolla 16 to 22 mm. long, the tube and throat 11 to 16 mm. long, the throat strongly inflated and rounded ventrally, the 2 posterior lobes 5 to 6 mm. long, united and arched one-third to one-half their length, projecting, the 3 anterior lobes slightly longer, united at base, the free portions widely spreading; corolla very sparsely glandular-puberulent externally, glabrous within, deep blue (not seen fresh); anther sacs widely divaricate, 1.2 to 1.4 mm. long, lanceolate, distinct, opening from distal apex throughout, pubescent on the side with short hairs; sterile filament about equaling the anterior pair, slightly enlarged distally, flattened, bearded on the posterior face distally with short yellow hairs; capsule not seen.

Type in the herbarium of the New York Botanical Garden, collected on rocky hillsides, Woods Creek, Albany County, Wyoming, in flower, July 3, 1903, by L. N. Goodding (no. 1428; distributed as *P. strictus* Benth.).

Rocky slopes, at altitudes of 2,500 to 2,800 meters; Montane Zone; flowering from early July to mid-August. Hills, mountain slopes, and mesas, southeastern Wyoming and northern and west-central Colorado; on both continental slopes.

WYOMING: Albany: Centennial Mountain, *Nelson* 8759 (F, M, U, Y); near Fox Park, *Nelson* 9060 (M); Cummins (M); Woods Creek, *Goodding* 1428 (A, B, M, P, U, Y). Carbon: Battle Lake, *Nelson* 4186 (R).

COLORADO: Delta: Oak Mesa, north of Hotchkiss, *Cowen* (Y). Jackson: Camp Creek, *Goodding* 1455 (B, M, U, Y); Spicer, *Goodding* 1507 (A, B, M, U, Y). Routt: Anita Peak, *Goodding* 1759 (A, B, M, P, U, Y); Hahns Peak, *Goodding* 1704 (B, R, U, Y), *Tweedy* 4299 (U, Y).

31. **Penstemon subglaber** Rydb.

Penstemon glaber utahensis S. Wats. in King, Geol. Expl. 40th Par. **5**: 217. 1871. "Uinta Mountains, (Pack's cañon) Utah; 7,000 feet altitude [S. Watson] (771) [in 1869]." Isotype, collected July, 1869, seen in herbarium of Columbia University at the New York Botanical Garden.

Penstemon utahensis A. Nels. Bull. Torrey Club **26**: 242. 1899. Not *P. utahensis* Eastw. 1893.

Penstemon subglaber Rydb. Bull. Torrey Club **36**: 688. 1909. New name for *P. glaber utahensis* S. Wats.

Gravelly sagebrush slopes, at altitudes of 2,100 to 3,000 meters; Submontane and Montane zones; flowering from early July to early September. Foothills and lower slopes of the Teton and Wasatch ranges, western Wyoming to Sevier County, Utah.

WYOMING: Fremont: Wind River Mountains, *Forwood* (U). Lincoln: Headwaters of Cliff Creek (Y); Gros Ventre River, *Nelson* 3981 (R). Uinta: Evanston, *Pennell* 5940 (Y); Fort Bridger (A, P).

UTAH: Salt Lake: Near Salt Lake, *Stokes* (U). San Pete: Ephraim Canyon, *Tidestrom* 221 (U); Manti Canyon (M); Mount Pleasant (U). Sevier: Fish Lake, *Jones* 5717q (U). Summit: Peck Canyon, *Watson* 771 (U, Y). Utah: Soldier Summit, *Pennell* 6129 (D, F, K, P, S, Y).

32. **Penstemon uintahensis** Pennell, sp. nov.

Stems several, 10 to 20 cm. tall, from a short caudex, slender, glabrous, sparsely glandular-puberulent in the inflorescence, not glaucous; leaves green, not or scarcely glaucous, very obscurely veined, glabrous, those at the base of the stem with narrow, oblanceolate, rounded but mucronately acute blades 3 to 5 cm. long and 0.6 to 0.8 cm. wide, narrowed into petiole-like bases of nearly one-half the total length, those of the stem similar, clasping from a narrowed base, smaller, becoming much reduced in the inflorescence; thyrsus narrow, strongly secund, raceme-like, nearly one-third the height of the plant, composed of 5 or 6 fascicles, each consisting of 2 short axillary branches, the pedicels equaling the peduncle; sepals 5 to 6 mm. long, broadly ovate, with a slightly defined short acute tip, apparently not veined, with broad, white to pinkish, strongly and irregularly denticulate margin, finely glandular-puberulent; corolla 18 to 20 mm. long, the tube and throat 12 to 13 mm. long, the tube broad, the throat inflated and rounded ventrally, the 2 posterior lobes 5 to 6 mm. long, united and arched about one-third their length, projecting, the 3 anterior lobes 6 to 7 mm. long, united at base, the free portions spreading; corolla externally sparsely glandular-puberulent, within glabrous, probably blue (not seen fresh); anther sacs widely divaricate, 1 to 1.2 mm. long, lance-ovate, distinct, opening from the distal apex throughout, pubescent on the side with short hairs; sterile filament apparently equaling the anterior pair, gradually enlarging distally, flattened, bearded on the posterior face distally with yellow hairs; capsule not seen.

Type in the herbarium of the New York Botanical Garden, collected on crest of mountains, Dyer Mine, Uinta Mountains, Uinta County, Utah, in flower, June 30, 1902, by L. N. Goodding (no. 1221; distributed as *P. hallii* A. Gray). Isotypes in herbarium of Field Museum of Natural History and U. S. National Herbarium.

Alpine Zone.

33. Penstemon cyaneus Pennell, sp. nov.

Stems several, 40 to 80 cm. tall, from a short stout caudex, glabrous throughout, not or slightly glaucous; leaves light green, not glaucous, obscurely veined, glabrous, those at the base of the stem with lanceolate acute blades 15 cm. long and 1 to 2 cm. wide, narrowed into petiole-like bases of about one-third the total length, those of the stem lanceolate, clasping from a narrowed (or, in the upper leaves, widened) base, the longest 6 to 10 cm. long, becoming much reduced in the inflorescence; thyrsus narrowly elongate, strongly secund, nearly one-half the height of the plant, composed of 7 to 12 fascicles, each consisting of 2 axillary branches; pedicels shorter than (or the longest exceeding) the peduncle; sepals 4.5 to 5 mm. long, broadly ovate to nearly orbicular, with an evident short-acuminate tip, finely veined in age, with very broad, white to bluish, irregularly denticulate, scarious margin, glabrous; corolla 27 to 30 mm. long, the tube and throat 19 to 21 mm. long, the tube narrow, the throat inflated and rounded ventrally, somewhat contracted to the orifice, the 2 posterior lobes 8 to 9 mm. long, united one-third their length, projecting, the 3 anterior lobes slightly longer, united and flattened for 4 mm., the free lobes spreading to deflexed; corolla glabrous without and within, (early changing from violet-pink to) deep sky blue, violet toward tube; anther sacs divaricate, 1.8 to 2 mm. long, lanceolate, distinct, opening from the distal apex two-thirds to four-fifths their length, violet-purple on the sides, pubescent on the side with short fine hairs; sterile filament shorter than or equaling the anterior pair, violet-blue, gradually enlarging distally, flattened, bearded on the posterior face distally with yellow hairs; capsule 12 to 15 mm. long, ovate, acuminate, glabrous; seeds 2 to 3 mm. long, irregularly quadrangular in outline, curved, the angles sharp, thin, not winged, the surface finely alveolate-reticulate, brown, glistening.

Type in the herbarium of the New York Botanical Garden, collected in dry sagebrush, along railroad north of Ashton, Fremont County, Idaho, altitude of 1,560 to 1,590 meters, in flower and immature fruit, July 9, 1915, by F. W. Pennell (no. 6046).

Open sagebrush slopes, frequently gravelly or rocky, at altitudes 1,500 to 2,000 (3,000) meters; Submontane Zone; flowering mid-June to early August. Foothills and high plains, Park County and Yellowstone National Park, Wyoming, and adjacent Montana (in Madison Valley) to Blaine County, Idaho.

WYOMING: Yellowstone National Park: Near Mammoth Hot Springs, *Mearns* 496 (U), 1079 (Y), 1216 (Y), 2638 (U), *A. & E. Nelson* 5633 (M, U, Y), *Pennell* 6034 (H, P, Y); Spring Creek (R); Witch Creek (F); Yellowstone Lake (M, U).

IDAHO: Bingham: "Big Butte Station," *Palmer* 234 (U), 235 (U), 474 (U). Fremont: Ashton, *Pennell* 6046 (Y); Mount Chauvet, *Rydberg & Bessey* 4912 (F, U, Y), 4913 (Y); St. Anthony, *Merrill & Wilcox* 821 (U, Y).

34. **Penstemon cyananthus** Hook.

Penstemon cyananthus Hook. in Curtis's Bot. Mag. **75**: *pl. 4464*. 1849. "It is * * * an inhabitant of * * * the upper valleys of the Platte River in the Rocky Mountains, where seeds were collected by Mr. Burke. These seeds were reared by Messrs. Lucombe, Pince and Co., in whose Exeter nursery the plants flowered beautifully * * * in May 1849." Type not seen or verified.

Penstemon glaber cyananthus A. Gray, Proc. Amer. Acad. **6**: 60. 1862–63.

Varies in width of leaf and size of flowers. Southward (at Mount Nebo) specimens occur with more scarious calyx lobes, possibly approaching *P. cyananthus longiflorus.*

Mostly gravelly or rocky soil, sagebrush slopes, and openings in mountain woods, at altitudes of (1,300) 1,500 to 3,000 meters; Submontane and Montane zones, at times descending and ascending from these; flowering from late May to mid-August. Hills and mountains from southwestern Montana southward to Piute County, Utah; abundant in the Wasatch Range.

WYOMING: Uinta: Evanston, *Pennell* 5898 (Y), 5900 (F, P, Y); Medicine Butte, *Pennell* 5907 (Y).

IDAHO: Bear Lake: Fish Haven Canyon, *Mulford* 230 (M, Y). Fremont: Ashton, *Pennell* 6046B (Y).

UTAH: Cache: Cache Junction (M, U); Logan, *C. P. Smith* 1613 (R), 2201 (Y). Davis: Farmington Canyon; Kaysville, *Armstrong* 328 (Y). Juab: Mount Nebo, *Goodding* 1104 (F, U, Y). Morgan: Devils Slide, *Pennell* 5943 (B, H, M, R, U, Y). Piute: Mountains north of Bullion Creek, *Rydberg & Carlton* 7113, in part (Y). Salt Lake: Alta; Altus, *Pennell* 5962 (H, P, R, S, Y), 5967 (Y; albino); east of Barclay, *Pennell* 5956 (M, Y); South Fork of Big Cottonwood Creek, *Pennell* 5976 (Y); City Creek Canyon (Y); Dry Canyon (Y); Emigration Canyon, *Pennell* 5984; benches near Salt Lake City (Y); Silver Lake, *Pennell* 6085 (Y); above Sulphur Baths (F, M). Sevier: Belknap, *Stokes* (U, Y). Summit: Echo, *Pennell* 5935 (D, U, Y). Tooele: Ophir City,[1] *E. S. Blackwell* (P). Utah: Rock Canyon, east of Provo, *Pennell* 6123 (F, Y). Weber: Ogden, *Meehan* (A).

34a. **Penstemon cyananthus subglaber** (A. Gray) Pennell.

Penstemon fremontii subglaber A. Gray, Syn. Fl. **2**[1]: 262. 1878. "Idaho," in mountains near Fort Hall, *Burke.* Type in Gray Herbarium, verified by Mr. J. F. Macbride, who in a letter says of it, "The leaves are narrower than usual in *P. cyananthus.*" A corolla sent me shows it to be this form.

Stems puberulent below, frequently for most of their length; leaves prevailing lanceolate, the largest stem leaves 6 to 7 cm. long, 1 to 1.5 cm. wide, more densely puberulent; corolla about 20 mm. long; capsule 8 to 10 mm. long. Otherwise as in the species.

Dry sagebrush slopes, at altitudes of 1,500 to 2,100 meters; Submontane Zone; flowering in July and early August. Hills and lower mountain slopes, western Wyoming, eastern Idaho, and northwestern Utah. Probably grades into the species.

WYOMING: Lincoln: Spread Creek, *Tweedy* 231 (Y).

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[1] More puberulent on stem, although glabrous above.

IDAHO: Bannock: Pocatello, *Pennell* 6061 (M, R, Y), 6062 (F, H, U, Y), 6066 (P, Y). Fremont: Ashton, *Pennell* 6046a (Y); near Fall River (M).

UTAH; Box: Holstein Ranger Station, Minidoka National Forest, *J. H. Kroencke* 22548 (U. S. Forest Service Herb.).

34b. Penstemon cyananthus longiflorus Pennell, subsp. nov.

Stems puberulent, at least below, to nearly or quite glabrous; calyx lobes broader, with more evidently scarious margin and relatively shorter tips; corolla 25 to 30 mm. long, with longer tube at base; inflorescence more secund. Otherwise as in the species.

Type in the herbarium of Columbia University at New York Botanical Garden, collected at Beaver City, Utah, in flower, by Edward Palmer (no. 376; distributed as *P. glaber cyananthus*).

Southwestern Utah. Probably Submontane Zone; flowering in late July.

UTAH: Beaver: Beaver City, *Palmer* 376 (M, Y). Millard: Filmore National Forest, *L. Tuttle* 25318 (U. S. Forest Service Herb.). Piute: Near Marysvale, *Rydberg & Carlton* 7083 (Y).

35. Penstemon scariosus Pennell, sp. nov.

Stems several, 20 to 30 cm. tall, from a branched caudex, sparsely glandular-puberulent in the inflorescence, dull or slightly glaucous; leaves apparently dull green and somewhat glaucous, obscurely veined, glabrous, those at the base of the stem with broadly oblanceolate, acute blades 6 to 7 cm. long, narrowed into petiole-like bases about two-thirds the length of the blade, those of the stem similar, lanceolate, clasping (bases of the upper meeting around stem), the largest 7 to 9 cm. long, 0.9 to 1.1 cm. wide; thyrsus narrow, racemiform, strongly secund, about one-third the height of the plant, composed of 4 to 6 fascicles, each consisting of 2 axillary ascending branches; pedicels shorter than or equaling the peduncle; sepals 8 to 12 mm. long, ovate-lanceolate, with a caudate tip nearly or quite equaling the length of the body, obscurely or not veined, proximally with a conspicuous broad, white, scarious, slightly denticulate margin, sparsely and minutely glandular-puberulent; corolla about 30 mm. long, the tube and throat 20 mm. long, the tube narrow, the throat inflated and rounded ventrally, the 2 posterior lobes 10 mm. long, united and arched two-fifths to one-half their length, the free portions projecting, the 3 anterior lobes slightly longer, united at base, the free portions spreading; corolla externally glabrous, within glabrous or slightly pubescent over bases of anterior lobes, blue (not seen fresh); anther sacs widely divaricate, 1.8 mm. long, oblong-lanceolate, distinct, opening from the distal apex for three-fourths to four-fifths their length, densely pubescent on the side with loose white hairs, their length not exceeding the width of the sacs; sterile filament shorter than the anterior pair, gradually enlarging distally, flattened, bearded on the posterior face distally with scattered (or at apex more dense) short yellow hairs; capsule not seen.

Type in the U. S. National Herbarium, no. 507700, collected on aspen slopes, east of Musinia Peak, Wasatch Mountains, headwaters of Muddy Creek, Utah, altitude 2,700 meters, in flower, September 12, 1907, by Ivar Tidestrom (no. 568).

Also collected in the Uinta Mountains by H. D. Longille (no. 120; U, Y).

Montane Zone.

36. Penstemon garrettii Pennell, sp. nov.

Stems several, 20 to 40 cm. tall (very sparsely glandular-puberulent in the inflorescence), from a stout branched caudex, dull or slightly glaucous; leaves apparently dull green and somewhat glaucous, obscurely veined, glabrous, those at the base of the stem with lanceolate acute blades 6 to 7 cm. long, narrowed into petiole-like bases about one-half their length, those of the stem similar, narrowly lanceolate, clasping, the largest 6 to 10 cm. long, 0.7 to 0.9 cm. wide; thyrsus narrowly racemiform, strongly secund, less than one-half the height of the plant, composed of 7 to 10 fascicles, each consisting of 2 erect axillary branches; longer pedicels exceeding the peduncle; sepals 4 to 6 mm. long, ovate, with an acuminate tip about one-half the length of the body, obscurely veined in fruit, with conspicuous broad, white, scarious, coarsely and irregularly denticulate margin, finely and sparsely glandular-puberulent; corolla about 20 mm. long, the tube and throat 15 mm. long, the tube narrow, the throat inflated and rounded ventrally, the 2 posterior lobes 5 mm. long, united and arched one-half their length, apparently spreading, the 3 anterior lobes slightly longer, united at base, the free portions spreading; corolla glabrous without and within, probably blue (not seen fresh); anther sacs widely divaricate, 1.2 to 1.4 mm. long, oblong-lanceolate, distinct, opening from the distal apex nearly throughout, pubescent on the side with loose white hairs, their length not exceeding the width of the sacs; sterile filament shorter than the anterior ones, gradually enlarging distally, flattened, bearded on the posterior face distally with scattered (or at apex dense) short yellow hairs; capsule 8 to 9 mm. long, ovate, acuminate, glabrous, brownish; seeds about 2 mm. long, irregularly quadrangular in outline, curved, the angles sharp, not winged, the surface finely alveolate-reticulate, brown, slightly glistening.

Type in the herbarium of the New York Botanical Garden, collected in crevices in travertine rock in exposed places, "Hot Pots," near Midway, Wasatch County, Utah, in flower and fruit, July 6, 1905, by E. C. Carlton and A. O. Garrett (no. 6697). Isotypes in herbarium of Academy of Natural Sciences of Philadelphia, Rocky Mountain Herbarium, and U. S. National Herbarium.

At altitudes of 1,900 to 2,100 meters; probably Submontane Zone; flowering in early July. Eastern slope of the Wasatch Range, northeastern Utah.

UTAH: Utah: Price Canyon at Kyune, *Jones* 5603g (U). Wasatch: Near Midway, *Carlton & Garrett* 6697 (A, R, U, Y); "Hot Pots," July 4, 1905, *Garrett* 1329 (A).

37. **Penstemon cyanocaulis** Payson.

Penstemon cyanocaulis Payson, Bot. Gaz. **60**: 380. 1915. "Collected on high, dry mesas near Naturita [Montrose County, Colorado], May 25, 1914, where it is rather infrequent; alt. about 5,800 ft.; [*Edwin Payson*] no. 348." Type seen in Rocky Mountain Herbarium.

Dry, rocky or gravelly soil, at altitudes of 1,600 to 2,000 meters; Upper Sonoran Zone; flowering in late May. Mesas and foothills, drainage of Grand River, southwestern Colorado and southeastern Utah.

COLORADO: Montrose: Naturita, *Payson* 348 (F, M, R); Paradox, *Walker* 166 (U, Y).
UTAH: San Juan: Near Little Springs, western slope of La Sal Mountains, *Rydberg & Garrett* 8540 (Y).

38. **Penstemon caryi** Pennell, sp. nov.

Stem 10 cm. tall, from a caudex, slender, glabrous throughout, purplish glaucous; leaves apparently pale green, obscurely veined, glabrous, those at the base of the stem with narrowly lanceolate, obtuse blades 7 cm. long, narrowed into petiole-like bases about one-third the total length, those of the stem similar, nearly linear, the largest 4 to 5 cm. long, 0.2 to 0.3 cm. wide; thyrsus racemiform, strongly secund, one-third the height of the plant, composed of 4 fascicles, each consisting of 2 axillary ascending branches; longest pedicels equaling the peduncle; sepals 5 mm. long, ovate, with a long acuminate tip nearly equaling the length of the body, with white scarious margin, glabrous; corolla 15 mm. long, the tube and throat 11 mm. long, the throat inflated and rounded ventrally, the 2 posterior lobes 4 mm. long, united and arched for one-third their length, projecting, the 3 anterior lobes 5 mm. long, united at base, the free portions spreading; corolla glabrous without and within, probably blue (not seen fresh); anther sacs widely divaricate, 1.4 to 1.5 mm. long, oblong-lanceolate, distinct, opening from the distal apex throughout, pubescent on the side with loose white hairs, their length not exceeding the width of the sac; sterile filament shorter than the anterior pair, gradually enlarging distally, flattened, bearded on the posterior face distally with scattered (or at apex dense) short yellow hairs; capsule not seen.

Type in the U. S. National Herbarium, no. 858840, collected in the Bighorn Mountains, Wyoming, altitude 2,400 meters, in flower, June 4, 1910, by Merritt Cary (no. 504).

Probably Submontane Zone.

39. **Penstemon strictiformis** Rydb.

Penstemon strictiformis Rydb. Bull. Torrey Club **31:** 642. 1905. "Colorado: Mancos, 1898, *Baker, Earle & Tracy* 76 (type)." Type seen in herbarium of the New York Botanical Garden.

At altitudes of 1,900 to 2,100 meters; probably Submontane Zone; flowering from late June to July. Foothills, valley of San Juan River in southwestern Colorado.

COLORADO: Archuleta: Pagosa Springs, *B. H. Smith* (A). La Plata: Durango, *Eastwood* (U). Mineral: Wagonwheel Gap, *A. D. McNair* 16718 (U. S. Forest Service Herb.). Montezuma: Mancos, *Baker, Earle & Tracy* 76 (F, M, Y), *Eastwood* (Y).

40. **Penstemon strictus** Benth.

Penstemon strictus Benth. in DC. Prodr. **10:** 324. 1846. "In montibus Scopulosis ad fontes fl. Sweetwater (Frémont!) * * * (v. in herb. Torrey)." Type, labeled as collected August 7, 1842, seen in herbarium of Columbia University at the New York Botanical Garden. On August 7 Frémont was about South Pass, Sweetwater County, Wyoming, in the region assigned by Bentham as that of the type.

Variable, especially southward, in amount and length of hairs on the anther sacs and on the sterile filament, and in the length and acumination of the sepals. Northward more frequently with nearly linear leaves (this the typical state), although rarely such forms occur southward. Pubescence on petioles and bases of stems more pronounced southward in the La Sal Mountains, Utah.

Sagebrush and wooded slopes, at altitudes of 1,800 to 2,800 (3,000) meters; Submontane and Montane zones; flowering from mid-June to early August. Foothills, mountain slopes, and mesas, southern Wyoming, through Colorado to northern New Mexico. On both continental slopes.

WYOMING: Albany: Centennial, *Nelson* 3314 (M, U, Y); Cummins (M, U, Y); Laramie (Y); Sheep Mountain (F); Sybille Creek (U). Carbon: Encampment, *Tweedy* 4297 (U, Y); Hayden Forest (U); Hilton's; near T B Ranch (R). Fremont: Near South Pass, *Frémont* (Y). Sweetwater: Leucite Hills, *Merrill & Wilcox* 676 (U, Y), 705 (U, Y).

COLORADO: Archuleta: Arboles, *Baker* 602 (F, M, U, Y); Pagosa Springs (A). Conejos: South of Antonito, *Crandall* 4196 (Y). Costilla: Near Grayback, *Rydberg & Vreeland* 5629 (Y), 5630 (R, Y); Sangre de Cristo Creek (Y). Delta: Tongue Creek, Mesa Grande, *Purpus* 257 (F). Eagle: Gypsum Creek Canyon, *Crandall* (M); Wolcott. El Paso: Palmer Lake, *Mrs. Osterhout* 286. Garfield: Glenwood Springs, *Pennell* 6146 (B, D, F, H, Y), 6154 (R, Y), 6155 (U, Y), 6167 (Y). Grand: Coulter; Hot Sulphur Springs, *Ramaley & Robbins* 3612 (B). Gunnison: Gunnison, *Pennell* 6289 (M, Y); near Mount Carbon (U); Sapinero, *Pennell* 6271 (H, Y). Jackson: Michigan Creek; Pearl (U, Y); Walden, *Goodding* 1500 (A, B, M, P, U, Y). La Plata: Durango (U); La Plata River, *Baker, Earle & Tracy* 660 (F, M, Y); Parrote City (M). Mineral: Wagon Wheel Gap, *B. H. Smith* (A). Montezuma: Chicken Creek, *Baker, Earle & Tracy* 354 (F, M, R, U, Y); Dolores (U); Mancos (Y). Montrose: Cerro Summit (Y); Cimarron, *Pennell* 6253 (D, K, M, P, S, Y); Tabeguache Basin (F, M). Ouray: Ouray, *Pennell* 6179 (A, R, U, Y), 6243 (F, Y); Ridgway (U). Rio Blanco: Meeker, *Robbins* 7143 (B); Rio Blanco (B). Routt: Elk River (Y); Hayden (F, Y); Steamboat Springs, *Crandall* (U); Yampa. Saguache: Sargents, *Pennell* 6303 (Y). Summit: Mount Guyot, *J. P. Anderson* (M).

UTAH: Grand: La Sal Mountains, *Purpus* 7008 (M, U). San Juan: Ridge north of Brumley Creek, *Rydberg & Garrett* 8935 (U, Y); Geyser Canyon (U, Y). Uinta: Carter Dugway, *Goodding* 1406 (R).

40a. Penstemon strictus angustus Pennell, subsp. nov.

Stem usually puberulent, at least below; basal leaves narrowly lanceolate, 5 to 10 cm. long, 0.5 to 1.1 cm. wide, puberulent, glaucous; stem leaves linear or nearly so; corolla 25 to 32 mm. long (frequently larger than in the species). Otherwise as in the species.

Type in the herbarium of the New York Botanical Garden, collected at Piedra, Colorado, in flower, by C. F. Baker (no. 604; distributed as *P. strictus* Benth.).

Sagebrush slopes, at altitudes of 2,000 to 2,400 meters; Submontane Zone, but probably descending into Upper Sonoran; flowering in early July. Mesas and foothills, southwestern Colorado and southeastern Utah.

COLORADO: Archuleta: Piedra, *Baker* 604 (M, U, Y). Delta: Coal Springs Ranger Station (Y). La Plata: Durango, *T. S. Parsons*. Montezuma: Mancos, *Baker, Earle & Tracy* 405 (F, M, U, Y).

UTAH: San Juan: Along Brumley Creek, *Rydberg & Garrett* 8879, in part (Y), 8880(Y).

41. Penstemon comarrhenus A. Gray.

Penstemon comarrhenus A. Gray, Proc. Amer. Acad. **12:** 81. 1876 "Common in Utah, especially southward, coll. by Gordon, E. W. Emerson, Mrs. Thompson, Siler and recently by L. F. Ward." According to a memorandum by Mr. J. F. Macbride the specimen of Gordon, of which but a fragment is in the Gray Herbarium, is *P. strictus* Benth. This fails to answer the original description of *P. comarrhenus*. Of the remaining specimens cited, that of Ward was evidently particularly studied, and, as this fully answers the description, it may be considered as the type. Isotype seen in herbarium of Columbia University at the New York Botanical Garden.

Rocky or gravelly sagebrush slopes, at altitudes of 1,400 to 2,600 (3,000) meters Upper Sonoran and Submontane zones; flowering from late June to early August. Mesas in Colorado drainage and westward, western Colorado and central Utah.

COLORADO: Delta: Cedar Edge, *Baker* 245 (M, U, Y). Garfield: Glenwood Springs, *Pennell* 6157 (B, K, S, Y), 6159 (A, D, F, H, M, P, R, U, Y); Newcastle (B). Montezuma: Mesa Verde, *F. E. Lutz* (Y). Montrose: Naturita (F, M, P); Paradox, *Walker* 130 (U. Y). San Miguel: Norwood Hill, *Walker* 429 (U).

UTAH: Beaver: Beaver City, *E. Palmer* 375 (U, Y). Carbon: Castle Gate (M, U, Y); Helper, *Pennell* 6141 (Y), 6142 (H, Y). Garfield: Aquarius Plateau, *Rydberg & Carlton* 7383 (U, Y), *Ward* 462 (F, M, U); Panguitch Lake (U). Grand: Near Wilson Mesa, *Rydberg & Garrett* 8417 (Y). La Sal Mountains, *Purpus* 6613 (M, U). Kane: Asa's, *Jones* 6030q (U). Piute: Marysvale, *Rydberg & Carlton* 7030 (Y). San Juan: Monticello, *Rydberg & Garrett* 9159 (Y). Sevier: Fish Creek Canyon, *Garrett* 2503 (M, Y); Fish Lake. Wayne: Mount Ellen, *Jones* 5684as (U).

42. **Penstemon grandiflorus** Nutt.

Penstemon grandiflorus Nutt. in Fraser's Cat. 1813. "It was first met with near the confluence of the River Platte [with the Missouri], from whence it continues to the Andes. [*Nuttall.*]"

Penstemon bradburii Pursh, Fl. Amer. Sept. 738. 1814. "*P. grandiflorum* Fraser, Catal. 1813." Description, but no habitat given. Probable isotype seen in herbarium of the Academy of Natural Sciences of Philadelphia.

Chelone bradburii Steud. Nom. Bot. 186. 1820–24.

Chelone grandiflora Spreng. Syst. Veg. **2:** 813. 1825.

Plains, at altitudes of 900 to 1,200 meters; Upper Sonoran and Subboreal zones; flowering from late May to late June. High plains, within the Missouri drainage, occurring probably rarely through eastern Wyoming and eastern Colorado.

South Dakota: Custer: Hermosa, *Rydberg* 915 (U). Fall River: Hot Springs, *C. S. Williamson* (A). Meade: Fort Meade, *Forwood* 288 (U). Stanley: Fort Pierre, *Hayden* (A).

Nebraska: Cherry: Fort Niobrara, *T. E. Wilcox* (Y). Dawes: Belmont (Y); Crawford, *MacDougal* 118 (Y). Thomas: Halsey, *Krautter* (P).

Wyoming: Sheridan: Little Goose Grade, *Nelson* 2333, in part (U, Y).

Colorado: "Eastern Colorado," *W. J. Laybourn* (M).

43. **Penstemon secundiflorus** Benth.

Penstemon secundiflorus Benth. in DC. Prodr. **10:** 325. 1846. "In montibus Scopulosis (Frémont!) * * * (v. in herb. Torrey)." Type seen in herbarium of Columbia University at the New York Botanical Garden. Lacks satisfactorily opened flowers, but leaves and young flowers indicate the plant here considered. The specimen is labeled "Fremont–2nd. Exped.," "named by Bentham"; unfortunately the number of collection is lost, but Frémont upon his second expedition was in eastern Colorado.

Sagebrush slopes, granitic soil, at altitudes of 1,500 to 2,700 meters; Submontane Zone (perhaps entering lower Montane Zone); flowering from late May to early June. Foothills and outlying hills in high plains, often abundant, from Albany County, Wyoming, southward on the eastern continental slope to Bernalillo County, New Mexico.

Wyoming: Albany: Crow Creek (Y); Laramie, *Pennell* 5876 (Y); Sand Creek (Y); Table Mountain (M, U).

Colorado: Boulder: Boulder, *Pennell* 5833 (K, P, S, Y); Miramonte (B); Nederland (B); St. Vrain Creek (B); Valmont (F). Chaffee: Near Buena Vista (U, Y); Salida, *Pennell* 6309 (D, R, Y). Clear Creek: Clear Creek Canyon (F, U); Empire, *Patterson* 254 (A, F, M, P, Y); Georgetown (M). Denver: Denver, *Pennell* 5843 (Y); Valverde, *Pennell* 5839 (B, Y). El Paso: Crystal Park (Y); Eastonville (U); Garden of the Gods, *Pennell* 5779 (Y), 6316 (Y); Manitou, *Pennell* 5782 (Y), 5789 (U, Y); North Cheyenne Canyon, *Pennell* 5773 (D, F, H, M, R, Y), 5776 (Y); Pring (U); South Cheyenne Canyon, *Pennell* 5793 (Y), 6342 (F, H, M, P, U, Y); Ute Pass (M); Palmer Lake, *Pennell* 5808 (Y). Gilpin: Lake Ranch (Y); Rollinsville, *Overholts* (M, Y). Grand: Middle Park, *W. A. Henry* (F, M). Jackson: Camp Creek, *Goodding* 1457 (B, M, P, U, Y). Jefferson: West of Arena, *Pennell* 6346 (Y); Golden, *Pennell* 5817 (Y), 6383 (Y); Morrison, *Pennell* 5823 (U, Y). Larimer: Estes Park (U); Fort Collins (Y); Fossil Creek (B); Horsetooth Mountain, *Pennell* 5860 (D, F, H, Y); La Porte (Y); Owl Canyon, *Pennell* 5868 (A, M, R, Y); Ten-mile Creek (B). Park: South Park, *Wolf* 300 (A, U, Y). Weld: Carr, *Johnston* 3 (M).

43a. **Penstemon secundiflorus lavendulus** Pennell, subsp. nov.

Stems 20 to 40 cm. tall, relatively slender; basal leaves lanceolate; stem leaves more or less narrowly lanceolate, acuminate from a not conspicuously widened base; inflorescence one-half the height of the plant; sepals about 4 mm. long, ovate, acute to acuminate, with scarious, white to pink margins; corolla smaller and narrower than in the species, 15 to 20 mm. long, a paler lavender-pink to lavender-blue; capsule not seen. Otherwise nearly as in the species.

Type in the herbarium of the New York Botanical Garden, collected on bluff of Baculite Mesa, altitude 1,530 meters, six miles northeast of Pueblo, Pueblo County, Colorado, in flower, June 7, 1915, by F. W. Pennell (no. 5739). Isotypes in U. S. National Herbarium, herbarium of Missouri Botanical Garden, Gray Herbarium, and Rocky Mountain Herbarium.

Upper Sonoran Zone.

44. **Penstemon osterhoutii** Pennell, sp. nov.

Stems one to several, 40 to 80 cm. tall, from a short branched caudex, glabrous, slightly pale or bluish glaucous; leaves thickened, greenish, slightly glaucous, evidently reticulate-veined, glabrous, those at the base of the stem with ovate acute blades 7 to 9 cm. long, narrowed into margined petioles 3 to 5 cm. long, those of the stem clasping (bases of opposite leaves meeting around stem), lanceolate-ovate to ovate, acuminate from a widened base, the largest mostly 6 to 9 cm. long, 3 to 4 cm. wide: thyrsus narrowly elongate, nearly one-half (or more) the height of the plant, composed of 5 to 10 fascicles, each consisting of 2 short axillary branches, their pedicels shorter or longer than the peduncle; sepals 7 to 8 mm. long, ovate, acuminate, fine-ribbed, with broad, white to pink, scarious margin, glabrous; corolla 20 mm. long, the tube and throat 13 mm. long, the throat inflated and rounded ventrally, the 2 posterior lobes 7 mm. long, united and arched one-third to nearly one-half their length, the 3 anterior slightly longer, 7 mm. wide, united about two-fifths their length, all the free portions widely spreading; corolla externally glabrous, within lanate-pubescent over the base of the anterior lobes, glabrous elsewhere, blue or bluish (not seen fresh); anther sacs widely divaricate (explanate), 1 to 1.2 mm. long, oblong, distinct, with short line of contact, opening throughout, the suture glabrous; sterile filament 14 to 15 mm. long, slightly exserted, flat, much enlarged distally, recurved at apex, very densely bearded on the posterior face distally with golden-yellow hairs; capsule 10 to 13 mm. long, ovate, acuminate, glabrous, pale brown; seeds 3 to 4 mm. long, irregularly lanceolate-curved in outline, the angles sharp, semiwinged, the surface alveolate-reticulate, cinnamon-brown, glistening.

Type in the herbarium of the New York Botanical Garden, collected at Glenwood Springs, Garfield County, Colorado, in flower, May 24, 1911, by G. E. Osterhout (no. 4575).

Loamy sagebrush slopes, at altitudes of 1,700 to 2,100 meters. Submontane Zone; flowering from late May to late June. Valley of Grand River in Eagle and Garfield counties, Colorado.

COLORADO: Eagle: State Bridge, *Osterhout* 4213. Garfield: Glenwood Springs, *Osterhout* 4575 (Y), 4702 (Y), *Pennell* 6158 (A, D, F, H, M, R, S, U, Y), 6165 (F, Y), 6170 (B, K, P, Y), 6172 (Y).

45. **Penstemon versicolor** Pennell, sp. nov.

Stems several, 20 to 35 cm. tall, from a short branched caudex, glabrous, bluish glaucous; leaves thickened, dull green, glaucous, obscurely reticulate-veined, glabrous, those at the base of the stem with obovate acutish blades 3 to 4 cm. long, narrowed into scarcely defined petioles (less than 1 cm. long), those of the stem cordate-clasping (opposite leaves meeting), ovate, acute, from a cordate base, the largest mostly 3 to 5 cm. long, 2 to 2.5 cm. wide; thyrsus narrowly elongate, one-half (or more) the height of the plant, composed of 6 to 12 fascicles, each consisting of 2 short axillary branches, their pedicels longer than or equaling the peduncle; sepals 5 to 6 mm. long, ovate, acutish to acute, obscurely and finely ribbed, with white to pinkish scarious margins, glabrous; corolla 20 mm. long, the tube and throat 14 mm. long, the throat inflated and rounded ventrally, the 2 posterior lobes 6 mm. long, united and arched one-third their length, the three anterior lobes slightly longer, united at base, all the free portions widely spreading; corolla externally glabrous, within lanate-pubescent with few hairs over the base of anterior lobes or glabrous, pink, changing to blue, within throat with more or less conspicuous red-purple lines; anther sacs widely divaricate (explanate), 1 mm. long, oblong, slightly confluent, with short line of contact, opening throughout, the suture glabrous; sterile filament 14 to 15 mm. long, slightly exserted, flat, much enlarged distally into a broad white obtuse expansion, recurved at the apex, bearded on the posterior face distally with two lines of short dense golden-yellow hairs; capsule 10 to 12 mm. long, ovate, acuminate, glabrous, brown; seeds 4 to 5 mm. long, irregularly lanceolate in outline, nearly straight, irregularly convolute, the angles sharp, semiwinged, the surface alveolate-reticulate, cinnamon-brown, glistening.

Type in the herbarium of the New York Botanical Garden, collected on high prairie (mesa) east of Pueblo, Pueblo County, Colorado, in flower, June 5, 1915, by **F. W. Pennell** (no. 5732). Isotypes in the U. S. National Herbarium and in the Rocky Mountain Herbarium.

Loam sagebrush mesas, at altitudes of 1,400 to 1,700 meters; Upper Sonoran Zone; flowering in early June. Upper valley of Arkansas River, Colorado.

COLORADO: Fremont: Canon City, *Brandegee* (M). Pueblo: East of Pueblo, *Pennell* 5732 (R, U, Y); west of Pueblo, *Pennell* 5734 (D, F, H, M, P, U, Y), 6315 (B, D, F, H, K, M, P, R, S, U, Y).

46. **Penstemon lentus** Pennell, sp. nov.

Stems several, 20 to 30 cm. tall, from a relatively long, branched caudex, glabrous, pale or bluish glaucous; leaves strongly thickened, pale or dull green, glaucous, in age evidently reticulate-veined, glabrous, those at the base of the stem with more or less broadly oval, obtuse to acute blades 2.5 to 4 cm. long, rather abruptly narrowed into strongly margined petioles 1.5 to 2.5 cm. long, those of the stem clasping (bases of opposite leaves meeting around stem), lanceolate to ovate, acute or obtuse with a mucro, the largest mostly 3 to 7 cm. long, 1 to 2 cm. wide; thyrsus narrowly elongate, one-third to one-half the height of the plant, composed of 4 to 8 fascicles, each consisting of 2 short axillary branches, the pedicels shorter or longer than the peduncle; sepals 3 to 6 mm. long, ovate, acute to acuminate, fine-ribbed, with evident narrow, white to pinkish, slightly sinuate, scarious margins, glabrous; corolla 18 to 20 mm. long, the tube and throat 13 to 14 mm. long, the throat somewhat inflated and rounded ventrally, the 2 posterior lobes 5 to 6 mm. long, united and arched one-fourth their length, the 3 anterior lobes slightly longer, 4 to 6 mm. wide, united at the base, all free portions more or less spreading; corolla externally glabrous, within slightly lanate-pubescent over the bases of the anterior lobes, glabrous elsewhere, blue or bluish (not seen fresh); anther sacs widely divaricate (explanate), 0.9 to 1 mm. long, oblong, distinct, with relatively long line of contact, opening from the distal apex throughout, the suture glabrous; sterile filament slightly exserted, flat, slightly enlarged distally, recurved at apex, densely bearded on the posterior face toward the apex with relatively short, yellow hairs; capsule 8 mm. long, ovate, acuminate, glabrous; seeds 2 to 3 mm. long, curved in outline, the angles sharp, the surface dull brown.

Type in the herbarium of the New York Botanical Garden, collected at Arboles, Colorado, in flower, June 3, 1899, by *C. F. Baker* (no. 596; distributed as *P. acumi-*

natus Dougl.). Isotypes in herbarium of Missouri Botanical Garden and U. S. National Herbarium.

Dry hills and mesas, at altitudes of 1,800 to 2,100 meters; Upper Sonoran Zone; flowering in late May and early June. Valleys of the San Juan and Dolores rivers, southwestern Colorado and southeastern Utah.

COLORADO: Archuleta: Arboles, *Baker* 596 (M, U, Y). Montezuma: Mancos, *Eastwood* (Y). Montrose: Naturita, *Payson* 340 (F, M).

UTAH: San Juan: Monticello, *Rydberg & Garrett* 9209, in part (Y).

47. Penstemon pachyphyllus A. Gray.

Penstemon nitidus major Benth. in DC. Prodr. **10:** 323. 1846. "In montibus Scopulosis (Frémont!). (v. in herb. Torrey.)." Type, from "Hillsides of Du Chene Fork," Wasatch County, Utah, collected, in flower, May 31, 1844, by J. C. Frémont (Second Expedition, no. 485), seen in herbarium of Columbia University at the New York Botanical Garden. Type bears also the annotation "'*P. pachyphyllus*' Gray mss."

Penstemon acuminatus congestus Jones, Proc. Calif. Acad. II. **5:** 714. 1895. "[*M. E. Jones*] no. 5262. May 19, 1894, near Canaan Ranch, Utah, 5,000° alt., in sand." *Jones* 5262, seen only in the herbarium of the Missouri Botanical Garden, includes specimens of two species, *P. laevis* and *P. pachyphyllus*. The latter, fitting the description and being the same as the other collections cited, is taken as typical.

Penstemon pachyphyllus A. Gray; Rydb. Fl. Rocky Mts. 770, 1066. 1917. Based upon *P. nitidus major* Benth.

Stems several, 30 to 60 cm. tall, from a short branched caudex, glabrous, pale or bluish glaucous; leaves strongly thickened, pale green, glaucous, in age evidently reticulate-veined, glabrous, those at the base of the stem with oval obtuse (with a mucro) blades 5 to 7 cm. long, narrowed into strongly margined petioles 3 to 5 cm. long, those of the stem clasping (bases of opposite leaves meeting around stem), lanceolate-oval to ovate, mostly 3 to 5 cm. long, 2 to 4 cm. wide; thyrsus narrowly elongate, one-third to one-half the height of the plant, composed of 5 to 10 fascicles, each consisting of 2 short axillary branches, their pedicels shorter or longer than the peduncle; sepals 5 mm. long, ovate, acute, fine-ribbed, with evident white to pinkish, slightly sinuate, scarious margin, glabrous; corolla 15 to 18 mm. long, the tube and throat 10 to 12 mm. long, the throat somewhat inflated and rounded ventrally, the 2 posterior lobes 5 to 6 mm. long, united and arched one-third their length, the 3 anterior lobes slightly longer, 4 to 5 mm. wide, united at base, all free portions widely spreading; corolla externally glabrous, within lanate-pubescent over the base of the anterior lobes, glabrous elsewhere, blue or bluish (not seen fresh); anther sacs widely divaricate (explanate), 1 to 1.2 mm. long, oblong, distinct, with relatively long line of contact, opening from the distal apex throughout the suture, glabrous; sterile filament 10 to 12 mm. long, slightly exserted, flat, slightly enlarged distally, recurved at apex, densely bearded on the posterior face distally with apparently dull yellow hairs; capsule 10 to 14 mm. long, ovate, acuminate, glabrous, pale brown; seeds 2 to 3 mm. long, thick-crescentic, curved in outline, the angles sharp, semiwinged, the surface alveolate-reticulate, cinnamon-brown, glistening.

Loamy sagebrush slopes, at altitudes of 1,500 to 2,600 meters; Upper Sonoran and Submontane zones; flowering from late May to late June. Colorado Valley from Duchesne River southward to northern Arizona.

UTAH: Beaver: Frisco, *Jones* 1812 (F, Y). Carbon: Helper, *Pennell* 6143 (H, U, Y); Price, *Pennell* 6145 (P, Y). Sevier: Near Richfield, *Ward* 166 (U); head of Salina Canyon, *Jones* 5441ai (M, R, Y). Wasatch: "Hillsides of Du Chene Fork," *Frémont* 485 (Y). Washington: Near Canaan Ranch (near Rockville), *Jones* 5262, in part (M).

48. Penstemon haydeni S. Wats.

Penstemon haydeni S. Wats. Bot. Gaz. **16:** 311. 1891. "First collected by Dr. F. V. Hayden, in the Laramie Mountains of Wyoming, during some one of his early surveys, without flowers or fruit. * * * Rediscovered during the past season, in flower and fruit, by Mr. H. L. Webber, on the Dismal River in Thomas County, Nebraska, about a hundred miles west of the 100th meridian." Description evidently based upon specimen of H. L. Webber, collected in 1891, which is therefore taken as type; cotype, collected July 12, 1889, seen in herbarium of Columbia University at New York Botanical Garden. The plant of Hayden I have not seen; it is possibly not of this species.

Dry, sandy soil, at altitudes of about 800 meters; Subboreal Zone; flowering from early June to early July. Sandhills of western Nebraska.

NEBRASKA: Cherry: 20 miles south of Valentine, *Bates* (Y). Thomas: Near Plummer Ford, Dismal River, *Rydberg* 1506 (U, Y); Dismal River, *Webber* (Y); Halsey, *Krautter* (P).

49. Penstemon angustifolius Nutt.

Penstemon angustifolius Nutt. (in Fraser's Cat. 1813, *nomen nudum*), Pursh, Fl. Amer. Sept. 738. 1814. "In Upper Louisiana, *Bradbury* * * * *v. s. in herb. Bradbury.*" According to Bradbury (Travels, 318), "Near the Mintaree village," North Dakota. Pursh's description possibly included also *P. gracilis*, but Nuttall, under account of *P. coeruleus*, designated which is to be considered typical. Isotype, collected by Bradbury in Louisiana, seen in herbarium of Academy of Natural Sciences of Philadelphia.

Penstemon coeruleus Nutt. Gen. Pl. **2:** 52. 1818. "Hab. On the plains of the Missouri, near Fort Mandan and the Indian towns."

Chelone angustifolia Steud. Nom. Bot. 186. 1820–4. Not *C. angustifolia* H. B. K. 1817.

Chelone coerulea Spreng. Syst. Veg. **2:** 813. 1825.

Varies irregularly, the leaves linear to lanceolate, the bracts conspicuously elongate to short, the stem and leaves glabrous to finely puberulent.

Prairies, at altitudes of 800 to 2,300 meters; Subboreal, southward into Upper Sonoran Zone; flowering from mid-May to early July. High plains, westward to base of foothills in eastern Wyoming and Colorado. North Dakota and eastern Wyoming to southeastern Colorado; including subspecies to northern New Mexico.

SOUTH DAKOTA: Fall River: Hot Springs, *Rydberg* 917 (U, Y). Stanley: For Pierre, *Hayden* (A). Todd: Rosebud, *E. J. Wallace* (R). Washabaugh: Bear Creek, *Over* 2083 (U).

NEBRASKA: Cherry: Fort Niobrara, *T. E. Wilcox* (Y); Merriman. Deuel: *Rydberg* 275, in part (Y). Hooker: Mullen, *Rydberg* 1284 (U). Keith: Ogallala, *Pennell* 6402 (H, K, R, U, Y). Lincoln: Hershey; North Platte, *Pennell* 6407 (A, F, M, Y). Scotts Bluff: Eaglenest Butte, *Hayden* (Y). Sheridan: Near Hay Springs, *MacDougal* 103 (Y). Thomas: Halsey (P); Thedford, *Rydberg* 1284 (U, Y).

KANSAS: County uncertain: Kansas National Forest, *d'Allemand* (U. S. Forest Service Herb.).

WYOMING: Albany: Laramie, *Pennell* 5872 (Y); Lookout (M); near Prayers Crossing (U); Red Buttes (B, Y); Sand Creek (Y). Goshen: Fort Laramie, *Nelson* 8304 (U, Y). Laramie: Cheyenne (U); Corlett, *Johnston* 1 (M).

COLORADO: Boulder: White Rocks, *Ramaley* (B). Cheyenne: Arapahoe, *Mrs. S. B. Walker* (F). Denver: Denver, *Wolf* 291 (F, U). El Paso: Garden of the Gods, *Pennell* 5780 (Y); Manitou, *Pennell* 5787 (Y), 5788; Nob Hill, *Pennell* 5796 (Y); North Cheyenne Canyon, *Pennell* 5772 (D, Y); South Cheyenne Canyon, *Pennell* 6341 (D, P, Y). Gilpin: Tolland ("along R. R. track, probably introduced"), *Ramaley* 10497 (B). Larimer: "The Glades," *Pennell* 5865 (Y); Fossil Creek (B); Livermore (B); Owl Canyon, *Pennell* 5869 (Y); Red Mountain, (B); Ten-mile Creek (B). Las Animas: Stonewall, *Beckwith* 165 (Y); Trinidad (Y). Lincoln: Hugo, *C. D. Marsh* (U; approaching *P. angustifolius caudatus*). Sedgwick: Julesburg, *Pennell* 6399 (R, U, Y). Weld: Crow Creek (U); Evans (Y); Greeley (Y); Pawnee Buttes (B); Peckham (M); Windsor, *Pennell* 5848 (M, Y), 5849 (Y).

49a. **Penstemon angustifolius caudatus** (Heller) Rydb.

Penstemon caudatus Heller, Minn. Bot. Stud. **2**: 34. 1898. "The type is our no. 3580, collected May 26, 1897, at Barranca, Taos County [New Mexico], altitude 6,900 feet. It is very abundant in open grassy, sandy soil, about Barranca station, growing in large patches." Probable isotype, *Heller* 3581, seen in herbarium of the New York Botanical Garden.

Penstemon angustifolius caudatus Rydb. Bull. Torrey Club **33**: 151. 1906.

Prairies, at altitudes of 1,000 to 2,300 meters; Upper Sonoran Zone; flowering from mid-May to early June. High plains, valley of the Arkansas River in southeastern Colorado and in western Kansas, to Taos County, northern New Mexico. Variable and very inconstantly distinguished; perhaps a robust form, rather than a geographical subspecies of *P. angustifolius*.

KANSAS: Wallace: Wallace, *W. A. Kellerman* (U, Y).

COLORADO: Bent: Rule Creek, *Osterhout* 4869. El Paso: Colorado Springs, *Eggleston* 11155 (U). Fremont: Canon City, *Pennell* 6311 (H, R, U, Y). Huerfano: Near La Veta, *Rydberg & Vreeland* 5642 (Y), 5643 (Y), 5644 (Y), 5645 (Y); Ojo (Y); Walsenburg (Y). Las Animas: Wootton, *Rusby* (Y). Otero: La Junta, *Osterhout* 3963. Prowers: 25 miles south of Lamar, *Osterhout* 5071. Pueblo: Beulah (B, R); Pueblo, *Pennell* 5738 (Y), 6314 (D, F, M, Y). Yuma: Wray, *Osterhout* 5257.

50. **Penstemon arenicola** A. Nels.

Penstemon arenicola A. Nels. Bull. Torrey Club **25**: 280. 1898. "Abundant in the sand dunes in the hill region of the Red Desert, near Point of Rocks [Wyoming]. Collected June 1, 1897. * * * Type specimen in herb. University of Wyoming, no. 3090." Isotype seen in herbarium of Columbia University at the New York Botanical Garden.

Sandy hills and plains, at altitudes of 1,900 to 2,100 meters; Upper Sonoran Zone; flowering from early to middle June. Red Desert of southwestern Wyoming.

WYOMING: Sweetwater: Point of Rocks, *Nelson* 3090 (M, Y), *Pennell* 5889 (D, F, P, U, Y); 15 miles north of Point of Rocks, *Merrill & Wilcox* 693 (U); southeast of Red Desert, *Pennell* 5881 (H, M, R, Y); Steamboat Mountain, *Nelson* 7050 (R). Uinta: Carter (R); Fort Bridger, *Nelson* 4598 (R); Henrys Fork (R).

51. **Penstemon nitidus** Dougl.

Penstemon nitidus Dougl.; Benth. in DC. Prodr. **10**: 323. 1846. "In collibus siccis ad flumina Saskatchawan, Assinaboin et Red River (Douglas! Richardson!) * * * (v. s.)." Type not seen or verified.

Prairies, at an altitude of 1,500 meters; Subboreal Zone; flowering in June. High plains, entering northern Wyoming in valley of Tongue River. Manitoba to Alberta and northern Wyoming.

WYOMING: Sheridan: Jackson Creek (R); Little Goose Grade, *Nelson* 2333, in part (M); *Tweedy* 47 (Y), 2332 (Y), 3417 (Y). Sweetwater: South Butte, "Thirteen Mile," *Nelson* 3554 (R).

52. **Penstemon cyathophorus** Rydb.

Penstemon cyathophorus Rydb. Bull. Torrey Club **31:** 643. 1905. "Colorado: Pearl, 1901, *Tweedy* 4307 (type)." Type seen in herbarium of the New York Botanical Garden.

"Meadows," "sagebrush", at altitudes of 2,400 to 2,600 meters; probably Montane Zone; flowering from early June to late July. Middle and North Park, northern Colorado and adjacent southeastern Wyoming.

WYOMING: Carbon: "Hiltons" ("North Park in edge of Wyoming"), *Osterhout* 986.

COLORADO: Grand: Sulphur Springs, *Clements* (Y), *Osterhout* 2975, 3255. Jackson: Grizzly Creek (Y); Pearl, *Tweedy* 4307 (U, Y).

53. **Penstemon coloradoensis** A. Nels.

Penstemon coloradoensis A. Nels. Bull. Torrey Club **26:** 355. 1899. "Of this species I have before me specimens from two collections made near Mancos, Colorado, by Messrs. Baker, Earle and Tracy, 1898, and distributed as *P. caespitosus* Nutt." Type (no. 70, collected in flower June 23, 1898) seen in the Rocky Mountain Herbarium. The second collection referred to (no. 27, collected in flower June 21, 1898) is *P. xylus* A. Nels.

Sagebrush plains, at altitudes of 900 to 2,100 meters; Upper Sonoran Zone; flowering from mid-June to early July. San Juan Valley of southwestern Colorado to southern Utah, northwestern New Mexico, and northern Arizona.

COLORADO: La Plata: Durango, *Crandall* 1826 (B, F, R, U, Y). Montezuma: Dolores (Y); Mancos, *Baker, Earle & Tracy* 70 (F, M, R, U, Y).

UTAH: Washington: Pine Valley (U. S. Forest Service Herb.); St. George, *Palmer* (Y).

53a. **Penstemon coloradoensis sileri** (A. Gray) Pennell.

Penstemon linarioides sileri A. Gray, Syn. Fl. **2**[1]**:** 270. 1870. "S. Utah, *Siler*." Probable isotype, from Osmer, *Siler* 90, seen in herbarium of the Missouri Botanical Garden.

Probably only a form of *P. coloradoensis.*

Southern Utah; flowering from middle to late June.

UTAH: Kane: Sink Valley, *Jones* (M, U).

54. **Penstemon exilifolius** A. Nels.

Penstemon exilifolius A. Nels. Bull. Torrey Club **28:** 230. 1901. "The latter [*A. Nelson* 7460] is taken as the type and is from Halleck Cañon [Wyoming], July 6, 1900." Isotype seen in herbarium of the New York Botanical Garden.

Dry, stony plateaus and hillsides, at altitudes of 2,200 to 2,700 meters; probably Montane Zone; flowering from early July to early August. Southeastern Wyoming and northeastern Colorado.

WYOMING: Albany: Cummins (R); Halleck Canyon, *Nelson* 7460 (B, M, U, Y); Laramie Hills, *E. Nelson* 52 (Y); Laramie Plains, *Nelson* 419 (M, U, Y); Red Buttes; Sheep Mountain, *Goodding* 2086 (U, Y); near Upper Laramie River, *Frémont 2nd Exped.* 533 (Y); west of Sherman (M).

COLORADO: Larimer: Medicine Bow Mountains, *Crandall* (Y).

55. **Penstemon laricifolius** Hook. & Arn.

Penstemon laricifolius Hook. & Arn. Bot. Beech. Voy. 376. 1841. "Hab. Snake Fort, Snake Country, [a friend of] *Mr. Tolmie.*" Isotype, labeled "Snake Country," and probably from southeastern Idaho, seen in herbarium of Columbia University at New York Botanical Garden.

Penstemon exilifolius desertus A. Nels. Bull. Torrey Club **28**: 231. 1901. "On dry sandstone ridges * * * Point of Rocks [Wyoming], Jun. 12, 1900 [*A. Nelson*] no. 7160." Isotype seen in herbarium of New York Botanical Garden.

Dry sandstone ridges, at altitudes of 2,100 to 2,400 meters; Submontane Zone; flowering from mid-June to early July. Interior low ridges, central and southwestern Wyoming and (probably) southeastern Idaho.

WYOMING: Fremont: Big Sandy (U); Birds Eye, *Nelson* 9363 (M, U, Y); Camp Stambaugh (U); Wind River Mountains (U). Hot Springs: Owl Creek, *Parry* 206, in 1873 (A, F, Y). Natrona: Bessemer, *Goodding* 181 (M, U, Y); Garfield Peak (R); Platte River Canyon (M). Sweetwater: Leucite Hills (U); Point of Rocks, *Nelson* 4748 (R), 7160 (B, F, M, U, Y), *Pennell* 5888 (U, Y).

IDAHO: "Snake Country, [a friend of] *Tolmie*" (Y).

56. Penstemon ambiguus Torr.

Penstemon ambiguus Torr. Ann. Lyc. N. Y. **2**: 228. 1828. "Hab. Near the Rocky Mountains [*E. P. James* in 1820]." Type, collected probably in eastern Colorado, northeastern New Mexico, or northwestern Texas, seen in herbarium of Columbia University at the New York Botanical Garden.

Leiostemon purpureus Raf. Atl. Journ. 1: 145. 1832. Based upon "*Penstemon ambiguum*" Torr.

Penstemon ambiguus foliosus Benth. in DC. Prodr. **10**: 321. 1846. "In montibus Scopulosis (Fremont!). (v. in herb. Torrey.)." Type, *Frémont* 623; according to his notes, collected "On the high level prairie, Jul. 7, 1844," probably in Cheyenne County, Colorado; seen in herbarium of Columbia University at the New York Botanical Garden.

Leiostemon ambiguus Greene, Leaflets 1: 223. 1906.

Prairies, at altitudes of 800 to 1,300 meters; Upper Sonoran Zone; flowering from mid-June to mid-July. High plains, on both continental slopes, western Oklahoma and eastern Colorado to southwestern Utah and Chihuahua.

COLORADO: Cheyenne (?): *Frémont* (Y). Logan: Sterling, *Osterhout* 990. Otero: Rocky Ford, *Berg* 1836 (Y). Yuma: Wray, *Osterhout* 3984, 4332 (Y); Yuma.

UTAH: San Juan: Near Bluff, *Rydberg & Garrett* 9934 (Y). Washington: St. George, *Palmer* 379 (F, Y).

57. Penstemon deustus Dougl.

Penstemon deustus Dougl.; Lindl. Bot. Reg. **16**: *pl. 1318*. 1830. "P. deustum Douglas in herb. Hort. Soc. Native of Northwest America, where it was found by Mr. Douglas on scorched, rocky plains, in the interior. Our drawing was made in the Garden of the Horticultural Society in September, 1829." Type not seen or verified, but description evidently of plant here considered.

Dry, rocky soil, at altitudes of 1,500 to 2,200 meters; Submontane Zone; flowering from early to late July. Bighorn County, Wyoming to Washington, southward to Nevada and northern California.

WYOMING: Bighorn: *Worthley* 35 (U). Park: "Stinkingwater," *Parry* 207 (A, F, M, Y). Yellowstone National Park: Near Excelsior Geyser (F); Golden Gate, *Pennell* 6029 (D, H, P, S, Y); Junction Butte (U); Mammoth Hot Springs (F, M, U, Y); Obsidian Creek (R); Silver Gate (Y); head of Swan Lake Valley (U); divide between Snake River and Yellowstone Lake (U).

IDAHO: Bingham: Big Butte Station, *Palmer* 481 (U). Bonneville: Idaho Falls, *Palmer* 372 (U). Fremont: Ashton, *Pennell* 6045 (F, M, R, U, Y); St. Anthony (U, Y).

58. Penstemon watsoni A. Gray.

Penstemon fremontii parryi A. Gray in King, Geol. Expl. 40th Par. **5**: 218. 1871. "Colorado (Parry). Toyabe, Diamond and East Humboldt Mountains, Nevada;

(6–7,000 feet altitude) [*S. Watson*] (773)." Specimen collected in Colorado by C. C. Parry in 1862 and labeled *P. fremontii* Torr. & Gray, doubtless type or isotype, seen in U. S. National Herbarium.

Penstemon watsoni A. Gray, Syn. Fl. **2**[1]: 267. 1878. "Mountains of W. Colorado, Utah, and Nevada (*Fremont, Parry, Watson, Wheeler, Vasey, Ward*, &c.), to borders of Arizona, *Palmer*." Isotype, labeled as from Austin, Nevada, collected in flower, July, 1868, *S. Watson* 773, seen in herbarium of the New York Botanical Garden.

Penstemon phlogifolius Greene, Leaflets **1**: 164. 1906. "Castle Gate, Utah, M. E. Jones, 1894, sheet 237290, U. S. Herb." Type, *M. E. Jones* 5486s, collected in flower, June 23, 1894, seen in U. S. National Herbarium.

Sagebrush slopes, among junipers, summits of mesas, at altitudes of 1,800 to 2,600 (2,700) meters; Submontane and Upper Sonoran zones; flowering from mid-June to early July. Valley of Grand River in Colorado, westward across the Great Basin to southern Idaho, central Nevada, and northern Arizona. Eastern (our) plants, usually with more cuspidate calyx teeth, are perhaps of subspecific rank.

WYOMING: Uinta: Fort Bridger, *Porter* (Y).

COLORADO: Eagle: Red Cliff; Wolcott, *Osterhout* 2109 (R). Garfield: Glenwood Springs, *Pennell* 6168 (U, Y); Grizzly, *Pennell* 6162 (A, B, D, M, Y). Grand: Sulphur Springs, *Ramaley & Robbins* 3611 (B, R).

UTAH: Carbon: Castle Gate, *Jones* 5486s (M, U, Y), *Pennell* 6140 (D, F, H, K, P, R, S, U, Y). Iron (or Beaver): Buckskin Valley, *Engelhardt & Doll*. San Pete: Mountains east of Gunnison (Twelve Mile Creek Canyon), *Ward* 280 (M, U). Sevier: Fish Lake, *Rydberg & Carlton* 7633 (Y); canyon east of Glenwood (Brine Creek Canyon above Kings Meadows), *Ward* 308 (F, M, U); head of Salina Canyon, *Jones* 5433 (F, M, U, Y). Utah: Provo, *Coulter* (U).

IDAHO: Fremont: 12 miles east of Beaver, *Redeker* 58 (R).

59. Penstemon procerus Dougl.

Penstemon procerus Dougl.; Graham, Edinb. N. Phil. Journ. **7**: 348. 1829. "Raised at the Botanic Garden, Edinburgh, from seeds gathered by Mr. Drummond." Drummond's specimens would be from Alberta or Saskatchewan.

Penstemon micranthus Nutt. Journ. Acad. Phila. **7**: 45. 1834. "Hab. In the valleys of the Rocky Mountains, near the sources of the Columbia [*N. B. Wyeth*]." Type, collected by Wyeth, July 11, in Fremont County, Idaho, or in Lincoln County, Wyoming, seen in herbarium of Academy of Natural Sciences of Philadelphia.

Lepteiris parviflora Raf. New Fl. **2**: 73. 1836. (Type of genus *Lepteiris* Raf.) "Origon * * * collected by Wyeth." Type apparently the same as of *P. micranthus* Nutt.

Penstemon confertus violaceus Trautv. Bull. Acad. St. Pétersb. **5**: 344. 1839. "Found by Mr. Drummond on the Rocky Mountains." Based upon *P. procerus* Dougl.

Penstemon confertus coeruleo-purpureus A. Gray, Proc. Amer. Acad. **6**: 72. 1862–63. "Plains of the Saskatchewan, and through the Rocky Mountains to the coast range of Oregon and British Columbia." Aggregate name to go with earliest described component, *P. procerus* Dougl.

Penstemon confertus procerus Coville, Contr. U. S. Nat. Herb. **4**: 169. 1893.

Penstemon procerus micranthus Jones, Bull. Univ. Mont. Biol. Ser. **15**: 45. 1910.

Moist to dryish grassy slopes, at altitudes of (1,500) 1,900 to 3,200 (3,900) meters; Montane and Subalpine zones, rarely ascending to Alpine or descending to Submontane; flowering from mid-June to mid-August. Widespread through the Rockies, south to Chaffee County, Colorado. Manitoba to British Columbia, south in the mountains to Colorado, Utah, and Washington.

WYOMING: Carbon: Copperton, *Tweedy* 4303 (U, Y); Hilton's. Fremont: Leckie, *Merrill & Wilcox* 578 (U, Y), 581 (U, Y), 719 (U); Union Pass (Y). Johnson:

Eastern slope of Bighorn Mountains, *Tweedy* 3415 (Y). Lincoln: Cokeville [1] (R); La Barge (U); Mount Leidy (Y); Upper Hoback Basin, *C. C. Curtis* (Y). Sheridan: Big Horn, *Tweedy* 2329 (Y). Sweetwater: Bush Ranch, *Nelson* 7107, in part (Y). Uinta: Evanston, *T. A. Williams* (U). Yellowstone National Park: Devils Cut (U); along Madison River, *Pennell* 5991 (Y); near Mammoth Hot Springs (A, M); Middle Gardiner Falls (F); Swan Lake, *Pennell* 6036a (Y); Wraith Falls (M, U).

IDAHO: Fremont: Canyon Creek, *Merrill & Wilcox* 881, in part (U, Y).

COLORADO: Boulder: Caribou, *Penard* 526 (Y). Chaffee: Mount Harvard, *Clements* (Y). Clear Creek: Bard Creek Valley,[1] *Patterson* 255 (F, M, P, Y); Graymont;[1] Mount Lincoln [1] (U). Gilpin: Central City, *Scovell* (E). Jackson: Big Creek Park; near Pinkhampton (Y, Z); Walden,[1] *Goodding* 1502, in part (A, B, M, P, U, Y). Lake: Leadville (A, M, U); Mount Massive (F); Tennessee Pass, *D. A. Saunders* (Y); Twin Lakes (F, U). Larimer: Cameron Pass; Chambers Lake, *Crandall* (Y). Park: Between Como and Boreas,[1] *Cowen* 389 (M, U); South Park, *Wolf* (F, U). Summit: Breckenridge,[1] *Mackenzie* 145 (A, M); Farnham (M).

UTAH: Salt Lake: Altus (F); Clayton Peak (M, U); Gogorza, *Pennell* 5964 (F, H, R, U, Y); Silver Lake, *Pennell* 6083 (M, Y), 6105 (D, P, S, Y). Summit: Parley Park, *Watson* 783 (Y).

59a. Penstemon procerus aberrans (Jones) A. Nels.

Penstemon confertus aberrans Jones, Proc. Calif. Acad. II. **5**: 715. 1895. "[*M. E. Jones*] no. 5601i. July 6, 1894, Soldier Summit, Utah, 7,300° alt., in gravel." Type seen in U. S. National Herbarium.

Penstemon procerus aberrans A. Nels. Bot. Gaz. **54**: 146. 1912.

Gravelly soil, low sagebrush and meadows, at altitudes of 2,100 to 2,700 meters; Submontane and Montane zones; flowering from early July to early August. Wasatch Mountains of central Utah.

UTAH: Garfield: Aquarius Plateau, at head of Poison Creek, *Rydberg & Carlton* 7377 (Y), 7436 (Y). Sevier: Fish Lake, *Jones* 5740 (F, M, U), *Rydberg & Carlton* 7511 (U, Y), *Ward* 342 (F, M,U). Utah: Soldier Summit, *Jones* 5601i, in part (U), *Pennell* 6130 (F, H, M, R, Y).

59b. Penstemon procerus pulvereus Pennell, subsp. nov.

Sepals lanceolate-attenuate, more or less caudate, with relatively conspicuous scarious margins, more or less densely canescent-puberulent; corolla densely lanose within. Otherwise as in the species, with which it frequently grows and evidently intermingles.

Type in the herbarium of the New York Botanical Garden, collected on moist meadow knolls, north of Swan Lake, Yellowstone National Park, Wyoming, in flower, July 7, 1915, by F. W. Pennell (no. 6036).

Grassy soil, meadows; at altitudes of 1,900 to 2,700 meters; Montane and Submontane zones; flowering from mid-June to mid-August. Mountains, southwestern Montana, western Wyoming, and southeastern Idaho.

WYOMING: Fremont: Union Pass, *Nelson* 833 (F, M, U). Lincoln: Buffalo Fork, *Tweedy* 228 (Y); head of Clarks Fork (U); Gros Ventre River (U). Sweetwater: Bush Ranch, *Nelson* 7107, in part (M, U). Yellowstone National Park: Devils Cut (U); Gardiner River (Y); Mammoth Hot Springs (M, U); near Swan Lake, *Pennell* 6036 (F, H, K, M, P, R, U, Y); Wraith Falls (M, Y); mouth of Yellowstone Lake, *Pennell* 6013 (A, D, R, S, Y).

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[1] Approaching *P. rydbergii*.

IDAHO: Fremont: Beaver Canyon, *Shear* 3033 (Y), 3053 (Y); Canyon Creek (U, Y); Island Park (F).

60. Penstemon rydbergii A. Nels.

Penstemon rydbergii A. Nels. Bull. Torrey Club **25**: 281. 1898. "It was met with in abundance in an aspen grove in a draw in the Laramie Hills [Wyoming], July 1, 1897. Type specimen collected at Green Top [Albany County], in Herb. University of Wyoming, A. Nelson no. 3214." Isotype seen in herbarium of Columbia University at the New York Botanical Garden.

Penstemon erosus Rydb. Bull. Torrey Club **28**: 28. 1901. "Colorado: Indian Creek Pass, 1900, *F. K. Vreeland*, 615 (type)." Type seen in herbarium of the New York Botanical Garden.

Penstemon lacerellus Greene, Leaflets **1**: 161. 1906. "At Sargents', southern Colorado, 5 July, 1901, C. F. Baker, n. 352, as in U. S. Herb." Type seen in U. S. National Herbarium.

Penstemon latiusculus Greene, Leaflets **1**: 161. 1906. "Stony ground along stream banks at Gunnison, Colo., 24 July, 1901, C. F. Baker, n. 588, as in U. S. Herb." Type seen in U. S. National Herbarium.

Intergrades with *P. procerus;* apparently nearest to *P. procerus aberrans*, from which, however, its larger flowers and more lacerate sepals distinguish it.

Moist grassy flats or slopes, aspen thickets, at altitudes of (2,100) 2,200 to 3,000 (3,300) meters; Submontane and Montane zones; flowering from late June to mid-August. Mountains, eastern Wyoming, southward on both continental slopes, through most of Colorado.

WYOMING: Albany: Antelope Basin (M, U, Y); Centennial, *Nelson* 8725, in part (M, U, Y); Chug Creek (M, U, Y); Green Top, *Nelson* 3214 (M, Y); Nashs Fork (Y); head of Pole Creek (Y); Sherman (F). Carbon: Hayden Forest, *Eggleston* 11242 (U). Johnson: Crazy Woman Creek, *T. A. Williams* (U). Laramie: Horse Creek, *E. Nelson* 80 (Y).

COLORADO: Chaffee: Salida, *Clements* 253 (Y). Clear Creek: Grays Peak (U); Mount McClellan, *E. L. Greene* (E). Delta: On Tongue Creek, Mesa Grande, *Purpus* 303 (F). Grand: Middle Park, *W. A. Henry* (M). Gilpin: Central City (Y); Eldora to Baltimore (Y); Tolland, *Pennell* 6371 (Y), 6377 (M, U, Y). Gunnison: Gunnison, *Baker* 588 (M, U, Y), *Pennell* 6288 (D, R, Y); Parlin (Y); Pitkin (Y); Sapinero (B). Huerfano: Indian Creek Pass, *Vreeland* 615. Larimer: Mountains, *Osterhout* 57. Mineral: Wagon Wheel Gap, *B. H. Smith* (A, F). Montezuma: Chicken Creek, *Baker, Earle & Tracy* 658 (F, M, U, Y). Ouray: Engineer Mountain, *Purpus* 706 (F). Park: Como, *Crandall* 1795 (Y); Saguache: Marshall Pass (U, Y); Sargents, *Baker* 352 (M, U, Y), *Pennell* 6293 (A, D, H, K, Y), 6301 (Y). Summit: Robinson, *Shear* 3329 (U, Y).

UTAH: Uinta: Youngs Springs, *Goodding* 1196 (F, M, U, Y).

61. Penstemon aggregatus Pennell, sp. nov.

Stems few or several, slightly decumbent at base, erect, 30 to 80 cm. tall, from a much-branched rootstock, puberulent in lines to glabrous above, pale green; leaves pale green, obscurely veined, glabrous, those at the base of the stem much tufted, the blades lanceolate, acute (or the lowermost obtuse), entire, altogether 5 to 17 cm. long, narrowed into a petiole-like base one-half to two-thirds the length of blade, the stem leaves lanceolate or narrowly lanceolate, the upper ones slightly clasping, the largest 7 to 15 cm. long, 1 to 3 cm. wide; thyrsus narrow, not secund, less than one-half the height of the plant, composed of 3 to 8 rather close fascicles, each consisting of 2 axillary, closely erect branches, their pedicels shorter to much longer than the peduncle; sepals 5 to 7 cm. long, lanceolate-attenuate, acuminate, not veined, with white (to purplish), scarious, nearly entire to proximally erose margins, canescent-puberulent or canescent-ciliate or nearly or quite glabrous; corolla 15 to 18 mm. long, the tube and throat 9 to 11 mm. long (the latter 3 to 4 mm. wide), the throat flattened, 2-grooved anteriorly, the 2 posterior lobes 5 to 6 mm. long, united and arched one-third to one-half their length, with free projecting lobes, the 3 anterior lobes slightly longer, united at the base, the free lobes spreading; corolla externally glabrous (or in bud pubescent with loose nonglandular hairs), within slightly to moderately pubescent with yellowish hairs over the bases of anterior lobes, light blue-violet, more violet on throat, bluer on lobes, paler within and much paler on throat anteriorly; anther sacs widely divaricate, 0.7 mm. long, broadly oval, distinct, opening throughout, glabrous; sterile filament shorter than the fertile ones, slightly wider distally, slightly bearded distally on the dorsal face with yellowish hairs; capsule 6 mm. long, elliptic-ovate, acuminate, glabrous, pale brown; seeds 0.7 to 0.9 mm. long, irregularly quadrangular in outline, not curved, the angles rather blunt, not winged, the surface evidently alveolate-reticulate, glistening, gray, pale toward margin.

Type in the herbarium of the New York Botanical Garden, collected on margin of a draw on mountain side, conglomerate, 1 to 2 miles south of Evanston, Uinta County, Wyoming, altitude about 2,100 to 2,200 meters, in flower, June 26, 1915, by F. W. Pennell (no. 5918).

Apparently most closely allied to *P. rydbergii*, with which it may occasionally intergrade. Usually it may be distinguished readily from this not only by the characters given in the key, but also because it rarely blackens to the same degree.

Sagebrush slopes, among willows, and openings in forest, at altitudes of 1,800 to 2,900 meters; Montane and Submontane zones; flowering from late June to late August. Mountain slopes, through the Wasatch region from southern Lincoln County, Wyoming to Sevier County, Utah; through mountains eastward to Medicine Bow Range of southeastern Wyoming and Middle Park of northern Colorado; on the Uncompahgre Plateau and doubtless on intervening ridges. Extends northwestward into southern Idaho.

Wyoming: Albany: Centennial, *Nelson* 8725, in part (F, U); Fox Park (R). Carbon: Hilton Ranch (near Colorado line), *Osterhout* 1703. Lincoln: La Barge, *Stevenson* 164, in part (U). Uinta: Evanston, *Pennell* 5918 (A, D, F, H, K, M, R, U, Y); Medicine Butte, *Pennell* 5917 (Y).

Colorado: Grand: Sheephorn Divide, *Shear & Bessey* 4016 (Y); head of Willow Creek (M). Jackson: Rabbit Ears, *Goodding* 1567 (B, M, U, Y); foot of Mount Richtophen (on the Michigan) (U, Y); near Teller (F, Z). Larimer: Cameron Pass, *Osterhout* 56. Montrose: Uncompahgre Divide, *Payson* 559 (M). Routt: Columbine (U, Y); Steamboat Springs, *Goodding* 1606 (A, B, M, U, Y).

Utah: Salt Lake: Barclay, *Pennell* 5954 (B, P, Y). San Pete: Big Horseshoe Summit (U); Ephraim Canyon, *Tidestrom* 313 (U). Sevier: Fish Lake, Mount Terrill, *Tidestrom* 1823 (U). Summit: Echo Canyon, *Watson* 763 (U). Utah: Soldier Summit, *Pennell* 6131 (D, H, M, R, S, U, Y). Wasatch: Daniels Canyon, *Garrett* 2838 (Y).

62. **Penstemon pseudoprocerus** Rydb.

Penstemon pseudoprocerus Rydb. Mem. N. Y. Bot. Gard. **1**: 346. 1900. "Montana: Bridger Mountains, June 12, 1897, *Rydberg & Bessey*, 4919 (type)." Type seen in herbarium of the New York Botanical Garden.

Penstemon pseudohumilis Rydb. Mem. N. Y. Bot. Gard. **1**: 347. 1900. "Idaho: Mt. Chauvet, July 29, 1897, *Rydberg & Bessey* 4915 (type)." Type seen in herbarium of the New York Botanical Garden.

Penstemon owenii A. Nels. Bot. Gaz. **34**: 32. 1902. "Collected again in 1899, August 16, by the writer, this time also on the Tetons [Wyoming] at an alpine station, no. 6516 being the type." Isotype seen in herbarium of New York Botanical Garden.

Penstemon procerus pseudoprocerus A. Nels. in Coulter, New Man. Rocky Mount. 444. 1909.

Varies in the length of tip and laceration of the sepals, the type having a short tip and more lacerate, broad, scarious margin, nearly the opposite extreme being *P. pseudohumilis*.

Open rocky hillsides, at altitudes of 1,900 to 2,700 (3,150) meters; Montane and Submontane zones; flowering from late June to mid-August. Mountain slopes, extending southward in the Bighorn and Teton ranges; southern Montana, northern Wyoming, southern Idaho, and eastern Oregon.

WYOMING: Bighorn: *Worthly* 96 (U). Fremont: Upper Buffalo to head of Du Noir River, *C. C. Curtis* (Y). Lincoln: Sheep Mountain, *Tweedy* 230 (Y); Teton Mountains, *A. & E. Nelson* 6516 (M, Y). Sheridan: Headwaters of Tongue River, *Tweedy* 46 (Y). Yellowstone National Park: Devils Cut (U); Electric Peak (F, U); Hedges Peak, *Pennell* 6021 (Y); Mammoth Hot Springs, *Pennell* 6035 (A, D, H, K, M, P, R, S, Y); Whirlwind Peak, *Cary* 589 (U).

IDAHO: Fremont: Beaver Canyon (Y); Mount Chauvet, *Rydberg & Bessey* 4915 (U, Y).

63. **Penstemon virens** Pennell.

Penstemon virens Pennell; Rydb. Fl. Rocky Mts. 773, 1066. 1917. "Type: Stony hillsides, foothills north of Morrison, Colo., 1915, *Pennell 5821* (N. Y.)." Type seen in herbarium of the New York Botanical Garden.

Stems several to many, slightly decumbent at base, erect, 15 to 45 cm. tall, from much-branched rootstocks, slender, puberulent in lines, loosely glandular-pubescent above, green; leaves thin, green, dull to rather lustrous, obscurely veined, glabrous, those at the base of the stem much tufted, the blades lanceolate, acute, entire or rarely sparingly and slightly serrate, altogether 6 to 9 cm. long, narrowed into a petiole-like base nearly equaling to slightly exceeding the length of blade, the stem leaves lanceolate, acute, somewhat clasping, entire or serrulate-dentate above, the largest 3 to 7 cm. long, 0.5 to 1.2 cm. wide; thyrsus narrow, not secund, one-third to one-half the height of the plant, composed of 3 to 9 loose fascicles, each consisting of 2 axillary ascending branches, their pedicels shorter than the peduncle; sepals 3 to 4 mm. long, ovate, acuminate, slightly veined, with whitish, scarious, nearly entire margins, loosely glandular-pubescent; corolla 15 to 18 mm. long, the tube and throat 11 to 13 mm. long, the throat 3 to 4.5 mm. wide, inflated, but slightly flattened and 2-grooved anteriorly, the 2 posterior lobes 5 to 6 mm. long, united and arched one-third their length, with free recurved erect lobes, the 3 anterior lobes 5 to 6 mm. long, united proximally, the free lobes spreading; corolla externally glandular-pubescent, within slightly lanose-pubescent with whitish hairs over the bases of the anterior lobes, blue, more violet on throat and when young, paler within and slightly paler without, the throat anteriorly veined within with red-purple lines, these more evident on the anterior lobes; anther sacs widely divaricate, 0.7 to 0.8 mm. long, broadly ovate, distinct, opening throughout, glabrous, dark gray-blue; sterile filament nearly or quite equaling the anterior ones, not or slightly wider distally, densely bearded distally with yellow hairs; capsule 6 to 7 mm. long, ovate, acuminate, glabrous, greenish brown; seeds 1 to 1.2 mm. long, irregularly angular in outline, scarcely curved, the angles sharp, not winged, the surface reticular, dull dark gray or brownish gray, not pale toward margin.

Rocky, wooded slopes, at altitudes of 1,600 to 3,000 meters. Submontane and Montane zones: flowering from late May to early August. Foothills, eastern slope of Medicine Bow Range, southeastern Wyoming, to Culebra Range, southeastern Colorado; common through middle areas; also west of Medicine Bow Mountains in upper valley of North Platte River, in Carbon County, Wyoming, and Jackson County, Colorado, perhaps crossing from the north into Middle Park.

WYOMING: Albany: Cooper Hill (A, B, M, P, U, Y); Laramie, *Pennell* 5873 (D, F, M, Y); head of Pole Creek (A, M, U, Y); Sand Creek (B, M, U, Y); Sherman (M, U). Carbon: Encampment, *Tweedy* 4305 (U, Y). Laramie: Horse Creek, *Buffum* (F); west of Islay (U).

COLORADO: Boulder: Boulder, *Pennell* 5826 (A, M, U, Y); Eldora Lake (B); Lyons (M); Miramonte (B); Nederland (B); St. Vrains Creek (B); Sugarloaf Mountain (B); Ward (B, M, Y). Clear Creek: Empire (A, M, U, Y); near Georgetown, *Patterson* 117 (F, M, U, Y); Graymont (U); Grays Peak (F, M, Y); Leavenworth Mountain (F). Douglas: *Mrs. S. B. Walker* (F). El Paso: Cheyenne Mountain (Y); Crystal Park (M, U, Y); Eastinville (U); Lake Moraine (F); Manitou, *Pennell* 5784 (B, Y); North Cheyenne Canyon, *Pennell* 5774 (Y), 6339 (D, H, U, Y); Palmer Lake, *Pennell* 5807 (H, U, Y); Pikes Peak (above Halfway House), *Pennell* 6319 (R, Y); South Cheyenne Canyon, *Pennell* 5792 (F, M, R, Y). Fremont: Canon City, *Brandegee* (M). Gilpin: Antelope (B); Eldora to Baltimore (Y); Tolland, *Pennell* 6355 (F, P, Y). Grand (?): "Middle Park," *Henry* (M; with specimens of *P. watsoni*). Huerfano: Turkey Creek and tributaries (Y); Wahatoya Canyon, *Rydberg & Vreeland* 5638 (Y). Jackson: Camp Creek, *Goodding* 1458 (A, B, M, P, U, Y). Jefferson: Golden, *Pennell* 5816 (M, Y), 6387 (Y); Morrison, *Pennell* 5821 (D, H, R, U, Y); Platte Canyon (U). Larimer: Dale Creek (Y); Dixon Canyon (F, U); Estes Park (M, R, U); Horsetooth Mountain, *Pennell* 5853 (F, K, P, R, Y), 5854 (S, Y), 5861 (D, Y); Howes Gulch (Y); North Box Elder (B); Owl Canyon, *Pennell* 5871 (Y); Pinewood; Rist Canyon (M); Ten-mile Creek (B). Las Animas: Brantly Canyon, *Osterhout* (Y). Park: South Park, *Wolf* 297 (U, Y). Pueblo: Near Beulah, *Robbins* 4489 (B).

64. **Penstemon brevifolius** (A. Gray) A. Nels.

Penstemon humilis brevifolius A. Gray, Syn. Fl. **2**[1]: 267. 1878. "*P. humilis*, var. ? Watson l. c. [in King, Geol. Expl. 40th Par. **5**: 220. 1871]. * * * Utah, in the Wahsatch Mountains, at 9,000 or 10,000 feet, *Watson, Eaton*." According to Watson (loc. cit.), "In the Wahsatch Mountains; 9-10,000 feet altitude; July, August (781)." Isotype, *Watson* 781, collected in Cottonwood Canyon, Utah, altitude 2,700 meters, July, 1869, seen in herbarium of Columbia University at the New York Botanical Garden.

Penstemon brevifolius A. Nels. in Coulter, New Man. Rocky Mount. 445. 1909.

Rocky cliffs and summits, at altitudes of 2,400 to 3,200 meters; Montane and Subalpine zones; flowering from mid-June to late July. Northern Wasatch Mountains, Utah, and East Humboldt Mountains, Nevada.

UTAH: Salt Lake: Alta (F, Y); near Clayton Peak (M): Emigration Canyon, *Pennell* 5986 (H, M, R, U, Y); Lake Blanche, *Pennell* 5975 (D, H, M, P, R, U, Y); near Silver Lake, *Pennell* 6086 (F, K, S, Y), 6092 (A, Y). Toole: Ophir City, *E. S. Blackwell* (P). Utah: American Fork Canyon, *Jones* 1405 (F, U).

65. **Penstemon obtusifolius** Pennell, sp. nov.

Stems several, more or less decumbent at base, erect, 15 to 20 cm. tall, from much-branched rootstocks, slender, below puberulent with reflexed hairs, above glandular-pubescent, light green; leaves thin, pale green, dull, obscurely veined, glabrous, those at the base of the stem much tufted, the blades broadly oval, obtuse or nearly so, entire, 2 to 3 cm. long, 1.5 to 2.2 cm. wide, abruptly narrowed to a slightly margined petiole about equaling the length of blade, the stem leaves oblong-lanceolate, acutish, clasping, entire or serrulate, the largest 2.3 cm. long, 0.5 to 0.7 cm. wide; thyrsus narrow, not secund, one-third to one-half the height of the plant composed of about 4 loose fascicles, each consisting of 2 axillary ascending branches, their pedicels shorter than the peduncle; sepals 5 mm. long, lanceolate, acuminate, finely glandular-pubescent; corolla 10 to 12 mm. long, the tube and throat 7.5 to 9 mm. long, the throat 2 to 2.5 mm. wide, somewhat inflated, somewhat flattened and 2-grooved anteriorly, the 2 posterior lobes 2.5 to 3 mm. long, all the lobes united near base, the free lobes spreading; corolla externally glandular-puberulent, within slightly lanose-pubescent over the bases of the anterior lobes, blue (not seen fresh); anther sacs widely divaricate, 0.5 mm. long, broadly oval, distinct, opening throughout, glabrous, grayish; sterile filament nearly or quite equaling the anterior ones, scarcely wider distally, bearded distally with short yellow hairs; capsule not seen.

Type in the U. S. National Herbarium, no. 260682, collected at Springdale, Washington County, Utah, altitude 1,200 meters, in flower, May 16, 1894, by Marcus E. Jones (no. 5249am; distributed as *P. humilis brevifolius* S. Wats.).

Upper Sonoran Zone.

66. **Penstemon humilis** Nutt.

Penstemon humilis Nutt.; A. Gray, Proc. Amer. Acad. **6**: 69. 1862. "*P. humilis* Nutt., in herb. Acad. Philad. * * * Rocky Mountains, Nuttall (a very depauperate doubtless alpine specimen in herb. Acad. Philad.)". Aggregate, but name to be applied to Nuttall's plant. Type, doubtless collected by Nuttall on hills in southwestern Wyoming or southeastern Idaho, seen in herbarium of Academy of Natural Sciences of Philadelphia.

Penstemon collinus A. Nels. Bull. Torrey Club **25**: 279. 1898. "Type specimen in Herb. University of Wyoming [*A. Nelson*] no. 2960, Evanston [Wyoming], May 28, 1897." Isotype seen in herbarium of the New York Botanical Garden.

Gravelly sagebrush slopes, at altitudes of 1,500 to 2,400 meters; Submontane Zone (descending rarely into Upper Sonoran Zone); flowering from mid-May to early July. Foothills, from Jacksons Hole southward through the Teton and northern Wasatch regions to Juab County, Utah, southern Idaho, and northeastern Nevada.

WYOMING: Lincoln: Cokeville, *Nelson* 4549 (F); Jacksons Hole, *Hayden* (M); La Barge (U). Uinta: Evanston, *Nelson* 2960 (M, Y), 7197 (B, M, U, Y), *Pennell* 5894 (B, D, Y), 5901 (K, P, Y), 5922 (A, S, Y); base of Medicine Butte, *Pennell* 5914 (Y); Piedmont (R).

IDAHO: Bannock: Oxford; Pocatello, *Pennell* 6063 (A, F, H, M, R, U, Y); Soda Springs (M, Y). Bear Lake: Montpelier, *Macbride* 15 (M, U, Y), 202 (M, U).

UTAH: Cache: Logan, *C. P. Smith* 1629 (E, R), 2202 (Y). Juab: Eureka, *Jones* (M, U, Y). Morgan: Devils Slide, *Pennell* 5941 (F, U, Y), 5951 (Y). San Pete: Ephraim Canyon, *Tidestrom* 1171 (U); Indianola (U); San Pitch Mountains (U). Sevier: Fishlake Forest, *Eggleston* 11127 (U). Summit: Echo, *Pennell* 5930 (Y), 5936 (H, M, Y). Uinta: Brush Creek Canyon, *Goodding* 1289 (F, U, Y). Utah: Provo, *Pennell* 6112 (A, D, F, H, K, M, P, R, U, Y).

67. **Penstemon radicosus** A. Nels.

Penstemon radicosus A. Nels. Bull. Torrey Club **25**: 280. 1898. "Type specimens in Herb. University of Wyoming, [*A. Nelson*] no. 2962, Evanston [Wyoming], May 28, 1897." Isotype seen in herbarium of the New York Botanical Garden.

Dry, gravelly slopes, sides of mesas, sagebrush draws, at altitudes of 1,600 to 2,300 meters; Submontane, descending into Upper Sonoran Zone; flowering from late May to early July. Mesas and foothills from Medicine Bow River westward across southern Wyoming to the valley of Snake River in southern Idaho, southward entering North Park, Colorado, Summit County, Utah, and northern Nevada, northward through valley of Henry River and entering southwestern Montana and Yellowstone National Park.

WYOMING: Albany: Ridge (R); Rock River, *Goodding* 27 (F, M, U, Y). Carbon: Boggs (Y); Fort Steele (U, Y); Freezeout Hills (F); Medicine Bow (R); Rawlins, *Pennell* 5879 (F, H, M, R, Y). Fremont: Pacific Springs, *Parry* 208 (F). Lincoln: Cokeville, *Nelson* 4659 (R). Sweetwater: Bush Ranch (B, M, U, Y); Leucite Hills (U, Y); Point of Rocks, *Pennell* 5887 (Y); Tipton; Wamsutter, *Pennell* 5883 (A, B, D, F, H, K, M, P, R, S, U, Y), 5885 (Y; albino). Uinta: Evanston, *Nelson* 2962 (M, Y), *Pennell* 5896 (D, P, Y), 5903 (A, K, M, U, Y), 5920 (F, H, Y); base of Medicine Butte, *Pennell* 5915 (R, Y). Yellowstone National Park: Mammoth Hot Springs, *Pennell* 6033 (B, P, S, Y); on south fork of Shoshone (Y).

IDAHO: Bannock: Oxford (Y); Pocatello, *Pennell* 6064 (A, B, D, F, H, K, M, P, R, S, U, Y). Bingham: Big Butte Station, *Palmer* 203 (U). Fremont: Beaver Canyon, *Rydberg* (Y).

COLORADO: Jackson: Pinkham Creek, *Goodding* 1471 (A, B, M, U, Y).

UTAH: Summit: Echo, *Pennell* 5939 (Y).

68. **Penstemon oliganthus** Woot. & Standl.

Penstemon oliganthus Woot. & Standl. Contr. U. S. Nat. Herb. **16:** 172. (Feb. 12) 1913. "Type in the U. S. National Herbarium, no. 259061, collected in the mountains west of Grants Station [New Mexico], August 1, 1892, by E. O. Wooton." Type seen in the U. S. National Herbarium. Unfortunately this consists of late, small, shriveled-flowered specimens, with only few and small basal leaves still attached.

Penstemon griffinii A. Nels. Bot. Gaz. **56:** 70. (July 16) 1913. "Collected by Alfred A. Griffin in the Rio Grande Valley [Colorado], on moist east slopes, at 8,200 feet, July 28, 1912, no. 145." Type seen in the Rocky Mountain Herbarium.

Grassy glens, open pine woods, and rocky hillsides, at altitudes of 2,100 to 2,600 meters; Submontane and Montane zones; flowering from late July to mid-August. Mountain slopes from Park County, Colorado, southward to north-central New Mexico.

COLORADO: Chaffee: Base of Mount Princeton, *Sheldon* 243 (U), 554 (U, Y); Salida, *Pennell* 6310 (D, R, U, Y). Fremont(?): Wet mountain valley, *Redfield* 5981 (M), 6021 (M). Park: Divide west of salt works, South Park, *Porter* (F, Y). Mineral: Wagonwheel Gap, *Griffin* 145 (R).

69. **Penstemon gracilis** Nutt.

Penstemon gracilis Nutt. Gen Pl. **2:** 52. 1818. "Hab. from the Arikarees [South Dakota] to Fort Mandan [North Dakota], in depressed soils." Type seen in herbarium of Academy of Natural Sciences of Philadelphia.

Chelone gracilis Spreng. Syst. Veg. **2:** 813. 1825.

Penstemon digitalis gracilis Trauttv. Bull. Acad. St. Pétersb. **5:** 345. 1839.

Penstemon pubescens gracilis A. Gray, Proc. Amer. Acad. **6:** 69. 1862–3.

Moist grassy places, at altitudes of 1,000 to 2,100 meters; Submontane and Upper Sonoran zones; flowering from early June to mid-July. High plains, entering north-central Wyoming and eastern Colorado to the base of the foothills. Manitoba to Saskatchewan, south probably to Kansas and northeastern New Mexico.

SOUTH DAKOTA: Fall River: Hot Springs, *Rydberg* 921, in part (Y). Lawrence: Deadwood, *Carr* 35 (U, Y); Este (Y); Lead City (Y). Meade: Bear Butte ("Bear's Peak") (M); Fort Meade, *Forwood* 286 (U). Pennington: Rapid City, *Visher* (F). Stanley: Cedar Pass (U); Fort Pierre, *Geyer* 127 (U). Washabaugh: Cottonwood Canyon, *Visher* 200 (Y).

NEBRASKA: Deuel: *Rydberg* 279 (Y). Lincoln: Hershey, *Mell* 75 (U). Thomas: Halsey, *Krautter* (P).

WYOMING: Johnson: Eastern slope of Bighorn Mountains, *Tweedy* 3413 (Y), 3414 (Y). Sheridan: Little Goose Creek, *Nelson* 2375 (R).

COLORADO: Boulder: Boulder, *Ramaley* 9593 (B). Douglas: Larkspur, *Johnston & Hedgcock* 436 (Y). El Paso: North of Cheyenne Canyon, *Bessey* (Y); Colorado Springs; Monument Park (A, U); Palmer Lake (U); Ute Pass (M). Huerfano: Wahatoya Creek, *Rydberg & Vreeland* 5640 (P).

70. Penstemon harbourii A. Gray.

Penstemon harbourii A. Gray, Proc. Amer. Acad. 6: 71. 1862. "Rocky mountains of Colorado Territory, in the high alpine region, no. 396 of Hall and Harbour's distribution; found only by Mr. J. P. Harbour." Isotype seen in herbarium of Columbia University at the New York Botanical Garden.

Penstemon bakeri Greene, Pittonia 4: 318. 1901. "At 11,500 feet in the mountains about Pagosa Peak, southern Colorado, 6 Aug., 1899, *C. F. Baker.*"

Rocky slopes above timber line, especially on rock slides, at altitudes of 3,300 to 4,100 meters; Alpine Zone; flowering from early July to early August. High mountains of Colorado, from Medicine Bow Mountains to Sangre de Cristo Range and La Plata Mountains.

COLORADO: Chaffee: Mount Princeton, *Sheldon* 241 (U), 553 (U, Y). Clear Creek: Above Berthoud Pass (M); near Georgetown (M); Grays Peak (M, U); Mount Flora (M); Mount McClellan, *Patterson* 118 (F, M, U, Y). Fremont: Sangre de Cristo Range, *Brandegee* 804 (M). Gunnison: Sheep Mountain, *Purpus* 607 (F). Larimer: Near Lulu Pass, *Osterhout* 603; Mount Richtophin (Y). La Plata: La Plata Mountains (U); Virginia Gulch, south slope of Needle Mountains, *Cross* 27 (U). Ouray: Along Horsethief Trail east of Ouray, *Pennell* 6236 (A, B, D, F, H, K, M, P, R, S, U, Y). Mount Abram, *Pennell* 6187 (U, Y). San Miguel: Yellow Mountain, Ophir, *J. V. Brewster* (D). Summit: Mount Baldy (M); Mount Breckenridge, *Hall & Harbour* 396 (A, E, F, M).

71. Penstemon retrorsus Payson, sp. nov.

Stems loosely tufted, much branched below, spreading and soon ascending and erect, 10 to 20 cm. tall, from a very short caudex, pubescent with reflexed-spreading cinereous hairs; leaves light green, not veined, cinereous-pubescent, entire, the blades of lower leaves oblanceolate, attenuate to an ill-defined petiole, the stem leaves sessile, lanceolate, the largest leaves mostly 2.5 to 3.5 cm. long, 0.3 to 0.4 cm. wide; thyrsus narrow, composed of 6 to 12 fascicles, each consisting of 2 axillary branches, each of these bearing several flowers, their pedicels usually shorter than the common peduncle; sepals 3 to 4 mm. long, ovate-lanceolate, acutish to acute, not ribbed, not scarious-margined, densely and finely cinereous-pubescent; corolla 16 to 20 mm. long, the tube and throat 13 to 15 mm. long, the throat slightly inflated, flattened and 2-ridged within ventrally, the 2 posterior lobes 2.5 to 3 mm. long, united and arched about two-thirds their length, projecting, the 3 anterior lobes 3 to 5 mm. long, united at base, spreading; corolla externally glandular-puberulent, within pubescent over the bases of the anterior lobes, glabrous elsewhere, blue (not seen fresh); anther sacs widely divaricate, 0.6 mm. long, ovate, glabrous, distinct, with relatively long line of contact, opening throughout, the suture minutely ciliolate; sterile filament included, flat, not enlarged distally, bearded most of its length (densely distally) with golden-yellow hairs on the posterior face; capsule not seen.

Type in the herbarium of the New York Botanical Garden, collected on a dry adobe hill near Montrose, Colorado, altitude 1,740 meters, in flower, June 15, 1915 by Edwin Payson (no. 673).

Adobe hills, at an altitude of 1,740 meters; Upper Sonoran Zone; flowering in mid-June. Valley of Uncompahgre River in western Colorado.

COLORADO: Montrose: Montrose, *R. Dawson* (D); *Payson* 673 (Y).

72. **Penstemon thompsoniae** (A. Gray) Rydb.

Penstemon pumilus thompsoniae A. Gray, Syn. Fl. **2**[1]: 269. 1878. "S. Utah, *Mrs. Thompson.*" Type, from Kanab, Utah, collected in 1872, seen in Gray Herbarium.

Penstemon thompsoniae Rydb. Bull. Torrey Club **36**: 690. 1909.

Southern Utah and northern Arizona.

UTAH: Kane: Kanab, *Mrs. Thompson* (H). Without data, *Bishop* 250 in 1872 (U).

73. **Penstemon crandallii** A. Nels.

Penstemon crandallii A. Nels. Bull. Torrey Club **26**: 354. 1899. "I am indebted to Prof. C. S. Crandall for specimens of this plant, collected by him near Como, Park County, Colorado, July 23, 1897." Type seen in Rocky Mountain Herbarium.

"Gravelly places," at altitudes of 2,800 to 3,000 meters; Montane Zone; flowering from early July to early August. Park and Chaffee counties, central Colorado.

COLORADO: Chaffee: South Cottonwood Gulch, *Sheldon* 547 (U, Y, Z). Park: Como, *Cowen* (F, M, U, Y), *Crandall* 4197 (Y), *Shear* 4582 (Y), 4583 (Y).

74. **Penstemon suffrutescens** Rydb.

?*Penstemon caespitosus suffruticosus* A. Gray, Syn. Fl. **2**[1]: 270. 1878. "Utah, near Beaver, *Palmer.*" Type, in fruiting stage, seen in Gray Herbarium. Pedicels and calyx more glandular than in *P. suffrutescens.* Probably distinct.

Penstemon suffrutescens Rydb. Bull. Torrey Club **38**: 503. (Sept. 30) 1901. "Colorado: Ridgway, 1895, *F. Tweedy* 170." Type, collected June 20, seen in herbarium of the New York Botanical Garden.

Penstemon procumbens Greene, Pl. Baker. **3**: 23. (Nov. 18) 1901. "Forming large mats on open slopes at Keblar Pass [Colorado], 7 Aug., 1901, [*C. F. Baker*] n. 733." Isotype seen in U. S. National Herbarium. With smaller, broader leaves, and more procumbent habit than specimens seen of *P. suffrutescens;* needs further field study.

"Woods," at altitudes of 2,200 to 3,000 meters; Submontane and Montane zones; flowering from late June to early August. Gunnison and Delta to Ouray counties, west-central Colorado, and probably to central Utah.

COLORADO: Gunnison: Keblar Pass, *Baker* 733 (M, U, Y); Elk Mountains, *Brandegee* (M). Ouray: Ridgway, *Tweedy* 170 (U, Y).

UTAH: Piute: Mountains north of Bullion Creek, near Marysvale, *Rydberg & Carlton* 7106 (Y).

75. **Penstemon xylus** A. Nels.

Penstemon xylus A. Nels. Bot. Gaz. **34**: 31. 1902. "The specimens before me were collected by Mr. H. N. Wheeler at Sapinero, Colorado, 1898, no. 446." Type seen in Rocky Mountain Herbarium. Apparently but one specimen collected by me while at Sapinero, and this among dense growths of *P. teucrioides.* Perhaps the "species," at least at times, represents an intermediate (hybrid ?) between *P. teucrioides* and *P. suffrutescens.* Needs further field study.

Sagebrush hills, at altitudes of 1,700 to 2,800 meters; Upper Sonoran and Submontane zones; flowering from late May to mid-July. Scattered through western Colorado and southeastern Utah.

COLORADO: Delta: Paonia, *Osterhout* 4523 (Y); Mesa Grande (F). Eagle: Wolcott, *Osterhout* 2112. Fremont: *Brandegee* (M). Gunnison: Sapinero, *Pennell* 6269 (Y), *H. N. Wheeler* 446 (B). Hinsdale: Lake City, *Purpus* 721 (F). Mineral: Wagonwheel Gap, *B. H. Smith* (A). Montrose: Cimarron, *Baker* 333 (F, M, R, U, Y); Naturita, *Payson* 361 (R). Ouray: Ridgway, *Tweedy* 171 (U).

UTAH: La Sal Mountains, *Purpus* 5693 (M).

76. **Penstemon caespitosus** Nutt.

Penstemon caespitosus Nutt.; A. Gray, Proc. Amer. Acad. **6**: 66. 1862. "Rocky Mountains, Nuttall (a diminutive specimen in herb. Acad. Philad.)." Type, labeled "R. Mts., N. Calif.," seen in herbarium of the Academy of Natural Sciences of Philadelphia.

Dry, gravelly, sagebrush slopes, at altitudes of 1,800 to 2,100 meters; Submontane Zone; flowering from late May to early July. Foothills and lower mountain slopes, Wasatch Mountains, southwestern Wyoming, Uinta Mountains of northern Utah, and in northern Colorado.

WYOMING: Carbon: Saratoga, *Buffum* 713 (F, R). Uinta: Carter (R); Fort Bridger; Evanston, *Pennell* 5895 (F, H, M, U, Y); Leroy (R).

COLORADO: Eagle: McCoys, *Osterhout* 2762 (Y). Grand: Mount Bross, *Patterson* (F, M, Y); Sulphur Springs (Y); Willow Creek (M). Moffat: North of Craig, *Osterhout* 2623 (Y). Routt: Egeria Park, *Eastwood* (Y).

UTAH: Uinta: Dyer Mine, *Goodding* 1237 (F, R, U, Y).

76a. **Penstemon caespitosus perbrevis** Pennell, subsp. nov.

Leaves shorter, 0.5 to 1 (sometimes 1.2) cm. long, much more abruptly widening upward, spatulate-obovate, nearly all with petiole-like bases; sepals less attenuate, acuminate; plants closely prostrate, the ultimate ascending branches very short. Otherwise as in the species.

Type in the herbarium of the New York Botanical Garden, collected on dry sagebrush summit of mesa, at Castle Gate, Carbon County, Utah, altitude about 2,200 to 2,400 meters, in shriveled blossom, July 18, 1915, by F. W. Pennell (no. 6138).

Sagebrush-covered mesas, at altitudes of (1,600) 2,100 to 2,400 meters; Upper Sonoran and Submontane zones; flowering from early June to early July. Wasatch region of central Utah.

UTAH: Carbon: Castle Gate, *Pennell* 6138 (R, U, Y). Garfield: Tropic, *Jones* 5312ai (U). Utah: Soldier Summit, *Jones* 5599 (M, U, Y); near Thistle (U, Y).

77. **Penstemon teucrioides** Greene.

Penstemon teucrioides Greene, Pl. Baker. **3**: 23. 1910. "Collected at Sapinero [Colorado], 19 June [1901]; said to be commom there on dry ground, [*C. F. Baker*] n. 186." Isotype seen in U. S. National Herbarium.

Dry, stony, sagebrush slopes, at altitudes of 2,100 to 2,800 meters. Submontane Zone; flowering from late June to early August. Common to abundant in Gunnison Valley, west-central Colorado.

COLORADO: Gunnison: Gunnison, *Pennell* 6283 (Y); Sapinero, *Baker* 186 (M, R, U, Y), *Pennell* 6263 (B, F, Y), 6268 (D, H, K, M, P, R, U, Y), 6276 (A, S, Y), *H. N. Wheeler* 399 (B, R). Hinsdale: Lake City, *Purpus* 721, in part (F). Saguache: Sargents, *Pennell* 6302 (D, F, H, M, R, U, Y).

78. **Penstemon glabrescens** Pennell, sp. nov.

Stems tufted, much branched, prostrate and ascending, spreading, 7 to 15 cm. tall, from a woody caudex, with long woody prostrate stems, puberulent with reflexed cinereous hairs; leaves somewhat thickened, light green above and beneath, not veined, sparsely puberulent above proximally or usually glabrate, entire, all cauline, the blades sessile, linear, acute, the largest mostly 1 to 1.5 cm. long, 0.7 to 1 mm. wide; thyrsus narrow (flowers seemingly axillary), composed of 4 to 8 fascicles, each consisting of 2 axillary branches, each bearing 1 or 2 flowers; sepals 5 to 8 mm. long, lance-ovate to ovate, acuminate to caudate, not ribbed, proximally with margins more or less scarious and erose, slightly glandular-puberulent; corolla 16 to 18 mm.

long, the tube and throat 12 to 13 mm. long, the throat slightly inflated, flattened and 2-ridged within ventrally, the 2 posterior lobes 4 to 5 mm. long, united and arched two-thirds their length, projecting, the 3 anterior lobes 4 to 5 mm. long, united at base, spreading; corolla externally glandular-puberulent, within slightly pubescent over the bases of the anterior lobes, glabrous elsewhere, sky-blue, within violet at base of lobes, pale within the throat, on anterior side with violet lines, one of these extending medianly into each lobe (not seen fresh); anther sacs widely divaricate, 1 mm. long, oblong, glabrous, distinct, with short line of contact, opening throughout, the suture minutely ciliolate; sterile filament included, flat, scarcely enlarged distally, bearded nearly throughout (densely so distally) with golden-yellow hairs on the posterior face; capsule 7 mm. long, ovate, acuminate, glabrous; seeds 1.5 to 1.7 mm. long, irregularly quadrangular, curved, the angles sharp, not winged, the surface very minutely alveolate-reticulate, blackish, slightly glistening.

Type in the herbarium of the New York Botanical Garden, collected on open mesas and gravelly hillsides at Pagosa Springs, Colorado, in flower, July 2, 1917, by E. Bethel.

Open sagebrush (?) mesas and slopes, frequently gravelly, at altitudes of 2,000 to 2,200 meters; Upper Sonoran Zone; flowering from June to late July. Valley of San Juan River in southwestern Colorado.

COLORADO: Archuleta: Pagosa Springs, *Bethel* (D, Y). La Plata: Bayfield, *Bethel* (D, Y). Montezuma: Lone Mesa (U); Mancos, *Baker, Earle & Tracy* 27 (F, M, U, Y).

79. **Penstemon abietinus** Pennell, sp. nov.

Stems tufted, much branched, prostrate and ascending, spreading, less than 5 cm. tall, from a thick woody caudex, although often with long woody prostrate stems, densely grayish-puberulent with reflexed hairs; leaves thickened, dull pale green above and beneath, not veined, sparsely puberulent above or glabrate, entire, all cauline, the blades sessile, linear, acute, the largest mostly 1 to 1.2 cm. long, 0.8 to 1.2 mm. wide; thyrsus narrow (flowers seeming axillary), composed of few (1 to 4) fascicles, each consisting of 2 axillary shortened branches, each of these bearing usually but a single flower; sepals 4 to 5 mm. long, lanceolate-attenuate, acuminate, not ribbed, proximally with slightly erose, expanded, scarious margins, slightly glandular-puberulent; corolla 12 to 15 mm. long, the tube and throat 8 to 10 mm. long, the throat scarcely inflated, flattened and 2-ridged within ventrally, the 2 posterior lobes 4 to 5 mm. long, united and arched one-third to two-fifths their length, projecting, the 3 anterior lobes 4 to 5 mm. long, united at base, spreading; corolla externally glandular-puberulent, within slightly pubescent over bases of the anterior lobes, glabrous elsewhere, blue (not seen fresh); anther sacs widely divaricate, 1 mm. long, oblong-ovate, glabrous, distinct, with short line of contact, opening throughout, the suture nearly glabrous; sterile filament included, flat, scarcely enlarged distally, densely bearded nearly throughout with golden-yellow hairs on the posterior face; capsule not seen.

Type in the U. S. National Herbarium, no. 237297, collected at Ireland Ranch, head of Salina Canyon, Utah, altitude 2,400 meters, in flower, June 15, 1894, by Marcus E. Jones (no. 5440; distributed as *P. caespitosus* Nutt.). Isotype in herbarium of New York Botanical Garden.

Probably Submontane Zone.

UTAH: Sevier: Ireland Ranch, head of Salina Canyon, *Jones* 5440 (F, M, R, U, Y); Salina Experiment Station, Fishlake Forest, *Eggleston* 11138 (U).

80. **Penstemon whippleanus** A. Gray.

Penstemon glaucus stenosepalus A. Gray, Proc. Amer. Acad. 6: 70. 1862. "Rocky Mountains, about Pikes Peak, Clear Creek, &c., Dr. James in herb. Torr., Dr

Parry, 261, 262, and coll. 1862, distributed by Hall and Harbour, 399." Isotype, *Parry* 261, "from the headwaters of Clear Creek and the alpine ridges lying east of Middle Park, Colorado," collected in 1861, seen in herbarium of the New York Botanical Garden.

Penstmon whippleanus A. Gray, Proc. Amer. Acad. **6**: 73. 1862. "Arroyas in the Sandia Mountains, New Mexico, east of the Rio Grande, Dr. J. M. Bigelow, in Whipple's Expedition, Oct., 1853." Sterile filament in species slightly barbed at apex to nearly or (in type material) quite glabrous.

Penstemon stenosepalus Howell, Fl. Northw. Amer. **1**: 514. 1901.

Occurs in several apparently distinct color forms, separable only by field observation. Through the Colorado and Utah mountains red-violet is prevalent, but high on some mountains—e. g., Pikes Peak—a very pale greenish brown form occurs. In the Wasatch Mountains I have seen the color lavender, but Watson says that this is not the prevalent form. In the Teton Mountains, Wyoming (*Nelson* 100) a blue form exists.

Wooded or subalpine grassy mountain slopes, at altitudes of (2,200) 2,500 to 3,600 (3,900) meters; Subalpine and Montane zones, ascending to Alpine Zone; flowering from early July to late August. High mountains, from Teton and Wind River mountains, Wyoming, southward through Bear River Range, Idaho, through nearly all chains of Colorado and Utah to northern New Mexico and northern Arizona.

WYOMING: Albany, Carbon, Fremont, Lincoln, and Park counties.

IDAHO: Oneida County.

COLORADO: Boulder, Chaffee, Clear Creek, Delta, El Paso (6326), Gilpin (6361, 6362), Grand, Gunnison, Hinsdale, Huerfano, Jackson, Lake, La Plata, Larimer, Mineral, Montrose, Ouray (6192, 6202, 6206, 6210, 6244), Park, Routt, Saguache, San Juan, San Miguel, and Summit counties.

UTAH: Grand, Piute, Salt Lake (6074, 6104), San Juan, San Pete, Sevier, Summit, Utah, and Wayne counties.

81. **Penstemon montanus** Greene.

Penstemon montanus Greene, Pittonia **2**: 240. 1892. "Mr. Tweedy's n. 866, from alpine heights on the mountains of Yellowstone Park, Wyoming." Isotype, collected on Mount Norris, in flower, July, 1885, seen in U. S. National Herbarium.

Rocky slopes, at altitudes of 2,400 to 3,000 (3,200) meters; Subalpine and perhaps neighboring zones; flowering from late July to late August. High mountains, from Yellowstone and Wasatch mountains to San Pete County, Utah. In southwestern Montana and central Idaho.

WYOMING: Lincoln: Buffalo Fork, *Tweedy* 232 (Y), 233 (Y); headwaters of Cliff Creek (Y); Hoback River Canyon (U). Park: "Stinking-water," *Parry* 204 (F). Yellowstone National Park: Electric Peak, *Rydberg & Bessey* 4909 (F, U, Y); Mount Norris (U).

IDAHO: Fremont: Mount Chauvet, *Rydberg & Bessey* 4908 (F, R, U, Y). Franklin: Western boundary of Franklin Basin, *C. P. Smith* 2296 (R, Y).

UTAH: Salt Lake: Little Cottonwood Canyon, *Jones* (M, U). San Pete: Black Mountain, Manti, *Jones* (M). Utah: Silver Lake, American Fork Canyon, *Jones* (M, U).

82. **Penstemon fruticosus** (Pursh) Greene.

Gerardia fruticosa Pursh, Fl. Amer. Sept. 423. *pl. 18.* 1814. "In great abundance in the pine forests of the Rocky Mountains. *M. Lewis* * * * *v. s. in Herb. Lewis.*" Specimen (from Lambert Herbarium) in herbarium of Academy of Natural Sciences of Philadelphia labeled "Gerardia suffruticosa n. sp. new species. A small shrub from the Rocky Mountain, abundant in piny lands, Jun. 15, 1806." According to E. Coues (Proc. Acad. Phila. **1898**: 293. 1899), Lewis and Clark were, on June 15, 1806, along Collins Creek, a branch of the Kooskooskee; now Nahwah River, or Lolo Fork of Clearwater River, in Clearwater County, Idaho. Isotype seen in herbarium of Academy of Natural Sciences of Philadelphia. The type shows leaves relatively strongly serrate, a variable character, but it has broadly lanceolate sepals, thus differing from *P. scouleri* Hook.

Dasanthera fruticosa Raf. Amer. Month. Mag. 267. 1818. Type of genus *Dasanthera* Raf.

Penstemon crassifolius Lindl. Bot. Reg. **24:** *pl. 16.* 1838. "A native of the North West coast of North America, whence seeds were sent by the late Mr. Douglas to the Horticultural Society of London in whose garden it was figured in June last." This represents the state of the species with leaves most nearly entire.

Penstemon fruticosus Greene, Pittonia **2:** 239. 1892.

Penstemon menziesii crassifolius Schelle in Beissner, Schelle & Zaber, Handb. Laubh. Benen. 432. 1903.

Penstemon fruticosus crassifolius Krautter, Contr. Bot. Lab. Univ. Pa. **3:** 100. 1908.

Rocky woodland, mountain slopes, at altitudes of 2,000 to 2,300 meters; Montane Zone; flowering from early July to early August. Bighorn Mountains and Yellowstone National Park, Wyoming, westward. Western Montana and northern Wyoming to eastern Washington and eastern Oregon.

WYOMING: Park: Grinnell Creek, *Cary* 569 (U). Yellowstone National Park: Crevasse Mountain; Golden Gate, *Pennell* 6030 (F, H, Y); along Madison River, *Pennell* 5990 (Y); Mammoth Hot Springs (M, U, Y); Slough Creek (U); Spring Creek (R); Upper Geyser Basin, *Pennell* 6001 (R, U, Y).

IDAHO: Fremont: Henrys Lake and Mount Chauvet, *Rydberg & Bessey* 4907 (F, U, Y).

83. Penstemon bridgesii A. Gray.

Penstemon bridgesii A. Gray, Proc. Amer. Acad. **7**: 379. 1868. "No. 218 in Californian collection of the late Thomas Bridges." Isotype seen in herbarium of the New York Botanical Garden.

Rocky cliffs, canyons, mountain slopes, at altitudes of 1,800 to 2,600 meters; Submontane and Montane zones; flowering from mid-June to late August. Low mountains, Sierra el Late, Montezuma County, Colorado and Abajo Mountains, San Juan County, Utah, westward across southern Utah. Extending to northern Arizona and central and southern California.

COLORADO: Montezuma: Sierra el Late, *Brandegee* 1293 (M).

UTAH: Piute: Marysvale, *Rydberg & Carlton* 7123 (U, Y). San Juan: Sierra Abajo (U, Y); Western Bears Ear, Elk Mountains, *Rydberg & Garrett* 9373 (U, Y), 9374 (Y). Sevier: Clear Creek Canyon, *Garrett* 2517 (M, Y); canyon south of Glenwood (U). Wayne: Jukes Butte, Henry Mountains, *Jones* 5664 (M, U, Y).

84. Penstemon platyphyllus Rydb.

Penstemon heterophyllus latifolius S. Wats. in King, Geol. Expl. 40th Par. **5:** 222. 1871. "Wahsatch Mountains; 5–8,000 feet altitude. [*S. Watson*] (787)." Isotype, collected in Cottonwood Canyon, Utah, July, 1869, seen in herbarium of Columbia University at the New York Botanical Garden.

Penstemon latifolius Krautter, Contr. Bot. Lab. Univ. Pa. **3:** 194. 1908. Not *P. latifolius* Hoffmg. 1824.

Penstemon platyphyllus Rydb. Bull. Torrey Club **36: 6**90. 1909. "Utah: Cottonwood Cañon, July, 1869, *S. Watson* 787." Type is isotype of *P. heterophyllus latifolius* S. Wats.

Rocky mountain slopes and canyons, at altitudes of 1,300 to 2,400 meters; Subalpine Zone, descending on canyon sides into Upper Sonoran Zone; flowering from mid-May to late July. Western slope of Wasatch Mountains from Weber to Utah counties, Utah.

UTAH: Davis: Farmington Canyon, *Pammel & Blackwood* 3659 (M). Salt Lake: Big Cottonwood Canyon, *Pennell* 6067 (H, M, R, U, Y), 6068 (U, Y); South Fork of Big Cottonwood Creek, *Pennell* 5980 (A, B, F, M, R, Y); City Creek Canyon (U, Y); Emigration Canyon, *Pennell* 5985a (F, Y); Mill Creek Canyon (U, Y); Parleys Canyon. *Pennell* 5957 (D, H, K, M, P, R, S, U, Y); Red Butte (F, M). Utah: American Fork Canyon, *Jones* 1888 (F, M, U). Weber Mountains near Ogden, *Coulter* (Y).

85. Penstemon leonardi Rydb.

Penstemon leonardi Rydb. Bull. Torrey Club **40**: 483. 1913. "Utah: Diehl's Grove, Wahsatch Mountains, Aug. 1, 1884, *Leonard* (type, in herb. N. Y. Bot. Gard.)." Type seen.

Rocky hillsides, frequently among shrubs, at altitudes of 1,900 to 3,000 meters; Montane, descending to upper Submontane Zone; flowering from late June to early August. Franklin Basin of southeastern Idaho, southward through the Wasatch region to Washington County, Utah.

IDAHO: Oneida: Franklin Basin, *C. P. Smith* 2278 (Y).

UTAH: Morgan: Peterson Canyon, *Pammel & Blackwood* 3866 (M). Salt Lake: Bingham Canyon (M); divide between Big Cottonwood Canyon and Heber Valley (U, Y); Diehls Grove, *Leonard* 179 (Y); Emigration Canyon, *Pennell* 5985 (D, F, H, P, U, Y); Parleys Canyon, *Pennell* 5953 (A, H, K, R, Y), 5961 (M, S, U, Y). Kane: *Siler* (A). Summit (?): Deer Creek, *Jones* (F, Y). Utah: Aspinwall Peak, American Fork Canyon, *Jones* (M, U). Washington: Pine Valley Peak, *Purpus* 6193 (U).

86. Penstemon sepalulus A. Nels.

Penstemon azureus ambiguus A. Gray, Syn. Fl. **2**[1]: 272. 1878. "Cañons of the Wahsatch Mountains, Utah, viz. of the Provo and American Fork, *Watson* &c." Probable isotype, *Watson* 786, collected July, 1869, in Provo Canyon, seen in herbarium of the New York Botanical Garden.

Penstemon sepalulus A. Nels. in Coulter, New. Man. Rocky Mount. 444. 1909. "In the mountains of northwestern Colorado, in adjacent Utah and Wyoming." Based primarily upon *P. azureus ambiguus* A. Gray.

Rocky canyon sides, at altitudes of 1,500 to 1,800 (2,300) meters; Upper Sonoran and Submontane zones; flowering from mid-June to late July. Western slopes of Wasatch Mountains, central Utah.

UTAH: Salt Lake: *Garrett* 907 (Y). Utah: American Fork Canyon, *Jones* 1883 (F, U, Y); Kyune, *Jones* 5613e (U); Provo, near mouth of Provo Canyon, *Pennell* 6110 (A, D, H, K, M, P, R, S, U, Y), 6113 (Y); Slide Canyon, *Pennell* 6120 (F, Y).

The two following species have been detected in material recently examined by the writer.

25a. Penstemon tidestromii Pennell, sp. nov.

Stems one or several, 30 to 50 cm. tall, from a caudex, puberulent, glabrate above, glaucous; leaves pale dull green, somewhat glaucous, obscurely veined, puberulent, those at the base of the stem with oblanceolate obtuse (at times retuse) blades altogether 10 to 12 cm. long, 1 to 1.5 cm. wide, narrowed into petiole-like bases one-third the total length, the stem leaves similar, smaller, slightly clasping from a narrowed base (bases of opposite leaves not meeting around stem), becoming reduced and bractlike through the inflorescence; thyrsus narrow, secund, from one-third to two-thirds the height of the plant, composed of (about) 9 to 15 fascicles, each of 2 short axillary branches, their pedicels (when in bloom) shorter than the peduncles; sepals 3 to 5 mm. long, narrowly ovate, acute to slightly acuminate, not veined, with no or narrow, slightly denticulate, scarious margin, glabrous or glabrate; corolla 15 to 20 mm. long the tube and throat 12 to 15 mm. long, the throat somewhat inflated and rounded ventrally, the 2 posterior lobes 3 to 5 mm. long, united and arched one-third to one-half their length, projecting, the 3 anterior lobes about equaling the posterior ones, united at base, the free portions spreading; corolla glabrous without and within, blue (not seen fresh); anther sacs widely divaricate, 1.6 to 1.8 mm. long, oblong-lanceolate, distinct, opening from distal apex nearly (or quite) throughout, glabrous; sterile filament equaling the anterior pair, scarcely enlarging distally, flattened, bearded with yellow hairs on the posterior face, more densely so distally; capsule not seen.

Type in the U. S. National Herbarium, no. 507825, collected in the oak zone, "XL" Canyon, San Pitch mountains, central Utah, altitude 1,650 meters, in flower, June 24, 1908, by Ivar Tidestrom (no. 1296).

"Occasional in the oak zone," at altitudes of 1,650 to 1,800 meters; Upper Sonoran Zone; flowering in June. Wasatch and San Pitch mountains of central Utah.

UTAH: San Pete: "XL" Canyon, San Pitch Mountains, *Tidestrom* 1296 (U); Ephraim Canyon, *Tidestrom* 1134 (U).

Related to *P. laevis* (p. 347) and *P. wardii* (p. 347), the three species to be distinguished as follows:

Corolla glandular-puberulent externally; sterile filament glabrous; plants 20 to 25 cm. tall, densely cinereous-puberulent .... **P. wardii.**

Corolla glabrous externally; sterile filament bearded; plants 30 to 70 cm. tall, glabrous or finely puberulent.

- Plant glabrous throughout; sepals 4 to 7 mm. long, conspicuously acuminate, with scarious dentate margins; corolla 20 to 30 mm. long; leaves at the base of the stem ovate, those on the stem conspicuously clasping by a rounded base .... **P. laevis.**
- Plant puberulent; sepals 3 to 5 mm. long, acute or slightly acuminate, with margins slightly or not scarious; corolla 15 to 20 mm. long; leaves at base of stem oblanceolate, those on the stem narrowed to a slightly clasping base. . **P. tidestromii.**

35a. **Penstemon mensarum** Pennell, sp. nov.

Stem 40 to 50 cm. tall, from a slender caudex, finely glandular-pubescent in the inflorescence, slightly glaucous; leaves dull green, not glaucous, obscurely veined, glabrous, those at the base of the stem with oblong, obtuse to acutish blades 5 to 6 cm. long, narrowed into petiole-like bases about one-half length of blade, those of the stem similar, oblanceolate, the upper clasping (bases meeting around stem), the largest 8 cm. long, 1.5 cm. wide; thyrsus lax, secund nearly one-half height of plant, composed of at least 8 fascicles, each consisting of 2 axillary ascending branches; pedicels shorter than to equaling the peduncles, together reaching 20 mm. long; sepals 4 mm. long, oblong-ovate, acutish to acute, obscurely or not veined, proximally with obscure narrow whitish margin, finely glandular-pubescent; corolla 20 to 24 mm. long, the tube and throat 15 mm. long, the throat somewhat inflated and rounded ventrally, the 2 posterior lobes 4 mm. long, united and arched two-fifths their length, the free portions projecting, the 3 anterior lobes much longer, united at base, the free portions spreading; corolla externally glandular-puberulent, within glabrous, blue (not seen fresh); anther sacs widely divaricate, 1 mm. long, oblong-lanceolate, distinct, opening from the distal apex for nearly the entire length, pubescent on the side with slender white hairs, their length much less than the width of the sacs; sterile filament as long as the anterior pair, gradually enlarging distally, flattened, bearded on posterior face distally with scattered (or at apex dense) yellow hairs; capsule not seen.

Type in the U. S. National Herbarium, no. 1012411, collected on deep clayey loam, Battlement National Forest, Colorado, altitude 2,700 meters, in flower, July 15, 1912, by A. F. McDuffie (U. S. Forest Service, no. 7919).

To be placed in the key before *P. scariosus*, *P. garrettii*, and *P. cyanocaulis*, and to be separated as follows:

Corolla glandular-puberulent externally; pedicels and sepals strongly glandular-pubescent; inflorescence laxer.......................................**P. mensarum.**

Corolla glabrous externally; pedicels and sepals sparsely glandular-puberulent; inflorescence more congested.......**P. scariosus, P. garrettii, P. cyanocaulis.**

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CONTRIBUTIONS FROM THE NEW YORK
BOTANICAL GARDEN—No. 220

NOTES ON ROSACEAE—XII

PER AXEL RYDBERG

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[From the BULLETIN OF THE TORREY BOTANICAL CLUB 47: 45-66. 13 Mr 1920.]

Notes on Rosaceae—XII

PER AXEL RYDBERG

ROSES OF NORTHEASTERN NORTH AMERICA

By northeastern North America is meant the parts of the United States and Canada east of the Mississippi River and the Lake of the Woods and north of North Carolina and Tennessee. It comprises about the same region as that covered by Gray's and Britton's manuals, except the extreme western portion included in the latter.

As the genus *Rosa* is too large to be treated in one paper, my intention has been to discuss the different species according to their distribution, in six or seven articles. One of these articles, entitled "Roses of California and Nevada,"* has already been published; the roses of the Rocky Mountain Region have been described in my Flora,† and the whole genus, as represented in North America, has been monographed in the North American Flora.‡ There is, therefore, no need of giving full descriptions or of citing lists of synonyms. For the sake of those who do not have access to the later publication, it may be desirable to include keys to the species. The articles will otherwise contain only such notes as could not be included in the North American Flora.

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* Bull. Torrey Club 44: 65–84. 1917.

† Flora of the Rocky Mountains and adjacent plains. New York. 1917.

‡ N. Am. Flora 22: 483–533.

Key to the groups

Styles much exserted, united, about equaling the stamens; stipules adnate; sepals reflexed, deciduous; stem climbing, with curved prickles.	I. SYNSTYLAE.
Styles not exserted, or only slightly so, distinct; stigmas forming a head closing the mouth of the hypanthium.	
Stipules almost free from the petioles; introduced climbers or trailers.	II. BRACTEATAE.
Stipules for most of their length adnate to the petioles; plants rarely climbing.	
Sepals after flowering reflexed and soon deciduous.	
Achenes inserted both on the inner walls and in the bottom of the hypanthium; prickles rarely infrastipular.	
Stem prickly.	
Leaflets 3–5, rarely 7, large, round; stem with both scattered prickles and bristles; flowers mostly solitary.	III. GALLICAE.
Leaflets mostly 7; stem with strong prickles, very rarely with bristles.	IV. CANINAE.
Stem unarmed.	VI. CINNAMOMIAE.
Achenes inserted only in the bottom of the bristly hypanthium; stem with infrastipular prickles and usually with numerous bristles on the young shoots.	V. CAROLINAE.
Sepals after flowering erect, connivent, long-persistent on the fruit; achenes inserted both on the inner walls and in the bottom of the hypanthium.	
Flowers corymbose or, if solitary, then supported by a bract; leaflets large.	
Stem with scattered prickles, rarely with intermixed bristles; sepals more or less lobed; foliage glandular-punctate, sweet-scented (in *R. rubiginosa* and *R. tomentosa*).	IV. CANINAE.
Stem, at least the young shoots, bristly; prickles infrastipular or lacking; sepals entire or the outer sometimes with one or two lobes; foliage not very sweet-scented.	VI. CINNAMOMIAE.
Flowers solitary, bractless; leaflets very small.	VII. PIMPINELLIFOLIAE.

I. SYNSTYLAE

Stipules pectinate.	1. *R. multiflora.*
Stipules entire or denticulate.	
Leaflets glabrous or slightly pubescent on the veins beneath, dark green and shining above.	2. *R. setigera.*
Leaflets velutinous-pubescent beneath, rather dull above.	3. *R. rubifolia.*

1. ROSA MULTIFLORA Thunb.

This species is a native of Japan and China. It is extensively cultivated, and has developed into numerous horticultural varieties, mostly with double flowers. Numerous hybrids have also been produced. It has become naturalized in Alabama and on Porto Rico, and is otherwise found occasionally escaped in the Southern States. Within the area covered by this paper, there is a simple record from Maryland. The species is distinguished from its relatives by the fringed stipules.

2. ROSA SETIGERA Michx.

This is a native of the Southern States and is common from North Carolina and Kentucky to Alabama and Florida. It is found, however, outside of this range as far west as Kansas and Arkansas. The following localities north of Kentucky have been recorded. The specimens collected at these places might have been from plants escaped from cultivation.

NEW YORK: Oneida, *Maxon;* Ithaca, *Coville.*

3. ROSA RUBIFOLIA R. Br.

This species has been regarded as the same as the preceding. In its typical form, however, with its broader and thicker leaflets densely pubescent beneath, it seems quite distinct. The few intermediate forms seen by the author may have been hybrids. *R. rubifolia* has its best development in the Mississippi Valley and is rare east of the Alleghanies. It extends further north than *R. setigera.* The following specimens are here recorded from outside of the range proper. These may have been collected from escaped plants, as this species, as well as *R. setigera,* is extensively cultivated.

NEW JERSEY: Milburn, *Mackenzie.*

ONTARIO: Sandwich and Pelee Island, *Macoun.*

II. BRACTEATAE

One species. 4. *R. bracteata.*

4. ROSA BRACTEATA Wendl.

A native of China, often cultivated and occasionally escaped and naturalized from Virginia to Florida and Texas. It is well understood and no specimens need to be cited. The only synonyms the author has found, are: *R. lucida* Lawrence, and *R. Macartnea* Dum. Cours. The former is a hyponym and a homonym. The latter has often been given as a synonym of *R. laevigata*, but erroneously so, for it is easily seen from Dumortier's description that it belongs to *R. bracteata*.

III. GALLICAE

One species. 5. *R. gallica*.

5. Rosa gallica L.

Cultivated in many forms and occasionally escaped. Some of these escaped specimens may belong to the pure-blooded *R. gallica*, but others are plainly referable to *R. centifolia*. Whether or not the latter is a distinct species is a question which I have had neither the time nor the inclination to settle. The following specimens, belonging to *R. gallica* or closely related species, have been recorded within the area.

NEW YORK: New Baltimore, *N. Taylor*.
WISCONSIN: *Stennett*.

IV. CANINAE

Leaflets glandular-pruinose beneath, distinctly double-serrate with gland-tipped teeth.
- Leaflets suborbicular or broadly oval, mostly rounded at the apex; hypanthium in fruit obovoid or broadly ellipsoid, abruptly contracted at the apex; sepals tardily deciduous or more or less persistent; styles pubescent. 6. *R. rubiginosa*.
- Leaflets ovate or oval, acute or short-acuminate; hypanthium in fruit narrowly elliptic, tapering at both ends; sepals rather early deciduous; styles glabrous or nearly so. 7. *R. micrantha*.

Leaflets not glandular beneath, except sometimes on the midrib; teeth only occasionally double.
- Leaves pubescent, at least beneath, and on the rachis. 8. *R. dumetorum*.
- Leaves glabrous on both sides, shining above. 9. *R. canina*.

6. Rosa rubiginosa L.

The Sweetbrier is often cultivated and has become thoroughly naturalized in many places. It is very variable in cultivation and the naturalized specimens show also such variation. All specimens labeled *R. rubiginosa* do not, however, belong to that species. At least one-fourth of them belong to the next.

7. ROSA MICRANTHA Borrer

This is often mistaken for *R. rubiginosa* but differs in the less rounded leaflets, the more ellipsoid fruit, the more deciduous sepals, the smaller petals, and the almost glabrous styles. The following specimens belong to it:

MASSACHUSETTS: Manchester, *Chamberlain;* Ipswich, *Morong.*

NEW YORK: Oak Point, *Burnham 77;* High Bridge, *Elizabeth Knight;* Fort Lee, *Torrey Botanical Club.*

NEW JERSEY: Rocky Hill, *Lighthipe;* Great Notch, *Nash 1056.*

MARYLAND: Rush River, *Shull 347.*

VIRGINIA: Bedford, *A. H. Curtiss.*

8. ROSA DUMETORUM Thuill.

Closely resembling the Dog Rose but with the leaves pubescent beneath. The only record of this species from America is one from Bowling Green, Kentucky. This might have been an escape from cultivation.

9. ROSA CANINA L.

The Dog Rose is well understood, though it is only sparingly naturalized in the Northeastern States.

V. CAROLINAE

Hypanthium globose or short-ellipsoid, rounded or barely acute at the base.	
Infrastipular prickles decidedly curved.	
Leaflets finely serrulate, elliptic or oblanceolate; prickles short and stout.	
Leaflets mostly 7; flowers usually corymbose on erect branches; fruit depressed-globose, about 12 mm. thick.	10. *R. palustris.*
Leaflets mostly 5; flowers usually solitary or two together on spreading branches; fruit ellipsoid, acute at the base, 8–9 mm. thick.	11. *R. dasistema.*
Leaflets coarsely serrate, oval or obovate.	
Leaflets not shining; prickles short and weak.	
Leaflets obovate; fruit 10–12 mm. in diameter.	12. *R. gemella.*
Leaflets oblanceolate; fruit 7–10 mm. in diameter.	13. *R. nanella.*
Leaflets shining; prickles long and stout.	14. *R. virginiana.*
Infrastipular prickles straight or slightly curved.	
Leaflets oval or obovate or broadly lance-elliptic, 5–7 (in *R. virginiana* rarely 9).	

Leaves decidedly pubescent beneath. 15. *R. Lyoni.*
Leaves glabrous or pubescent only on the veins beneath.
Leaflets shining above; flowers usually corymbose; prickles as a rule stout and flattened at the base. 14. *R. virginiana.*
Leaflets not shining above; flowers usually solitary, rarely a few together; prickles slender, terete.
Leaflets not glandular-dentate.
Plant low, usually less than 2 dm. high; leaflets less than 2 cm. long, dark green; prickles 3–5 mm. long, stout, often curved. 13. *R. nanella.*
Plant usually more than 2 dm. high; leaflets usually more than 2 cm. long; prickles more than 5 mm. long, slender.
Leaflets broadly oval. 16. *R. obovata.*
Leaflets elliptic or narrowly oval. 17. *R. carolina.*
Leaflets glandular-dentate and rachis usually glandular. 18. *R. serrulata.*
Leaflets narrowly elliptic or lance-oblong, usually 9–11, at least on the new shoots. 19. *R. nitida.*
Hypanthium decidedly pyriform, or ellipsoid, long-tapering at the base. 20. *R. Bicknellii.*

10. ROSA PALUSTRIS Marsh.

This has usually been known as *Rosa carolina* L. It is the *R. carolina* of the second edition of Linnaeus's Species Plantarum, but not that of the first. It is evident that Linnaeus, when he prepared the manuscript for the first edition, did not have any specimens, but based his *R. carolina* wholly on the plate and description in Dillenius's Hortus Elthalmensis, *pl. 245, f. 316.* This plate does not represent *R. carolina* as usually understood, but the species commonly known as *R. humilis* Marsh. In discussing *R. carolina*, Crépin states: "The latter description, i.e., that of Hortus Elthalmensis, and the figure can apply either to *R. humilis* Marsh. or to *R. lucida* Ehrh., but not to *R. carolina* as we know it today. Besides the branch which I have seen in Sherard's herbarium with Dillenius's name on, belongs to *R. humilis* Marsh (= *R. parviflora* Ehrh.). The result is that the first name for *R. humilis* Marsh. is *R. carolina* L. Sp., ed.1." Crépin therefore arrived at the same conclusion as I. The oldest name for the Swamp Rose, or what has usually been known as *R. carolina*, is thus *R. palustris* Marsh., a very appropriate name. The synonymy of this species is much involved; see North American Flora.

West of Lake Michigan, especially in the Green Bay region, *R. palustris* has more pubescent, smaller, and less bluish green leaflets. This form may represent a distinct species or geographical variety.

11. ROSA DASISTEMA Raf.

Some specimens, collected especially in Missouri and named *R. carolina*, differ from *R. palustris* in having a smaller hypanthium decidedly pear-shaped and acute at the base, instead of depressed-globose and rounded below, and also in having fewer leaflets, usually five, rarely seven, instead of seven or nine. These specimens agree closely with the description of *R. dasistema* Raf. The type of the latter was from Indiana, from which state I have seen no specimens. This fact, however, does not disprove the identity of the Missouri specimens with Rafinesque's species. These specimens are:

MISSOURI: Paw Paw Junction, *Bush 226;* Kennett, *Trelease 177;* Campbell, *Bush 109, 6214;* Butte County, *Bush 3688.*

12. ROSA GEMELLA Willd.

Although this has usually been regarded as a synonym of *R. blanda*, the description shows that it can not be that species. The description of the prickles of *R. gemella* (slender and curved) would exclude it from *R. blanda*. There is, however, a plant, though rather rare, which answers Willdenow's description. It is related to *R. carolina*, but differs in the curved prickles, the more corymbose inflorescence, and the entire sepals. It may be confused also with *R. virginiana* and *R. palustris*. From the former it differs in the thin dull leaflets, the slender more curved prickles and the low habit. Its prickles resembles those of *R. palustris* but are much weaker, while its leaflets are broad and rather short and more coarsely serrate. The following specimens belong here:

NOVA SCOTIA: Yarmouth, *Howe & Lang 122.*

MASSACHUSETTS: Ipswich, *Nash, Morong;* Provincetown, *Hollick.*

NEW YORK: South Beach, Staten Island, *Burnham 746;* New Dorp, *Kearney;* Eastport, *Schrenk.*

VIRGINIA: Marion, *N. L. & E. G. Britton & A. M. Vail.*

13. ROSA NANELLA Rydberg

Mr. E. P. Bicknell collected a small rose on the sand-dunes of Chappaquiddick Island, east of Martha's Vineyard, Massachusetts, which was described in the North American Flora under this name. It is related to *R. carolina*, but smaller, has smaller leaflets, smaller fruit, and short, usually curved prickles. It also resembles *R. nitida*, especially in the small shining leaflets, but the latter are fewer in number and more obovate, and its prickles are different. The following specimens belong here:

MASSACHUSETTS: Chappaquiddick Island, *Bicknell.*

NEW YORK: Peconic River, Long Island, *N. Taylor;* Smith's Point, Fire Island, *E. L. Morris;* Oak Island, *N. Taylor.*

14. ROSA VIRGINIANA Mill.

This has usually been regarded as a synonym of *R. blanda.* This may have been due partly to the fact that Miller described *R. virginiana* as unarmed, partly perhaps to the fact that at least one of the specimens on which *R. blanda* was originally based belonged to the species here treated. Another character assigned to *R. virginiana* by Miller, viz., "the shining leaves," does not very well apply to *R. blanda* as usually understood. The name *R. virginiana* Mill. was substituted for *R. lucida* Ehrh. in the New Gray's Manual by Robinson and Fernald. I therefore wrote to Professor Fernald, asking him kindly to let me know the reasons for the change made. In answer I received the following letter, which I take the liberty of publishing:

Rosa virginiana Miller, Gard. Dict. ed. 8, no. 10 (1769), is represented by a fine sheet in the herbarium of the British Museum, marked "*Rosa virginiana* Mill. Dict. No. 10!" James Britten and J. G. Baker who called my attention to it say there is absolutely no question about its authentity. There are three fruiting branches and they are perfectly good *R. lucida* Ehrh. Crépin recognized it and has written on the sheet "*R. lucida* Ehrh. Cr." and J. G. Baker (Jour. Linn. Soc. XXXVII. 74) in his Revised Classification of Roses so treats it. I took a photograph—an excellent one nearly life-size—and it shows the characteristic broad-base and curved infra-stipular prickles at two points.

It is therefore plain that *R. virginiana* Mill. is the oldest name for the rose usually known as *R. lucida* Ehrh. To me it seems that *R. carolinensis* Marsh. applies better to this species than does either of the two species described by Linnaeus under the name of *R. carolina*. *R. rapa* Bosc is apparently a double form of this species.

Mr. Best reduced this species to a variety of *R. humilis*. He had collected a great number of rose-specimens in New Jersey. Some of these were presented to Columbia University. These show many gradations between *R. lucida* Ehrh. and *R. humilis* Marsh. (i.e., the original *R. carolina* L.), and also between these and another form, *R. humilis villosa* Best (*R. Lyoni* Pursh). Best concluded that all should be regarded as a single variable species. He has been followed by N. L. Britton and C. K. Schneider, the latter using the name *R. virginiana lucida* Best. I doubt if Best ever used said combination, at least in print. In my opinion several of Mr. Best's specimens are of hybrid origin, and this circumstance would give a satisfactory explanation for the intergradation, which is rarely met with elsewhere.

Rosa blanda Willmottiana Baker, according to the figure, has nothing to do with *R. blanda*, but belongs without doubt to *R. virginiana*.

15. ROSA LYONI Pursh

A species which has been confused with both *R. virginiana* Mill. (*R. lucida* Ehrh.) and *R. carolina* L. (*R. humilis* Marsh.), but which differs from both in having the leaves densely pubescent beneath. In general habit and in the sepals and the prickles, it resembles most the latter, but the leaflets are much broader and the flowers are as large as in *R. virginiana*. The flowers are also more inclined to be corymbose than in *R. carolina*. *R. Lyoni* is a more western species, receiving its best development in Missouri, but extends as far east as central New York and New Jersey, where it mixes with the two species mentioned, and hybridizes with them. See remarks under *R. virginiana*. *R. Lyoni* is apparently the same as *R. pusilla* Raf., *R. lucida* α T. & G., and *R. humilis villosa* Best.

16. ROSA OBOVATA Raf.

The first one to give a good description of this species was Lindley, who described it in his monograph under the name *R. laxa*. Unfortunately this name was preoccupied by *R. laxa* Retz., for which reason Sprengel substituted *R. Lindleyi*, also a homonym or rather pseudo-homonym, as there was already a *R. Lindleyana* Tratt. Mr. Baker, in Miss Willmott's Genus *Rosa*, described it as *R. humilis grandiflora*. There is, however, a *R. grandiflora* Salisb., so the name is not available. The only name left to consider is *R. obovata* Raf. Rafinesque's description, in this case as usually, is far from satisfactory, but "the single large flowers; obovate leaflets, and straight prickles," would indicate this species. In many respects it is intermediate between *R. virginiana* and *R. carolina*, but has comparatively broader leaflets than either. The leaflets are rather dull, sometimes somewhat glaucous. The following specimens are to be referred to it:

MAINE: Hudson, *Briggs;* Bangor, *O. W. Knight.*

MASSACHUSETTS: Nantucket Island, *Bicknell.*

RHODE ISLAND: Newport, *Mearns 553.*

NEW YORK: Ithaca, *Coville, Pearce;* Long Beach, Long Island, *Bicknell;* Lake Ronkonkoma, *Bicknell.*

NEW JERSEY: Bay Head, Ocean County, *Mackenzie.*

PENNSYLVANIA: Raymond's Kill, Pike County, *Nash.*

MISSOURI: Chadwick, *Trelease 185.*

17. ROSA CAROLINA L.

This name was taken up in the North American Flora for the plant described by Linnaeus in the first edition of his Species Plantarum. It is the same as *R. humilis* Marsh. and *R. parviflora* Ehrh. See the discussion under *R. palustris*. Wangenheim described it under the name *R. pennsylvanica*, and Michaux changed the form of the name to *R. caroliniana*. It appears also to be *R. pratensis* Raf. The rest of the synonyms are easily explained.

18. ROSA SERRULATA Raf.

This is closely related to the preceding species and has usually been confused with it. It differs in the double-toothed leaflets, each tooth usually ending in a distinct gland. In the South it is more common than *R. carolina*, but extends as far north as central New York and Wisconsin. It is the same as *R. parviflora glandulosa* Crépin, and also as his var. *setigera*, at least in part.

19. ROSA NITIDA Willd.

This is well understood. It is distributed from Newfoundland to Massachusetts, near the coast, and has likewise been collected in Connecticut.

20. ROSA BICKNELLII Rydberg

This species is probably most closely related to *R. virginiana* but differs in the smaller and less numerous flowers, the obovoid fruit acute at the base, the smaller, thinner, and not shining leaflets. It may be the same as *R. acuminata* Raf., but the leaflets are by no means "acuminate," and the distribution, as far as known, is quite different. The following specimens belong to it:

NOVA SCOTIA: Purchell's Cove, Halifax Harbor, *Howe & Lang.*

MASSACHUSETTS: Coscati and Wauwinet, Nantucket Island, and Chappaquiddick Island, *Bicknell.*

NEW YORK: Long Beach, East Rockaway and Lawrence, Long Island, *Bicknell;* Lone Hill and Peconic River, *N. Taylor.*

VI. CINNAMOMIAE

Infrastipular prickles not present; branches unarmed or bristly, not prickly.
  Inflorescence corymbose, terminating the stem; plant more or less suffruticose; stem very bristly, mostly dying back to the ground in the winter; leaflets usually 9–11.
    Leaves glabrous or nearly so. — 21. *R. arkansana.*
    Leaves densely pubescent, especially beneath. — 22. *R. suffulta.*
  Inflorescence of solitary or few corymbose flowers ending lateral branches; plant shrubby; leaflets usually 5 or 7 (or 9 on the new shoots only).
    Stem densely bristly even in age.
      Leaflets comparatively thin, neither rugose nor strongly reticulate; branches and prickles glabrous.
        Hypanthium decidedly pear-shaped or ellipsoid, acute at the base, with a distinct neck at the top. — 23. *R. acicularis.*

Hypanthium subglobose, without a neck.
Leaflets glandular-granuliferous and pubescent beneath; fruit 1.5 cm. thick. — 24. *R. Bourgeauiana.*
Leaflets villous beneath; fruit about 1 cm. thick. — 25. *R. acicularioides.*
Leaflets thick, strongly reticulate, and rugose; branches and even the prickles pubescent. — 26. *R. rugosa.*
Stem unarmed or when young covered with more or less deciduous bristles.
Sepals erect or connivent in fruit.
Leaflets decidedly but finely pubescent beneath. — 27. *R. blanda.*
Leaflets glabrous on both sides, shining. — 28. *R. subblanda.*
Sepals reflexed in fruit.
Leaflets decidedly puberulent or short-pilose; sepals 9–15 mm. long; petals 1.7–2 cm. long. — 29. *R. Williamsii.*
Leaflets glabrous or nearly so; sepals 2–5 cm. long; petals 2.5–3.5 cm. long. — 30. *R. johannensis.*
Infrastipular prickles present, more or less curved.
Flowers mostly solitary; petals 2.5 cm. long or more: leaflets densely pubescent beneath. — 31. *R. spinosissima.*
Flowers corymbose; petals about 2 cm. long; leaflets finely puberulent beneath. — 32. *R. palustriformis.*

21. ROSA ARKANSANA Porter

Collected in Wisconsin.

22. ROSA SUFFULTA Greene

Collected near the Bureau of Standards, Washington, D. C. This and the preceding species belong to the prairies and plains west of the Mississippi River and will be treated in a subsequent article.

23. ROSA ACICULARIS Lindley

This species was originally described from Siberian material, but Alaskan specimens match exactly Lindley's figure and so do specimens from Siberia. Specimens from the southern and eastern limits of its range differ a little, in having smaller and less firm leaflets, less glaucous beneath, and smaller flowers. They differ from *R. Engelmannii* and *R. Bourgeauiana* in the leaflets, which are narrower and decidedly pubescent beneath; from the former in the simple teeth and the lack of glandular granules on the lower ieaf-surfaces, and usually in the larger fruit; and from the latter In the elongate fruit with a distinct neck. All specimens from

Wisconsin, Michigan, and northern New York, labelled *R. Engelmannii* and many labelled *R. Sayi* belong here. *R. Sayi* Schwein. is in reality a synonym of this. See discussion under the next species. Sometimes *R. acicularis* is nearly destitute of bristles, and may then be mistaken for *R. blanda*, but the ellipsoid fruit always distinguishes it. Such specimens are:

MICHIGAN: Presque Isle Park, Marquette, *Wheeler* (determined by Crépin as *R. blanda*, with the following remark, "fruiting receptacle resembling that of *R. acicularis* var. *Engelmannii*").

24. ROSA BOURGEAUIANA Crépin

This was first collected by Richardson on the Saskatchewan or somewhere between that river and the Mackenzie, and was published as *R. majalis* Borrer in Hooker's Flora. There is an older *R. majalis* Herm., however. In 1875, Crépin proposed the name *R. Bourgeauiana*, without a description, but the next year he reduced it to a variety of *R. acicularis*. Watson, in his Monograph of the North American Roses, adopted the name *R. Sayi* Schwein, and it has usually been known under that name. It is not *R. Sayi* Schwein., however, for Schweinitz described his species as having ellipsoid fruit and the leaves pubescent beneath. These characters point without any doubt to *R. acicularis*, which is also found in the region visited by Schweinitz. *R. Sayi* must therefore be regarded as a synonym of *R. acicularis*.

25. ROSA ACICULARIOIDES Schuette

Schuette's description* is very meager, but the writer has seen some of his specimens. The description in the North American Flora was drawn from those in the Gray Herbarium. Later some were also found at the New York Botanical Garden, among duplicates from Schuette's herbarium, received in exchange from the Field Columbian Museum, Chicago. The plant perhaps most resembles *R. Bourgeauinana* in habit, leaf-form, and size and form of the fruit, but the leaflets are densely pubescent beneath as in *R. acicularis;* yes, even more so, and with longer hairs. The specimens are from Lily Bay, Sturgeon Bay, and Little Sturgeon, Door County, Wisconsin.

* Proc. Am. Ass. Adv. Sci. **46**: 278–9. 1898.

26. ROSA RUGOSA Thunberg

Common in cultivation and occasionally found as an escape; it is well established in a few places in Connecticut and on Nantucket Island.

27. ROSA BLANDA Ait.

The species was based on three different elements, judging from the following statements in the Hortus Kewensis:

Nat. of Newfoundland and Hudson's-bay.
Cult. 1773, by Mr. James Gordon.

Fernald* has properly discussed the status of the two native specimens covered by the description. Having previously discussed the matter with him, the author agreed that the name must be applied to the Hudson Bay specimen, rather than the Newfoundland one, for the plant is named the "Hudson Bay Rose,"* and the hypanthium is described as glabrous. Prior to this discussion with Professor Fernald, I had held the opinion that the Newfoundland plant should be regarded as the type, partly because Solander, who prepared part of the manuscript for the first edition of Aiton's Hortus Kewensis, had in manuscript called this *R. blanda* and the Hudson Bay shrub *R. blanda* β; and partly because *R. blanda* is described as glabrous. I therefore adopted the name *R. Solanderi* Tratt. for the shrub usually called *R. blanda*, the species with pubescent leaves. Having conceded to Fernald's argument, I have left *R. blanda* as interpreted by Lindley. If the name *R. blanda* is applied to the Newfoundland plant, it would become a synonym of *R. virginiana* and be eliminated altogether.

In the Green Bay region of Wisconsin and Upper Michigan, *Rosa blanda* is much more pubescent than elsewhere, so far as I know, and the pubescence of the lower surface of the leaves is sometimes as as long as in *R. acicularis* and *R. acicularioides*. In some of these specimens the leaflets are more elongate-elliptic and the hypanthium more elongate, or pear-shaped, or with a distinct neck, and in such cases the specimens are probably of hybrid origin, i.e., represent *R. acicularis* × *blanda*. In the same region *R. palustris* is also more pubescent. Could, perhaps, some *R. acicularis* blood have been infused in both many generations back?

* Rhodora **20**: 90–96. 1918.

Lindley recognized a so-called glabrous *R. blanda* and described it under the name *R. fraxinifolia* Borkh., but Borkhausen's description does not agree with Lindley's conception of *R. fraxinifolia*. Neither does C. C. Gmelin's description,* which has been cited as a synonym of *R. blanda*. Lindley included in this *R. fraxinifolia* not only *R. blanda* α of Solander's manuscript, i.e., the Newfoundland rose, but also the *R. blanda* described and figured by N. J. Jacquin† The former is, as shown by Fernald, nothing but *R. virginiana* Mill. and belongs to a different group, the CAROLINAE, instead of the CINNAMOMIAE. Jacquin's *R. blanda* is probably the same as the cultivated specimens mentioned by Aiton. Jacquin described *R. blanda* as being perfectly glabrous both as to the leaves and the hypanthium. His illustration does not in any way indicate that his plant was *R. virginiana*. In nearly every respect, it suggests *R. blanda*, except that both the illustration and the text inform us that it was glabrous. Is there such a plant, and what name should it bear? As stated before, Lindley recognized such a plant, though he erroneously included in it *R. blanda* α of Solander, from Newfoundland, which had a glandular bristly hypanthium. Neither can the name which he adopted be used for the reason given above. Crépin, who had seen the original specimens of *R. blanda* α, and had written on the sheet "verus *R. lucida*," i.e., *R. virginiana*, recognized a glabrous *R. blanda*, and described it as *R. blanda glabra*. As this plant evidently has no valid name, I gave it the name *R. subblanda* in the North American Flora.

28. ROSA SUBBLANDA Rydberg

This species is much rarer than *R. blanda* and wholly confined to the Northeast. The following specimens may be cited:

QUEBEC: *Mrs. Persival;* Cape Enrage, Bic, *Williams, Collins & Fernald.*

VERMONT: Gardener's Island, Lake Champlain, *Faxon;* Royalton, *Eggleston.*

NEW YORK: Bluff Point, Lake Champlain, *Vail.*

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* Fl. Bad. 2: 413. 1806.

† Fragmenta *pl. 107.* 1809.

29. ROSA WILLIAMSII Fernald

30. ROSA JOHANNENSIS Fernald

This and the preceding species have been discussed by their author,* and nothing more needs to be added.

31. ROSA SPINOSISSIMA L.

This is the earliest name for the Cinnamon Rose. Linnaeus probably included in the original description two different species, or at least cited also synonyms belonging to *R. pimpinellifolia*. Many authors have applied the name *R. spinosissima* to the latter species. It is evident that Linnaeus principally had in mind a native rose of Sweden, which could be none but the Cinnamon Rose.

Crépin† has shown that the original *Rosa cinnamomea* L., of the first edition of the Species Plantarum, which was based wholly on a plant from Switzerland and described by Haller and Bauhin, is the same as *R. pendulina* L. In the first edition Linnaeus gives as a synonym under *R. cinnamomea*, "Rosa sylvestris, odoratissimo rubro flore. *Bauh. pin.* 483." Under the same name, in the second edition, he cited, "Rosa, odore cinnamomi, simplex. *Bauh. pin.* 483," which shows that *R. cinnamomea* L. of the first edition was not the same as that of the second. The first was evidently what in the tenth edition of his Systema and in the second edition of his Species Plantarum is called *R. alpina*, which is the same as *R. pendulina* L.

The *R. cinnamomea* of the second edition is the plant usually known under that name. As stated before, the oldest name of this is evidently *R. spinosissima* L. Not that that name should be entirely equivalent to *R. cinnamomea* of the second edition, for Linnaeus evidently had two species confused. He gave two references under it, one to his Flora Suecica and the other to Bauhin's Pinax. The latter may well be *R. spinosissima* as usually understood, i.e., a form of *R. pimpinellifolia;* but the former must be something else. *R. pimpinellifolia* is not found, even as an escape, in the part of Sweden where Linnaeus reported his *R. spinosissima*. In his Flora Suecica, he gave the vernacular name

* Rhodora 20: 94, 95. 1918.

† Bull. Herb. Boiss. 5: 135–138. 1897.

of the plant in the province of Upland, north of Stockholm, and stated that it grew along margins of fields. Wahlenberg, both in his Flora Upsaliensis and in his Flora Suecica, identified it with *R. majalis* Retz. and *R. cinnamomea* Sm., which is the same as *R. cinnamomea* of the second edition of the Species Plantarum; he even adopted the name *R. spinosissima.*

In the tenth edition of his Systema, Linnaeus placed *R. spinosissima* in the second division, i.e., with the species having ovate fruit, while he placed *R. pimpinellifolia* in the first division with suglobose fruit. In the second edition of the Species Plantarum, he added nothing to what he had in the first edition except one sentence from the Systema. In his second Mantissa, he seems to have changed his views altogether. Under *R. pimpinellifolia* he made the following remark: "Cum *R. spinosissima* eadem facit *Hallerus.*" Evidently on account of Haller's interpretation, he adopted the name *R. spinosissima* for *R. pimpinellifolia.* He omitted all his previous synonyms, cited "*Clus. hist.* I. *p.* 116," and made a new description, incorporating in it not only a globose fruit, but white petals, yellow at the base, characters all belonging to *R. pimpinellifolia.*

Rosa spinosissima (*R. cinnamomea* of the second edition of the Species Platarum) is in cultivation, and has been found occasionally escaped in the northeastern part of this continent, and also in Wisconsin.

32. ROSA PALUSTRIFORMIS Rydberg

This species was discovered by Dr. Schuette of Green Bay, Wisconsin, who distributed it under an untenable manuscript name. In habit, pubescence and prickles, it strongly resembles *R. palustris,* but the hypanthium and sepals are in form and size like those of *R. blanda.* The sepals are erect and persistent in fruit, while the hypanthium is glabrous, not glandular-hispid. At first I thought that it might be a hybrid between the two species, but it has one feature not found in either—the sepals are wholly without glands on the back, only with a few gland-teeth on the margins. In both *R. palustris* and *R. blanda,* the sepals are glandular on the back. The description in the North American Flora was drawn from the specimens in the Gray Herbarium. Those received later, which are in the herbarium of the New York Botanical Garden, do not resemble *R. palustris* so much, but the distinctive characters are there. Besides the Green Bay specimens, there is also one from Neenah, Wisconsin.

VII. PIMPINELLIFOLIAE

One species. 33. *R. pimpinellifolia.*

33. ROSA PIMPINELLIFOLIA L.

As stated before, Linnaeus included this species under *R. spinosissima* in the first edition of the Species plantarum, but it is not the type of it. See the remarks under *R. spinosissima.* Many recent authors have readopted the name *R. pimpinellifolia* for the present species. I am glad that the latter name, which has been in use for this species during a hundred and fifty years, is to be taken up again.

R. pimpinellifolia is extensively cultivated and has escaped in many places. It has been mistaken for a native more than once. Pursh described it as *R. lutescens,* and lately E. G. Baker has given it another name, *R. illinoensis.* The latter was based on specimens collected, according to Baker, by Green, Lansing and Dixon at La Salle, Illinois. There is a sheet in the herbarium of the New York Botanical Garden, collected by Greenman [not Green], Lansing and Dixon. Baker distinguished it from *R. spinosissima* (i.e., from *R. pimpinellifolia*) by the smaller number of leaflets, only seven and by the upper prickles being paired under the leaves. In our specimens, some leaves have nine leaflets, while some of the upper leaves have only three or five. We have also some specimens from England and Scandinavia, which do not have more than seven leaflets. The arrangement of paired infrastipular prickles, I think, was only incidental, for our specimens, duplicates of the type, do not show this characteristic. *R. illinoensis* is nothing but the escape of one of the numerous cultivated forms of *P. pimpinellifolia.* The following American species belong to this species:

VERMONT: Johnson, *Grout.*

ONTARIO: Amherstbough, *Macoun 34752.*

ILLINOIS: La Salle County, *Greenman, Lansing & Dixon 133.*

HYBRIDS

It is well known that hybrids among roses are very common in cultivation, and many wild hybrids have been recorded in Europe. No attempt has been made in this country until recently to distinguish hybrids among our native species. The first and only record in print that I know of, was made in 1900 and by a European, Crépin, who published *R. carolina* × *nitida* in Rhodora. This hybrid should now be known as *R. nitida* × *palustris*.

Outside of this record, I did not know of anyone besides myself and Mr. E. P. Bicknell, who had undertaken to distinguish hybrids among our native roses, and neither of us had put our observations in print. Bicknell, who did so much in clearing up the *Rubus* hybrids, did some work on *Rosa* at the same time, though his notes have remained in manuscript.

While spending some time last fall at the Gray Herbarium, I found there a collection made by Dr. Schuette of Green Bay, Wisconsin, which collection I worked over in the light of a small paper published by him in 1889.* After my return to New York, I found that the New York Botanical Garden had received a set of Dr. Schuette's duplicates in exchange with the Field Columbian Museum in Chicago. The numerous notes accompanying these duplicates, as well as those at the Gray Herbarium, show that Schuette had done considerably more intelligent work than his published paper indicated. In his article, he described one new species, *R. acicularioides*, and several varieties of *R. blanda* and *R. carolina* (i.e., *R. palustris*). His descriptions are meager, mostly one or two lines long, and apparently of little value, unless studied in connection with his specimens. His notes, however, show that most of his varieties he regarded as hybrids between those two species and other roses found in the region. The notes if published would make a long paper by themselves. It would not be advisable to do so now, as nobody could now present the matter with Schuette's final views. It is evident that even at the time when he published his paper, he was inclined to regard these forms as hybrids. It is unfortunate that he did not dare or did not think it advisable to put his convictions in print and

* Proc. Am. Ass. Adv. Sci. 46: 278–279. 1898.

publish them as hybrids instead of varieties. His published paper does not give justice to his knowledge of, and insight into, the relationship of the roses of Green Bay and vicinity.

It is hardly worth while to redescribe our rose hybrids in this paper. Anyone who wishes to avail himself of descriptions can find them in the North American Flora. I shall therefore only indicate which hybrids have been recorded and cite some specimens which I regard as belonging to each.

ROSA ACICULARIS × BLANDA

WISCONSIN: Sturgeon Bay, Fort Howard, Elkhart, Little Sturgeon, and Lily Bay, *Schuette.*

MICHIGAN: Menominee, *Schuette.*

ROSA ACICULARIS × CAROLINA

WISCONSIN: Little Sturgeon, *Schuette.*

ROSA ACICULARIOIDES × CAROLINA

WISCONSIN: Lily Bay, Door County, *Schuette.*

ROSA BICKNELLII × NANELLA

MASSACHUSETTS: Chappaquiddick Island, *Bicknell.*

ROSA BICKNELLII × VIRGINIANA

MASSACHUSETTS: Squam, Nantucket Island, *Bicknell.*

NEW JERSEY: Farmingdale, *N. Taylor.*

ROSA BLANDA × CAROLINA

WISCONSIN: Peak's Point, Green Bay, Marinette, Dutch Creek, Peshtigo, Preble, and Big Swamico, *Schuette.*

ROSA BLANDA × PALUSTRIS

WISCONSIN: Fort Howard, Marinette, Green Bay, Big Swamico, *Schuette.*

ROSA BLANDA × VIRGINIANA

ONTARIO: Point Abino, *Small;* Mt. Denis, *Biltmore Herbarium.*

MICHIGAN: Ann Arbor (collector unknown).

ROSA CAROLINA × PALUSTRIS

NEW YORK: Jamaica, *P. Wilson;* Sylvan Beach, Oneida County, *House.*

PENNSYLVANIA: Island Park, near Easton, and on the Delaware, *Porter.*

NEW JERSEY: Spotswood, *N. Taylor.*

WISCONSIN: Big Swamico and Preble, *Schuette.*

ROSA CAROLINA × VIRGINIANA

NEW JERSEY: Farmingdale, *N. Taylor.*

INDIANA: Boss Lake, *Deam.*

ROSA DASISTEMA × VIRGINIANA

MISSOURI: Butler County, *Eggert.*

ROSA JOHANNENSIS × PALUSTRIS

MAINE: Portage Lake, *Robinson & Fernald.*

ROSA LYONI × SERRULATA

VIRGINIA: Marion and Rye Valley, *Small.*

WEST VIRGINIA: Little Falls, *Millspaugh;* White Sulphur Springs, *Biltmore Herbarium.*

NORTH CAROLINA: Matthews, *Biltmore Herbarium.*

GEORGIA: Floyd County, *Chapman;* Coosa River, *Biltmore Herbarium.*

ROSA LYONI × VIRGINIANA

NEW JERSEY: Kingswood and Rosemont, *Best.*

ROSA NITIDA × PALUSTRIS

MAINE: Foxcroft, *Fernald.*

ROSA NITIDA × VIRGINIANA

NEWFOUNDLAND: St. George, *Howe & Lang.*

MASSACHUSETTS: Branch Island.

ROSA PALUSTRIS × SERRULATA

WISCONSIN: Fort Howard, *Schuette.*

ROSA PALUSTRIS × VIRGINIANA

MASSACHUSETTS: Nantucket Island, *Bicknell.*

NEW JERSEY: Palisades: *Southwick.*

ROSA SERRULATA × VIRGINIANA

ALABAMA: Monte Sano and Auburn, *C. F. Baker.*

The following table indicates the hitherto recorded hybrids among our northeastern native roses:

	Rosa palustris	*Rosa dasistema*	*Rosa nanella*	*Rosa virginiana*	*Rosa Lyoni*	*Rosa carolina*	*Rosa serrulata*	*Rosa Bicknellii*	*Rosa nitida*	*Rosa acicularis*	*Rosa acicularioides*	*Rosa blanda*	*Rosa johannensis*
Rosa palustris				×		×	×		×			×	×
" *dasistema*				×									
" *nanella*								×					
" *virginiana*	×	×			×	×	×	×	×			×	
" *Lyoni*				×			×						
" *carolina*	×			×						×	×	×	
" *serrulata*	×			×	×								
" *Bicknellii*			×	×									
" *nitida*	×			×									
" *acicularis*						×						×	
" *acicularioides*						×							
" *blanda*	×			×		×				×			
" *johannensis*	×												

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SCROPHULARIACEÆ OF THE SOUTH-EASTERN UNITED STATES

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SCROPHULARIACEÆ OF THE SOUTHEASTERN UNITED STATES

BY FRANCIS W. PENNELL.

The present revision of the species of the Scrophulariaceæ occurring in the southeastern portion of the United States, from North Carolina to Florida and westward to the Mississippi River, is the outgrowth of a long-continued and especial interest. Nearly fifteen years ago, when the writer was a student in the Botanical Section of The Academy of Natural Sciences of Philadelphia, certain problems in this field appeared, and have waited for the solutions now proposed. Perhaps this early connection will make more fitting the appearance of this paper in these PROCEEDINGS.

During the late summers and early autumns of 1912 and 1913, I collected extensively through every state of this area. This was in pursuit of a monographic study of the genera now called *Macranthera, Dasistoma, Afzelia, Aureolaria, Agalinis* and *Otophylla*. Nearly every species was found, and descriptions made of the form and color of the corolla of each. Later, almost every herbarium of significance for these species has been reviewed, and the results are presented with some confidence. A preliminary paper, dealing with the species of the Coastal Plain, was published in the "Torrey Bulletin" in 1913, and a summary of this group for North America is now awaiting publication in the Contributions from the Botanical Laboratory of the University of Pennsylvania.

In the course of these two trips many collections were made of the nearly related *Buchnera*, and, less consistently, attention was given to other genera of the family. But, to obtain field-descriptions and to collect for the first time the spring-flowering species, another trip was necessary. In the Spring of 1917 I traveled as far south as Key West, and from the Coast into the Appalachians. The expedition was peculiarly successful, so that now, excepting for a few local species of the lowland, as *Herpestis rotundifolia* and several of *Agalinis*, or of the upland, as *Ilysanthes saxicola* and *Penstemon smallii*, or of the mountains in late summer, as *Chelone lyoni*, practically every species has been described from flowering plants.

Excluding *Agalinis* and its allies, specimens preserved in eastern herbaria only have been reviewed. I have studied all in the herbaria of The New York Botanical Garden, the Brooklyn Botanic Garden, The Academy of Natural Sciences of Philadelphia, the University of Pennsylvania, the United States National Museum, (including the former Biltmore Herbarium), and the Charleston Museum. In all institutions I have received the kindest attention and assistance.

The present revision follows a plan which should lead to a simple and helpful presentation of our taxonomic knowledge of this family within the area considered. Keys are given throughout, and these are made so ample as to include all features of evident contrast noted. Effort is made to group species and genera according to real relationship, hence giving the keys a phylogenetic value. To accomplish this, and to show what appears to have been the evolutionary progress within this family, a rearrangement of the whole has been made. This was first attempted in my "Scrophulariaceæ of the Local Flora,"[1] but the placing of the Gratioleæ as introductory to the genuine Scrophulariaceæ now appears to me more satisfactory. While of theoretic suggestiveness, it is hoped that these keys may prove of practical service.

Synonomy is given, so far as to explain the origin and application of each specific and varietal name used, and to account for every such name ever proposed from within this area. The original statement as to the type or to typic distribution is quoted, and consequent discussion is given. Practically all typic or isotypic[2] material known to occur in this country has been verified, and in *Agalinis* and allies much of that abroad. Especially rich in types are the herbaria of The Academy of Natural Sciences of Philadelphia, where Nuttall's and de Schweinitz's plants are preserved, and of the Charleston Museum, containing Elliott's collection.

The statements of distribution, variability, season of flowering and of fruiting, corolla-color, and other comment scarcely need explanation. For *Agalinis* and allies, which I have collected repeatedly and over a wide range, my forthcoming monograph will give a more detailed analysis of the range of each species. At present for all species I am stating range in general terms, and shall trust to receive corrections from workers who find this treatment partial or erroneous. The detailed noting of corolla-color will be of interest to students in the field. In every case, unless otherwise stated,

[1] Torreya 19: 109-114. 1919.

[2] The word "isotype" is used to designate a specimen of the original collection, other than the type itself. See Torreya 19: 13. 1919.

this has been recorded from notes made with fresh flowers before me.

A last insertion may require more justification. This is of the collection-numbers of the specimens made by me, grouping these by states. While not attempting to list collections, because of space-limitation, it does seem advisable to present this series, showing specimens considered authentic. For *Agalinis* and allies my forthcoming monograph will state fully the herbaria in which each may be consulted; for these and for the other genera, the numbers between 4,000 and 6,000 may be seen in the herbarium of the University of Pennsylvania at Philadelphia and numbers between 9,000 and 10,000 in that of the New York Botanical Garden. Duplicates are in many collections.

Corolla with the posterior lobes external in the bud.
(ANTIRRHINOIDEÆ.)

- Tree. Leaves cordate, 15–20 cm. long. Inflorescence a panicle. Sepals leathery, clothed with stellate hairs. Corolla 50–60 mm. long. Capsule 40 mm. long, with broadly winged overlapping seeds. I. PAULOWNIEÆ.
- Herbs. Leaves smaller. Sepals membranous (with stellate hairs only in *Verbascum*.) Corolla smaller. Capsule smaller, and seeds not overlapping.
  - Capsule septicidal or loculicidal by a simple median slit, the septum rupturing or deciduous. Corolla not spurred.
    - Corolla not saccate anteriorly, not horned.
      - Stigma two-lipped. Leaves usually more or less glandular-punctate. Pedicels frequently bibracteolate. II. GRATIOLEÆ.
      - Stigma capitate. Leaves not glandular-punctate. Pedicels not bracted (or with a varying number of bractlets in *Chelone*).
        - Filaments five. Capsule without placental hairs. Leaves opposite, ternate or alternate, with blades much wider than the stem.
          - Corolla rotate, slightly zygomorphic, its lobes much longer than the tube. Filaments all with fertile anthers. Leaves alternate. III. VERBASCEÆ.
          - Corolla tubular-campanulate, zygomorphic, its lobes shorter than the tube. Posterior filament without anther, the others didynamous. Leaves opposite or ternate. IV. CHELONEÆ.
        - Filaments four. Capsule filled with tortuous hairs, between which are the scattered seeds. Leaves in fours, sixes or eights, with rudimentary blade which is narrower than the stem. V. RUSSELIEÆ.

Corolla saccate anteriorly, and with a fine horn at the base of the anterior lobes. Leaves opposite.

VI. ANGELONIEÆ.

Capsule loculicidal, the septum and adjacent capsule-wall persisting, the remaining wall splitting irregularly. Corolla with a spur at the base of the anterior petal. Leaves alternate. VII. ANTIRRHINEÆ.

Corolla with the anterior lobes external in the bud. Herbs.

(RHINANTHOIDEÆ.)

Stamens two, the postero-laterals present, the antero-laterals completely lost. Antero-lateral lobes of corolla external in bud. Not parasitic. Sepals four, the posterior lost. Posterior lobes of corolla completely united.

VIII. VERONICEÆ.

Stamens four, didynamous, the antero-laterals usually slightly the longer. Usually, perhaps always, parasitic on the roots of other plants.

Sepals five, alike, more or less united. Corolla-lobes all somewhat distinct, the two posterior spreading or broadly arched; anterior lobe external in the bud.

IX. BUCHNEREÆ.

Posterior sepal shorter or wanting. Corolla decidedly two-lipped, the posterior lobes united and arched nearly to apex, the anterior lobes usually shorter; anterior or one antero-lateral lobe external in the bud.

X. RHINANTHEÆ.

I. PAULOWNIEÆ 1. *Paulownia.*

II. GRATIOLEÆ.

Leaves alternate. Stamens five. Corolla essentially regular. Pedicel not bibracteolate. 2. *Capraria.*

Leaves opposite. Stamens four or two (the posterior stamen lost). Corolla more or less zygomorphic.

Leaves entire to serrate. Seeds brown or yellow.

Seeds reticulate. Corolla with the ridges to the antero-lateral sinuses low and not projecting beyond those points (so anterior filaments simple). Posterior lobes of the corolla little, if at all, shorter than the anterior.

Leaves uniform. Capsule longer than wide, acute or obtuse, its dehiscence septicidal, or septicidal plus loculicidal.

Sepals all alike. Pedicels never bibracteolate. Stamens four. First splitting of capsule loculicidal.

Corolla white, rotate, 3–5 mm. long, densely hirsute within over bases of all lobes; lobes longer than tube, the two posterior united throughout. Sepals four, distinct. Lips of stigma united, but line of union stigmatic. Placentæ fused with septum. Upper leaves alternate.

3. *Scoparia.*

Corolla lavender, personate, 20–35 mm. long, pubescent within below bases of the anterior lobes; lobes shorter than tube, the two posterior united about three-fourths length. Sepals five, united over one-half length. Lips of stigma distinct. Placentæ wide, peltate in cross-section, attached by a narrow line to the septum. Leaves all opposite. 4. *Mimulus.*

Sepals unequal, all distinct. Pedicels frequently bibracteolate. First splitting of capsule septicidal.

Pedicels bibracteolate at base. Stamens four. Corolla pubescent within at base of posterior lobes. 5. *Mecardonia.*

Pedicels bibracteolate at apex or not at all.

Erect. Outer sepal not more than twice the width of the innermost. Corolla 8–20 mm. long, with tube much longer than the lobes. Pedicels bibracteolate. Postero-lateral stamens fertile, the antero-laterals rudimentary or wanting.

Corolla-tube broad, within densely pubescent on the posterior side. Sepals of nearly uniform length. Plants relatively lax or succulent, the leaves and sepals plane. 6. *Gratiola.*

Corolla-tube very narrow, within uniformly short-pubescent on all sides. Sepals very unequal in length. Plant stiff, the leaves and sepals revolute. 7. *Sophronanthe.*

Extensively repent. Outer sepal over twice the width of the innermost. Corolla 3–11 mm. long, with tube little longer than the lobes.

Stamens four. Corolla 7–11 mm. long. Outer sepal not deeply cordate nor conspicuously reticulate.

Corolla glabrous within, the throat yellow, the lobes white; posterior lobes distinct. No hypogynous bristles. Outer sepal oval or ovate, scarcely exceeding the oblong or lanceolate innermost. Capsule over one-half as broad as long. Leaves widening distally, very entire. Pedicels reflexed in fruit. Plants inodorous.

Stem pubescent. Leaves spatulate-oval to nearly orbicular, with seven to nine longitudinal nerves. Pedicel not bibracteolate. Sepals obtuse, scarcely longer than the rounded capsule. Styles distinct at apex. 8. *Ranapalus.*

Stem glabrous. Leaves spatulate-oblong, with one evident longitudinal nerve. Pedicel bibracteolate. Sepals acute or acutish, much exceeding the acute capsule. Styles united to apex, and stigmas short, semi-capitate. 9. *Bramia.*

Corolla pubescent within over bases of all lobes, blue throughout; posterior lobes united to apex. A circle of bristles surrounding the base of the ovary. Outer sepal slightly cordate, evidently exceeding the linear-attenuate innermost. Capsule less than one-half as broad as long. Leaves clasping, broadest proximally, crenate. Pedicels bibracteolate, spreading in fruit. Stem pubescent. Plant lemon-scented. 10. *Hydrotrida.*

Stamens two, the antero-laterals lost. Corolla 3 mm. long, white. Outer sepal deeply cordate and conspicuously reticulate. Stem finely pubescent. Pedicels not bibracteolate. 11. *Herpestis.*

Leaves dimorphic; several lanceolate ones borne on the abbreviated basal portion of the stems, and a pair of oval ones at the apex of the slender distal portion. Capsule wider than long, deeply notched, with rounded flattened lobes, only dehiscing loculicidally. 12. *Amphianthus.*

Seeds with fine transverse lines. Corolla with two raised ridges (each formed by the adherence of the filament) to the antero-lateral sinuses, and which project as knob-like processes beyong this point (the free portion of the filament appearing as a lateral outgrowth of the adherent portion). Posterior lobes of the corolla less than two-thirds the length of the anterior.

Corolla violet-blue, 6–11 mm. long, the posterior lobes $\frac{1}{3}$–$\frac{2}{3}$ length of the anterior. Postero-lateral stamens perfect, antero-lateral filaments without anthers. Style with an enlarged callose base. Sepals five, united at base. Capsule two-celled, oval in outline, 2–5 mm. long. Ascending or repent. 13. *Ilysanthes.*

Corolla pale-lavender or white, 1.5–2 mm. long. Postero-lateral stamens lost, antero-lateral filaments with anthers. Style filamentous to base. Sepals four, the posterior lost. Capsule one-celled at maturity (by loss of septum and shortening of the placentæ), globose, 1 mm. long. Repent.

Sepals united only at base. Corolla with posterior lobes evident, united one-half length of anterior. Styles distinct less than one-fourth length. Leaves orbicular. 14. *Globifera.*

Sepals united $\frac{1}{2}$–$\frac{2}{3}$ length, split nearly to base on the anterior side. Corolla with the posterior lobes lost, the tube split nearly to base on posterior side. Styles distinct $\frac{1}{3}$–$\frac{1}{2}$ length. Leaves elliptic-obovate. 15. *Hemianthus.*

Leaves bipinnatifid. Seeds pale greenish-yellow, ridged, with faint transverse lines. Pedicel not bibracteolate. Corolla lavender. Erect. 16. *Leucospora.*

III. VERBASCEÆ 17. *Verbascum.*

IV. CHELONEÆ.

Seeds angled or winged, maturing many to each cell. Corolla-lobes uniformly colored, shorter than the tube which is not conspicuously pouched at base posteriorly. Posterior filament a conspicuous process. Sepals nearly or quite distinct. Plants stiff, 4–20 dm. tall.

Corolla white or pink-red, pubescent or glabrous within, its anterior lobes projecting. Sepals distinct. Sterile filament slender, filiform, white.

Corolla membranous, somewhat pubescent or glabrous within over base of anterior lobes. Sterile filament as long as the others, pubescent on its posterior face. Anther-sacs distinct, glabrous or barbate with short hairs. Sepals lanceolate to ovate, acute to acuminate. Seeds wingless. Inflorescence compound, a raceme of cymosely branching lax flower-clusters. 18. *Penstemon.*

Corolla semi-fleshy, densely pubescent within over base of anterior lobes. Sterile filament much shorter than the others, glabrous. Anther-sacs becoming confluent, densely lanate. Sepals ovate-orbicular, rounded. Seeds winged. Inflorescence simple, a spike-like raceme of single flowers on short several-bracted pedicels. 19. *Chelone.*

Corolla red-brown, glabrous within, its antero-lateral lobes vertically projecting, the anterior lobe deflexed. Sepals obviously united at base. Sterile filament shorter than wide, two-lobed, red-brown. Inflorescence compound. 20. *Scrophularia.*

Seeds rounded, smooth, maturing one to each cell. Anterior corolla-lobes blue, posterior white, all longer than the tube which is strongly pouched at base posteriorly. Posterior filament a crescentic scarcely raised process. Sepals united over one-third length, enclosing over half the capsule. Plant lax, 1–3 dm. tall. 21. *Collinsia.*

V. RUSSELIEÆ. 22. *Russelia.*

VI. ANGELONIEÆ. 23. *Angelonia.*

VII. ANTIRRHINEÆ.

Plants glabrous. Flowering stems erect. Leaves linear, only the uppermost small ones with axillary flowers. Pedicels not over 10 mm. long. 24. *Linaria.*

Plants hirsute. Flowering stems prostrate. Leaves ovate to orbicular, nearly all with axillary flowers. Pedicels over 10 mm. long. 25. *Kickxia.*

VIII. VERONICEÆ.

Leaves whorled. Corolla white, its lobes shorter than the tube. Capsule acute, longer than broad, not flattened. Plant 10–20 dm. tall. 26. *Veronicastrum.*

Leaves opposite or alternate. Corolla blue or white, its lobes longer than the tube. Capsule acute to deeply notched, broader than long, flattened. Plants lower. 27. *Veronica.*

IX. BUCHNEREÆ.

Corolla not blue, with open orifice. Stamens all with anthers two-celled, lanate. Filaments and style nearly as long as or longer than the tube of the corolla. Capsule exserted from the calyx-tube. Pedicels not bracted.

Corolla tubular, orange, with thickened base, fleshy, semi-persistent, shriveling and blackening before falling. Filaments equal, long-exserted, pubescent with beaded hairs. Anther-sacs closely parallel, 6–7 mm. long. Pedicels deflexed in fruit. 28. *Macranthera.*

Corolla with inflated throat and spreading lobes, yellow or pink, membranous, soon falling. Filaments not long-exserted, pubescence not beaded. Anther-sacs less than 5 mm. long. Pedicels erect or permanently spreading.

Anther-sacs glabrous or with a few bristle-like hairs at apex. Stigma short, punctiform or capitate. Filaments dilated-flattened and pubescent. Corolla yellow.

Corolla densely pubescent within on all sides, its lobes all distinct and slightly shorter than the tube. Filaments clearly didynamous, dilated and pubescent throughout. Anther-sacs each opening by a slit its entire length. Style short, thick, more or less bilobed, persistent and reflexed on the capsule. Pedicels 1–2 mm. long. Plant stout, 15–20 dm. tall, the leaves 10–30 cm. long. 29. *Dasistoma.*

Corolla slightly pubescent within (in a ring about the base of the filaments and below posterior sinus), its lobes longer than the tube, the two posterior united nearly one-half their length. Filaments nearly equal, dilated and pubescent at base. Anther-sacs each opening by a slit one-sixth to one-fourth its length. Style long, slender, entire, deciduous,

straight. Pedicels 4–10 mm. long. Plants slender, 2–10 dm. tall, the leaves 1–3 cm. long.
30. *Afzelia.*

Anther-sacs lanate on the valvular surface. Stigma linear, consisting of a line down each side of the linguiform style-apex. Filaments slender, not dilated, more or less lanate.

Corolla yellow. Capsule acute to acuminate. Leaves lanceolate to ovate, entire to bipinnatifid, petioled. Stem stout, over 4 dm. tall. 31. *Aureolaria.*

Corolla pink, with red spots within on the anterior side. Capsule rounded, with a mucro. Leaves filiform to lanceolate, entire or auriculate-lobed at base, sessile. Stem usually slender.

Stem ascending-scabrous to glabrous. Leaves linear to filiform, entire. Pedicels over 1 mm. long. Calyx-lobes linear to subulate, slightly longer to much shorter than the tube. Anther-sacs of both pairs of stamens uniform. Capsule globose to globose-ovoid, 3–7 mm. long. Seeds closely reticulate. 32. *Agalinis.*

Stem retrorse-hispid. Leaves lanceolate, usually auriculate-lobed at base. Pedicels less than 1 mm. long. Calyx-lobes ovate, longer than the tube. Anther-sacs of posterior stamens shorter. Capsule broadly ovate in outline, 10–13 mm. long. Seeds reticulate with raised ridges.
33. *Otophylla.*

Corolla purple-blue or white, salverform, the tube very narrow and densely pilose within, the lobes widely spreading. Stamens each with but one anther-sac developed. Filaments and style less than one-half length of corolla-tube. Capsule mostly or quite enclosed within calyx-tube. Pedicels bibracteolate. 34. *Buchnera.*

X. RHINANTHEÆ.

Posterior sepal shorter than the others. Pedicels bibracteolate at apex. Capsule turgid, septicidal, only tardily slightly loculicidally dehiscent. Seeds linear, flat, 2 mm. long.
35. *Schwalbea.*

Posterior sepal wanting. Pedicels not bracted. Capsule flattened, loculicidal, splitting through septum. Seeds turgid.

Corolla with posterior lobes projecting, not hooded at apex, the anterior lobes very short, thickened, deep-green. Capsule cylindric, equally two-celled, in dehiscence splitting on both posterior and anterior sides. Seeds many, reticulate. Bracts foliaceous, distally scarlet.
36. *Castilleja.*

Corolla with posterior lobes arched, hooded at apex, the anterior lobes membranous, flat, colored. Capsule ensiform, unequally two-celled, splitting only on the posterior side. Seeds few, not reticulate. Bracts not colored.

Corolla yellow or pink throughout, the anterior lip not raised into a palate. Anthers glabrous. Seeds maturing more than four to a capsule. Sepals of each side united nearly or quite to apex. Leaves bipinnatifid-lobed. 37. *Pedicularis.*

Corolla white, the anterior lip raised into a yellow densely pubescent palate. Anthers pubescent. Seeds maturing two to four to a capsule. Sepals united at base only, the two postero-laterals longer. Leaves lanceolate, entire or setaceous-toothed near base. 38. *Melampyrum.*

1. **PAULOWNIA** Siebold and Zuccarini.

Paulownia Sieb. and Zucc., Fl. Jap. 1: 25. pl. 10. 1835. Type species, *P. imperialis* S. & Z., of Japan.

1. **Paulownia tomentosa** (Thunb.) Baill.

Of Japan. Is occasionally found, along roads, railways, etc. A frequently cultivated tree.

2. **CAPRARIA** Linné.

Capraria L., Sp. Pl. 628. 1753.

Type species, *C. biflora* L.

1. **Capraria biflora** L.

Capraria biflora L., l. c. 628. 1753. "Habitat in Curassao." Specimens from Curaçao seen in Herb. New York Botanical Garden.

Sandy soil, mostly along the beach, somewhat in waste ground and on edges of hammocks inland, subtropical Florida. A widespread species of lowland Tropical America. Very variable; varies with us mainly in size and proportions of leaf, and in the length of the hairs on the stem and pedicels, such hairs in the plant considered to be typical are entirely wanting. The pubescent state may be called forma *hirta* Loes., in Bull. Herb. Boiss., ser. II, 3: 284. 1903. ("Habitat in Guatemala, in dept. Chiquimula in ruderalibus ad S. Juan Ermita—Sel[er] n. 3314." Isotype seen in herbarium New York Botanical Garden.)

Flowering and fruiting probably throughout the year, although all specimens seen were collected between November and June. Corolla white or violet-tinged and slightly spotted with violet within throat. Normally the five stamens are fertile, but any, and as many as four, may become rudimentary. Examination of fresh flowers shows that both in *Capraria* and *Scoparia* the posterior lobes of the corolla are external in the bud, thus confirming the impression gained from distribution and the nature of the glands in the leaves of the latter, that these genera belong to the *Gratioleae*.

Pennell (Florida)—9559, 9598, 9610, 9633.

3. SCOPARIA Linné.

Scoparia L., Sp. Pl. 116. 1753.

Type species, *S. dulcis* L.

1. Scoparia dulcis L.

Scoparia dulcis L., l. c. 116. 1753. "Habitat in Jamaica, Curassao . . . Hort. Cliff. 320." ex L., Hort. Cliff. 320. 1737. "Crescit in Curassao & Jamaica." No specimens from Curaçao seen, but the plant here considered unquestionably occurs there.

Gratiola micrantha Nutt., Amer. Jour. Sci. 5: 287. 1822. "Collected in East Florida, during October and November, 1821, by A. Ware, Esq." Type, collected by Nathaniel A. Ware, seen in Herb. Academy of Natural Sciences of Philadelphia.

Scoparia grandiflora Nash, Bull. Torr. Bot. Club 23: 105. 1896. "Collected in the flatwoods at Tampa [Florida], where it was quite frequent. [G. V. Nash] No. 2417." Type seen in Herb. Columbia University at the New York Botanical Garden. I have collected this at Tampa, my number 9643. *Scoparia dulcis* varies considerably in size of corolla, but no other character correlates with this, nor do larger-flowered plants occur in an environment distinct ecologically or geographically. Wide gradation in corolla-size may be found within one colony.

Waste places, cultivated ground, especially in sandy soil, southern Georgia to southeastern Texas and southward; wholly within the Coastal Plain. A wide-spread weed of lowland Tropical America.

Flowering and fruiting in subtropical Florida throughout the year, northward flowering in summer (from about May to September), and soon ripening fruit. Corolla white, at times the lobes slightly pinkish.

Pennell (Florida)—9643, 9656, 9678, 9702. (Louisiana)—4254.

4. MIMULUS Linné.

Mimulus L., Sp. Pl. 634. 1753.

Type species, *M. ringens* L.

Leaf-blades ovate, petioled. Angles of stem slightly winged. Pedicels stout, in fruit 5–10 mm. long. Calyx-lobes setaceous-tipped, 1–2 mm. long. Corolla 35 mm. long. Seeds pale-yellow. 1. *M. alatus*.

Leaf-blades lanceolate, not petioled. Angles of stem not winged. Pedicels slender, in fruit 30–60 mm. long. Calyx-lobes lanceolate, 3–5 mm. long. Corolla 20–30 mm. long. Seeds brownish yellow.

Cauline leaves with the blades narrowed at the base, not clasping. Corolla 20–25 mm. long. 2. *M. minthodes*.

Cauline leaves with the blades broader and clasping at the base. Corolla 25–30 mm. long. 3. *M. ringens*.

1. Mimulus alatus Ait.

Mimulus alatus Ait., Hort. Kew. 2: 361. 1789. "Nat. of North America. Introd. 1783, by Mr. William Malcolm."

Wet woods and shaded river-bottoms, loam soil, throughout the area above the Fall line, but not extending into the higher Appalachians; and along river-bottoms in the Coastal Plain. Ranges from Connecticut to Ontario and Kansas, south to northern Florida (along the Apalachicola River), Mississippi and Oklahoma.

Flowering from late July to late August, probably ripening fruit in September and October. Corolla lavender pink, within throat essentially as in *M. ringens* but the spots are smaller and the coloring fainter.

2. Mimulus minthodes Greene.

Mimulus minthodes Greene. Leaflets Bot. Obs. & Crit. 2: 1. 1909. "The type specimens are in U. S. Herb. and were collected at Birmingham, Ala., Aug., 1888." Type seen in United States National Herbarium.

Meadows, northern Georgia and northern Alabama; Piedmont region.

Not seen growing. Possibly not distinct from *M. ringens.*

3. Mimulus ringens L.

Mimulus ringens L., Sp. Pl. 634. 1753. "Habitat in Virginia, Canada . . . . Hort. ups. 176. t. 2." In the Hortus Upsalensis 176, pl. 1, 1748, Linné described and figured our plant.

Swales and along streams in woodland, in loam, through the area above the fall line, reaching at least to 4400 feet altitude in the southern Appalachians, mostly more common northward; apparently not descending into the Coastal Plain. Ranges from Nova Scotia to Minnesota, south to upper South Carolina, northern Florida[3] and Kansas.

Flowering from mid July to late August, fruiting in September and October. Corolla lavender, paler externally, within on anterior side two ridges which distally bear purple-red spots and proximally two yellow areas mottled with faint brownish patches.

5. MECARDONIA Ruiz and Pavon.

Mecardonia R. and P., Syst. Veg. Fl. Per. et Chil. 164. 1798.

Type species, *M. ovata* Ruiz & Pavon, of Peru.

Corolla white, its posterior lobes united $\frac{1}{2}$–$\frac{2}{3}$ their length. Outer sepals lanceolate, rarely more than twice width of inner. Leaf-blades prevailingly lanceolate, conspicuously cuneate at base. Erect or somewhat diffuse.

[3] Reported from Quincy, Florida, by A. W. Chapman in West. Jour. Med. & Surg. 3: 473. 1845.

Leaf-blades mostly oblanceolate, long-cuneate at base. Pedicels mostly over 15 mm. long. Corolla-lobes less widely spreading.

Main stem-leaves 3–4.5 cm. long. Outer sepals 6–8 mm. long. Corolla about 10 mm. long. Plant branched above, usually 3–4 dm. tall, erect or nearly so.
1. *M. acuminata.*

Main stem-leaves 1.3–2 cm. long. Outer sepals 5 6 mm. long. Corolla 7–8 mm. long. Plant much branched from the base, 1–2 dm. tall, diffusely spreading and ascending.
1a. *M. acuminata peninsularis.*

Leaf-blades ovate, more shortly cuneate at base, 1–1.7 cm. long. Pedicels mostly 8–12 mm. long. Corolla 7–8 mm. long, its lobes relatively widely spreading. Plant apparently laxly ascending. 1b. *M. acuminata brevifolia.*

Corolla yellow, its posterior lobes united nearly to apex. Outer sepals ovate, more than four times width of inner. Leaf-blades often ovate, more shortly cuneate at base. Procumbent or ascending.

Corolla lemon-yellow, 6 mm. long, glandular-puberulent within. Outer sepals broadly ovate. Pedicels 1–2 times the length of the ovate bracts. 2. *M. procumbens.*

Corolla deep lemon-yellow, 7–8 mm. long, short-pubescent within. Outer sepals ovate. Pedicels several times the length of the lanceolate-ovate bracts. 3. *M. tenuis.*

1. **Mecardonia acuminata** (Walt.) Small.

Gratiola acuminata Walt., Fl. Carol. 61. 1788. Type not verified, but description evidently of plant here considered. Doubtless from lower South Carolina where this plant is common.

Gerardia cuneifolia Pursh, Fl. Amer. Sept. 422. 1814. "In Georgia. Bartram. v. s. in Herb. Banks." Type not verified. Description appears to be of our plant, but the statement is made that the leaves are alternate above while in *acuminata* they are opposite throughout.

Matourea nigrescens Benth., Comp. Bot. Mag. 1: 173. 1836. "(*Gratiola acuminata* Ell., non Pursh.)" ex Ell., Sketch Bot. S. C. & Ga. 1: 15. 1816. "Grows in ditches and wet places, extensively diffused." Elliott interpreted correctly the species of Walter, but Pursh had confused with this *Gratiola virginiana* L.

Mecardonia acuminata (Walt.) Small, Fl. S. E. Un. St. 1065, 1337. 1903.

Moist sandy loam, or heavier loam soil, usually near streams, in pineland or deciduous woodland, frequent or common in most portions of the Coastal Plain (although absent from such an area as the Altamaha Grit of southern Georgia), extending to Cape Canaveral in southern Florida although through the Everglade Keys mostly replaced by var. *peninsularis;* and also reaching the mountain valleys of western North Carolina and northern Georgia. Ranges from Maryland to Florida and eastern Texas, extending inland to western Kentucky, southern Missouri and eastern Oklahoma.

Flowering from May to September, and soon ripening fruit. Corolla white, within with longitudinal pink veins on the posterior side.

Pennell (Georgia)—4088. (Florida)—9658. (Louisiana)—4283.

1a. Mecardonia acuminata peninsularis Pennell, var. nov.

Plants much branched from the base, diffusely spreading and ascending. Main stem-leaves oblanceolate, long-cuneate at base, 1.3–2 cm. long. Outer sepals 5–6 mm. long. Corolla 7–8 mm. long.

Type, in hammocks and pine-lands, Black Point, below Cutler, Florida, collected in fruit and late flower, November 13, 1903, J. K. Small & J. J. Carter 824, in Herb. New York Botanical Garden; isotype in Herb. Academy of Natural Sciences of Philadelphia.

Moist places, pine-land, hammocks and everglades, southern Florida.

Pennell (Florida)—9542.

1b. Mecardonia acuminata brevifolia Pennell, var. nov.

Plants apparently laxly ascending, slightly branched, 1–4 dm. tall. Main stem-leaves ovate, cuneate at base, 1–1.7 cm. long. Outer sepals 5–6 mm. long. Corolla 7–8 mm. long.

Type, Gulfport, Mississippi, collected in flower September 8, 1900, F. E. Lloyd & S. M. Tracy 94; in Herb. New York Botanical Garden.

Moist places in longleaf pine-land, southern Georgia and northern Florida to southern Texas.

2. Mecardonia procumbens (Mill.) Small.

Erinus procumbens Mill., Gard. Dict. ed. VIII. n. 6. 1768. " . . . Houst. MSS." Type not known to exist, but description appears to be of the plant here considered. Houston collected in tropical America.

Mecardonia procumbens (Mill.) Small, Fl. S. E. Un. St. 1065, 1338. 1903.

Moist soil, loam or sand, meadows and edges of hammocks, subtropical Florida.[4] A wide-spread weed of lowland Tropical America, perhaps introduced into our flora.

Flowering and fruiting probably throughout the year. Corolla externally greenish-yellow, within on the lobes lemon-yellow, and with more or less evident longitudinal dark veins on the posterior side.

Pennell (Florida)—9549.

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[4] Reported as "*Monniera chamaedryoides peduncularis*" by Mohr, Contrib. Nat. Herb. 6: 721. 1901, as occurring in Alabama from "Upper Division Coast Pine belt to Coast Plain." Surely confused with a form of *Mecardonia acuminata*.

3. Mecardonia tenuis Small.

Mecardonia tenuis Small, Fl. S. E. Un. St. 1065, 1338. 1903. "Type, Key West, Fla., Blodgett, in Herb. C. U." Type seen in Herb. Columbia University at the New York Botanical Garden.

Light loam over limestone, hammock and thickets, Key West, Florida Keys, Subtropical Florida. Endemic, but so close to *M. procumbens* and to *M. peduncularis* (Benth.) Small of Texas that the actual relationship of these species should be more fully investigated in the field.

Pennell (Florida)—9555, 9599.

6. GRATIOLA Linné.

Gratiola L., Sp. Pl. 17. 1753.

Type species, *G. officinalis* L., of Europe.

Corolla slightly exceeding calyx, externally glabrous. Capsule nearly pyramidal, acuminate. Pedicels very short.
  Plant pubescent with several-celled hairs. Leaves 1–2 cm. long; bracts usually much exceeding the flowers. 1. *G. pilosa.*
  Plant glabrous. Leaves .8–1.2 cm. long; bracts not exceeding the flowers. 1a. *G. pilosa epilis.*
Corolla more than twice as long as the calyx, externally more or less puberulent. Capsule broader, acute to rounded. Pedicels longer. Stem glabrous or puberulent with one-celled hairs, these frequently gland-bearing.
  Pedicels exceeding 10 mm. in length. Corolla within throat on posterior side densely pubescent with knobbed hairs. Capsule ovate in outline, 1–5 mm. long, equaled or exceeded by the sepals. Seeds .3–.5 mm. long, semi-globose to oblong.
    Capsule 1–3 mm. long, much exceeded by the sepals. Stem-leaves clasping by a broad base, usually at least the upper with resinous dots. Roots perennial, slender. Stoloniferous.
      Corolla golden-yellow throughout. Capsule 3 mm. long. Seeds brown. Leaves with blackish glandular dots. 2. *G. georgiana.*
      Corolla with throat dull-yellow, the lobes white. Capsule 1–2 mm. long. Seeds paler. Leaves with brown glandular dots, these usually more sparsely distributed.
        Leaf-blades linear-lanceolate to lanceolate, usually with a few coarse serratures. Sepals linear to linear-subulate. Capsule 1–2 mm. long. 3. *G. ramosa.*
        Leaf-blades ovate, with many usually finer serratures. Sepals lanceolate to oblong-lanceolate. Capsule 2 mm. long. 4. *G. viscidula.*
    Capsule 4–5 mm. long, about equaled by the sepals. Stem-leaves narrowed to a sessile or slightly clasping base, not

resinous-dotted. Roots apparently annual, the main root thick, and giving off numerous fibers. Not stoloniferous.

Corolla of earlier flowers 8–12 mm. long, not lined within, pubescent below anterior lobes with unknobbed hairs. Leaves prevailingly lanceolate. 5. *G. neglecta.*

Corolla of earlier flowers 15–20 mm. long, purple-lined within, pubescent below anterior lobes with knobbed hairs. Leaves prevailingly ovate. Pedicels more slender and usually longer. 6. *G. floridana.*

Pedicels less than 10 mm. long. Corolla within throat on posterior side pubescent with unknobbed hairs. Capsule globose, 5–6 mm. long, slightly exceeding the sepals. Seeds .7 mm. long, linear. Leaves and root as in *neglecta.* 7. *G. virginiana.*

1. Gratiola pilosa Michx.

Gratiola pilosa Michx., Fl. Bor. Amer. 1: 7. 1803. "Hab. in Carolinae inferioris uliginosis [A. Michaux]." Description sufficiently distinctive.

Moist or rather dry sandy pineland, common nearly throughout the Coastal Plain, south to central Florida; occasional inland, reaching the mountain-valleys of North Carolina and northern Alabama. Ranges from New Jersey to Florida, central Arkansas and eastern Texas.

Flowering from late May to September, and soon ripening fruit. Corolla white, throat distally with faint bluish-purple lines on all petals.

Pennell (Georgia)—10172. (Florida)—9671, 9682, 9709. (Alabama)—9721.

1a. Gratiola pilosa epilis Pennell, var. nov.

Plant throughout glabrous, or the sepals rarely with a few hairs. Leaves shorter, less evidently serrate. Corolla 7–9 mm. long. Calyx-lobes 4.5 mm. long, scarcely exceeding the capsule. Capsule browner than in the species.

Type, Myers, Lee Co., Florida, collected in flower and fruit July-August, 1900, A. S. Hitchcock 258, in United States National Herbarium; isotype in Herb. New York Botanical Garden.

Around ponds, southern Florida. Only the above specimens seen.

2. Gratiola georgiana Pennell, sp. nov.

Stem fleshy, glabrous, repent, ascending, 2–4 dm. long. Leaf-blades lanceolate to lanceolate-ovate, 1.5–2.5 cm. long, serrate to nearly entire, acute or acutish. Pedicels 7–15 mm. long. Calyx-lobes linear or nearly so, 4–8 mm. long. Corolla 8–12 mm. long, bright yellow. Capsule not seen.

Type, Augusta, Georgia, collected in flower by Dr. William Baldwin; in Herb. Academy of Natural Sciences of Philadelphia.

Wet pine-barrens, North Carolina[5] to Florida and Alabama; also in southern Delaware. Not seen growing.

This has been confused with the northern *Gratiola aurea* Pursh, of which perhaps it should be counted a southern variety. They may be separated as follows:

Plant erect or repent-ascending, 1–3 dm. long. Leaf-blades linear to lanceolate, frequently denticulate distally. Pedicels 10–25 mm. long, usually equaling or exceeding the bracts. *G. aurea.*

Plant repent and ascending, 2–4 dm. long. Leaf-blades lanceolate to lanceolate-ovate, usually more uniformly serrate. Pedicels 7–15 mm. long, shorter than the bracts. *G. georgiana.*

Beside the collection of Baldwin, Rugel 99 (U, Y) from an unstated locality on Florida, and also collected very many years ago, is this species. The plant is also well described by Elliott, "Sketch Bot. S. C. & Ga.," 1: 13. 1816. It should be re-collected.

3. Gratiola ramosa Walt.

Gratiola ramosa Walt., Fl. Carol. 61. 1788. Type not verified, but descriptive of this plant common in lower South Carolina.

Gratiola quadridentata Michx., Fl. Bor. Amer. 1: 6. 1803. "Hab. in Carolina inferiore [A. Michaux]." Type not verified, but description sufficiently distinctive.

Moist or wet sandy pineland, edge of ponds, common in the Coastal Plain, South Carolina to southern Florida, west to southern Mississippi. Varies with frequently broader leaves inland, and with shorter fleshier leaves in southern Florida. In the spring erect, but later in the season the stems become lax, long and much branched.

Flowering from March to September, and soon ripening fruit. Corolla with tube dull-yellow, the lobes dull-white, the tube with longitudinal brown lines.

Pennell (Georgia)—9523. (Florida)—9657, 9669.

4. Gratiola viscidula Pennell.

Gratiola viscosa Schwein., Le Conte, Ann. Lyc. N. Y. 1: 106. 1824. "Inhabits Virginia, and the upper parts of North Carolina." The plant now considered, although the description appears inaccurate in stating that the capsule is as long as the sepals. Type, from Salem, North Carolina, seen in Herb. Academy of Natural Sciences of Philadelphia. Not *G. viscosa* Hornem., Enum. Pl. Hort. Hafn. 19. 1807.

Gratiola viscidula Pennell, Torreya 19: 145. 1919. New name for *G. viscosa* Schwein.

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[5] Reported as "*Gratiola aurea* Muhl." in Hyam's "Flora of North Carolina," N. C. Coll. A. & M. Arts, Bull. 164: 327. 1891; and in Mohr, Contrib. Nat. Herb. 6: 720. 1901, as from the Coast Plain of southern Alabama.

Swales and along streams, above the fall-line, through the Piedmont, ascending to the valleys of the southern Appalachians. Delaware to northern Georgia and eastern Tennessee.

Flowering from late June to September, and soon ripening fruit. Not seen growing.

5. **Gratiola neglecta** Torr.

Gratiola neglecta Torr., Cat. Pl. N. Y. 89. 1819. "Within thirty miles of the City of New York." Type probably seen in herbarium of Columbia University at the New York Botanical Garden. For discussion see Torreya 19: 146. 1919.

Wet loam, usually in deciduous woodland, frequent through the Piedmont, both east and west of the Appalachians; apparently not in the Coastal Plain, nor ascending appreciably into the mountains. Ranges across the continent northward, south in the East to northern Georgia and northern Alabama.

Flowering from April to June, and soon ripening fruit. Corolla with tube greenish-yellow, the lobes white, at times pinkish-tinged.

Pennell (Georgia)—9509. (Alabama)—9760, 9769, 9784.

6. **Gratiola floridana** Nutt.

Gratiola floridana Nutt., Jour. Acad. Nat. Sci. Phila. 7: 103. 1834. "Hab. near Chipola, in West Florida [in Herb. Academy of Natural Sciences]." Type, labeled "*Gratiola* * *grandiflora*," collected in 1830, seen in Herb. Academy of Natural Sciences of Philadelphia.

Gratiola macrantha Chapm., Fl. S. Un. St. ed. III. 311. 1897. "Cool springs near Quincy, Middle Florida." Distinguished from *G. floridana* by having the staminodia present and relatively conspicuous. In this species, as in *G. neglecta*, the size of the rudiments of the antero-lateral stamens is quite variable.

Muddy banks and in wet woods, loam soil, in river-bottoms in the Coastal Plain, southern Georgia, southern Alabama and northern Florida; apparently occurring inland to the base of the mountains of northeastern Georgia and northeastern Alabama.

Flowering in April and May, fruiting in May and June. Corolla white, or pinkish on the lobes, yellow over base of the posterior lobes, and marked with longitudinal fine purple lines.

Pennell (Florida)—9704.

7. **Gratiola virginiana** L.

Gratiola virginiana L., Sp. Pl. 17. 1753. "Habitat in Virginia." For discussion of the type of this see S. F. Blake in Rhodora 20: 65. 1918.

Gratiola sphaerocarpa Ell., Sketch Bot. S. C. and Ga. 1: 14. 1816. "Grows in ponds 4 miles from Charleston [South Carolina], on the neck." Description distinctive, made from plants which flowered in the autumn. Type seen in the Elliott Herbarium at the Charleston Museum.

Gratiola megalocarpa Ell., l. c. 16. 1816. "Grows in ditches and pools from Pennsylvania to Carolina. Pursh." Ex Pursh, Fl. Amer. Sept. 12. 1814. "In ditches and pools: Pensylvania to Carolina . . . v. v." With a plant of his own, Pursh combined an account of Walter's *Gratiola acuminata;* his own plant would appear to have been the species now considered, although any extant type should be examined. Specimens from Salem, North Carolina, collected by Schweinitz and labeled "*megalocarpa*," seen in Herb. Academy of Natural Sciences of Philadelphia.

Gratiola caroliniensis Le Conte, Ann. Lyc. N. Y. 1: 105. 1824. "Inhabits in wet grounds from Carolina to Florida." Description sufficiently distinctive. Probable type, collected by Le Conte at "Shallowford," seen in Herb. Academy of Natural Sciences of Philadelphia.

Wet loam, in shade, usually along streams, common through the Piedmont, not ascending into the Appalachians; and through the Coastal Plain south to central Florida. Ranges from New Jersey to Florida and Texas, inland in the Mississippi Valley to Illinois and Missouri.

Flowering from March to May, fruiting May to June. Corolla white, within with longitudinal purple lines, more pronounced on posterior side.

Pennell (Georgia)—9506. (Florida)—9705, 9714. (Alabama)—9726.

7. SOPHRONANTHE Bentham.

Sophronanthe Bentham; Lindl., Nat. Syst. Bot., ed. II, 445. 1836.

Type species, *S. hispida* Benth.

1. Sophronanthe hispida Benth.

Sophronanthe hispida Benth., l. c. 445. 1836. "The plant was gathered by Drummond at Apalachicola." Isotype, Drummond 20, seen in Herb. Columbia University at the New York Botanical Garden.

Gratiola subulata Baldwin; Benth., in DC. Prod. 10: 405. 1846. "In Florida (. . . Baldwin! . . .)." Specimen collected by Baldwin, labeled "W. Florida, St. Marys river, south side," so probably an isotype, seen in Herb. Academy of Natural Sciences of Philadelphia.

Dry sandy pineland, Coastal Plain, southern Georgia to Louisiana, south through the Florida peninsula to Dade County.

Flowering from late April to September, and soon ripening fruit; in southern Florida flowering and fruiting throughout the year. Corolla with tube externally yellowish-white, on lobes and within white.

Pennell (Georgia)—9528. (Florida)—9660, 9676, 9689, 9700.

8. RANAPALUS Kellogg.

Ranapalus Kellogg, Proc. Calif. Acad. 7: 113. 1877.

Type species, *R. eisenii* Kell., of California.

1. Ranapalus rotundifolius (Michx.) Pennell, comb. nov.

Monniera rotundifolia Michx., Fl. Bor. Amer. 2: 22. 1803. "Hab. in regione Illinoensi [A. Michaux]." Type not verified, but description sufficiently distinctive.

Aquatic in shallow mud-bottomed open ponds, central and western Tennessee. Through the Mississippi Valley from Indiana and Tennessee to North Dakota, eastern Colorado and northern Texas.

Flowering from July to September, and soon ripening fruit. Corolla with throat yellow within, the lobes white.

9. **BRAMIA** Lamarck.

Bramia Lam., Encyc. Meth., Bot. 1: 459. 1785.

Type species, *B. indica* Lam., of India.

1. **Bramia monnieri** (L.) Pennell, comb. nov.

Lysimachia monnieri L., Cent. Pl. 2: 9. 1756. "Habitat in America meridionali. Hallman." D. Z. Hallman sent to Linné specimens from Spain, so it would appear that the type of this was probably transmitted through him from some source in Spanish America.

Monniera cuneifolia Michx., Fl. Bor. Amer. 2: 22. 1803. "Hab. in locis mari inundatis Carolinae inferioris [A. Michaux]." Description sufficiently distinctive. Type of the genus *Habershamia* Raf., Neogyn. 2. 1825.

Bramia monnieria (L.) Drake, Fl. Polyn. Franc. 142. 1892.

Sandy beaches, especially where subject to inundation, common within tidewater, both where brackish and where fresh, growing also in pools in the sand dunes, in the coastal pine-land, and inland up the river-courses as far as Lake Okeechobee; on and near the coast, North Carolina to Florida and Texas. A widespread maritime plant of both the New World and Old World Tropics. Variable in size of its vegetative parts, and even of its flowers, plants everyway smaller occurring especially in drier situations and around the pineland pools.

Flowering in southern Florida throughout the year, northward from April to November; soon ripening fruit. Corolla with tube yellowish within, elsewhere white, or frequently tinged with pink. Anthers dark-purple.

Pennell (Florida)—9534, 9537, 9665.

10. **HYDROTRIDA** Small.

Hydrotrida Small, Fl. Miami 165. 1913.

Type species, *Obolaria caroliniana* Walt.

1. **Hydrotrida caroliniana** (Walt.) Small.

Obolaria caroliniana Walt., Fl. Carol. 166. 1788. Type not verified, but description sufficiently distinctive. Doubtless from lower South Carolina, a district where the species now considered is frequent.

Monniera amplexicaulis Michx., Fl. Bor. Amer. 2: 22. 1803. "Hab. in fossis, stagnis Carolinae [A. Michaux]." Type not verified, but description sufficiently distinctive.

Monniera crenulata Small, Bull. Torr. Bot. Club 22: 46. 1895. "Found by Mr. A. H. Curtiss, growing in the bottom of ditches between Jacksonville and Trout Creek, Florida, on July 13, 1893." Type seen in Herb. Columbia University at the New York Botanical Garden. This represents but a robust, broad-leaved state of the species.

Hydrotrida caroliniana (Walt.) Small, Fl. Miami 165. 1913.

Aquatic in shallow water, sandy soil, edges of ponds and in small streams, in pineland in the Coastal Plain, North Carolina to Florida and Louisiana, south through the Florida peninsula to the Everglades.

Flowering from May to September, and soon ripening fruit; in southern Florida flowering and fruiting throughout the year. Corolla uniformly sky blue.

In the herbarium of Columbia University is a memorandum description of this by Boykin. He proposed it as a new genus, but his name "Beyrichia" was preoccupied, and unfortunately no name was substituted and his suggestion has lain unheeded.

Pennell (Florida)—9675, 9683.

11. **HERPESTIS** Gaertner, f.

Herpestis Gaertn. f., Fruct. et Sem. Pl. 3: 186. 1807.

Type species, *H. rotundifolia* Gaertn. f.

1. **Herpestis rotundifolia** Gaertn. f.

Herpestis rotundifolia Gaertn. f., l. c. 186. pl. 214. 1807. "E America septentrionali a Dno Bosc, ex collectione Desfontaines." Bosc collected in Carolina, and his plant, as shown from the parts described, is certainly the species now considered. While Gaertner was doubtless influenced in his selection of a name by Michaux' *Monniera rotundifolia*, 1803, Bosc's plant is stated to be only perhaps this. Moreover Michaux' name is not connected with the phrase "*Herpestis rotundifolia*," so that we must consider this combination as here originating for the plant of Bosc. This has been confused with *Gratiola repens* Sw., a species of *Ranapalus*.

In shallow water, muddy shores, within the Coastal Plain, Maryland to Florida. Also in the West Indies. Very few collections are known, and in our area only the following stations have been noted: Wilmington, North Carolina; Ogeechee, Georgia; Jacksonville and Eustis, Florida. While doubtless often overlooked, the plant is certainly of scattered and rare occurrence.

Flowering at least from July to September, and soon ripening fruit. Not seen growing.

12. **AMPHIANTHUS** Torrey.

Amphianthus Torr., Ann. Lyc. N. Y. 4: 82. 1837.

Type species, *A. pusillus* Torr.

1. **Amphianthus pusillus** Torr.

Amphianthus pusillus Torr., l. c. 82. 1837. "Hab.—In small excavations on flat rocks, where the soil is wet during the flowering season; Newton County, Georgia . . . Dr. M. C. Leavenworth!" Type seen in Herb. Columbia University at the New York Botanical Garden.

"Growing in water in very shallow depressions in granite rock," Stone Mountain and nearby granite hills of Dekalb and Newton counties, central Georgia.

Flowering in April, fruiting in May. Not seen growing.

Apparently this plant only flourishes during wet seasons. On April 25, 1917, I searched most carefully for it on the summit and slopes of Stone Mountain (Canby's record of May 15, 1869, specifies "the summit"), but found no trace whatever. The season had been dry and there were no pools.

A remarkable plant with a unique dimorphic habit. It should be carefully studied living in order to assist in discovering its real relationship. Certainly aberrant in *Gratioleæ*, it may possibly belong to the *Veroniceæ*, as is suggested by the fruit. This was long ago the thought of Dr. Leavenworth as shown by his notes preserved in the herbarium of Columbia University.

13. **ILYSANTHES** Rafinesque.

Ilysanthes Raf., Ann. Nat. 13. 1820.

Type species, *I. riparia* Raf., of the banks of the Ohio.

Stem erect or ascending. Leaf-blades more or less elongate, the lower ones narrowed at the base.
- Pedicels stout, shorter than the subtending bracts. Sepals usually as long as the capsule. 1. *I. dubia.*
- Pedicels filiform, longer than the subtending bracts. Sepals shorter than the capsule.
  - Upper leaves or bracts but slightly smaller than the lower. Pedicels erect or ascending (or in fruit rarely slightly reflexed). Leaves mainly cauline.
    - Stem-leaves partially clasping, all opposite, none of the leaves obviously punctate. Sepals decidedly shorter than the capsules. 2. *I. inaequalis.*
    - Stem-leaves sessile or narrowed at base, frequently in threes, the leaves all evidently glandular-punctate. Sepals scarcely shorter than the capsule. 3. *I. saxicola.*
  - Upper leaves or bracts reduced to scales. Pedicels conspicuously reflexed in fruit. Leaves mainly basal. 4. *I. refracta.*

Stem repent or prostrate throughout. Leaf-blades orbicular or ovate-orbicular, rounded at the base and closely sessile. 5. *I. grandiflora.*

1. Ilysanthes dubia (L.) Barnhart.

Gratiola dubia L., Sp. Pl. 17. 1753. "Habitat in Virginiae aquosis. . . . Gron. virg. 129." Type, Clayton 164, identified by Dr. B. L. Robinson in Rhodora 10: 67. 1908, as the species here considered.

Capraria gratioloides L., Syst. ed. X. 1117. 1759. Based upon *Gratiola dubia* L.

Gratiola tetragona Ell., Sketch Bot. S. C. and Ga. 1: 15. 1816. "Grows in ponds and ditches four miles from Charleston [South Carolina]." Type seen in the Elliott Herbarium at the Charleston Museum.

Lindernia attenuata Muhl.; Ell., l. c. 17. 1816. "Grows in wet places. Vall' Ombrosa, Ogechee, Georgia. Type seen in the Elliott Herbarium at the Charleston Museum. Isotype in Herb. Columbia University at the New York Botanical Garden.

Ilysanthes dubia (L.) Barnhart, Bull. Torr. Bot. Club 26: 376. 1899.

Swamps, and stream margins, especially in groves or woodland, loam soil, through the southern Appalachians and the Piedmont, both east and west of the mountains, apparently more frequent northward; in the Coastal Plain occasional or local, in heavier soils, along river-bottoms and along the coastal bays. Ranges from New Brunswick and Ontario south to northern Florida; also in the West Indies and South America. In the lower Piedmont and Coastal Plain forms transitional to *I. inaequalis* occur.

Flowering from May to September, and soon ripening fruit. Corolla pale lavender, deeper in color near margin of lobes, and within along the antero-lateral ridges with short yellow hairs.

Pennell (Florida)—9707. (Alabama)—9723.

2. Ilysanthes inaequalis (Walt.) Pennell.

Gratiola inaequalis Walt., Fl. Carol. 61. 1788. Type not verified, but is from lower South Carolina where the plant here considered is frequent. Walter's species was interpreted as this plant by Elliott, the most critical student of the Carolina flora.

Gratiola anagallidea Michx., Fl. Bor. Amer. 1: 6. 1803. "Hab. in humidis Carolinae [A. Michaux]." Type not verified.

Lindernia dilatata Muhl.; Ell., Sketch Bot. S. C. and Ga. 1: 16. 1816. "Grows in ditches, around ponds." Type seen in the Elliott Herbarium at the Charleston Museum. It is labeled "Vall Ombrosa," whereas that of *L. attenuata* bears no definite indication of locality. The first good characterization of this species.

Gratiola dilatata Muhl.; Spreng., Syst. 1: 39. 1825. "Carolin[a]." Surely based upon *Lindernia dilatata* Muhl., but this not cited.

Ilysanthes inaequalis (Walt.) Pennell, Torreya 19: 149. 1919.

Swamps, loam and more usually in sandy soil, frequently in open situations, pineland pools and edges of hammocks, through the Coastal Plain, frequent or local; extending inland locally into the Piedmont. Ranges from Massachusetts to Florida and Texas; apparently also in Colorado, the Pacific Coast states, in Mexico, the West Indies, Central and South America. Intergrades with *Ilysanthes dubia*.

Flowering from March to September, and soon ripening fruit. Corolla as in *I. dubia*.

Pennell (Florida)—9649, 9673. (Alabama)—9768.

3. Ilysanthes saxicola (M. A. Curtis) Chapm.

Lindernia saxicola M. A. Curtis, Amer. Journ. Sci. 44: 83. 1843. "On rocks in the Hiwassee River [North Carolina] [M. A. Curtis]. . . ." Isotype seen in Herb. Columbia University at the New York Botanical Garden.

Ilysanthes saxicola (M. A. Curtis) Chapm., Fl. S. Un. St. 294. 1860.

On rocks in rapid mountain-streams, known only from the Hiwassee River in North Carolina, and from the headwaters of the Savannah River at Tallulah Falls, northern Georgia.

Flowering at least in August and September, and soon ripening fruit. Not seen growing.

4. Ilysanthes refracta (Ell.) Benth.

Lindernia refracta Ell., Sketch Bot. S. C. and Ga. 1: 579. 1821. "Grows around the margins of ponds in Barnwell district, South Carolina; in Burke County, and near Milledgeville, Georgia." Type, "Hab. in sphagnis, Barnwell Co., So. Car.," seen in Elliott Herbarium at the Charleston Museum.

Tittmannia monticola Spreng., Syst. 2: 800. 1825. "Carolina bor. (*Lindernia monticola* Nutt.)." The name of Nuttall was a *nomen nudum*, and Nuttall (Gen. Am. 1: 9. 1818) says, perhaps due to a typographic slip, "from the hills of New Hampshire." But that the name *monticola* was in use before the date of Sprengel's publication is proven by the existence of old specimens labeled "*Lindernia monticola*," collected by Schweinitz probably in North Carolina. Such a specimen, in the herbarium of Columbia University at the New York Botanical Garden, is probably an isotype of *T. monticola*, and is *Ilysanthes refracta*.

Ilysanthes refracta (Ell.) Benth., in DC. Prod. 10: 419. 1846.

Moist sandy soil, shallow depressions in pineland, in the Coastal Plain from South Carolina to northern Florida and eastern Alabama; inland on the granite of central Georgia and eastern Alabama, and likewise in the Piedmont of central North Carolina, doubtless also on granite.

Flowering from March to September, and soon ripening fruit. Corolla externally violet-purple, paler on the anterior side, within paler, but with three violet-purple streaks below the posterior sinuses, a horizontal band of violet-purple on anterior side just within the mouth, and with darker blotches below the anterior sinuses.

Pennell (Georgia)—4053, 9510, 9522.

5. Ilysanthes grandiflora (Nutt.) Benth.

Lindernia grandiflora Nutt., Gen. Amer. 2: 43. 1818. "Hab. On the spongy margins of sandy springs and ponds in Georgia, (betwixt Savannah and Augusta in many places)." Type seen in Herb. Academy of Natural Sciences of Philadelphia.

Ilysanthes grandiflora (Nutt.) Benth. in DC. Prod. 10: 418. 1846.

Moist sandy soil, especially along streams, in longleaf pineland, and southward in the Everglades, southern Georgia to southern Florida.

Flowering from March to at least July, probably to September, and soon ripening fruit. Corolla externally violet-blue, paler on anterior side; posterior lobes externally pale purplish-blue, within very pale and with light-violet median line; anterior lobes white externally and within, excepting for two violet-blue blotches near the bases of the lobes.

Pennell (Florida)—9654, 9670, 9672.

14. GLOBIFERA J. F. Gmelin.

Globifera J. F. Gmel., Syst. 2: 32. 1791.

Type species, *Anonymos umbrosa* Walt.

1. **Globifera umbrosa** (Walt.) J. F. Gmel.

Anonymos umbrosa Walt., Fl. Carol. 63. 1788. Type, probably from lower South Carolina, identified by Dr. S. F. Blake, in Rhodora 17: 131. 1915, as the species here considered.

Micranthemum orbiculatum Michx., Fl. Bor. Amer. 1: 10. pl. 2. 1803. Type not verified, but description and plate evidently of species here considered. Type of genus *Micranthemum* Michx.

Micranthemum emarginatum Ell., Sketch Bot. S. C. and Ga. 1: 18. 1816. "Grows in ditches and wet places—Vall'Ombrosa, Great Ogechee." Type seen in Elliott Herbarium at the Charleston Museum. Said to be "in the upper country, common," and characterized from the "very common" (and evidently lowland) *M. orbiculatum* by its more remote and larger leaves. *Globifera umbrosa* varies considerably in size of leaves, but the ample collections at hand show this to be ecologic, and not to distinguish plants of differing range.

Wet loam or in shallow water, in woodland, especially in river-bottoms, locally common throughout the Coastal Plain, especially near the ocean, North Carolina to central Florida and eastern Texas; rarely reported from above the fall-line. Also in eastern Mexico and the West Indies.

Flowering from May to October, and soon ripening fruit. Corolla uniformly dull-white. Anthers red-brown.

Pennell (Florida)—9706.

15. HEMIANTHUS Nuttall.

Hemianthus Nutt., Journ. Acad. Nat. Sci. Phila. 1: 119. pl. 6. 1817.

Type species, *H. micranthemoides* Nutt., of Pennsylvania.

1. **Hemianthus glomeratus** (Chapm.) Pennell, comb. nov.

Micranthemum nuttallii glomeratum Chapm., Fl. S. Un. St. ed. III. 313. 1897. "Rivers and wet banks, South Florida." Type not verified.

Sandy shores of lakes and rivers, known from Lake Okeechobee and along the Gulf coast from Tampa to the Caloosahatchee River, southern Florida.

Flowering and fruiting probably throughout the year, the specimens seen collected in May and November. Not seen growing.

This may be distinguished from the other species of the eastern United States, *Hemianthus micranthus* (Pursh) Pennell (*H. micranthemoides* Nutt.) of the Delaware and Chesapeake drainage by the following contrast:

Calyx-lobes obtuse or obtusish, less than one-fourth the length of the tube. Anterior lobe of the corolla nearly as long as the portion of the anterior lip below the base of the lateral lobes.
H. micranthus.

Calyx-lobes acute, one-third to one-half the length of the tube. Anterior lobe of the corolla about half as long as the portion of the anterior lip below the base of the lateral lobes.
H. glomeratus.

16. LEUCOSPORA Nuttall.

Leucospora Nutt., Journ. Acad. Nat. Sci. Phila. 7: 87. 1834.

Type species, *Capraria multifida* Michx.

1. **Leuscopora multifida** (Michx.) Nutt.
   Capraria multifida Michx., Fl. Bor. Amer. 2: 22. pl. 35. 1805. "Hab. in ripis arenosis fluminum amniculorumque, in *Tennassée* et Illinoensi regione." Type not verified, but description and plate certainly of species here considered.
   Leucospora multifida (Michx.) Nutt., l. c. 87. 1834.

Sandy or loam banks of brooks or rivers, in open meadows or along shores, also in "Cedar Glades," Tennessee west of the Cumberland Mountains, to western Alabama and central Mississippi. Ranges from southwestern Ontario to Kansas, south to Alabama and Texas.

Flowering from June to October, and soon ripening fruit. Corolla pale-lavender, deeper on lobes, and lined with deeper lavender; tube within at base greenish-yellow, then yellow on the anterior side, and toward mouth with a purplish ring; white at base of the lavender anterior lobes. This plant has been placed in the very different tropical genus *Conobea* Aubl.

17. VERBASCUM Linné.

Verbascum L., Sp. Pl. 177. 1753.

Type species, *V. thapsus* L., of Europe.

Stem glabrous or with simple gland-tipped hairs above. Leaves glabrous. Pedicels 10–15 mm. long. Filaments all densely lanose with knobbed purple hairs. Capsule subglobose, glandular-puberulent. Seeds .8–.9 mm. long, dark-gray.
1. *V. blattaria.*

Stem pubescent with stellate glandless hairs. Leaves, at least beneath, pubescent. Pedicels less than 10 mm. long. Filaments: three posterior lanose, two anterior sparingly lanose to glabrous, with filiform yellow hairs. Capsules ovoid to oblong, stellate-pubescent. Seeds .4–.7 mm. long, brownish-gray.

Leaf-blades crenate, glabrate above, those of the stem sessile. Pedicels usually several in an axil. Sepals about one-half length of capsule. Inflorescence not densely crowded.

Inflorescence a simple raceme, the pedicels 1–5 to an axil. Capsule globose, 7–8 mm. long. Leaves green and slightly pubescent beneath.
2. *V. virgatum.*

Inflorescence a panicle of racemes, the pedicels 3–12 to an axil. Capsule oblong or oblong-ovoid, 4–5 mm. long. Leaves white and densely stellate-tomentose beneath.
3. *V. lychnitis.*

Leaf-blades entire or but obscurely crenate, densely pubescent above, those of the stem decurrent. Pedicels one to an axil. Sepals equaling the capsule. Inflorescence densely crowded.
4. *V. thapsus.*

1. **Verbascum blattaria** L.

Old fields and roadsides, throughout area north of central Florida. Naturalized from Eurasia.

2. **Verbascum virgatum** With.

Berkeley Co., South Carolina. Naturalized from Eurasia.

3. **Verbascum lychnitis** L.

Old fields and roadsides, occasional in North Carolina. Naturalized from Eurasia.

4. **Verbascum thapsus** L.

Old fields, roadsides and thickets, throughout area north of central Florida, usually common. Naturalized from Eurasia.

18. **PENSTEMON** [Mitchell] Schmidel.

Penstemon Schmidel, Icon. Pl. 2. 1762.

Type species, *Chelone pentstemon* L.

Leaf-blades dimorphic, those of the prostrate wintering stems entire or few-toothed, those of the erect flowering stems bipinnatifid with linear segments. Corolla pink-purple, its throat strongly inflated and but obscurely ridged anteriorly. Anther-sacs shallowly saccate. Sterile filament conspicuously exserted.
1. *P. dissectus.*

Leaf-blades uniform, entire or merely toothed. Corolla reddish-purple to white, its throat moderately to slightly inflated, obviously ridged anteriorly. Sterile filament included or slightly exserted.

Anther-sacs dehiscent by short proximal slits, the distal portion of each remaining pouch-like. Leaf-blades entire or essentially so. Branches of the inflorescence elongate. Corolla white, unlined, nearly glabrous within the throat.
2. *P. multiflorus.*

Anther-sacs dehiscent their entire length, so never pouch-like. Leaf-blades more or less serrate. Branches of the inflorescence less elongate. Corolla lanose within, nearly always with more or less conspicuous lines of deeper color within on the anterior side.

Corolla with throat relatively inflated, its mouth open, not closed by the anterior lip. Sterile filament slightly to moderately densely bearded. Plants taller.

Corolla white, rather strongly inflated. Anther-sacs usually barbate. Stem glabrous or nearly so......3. *P. digitalis.*

Corolla more or less violet-purple, moderately inflated. Anther-sacs glabrous. Stem usually puberulent.

Corolla more open, its throat anteriorly shallowly two-ridged, and with broader less evident lines. Anther-sacs grayish. Sterile filament included, slightly bearded. Stem finely puberulent.

Calyx-lobes becoming 4–7 mm. long, one-half to two-thirds the length of the capsule. Corolla 20–25 (–28) mm. long, usually light violet-purple. Leaf-blades lanceolate, sparsely serrate. 4. *P. pentstemon.*

Calyx-lobes becoming 8–10 mm. long, equaling the capsule. Corolla 25–35 mm. long, usually deeper violet-purple. Leaf-blades broadly lanceolate, usually more serrate. 5. *P. calycosus.*

Corolla narrower, its throat within strongly two-ridged anteriorly, and (at least in *P. canescens*) with narrow sharply defined lines. Anther-sacs violet-purple. Sterile filament slightly exserted, moderately bearded. Stems more loosely puberulent.

Blades of the cauline leaves tapering from the broad base, more serrate, glabrous or nearly so. Corolla "bright pink-purple." Capsule broadly ovoid. 6. *P. smallii.*

Blades of the cauline leaves usually narrowed from above the narrower base, less serrate, more pubescent. Corolla faint violet-purple, conspicuously lined within throat. Capsule ovoid. 7. *P. canescens.*

Corolla with throat scarcely inflated, its mouth closed by the anterior lip, which rises as a convex arc. Sterile filament very densely bearded. Plants lower.

Corolla 20–25 mm. long, broader, red-purple, throat deeply lined within, white on anterior lobes within. Sterile filament bearded with golden-yellow hairs. 8. *P. australis.*

Corolla 25–30 mm. long, very narrow and slender, white throughout. Sterile filament bearded with lemon-yellow hairs. 9. *P. tenuiflorus.*

1. Penstemon dissectus Ell.

Penstemon dissectus Ell., Sketch Bot. S. C. and Ga. 2: 129. 1822. "This . . . species was sent me . . . from Louisville, Georgia, by Mr. Jackson." Type seen in the Elliott Herbarium at the Charleston Museum.

Light gravelly soil, rock-ledges, rock outcrops of Altamaha Grit, southern Georgia.

Flowering in April and May, fruiting in June. Corolla violet-purple, externally slightly redder, paler on anterior side, within bluer on lobes, paler within throat and in a triangle at base of each lobe, the throat within with fine longitudinal violet-purple lines. Sterile filament with slightly yellowish hairs.

The peculiar dimorphism of the leaves of this species, as well as the occurrence of bipinnatifid leaf-blades, is unique in this genus.

Pennell (Georgia)—9527.

2. Penstemon multiflorus Chapm.

Penstemon pubescens multiflorus (Chapm.) Benth. in DC. Prod. 10: 327. 1846. "In Louisiana et Florida. *P. multiflorus* Chapm. mss." Specimen seen in Herb. Columbia University at the New York Botanical Garden, from "sandy pine woods, between Mariana & St. Andrew's Bay," collected by A. W. Chapman "Oct., 1838," and labeled "probably a distinct species," is probably an isotype.

Penstemon multiflorus Chapm.; Small, Fl. S. E. Un. St. 1061. 1903.

Sandy or gravelly soil, scrub-oak land or pine land, through peninsular Florida, and westward through Middle Florida to the West Florida Pine Hills, and in extreme southern Georgia.

Flowering from May to July, and soon ripening fruit, southward flowering and fruiting throughout the year. Corolla white, within slightly purple on proximal part of tube, and sometimes on the lobes.

Pennell (Florida)—9539, 9548, 9644.

3. Penstemon digitalis Nutt.

Chelone digitalis (Nutt.) Sweet, Brit. Fl. Gard. pl. 120. 1825. "*Pentstemon Digitalis* Nutt. . . . Found by Mr. Nuttall in the Arkansas territory of North America. . . . The plant from which our drawing was taken was received last autumn from New York, by Mr. Anderson, of the Apothecaries' Garden at Chelsea, to whom it was sent by Mr. Hogg." A careful description and illustration, certainly of the plant now considered, the description being apparently more accurate than Nuttall's own in mentioning the pubescence of the anthers.

Penstemon digitalis Nutt., Trans. Amer. Phil. Soc. ser. II. 5: 181. 1837. "Hab. in wet woods and prairies [Arkansas Territory]; common. [T. Nuttall.]" Possible type, labeled "*Pentstemon latifolium*, Arkansa, Nuttall," seen in Herb. Columbia University at the New York Botanical Garden. Described without reference to *Chelone digitalis*.

Fields and edges of woodland, loam, western Tennessee and near Birmingham, Alabama, probably elsewhere northward. Native in the southwestern Mississippi valley; extensively introduced into the northeastern United States, and probably an introduction into the southeastern flora.

Flowering in May and June, fruiting in August and September. Corolla white throughout, or within on the anterior side with more or less evident violet lines.

4. Penstemon pentstemon (L.) Macm.

Chelone pentstemon L., Sp. Pl. 612. 1753. "Habitat in Virginia." Type not verified, but must have been the species here considered, because in 1753 this was certainly the only essentially glabrous species of the Atlantic seaboard.

Penstemon laevigatus Ait., Hort. Kew. 2: 361. 1789. "*Chelone Pentstemon* J. F. Miller ic. 4. . . . Nat. of North America. Cult. 1776, by John Fothergill, M. D." The description, and also the plate of Miller, clearly denote the species now considered.
Bartramia pulchella Salisb., Prod. Stirp. Chapel Allerton 99. 1796. New name for *Penstemon laevigatus* Ait. Type of genus *Bartramia* Salisb.
Penstemon pentstemon (L.) Macm., Bull. Torr. Bot. Club 19: 15. 1892.

Meadows, river-banks and edges of forest, loam or clay, frequent or common through the Piedmont, both east and west of the mountains, and through the lower valleys of the southern Appalachians: descending along river-banks slightly into the Coastal Plain. Ranges from Virginia to northern Florida and Louisiana, and inland probably to Illinois; perhaps introduced westward.

Flowering from mid-May to mid-June, fruiting in July and August. Corolla externally violet-purplish, deepest on tube, on throat and lobes pale-purplish, nearly white on anterior side; within white, and within throat on anterior side with more or less evident violet lines. Sterile filament with yellow hairs.

Pennell (Georgia)—9787. (Alabama)—9746, 9756, 9780.

5. **Penstemon calycosus** Small.

Penstemon calycosus Small, Bull. Torr. Bot. Club 25: 470. 1898. "Nashville, Tennessee." This refers to a note in Bull. Torr. Bot. Club 21: 304. 1894, reporting the occurrence of "*Penstemon Smallii*" and stating: "Mr. Bicknell has lately discovered this . . . at Nashville, Tennessee. He remarks that it grows plentifully on the bluffs of the Cumberland River about that city." Type seen in Herb. Columbia University at the New York Botanical Garden.

Rocky places, limestone ledges, in forest, Tennessee Basin and lower slopes of the Cumberland Mountains, central and eastern Tennessee, and northern Alabama. Ranges northward to Indiana and Illinois.

Flowering from mid-May to mid-June, fruiting in July. Corolla externally violet-purple (redder than in *P. pentstemon*), deeper posteriorly, fainter to white on anterior side; within nearly white within throat, on lobes faintly violet-purple, and with a few obscurely violet-purple lines within throat on anterior side. Sterile filament with yellowish hairs.

Pennell (Alabama)—9772.

6. **Penstemon smallii** Heller.

Penstemon smallii Heller, Bull. Torr. Bot. Club 21: 25. 1894. "Collected by the writer on Blowing Rock Mountain, Caldwell County, N[orth] C[arolina], July 21, 1890, at an elevation of 4000 feet. . . . Early in June, 1891, the locality was again visited in company with Mr. John K. Small." Type, Blowing Rock Mountain, Watauga Co., collected in flower June 10–20, Small & Heller 451, seen in Herb. Columbia University at the New York Botanical Garden. Isotype in Herb. Academy of Natural Sciences of Philadelphia.

Rocky lower mountain-slopes and on river-bluffs, in forest, Appalachians of North Carolina, eastern Tennessee and northernmost Georgia. Ranges northward into southwestern Virginia.

Flowering from late May to late June, fruiting in July. Not seen growing.

7. Penstemon canescens (Britton) Britton.

Penstemon laevigatus canescens Britton, Mem. Torr. Bot. Club 2: 30. 1890. "High, rocky banks of the Roanoke River [near Roanoke, Virginia, May, 1890, A. M. Vail and others]." Type, collected May 29, labeled by Dr. Britton who was of the party, seen in Herb. Columbia University at the New York Botanical Garden.

Penstemon canescens (Britton) Britton, l. c. 5:291. 1894.

Rocky loam, in open forest, lower mountain slopes, in the eastern Appalachians seen only from near the French Broad River in North Carolina; through at least the southern Cumberlands (abundant on Lookout Mountain), and in extreme northwestern Georgia (and doubtless northeastern Alabama).

Flowering in May and June, fruiting in July and August. Corolla externally faint violet-purple, within nearly white, and on the anterior side with eleven narrow sharply defined deep violet purple lines. Sterile filament with pale brownish yellow hairs.

Pennell (Georgia)—9785. (Tennessee)—5717, 9788.

8. Penstemon australis Small.

Penstemon australis Small, Fl. S. E. Un. St. 1060, 1337. 1903. "Type, Nash, Pl. Fla., 1822, in Herb. C. U." Type, Eustis, Lake County, Florida, collected in flower and fruit May 28–June 15, 1895, seen in Herb. Columbia University at the New York Botanical Garden.

Dry sandy soil, fields, scrub oak and pine land, through the Coastal Plain from North Carolina to central Florida and eastern Texas, mostly common; inland to the granite of central Georgia, and in upper South Carolina. Usually with broader leaves inland, while in the pine-barrens of the Coastal Plain the cauline may be fewer and usually much smaller so that the stem appears somewhat scapose.

Flowering in April and May, fruiting in June and July. Corolla externally reddish-purple, paler on anterior side; within red-purple on posterior lobes with on each a fine median line of deeper color, anterior lobes white, with deep red-purple streaks, three to each lateral lobe, and five, which anastomoze distally, to the median lobe. Sterile filament with yellow hairs.

This and other southern species have been freely listed as "*Penstemon pubescens*" or "*P. hirsutus*," a northern plant, with lavender corollas, and not definitely known from our area.

Pennell (North Carolina)—4944. (Georgia)—4032, 9515, 9525. (Florida)—9680, 9694, 9708.

9. Penstemon tenuiflorus Pennell.

Penstemon tenuiflorus Pennell, Addisonia 4: 79. pl. 160. 1919. "The type specimen was collected in loam soil in open pineland, three miles southeast of Albany, Morgan County, Alabama, on May 27, 1917, my number 9753, and is preserved in the herbarum of the New York Botanical Garden."

Stem 3–6 dm. tall, whitish-puberulent. Blades of the cauline leaves 3–9 cm. long, obscurely serrulate, puberulent to pubescent. Panicle narrow, its branches glandular-pubescent. Calyx-lobes ovate, 3–5 mm. long. Corolla 25–30 mm. long, its throat narrowly arched and keeled posteriorly, flattened and strongly two-ridged within anteriorly; externally glandular-puberulent, within pubescent with yellow hairs over the projecting bases of the anterior lobes; white, faintly tinged externally and on margins of lobes with violet, not lined within throat. Posterior lobes united two-thirds their length, their free portions erect-recurved. Sterile filament distally densely bearded with short lemon-yellow hairs. Capsule not seen.

Open woodlands, in loam soil, western Tennessee and northern Alabama. Ranges north to Illinois and west to Oklahoma.

Pennell (Alabama)—9753.

19. CHELONE Linné.

Chelone L., Sp. Pl. 611. 1753.

Type species, *C. glabra* L.

Leaf-blades sessile and somewhat clasping. 1. *C. cuthbertii.*
Leaf-blades manifestly petioled.
- Leaf-blades of a lanceolate type, narrowed to short petioles. Corolla cream-white, white-lanose within the throat. Sepals obscurely or not ciliate. 2. *C. glabra.*
- Leaf-blades of an ovate type, slightly cordate or narrowed into petioles 1.5–3 cm. long. Corolla rose-purple, yellow-lanose within the throat. Sepals evidently ciliate. 3. *C. lyonii.*

1. Chelone cuthbertii Small.

Chelone cuthbertii Small, Fl. S. E. Un. St. 1058, 1337. 1903. "Type, Highlands, N. C., Cuthbert, no. 283, in N. Y. B. G." Type, collected in flower August, 1897, in a wet meadow, at an altitude of 3800 feet, seen in Herb. New York Botanical Garden.

Wet meadows, western North Carolina. Little known, and the relation between this and *C. glabra* should be studied in the field.

Flowering in August. Not seen growing.

2. Chelone glabra L.

Chelone glabra L., Sp. Pl. 611. 1753. "Habitat in Virginia, Canada." Based upon a plant grown in the Clifford Garden in Holland. Description sufficiently distinctive.

Wet meadows and woodland swamps, through the southern Appalachians and Piedmont, common northward; descending into the Coastal Plain in river-valleys, reaching Florida, probably near the Apalachicola River. Ranges from Newfoundland to Manitoba, south to northern Florida, and Kansas.

Flowering in late September and October, fruiting probably in October and November. Corolla cream-white, more or less pink-tinged within posterior lip, on anterior lobes, and laterally along anterior lip; occasionally entirely pink.

The forma *tomentosa* (Raf.) Pennell (in Torreya 19: 117. 1919), with leaves tomentose or pubescent beneath, is to be looked for in our area.

3. Chelone lyonii Pursh.

Chelone lyonii Pursh, Fl. Amer. Sept. 2: 737. 1814. "In Upper Carolina and Georgia. Lyon. . . . v. s. in Herb. Lambert."

Chelone major Sims, Bot. Mag. 44: pl. 1864. 1816. "Introduced by the late Mr. Lyons, from Carolina. . . . Communicated by Mr. Lambert, from Boyton, . . ." Obviously of the same origin as *C. lyonii* Pursh, and with a distinctive illustration.

Chelone latifolia Muhl.; Ell., Sketch Bot. S. C. and Ga. 2: 127. 1822. "This plant . . . was discovered . . . by Mr. Lyon along the base of the mountains of Carolina, but principally in Burke County, N. C." Description obviously of the species now considered. Described as having ovate leaf-blades, tapering at base, in contrast to the cordate blades of *C. lyonii* Pursh. This species shows complete gradation in leaf-form between these two states.

Moist mountain-woodland, eastern Appalachians, North Carolina and Tennessee, said to occur southward to northeastern Alabama.[6]

Flowering from mid-July to mid-September; fruiting in September and October. Not seen growing.

20. SCROPHULARIA Linné.

Scrophularia L., Sp. Pl. 619. 1753.

Type species, *S. nodosa* L., of Europe.

1. Scrophularia marilandica L.

Scrophularia marilandica L., l. c. 619. 1753. "Habitat in Virginia." Based upon a plant grown in the Upsala Garden, which from the description in the Hortus Upsalensis 177, 1748, would appear to have been the species now considered.

Open woodland, loam soil, Appalachians, and Piedmont both east and west of the mountains. Ranges from Massachusetts, southern Ontario and eastern Nebraska, south to Florida,[7] central Alabama and Arkansas.

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[6] Reported from Jackson Co., Alabama, by Mohr, Contrib. Nat. Herb. 6: 718. 1901.

[7] Reported from Quincy, Florida, by A. W. Chapman in West. Jour. Med. and Surg. 3: 473. 1845; and from the Marianna Red Lands of northern Florida by R. M. Harper, Fla. Geol. Surv. Rep. 6: 199. 1914.

Flowering in July and August, fruiting in August and September. Corolla externally pale-greenish, on posterior side brownish, within purple-brown on posterior side (on and below posterior lobes, and posterior half of antero-lateral lobes), anteriorly (elsewhere) pale-greenish. Sterile filament dark purple-brown.

The northern *Scrophularia leporella* Bickn., easily distinguished by its yellow sterile filament, its more cut leaves and its earlier flowering season (for fuller contrast see Torreya 19: 118), is to be looked for in upland North Carolina[8] and Tennessee.

The type of *Scrophularia serrulata* Small, Fl. S. E. Un. St. 1058, 1337. 1903, "Type Ga., Chapman, in Herb. C. U.," appears to be a specimen of the Palæarctic *Scrophularia nodosa* L. The plant is from the Chapman herbarium but without indication of collector; certainly some confusing of data has occurred, or perhaps the specimen is from Georgia in the Caucasus.

21. COLLINSIA Nuttall.

Collinsia Nutt., Journ. Acad. Nat. Sci. Phila. 1: 190. 1817.

Type species, *C. verna* Nutt.

1. **Collinsia verna** Nutt.

Collinsia verna Nutt., l. c. 190. pl. 8. 1817. "On descending the Ohio . . . nearly to Galiopolis, . . . I recognized it on the more open alluvions of the river, withered and nearly past affording seed. . . . From these seeds . . . I have been fortunate enough to obtain the plant from which the accompanying drawing was taken by . . . M. C. A. Le Sueur." Type seen in Herb. Academy of Natural Sciences of Philadelphia.

Moist woods, alluvial river-bottoms, in central or western Tennessee. Ranges from western New York to southern Minnesota, south to Tennessee and Missouri.

Flowering in late April and early May, and soon ripening fruit. Not seen growing.

22. RUSSELIA Jacquin.

Russellia Jacq., Enum. Pl. Carib. 25. 1760.

Type species, *R. sarmentosa* Jacq., of Cuba.

1. **Russelia juncea** Zucc.

Occasional in pineland and hammock, Dade County, southern Florida. Escaped from gardens. Introduced from Mexico.

23. ANGELONIA Humboldt & Bonpland

Angelonia H. & B., Pl. Aequin. 2: 92. pl. 108. 1809.

Type species, *A. salicariaefolia* H. & B., of Venezuela.

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[8] Reported from western North Carolina by Hyams, N. C. Coll. A. & M. Arts, Bull. 164, 326. 1899.

1. Angelonia angustifolia Benth.

Occasional in pineland, Dade County, southern Florida. Escaped from gardens. Introduced from Mexico.

24. LINARIA Miller.

Linaria Mill., Gard. Dict. ed. IV. 1754.

Type species, *Antirrhinum linaria* L., of Europe.

Corolla, excluding spur, 4–12 mm. long, blue, posterior lip erect; anterior lip broadly spreading, but not forming a definite raised palate. Capsule 2–3.5 mm. long, equaling to exceeding the sepals. Seeds .3–.4 mm. long, cylindric, prismatic-angled, not winged. Stem less leafy, the younger stems spreading-prostrate from base. (*Leptoplectron.*)
  Pedicels glandular-pubescent, longer than the corollas. Spur very short. 1. *L. floridana.*
  Pedicels nearly glabrous, shorter than the corollas. Spur slender.
    Corolla less than 8 mm. long, excluding the spur. Surface of seeds smooth to slightly tuberculate. 2. *L. canadensis.*
    Corolla over 10 mm. long, excluding the spur. Surfaces and angles of seed densely tuberculate. 3. *L. texana.*
Corolla, excluding spur, 15–18 mm. long, yellow; posterior lip arched over anterior; anterior lip forming a conspicuous protruding orange palate; spur stout. Capsule 10 mm. long, much exceeding the sepals. Seeds 1.7 mm. long, flattened and circularly broadly winged. Stem densely leafy, always erect. 4. *L. linaria.*

1. Linaria floridana Chapm.

Linaria floridana Chapm., Fl. S. Un. St. 290. 1860. "Drifting sands near the coast, West Florida." Several specimens, collected by Dr. Chapman at Apalachicola, seen in Herb. New York Botanical Garden and Academy of Natural Sciences of Philadelphia.

Dry sandy soil, sand ridges along rivers and near the coast, southern Georgia to central Florida, westward near the Gulf Coast to southern Mississippi.

Flowering in March and April, and soon ripening fruit, the late flowering and fruiting plants persisting through May. Corolla light-blue, the palate paler.

Pennell (Florida)—9579, 9581.

2. Linaria canadensis (L.) Dum.-Cours.

Antirrhinum canadense L., Sp. Pl. 618. 1753. "Habitat in Virginia, Canada." Type probably from southern New Jersey, and certainly the species now considered. For discussion see Torreya 19: 151. 1919.
Linaria canadensis Dum.-Cours. Bot. Cult. 2: 96. 1802. "Lieu, Le Canada, la Virginie." Doubtless based upon *Antirrhinum canadense* L.

Open sandy soil, usually a weed, mostly common in the Atlantic Coastal Plain south to central Florida (intergrading somewhat with *L. texana* in Georgia and Florida); in the Piedmont on the

Granite of the Carolinas and central Georgia, and on other sandy soils, where probably introduced, inland to the southern Appalachians. Ranges northward to Massachusetts. Westward and inland at occasional stations where probably introduced.

Flowering from March to May, and soon ripening fruit. Corolla purplish-blue, the palate pale to white. Occasionally a pink-flowered form occurs.

Pennell (Georgia)—9502. (Florida)—9533, 9536, 9577, 9701.

3. **Linaria texana** Scheele.

Linaria texana Scheele, Linnaea 21: 761. 1848. "Zwischen Houston und Austin [Texas] haufig: Römer." Description sufficiently distinctive.

Open sand or sandy loam, frequently a weed, in the Coastal Plain from South Carolina to southern Mississippi, probably more common westward. Ranges widely through western North America, and into South America. Probably *Linaria canadensis* is a derivative of this.

Flowering from March to May and soon ripening fruit. Corolla pale-blue, reticulate-veined with slightly darker color, essentially as in *L. canadensis* but larger throughout.

Pennell (Georgia)—9512, 9521. (Alabama)—9724, 9727.

4. **Linaria linaria** (L.) Karst.

Linaria vulgaris Mill.

Loam or sandy soil, fields and waste ground, a weed; mostly above the Fall-line, probably common northward. Naturalized from Eurasia.

25. KICKXIA Dumortier.

Kickxia Dum., Fl. Belg. 35. 1827.

Type species, *Antirrhinum elatine* L., of Europe.

Leaf-blades rounded-cordate at base. Calyx-lobes ovate. 1. *K. spuria*.

Leaf-blades hastate. Calyx-lobes lanceolate. 2. *K. elatine*.

1. **Kickxia spuria** (L.) Dumort.

Waste places and roadsides, occasional eastward. Naturalized from Eurasia.

2. **Kickxia elatine** (L.) Dumort.

Waste places, roadsides and stone-walls, occasional eastward. Naturalized from Eurasia.

26. VERONICASTRUM Heister.

Veronicastrum Heist.; Fabr., Enum. Meth. Pl. Hort. Helmstad. 111. 1759.

Type species, *Veronica virginica* L.

1. Veronicastrum virginicum (L.) Farwell.

Veronica virginica L., Sp. Pl. 9. 1753. "Habitat in Virginia." Grown in the Clifford Garden. Certainly the species here considered.

Veronicastrum album Moench., Meth. 437. 1794. ". . . *Veronica virginica* L."

Calistachya alba Raf., Med. Repos. N. Y. IInd Hex. 5: 352. 1808. Based on *Veronica virginica* L. Type of *Calistachya* Raf., not *Callistachys* Vent., 1804.

Eustachya alba (Raf.) Raf., Cat. 14. 1824. *Eustachya* Raf., Amer. Mo. Mag. 4: 190. 1819, was a new name for *Calistachya* Raf. Preoccupied by *Eustachys* Desv., 1810.

Leptandra alba (Raf.) Raf., Med. Fl. 2: 21. 1830. "The true *V. virginica* of L. . . . The most common species being found all over the United States."

Leptandra villosa Raf., l. c. 21. 1830. "Mr. Schweinitz has found it in North Carolina." If the state with the leaves pubescent beneath be distinguished as a forma, this name should be used.

Veronicastrum virginicum (L.) Farwell, Drugg. Circ. 61: 231. 1917.

Varying, in number of leaves in whorl, in inflorescence of one or several racemes, and in leaves from lanceolate to nearly ovate, pubescent to nearly or quite glabrous beneath.

Sandy or loam soil, swales or moist meadows, hillside thickets, through the southern Appalachians and Piedmont, both east and west of the mountains, apparently scarce; rarely descending into the Coastal Plain. Ranges from Connecticut and Ontario and Minnesota, south to Mississippi and Texas.

Flowering in August, fruiting in September. Corolla white throughout, anthers brown.

27. VERONICA Linné.

Veronica L., Sp. Pl. 9. 1753.

Type species, *V. officinalis* L., of Europe.

Flowers solitary, axillary, frequently approximating so as to form a terminal raceme. Leaves alternate through the inflorescence.
  Pedicels longer than the sepals, usually exceeding the bracts. Sepals ovate. Capsule turgid. Seeds few, 1.3–3 mm. long, convex-arched, roughened. Leaves petioled (rarely the uppermost sessile), primarily palmately 5–7 nerved, the midvein usually with some radiating pinnate veins; mainly alternate, the lower sometime opposite.
    Leaves broadly cordate, 3–5 lobed, the lobes rounded. Sepals broadly ovate, conspicuously ciliate. Capsule very turgid, scarcely notched at apex, only slightly 2-lobed. Seeds 2.5–3 mm. long, blackish. 1. *V. hederaefolia.*
    Leaves ovate, serrate to dentate. Sepals more shortly ciliate. Capsule slightly flattened, deeply notched at apex, thus strongly two-lobed. Seeds 1.3–1.5 mm. long, brown.
      Petals not exceeding the ovate sepals. Capsule-lobes rounded, the most distal point of each about midway between the style and the lateral margin.
        2. *V. agrestis.*

Petals exceeding the narrowly ovate sepals. Capsule-lobes acutish, the most distal point of each near the lateral margin. 3. *V. persica.*

Pedicels shorter than sepals or bracts. Sepals linear to narrowly ovate. Capsule flattened. Seeds many, less than 1 mm. long, flat, smooth or nearly so. Leaves sessile (or the lower petioled), scarcely palmate, alternate only through the inflorescence.

Perennial. Repent, with ascending stems. Leaves oval or ovate, obscurely crenate. Inflorescence spike-like, restricted to the distal portion of the stem. Sepals ovate. Corolla white, with blue lines on posterior side. Capsule retuse or shallowly notched, glandular-pubescent. 4. *V. serpyllifolia.*

Annuals. Erect, much branched below. Most leaf-axils flower-bearing. Sepals lanceolate to linear. Capsule deeply notched.

Lower stem-leaves ovate, crenate-serrate, the lowermost frequently petioled. Corolla deep violet-blue. Capsule pubescent with slightly gland-tipped hairs. Plant pubescent with glandless hairs. 5. *V. arvensis.*

Lower stem-leaves oblanceolate, entire or distally remotely toothed, all sessile. Corolla whitish throughout. Capsule glabrous. Plant glabrous or with short gland-tipped hairs.

Plant glabrous. 6. *V. peregrina.*

Plant pubescent with gland-tipped hairs. 6a. *V. peregrina xalapensis.*

Flowers all in axillary small-bracted racemes. Leaves opposite throughout. Perennials.

Capsule glandular-pubescent, strongly two-lobed, longer than the sepals. Stems, pedicels, leaves and sepals pubescent. Leaves oval, crenate-serrate, narrowed to a petiolar base. Extensively repent, at apex ascending. Plant of dry soil. 7. *V. officinalis.*

Capsule glabrous, scarcely or not two-lobed, equaling the sepals. Plant glabrous or with scattered gland-tipped hairs. Leaves oblong-ovate to broadly lanceolate, obscurely crenate-serrate. Ascending or wholly erect. Aquatics.

Stem distally, rhachis and pedicels glabrous. Leaves oblong-ovate, all petioled, mostly emersed. Racemes usually 10–25 flowered. Plant emersed. 8. *V. americana.*

Stem distally, rachis and pedicels sparsely pubescent with glands, borne upon jointed stalks. Leaves lanceolate, clasping. Racemes usually 25–50 flowered. Plant nearly submersed. 9. *V. glandifera.*

1. Veronica hederaefolia L.

Waste places, mostly near cities, occasional. Naturalized from Eurasia.

2. Veronica agrestis L.

Waste places and fields, mostly near cities, occasional. Naturalized from Eurasia.

3. Veronica persica Poir.

Fields, roadsides and waste places, occasional or local. Naturalized from Eurasia.

Corolla with tube and base of lobes white, anterior lobes pale, lateral darker, posterior sky blue; lobes all with blue longitudinal veins.

4. Veronica serpyllifolia L.

Fields, thickets and waste places, common at least northward. Naturalized from Eurasia.

Corolla white or nearly so, on posterior side with blue lines.

5. Veronica arvensis L.

Fields, cultivated soil, and waste ground, common at least northward. Naturalized from Eurasia.

Corolla with all lobes deep sky-blue, whitish at base, veined with deeper sky-blue.

6. Veronica peregrina L.

Veronica peregrina L., Sp. Pl. 14. 1753. "Habitat in Europae hortis, arvisque." Described, as the specific name would suggest, from specimens of an introduced plant.

Fields and cultivated soil, especially where moist, common. Certainly American in origin, but now wholly weed-like.

Corolla uniformly dull-white.

Pennell (Florida)—9712. (Alabama)—9725, 9758.

6a. Veronica peregrina xalapensis (H.B.K.) Pennell.

Veronica xalapensis H. B. K., Nov. Gen. et Sp. 2: 389. 1817. "Crescit in Regno Mexicano prope Xalapa (alt. 630 hex. [ca. 1200 m.]), in nemoribus Liquidambaris Styracifluae."

Veronica peregrina xalapensis (H. B. K.) Pennell, Torreya 19: 167. 1919.

Occasional in cultivated soil. In the western half of the continent this glandular-pubescent variety quite replaces true *peregrina*. In the East it is only occasionally seen, and that probably as an introduction.

7. Veronica officinalis L.

Dry fields, open woods and stony hillsides, common at least northward. Naturalized from Eurasia.

Corolla very pale-lavender, on posterior side with seven lavender-blue lines.

8. Veronica americana Schwein.

Veronica americana Schwein., Benth. in DC. Prod. 10: 468. 1846. "*Veronica americana* (Schweinitz! mss.). . . . In America boreali a

Canada et Carolina usque ad flum. Oregon et in ins. Sitcha . . . (v. s.)." Specimen seen in Herb. Academy of Natural Sciences of Philadelphia, labeled "Bethl." [Bethlehem, Pennsylvania], collected by Schweinitz, may be of collection sent Bentham.

Springheads in woodland, and along streams, in the southern Appalachians of North Carolina and eastern Tennessee, in the Piedmont of South Carolina, likely occasional in this zone both east and west of the mountains. Ranges from Quebec to Alaska, south to South Carolina, New Mexico and California.

Flowering from June to August, and soon ripening fruit. Corolla pale-blue, distally with few rather faint deeper-blue lines.

9. **Veronica glandifera** Pennell.

Veronica glandifera Pennell, Torreya 19: 170. 1919. "Type, vicinity of Suffolk, Nansemond County, Virginia, collected in flower and fruit May 27, 1893, N. L. Britton and J. K. Small; in herbarium Columbia University at the New York Botanical Garden."

Shallow flowing streams, mostly in calcareous soil, Appalachians of North Carolina and eastern Tennessee. Ranges from New Jersey to North Carolina, Minnesota and Kentucky.

Flowering in June and July, and soon ripening fruit. Corolla pale-blue, with few deeper-blue lines.

28. MACRANTHERA Torrey.

Macranthera Torr.; Benth., Comp. Bot. Mag. 1: 174. 1836.

Type species, *Conradia fuchsioides* Nutt.

1. **Macranthera flammea** (Bartram) Pennell.

Gerardia flammea Bartram, Trav. 410. 1791. "Stony gravelly heights [along Tensaw River near] Taensa" In Alabama. No type known to exist. Identified by Mohr in Contr. U. S. Nat. Herb. 6: 15. 1901.

Conradia fuchsioides Nutt., Journ. Acad. Nat. Sci. Phila. 7: 88. pl. 12. 1834. No locality given. Type, without data, seen in Herb. Academy of Natural Sciences of Philadelphia. Type of genus *Conradia* Nutt., not *Conradia* Mart., 1829.

Macranthera lecontei Torr., Ann. Lyc. Nat. Hist. N. Y. 4: 80. pl. 4. 1837. "In dry pine woods on the Alatamaha, in Liberty County, Georgia, Major Le Conte!" Type, without data, seen in Herb. Columbia University at the New York Botanical Garden.

Dasystoma tubulosa Bertol., Mem. Accad. Sci. Instit. Bologna 4: 75. pl. 4. 1853. "Ex Alabama, Dr. Gates." Probable isotypes seen in Herb. New York Botanical Garden, Herb. Academy of Natural Sciences of Philadelphia and Gray Herbarium.

Macranthera flammea (Bartram) Pennell, Bull. Torr. Bot. Club 40: 124. 1913.

Borders of wet sandy thickets, in the Coastal Plain, southern Georgia and northern Florida to eastern Louisiana.

Flowering from August to October, fruiting September and October. Corolla orange throughout.

Pennell (Florida)—4564, 4595, 4681. (Alabama)—4406, 4459, 4462, 4534, 4553, 4641.

29. DASISTOMA Rafinesque.

Dasistoma Raf., Journ. de Phys. 89: 99. 1819.

Type species, *D. aurea* Raf., of Kentucky.

1. Dasistoma macrophylla (Nutt.) Raf.

Seymeria macrophylla Nutt., Gen. N. Amer. Pl. 2: 49. 1818. "Hab. In shady alluvial soils of the banks of the Little Miami, near the town of Lebanon." In Ohio. Specimen in Kew Herbarium labeled "Ohio Nuttall misit Mart. 1824," may stand as the type; this seen.
Dasistoma macrophylla (Nutt.) Raf., New Fl. Amer. 2: 67. 1837.
Brachygyne macrophylla (Nutt.) Small, Fl. S. E. Un. St. 1073, 1338. 1903. Type of genus, *Brachygyne* Small.

Sandy to clay soil, mostly in rich woods, usually along streams, western North Carolina,[9] central Tennessee and northern Alabama. Ranges from Ohio to eastern Nebraska, south to northern Alabama and northeastern Texas.

Flowering in July and August, fruiting August and September. Corolla yellow, externally tinged or marked with purple-red.

30. AFZELIA J. F. Gmelin.

Afzelia J. F. Gmel., Syst. 927. 1791.

Type species, *Anonymos cassioides* Walt.

Stem closely pubescent, viscid. Leaf-segments lanceolate or broader. Calyx-lobes lanceolate. Corolla deep-yellow, externally pubescent, its lobes ovate, 3–3.5 mm. wide. Distal portion of filament and connective of anther lanose. Anther-sacs opening one-fifth to one-fourth length. Capsule ovate, 6–7 mm. long, densely tomentose with short brown more or less glandular hairs. Seeds winged. Plant low, 2–6 dm. tall, widely branched.

Stem lanose to pubescent with reflexed-incurved to -appressed hairs. Pedicels 6–7 mm. long. Capsule densely glandular-tomentose, with hairs dark-jointed, some of them glandular-knobbed at tip. Seeds 1–1.2 mm. long. 1. *A. pectinata.*

Stem finely pubescent to puberulent in lines with ascending-incurved to -appressed hairs. Pedicels 7–10 mm. long. Capsule less tomentose to nearly glabrous, with hairs slightly dark-jointed, most or all of them glandular-knobbed at tip. Seeds 1.2–1.4 mm. long. 1a. *A. pectinata peninsularis.*

Stem sparingly pubescent, with ascending-incurved hairs, scarcely glandular. Leaf-segments filiform. Calyx-lobes linear. Corolla pale-yellow, externally glabrous, its lobes lanceolate, 1.5–2 mm. wide. Distal portion of filament and connective of anther glabrous. Anther-sacs opening one-sixth to one-fifth length. Capsule urceolate-acuminate, 4–4.5 mm. long, glabrous. Seeds not winged, .5–.7 mm. long. Plant 5–10 dm. tall, virgately branched. 2. *A. cassioides.*

[9] Reported from western North Carolina by Hyams, N. C. Coll. A. & M. Arts, Bull. 164: 327. 1899.

1. **Afzelia pectinata** (Pursh) Kuntze.

Seymeria pectinata Pursh, Fl. Amer. Sept. 2: 737. 1814. "In South Carolina. Catesby. v. s. in Herb. Sherard." Type not seen, but description distinctive.

Seymeria jacksoni Ell., Sketch Bot. S. C. and Ga. 2: 123. 1824. "Sent to me from Louisville, Ga., by Mr. Jackson." Type seen in the Elliott Herbarium at the Charleston Museum.

Seymeria heterophyla Raf., New Fl. Amer. 2: 68. 1837. "Alabama and Georgia, my specimen from Le Conte." Type not known to exist.

Afzelia pectinata (Pursh) Kuntze, Rev. Gen. 1: 457. 1891.

Dry sandy longleaf pineland, in the Coastal Plain from South Carolina[10] to Louisiana, south in the Florida peninsula to Brevard County; inland reported from the Pine Mountains of Meriwether County, Georgia,[11] and from the metamorphic region of northeastern Alabama.[12]

Flowering in August and September, fruiting September and October. Corolla deep golden-yellow, more or less marked with purple-red within throat and at the bases of the lobes.

Pennell (Georgia)—4732, 4760, 4780, 4845. (Florida)—4568, 4585, 4645, 4656, 4674, 4686, 4705, 4715, 4802. (Alabama)—4630.

1a. **Afzelia pectinata peninsularis** Pennell, var. nov.

Stem 4–6 dm. tall, finely glandular-pubescent to -puberulent in lines with ascending-incurved to -appressed hairs. Leaves glandular-pubescent to -puberulent, those of the stem 1–2 cm. long, 5–8 mm. wide. Pedicels in flower 5 mm. long, in fruit 7–10 mm. long. Calyx-lobes 4.5 mm. long. Corolla 8 mm. long, its tube 3–3.5 mm. long, its lobes 4.5 mm. long. Style 4–5 mm. long. Capsule minutely glandular-pubescent with hairs slightly dark-jointed, most or all with terminal knob-like glands. Seeds 1.2–1.4 mm. long.

Type, flat woods, Marco, Lee Co., Florida, collected in fruit July–August, 1900, A. S. Hitchcock 254, in United States National Herbarium.

Flat long-leaf pineland or hammocks, southern Florida.

Flowering June to August, probably flowering and fruiting throughout the year.

2. **Afzelia cassioides** (Walt.) J. F. Gmel.

Anonymos cassioides Walt., Fl. Carol. 171. 1788. Presumably from lower South Carolina. Description sufficiently distinctive.

Afzelia cassioides (Walt.) J. F. Gmel., Syst. 927. 1791.

Gerardia afzelia Michx., Fl. Bor. Amer. 2: 20. 1803. New name for *Afzelia cassioides* (Walt.) Gmel.

Seymeria tenuifolia Pursh, Fl. Amer. Sept. 737. 1814. New name for *Gerardia cassioides* (Walt.) Pers.

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[10] Reported from lower North Carolina, collected by Croom [see M. A. Curtis, Bot. N. C. 39. 1867].

[11] Harper, Bull. Torr. Bot. Club 36: 587. 1909.

[12] Earle, Ala. Agric. Exp. Sta., Bull. 119: 104. 1902.

Moist or dry pineland, usually in sandy soil, in the Coastal Plain from North Carolina to Florida and Louisiana, in the Florida peninsula south to Manatee County; inland to the mountains of northern Georgia, northern Alabama and eastern Tennessee; also on the Bahamas.

Flowering from September to mid-October, and soon ripening fruit. Corolla pale-yellow, more or less marked with purple-red within throat and at the bases of the lobes.

Pennell (North Carolina)—4900, 4919. (South Carolina)—4866, 4872, 4878. (Georgia)—4725, 4743, 4762, 4809, 10173. (Florida)—4588, 4649, 4653, 4678, 4691, 4713, 4719, 9647. (Alabama)—4552, 4639. (Louisiana)—4217.

31. **AUREOLARIA** Rafinesque.

Aureolaria Raf., New Fl. Amer. 2: 58. 1837.

Type species, *Aureolaria villosa* Raf.

Annuals. Stem, leaves and calyx glandular. Leaves bipinnatifid, more or less pectinately cut. Calyx-lobes dentate to pectinate. Corolla externally glandular-pubescent, within pubescent below posterior sinus and over bases of posterior lobes; more or less marked or tinged with purple-red. Anther-sacs 2.5–4 mm. long. Capsule ellipsoid to broadly-ovoid in outline, glandular-puberulent to -pubescent. Seeds .8–1 mm. long, not winged. (*Panctenis* Raf.)

Leaves less sharply cut, with mostly rounded teeth, puberulent to somewhat glandular-pubescent. Pedicels 10–28 mm. long. Calyx-tube turbinate, glandular-puberulent externally. Capsule narrowly to broadly ellipsoid, 9–15 mm. long, one-half to two-thirds enclosed in the calyx-tube. Seeds .8 mm. long.

Stem closely pubescent above, not or slightly glandular. Leaves puberulent, not or slightly glandular. Calyx-lobes 8–10 mm. long. Capsule narrowly ellipsoid, 9–11 mm. long.

Leaves 3–6 cm. long, more strongly cut, incisions extending mostly about two-thirds distance to midrib, not or scarcely glandular. Pedicels permanently more or less glandular-pubescent. Calyx-tube 4–5 mm. long. Stem closely pubescent, not or scarcely glandular above. 1. *A. pedicularia.*

Leaves 2–3.5 cm. long, less cut, incisions extending mostly about one-half distance to midrib, slightly glandular. Pedicels tending to become nearly glabrous. Calyx-tube 5–7 mm. long. Stem from nearly glabrous to slightly glandular. 1a. *A. pedicularia carolinensis.*

Stem glandular-pubescent to hirsute above. Leaves glandular-puberulent to -pubescent. Calyx-lobes 10–16 mm. long, relatively deeply lobed. Capsule broadly ellipsoid, 11–14 mm. long. 1b. *A. pedicularia austromontana.*

Leaves more sharply cut, with acute or acutish teeth, glandular-pubescent to -villose. Pedicels 4–20 mm. long. Calyx-tube hemispheric, glandular-hirsute to -lanose. Capsule broadly ovoid, 11–16 mm. long, only its base enclosed in the calyx-tube. Seeds 1 mm. long.

Stem stiffly branched. Leaves all spreading, the upper smaller but not excessively reduced, those of the stem 2–6 cm. long. Pedicels 4–20 mm. long, conspicuous when in flower. Calyx-tube glandular-hirsute to -lanose. Corolla 30–40 mm. long. Anther-sacs ovate. 2. *A. pectinata.*

Stem virgately branched. Leaves, at least the upper, appressed-ascending, uppermost leaves very much reduced, those of the stem 1.5–3 (–4) cm. long. Pedicels 4–9 mm. long, usually very short when in flower. Calyx-tube glandular-lanose. Corolla 38–45 mm. long. Anther-sacs lanceolate-ovate 2a. *A. pectinata floridana.*

Perennials. Not glandular. Leaves entire to somewhat coarsely bipinnatifid, not pectinately cut. Calyx-lobes entire to dentate. Corolla externally glabrous, within glabrous or diffused-pubescent; not marked nor tinged with purple-red. Anther-sacs 4–6 mm. long. Capsule ovate to globose-ovate in outline, not glandular. Seeds 1.3–2.7 mm. long, strongly winged. (*Aureolaria*, sensu strictu.)

Capsule densely rusty-pubescent. Pedicels 1.5–3 mm. long. Stem puberulent to pubescent, at least above.

Stem puberulent to pubescent throughout. Leaves permanently downy-pubescent. Capsule 12–15 mm. long. Seeds 1.5–1.8 mm. long 3. *A. virginica.*

Stem glabrous below, more or less puberulent above. Leaves puberulent becoming glabrous. Capsule 9–12 mm. long. Seeds 1.3–1.5 mm. long. 4. *A. microcarpa.*

Capsule glabrous. Pedicels 3–25 mm. long. Stem glabrous to minutely puberulent.

Bracts entire to finely crenate-serrate. Pedicels slender, 15–25 mm. long. 5. *A. patula.*

Bracts entire to coarsely dentate. Pedicels stouter, 3–15 mm. long.

Lower leaves ovate-lanceolate in general outline, widest about the middle, not long-acuminate. Petioles evident, mostly 10–30 mm. long. Pedicels 5–15 mm. long. Calyx densely pubescent within. Corolla 35–60 mm. long. Capsule 12–24 mm. long. Seeds 2–2.7 mm. long. Stem relatively stout, frequently purple.

Stem finely puberulent, not glaucous. Pedicels and calyx externally puberulent. Anther-sacs ovate. 6. *A. dispersa.*

Stem glabrous, glaucous. Pedicels and calyx externally glabrous. Anther-sacs ovate-lanceolate.

Stem slightly glaucous. Lower leaves from nearly entire to more or less dentate or cut, rarely ½ distance to midrib. 7a. *A. flava reticulata.*

Stem quite glaucous. Lower leaves more or less pinnately cut, lowermost somewhat bipinnatifid, mostly over ½ distance to midrib.

7. *A. flava.*

Lower leaves lanceolate to ovate-lanceolate, widest below the middle, long-acuminate. Petioles very short, less than 10 mm. long. Pedicels 3–8 mm. long. Calyx sparingly pubescent to glabrous within. Corolla 30–35 mm. long. Capsule 10–12 mm. long. Seeds 1.5–1.7 mm. long. Stem slender, rarely purplish, not puberulent nor glaucous. 8 *A. laevigata.*

1. Aureolaria pedicularia (L.) Raf.

Gerardia pedicularia L., Sp. Pl. 611. 1753. "Habitat in Virginia, Canada." Type not verified, but description sufficiently distinctive.
Aureolaria pedicularia Raf., New Fl. Amer. 2: 61. 1837.

Dry oak-woods, sandy or rocky, perhaps in the Piedmont of North Carolina.[13] Ranges from Maine to Virginia (and Minnesota.

Flowering in August and September, fruiting September and October. Corolla yellow, externally more or less tinged with reddish, within at times with some purple-red spotting.

1a. Aureolaria pedicularia carolinensis Pennell.

Aureolaria pedicularia carolinensis Pennell, Bull. Torr. Bot. Club 40: 413. 1913. "Type, savannahs near Mill Pond, Wilmington, North Carolina, June 23, 1909, J. M. Macfarlane in Herb. University of Pennsylvania."

Dry sandy oak and mixed woods, pine-barrens of southeastern North Carolina.

Pennell (North Carolina)—4925.

1b. Aureolaria pedicularia austromontana Pennell, var. nov.

Stem glandular-pubescent to -hirsute above, with spreading short hairs, and among these, usually outnumbering them and exceeding them in length, gland tipped hairs, so that stem is very glandular. Leaf-blades tending to lanceolate ovate, mostly deeply and sharply cut, finely puberulent with gland tipped hairs, more rarely evidently glandular-pubescent. Pedicels in flower 10–20 mm. long, in fruit (12–)18–25 mm. long. Calyx relatively sparingly pubescent with gland-tipped hairs, its lobes 10–16 mm. long, linear-lanceolate to lanceolate, relatively deeply lobed. Capsule 11–14 mm. long, broadly ellipsoid.

[13] *Aureolaria pedicularia caesariensis* Pennell, Bull. Torr. Bot. Club 40: 413, 1913, with leaves 1.2 5 cm. long, pedicels longer than bracts and stem not glandular hirsute below, has been found in woodland in Orange Co., N. C.

Type, Biltmore, North Carolina, collected in flower August 27, 1897, Biltmore Herbarium 481; in United States National Herbarium.

Dry oak or mixed woodland, on mountain-slopes, eastern and western Appalachians, from southwestern Virginia and southeastern Kentucky to northern Georgia.

This differs from *Aureolaria pedicularia ambigens* (Fernald) Farwell of the southern Lake region in its leaves narrower, more deeply and sharply cut, and its calyx-lobes longer and more deeply lobed.

Pennell (Tennessee)—5725.

2. Aureolaria pectinata (Nutt.) Pennell.

Gerardia pedicularia pectinata Nutt., Gen. Pl. N. Amer. 2: 46. 1818. "Hab. In the sandy pine forests of Carolina and Georgia." Specimen of Nuttall's collecting in the British Museum, labeled "*Gerardia millefolia* S. Carol.?" may represent the type. It is determined by Dr. S. Moore as the form now considered, agreeing with my number 5638 from Louisiana.

Aureolaria pectinata (Nutt.) Pennell, Bull. Torr. Bot. Club 40: 414. 1913.

Dry sandy pine and oak lands, especially hilly, through the Coastal Plain from South Carolina to northwestern Florida and Louisiana; extending inland on sandy soils (as the granite of central Georgia), to westernmost North Carolina and eastern Tennessee, and through the Mississippi Valley westward in our area. Ranges northwestward to Kentucky and southern Missouri. The inland forms have larger leaves and fruit, and probably represent several geographic varieties, an enumeration of which will be given in the writer's "Agalinis and Allies in North America."

Flowering from July to October, fruiting in September and October. Corolla yellow, externally more or less tinged with reddish, within not marked with purple-red.

Pennell (Georgia)—4066, 5694, 5695, 5700, 5708, 5713. (Alabama)—4532, 4625, 5689. (Tennessee)—5707, 5716.

2b. Aureolaria pectinata floridana Pennell.

Aureolaria pectinata floridana Pennell, Bull. Torr. Bot. Club 40: 414. 1913. "Type, Fort Gadsden, Franklin Co., Florida, Sept. 20, 1912, F. W. Pennell 4683, in Herb. University of Pennsylvania."

Dry sandy pineland, through the flatwoods of southern Georgia to central Florida.

Pennell (Georgia)—4724. (Florida)—4683.

3. Aureolaria virginica (L.) Pennell.

Rhinanthus virginicus L., Sp. Pl. 603. 1753. "Habitat in Virginia." Type, Clayton 488, is identified by Dr. S. F. Blake, in Rhodora 20: 66. 1918, as the plant here considered.

Aureolaria villosa Raf., New Fl. Amer. 2: 59. 1837. No type locality stated, nor type known to exist. Description sufficiently distinctive.

Dasystoma pubescens Benth., in DC. Prod. 10: 520. 1846. "In Americae sept. civitatibus orientalibus frequens." Type not verified, but description sufficiently distinctive.

Dasystoma brachycarpa Small, Bull. Torr. Bot. Club 28: 452. 1901. "The specimens on which this species is based were collected by the writer on the slopes of Stone Mountain, Georgia, Sept. 6–12, 1894." Type seen in Herb. New York Botanical Garden. Also collected by myself at Stone Mountain, Pennell 4050, 5692. The short capsules of this plant are quite within the normal range of variation of *Aureolaria virginica.*

Aureolaria virginica (L.) Pennell, Bull. Torr. Bot. Club 40: 409. 1913.

Dry open woods, usually sandy, frequent through the Piedmont and eastern Appalachians south to central Georgia, less common through the western Appalachians and Mississippi Valley of our area; occasional in the Coastal Plain south to northern Florida and west to Louisiana. Ranges from New Hampshire, south to Florida and Louisiana. This species has been long known as "*Gerardia flava.*"

Flowering from late May to July, fruiting from July to September. Corolla yellow, with no tinge of purple-red.

Pennell (Georgia)—4050, 4070, 4090, 5691, 5692, 5697, 5702. (Tennessee)—5724.

4. **Aureolaria microcarpa** Pennell, sp. nov.

Perennial. Stem 6–10 dm. tall, simple or with stiff ascending branches above, below glabrous, above less or more densely puberulent with recurved-spreading dark-jointed hairs. Petioles more or less defined from the narrowed base of the leaves. Lower leaves lanceolate-ovate, somewhat deeply and coarsely sinuate-lobed or merely shallowly dentate, 6–11 cm. long, 15–40 mm. wide; upper leaves gradually smaller and simpler, bracts ovate-lanceolate; leaves above scabrous-puberulent, beneath softly puberulent, becoming nearly or quite glabrous, above dull-green, beneath paler. Pedicels stout, closely pubescent, in flower 1–2 mm. long, in fruit 2–3 mm. long. Calyx externally closely puberulent, its tube 3–5 mm. long, turbinate, within puberulent, its lobes 3.5–7 mm. long, lanceolate to spatulate-ovate, acute to acutish. Corolla 30–40 mm. long, its tube inflated ventrally, its lobes 5–10 mm. long, ovate-orbicular, rounded; externally glabrous, within sparingly pubescent proximally, but glabrous below sinuses of lobes; yellow, with no tinge of purple-red. Filaments slender, flattened, posterior 13–17 mm. long, anterior 18–23 mm. long, all loosely lanose near base and again distally, especially close to the apex; anther-sacs 4–4.5 mm. long, ovate, broadly narrowed at apex into a rigid downcurved awn .8–.9 mm. long; sacs lanose-pubescent with retrorse white hairs. Style 25–30 mm. long. Capsule 9–12 mm. long, ovate to globose-ovate in outline, acute to acuminate, brownish, densely rusty-pubescent with reflexed-appressed brown hairs. Seeds 1.3–1.5 mm. long, broadly angular-lunate, flattened; testa gray, with reticulations dark, produced on outer side into several thin wings $\frac{1}{3}$–$\frac{1}{4}$ diameter of seed.

Type, Stevenson, Jackson Co., Alabama, collected in fruit October 17, 1913, F. W. Pennell 5720, in Herb. University of Pennsylvania.

Dry oak-woods, on siliceous soil, southeastern Tennessee to southern Alabama and northwestern Florida, especially in the southern Cumberland Mountains.

Flowering from early June to late August, fruiting August to October.

Pennell (Georgia)—5711. (Alabama)—5720, 9739, 9742. (Tennessee)—5703, 5706, 5715.

5. **Aureolaria patula** (Chapm.) Pennell, comb. nov.

Dasystoma patula Chapm. Bot. Gaz. 3: 10. 1878. "Valley of the Coosa River, near Rome, Georgia." Several collections of Chapman's seen, one labeled "Banks of Horse-leg Creek, a tributary of the Coosa River," in Herb. New York Botanical Garden, may stand as the type.

Wooded bluffs along rivers, central and eastern Tennessee, and northwestern Georgia.

Flowering from August to October. Corolla yellow, with no tinge of purple-red.

Pennell (Tennessee)—5722.

6. **Aureolaria dispersa** (Small) Pennell.

Dasystoma dispersa Small, Bull. Torr. Bot. Club 28: 452. 1901. "Louisiana: Feliciana, Carpenter; type in the herbarium of Columbia University." Type seen in Herb. Columbia University at the New York Botanical Garden.

Aureolaria dispersa (Small) Pennell, Bull. Torr. Bot. Club 40: 411. 1913.

Sandy thickets and oak-land, pineland from southern Alabama to Louisiana.

Flowering in August and September, fruiting in October.

Pennell (Alabama)—4504, 4521. (Mississippi)—4384. (Louisiana)—4117, 4245.

7. **Aureolaria flava** (L.) Farwell.

Gerardia flava L., Sp. Pl. 610. 1753. "Habitat in Virginia, Canada." Specimen in Linnean Herbarium identified by Bentham; see in Comp. Bot. Mag. 1: 198. 1836.

Gerardia quercifolia Pursh, Fl. Amer. Sept. 2: 423. pl. 19. 1814. "On the banks of rivers in rich shady places: Pensylvania to Carolina." Type not verified, but description sufficiently distinctive.

Aureolaria flava (L.) Farwell, Rep. Mich. Acad. Sci. 20: 188. 1918.

Oak woodland, usually on rocky hillsides, loam or sometimes sandy soil, nearly throughout above the Fall-Line, common in the southern Appalachians; scarcely entering the southern Coastal Plain, where it passes into the following variety. In the southwestern Appalachians and westward, largely replaced by several ill-defined varieties, to be characterized in the writer's monograph of this group. This species has been known as "*Gerardia virginica*" and "*Dasystoma virginica.*"

Flowering from mid-July to mid-September, fruiting late August to October. Corolla yellow, with no tinge of purple-red.

Pennell (Georgia)—4109, 5693, 5712. (Alabama)—5688, 9728, 9750. (Tennessee)—5704, 5718.

7a. Aureolaria flava reticulata (Raf.) Pennell, comb. nov.

Aureolaria reticulata Raf., New Fl. Amer. 2: 59. 1837. "Florida and Alabama." No type known to exist.

Dasystoma bignoniiflora Small, Bull. N. Y. Bot. Gard. 1: 285. 1899. "Collected by Dr. Burrows, at Tampa Bay, Florida, in 1834." Type seen in Herb. Columbia University at the New York Botanical Garden.

Sandy ravines and moist woodland, in the Coastal Plain from Maryland to central Florida. Replaces the species in the southern Coastal Plain.

Flowering from late-August to mid-October, fruiting in September and October.

Pennell (South Carolina)—4875. (Georgia)—4723, 4765. (Florida)—4565, 4566, 4696, 4698, 4720, 9703.

8. Aureolaria laevigata (Raf.) Raf.

Gerardia levigata Raf., Ann. Nat. 13. 1820. "It grows on the knob hills of Kentucky, the Cumberland mountains and the Alleghany." Specimen in Herb. Columbia University at the New York Botanical Garden labeled in Rafinesque's handwriting "Gerardia—n. sp.—Kentucky," may be the type. Description sufficiently distinctive.

Aureolaria levigata (Raf.) Raf., New Fl. Amer. 2: 59. 1837.

Rocky oak-woods, along streams or on mountain-sides, frequent or common through the Appalachians south to northwestern South Carolina and eastern Tennessee. Ranges northward to Pennsylvania.

Flowering from late July to early September, fruiting in September and October. Corolla yellow, with no tinge of purple-red.

Pennell (Tennessee)—5721, 5726, 9791.

32. AGALINIS Rafinesque.

Agalinis Raf., New Fl. Amer. 2: 61. 1837.

Type species, *A. palustris* Raf.

Perennial, from a running rootstock. Pedicels erect. Corolla slightly fleshy, pink with darker spots, but with no yellow lines within throat. (*Linifoliæ.*) 1. *A. linifolia*.

Annuals, fibrous-rooted. Pedicels ascending or spreading. Corolla membranous, rose-pink, mostly with darker spots and two yellow lines within throat on the anterior side.

Corolla with lobes all spreading, pubescent within at base of posterior lobes, externally more or less pubescent.

Seeds dark-brown. Plants tending to blacken in drying. Calyx-tube not decidedly reticulate-venose. (*Purpureæ.*)

Leaves uniform, linear to filiform-linear.

Inflorescence of elongated normal racemes; pedicels less than 12 mm. long. Seed-coat with dark-brown ridges, between which mostly paler and minutely reticulate.

Leaves and calyx-lobes obtuse to acutish. Anther-sacs obtuse to acutish at distal apex. Plant fleshy, bushy-branched below with elongated racemes above. Pedicels 5–12 mm. long. 2. *A. spiciflora.*

Leaves and calyx-lobes acute to acuminate. Anther-sacs mucronate to caudate at distal apex. Plants not fleshy, more uniformly branched. Pedicels .5–5(–8) mm. long.

Corolla rose-pink to pink, two yellow lines and almost always darker spots within throat evident. Capsule 4–7 mm. long. Plants dull-green or purplish.

Stem smooth or minutely scabrellous. Axillary fascicles not or slightly developed, if present shorter than the leaves. Seeds .6–1.5 mm. long.

Corolla 20–38 mm. long, deeper rose-pink.

Axillary fascicles slightly developed. Pedicels 3–8 mm. long. Seeds .9–1.5 mm. long; areas between reticulations mostly paler, and intrareticular lines discernible.

Stem relatively stiffly branched, sparingly scabrellous. Calyx-lobes triangular-lanceolate to -subulate. Corolla 20–38 mm. long. 3. *A. purpurea.*

Stem slender, virgately branched, glabrous. Calyx-lobes triangular-subulate to subulate. Corolla 20–25 mm. long. 4. *A. virgata.*

Axillary fascicles scarcely or not developed. Pedicels 2–3 mm. long. Seeds .9–1 mm. long; areas between reticulations nearly black, and no intrareticular lines discernible. 5. *A. pinetorum.*

Corolla 15–18 mm. long, paler rose-pink. Flowers nearly sessile, on pedicels less than 2 mm. long. 6. *A. harperi.*

Stem more or less scabrous. Axillary fascicles usually abundantly developed, mostly equaling the leaves. Seeds .5–.8 mm. long. 7. *A. fasciculata.*

Corolla lavender-pink, no yellow lines nor darker spots evident within throat. Capsule 3.5–5 mm. long. Plant bright-green, little darkening in drying. Stem smooth or nearly so. Axillary fascicles abundantly developed.
8. *A. georgiana.*

Inflorescence usually of short or much broken racemes (if elongated and normal, pedicels over 10 mm. long), usually some flowers by slower or arrested growth of stem-apex appearing terminal. Pedicels 5–50 mm. long.

Stem scabrous. Corolla pubescent within in narrow line below sinus of posterior lobes. Anther-sacs strongly mucronate-caudate at distal apex, densely lanose with pink hairs on the sides. Seed-coat with dark-brown reticulations, areas between these more or less hexagonal, pale and not reticulated. Stem-leaves opposite, axillary fascicles abundantly developed. Pedicels 25–40 mm. long. Corolla 25–30 mm. long.
9. *A. pulchella.*

Stem glabrous or essentially so. Corolla pubescent within over entire width of basal portions of posterior lobes. Anther-sacs acute to minutely mucronate-caudate at distal apex, glabrous over much of dorsal surface. Seed-coat with dark-brown reticulations, areas between these elongated, scarcely paler, and scarcely or not reticulated.

Stem-leaves alternate, widening distally, slightly fleshy. Axillary fascicles abundantly developed. Stigma 3.5–5.5 mm. long. Pedicels 20–35 mm. long. Corolla 22–28 mm. long.
10. *A. filifolia.*

Stem-leaves all opposite, not widening distally, not fleshy. Axillary fascicles not or scarcely developed. Stigma 1–2 mm. long.

Branches very widely and laxly ascending. Pedicels 25–50 mm. long, very slender, four or five times as long as the bracts. Corolla 15–18 mm. long, paler rose-pink. Seeds .3–.5 mm. long.
11. *A. laxa.*

Branches more closely and stiffly ascending. Pedicels 4–40 mm. long, less than twice as long as the bracts. Corolla 15–30 mm. long, deeper rose-pink. Seeds .5–.9 mm. long.

Leaves 2–3.5 cm. long, equaling or exceeding the internodes, slightly scabrous to glabrous above.

Pedicels 15–40 mm. long, longer than the bracts. Calyx-tube $\frac{2}{3}$–$\frac{4}{5}$ the length of the capsule.

Corolla mostly 17–25 mm. long. Capsule 3–4 mm. long. Seeds .5–.6 mm. long. Leaves sparingly scabrous to glabrous above.

Leaves narrowly linear to filiform, .3–1.5 mm. wide. Racemes mostly somewhat developed, so flowers not conspicuously "terminal." Pedicels 15–40 mm. long. Calyx-lobes .2–.5 mm. long. Corolla 18–25 mm. long. Seeds rounded, turgid, with reticulations very fine, relatively close. 12. *A. holmiana.*

Leaves filiform-setaceous, .1–.3 mm. wide. Racemes scarcely developed, so flowers conspicuously "terminal." Pedicels 15–20 mm. long. Calyx-lobes .1–.3 mm. long. Corolla 17–20 mm. long. Seeds angled, with reticulations less fine and more remote.

13. *A. stenophylla.*

Pedicels 5–10 (–15) mm. long, shorter than or equaling the bracts. Calyx-tube $\frac{3}{5}$–$\frac{2}{3}$ the length of the capsule. Corolla mostly 25–30 mm. long. Capsule 4–5 mm. long. Seeds .6–.8 mm. long. Leaves slightly scabrous above. Flowers conspicuously "terminal." 14. *A. setacea.*

Leaves .5–1.2 cm. long, shorter than the internodes, scabrous above. Corolla 15–22 mm. long.

Stem slightly striate-four-angled, sparingly scabrellous to glabrous. Leaves filiform, .8–1.2 cm. long. Pedicels 4–6 mm. long, about equaling the bracts. Calyx-lobes not becoming callose. 15. *A. keyensis.*

Stem nearly terete, striate-ridged, minutely hispidulo-roughened on the ridges. Leaves linear-subulate, .5–1 cm. long. Pedicels 4–15 mm. long, three to six times the length of the bracts. Calyx-lobes becoming more or less callose. 16. *A. oligophylla.*

Leaves dimorphic, those near the base of the stem oval ovate, spreading, the cauline minute, scale-like, appressed. Pedicels 1.5–3 mm. long (many flowers appearing to terminate minute axillary branchlets). Calyx-lobes minute, subulate, callose. Corolla 15–20 mm. long. Stem striate-four-angled, ridged, minutely hispidulo-roughened on the ridges, often pubescent at base.

17. *A. aphylla.*

Seeds yellowish-brown. Plants not tending to blacken in drying. Calyx-tube evidently reticulate-venose. (*Erectæ.*)

Stem evidently striate-four-angled, simple to moderately branched. Leaves linear to nearly filiform, 1–2.5 cm. long. Racemes well-developed, so flowers not conspicuously "terminal." Stigma 1–2 mm. long.

Leaves linear to nearly filiform, not widening distally, acutish to acuminate. Corolla with two yellow lines and purple-red spots within throat strongly defined. Capsule globose to globose-ovoid, somewhat flattened at base.

Leaves 2–2.5 cm. long, filiform-linear, relatively scabrous above. Pedicels one to three times the length of the bracts. Corolla 13–15 mm. long. Seeds .6–.8 mm. long. 18. *A. decemloba.*

Leaves 1–1.5 (–2) cm. long, linear-filiform to nearly filiform, slightly scabrous above. Pedicels mostly three to eight times the length of the bracts. Corolla 15–20 mm. long. Seeds .9–1.1 mm. long. 19. *A. tenella.*

Leaves linear, widening distally, acutish to obtuse, 1–1.5 (–1.8) cm. long. Corolla with lines and spots within throat faint or obsolete. Capsule globose-ovoid to globose-elliptic, rounded at base. Corolla 12–16 mm. long. 20. *A. erecta.*

Stem nearly terete, much branched. Leaves narrowly linear, 2–3 cm. long. Racemes scarcely developed, so flowers scattered and conspicuously "terminal." Stigma 2–3 mm. long. Corolla 12–18 mm. long. 21. *A. gattingeri.*

Corolla with posterior lobes arched over stamens and style, glabrous within at their base. (*Tenuifoliæ.*)

Corolla pubescent externally, its posterior lobes about two-thirds the length of the anterior, minutely ciliate, concave-arched. Pedicels, if exceeding the bracts, less than twice their length. Corolla 10–23 mm. long, rose-pink. Leaves linear.

Corolla 15–23 mm. long. 22a. *A. tenuifolia leucanthera.*

Corolla 10–15 mm. long.

Leaves linear, 1–6 mm. wide, those of the stem obviously wider than those of the branches.

Calyx-lobes mostly 1–2 mm. long. Capsule mostly 5–7 mm. long. Seeds .7–1.3 mm. long, with reticulations more pronounced. Leaves 1–6 mm. wide. 22b. *A. tenuifolia macrophylla.*

Calyx-lobes mostly less than 1 mm. long. Capsule mostly 3–4 mm. long. Seeds .6–.9 mm. long, with reticulations very fine. Leaves 1–3.5 mm. wide. 22. *A. tenuifolia.*

Leaves linear-filiform to filiform, .3–1 mm. wide, those of the stem scarcely wider than those of the branches.
22c. *A. tenuifolia polyphylla.*

Corolla glabrous externally, its posterior lobes less than one-half the length of the anterior, conspicuously ciliate, flattened. Pedicels at least three times the length of the bracts.

Leaves filiform, those of the stem 1.5–2 cm. long. Racemes well-developed, so flowers not appearing "terminal." Pedicels 20–32 mm. long, three to twelve times the length of the bracts. Corolla 15–18 mm. long, rose-pink. Plant widely much branched.
23. *A. divaricata.*

Leaves minute, triangular-subulate, .1–.2 cm. long. Flowers scattered, mostly appearing "terminal." Pedicels 6–10 mm. long, many times the length of the bracts. Corolla 10–13 mm. long, lavender-pink. Plant sparingly very laxly branched. 24. *A. filicaulis.*

1. **Agalinis linifolia** (Nutt.) Britton.

Gerardia linifolia Nutt., Gen. Pl. N. Amer. 2: 47. 1818. "Hab. From Wilmington, North Carolina, to Florida." Type, labeled "Carolina," and collected by T. Nuttall, seen in Herb. Academy of Natural Sciences of Philadelphia.

Agalinis perennis Raf., New Fl. Amer. 2: 63. 1837. "My specimen is from Florida." Type not known to exist, but description quite distinctive.

Agalinis linifolia (Nutt.) Britton; Britton & Brown, Ill. Fl. ed. II. 3: 209. 1913.

Wet sandy pineland, usually about margins of ponds in long-leaf pineland, in the Coastal Plain from North Carolina to southern Florida and west to Louisiana. Northward occurs in southern Delaware.

Flowering from mid-August to October, fruiting September to November. Corolla pink, with no yellow lines but with diffused purple-red spots within throat anteriorly.

Pennell (Georgia)—4729, 4745, 4790, 4823. (Florida)—4600, 4648, 4654, 4666, 4690, 4714, 4794, 4807, 4813.

2. **Agalinis spiciflora** (Engelm.) Pennell, comb. nov.

Gerardia maritima grandiflora Benth., Comp. Bot. Mag. 1: 208. 1836. "Texas, Drummond, (1st Coll.)" Type in Kew Herbarium verified by Dr. N. E. Brown as agreeing with my number 4702 from Florida; isotype seen in Herb. Columbia University at the New York Botanical Garden.

Gerardia spiciflora Engelm., Bost. Journ. Nat. Hist. 5: 227. 1845. New name for *Gerardia maritima grandiflora* Benth.

Gerardia maritima major Chapm., Fl. S. Un. St. 300. 1860. "Brackish marshes, Apalachicola, Florida." Different collections of this, made by Dr. Chapman, seen.

Salt marshes, along the coast from North Carolina to Texas. Ranges through the West Indies and on the shore of Yucatan. Probably not specifically distinct from the northern smaller ally, *A. maritima* (Raf.) Raf.

Flowering from March to September, and soon ripening fruit; in subtropical Florida flowering and fruiting throughout the year. Corolla pink, with two yellow lines and many small purple-red spots within throat anteriorly.

Pennell (Florida)—4702, 9550, 9561.

3. **Agalinis purpurea** (L.) Pennell.

Gerardia purpurea L., Sp. Pl. 610. 1753. "Habitat in Virginia, Canada." Linnean diagnosis includes long- and short-pediceled plants, so could include any pink (= "purple") flowered species. The first citation accompanied by a figure, Plukenet's *Digitalis virginiana rubra, foliis & facie Antirrhini vulgaris,* evidently the prevalent plant of the Atlantic seaboard, is considered as the type.

Agalinis palustris Raf., New Fl. Amer. 2: 62. 1837. "Near marshes. . . . From New England to Carolina." Type not known to exist, but characterization evidently of the common species of the Atlantic seaboard.

? *Agalinis corymbosa* Raf., l. c. 63. 1837. "Carolina and Florida." Type not known to exist; either the species now considered or a near ally.

Agalinis purpurea (L.) Pennell, Bull. Torr. Bot. Club 40: 126. 1913.

Moist sandy soil, edges of salt-marsh, of ponds or of rivers, depressions in sand-dunes, or locally on barren soil, common and locally abundant through the Coastal Plain, especially near the coast, along rivers and sand-hills, locally absent or replaced by derivitive species in the longleaf pine belt; southward in a modified form to extreme southern Florida; inland much less frequent, although ascending river-valleys into the southern Appalachians. Ranges from Massachusetts to Florida, Minnesota, Nebraska and Texas.

Flowering from mid-July to mid-September, and soon ripening fruit. Corolla rose-pink, with two yellow lines and many small diffused purple-red spots within throat anteriorly.

Pennell (North Carolina)—4914, 4927, 4932, 4948. (South Carolina)—4850, 4854, 4869, 4876. (Georgia)—4735a, 4746, 4753, 4758, 4767, 4769, 4784, 4811. (Florida)—4703, 4799, 4806. (Mississippi)—4357.

4. **Agalinis virgata** Raf.

Agalinis virgata Raf., New Fl. Amer. 2: 62. 1837. "Glades of pine woods in South New Jersey near Mullica Hill, etc." Type not known to exist.

Moist sandy pine barrens, in the Coastal Plain south to South Carolina. Ranges northward to Long Island.

Flowering from September to mid-October, and soon ripening fruit. Corolla pink, with two yellow lines and diffused purple-red spots within throat anteriorly.

Pennell (North Carolina)—4902, 4921. (South Carolina)—4877.

5. Agalinis pinetorum Pennell.

Agalinis pinetorum Pennell, Bull. Torr. Bot. Club 40: 424. 1913. "Type, St. Marks, Wakulla Co., Florida, Sept. 26, 1912, F. W. Pennell 4708, in Herb. University of Pennsylvania."

Agalinis delicatula Pennell, l. c. 425. 1913. "Type, Ponce de Leon, Holmes Co., Florida, Sept. 17, 1912, F. W. Pennell 4661 in Herb. University of Pennsylvania." A distinct-seeming plant, with leaves more slender, filiform, curling in drying, and corolla within not spotted with purple-red. Until known from other stations not maintained as a species.

Moist soil in longleaf pineland, and on coastal prairie, southern Georgia and northern Florida to Louisiana.

Flowering in September and October, and soon ripening fruit. Corolla pink, with two yellow lines and purple red spots within throat anteriorly.

Pennell (Georgia)—4734, 4738, 4750, 4770, 4771, 4773, 4775, 4781, 4791. (Florida)—(4661 *delicatula*), 4688, 4708, 4795.

6. Agalinis harperi Pennell.

Agalinis harperi Pennell; Small, Fl. Miami 167, 200. 1913. "Type, St. Marks, Wakulla County, Florida, F. W. Pennell 4707." Type, collected September 25, 1912, seen in Herb. University of Pennsylvania.

Moist sandy pineland and borders of salt-marshes, longleaf pineland, from southern Georgia south to the Everglades of southern Florida. Also on the Bahamas.

Flowering northward from mid-September to October, and soon ripening fruit, southward flowering and fruiting throughout the year. Corolla pale rose-pink, with two yellow lines and small purple-red spots mostly along these lines within throat anteriorly. This has been confused with the northern "*Gerardia paupercula.*"

Pennell (Georgia)—4726, 4810. (Florida)—4701, 4707, 4711.

7. Agalinis fasciculata (Ell.) Raf.

Gerardia fasciculata Ell., Sketch Bot. S. C. and Ga. 2: 115. 1822. "Grows principally in lands subject to occasional inundation from the ocean . . . on Eding's Island near Beaufort very common." Type seen in the Elliott Herbarium at the Charleston Museum.

Agalinis fasciculata (Ell.) Raf., New Fl. Amer. 2: 63. 1837.

Moist to dry sandy loam or clay soil, in depressions among sand-dunes, edges of salt-marsh, or loam soil in limestone districts; the only species of cultivated fields; locally common through the Coastal Plain from South Carolina to southern Florida and westward near the Gulf Coast. Ranges westward to Texas and southern Missouri. In southern Florida represented by a variant with less scabrous stem.

Flowering from August to October and soon ripening fruit. Corolla pink, with two yellow lines and many diffused purple-red spots within throat anteriorly.

Pennell (North Carolina)—4949. (South Carolina)—4849, 4860, 4863, 4868. (Georgia)—4735, 4740, 4747, 4751, 4755, 4761, 4766, 4772, 4792, 4818. (Florida)—4669, 4675, 4680, 4695, 4697, 4706, 4717, 4718, 4793, 9544, 9562. (Mississippi)—4356, 4370. (Louisiana)—4267, 4276, 4303, 4304, 4330.

8. Agalinis georgiana (Boynton) Pennell.

Gerardia georgiana Boynton, Biltm. Bot. Stud. 1: 148. 1902. "In the pine barrens near Cordele, Dooly County, Georgia, in September, 1901. . . . In moist sandy soil in pine barrens. . . . The type specimens are deposited in the Biltmore Herbarium." Type, collected Sept. 18, 1901, seen in the Biltmore Herbarium.

Agalinis georgiana (Boynton) Pennell, Bull. Torr. Bot. Club 40: 427. 1913.

Dry sandy or clay soil, in longleaf pineland, southern Georgia, southern Alabama and northern Florida.

Flowering from mid- to late-September, and soon ripening fruit. Corolla lavender-pink, without yellow lines or purple-red spots within throat anteriorly.

Pennell (Georgia)—4728, 4739. (Florida)—4586, 4662, 4665, 4693. (Alabama)—4609, 4629, 4632.

9. Agalinis pulchella Pennell.

Agalinis pulchella Pennell, Bull. Torr. Bot. Club 40: 428. 1913. "Type, Ponce de Leon, Holmes Co., Florida, Sept. 17, 1912, F. W. Pennell 4658, in Herb. University of Pennsylvania."

Dry open sandy longleaf pineland, southern Georgia and northern Florida, westward to Louisiana.

Flowering in September, fruiting in October. Corolla rose-pink, with two yellow lines and relatively large longitudinal purple-red spots within throat anteriorly.

Pennell (Georgia)—4731, 4776, 4779. (Florida)—4587, 4650, 4658, 4663, 4692. (Alabama)—4427, 4452, 4454, 4455, 4493, 4515, 4642.

10. Agalinis filifolia (Nutt.) Raf.

Gerardia filifolia Nutt., Gen. Pl. N. Amer. 2: 48. 1818. "Hab. In West Florida. Dr. Baldwyn." No type in the herbarium of the Academy of Natural Sciences of Philadelphia, but the description is quite distinctive.

Agalinis filifolia (Nutt.) Raf., New Fl. Amer. 2: 65. 1837.

Rather dry sandy longleaf pineland, in the Coastal Plain from southern Georgia southward to southern Florida.

Flowering in September and early October, and soon ripening fruit. Corolla rose-pink, with two yellow lines and diffused purple-red spots within throat anteriorly.

Pennell (Georgia)—4741, 4752, 4785, 4821, 4828, 10174. (Florida)—4671, 4673, 4694, 4800, 4803.

11. Agalinis laxa Pennell.

Agalinis laxa Pennell, Bull. Torr. Bot. Club 40: 431. 1913. "Type, Brunswick, Glynn Co., Georgia, Oct. 10, 1912, F. W. Pennell 4824, in Herb. University of Pennsylvania."

Dry sandy longleaf pineland, or more especially on river-sandhills and old dunes, near the coast, South Carolina to central Florida.

Flowering in late September and October, and soon ripening fruit. Corolla pink, with two yellow lines and, especially along these, small purple-red spots within throat anteriorly.

Pennell (South Carolina)—4880. (Georgia)—4778, 4783, 4824. (Florida)—4801, 4805.

12. Agalinis holmiana (Greene) Pennell.

Gerardia holmiana Greene, Pittonia 4: 52. pl. 10. 1899. "Plentiful in open pine and oak groves along Michigan Avenue south of the Soldiers' Home grounds near Brookland, D. C., collected by Mr. Holm and the writer, 20 Oct., 1898." Probable type seen in the herbarium of the New York Botanical Garden, and I have myself collected the plant at the type station.

Agalinis holmiana (Greene) Pennell, Bull. Torr. Bot. Club 40: 429. 1913.

Dry sandy pineland, in the Coastal Plain; near the coast south to South Carolina, and apparently in the sand-hills near the Fall-Line southwestward into Georgia. Ranges northward to Long Island, New York.

Flowering from late August to mid-October, and soon ripening fruit. Corolla rose-pink, with two yellow lines, and, especially along these, small purple-red spots within throat anteriorly.

Pennell (North Carolina)—4904, 4923, 4929. (South Carolina)—4864.

13. Agalinis stenophylla Pennell, sp. nov.

Plant dull-green or purplish, tending to blacken in drying. Stem 6–7 dm. tall, slender, with many ascending branches, essentially glabrous. Leaves ascending-spreading, filiform-setaceous, entire, acuminate, those of the stem 2–3 cm. long, .1–.3 mm. wide; scabro-roughened to glabrous above. Axillary fascicles scarcely or not developed. Racemes scarcely elongate, often broken, usually but one flower of each pair developed, 1–6 flowered. Pedicels ascending, glabrous, in flower 8–12 mm. long, in fruit 15–20 mm. long, 2–2.5 times the length of the bracts, some on all the branches appearing "terminal." Calyx-tube 2.5 mm. long, hemispheric-campanulate, $\frac{2}{3}$–$\frac{4}{5}$ the length of the capsule, truncate, its lobes .1–.3 mm. long, triangular-subulate, not callose. Corolla 17–20 mm. long; its tube 11–17 mm. long, slightly upcurved, its lobes 6–7 mm. long, rounded to retuse, all spreading; externally minutely pubescent, within pubescent below sinus and over entire width of basal portions of posterior lobes; probably rose-pink (not seen fresh). Anther-sacs 1.7–2 mm. long, lanceolate, acuminate at distal apex, lanate with white hairs on the valvular surface. Style glabrous. Stigma 1.5–2 mm. long. Capsule 3–4 mm. long, globose-ovoid, dark-brown. Seeds .5–.6 mm. long; testa dark-brown to nearly black, with reticulations heavy and relatively remote; intra-reticular lines not discernible.

Type, Tampa, Florida, collected in flower and young fruit October, 1877, A. P. Garber 281; in Herb. Academy of Natural Sciences of Philadelphia.

Known only from the original collection.

14. Agalinis setacea (Walt.) Raf.

Anonymos setacea Walt., Fl. Car. 170. 1788. Supposedly from lower South Carolina, but probably from much further west. Type in the British Museum identified by Dr. A. B. Rendle as agreeing with my number 4757 from Cobb, Sumter Co., Georgia.

Gerardia plukenetii Ell., Sketch Bot. S. C. and Ga. 2: 114. 1822. "Grows in wet spungy soils, very common between the Oakmulgee and Chatahouchie Rivers." Type seen in the Elliott Herbarium at the Charleston Museum. Statement of habitat probably due to confusion with *Agalinis pinetorum* Pennell.

Agalinis setacea (Walt.) Raf., New Fl. Amer. 2: 64. 1837.

Gerardia filifolia gatesii Benth., in DC. Prod. 10: 518. 1846. "In Alabama (Gates!)." Type in the Kew Herbarium, identified, frum a fragment sent me, as this species.

Dry open sandy pineland. In the Coastal Plain from western Georgia and northern Florida to eastern Mississippi, usually in long-leaf pineland; inland in pinewoods on mountain-slopes through northern Georgia and northern Alabama.

Flowering from mid-September to October, and soon ripening fruit. Corolla rose-pink, with two yellow lines and many small diffused purple-red spots within throat anteriorly.

Pennell (Georgia)—4757, 5710. (Florida)—4569, 4570, 4583, 4584, 4672. (Alabama)—4426, 4457, 4461, 4517, 4523, 4524, 4561, 4623, 5690. (Mississippi)—4382.

15. Agalinis keyensis Pennell, sp. nov.

Plant dull-green, tending to blacken in drying. Stem at least 7 dm. tall, slender, with many spreading-ascending branches, sparingly scabrellous or glabrous. Leaves spreading, filiform, entire, acuminate, those of the stem (lowest not seen) .8–1.2 cm. long, .2–.4 mm. wide; scabrous above. Axillary fascicles none. Racemes not elongate, much broken and but one flower of each pair developed, 1–4 flowered. Pedicels ascending, glabrous, in flower 3–4 mm. long, in fruit 4–6 mm. long, about equaling the bracts, some on all the branches appearing "terminal." Calyx-tube 2.5–3 mm. long, hemispheric, $\frac{1}{2}$–$\frac{2}{3}$ the length of the capsule, truncate, its lobes .4–.6 mm. long, triangular-subulate, not becoming callose. Corolla 18–20 mm. long; its tube 14–15 mm. long, slightly upcurved, its lobes 4–5 mm. long, truncate to emarginate, all spreading; externally minutely pubescent, within pubescent below sinus and over entire width of basal portions of posterior lobes; probably pink (not seen fresh). Anther-sacs 2.5 mm. long, lanceolate, cuspidate at distal apex, lanate with white hairs on the valvular surface. Style glabrous. Capsule 3–3.5 mm. long, globose, brown. Seeds .7–.9 mm. long; testa dark-brown to nearly black, with reticulations rather fine; intrareticular lines not discernible.

Type: woods, Pine Key, Florida, collected in flower and fruit by Mr. Blodgett; in herb. Columbia University at the New York Botanical Garden.

Known only from the original station in the Florida Keys. Not re-collected; Dr. Small and myself have hunted in vain for this on Pine Key, but at the time of our joint visit the season had been unusually dry.

16. Agalinis oligophylla Pennell.

Gerardia aphylla grandiflora Benth., Comp. Bot. Mag. 1: 174. 1836. "Jacksonville [Drummond]." Type, labeled "Jacksonville," [certainly an error for Louisiana], seen in Kew Herbarium.

Gerardia plukenetii microphylla A. Gray, Syn. Fl. N. Amer. II. 1: 293. 1878. "Louisiana, Drummond, Hale." Type, an isotype of *Gerardia aphylla grandiflora* Benth., seen in Gray Herbarium.

Agalinis oligophylla Pennell, Bull. Torr. Bot. Club 40: 432. 1913. New name for *Gerardia plukenetii microphylla* A. Gray.

Moist longleaf pineland, in the Coastal Plain from southern Mississippi to southeastern Texas.

Flowering from late September to late October, and soon ripening fruit. Corolla rose-pink, with two yellow lines and, mostly along these, rather large purple-red spots within throat anteriorly.

17. Agalinis aphylla (Nutt.) Raf.

Gerardia aphylla Nutt., Gen. Pl. N. Amer. 2: 47. 1818. "Hab. From North Carolina to Florida, where it was first detected by Dr. Baldwyn." Type seen in herbarium of the Academy of Natural Sciences of Philadelphia.

Agalinis microphylla Raf., New Fl. Amer. 2: 65. 1837. "In Florida, collected by Le Conte (Collins herb.)." Type not known to exist.

Agalinis aphylla (Nutt.) Raf., l. c. 65. 1837.

Moist sandy longleaf pineland, near the coast, North Carolina to northern Florida and Louisiana.

Flowering from mid-September to early November, and soon ripening fruit. Corolla pale-pink, with two yellow lines but without purple red spots within throat anteriorly.

Pennell (Georgia)—4748, 4789, 4808, 4819. (Florida)—4647, 4655, 4664, 4676, 4682, 4712, 4798, 4814.

18. **Agalinis decemloba** (Greene) Pennell.

Gerardia decemloba Greene, Pittonia 4: 51. pl. 9. 1899. "Plant not uncommon about Brookland, D. C., inhabiting grassy knolls and hillsides bordering on pine woods." Type probably seen in Herb. New York Botanical Garden, and I have collected the plant at the type station.
Agalinis decemloba (Greene) Pennell, Bull. Torr. Bot. Club 40: 434. 1913.

Dry open soil, sandy or clay, southward on mountain sides, locally frequent in the Piedmont and southern Appalachians. Ranges from southeastern Pennsylvania to northern Alabama, but with a very broken distribution and wholly east of the mountains.

Flowering from late August to mid-October, and soon ripening fruit. Corolla pink, with two yellow lines and fine purple-red spots within throat anteriorly.

Pennell (Alabama)—5687. (Tennessee)—5709.

19. **Agalinis tenella** Pennell.

Agalinis tenella Pennell, Bull. Torr. Bot. Club 40: 434. 1913. "Type Thomasville, Thomas Co., Georgia, Sept. 28, 1912, F. W. Pennell 4727 in Herb. University of Pennsylvania."

Dry sandy pineland, in the Coastal Plain from South Carolina to north-central Florida, west to Louisiana.

Flowering from mid-September to mid-October, and soon ripening fruit. Corolla pink, with two yellow lines and purple-red spots within throat anteriorly.

Pennell (South Carolina)—4853, 4871. (Georgia)—4727, 4744. 4756, 4764, 4768, 4774, 4777, 4782, 4786.

20. **Agalinis erecta** (Walt.) Pennell.

Anonymos erecta Walt., Fl. Car. 170. 1788. Presumably from lower South Carolina; no type in the Walter herbarium in the British Museum and only identified as possibly the plant here considered.
Gerardia setacea parvifolia Benth., Comp. Bot. Mag. 1: 174. 1836. "Jacksonville." Drummond. Type in Kew Herbarium verified by Dr. N. E. Brown as agreeing with my number 4659 from Ponce de Leon, Florida.
Agalinis obtusifolia Raf., New Fl. Amer. 2: 64. 1837. "West Tennessee, Alabama and Florida." Type not known to exist. Description, and certainly the name, belongs to the plant now considered, although the Tennessee specimen could hardly belong here.
Agalinis erecta (Walt.) Pennell; Small, Fl. Florida Keys 133. 1913.

Moist to dry sandy pineland, mostly longleaf, usually common, in the Coastal Plain, from North Carolina to southernmost Florida, and west to Louisiana. Occurs northward in southward Delaware.

Flowering from early September to mid-October, and soon ripening fruit. Corolla pink, with the two yellow lines and purple-red spots within throat anteriorly faint or absent.

This and related species have been known as "*Gerardia skinneriana.*"

Pennell (North Carolina)—4910, 4915, 4926, 4933. (South Carolina)—4870, 4879. (Georgia)—4733. (Florida)—4596, 4640, 4646, 4659, 4667, 4685, 4710, 4797, 4804, 4815. (Alabama)—4428, 4453, 4503, 4526, 4548, 4562, 4614, 4634. (Mississippi)—4363, 4399. (Louisiana)—4226, 4227, 4231.

21. **Agalinis gattingeri** (Small) Small.

Gerardia tenuifolia leptophylla Benth., Comp. Bot. Mag. 1: 174. 1836. "Jacksonville, Louisiana." Drummond. Type, doubtless from Louisiana, seen in Kew Herbarium.

Gerardia tenuifolia filiformis Benth., in DC. Prod. 10: 518. 1846. "Southern States." Type labeled "Amer. bor. Rafinesque. *Gerardia filiformis* Raf.," seen in Kew Herbarium.

Gerardia gattingeri Small, Fl. S. E. Un. St. 1078, 1338. 1903. "Type, Curtiss N. A. Pl. no. 1910* in Herb. C. U." Type, collected by A. Gattinger on hills around Nashville, Tennessee, seen in Herb. Columbia University at the New York Botanical Garden.

Agalinis gattingeri (Small) Small, in Britton & Brown, Ill. Fl. N. Un. St. and Can. ed. II. 3: 213. 1913.

Dry to moist, sandy or clayey soil, woodland, barrens or open bluffs, in central Tennessee and northern Alabama. Ranges from southwestern Ontario to Minnesota, south to Alabama and eastern Texas.

Flowering from late August to mid-October, and soon ripening fruit. Corolla pink, with two yellow lines and several to many rather large purple-red spots within throat anteriorly.

Pennell (Tennessee)—5705.

22. **Agalinis tenuifolia** (Vahl) Raf.

Gerardia tenuifolia Vahl, Symb. Bot. 3: 7. 1794. "Habitat in America septentrionali." Type in Herb. Universitetets Botaniske Museum, Copenhagen, Denmark, collected by Von Rohren, and said to be probably from Philadelphia, is identified by Dr. C. H. Ostenfeld as agreeing with my number 2681 from Pennsylvania.

Agalinis tenuifolia (Vahl) Raf., New Fl. Amer. 2: 64. 1837.

Loam or sandy soil, moist or dry, usually in open deciduous woodland, common throughout above the Fall-line, through the eastern Appalachians, southward smaller-leaved, passing into var. *polyphylla*, westward, mainly near river-banks, passing into var. *macrophylla;* descending into the Coastal Plain locally in heavier soils, as limestone, and in river-bottoms, there passing into var. *leucanthera*. Ranges from Maine to Michigan, south to Georgia and Louisiana.

Flowering from August to October, and soon ripening fruit. Corolla purplish-pink, with two yellow lines and small diffused purple-red spots within throat anteriorly.

Pennell (Georgia)—4091.

22a. Agalinis tenuifolia leucanthera (Raf.) Pennell, comb. nov.

Gerardia leucanthera Raf., Fl. Ludov. 50. 1817. Louisiana. C. C. Robin. Type not seen.

Stem 4–10 dm. tall, widely much branched. Pedicels .5–1.5 times the length of the bracts. Corolla 15–23 mm. long. Capsule 6–7 mm. long. Seeds apparently slightly longer and more evidently reticulate.

Usually in moist soil, loam or clay, more rarely in sand, woodland or meadow, especially near streams, in alluvial or limestone soils, in the Coastal Plain from southern Georgia and northern Florida to eastern Texas.

Pennell (Georgia)—4759. (Florida)—4601, 4670, 4699, 4721. (Alabama)—4522, 4597, 4606, 4619.

22b. Agalinis tenuifolia macrophylla (Benth.) Blake.

Gerardia tenuifolia macrophylla Benth., Comp. Bot. Mag. 1: 174. 1836. "St. Louis, Jacksonville." Drummond. Fragment of type, from Kew Herbarium, labeled "St. Louis," seen.

Gerardia besseyana Britton, Mem. Torr. Bot. Club 5: 295. 1894. New name for *Gerardia tenuifolia macrophylla* Benth., not *Gerardia macrophylla* (Nutt.) Benth.

Agalinis tenuifolia macrophylla (Benth.) Blake, Rhodora 20: 71. 1918.

In situations similar to that of the species, but more frequent along river-banks, from northern Alabama and Mississippi northward. Ranges from southern Ontario and Minnesota south to Alabama and Oklahoma.

Pennell (Alabama)—5719. (Mississippi)—5685. (Tennessee)—5714.

22c. Agalinis tenuifolia polyphylla (Small) Pennell, comb. nov.

Gerardia polyphylla Small, Bull. Torr. Bot. Club 25: 618. 1898. "The original specimens were collected by the writer on Little Stone Mountain, De Kalb County, Georgia, in September, 1895." Type seen in Herb. New York Botanical Garden.

Dry light soil over granite, locally in the granite region of central Georgia.

Pennell (Georgia)—4065, 5696, 5699.

23. Agalinis divaricata (Chapm.) Pennell.

Gerardia divaricata Chapm., Fl. S. Un. St. 299. Mar., 1860. "Low sandy pine barrens, West Florida." No type indicated, but numerous specimens collected and distributed by the describer seen.

Gerardia mettaueri Wood, Class-Book 530. Dec., 1860. "Wet sandy places, Middle Fla. (Dr. Mettauer.)" Type seen in herbarium of Columbia University at the New York Botanical Garden.

Gerardia mettaueri clausa Wood, l. c. 530. 1860. "With the others," that is, with the species and *G. mettaueri nuda.* No specimen so labeled seen.

Agalinis divaricata (Chapm.) Pennell, Bull. Torr. Bot. Club 40: 437. 1913.

Dry sandy longleaf pineland, western Florida and southeastern Alabama, mostly abundant.

Flowering in September and October, and soon ripening fruit. Corolla rose-pink, with no yellow lines but with faint purple-red spots within throat anteriorly.

Pennell (Florida)—4572, 4593, 4644, 4657, 4668, 4679, 4684, 4687, 4716. (Alabama)—4622, 4624, 4627, 4633.

24. Agalinis filicaulis (Benth.) Pennell.

Gerardia aphylla filicaulis Benth., Comp. Bot. Mag. 1: 174. 1836. "Jacksonville." Drummond. Type in Kew Herbarium, verified by Dr. N. E. Brown, as agreeing with my number 4660 from Florida.
Gerardia mettaueri nuda Wood, Class-Book 530. 1860. "Middle Fl. (Dr. Mettauer, 1855.)" No type seen.
Agalinis filicaulis (Benth.) Pennell, Bull. Torr. Bot. Club 40: 438. 1913.

Moist grassy sandy longleaf pineland, in the Coastal Plain from southern Georgia and northern Florida to eastern Louisiana.

Flowering from mid September to early November, and soon ripening fruit. Corolla lavender pink, without yellow lines or purple-red spots within throat anteriorly.

Pennell (Georgia)—4749, 4788. (Florida)—4594, 4643, 4660, 4677, 4689, 4709, 4796. (Alabama)—4608, 4626.

33. OTOPHYLLA Bentham.

Otophylla Benth., in DC. Prod. 10: 512. 1846.

Type species, *Gerardia auriculata* Michx.

1. Otophylla auriculata (Michx.) Small.

Gerardia auriculata Michx., Fl. Bor. Amer. 2: 20. 1803. "In pratis regionis Illinoensis [A. Michaux]." Description sufficiently distinctive.
Otophylla michauxii Benth., in DC. Prod. 10: 512. 1846.
Otophylla auriculata (Michx.) Small, Fl. S. E. Un. St. 1075, 1338. 1903.

Moist to dry prairies, old fields and waysides, known only from Jackson, Madison Co., western Tennessee, where probably introduced. Native of the prairies of the central Mississippi Valley from Michigan to Minnesota and Arkansas.

Flowering from late August to mid-September, fruiting in September and October.

34. BUCHNERA Linné.

Buchnera L., Sp. Pl. 630. 1753.

Type species, *B. americana* L.

Leaves 3–9 cm. long, lanceolate to ovate-lanceolate, relatively coarsely dentate. Corolla-lobes 6–9 mm. long, the tube 2–2½ times the length of the calyx. Capsule 8–9 mm. long, oblong. Stem hirsute-pubescent. 1. *B. americana.*

Leaves 2–7 cm. long, lanceolate-elliptic to linear, entire or the lower slightly dentate. Corolla-tube mostly 1–1½ times the length of the calyx. Capsule ovate, 5–6.5 mm. long. Seeds. Stem less pubescent or even glabrate.

Leaves prevailingly lanceolate-elliptic, mostly obtuse, only the uppermost at times linear and then reduced. Corolla-lobes usually 4–6 mm. long. 2a. *B. elongata obtusa.*

Leaves linear or nearly so, mostly acute to acuminate, only the lowermost if any lanceolate-elliptic. Corolla-lobes usually 6–8 mm. long. 2. *B. elongata.*

1. Buchnera americana L.

Buchnera americana L., l. c. 630. 1753. "Habitat in Virginia, Canada." Based upon Gron., Fl. Virg. 74. 1743, typified by Clayton 142 from Virginia. Description sufficiently distinctive.

Sandy or sterile loam soil, throughout the area except in the Appalachians, probably more frequent in the Coastal Plain where it may intergrade with *B. elongata obtusa.*

Flowering from June to September, and soon ripening fruit. Corolla purplish-blue throughout.

Pennell (Alabama)—4478, 4518, 4550, 4554.

2. Buchnera elongata Sw.

Buchnera elongata Sw., Prod. Veg. Ind. Occ. 92. 1788. "India occidentalis, Jamaica"; Fl. Ind. Occ. 1061. 1800, "Habitat in arenosis depressis Indiae occidentalis. Versus jugum montium paroeciae Clarendon Jamaicae."

Sandy soil, dunes and limestone pineland of southern Florida, passing into var. *obtusa.* Ranges through the West Indies, and in northern South America.

Pennell (Florida)—9541, 9543, 9546, 9547, 9552.

2a. Buchnera elongata obtusa Pennell, var. nov.

Buchnera angustifolia Raf., New Fl. Amer. 2: 32. 1837. "In Alabama." Described as with linear leaves, but these remote. Surely an attenuate state of our variety.

(?) *Buchnera levicaulis* Raf., l. c. 39. 1837. "Florida." Description of stem as angular and quite smooth suggests that this may belong to some other genus. However, while our plant is characteristically pubescent, it occasionally occurs nearly glabrous.

Leaves prevailingly lanceolate-elliptic, mostly obtuse, only the uppermost linear and then not elongate. Corolla usually smaller than in the species, its lobes usually 4–6 mm. long. Intergrades with the species in southern Florida and the Bahamas.

Type, open sandy pineland, 1–2 miles north of Abita Springs, St. Tammany Parish, Louisiana, collected in flower and fruit August 14, 1912, F. W. Pennell 4190, in herbarium New York Botanical Garden; isotype in herbarium University of Pennsylvania.

Sandy pineland, in the Coastal Plain from North Carolina to southern Florida, westward to southeastern Texas.

Flowering from March to October, and soon ripening fruit; southward throughout the year. Corolla purplish-blue throughout; occurring also frequently in an albino form.

Pennell (North Carolina)—4911. (South Carolina)—4874, 4882. (Georgia)—4730, 4787, 4812. (Florida)—4704, 4722, 9535, 9645, 9674. (Alabama)—4473. (Louisiana)—4190, 4296.

35. SCHWALBEA Linné.

Schwalbea L., Sp. Pl. 606. 1753.

Type species, *S. americana* L., of Virginia.

1. Schwalbea australis Pennell, sp. nov.

Stem 4–8 dm. tall, finely pubescent with short ascending or upcurved hairs. Leaves elliptic-oval, 3–4 cm. long, 12–18 mm. wide, acutish, obscurely reticulate, minutely strigose. Pedicels becoming 4–5 mm. long in fruit. Calyx 10-ridged, its lobes all acute, the posterior linear, 7–10 mm. long, postero-lateral lobes 19–20 mm. long, their free portion 6–7 mm. long, the anterior lobes 20–22 mm. long, united to within 1–2 mm. of their apices. Corolla about 30 mm. long, slender, the lips 10–11 mm. long, the posterior narrowly arched, strongly pubescent externally, the anterior densely lanose within over the bases of the three short lobes. Capsule at least 10 mm. long, not seen mature.

Type, damp pine barrens near Seville, Volusia Co., Florida, collected in flower May 10, 1900, A. H. Curtiss 6742; in herbarium of the New York Botanical Garden.

Distinguished from the northern *S. americana* by the following characters:

Pubescence of stem, pedicels and calyx consisting of recurved hairs. Leaves elliptic-lanceolate, rarely over 10 mm. wide, usually evidently veined. Anterior calyx-lobes obtuse. *S. americana.*

Pubescence of stem, pedicels and calyx consisting of upcurved, usually shorter hairs. Leaves elliptic-oval, usually about 15 mm. wide, usually more obscurely veined. Anterior calyx-lobes acute or acutish. *S. australis.*

Sandy soil, rather moist, oak-land and pine-land, in the Coastal Plain from South Carolina to central Florida and Louisiana; inland apparently occasional, seen only from "sandy humid places in the Cumberland Mountains between Montgomery and Jamestown," Tennessee, collected by Rugel in 1841.

Flowering from April to June. Not seen growing.

36. CASTILLEJA Mutis.

Castilleja Mutis; L. f. Suppl. 293. 1781.

Type species, *C. fissifolia* L. f., of Colombia.

1. Castilleja coccinea (L.) Spreng.

Bartsia coccinea L., Sp. Pl. 602. 1753. "Habitat in Virginia, Noveboraco . . . Hort. Cliff. 235." From L., Hort. Cliff. 325. 1737, "Crescit in Virginia, unde delatam communicavit DD. Gronovius". From Gron., Fl. Virg. 69. 1743: "Clayton n. 293." Certainly the plant here considered.
Castilleja coccinea (L.) Spreng., Syst. Veg. 2: 775. 1825.

Meadows or moist grassy slopes, loam or sandy loam, in the upland from North Carolina to Alabama.[14] Ranges from Maine to Manitoba, south to Georgia and Kansas.

Flowering from April to early June, and soon ripening fruit. Corolla yellowish-green throughout.

37. PEDICULARIS Linné.

Pedicularis L., Sp. Pl. 607. 1753.

Type species, *P. palustris* L., of Europe.

Stem 6–8 dm. tall, glabrous. Leaves shallowly lobed, the sinuses narrow, the lobes with minute regular crenations. Bracts auriculate near base. Rachis of inflorescence glabrous. Fused sepals of each side terminating in a slightly enlarged crenate foliar tip, glabrous or with a very few long hairs near base. Corolla with truncate apex of posterior lobes without tooth-like processes. Capsule brown, scarcely exceeding the calyx, slenderly beaked. Flowering in late summer. ....1. *P. lanceolata.*

Stem 1–3 dm. tall, hirsute, especially above. Leaves deeply lobed, the sinuses broad, the lobes with more prominent irregular crenations. Bracts entire near base. Rachis of inflorescence lanate. Fused sepals of each side broadly acute, entire, pubescent along the veins. Corolla with apex of posterior lobes each with a tooth-like process. Capsule straw-colored, twice as long as the calyx, scarcely beaked. Flowering in spring. 2. *P. canadensis.*

1. Pedicularis lanceolata Michx.

Pedicularis lanceolata Michx., Fl. Bor. Amer. 2: 18. 1803. "Hab. in regione Illinoensi" (A. Michaux). Type not verified, but description distinctive.

Swales and wet meadows, mountains of North Carolina. Ranges from Massachusetts to Manitoba, south to North Carolina and Nebraska.

Flowering from late July to September. Corolla yellow throughout.

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[14] Seen only south to Berkeley Co., lower South Carolina, but this very easily distinguished plant is recorded from upper Georgia by Elliott, Sketch Bot. S. C. and Ga. 2: 132. 1822; and from Etowah Co., Alabama, by Mohr, Contrib. Nat. Herb. 6: 728. 1901.

2. Pedicularis canadensis L.

Pedicularis canadensis L., Mant. 86. 1767. "Habitat in America septentrionali. Kalm."

Woodland or knolls in meadows, throughout above the Fall-line, probably more common northward; in the Coastal Plain descending locally to northern Florida. Ranges from Nova Scotia to Manitoba, south to Florida and Texas.

Pennell (Alabama)—9722. (Tennessee)—9789.

38. MELAMPYRUM Linné.

Melampyrum L., Sp. Pl. 605. 1753.

Type species, *M. cristatum* L., of Europe.

Main stem-leaves linear or lanceolate-linear. Bracts conspicuously fimbriate near base, with teeth frequently as long as the width of the blade. Capsules mostly 6–7 mm. long, curved and usually attenuate-beaked. Seeds 2–2.5 mm. long, brown to blackish.........1. *M. lineare.*

Main stem-leaves linear-lanceolate to nearly ovate. Bracts slightly or not fimbriate near base, the teeth shorter than the width of the blades. Capsules frequently larger, reaching 8–9 mm. long, slightly or not curved, and less or not attenuate-beaked. Seeds often larger, reaching 3 mm. long, usually black.
1a. *M. lineare latifolium.*

1. Melampyrum lineare Desr.

Melampyrum lineare Desr., Lam., Encyc. 4: 22. 1796. "Rapportee de la Caroline par M. Fraser . . . (v. s.)." Description made from a very young plant, but certainly of the form here considered. Characterization of the calyx as 5-toothed certainly erroneous.

Open woodland, thin acid soil, upland and probably midland districts of North Carolina. In the Appalachians mainly replaced by var. *latifolium.* Ranges northward to Long Island, and through its varieties much further northward and across the continent.

Flowering and fruiting through the summer. Corolla white, more or less pinkish externally, the palate yellow.

1a. Melampyrum lineare latifolium (Muhl.) Beauverd.

Melampyrum americanum Michx., Fl. Bor. Amer. 2: 16. 1803. "Hab. a sinu Hudsonis ad montosam Carolinam." (A. Michaux.) Description evidently of the prevalent inland broader-leaved plant.

Melampyrum latifolium Muhl. (Cat. 57. *nomen nudum*); Eaton, Bot. 316. 1818. From Muhlenberg's Catalog, the type station is in Delaware. Type not seen, but evidently is the prevalent inland plant.

Melampyrum lineare latifolium (Muhl.) Beauverd, Mem. Soc. Phys. Geneve 38: 474. 1916.

Moist open woodland, in the Appalachians south to northern Georgia. The prevalent inland plant, southward attaining its greatest distinctness from the species.

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THE LAND OF FERNS
THE HABITATS AND DISTRIBUTION OF THE FERNWORTS OF FLORIDA

By JOHN K. SMALL

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THE LAND OF FERNS

THE HABITATS AND DISTRIBUTION OF THE FERNWORTS OF FLORIDA

By John K. Small

Plates 24-28

Florida has been called the "land of flowers." Even more properly could it be called "the land of ferns." While its pinelands and prairies are themselves not without their own peculiar species, its woods, hammocks, marshes, swamps, and sand-dunes, so abound in fern plants, often in such remarkable luxuriance, that Florida becomes the Fern State, par excellence, among all the States of the Union.

The pinelands[1] are the forests of pine trees, apparently the permanent tree covering replacing the broad-leaved growth or hammocks of former ages, at least in some parts of the state.

The prairies[2] are flat, more or less extensive, usually damp, treeless areas, mostly in the peninsula.

The woods[3] are the broad-leaved forests, usually in the hilly or rolling parts, especially of northern Florida.

The hammocks[4] are dense growths of broad-leaved trees, in a pine-forest or on a prairie, mostly in peninsular Florida. The use of this word is confined to Florida and adjacent States. It was formerly confused with the word hummock. The word is probably of Indian origin. Lime-sinks which are usually conspicuous ferneries, are commonly in hammocks, and are included here.

The marshes[5] are wet prairies. They are common throughout the peninsula. Depressions in the prairies often form ponds.

The swamps[6] are wet woods. They are common throughout the state and are often along or near streams.

The sand-dunes[7] are undulating or hilly areas of siliceous or cal-

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[1] Their characteristic fernwort genera are few: *Anemia*, *Pycnadoria*, *Pteris*, *Sphenomeris*, *Lycopodium*, *Selaginella*.

[2] Their characteristic genera are few: *Blechnum*, *Onoclea*, *Lycopodium*.

[3] Their characteristic genera are few: *Botrychium*, *Ophioglossum*, *Lygodium*, *Pteris*, *Adiantum*, *Asplenium*, *Athyrium*, *Dryopteris*, *Polystichum*, *Selaginella*.

[4] Their characteristic genera are numerous: *Ophioglossum*, *Cheiroglossa*, *Trichomanes*, *Actinostachys*, *Stenochlaena*, *Polypodium*, *Phlebodium*, *Campyloneurum*, *Phymatodes*, *Vittaria*, *Paltonium*, *Adiantum*, *Hypolepis*, *Cheilanthes*, *Asplenium*, *Tectaria*, *Dryopteris*, *Nephrolepis*, *Selaginella*, *Psilotum*.

[5] Their characteristic genera are several: *Osmunda*, *Ceratopteris*, *Acrostichum*, *Blechnum*, *Anchistea*, *Lorinseria*, *Dryopteris*, *Azolla*, *Lycopodium*, *Selaginella*, *Isoetes*.

[6] Their characteristic genera are: *Osmunda*, *Actinostachys*, *Acrostichum*, *Anchistea*, *Lorinseria*, *Blechnum*, *Dryopteris*, *Meniscium*, *Nephrolepis*, *Onoclea*, *Lycopodium*, *Selaginella*, *Psilotum*.

[7] Their characteristic genera are few: *Pteris*, *Cheilanthes*, *Selaginella*.

PLATE 21

In Timm's Hammock near Perrine, Fla. Showing the simple Leaves of nearly simple Five-Halberd Fern (*Tectaria heracleifolia*) and the much compound Maidenhair (*Adiantum tenerum*). Both of these species are rock-lovers and [illegible] careous sand, active along the coast, stationary back of the coastal lagoons and in the interior. Shell-mounds or kitchen-middens are usually built on or near dunes. The so-called "scrub," which comprises extensive areas of white sand supporting a characteristic plant association, is included here.

In these various areas are found about one-third of the different kinds of ferns and fern-allies growing naturally in all America north of Mexico; and the variety in habit and leaf-form of these far exceeds that exhibited by the ferns of any other part of either the United States or Canada. In Florida more than one hundred ferns and fern-allies, both simple and complex, from very small to gigantic, grow either as native or as naturalized plants.

There are ferns in nearly every part of the State, but only the more marked areas of distribution will be referred to on the following pages, to-wit: northern Florida is the long horizontal (east-west) axis of the State, while peninsular Florida is the long perpendicular (north-south) axis. The Florida Keys[8] are the islands of the Florida reef off the southern coast. The Everglade Keys are islands in the southern part of the Everglades. The Florida Keys and Everglade Keys are islands of rock. The upper series of Florida Keys are of coral limestone and are clothed with hammock. The Everglade Keys and the lower series of Florida Keys are of öolitic limestone and are clothed with both hammock and pine forest. The lime-sink region is an area in the northwestern part of the peninsula, which is surrounded by other phytogeographic regions. It comprises mostly rolling sandy pine woods with depressions or sinks, but only few streams. However, near the rivers there are many large springs.

The different kinds of fernworts may be grouped thus: (a) naturalized exotic species, (b) endemic species, (c) species typically of a more northern distribution, and (d) species typically of more southern distribution, and consequently tropical.

There are, apparently, only three naturalized fernworts. These are:

Pycnadoria longifolia (Bracken)
Dryopteris setigera (Wood-fern)
Marsilea vestita (Pepperwort)

[8] Key (Spanish cayo, English cay) primarily applied to islands along the coast in and near Spanish-speaking countries, largely replaces the use of the word "island," particularly in southern Florida, and by the inhabitants is applied to islands in the Everglades as well as to the islands of the coast and reef of Florida.

Little is known concerning a rare bracken, *Pycnadoria longifolia,* within our range, and it may yet prove to be a native plant. There seems to be no good reason why it should not be native, for it occurs plentifully on the islands on the other side of the Gulf Stream. The other exotic has found such favorable habitats and grows in such a natural manner that it is difficult to realize that it is not a native plant. In fact, never has a satisfactory explanation been offered as to how the large wood-fern, *Dryopteris setigera,* did gain a foothold in these apparently natural habitats. Of course, it may be that its spores were primarily carried there by winds from cultivated plants and thus lodged in favorable habitats. But the true manner of its introduction may remain a mystery forever. The pepperwort, *Marsilea vestita,* is native west of the Mississippi River. It seems to have been brought into Florida through the agency of the railroads, and as far as we know it has not been found far away from the lines of traffic.

Two additional species, a bracken, *Pycnadoria cretica,* and a clubmoss, *Lycopodium cernuum,* are sometimes considered naturalized plants, but there has never been good evidence advanced to support that theory.

There are seven endemic species in Florida. These are:

Asplenium biscayneanum (Spleenwort)
Asplenium Curtissii
Tectara Amesiana (Halberd-fern)
Selaginella funiformis (Resurrection-plant)
Selaginella humifusa
Isoetes Chapmanii (Quillwort)
Isoetes alata

The first-mentioned spleenwort grows in only one hammock—a hammock on the Everglade Keys, in the southern end of the Everglades, while the second one is found in hammocks in the lime-sink region of the northern part of the peninsula. The *Tectaria* is known only in the hammocks of the Everglade Keys. The first-cited species of *Selaginella* occurs in peninsular Florida, while the second one has been found in northern Florida, as well as in the peninsula. The first-mentioned quillwort has been found only in western Florida, while the second one is known to occur only in the Gulf Hammock region. This region is a rather narrow strip along the upper western coast of the peninsula with limestone near the surface or cropping out. The coast line differs from that farther south in being devoid of

PLATE 25

On Robert's Island, Everglades, west of Little River Prairie. The most abundant fern in this photograph is the Boston fern (*Nephrolepis exaltata*). It is accompanied by the Swamp bracken (*Blechnum serrulatum*) which may be distinguished by the leaves with the longer and separated leaflets. The Swamp bracken is rarely epiphytic, but the Boston fern commonly inhabits both palms and deciduous-leaved trees.

islands. The very gradually sloping ocean bottom acts as a barrier against the approach of high waves from the Gulf of Mexico. The long-leaf pine is the most abundant tree, but there are many low hammocks besides the great Gulf Hammock of Levy County—whence the name for the region.

The vast majority of the species comprising this fern flora are native plants that occur also outside the state, either in the eastern United States or in tropical America. They fall into two groups: the one composed of northern elements, the other of southern elements. With very few exceptions the plants are fibrous-rooted. The species of the genera *Botrychium, Ophioglossum,* and *Cheiroglossa* are fleshy-rooted and doubtless all represent mycorrhiza forms.

The northern elements comprise about one-third of the species. They are not, however, all strictly typical of decidedly northern latitudes. On the one hand, some only extend northward as far as southern Georgia, and others are merely in the coastal plain of the Gulf of Mexico, while on the other hand a few of the species that are naturally included among the northern ferns are found in the American tropics. Following is a list of the species:

Botrychium obliquum (Grape-fern)
Botrychium virginianum (Rattlesnake-fern)
Ophioglossum vulgare (Adder's-tongue)
Ophioglossum crotalophoroides
Trichomanes Boschianum (Filmy-fern)
Osmunda regalis (Royal-fern)
Osmunda cinnamomea (Cinnamon-fern)
Lygodium palmatum (Climbing-fern)
Pteris aquilina (Brake)
Adiantum Capillus-Veneris (Venus'-hair fern)
Pellaea atropurpurea (Cliff-brake)
Anchistea virginica (Chain-fern)
Lorinceria areolata (Chain-fern)
Asplenium platyneuron (Spleenwort)
Asplenium resiliens
Athyrium Filix-foemina (Lady-fern)
Dryopteris Thelypteris (Shield-fern)
Dryopteris floridana (Wood-fern)
Dryopteris hexagonoptera (Beech-fern)
Polystichum acrostichoides (Christmas-fern)
Onoclea sensibilis (Sensitive-fern)
Marsilea vestita (Pepperwort)
Azolla caroliniana (Watermoss)
Lycopodium alopecuroides (Clubmoss)

Lycopodium prostratum
Lycopodium adpressum
Lycopodium carolinianum
Selaginella apus (Little-clubmoss)
Selaginella ludoviciana
Selaginella acanthonota (Resurrection-plant)
Selaginella arenicola
Isoetes flaccida (Quillwort)

These ferns occupy, for the most part, temperate and sub-tropical Florida.[9] The plants are predominantly terrestial. Some kinds, however, are aquatics; others are amphibious. Many kinds prefer as a habitat what we commonly call soil, others grow best on exposed rock, while a few seem to thrive luxuriantly in "peat."

The lowland kinds reach Florida along the Atlantic Coastal Plain, while the highland species extend southward from the mountains or from the Piedmont region along the hills and ridges and through the river-valleys of western Georgia and eastern Alabama. The typically lowland kinds, the majority of the species of the above list, often range far southward in the peninsula, while the ranges of the highland species generally end in northern Florida or in the upper part of the peninsula, for example: *Athyrium Filix-foemina, Dryopteris hexagonoptera, Polystichum acrostichoides.*

The tropical elements, comprising, as they do, about two-thirds of the species, furnish the more varied and consequently the more interesting fern-plants of our range. They are represented by:

Ophioglossum tenerum (Adder's-tongue)
Cheiroglossa palmata (Hand-fern)
Trichomanes lineolatum (Filmy-fern)
Trichomanes punctatum
Trichomanes Kraussii
Actinostachys Germani (Curly-grass)
Anemia adiantifolia (Flowering-fern)
Ceratopteris pteridoides (Floating-fern)
Ceratopteris deltoidea
Stenochlaena Kunzeana (Holly-fern)
Acrostichum aureum (Leather-fern)
Acrostichum excelsum
Polypodium Plumula (Polypody)
Polypodium pectinatum
Polypodium polypodiodes (Resurrection-fern)

[9] Includes particularly all the state, except the Everglade Keys, the Cape Sable region, and the Florida Reef. The ferns have been considered in "Ferns of Tropical Florida," i-ix, 1-80, 1918, and "Ferns of Royal Palm Hammock," i-vii, 1-38, 1918, and incidentally in papers published in the journal of The New York Botanical Garden from 1904 to 1920.

PLATE 76

Phlebodium aureum (Serpent-fern)
Campyloneurum angustifolium (Strap-fern)
Campyloneurum costatum
Campyloneurum latum
Campyloneurum Phyllitidis
Phymatodes exiguum (Vine-fern)
Vittaria lineata (Shoestring-fern)
Paltonium lanceolatum (Tip-fern)
Pycnadoria pinetorum (Bracken)
Pteris caudata (Brake)
Adiantum tenerum (Maidenhair-fern)
Adiantum melanoleucum
Hypolepis repens (Beaded-fern)
Cheilanthes microphylla (Lip-fern)
Blechnum serrulatum (Swamp-bracken)
Blechnum occidentale
Asplenium serratum (Spleenwort)
Asplenium heterochroum
Asplenium abscissum
Asplenium dentatum
Asplenium erosum
Asplenium verecundum
Asplenium Curtissii
Asplenium cristatum
Tectaria heracleifolia (Halberd-fern)
Tectaria coriandrifolia
Tectaria minima
Tectaria Amesiana
Meniscium reticulatum (Everglade wood-fern)
Meniscium serratum
Dryopteris panamensis (Shield-fern)
Dryopteris stipularis
Dryopteris normalis
Dryopteris augescens
Dryopteris ampla
Dryopteris gonglyodes
Dryopteris parasitica
Dryopteris radicans
Dryopteris tetragona
Nephrolepis exaltata (Boston-fern)[1]
Nephrolepis biserrata (Sword-fern)[1]
Sphenomeris clavata
Lycopodium cernum (Clubmoss)
Psilotum nudum (Brushmoss)

These tropical ferns, nearly all of which are hammock plants and

[1] These common names are used interchangeably.

grow for the most part on trees, in humus, or on exposed limestone, are largely confined to three well-defined areas. Two of these constitute "tropical Florida"—that is to say, the Florida Keys and the Everglade Keys. The other area is that lime-sink region in the northwestern part of the peninsula, mentioned above and to be referred to more fully further on.

The Florida Keys consist of a chain of low islands built upon the Florida Reef mainly south of the peninsula. All of them are remnants of what were evidently larger islands in past ages.[10] They are really situated in the waters of the Gulf Stream, and extend from the Atlantic Ocean on the northeast into the Gulf of Mexico on the southwest. They are naturally divided into two groups: those of the upper or more northern group, which are of coral-rock, and those of the lower or more southern group, which are of limestone. All the islands are clothed with tropical hammock, except portions of a few and here they are either partly heath-like or partly covered with pine. These hammocks and pinelands harbor but ten different kinds of native ferns. But of these, one only (*Paltonium lanceolatum*) has not yet been discovered on the Florida mainland.

The Upper Keys are for the most part long and narrow ridges of coral-rock and are clothed with evergreen hardwood forests which harbor the one kind of fern not yet known to occur on the Everglade Keys. The Lower Keys are more spread out, more even, and rather less elevated above the sea. They are clothed both with hardwood forests and, in the case of a half-dozen islands, with pine woods, at least in part. The Lower Keys have as yet yielded no ferns not already known on the Everglade Keys. In fact, the Florida Keys have a much smaller fern flora than the Everglade Keys. Only about one-fifth of the species of the Everglade Keys have been found there. No doubt in their past the fern flora was larger than it is now. It may have rivaled or excelled that of the Everglade Keys, for the Florida Keys consist of two areas of different ages, coral and limestone; but this region has been for a long time decidedly on the wane as regards area, and doubtless also vegetation.

In addition to the leaching process of erosion that has reduced the surface of the Everglade Keys, the Florida Keys have had the mechanical and chemical action of the sea to contend with and the evi-

[10] This statement refers to the islands composed of rock. The mud flats and islands covered with mangrove are evidently, as a rule, increasing in size, especially in sheltered places, but they scarcely figure in the matter of ferns. They are destitute of ferns, unless an occasional *Acrostichum aureum* got a foothold there.

PLATE [illegible]

In a fern grotto near Pucoka [illegible] referred to on page [illegible]. Here is where fourteen kinds of ferns grow [illegible] and [illegible] [illegible]. Some thrive on [illegible] [illegible] on [illegible] rocks. Notice the plant of the needle palm *Rhaphidophyllum hystrix* on the top of [illegible] [illegible] [illegible] dence of reduction are not hard to observe. These islands have been worn down and washed away not only by the never-ceasing action of the sea, but also by the hurricanes of ages. This is quite evident. The rock surface, particularly in the case of the Lower Keys whose limestone corresponds to that of the Everglade Keys, is polished off and plate-like, instead of merely leached out and honeycombed. What the former fernworts consisted of we cannot even imagine, but we are safe in assuming that the list was more extensive than that which we are able to record there now.

The Everglade Keys, the second tropical area—a phytogeographic region isolated in the Everglades—comprise a curved series of limestone islands appearing on the surface about the neighborhood of the Miami River, trending southwest and disappearing in the southern end of the Everglades. The area is surrounded by the Everglades, except where a portion fronts on Bay Biscayne or its lagoons.

As on the Florida Keys, the native flora of the Everglade Keys consists almost wholly of tropical plants. Pineland predominates in extent of area today; but the few hammocks—evidently themselves remnants of a once dominant and magnificent forest—still harbor nearly fifty kinds of our tropical ferns. And among these are no naturalized exotic species, no typically northern species. The only northern ferns in the vicinity are those occurring where the Everglades and the limestone islands meet.

The number of ferns and fern-allies in this region is quite remarkable when we consider that the area involved comprises only a few hundred square miles, a mere fraction of the State's large area. Although variety in soil and other physical features is slight, this area harbors more than fifty per cent. of the fern flora of Florida.

An overwhelming majority of the species are typically tropical American. In addition to these, there are several cosmopolitan species and a few endemic ferns. The plants of nearly one-third of the species are epiphytic, living on the moisture of the air and getting solid food from the bark and small quantities of humus, while anchored on trees and prostrate logs. This condition doubtless makes up to some extent for the lack of variety in topography, climate, and soil.

The Everglade Keys consist of two main divisions, the Biscayne pineland[11] and the Long Key pineland. The former group is made

[11] These two groups of islands are separated from each other by a distance of three miles. The intervening Everglades contain a number of sloughs which represent the upper reaches of an unmapped river that flows southward and empties into the Bay of Florida. The larger or eastern group of islands takes its name from Bay Biscayne which washes the shores of one of the islands for a distance of about fifteen miles. The smaller group takes its name from Long Key, the largest island lying west of the sloughs referred to above.

up of about a dozen larger islands, which are mostly bounded by the Everglades on two sides and separated from each other by narrow channel-like intersecting prairies. The Long Key group has a much smaller area than the Biscayne pineland. It consists of about five larger islands and a few smaller ones. Both groups are of limestone, and they are slightly elevated above the Everglades. The rock is rather porous and the softer spots of the almost universally exposed surface have been eroded, mostly by leaching out, so as to form a surface honeycombed with all sizes of cavities having very ragged and sharp edges. These limestone islands are almost completely forested with the Caribean-pine (*Pinus caribaea*) which grows nearly everywhere on the exposed rock. However, the pine-woods, or pinelands, are interrupted here and there by hammocks or areas of hardwood shrubs and trees, some areas small and some much larger, although all taken together these comprise but a very small percentage of the region under consideration. The hammocks may be divided into two groups; first, the high pineland hammocks which are islands or colonies of hardwood trees in the pine-woods. They are dry except for the water contained in deep lime-sinks and in the humid air. They number about a score. Second, are the low pineland hammocks, indefinite in number and situated along the boundary line of the pinelands and the Everglades proper and prairies. These are usually high and dry towards the pine-woods and low and wet along the Everglades or prairies.

The ratio of pineland ferns to hammock ferns seems astonishingly small. There are only three kinds of ferns that may be considered naturally pineland plants. Even two of these ferns will spring up in clearings in hammocks which have been partly destroyed either by nature or by man. The other forty-eight species are hammock plants. Their habit ranges from the stiffest to the most graceful and their structure from the coarsest to the most delicate. The pineland species are strictly terrestrial in habit. The hammock kinds are to a great extent epiphytic.

The hammocks of the Biscayne pineland are rich repositories of ferns. The trees are nearly all evergreen. More abundant are: pigeon-plum (*Coccolobis*), devil's claws (*Pisonia*), blolly (*Torrubia*), cherry (*Laurocerasus*), wild-tamarind (*Lysiloma*), Jamaica-dogwood (*Ichthyomethia*), coral-bean (*Erythrina*), torch-wood (*Amyris*), bitterwood (*Simarouba*), gumbo-limbo (*Elaphrium*), Guiana-plum

PLATE [illegible]

On Hamm[illegible] Key, [illegible] between Cape Sable and Royal Palm Hammock. The plant here illustrated [illegible] the oldest fern in Florida. The plant [illegible] The leaflets are rolled up in such a way [illegible] feet in length, the [illegible]

(*Drypetes*), soapberry (*Sapindus*), butter-bough (*Exothea*), wild-coffee (*Colubrina*), lancewood (*Ocotea*), stopper (*Eugenia*), and many others, all growing closely associated to make the hammocks.

Nearly all the kinds of ferns of tropical Florida may be found in them. The well-like lime-sinks, the hammock floor, and the trunks and limbs of rough-barked trees are the habitats of the many species, each and all usually forming ferneries of indescribable beauty. They can be appreciated by the eye alone; even the camera falls far short of doing them justice. In some places the deep well-like sinks have their sides completely covered with mats of iridescent filmy-ferns (*Trichomanes*) to the exclusion of all other vegetation, while nearby tree-trunks and logs are completely covered with another kind of filmy-fern. In other sinks the small halberd-fern (*Tectaria*) predominates, while in still others we find the honeycombed rock sides adorned with various ferns, filmies (*Trichomanes*), maidenhair (*Adiantum*), halberd-fern (*Tectaria*), wood-fern (*Dryopteris*), and spleenwort (*Asplenium*), not to mention the rarer holly-fern (*Stenochlaena*), which is one of the few climbing ferns of Florida. The hammock floor is another kind of fernery. There the strap-fern, various wood-ferns, maidenhair, spleenworts, sword-fern, and large halberd-fern, comprise the more conspicuous kinds. One species of wood-fern (*Dryopteris ampla*) is, at the same time, the most conspicuous and most elegant. It sometimes has an erect stem a foot and a half high and elegant lace-like leaves with a spread of a dozen feet! In these remarkable hammocks there are ferns everywhere, ferns underground, ferns on the ground, and ferns in the air. The trunks and limbs of rough-barked trees are actually clothed with masses of ferns, as well as with orchids, and other plants. The resurrection-fern (*Polypodium*), the strap-fern (*Campyloneurum*), and the Boston-fern (*Nephrolepsis*) are the most common epiphytic kinds, while the elegant vine-fern (*Phymatodes*) occurs plentifully in one hammock. Palmetto trees are often conspicuous ferneries. Below the crown of leaves and growing from among the old leaf-bases one often finds a collection of Boston-fern (*Nephrolepis*), shoestring-fern (*Vittaria*), hand-fern (*Cheiroglossa*), and serpent-fern (*Phlebodium*).

In passing, before taking up the additional tropical locality, it may be of interest to mention a kind of half-way station where a few tropical kinds of ferns have found congenial conditions, and flourish. It is the magnificent hammock that clothes the eastern shores of Lake

Okeechobee. Here vegetation is protected by the tempering of the westerly winds, that blow across the lake in winter. As a consequence the Boston-fern (*Nephrolepis*) and the strap-fern (*Campyloneurum*), as well as some epiphytic orchids, are abundant.

The third tropical fern area—and the one by far most difficult to understand or to interpret satisfactorily—is that district several hundred miles north of the Everglade Keys previously referred to, the lime-sink region in the northwestern part of the peninsula. Here the hammock is composed of trees not tropical, but characteristic of more northern warm temperate regions. The trees are mostly deciduous-leaved. There one finds iron-wood (*Carpinus*), oak (*Quercus*), elm (*Ulmus*), sugarberry (*Celtis*), mulberry (*Morus*), sweet-gum (*Liquidambar*), ash-leaved maple (*Negundo*), maple (*Acer*), and flowering dogwood (*Cynoxylon*). The boulders, sinks, chasms, cañons, caves, and cliffs hidden in these hammocks support a growth of ferns, even if of a fewer number and of less variety, yet, just as tropical, both in character and in kind, as do the lime-sinks of the Everglade Keys. There is one striking difference, it is true. This is the absence of the epiphytic kinds so common to the more southern area. The resurrection-fern (*Polypodium polypodioides*) is the only truly epiphytic kind. Following is a list of the species found in the largest known grotto:

Polypodium polypodioides (Resurrection-fern)
Polypodium Plumula (Polypody)
Polypodium pectinatum
Pteris cretica (Bracken)
Adiantum tenerum (Maindenhair-fern)
Asplenium abscissum (Spleenwort)
Asplenium Curtissii
Asplenium heterochroum
Asplenium platyneuron
Asplenium verecundum
Tectaria heracleifolia (Halberd-fern)
Dryopteris floridana (Wood-fern)
Dryopteris normalis (Shield-fern)
Dryopteris reptans

These species, or the related types in the case of the endemic *Asplenium Curtissii*, are of general tropical distribution. The plants are evergreen and have no apparent resting period during the year.

Such a copious growth of ferns is rarely seen anywhere else in Florida. Boulders and cliffs are often entirely hidden from view by dense masses of the various ferns growing intimately mixed. On other overhanging rocks with rather smooth faces the plants are often scattered. Most of the kinds grow not only on the perpendicular faces of the rocks, but also on the top of boulders and all more or less horizontal surfaces. The masses of leaves of all sizes and kinds of ferns often completely hide numerous pitfalls of various sizes and ranging from a few feet to twelve feet deep. Walking is rendered exceedingly dangerous from these treacherous pitfalls alone, not to mention the soft and crumbling edges of cliffs and ledges.[12]

Among the tropical ferns that do not comply with our rule of these three tropical phytogeographic areas, are the amphibious leather-ferns (*Acrostichum*), which extend northward along the coastal strip or through the Everglades up into the Lake region, the floating-ferns (*Ceratopteris*) which are scattered through the peninsula up into the Lake region, and such epiphytes as the hand-fern (*Cheiroglossa*), the serpent-fern (*Phlebodium*), the vine-fern (*Phymatodes*), the shoe-string fern (*Vittaria*), two species of strap-fern (*Campyloneurum*), and the sword-fern (*Nephrolepis*).

The exception in the case of the epiphytes, however, is easily accounted for. The soil or rock conditions in the country lying between southern Florida and the northern part of the peninsula are wanting, but whenever the conditions of hammocks in this intervening territory are favorable, for example, the hammock on the eastern shore of Okeechobee, these epiphytes, finding congenial conditions, take hold and thrive.

There are nine kinds of ferns common to the Everglade Keys and to the lime-sink region. They are of tropical origin. There are forty-two species growing on the Everglade Keys not yet found in the lime-sink region, and five species have been collected in the lime-sink region not yet met with on the Everglade Keys.

Travelers and botanists observed and perhaps collected specimens of ferns in Florida before the beginning of the Eighteenth century. Then during the earlier part of the last century, further collections were made in many localities, and about the middle of that century nearly fifty species of ferns were known to grow wild in the entire state. During the eighth and ninth decades of the last century and

[12] For more detailed accounts of these fern grottoes see A. H. Curtiss, Plant World 5: 68-70, 1902, and R. M. Harper, American Fern Journal 6: 68-81, 1916.

the first decade of the present century, however, during which periods collectors carried on botanical explorations in the less-known parts of the state, the list of Florida ferns was increased by more than fifty additional species. So that now, as already stated, we know that in this state alone there are growing, without cultivation, over one hundred different kinds of ferns and fern-allies.

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CALYMPERACEAE OF NORTH AMERICA

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Calymperaceae of North America

R. S. WILLIAMS

(WITH PLATES 15–17)

The next part of the North American Flora relating to mosses will comprise the families Fissidentaceae and Calymperaceae. The second of these families includes only two genera, *Syrrhopodon* and *Calymperes*. The results obtained from the study of this group are here offered in advance, partly to allow the illustrations of cross-sections of the leaves to be issued with the descriptions.

SYRRHOPODON Schwaegr. Suppl. 2^2: 110. 1824

Dioicous or rarely autoicous. Growing in mostly compact cushions of pale green to greenish brown color with more or less radiculose, branching stems from a few millimeters to 6–8 cm. high. Leaves with mostly imbricate, often conspicuously white base, mostly narrowed upward to a point varying from straight to crispate and from lanceolate to lingulate or ligulate, with acute or rounded, mostly denticulate apex and having a distinct border (except in *S. martinicensis*) either much thickened or of hyaline or yellowish cells. Costa stout, from nearly percurrent to excurrent, often papillose or spiny on one or both sides, in cross-section showing one row of guide-cells with rarely a few accessory guide-cells, stereid bands above and below them and outer cells mostly differentiated. Leaf-cells throughout upper part of leaf chlorophyllose and roundish or oval to quadratic, rarely smooth, mostly papillose or mamillose on one or both sides; cells of the erect base mostly hyaline (the cancellinae), square to linear, changing abruptly into the green cells of upper part of leaf. Perichaetial leaves usually smaller than the stem-leaves. Seta erect, elongate and smooth. Capsule erect, regular, oval to cylindric, mostly smooth and glossy. Annulus none. Peristome-teeth rarely wanting, mostly narrowly lanceolate and undivided, sometimes very short and irregular, usually papillose and golden brown. Lid conical and often long-rostrate. Calyptra cucullate, the base entire or somewhat split, the apex often rough. Spores usually rough. Gemmae often borne on the leaves, either growing from the upper costa or rarely from cells of leaf-blade on either side of the costa. [PLATES 15, 16.]

Type species: *Calymperes Gardneri* Hook.

Leaf-margin with external cells not differing in color or length from those of blade within but sometimes with an inner stereid band.
  Margin much thickened, forming a distinct border.
    Border triangular in cross-section and more or less doubly serrate-winged.
      Leaf-base golden brown or reddish.
        Leaves less than 0.4 mm. wide and about 1 mm. long, the margin sharply dentate with often spreading somewhat ciliate teeth. — 1. *S. rigidus.*
        Leaves mostly over 0.8 mm. wide and about 1.5 mm. long, the margins slightly serrulate above. — 2. *S. Bernoullii.*
      Leaf-base mostly pale or hyaline.
        Costa very rough with papillae up to 8 mm. high, more prominent on the back in the lower than the upper half of costa. — 3. *S. floridanus.*
        Costa nearly smooth or much smoother on the back in the lower half than in the upper half, with papillae up to 4 mm. high. — 4. *S. incompletus.*
    Border oval in cross-section, not winged and distantly serrulate; cells throughout upper leaf, distinct, mostly oval. — 5. *S. Berterianus.*
  Margin not thickened, without a border. — 6. *S. martinicensis.*
Leaf-margin with hyaline or yellowish border of narrow, elongate cells (sometimes wanting in upper part of leaf), sharply defined from cells of blade within.
  Border of a mostly cylindric band of stereid cells extending from or near apex to the basal part.
    Margin entire or nearly so all around except at apex of leaf.
      Leaves with point crispate when dry and only one or two times longer than the broadened leaf-base.
        Costa smooth on both sides except at the denticulate apex; leaf-cells densely covered with low papillae. — 7. *S. Gaudichaudii.*
        Costa more or less spiny dentate on back to

below the middle; leaf-cells with often high, spine-like papillae. 8. *S. inflexus.*

Leaves with point spreading-flexuous to incurved or nearly straight when dry and from two to many times longer than the basal part, or without a distinctly broader basal part.

Costa without accessory guide-cells; stems usually much longer than the longest leaves (about 12 mm.)

Leaves rather distant with the point abruptly spreading from the conspicuous, appressed base; costa dentate at apex, not papillose below. 9. *S. Husnoti.*

Leaves closer together on the stem with less spreading points; costa mostly papillose on the back in the upper part as well as dentate at apex. 10. *S. flavescens.*

Costa with accessory guide-cells; stems much shorter than the longest leaves (stems usually 5–6 mm. long and leaves up to 4 cm. long). 11. *S. tenuifolius.*

Margin serrulate to enlarged base, or base with more or less serrate or spiny-dentate border.

Cells of leaf smooth. 12. *S. lycopodioides.*

Cells of leaf either mamillose or papillose, that is, similar on both sides.

Costa about 25 μ wide halfway up, smooth except near the apex. 13. *S. recurvulus.*

Costa 50 μ wide or more half way up.

Smooth or with minute, distant teeth on the back, the upper face papillose mostly from just above the cancellinae half way to apex. 14. *S. graminicola.*

Rough with prominent, often spine-like teeth on the back.

Costa spiny-dentate on the back in the upper half, otherwise smooth. 15. *S. elongatus.*

Costa with dense, compound or forking papillae extending to below the cancelinae on the back. 16. *S. texanus.*

Border mostly wanting in upper third of leaf or in some leaves scarcely present or entirely wanting throughout.

Cancellinae mostly broad and somewhat rounded above. 17. *S. ligulatus.*

Cancellinae terminating above in narrowly acute angles next the costa.

Costa near the apex of cancellinae 60–80 μ wide and leaf-blade 0.6–1 mm. or more wide. 18. *S. parasiticus.*

Costa near apex of cancellinae 40–50 μ wide and leaf-blade 0.25–0.50 mm. wide. 19. *S. filigerus.*

1. SYRRHOPODON RIGIDUS Hook. & Grev. in Brewster, Edinb. Jour. Sci, 3: 226. 1826

Calymperes androgynum Mont. Ann. Sci. Nat. II. 3: 195. 1835.
Syrrhopodon longisetaceus C. Müll. Syn. 1: 535. 1849.

Dioicous, male plants much like the fertile in habit, bearing several buds in the axils of the upper leaves rather over 1 mm. long, composed of two or three broadly ovate, lanceolate-pointed, serrulate and costate perigonial leaves, enclosing eight to ten antheridia about 0.5 mm. long, with few paraphyses: in rather compact, dull, brownish green cushions, red-tomentose within, with stems 1–3 cm. high; stem-leaves 7–8 mm. or sometimes up to 12 mm. long, spreading flexuous, from an ovate base 1–1.5 mm. long, with margins sharply serrulate or somewhat spiny-dentate with often spreading teeth, rather gradually narrowed to a linear-lanceolate, acute point up to seven or eight times longer, with thickened, doubly serrate borders; costa stout, excurrent, grooved, enlarged at apex and bearing numerous slender propagula with two or three cross-walls, smooth in lower part, mostly rough above on both sides or rarely nearly smooth, in cross-section showing about seven guide cells, large stereid bands above and below and outer cells differentiated all round; cells throughout upper part of leaf distinct, mostly oblong, 6–8 μ wide and 12–16 μ long, mamillose on upper side, smooth beneath; cancellinae not filling entire basal part of leaf, more or less golden or reddish brown, mostly terminating above in acute angles; perichaetial leaves about like upper stem-leaves, but the inner smaller; seta 2–2.5 cm. long; capsule oblong, about 1.7 mm. long with conical, rostrate lid of about equal length; peristome a low, yellowish membrane, when moist scarcely extending above rim of capsule; spores rough, up to about 22 μ in diameter; calyptra nearly smooth throughout. [FIG. 1.]

TYPE LOCALITY: Trinidad.

DISTRIBUTION: Porto Rico, Guadeloupe, Martinique, St. Vincent, Grenada, Trinidad and northern South America.

ILLUSTRATION: Ann. Sci. Nat. II. 3: *pl. 3, f. 2.*

2. SYRRHOPODON BERNOULLII C. Müll. Bull. Herb. Boiss. 5: 189. 1897

Syrrhopodon Pittieri Ren. & Card. Bull. Soc. Bot. Belg. 41^1: 54. 1905.

Dioicous, male plants stout, branching, with often abundant axillary flowers, the perigonial leaves mostly golden brown, the inner ovate, acute, not quite entire, the outer longer with pale, lanceolate, serrulate point, enclosing five or six antheridia a little over one half mm. long with somewhat longer paraphyses: in large, not very compact, greenish brown tufts, with more or less curved, branching stems, tomentose below, up to 4 or 5 cm. high; stem-leaves spreading-flexuous, up to 6 or 7 mm. long, from an oblong-ovate, mostly golden brown base about 1.5 mm. long, slightly crenulate or serrulate on borders, gradually narrowed to a linear-lanceolate point, tubulose when dry, with thick, doubly serrate margins and acute apex; costa not quite percurrent, serrulate on back toward apex, smooth below, one half up about one sixth the width of leaf, in cross-section showing six or seven guide cells, large stereid bands above and below and outer cells differentiated; leaf-margin in cross-section triangular, showing a stereid band surrounded by rather large outer cells; cells throughout upper leaf mostly slightly elongate, the median about 6 μ wide by 7–8 μ long; cancellinae filling a rather small part of leaf-base, mostly broad and rounded or truncate above; inner perichaetial leaves scarcely smaller than outer; seta 10–18 mm. long; capsule ovate-oblong, small-mouthed, about 2 mm. long with a slender-beaked lid 1.5 mm. long; peristome teeth projecting above the mouth about 75 μ, often united to near apex, rather pale, with often numerous, golden brown, wart-like projections over the outer surface; spores rough, 18–24 μ in diameter; calyptra rough near apex. [FIG. 2.]

TYPE LOCALITY: Guatemala.

DISTRIBUTION: Guatemala to Panama and in Guadeloupe (*Père Duss 631*).

3. SYRRHOPODON FLORIDANUS Sull. in Gray, Man. ed. 2, 631. 1856

Dioicous: in compact cushions, greenish brown above, rusty brown within, with more or less fasciculate branching stems, somewhat tomentose below, up to 3 cm. high; stem-leaves incurved or crispate when dry, the upper 4.5–5 mm. long, from an ovate base about 1 mm. long, somewhat narrowed to a nearly linear point three and one half to four times longer with incurved, doubly serrulate-lamellate borders and broadly acute or obtuse, serrulate apex; costa not quite percurrent, about 80 μ wide half way up the leaf, mostly densely covered on the back, from the middle to the broadened base of leaf, with high, almost spine-like, papillae; leaves in cross-section near middle showing a terete costa with five or six guide-cells, large stereid bands above and below and outer cells differentiated; leaf-blade with cells highly mamillose on upper side, nearly smooth or somewhat mamillose on under side with a leaf-border triangular in cross-section, of about eight cells sometimes enclosing one or two stereid cells; cells of upper blade distinct, mostly somewhat angular, scarcely elongate, 5–7 μ in diameter; cancellinae extending up about 1 mm. from base, mostly rounded, sometimes acutely angular at apex; perichaetial leaves scarcely differing from those of upper stem; pedicel erect, 7–8 mm. long; capsule ovate-cylindric, about 1.75 mm. long, the flattish lid with acicular beak rather shorter; peristome-teeth attached well below the mouth, somewhat irregular, short-lanceolate, pale, projecting above the rim 50–60 μ, with five or six articulations; spores rough, about 16 μ in diameter; calyptra slightly rough above. [FIG. 3.]

TYPE LOCALITY: Florida.

DISTRIBUTION: Florida, Alabama, Georgia and Bermuda.

ILLUSTRATION: Sull. Icon. Musc. *pl. 31.*

This is very close to the next species, but the costa is usually much rougher on the back, and the cells of the upper part of the leaf are less inclined to be slightly elongate.

4. SYRRHOPODON INCOMPLETUS Schwaegr. Suppl. **2**[1]: 119. 1824

Syrrhopodon Hobsoni Hook. & Grev. in Brewster, Edin. Jour. **3**: 224. 1824.

Syrrhopodon semicompletus Schwaegr. Suppl. **2**[2]: 97. 1827.

Calymperes Hobsoni Grev. Ann. Lyc. N. Y. **1**: 271. 1825.

Syrrhopodon Mohrii C. Müll. Linnaea **38**: 633. 1874.

Syrrhopodon brachystelioides C. Müll. Nuovo Giorn. Bot. Ital. II. **4**: 48. 1897.

Syrrhopodon decolorans C. Müll. Bull. Herb. Boiss. **5**: 188. 1897.

Dioicous, male flowers one to several, terminal and axillary, the inner perigonial leaves short, broadly ovate, acutish, costate, minutely serrulate, nearly or quite without green point, enclosing numerous antheridia and paraphyses a little over 0.5 mm. long: in extensive, brownish green mats with more or less curved and branching stems 1–5 cm. long; stem-leaves 4–5 mm. long, from a rather broad, ovate or obovate base serrulate on margins above, abruptly narrowed to a broadly linear, when dry often subtubulose, point with thickened doubly serrulate border extending to the broadly acute or somewhat rounded serrulate apex; costa not quite percurrent, 60–70 μ wide one half up leaf and about one sixth leaf-width, at apex denticulate, below from nearly smooth on both sides to more or less papillose (the papillae mostly 1–4 high) on back down to cancellinae, in cross-section showing about six guide cells with stereid bands above and below and outer cells differentiated; cells throughout upper part of leaf from nearly square to hexagonal, often slightly elongate, the median mostly 5–6 μ wide and 6–8 μ long, mamillose on upper side, smooth or slightly mamillose or papillose on under side; cancellinae filling two thirds to three fourths of the leaf-base, broad and rounded above; inner perichaetial leaves very similar to outer but smaller; seta 6–7 mm. long; capsule oblong-ovate, small-mouthed, rather over 2 mm. long without lid, the beaked lid about two thirds as long; peristome a rather pale, smoothish membrane not extending above the mouth, often nearly entire; spores rough, 16–18 μ in diameter; calyptra slightly rough above. [FIG. 4.]

TYPE LOCALITY: Cuba.

DISTRIBUTION: Mexico, Florida, Cuba, Jamaica, Porto Rico, Montserrat and Guiana, South America.

ILLUSTRATION: Schwaegr. Suppl. **2**: *pl. 180*.

EXSICCATI: Krypt. Exsic. Mus. Palat. Vindob. *1896*, as *Syrrhopodon Hobsoni*.

5. SYRRHOPODON BERTERIANUS (Brid.) C. Müll. Syn. **1**: 539. 1849

Dicranum Berterianum Brid. Bryol. Univ. **1**: 445. 1826.

Syrrhopodon laevidorsus Besch. Rev. Bryol. **18**: 75. 1891.

Apparently dioicous, male flowers not found: in rather loose, deep, brownish green tufts with stout stems up to 7–8 cm. high; stem-leaves 5–6 mm. long, from a broad, obovate, erect and clasping base, slightly serrulate on margins above, abruptly narrowed to a linear, spreading-flexuous point with acute apex and thickened, distantly serrulate borders; costa not quite percurrent, nearly one third the width of upper leaf, terete, smooth on both sides; leaf in cross-section showing about six guide-cells in costa with large stereid bands above and below and outer cells differentiated all round, the leaf-border of a small stereid band enclosed by larger outer cells; cells throughout upper part of leaf distinct, mostly oval, 6–8 μ wide by 8–12 μ long, smooth on under surface, mostly mamillose above; cancellinae filling one half to two thirds of leaf-base, broad and rounded or truncate above; perichaetial leaves very similar to stem-leaves; seta 10–13 mm. long; capsule oblong, up to 2.5 mm. long with conical, slender-beaked lid two thirds as long; peristome not seen; calyptra smooth; spores rough, spores rough, up to 16 μ in diameter. [FIG. 5.]

TYPE LOCALITY: Porto Rico.

DISTRIBUTION: From Cuba and Jamaica to Trinidad and northern South America.

6. SYRRHOPODON MARTINICENSIS Broth. Symb. Ant. **3**: 422. 1903

Flowers and fruit unknown: in dull green cushions with stiff, erect stems 2–2.5 cm. high, in cross-section showing two to four rows of outer, thick-walled, golden brown cells and no central strand; stem-leaves 3.5–4 mm. long and 1 mm. wide, when dry obliquely incurved or appressed-imbricate, forming a compact bud at apex of stem showing the conspicuous, glossy, whitish costae, the leaf either oblong-ovate or slightly obovate, the base more or less yellowish; leaf-margin incurved when dry, not thickened, papillose on border, otherwise entire or slightly denticulate at apex; costa percurrent, broad and yellowish at base, about 300 μ wide and one third the width of leaf, tapering gradually to apex, in cross-section near middle showing about seven guide-cells with stereid bands above and below of about equal size and outer cells scarcely or not differentiated; cells throughout upper part of leaf more or less hexagonal, scarcely elongate, on upper side mostly mamillate and unipapillate, on under side papillate; cancellinae of leaves growing from below the apex of stem distinct, broad, extending about one third up leaf and terminating in rather acute angles; cancellinae of inner leaves at apex of stem rather ill-defined and leaf-cells on either side of costa just above the cancellinae mostly covered with a dense, green mass of filiform propagula up to 0.8 mm. long, with twenty-five cross-walls. [FIG. 6.]

TYPE LOCALITY: Martinique.

DISTRIBUTION: Guadeloupe and Martinique.

7. SYRRHOPODON GAUDICHAUDII Mont. Ann. Sci. Nat. II. **2**: 366. 1845

Dioicous, male plants about like the fertile, with often several antheridial buds aggregate near the apex of stem, the antheridia few, without paraphyses, enclosed by several short, ovate, serrulate, costate, brownish leaves: in compact, green tufts, showing the conspicuously white leaf-bases, with branching stems 1–3 cm. high; stem-leaves more or less twisted and crispate when dry, from an obovate or oblanceolate, nearly or quite entire, erect base narrowed to a linear-lanceolate or nearly linear, deeply grooved point from mostly as long to about twice longer than basal part, with a hyaline or yellowish border, entire except at the broadly acute, denticulate apex; costa not quite percurrent, smooth on both sides except at the denticulate apex, about one sixth the width of leaf at middle, in cross-section showing mostly four guide-cells, a stereid band much larger below than above and outer cells not differentiated; cells of upper part of leaf rather obscure, about 6 μ in diameter, densely papillose on both sides; cancellinae filling most of basal part of leaf, somewhat rounded or truncate above; outer perichaetial leaves much like the stem-leaves, the two or three inner much smaller, of mostly hyaline cells, often slightly serrulate; seta up to 5 or 6 mm. long, not quite smooth above; capsule erect, oblong, scarcely 1.5 mm. long, with convex-conical, rostrate lid about 1 mm. long; peristome-teeth golden-brown, not quite smooth, lanceolate, entire, projecting about 80 μ above the rim of capsule with rather prominent articulations; spores rough, 12–14 μ in diameter; calyptra not seen. [FIG. 7.]

TYPE LOCALITY: Isle of St. Catharine, Brazil.

DISTRIBUTION: West Indies and northern South America.

ILLUSTRATION: Ann. Sci. Nat. II. **2**: *pl. 16, f. 3*.

8. SYRRHOPODON INFLEXUS Mitt. Jour. Linn. Soc. **12**: 117. 1869

Syrrhopodon Sartorii C. Müll. Linnaea **37**: 633. 1874.

Male flowers unknown: in compact, green tufts with somewhat branching stems up to 2 cm. high; stem-leaves with conspicuous, white, imbricate base, twisted and crispate in upper part when dry, up to about 3 mm. long, from an oblanceolate base with entire margin, usually one half to two fifths the length of leaf, gradually narrowed to a nearly linear, grooved point with distinct, entire, pale yellowish border not quite reaching the rather broad, toothed and apiculate apex which sometimes bears numerous spindle-formed or club-shaped propagula up to 100 μ long, with six to eight cross-walls; costa usually smooth except on the more or less spiny-dentate back toward the apex, in cross section showing about five guide cells, stereïd bands above and below, the upper band much smaller than the lower and the outer cells not differentiated; cells throughout upper part of leaf mostly rather obscure, highly mamillose or papillose or sometimes almost spiny on both sides, the median about 8 μ in diameter; cancellinae filling most of erect base of leaf, usually rounded above; inner perichaetial leaves much shorter than outer, about 1.5 mm. long, with very short, green, serrulate points; pedicel 4–5 mm. long, bearing an oblong capsule 1–1.5 mm. long with slender-beaked lid about one half as long; peristome-teeth golden-brown, lanceolate, nearly smooth, with rather distinct articulations, projecting above the mouth about 100 μ; spores rough, 14–15 μ in diameter; calyptra rough in upper third. [FIG. 8.]

TYPE LOCALITY: Colombia near Bogota at 6000 ft. alt.

DISTRIBUTION: known only from Mexico and Colombia.

9. SYRRHOPODON HUSNOTI Besch. Ann. Sci. Nat. VI. **3**: 195. 1876

Flowers and fruit unknown: in loose, brownish green tufts with slender, fragile, more or less branching stems up to 4 cm. high; stem-leaves from a conspicous, white, imbricate, oblong-linear or oblanceolate, entire base about 1.5 mm. long, somewhat narrowed to an abruptly spreading nearly straight, setaceous, more or less twisted point two and one half to three times longer, with pale yellowish, cylindric border, entire except at the dentate, acute, or somewhat rounded apex; costa not quite percurrent, smooth on both sides except at the denticulate apex, one half up leaf one third to one fourth the width of leaf, in cross-section showing four guide cells, stereid bands above and below with outer cells not differentiated; cells of upper leaf rather obscure, papillose on both sides, the median about 6 μ wide and 8–10 μ long; cancellinae nearly filling leaf-base, terminating in mostly acute angles. [FIG. 9.]

TYPE LOCALITY: Guadeloupe.

DISTRIBUTION: Porto Rico, Guadeloupe and Martinique.

10. SYRRHOPODON FLAVESCENS C. Müll. Syn. **1**: 541. 1849

Syrrhopodon parvulus Schimp. C. Müll. Syn. **1**: 544. 1849.

Syrrhopodon Schwaneckeanus C. Müll. Bot. Zeit. **13**: 763. 1855.

Syrrhopodon scaber Mitt. Jour. Linn. Soc. **12**: 119. 1869.

Syrrhopodon calymperidianus Besch. Ann. Sci. Nat. VI. **3**: 19. 1876.*

Syrrhopodon subviridis Besch. Ann. Sci. Nat. VI. **3**: 196. 1876.

Syrrhopodon scaber var. *breviligulatus* C. Müll. Hedwigia **37**: 235. 1898.

Syrrhopodon breviligulatus C. Müll. Gen. Musc. 370. 1901.

Syrrhopodon Dussii Broth. Symb. Ant. **3**: 422. 1903.

Dioicous: in compact yellowish brown to pale green cushions with branching stems, mostly 1–2 cm. high, bearing radicles at their base and often at the base of easily separating branches; stem-leaves when dry erect-spreading, flexuous, 5–12 mm. long, with an oblong-linear base 1–1.5 mm. long, rather gradually narrowed to a linear point three to eight times longer and about one

* Type specimens not seen but belonging here according to the description.

third as wide as the base, with cylindric, yellowish or hyaline border extending all round and entire except at the acute or somewhat rounded, dentate apex; costa not quite percurrent, more or less spiny-dentate near apex on both sides, in cross-section showing four to eight guide-cells with stereid bands above and below, the outer cells on upper side and usually two or three outer cells next guide cells on either side below, differentiated; leaf-cells rather obscure, often slightly elongate, about $6 \times 6\,\mu$–$8 \times 10\,\mu$, with thickened, minutely papillose walls on both surfaces; cancellinae ending above in narrowly acute angles or sometimes somewhat obtuse, nearly filling leaf-base; perichaetial leaves scarcely differing from upper stem-leaves; seta slender, erect, red, 5–8 mm. long; capsule oblong-cylindric, scarcely 1.5 mm. long, with rostrate lid about 1 mm. long; peristome teeth lanceolate, yellowish, papillose, projecting above the mouth about $100\,\mu$, with often indistinct articulations; spores minutely roughened, about $12\,\mu$ in diameter; calyptra extending two thirds down capsule, somewhat rough at apex. [FIG. 10.]

TYPE LOCALITY: Trinidad.

DISTRIBUTION: throughout the West Indies and northern South America to Mexico.

11. SYRRHOPODON TENUIFOLIUS (Sull.) Mitt. Jour. Linn. Soc. **12**: 117. 1869

Calymperes tenuifolius Sull. Proc. Am. Acad. **5**: 280. 1861.

Flowers and fruit unknown: in rather loose, pale green to brown tufts with stems mostly under 5 mm. high; stem-leaves from a few millimeters up to over 4 cm. long, from an oblong-linear, entire base about 1.5 mm. long slightly narrowed to a filiform, somewhat grooved point with acute, dentate apex and hyaline or yellowish border of stereid cells entire below the apex; costa not quite percurrent, at apex somewhat rough to spiny-dentate, below on back mostly smooth, on inner side papillose, often to cancellinae, in cross-section showing about six guide-cells with one to three accessory cells on lower side, large stereid bands above and below and outer cells differentiated on upper side only; cells throughout upper part of leaf obscure, mostly angular and slightly elongate, 5–6 μ wide and 6–8 μ long, covered on both sides by more or less compound papillae; cancellinae filling entire base of leaf except a very narrow border above of green cells and terminating above in mostly acute angles. [FIG. 11.]

TYPE LOCALITY: Cuba.

DISTRIBUTION: Cuba, Jamaica and St. Kitts.

None of the specimens examined show propagula, but on the St. Kitts and Jamaican specimens are found young plants, one to three on a leaf, growing from radicles scattered along the leaf point.

12. SYRRHOPODON LYCOPODIOIDES (Sw.) C. Müll. Syn. 1: 538. 1849

Bryum lycopodioides Sw. Prodr. 139. 1788.

Dioicous, male plants more slender than the fertile, bearing several axillary, scattered antheridial buds, the inner perigonial leaves ovate-lanceolate, acute, nearly entire, enclosing numerous antheridia about 0.8 mm. long with few paraphyses: in loose brownish to pale green tufts with somewhat branching stems up to 8–10 cm. high; stem-leaves up to 9 or 10 mm. long, from an oblanceolate, slightly wider, nearly entire, erect base rather gradually narrowed to a spreading, flexuous, linear-lanceolate point with acute apex and bordered all round by a thickened, distantly serrate margin of brown, elongate cells enclosing a small band of stereid cells; costa not quite percurrent, smooth on both sides, about 80 μ wide one half up the leaf and one fifth the width of leaf, in cross-section showing six guide-cells, stereid bands above and below with outer cells differentiated all round; cells of middle and upper blade smooth on both sides, angular, not or slightly elongate, up to 12–14 μ in diameter, in lower leaf and just above the cancellinae often very irregular, transversely or obliquely elongate, with unequally thickened walls; cancellinae mostly broad and somewhat rounded above, filling one half to two thirds the erect leaf-base; perichaetial leaves much like stem-leaves, often longer and extending above the capsule; pedicel about 10 mm. long; capsule ovate-oblong or somewhat spindle-shaped, when dry contracted under the mouth, about 3 mm. long; lid with slender beak about two thirds capsule in length; peristome teeth incurved when dry and not projecting above the mouth, when moist, extending about 80 μ above the rim of capsule, golden brown, very irregular, more or less divided along median line; spores rough, up to 22 μ in diameter; calyptra smooth above. [FIG. 12.]

TYPE LOCALITY: Jamaica.

DISTRIBUTION: Jamaica, Santo Domingo, Guadeloupe, Martinique, Trinidad and northern South America.

ILLUSTRATION: Hedw. Sp. Musc. Suppl. *pl. 40*.

13. SYRRHOPODON RECURVULUS Mitt. Jour. Linn. Soc. **12**: 120. 1869

Dioicous, the male plants about like the fertile in habit, with numerous anthericial buds on very short axillary branches or terminal, the outer perigonial leaves about 1 mm. long, the inner one half as long, ovate, acute, costate, serrulate, enclosing about four antheridia without paraphyses: in compact, green mats with conspicuous, white leaf-bases and branching stems 1–2 cm. high; stem-leaves up to 3 mm. long, crispate when dry, from a somewhat oblanceolate or oblong base, ciliate to nearly entire on border, gradually narrowed to a nearly linear or linear-lanceolate point about one and one half times longer, with acute, slightly serrulate apex and pale yellow border entire below the apex, costa nearly percurrent, smooth on both sides except at the dentate or spiny-dentate apex, about 25 μ wide and one sixth width of leaf one half down, in cross-section near middle showing about four guide-cells with stereid bands above and below and outer cells not differentiated; cells throughout upper part of leaf rather distinct, somewhat angular, not or slightly elongate, about 6 μ wide by 6–8 μ long, rather densely papillate and mamillate on both sides of upper leaf, becoming more distinctly mamillate on upper surface just above the cancellinae; cancellinae nearly filling the erect leaf-base, mostly rounded above; perichaetial leaves much like stem-leaves but inner with shorter, green point; pedicel 6–7 mm. long; capsule oblong, about 1.35 mm. long with slender-beaked lid half as long: peristome-teeth golden brown, lanceolate, papillose with rather indistinct articulations, extending about 100 μ above the rim of capsule; spores rough, 12 μ in diameter; calyptra rough above. [FIG. 13.]

TYPE LOCALITY: Cuba.

DISTRIBUTION: known only from Cuba.

EXSICCATI: Wright's Cuban Mosses *47* (as *S. Gaudichaudii*).

Very similar to *S. Gaudichaudii* but more or less ciliate-toothed on upper margin of leaf-base.

14. **Syrrhopodon graminicola** Williams, sp. nov.

Flowers and fruit unknown: in small, dull green tufts with stout, branching, flexuous stems 1–2 cm. high, bearing incurved-imbricate or sometimes spreading flexuous and more or less crispate leaves when dry; upper stem-leaves from an ovate, nearly or quite entire base 0.75–1.4 mm. wide gradually narrowed to an oblong-linear or oblong-lanceolate, acute and apiculate point up to about twice as long, with hyaline border of elongate cells extending from base to apex, or sometimes nearly or quite disappearing in the upper one fourth of leaf, the border mostly with small, irregular often geminate teeth to near the base; costa percurrent, 50–125 μ wide and about one seventh the width of leaf one half up from base, slightly serrulate on back in upper part and papillose on upper side from near cancellinae half way or more to apex, in cross-section showing about seven guide-cells with stereid bands above and below and outer cells mostly differentiated on upper side; cells throughout upper part of leaf rather indistinct, scarcely elongate, 6–7 μ in diameter, with usually 2–4 minute papillae on either surface; cancellinae broad, not entirely filling the basal part of leaf, terminating above in mostly acute angles; older stem-leaves often with numerous, slender, cylindrical propagula, 200 to 300 μ long, with about twelve cross-walls, growing from cells of blade near either side of costa a little above the cancellinae on the upper surface of leaf and extending half way or more to the apex. [FIG. 14.]

TYPE collected in Jamaica, growing on bamboo joints, Woodstock, Westmoreland Hills, September, 1907, *E. G. Britton 579* (herbarum of the New York Botanical Garden).

DISTRIBUTION: known only from the type locality and Sierra Nipe, Cuba.

This is somewhat like *S. flexifolius* Mitt., but the cells are smaller, more obscure, less elongate, and densely papillose—not smooth or nearly so, as in *S. flexifolius*.

15. SYRRHOPODON ELONGATUS Sull. Proc. Am. Acad. 5: 280. 1861

Evidently dioicous, male flowers not found: in tall, compact, pale green to brown tufts with erect stems up to 12 cm. high, often bearing at the apex two to four short, fruiting branches with spreading-flexuous to somewhat squarrose leaves from a conspicuous, imbricate, whitish base and abundant tomentum on both stems and leaves; leaves of stem and branches, from an oblong base about 2 mm. long, somewhat spiny-dentate above, narrowed to a recurved, grooved, twisted and flexuous or nearly straight point about 3 mm. long, spiny-dentate above and slightly serrulate on the pale, cylindric border below to the enlarged base; costa excurrent into a thorn-point, about 50 μ wide near the middle, smooth on inner face, spiny-dentate about one half down on the back, in cross-section showing four guide-cells, stereid bands above and below, with outer cells not differentiated; cells throughout upper part of leaf distinct, roundish or slightly elongate, 8–9 μ in diameter, highly mamillose on both sides and more or less minutely papillose with three or four papillae to each cell surface; cancellinae nearly filling the erect base, mostly broad and rounded above; inner perichaetial leaves rather smaller than outer, with base yellowish; seta 15–18 mm. long; capsule oblong-cylindric, small-mouthed, about 2.5 mm. long; peristome-teeth projecting above mouth 125 μ, lanceolate, golden brown, rough, with rather indistinct articulations; spores rough, about 16 μ in diameter; lid with beak about 1.5 mm. long; calyptra descending over one half down capsule, rough in upper half. [FIG. 15.]

TYPE LOCALITY: Cuba: *Wright 49*, sterile specimens (fruit described from specimens collected in 1910 near Woodford, Sierra Nipe, Oriente, *J. A. Shafer 3733*.)

DISTRIBUTION: known only from Cuba.

16. SYRRHOPODON TEXANUS Sull. Musci U. S. 103. 1856

Syrrhopodon alabamensis Lesq. & Schimp.; Jaeger, Ber. St. Gall. Nat. Ges. **1877–78**: 413. 1879.

Male plants unknown: in pale green to dusky green cushions with simple or slightly branching stems 2–3 cm. high; stem-leaves more or less crispate and tubulose when dry, erect-spreading when moist, the upper about 4 mm. long, linear-lingulate (or above often consisting of little more than the stout, very rough costa if bearing propagula), from a somewhat broader, ovate base, one fourth or more the entire length, with apex obtuse, often spiny-dentate, and border of leaf pale, irregularly dentate to spiny-dentate almost to the insertion of leaf; costa stout, 90–125 μ in diameter below, vanishing just below apex, very rough on back to below the cancellinae, with irregular, low, somewhat forking or spinose papillae; leaves in cross-section showing a terete costa with six or seven guide-cells, thick stereid bands above and below and differentiated outer cells, the leaf-blade mostly mamillose and finely papillose on upper side, papillose on under side, the margin a cylindrical band of minute, stereid cells extending from a little below the apex to near the cancellinae; cells of lamina variable, mostly roundish, obscure, 6–7 μ in diameter in upper leaf to somewhat pellucid and larger below, at least near the cancellinae; cancellinae either acute or somewhat rounded at apex, the cells toward costa broad, often nearly square; perichaetial leaves very similar to upper stem-leaves; seta erect, 1–2 cm. long; capsule ovate-cylindric, contracted at mouth, about 2 mm. long, with slender-beaked lid nearly as long; peristome-teeth short, lanceolate, obtuse, with two or three prominent articulations; calyptra descending to base of capsule, scabrous one third down from apex; spores minutely punctate, about 14 μ in diameter. [FIG. 16.]

TYPE LOCALITY: Texas.

DISTRIBUTION: Texas to Florida and Georgia.

17. SYRRHOPODON LIGULATUS Mont. Syll. 47. 1856

Syrrhopodon crispus Aust. Bot. Gaz. **2**: 109. 1877.

Growing in compact, brownish green tufts with mostly simple stems up to 1.5 cm. high; stem-leaves with conspicuously white, imbricate base, crispate above when dry, 2–2.5 mm. long from an obovate-lanceolate base, entire to somewhat serrulate in upper part, slightly narrowed to a lingulate, grooved point, from scarcely as long to about one and one half times longer than the base, with rounded apex and margin crenulate-papillose with short green cells except in lower part, where a narrow, hyaline border of elongate cells is usually present; costa nearly or quite percurrent, slightly serrulate on back toward the apex, smooth below, about one eighth the width of leaf half way up, in cross-section showing toward the base four guide-cells, in upper half mostly two or three guide-cells with stereid bands above and below and no differentiated outer cells, the upper stereid band small, often of only three or four cells; cells of upper blade mostly obscure, not elongate, 6–8 μ in diameter, mamillate and densely papillose on both sides; cancellinae nearly filling the enlarged base, mostly broad and rounded above; perichaetial leaves about like those of the stem; seta 3–4 mm. long; capsule ovate, scarcely 1 mm. long; peristome teeth golden brown, projecting well above the mouth, rather rough, with indistinct articulations; spores rough, 12–15 μ in diameter; lid and calyptra not seen. [FIG. 17.]

TYPE LOCALITY: Guiana.

DISTRIBUTION: Florida, Guadeloupe and Guiana.

18. SYRRHOPODON PARASITICUS (Sw.) Besch. Ann. Sci. Nat. VIII. **1**: 298. 1895

Bryum parasiticum Sw. Prodr. 139. 1788.

Encalypta parasitica Sw. Ind. Occ. 1759. 1806.

Calymperes parasiticum Hook. & Grev. in Brewster, Edinb. Jour. Sci. **1**: 131. 1824.

Dioicous, the male plants with often two or three rather conspicuous, scattered buds, the inner perigonial leaves very short, broadly ovate-acute, enclosing numerous antheridia about 0.33 mm. long, without paraphyses: plants scattered or in loose tufts with stems up to 2 cm. high; stem-leaves usually 4–5 mm. long and about 0.65 mm. wide, nearly linear, the basal part often slightly narrower than the upper part, or the terminal leaves at times much shorter and broader, somewhat lanceolate, up to 1 mm. wide, all rather gradually acutely pointed, subtubulose and erect-flexuos when dry, widely spreading, almost squarrose when moist, with a pale, minutely serrulate or entire border of elongate, stereid cells (sometimes quite lacking in the apical leaves) extending from about one third below the apex to four fifths way down the leaf; costa nearly percurrent, smooth on the back except at the slightly denticulate apex, about 60 μ wide near the apex of the cancellinae, in cross-section showing three or four guide-cells, stereid bands above and below them and outer cells not differentiated in the upper part, but more or less differentiated on the ventral side in the lower costa; cells in upper part of blade mamillose on the upper, smooth or unipapillate on the under side, mostly hexagonal and not elongate or slightly so, the median about 8 μ wide by 8–10 μ long, those next the costa on upper side often bearing, from some distance below the apex to near the cancellinae filiform propagulae about 0.5 mm. long, with fifteen to twenty cross-walls; cancellinae filling the most of the leaf-base and terminating in narrow angles next the costa one fourth to one third way up the leaf; perichaetial leaves scarcely differentiated; seta 2–2.5 mm. long, bearing an erect, cylindric capsule about 1.5 mm. long; median exothecal cells more or less four-to-six-sided, 20–25 μ in diameter, with thick walls; peristome and lid not seen; calyptra (immature and not fissured) with rather narrow base, gradually tapering upward and rough throughout. [Fig. 18.]

Type locality: Hispaniola (Hayti).

Distribution: Cuba (*E. G. Britton 5040a*; *Brother Leon 3564*), Hayti, Porto Rico (*5197, E. G. Britton*), Trinidad and Yucatan.

Illustration: Schwaegr. Suppl. 2^2: *pl. 17*.

Known only from the original collection until obtained in Cuba by Mrs. Britton. The type specimens do not seem to show any propagula, but these bodies readily fall off as the leaves become older. The species is quite closely related to the South American *S. flexifolius* Mitt., which has similar propagula, but the latter has larger leaf-cells and a border extending nearer to both the base and the less acute apex while the cancellinae do not form so narrow an angle upward.

Lindberg* has given a rather full description of this species and

* Öfv. Kongl. Vet. Akad. Forh. 21: 604–5. 1864.

considers it to be dioicous; he retains it under *Calymperes* although describing a peristome of sixteen teeth that hardly project above the rim of the capsule, a pale, narrow border as in *Syrrholodon* and a calyptra split on one side; a sterile specimen is also mentioned as bearing filiform propagula as in the recent collections; the lid is said to be subulate and as long as the capsule, but both mature lids and calyptras seem to be unknown in any available collection.

19. **Syrrhopodon filigerus** (Aust.) Williams, comb. nov.

Calymperes filigera Aust. Bot. Gaz. 4: 151. 1879.

Flowers and fruit unknown: in thin, dusky green mats with stems 6–8 mm. high; leaves mostly 2.5–3.5 mm. long, incurved or crispate when dry, from a narrowed, more or less oblong, base becoming slightly wider upward to a point about three fourths up leaf, then gradually narrowing to the broadly acute apex, the leaf-blade somewhat keeled and borders flat and entire or nearly so; costa vanishing in apex, 40–50 μ wide about one half up and one tenth the width of the leaf, sometimes bearing numerous filiform propagula from near the middle half way up to apex; costa in cross-section somewhat semiterete, with six or seven guide-cells, stereid bands above and below them and without differentiated outer cells; the cells of leaf-blade mamillose on upper side, finely papillose on under side; border of leaf scarcely extending above the middle, often more or less wanting below, composed of a pale, cylindric band of elongate, stereid cells; cells of blade pellucid, mostly slightly elongate, somewhat angular, the median 7–8 μ wide and 8–10 μ long; cancellinae often extending two fifths up leaf and terminating next the costa in very acute angles. [FIG. 19.]

TYPE LOCALITY: Caloosa, Florida.

DISTRIBUTION: known only from the type locality.

This species is nearly related, by the position of the propagula and shape of leaf, to *S. parasiticus*, but the latter is a larger plant with much wider leaves and costa.

Note.—*S. circinatus* Schimp. is *Symblepharis Schimperianum* (Paris) Card.; *S. crispatus* Hampe is *Didymodon campylocarpus* C. Müll.; *S. fragilis* Hampe is *Trichostomum Schlimii* C. Müll.; *S. strigosus* (Brid.) Mitt., probably does not belong to the Calymperaceae, but the type does not seem to be known in Berlin.

CALYMPERES Sw. (?Weber f. Tab. Calypt. Operc. 1813) in Schwaegr. Suppl. 1^2: 333. 1816

Dioicous: plants mostly of medium size, growing in compact tufts with erect, often dichotomous stems, radiculose at the base. Stem-leaves when dry mostly strongly incurved or crispate and subtubulose above the erect, clasping, usually broader and conspicuously white base, the leaf-point varying from lanceolate to lingulate or ligulate with apex often broad. Costa stout, vanishing just below the apex or more or less excurrent, often enlarged and bearing propagula in dense clusters at the apex, from smooth to rough on both sides, sometimes spinose, in cross-section showing from one to three rows of guide-cells with stereid bands above and below and outer cells mostly differentiated. Leaf-margin usually more or less thickened and serrate or sometimes with two serrate wings. Ribbon-like bands of green, elongate cells (teniolae), occasionally wanting, extend just within the margin from base to near apex in some species, in others only for a short distance in the upper basal part of leaf. Cells of upper blade roundish to angular, sometimes shortly elongate, chlorophyllose, often rather obscure, mostly mamillose on upper side and smooth to somewhat mamillose and often papillose on under side; hyaline, rectangular or nearly square cells (cancellinae), usually filling most of basal or sheathing part of leaf, except a narrow border, and changing abruptly into the green cells of blade above (except in *S. fluviatile* which lacks cancellinae). Peristome none. Capsule oblong to cylindric, smooth, on an erect, more or less elongate seta. Calyptra persistent, plicate, rough in upper part, embracing the base of capsule and split on sides only part way down to the base. [PLATE 17.]

Type species: *Calymperes lonchophyllum* Schwaegr.

With cancellinae; teniolae usually present.
- Leaf-cells not transversely elongate throughout blade above cancellinae; the spreading blade more or less crispate when dry and not more than 3 or 4 times longer than clasping basal part; guide-cells of costa in one row except in *C. cubense*.
  - Leaf-margin distinctly serrulate throughout upper part of leaf or entire and basal part somewhat serrulate.
    - Teniolae extending to or above the middle of leaf.
      - Green cells of blade mostly up to 7 or 8 μ in diameter and in about forty rows or less from costa to margin in widest part of leaf.
        - Mamillose cells not terminating in small papillae; teniolae only two or three

cells in from margin in upper basal part of leaf; cancellinae mostly broad and rounded above.

Costa as wide or wider at the base than half way up. — 1. *C. Richardi.*

Costa about one half as wide at the base as half way up. — 2. *C. cubense.*

Mamillose cells terminating in one or two small papillae; teniolae four to eight cells in from margin in upper basal part.

Cancellinae terminating in acute angles next costa; leaf-base not much broader than blade above. — 3. *C. emersum.*

Cancellinae terminating in broad angles or rounded above; leaf-base two or three times wider than blade above. — 4. *C. disciforme.*

Green cells of blade about 4 μ in diameter, in fifty to one hundred rows in widest part of of leaf; teniolae usually six to twelve cells in from margin in lower leaf and distinct to insertion of leaf. — 5. *C. Donnellii.*

Teniolae very short or wanting, only found in upper basal part of leaf when present.

Upper side of costa rough to near cancellinae and teniolae present. — 6. *C. nicaraguense.*

Upper side of costa smooth except near apex and teniolae wanting. — 7. *C. Heribaudi.*

Leaf-margin entire above and below or slightly serrulate near apex only.

No teniolae; costa rough on both sides to below the middle. — 8. *C. Nashii.*

Teniolae short, but usually distinct in upper base; costa smooth, or nearly so, to apex. — 9. *C. Guildingii.*

Leaf-cells distinctly transversely elongate except in the small basal part; the spreading leaf-blade nearly straight or somewhat flexuous, rarely somewhat crispate, eight to fifteen times longer than the narrow clasping base; guide-cells of costa in two or three rows.

Leaves up to 15 or 18 mm. long; teniolae mostly more or less evident in basal part; stems under 6 mm. long. — 10. *C. lonchophyllum*

Leaves up to 8 or 10 mm. long; teniolae wanting; stems usually much more than 6 mm. high. — 11. *C. Levyanum.*

Without cancellinae; teniolae finely developed. — 12. *C. fluviatile.*

1. CALYMPERES RICHARDI C. Müll. Syn. **1**: 524. 1849

Calymperes Breutelii Besch. Ann. Sci. Nat. VIII. **1**: 278. 1895.

Calymperes guadalupense Besch. Ann. Sci. Nat. VIII. **1**: 285. 1895.

Calymperes hexagonum Besch. Ann. Sci. Nat. VIII. 1: 286. 1895.
Calymperes Hookeri Besch. Ann. Sci. Nat. VIII. 1: 287. 1895.
Calymperes panamae Besch. Ann. Sci. Nat. VIII. 1: 298. 1985.

In compact cushions with sometimes branching stems 5–6 mm., or rarely up to 2 cm. high; leaves strongly incurved or crispate when dry, the lower short, ovate, about 0.75 mm. wide by 1.5 mm. long, the upper 3–3.5 mm. long, from a variable base, sometimes distinctly ovate or obovate and considerably wider than blade above, sometimes scarcely or not wider than above, and extending into a broadly acute or obtuse point, or those leaves bearing propagulae narrowed above to a stout point without distinct blade and of variable length, with rounded apex; leaf-margin entire except along upper part of clasping base, which is more or less irregularly serrulate; costa stout, vanishing just below apex, rough on both sides above, slightly rough or smooth below the middle and bearing often on upper side at apex a dense cluster of narrowly spindle-shaped propagula, up to 250 μ long with ten to fifteen cross-walls; cells of upper leaf mamillose, distinct, mostly roundish, 6–8 μ in diameter; teniolae two or three cells wide and one to five cells in from lower margin, extending nearly three fourths up leaf and running into the thickened border of upper leaf; cancellinae extending one third to one fourth up leaf, broad, mostly rounded above; perichaetial leaves much like stem-leaves but larger below with cancellinae extending higher up; seta erect, about 3 mm. long; capsule 1.5 mm. long, elongate-oval, smooth, without peristome; lid short-rostrate; calyptra persistent, plicate, rough toward apex, clasping the seta below capsule and split mostly along the middle on one side; spores rough, up to 35 μ in diameter. [FIG. 1.]

TYPE LOCALITY: Guiana.

DISTRIBUTION: Florida, Panama and the West Indies to Brazil.

2. **Calymperes cubense** Williams, sp. nov.

Evidently dioicous: growing in compact tufts with mostly simple stems 6–8 mm. high; stem-leaves up to 3 mm. long, from a white, appressed, more or less obovate or obcuneate base rather gradually or somewhat abruptly narrowed into an oblong-linear to lanceolate, more or less acute point from shorter to about one and one half times longer than the basal part, the margins serrulate nearly all round and the point more or less crispate when dry; costa not quite percurrent, very rough on both sides to near the base, widest, 100 μ or more, about half way up and tapering to a base about one half as wide, in cross-section near the middle showing about two rows of guide-cells with an indefinite number of smaller accessory cells and stereid cells in one or two rows at the upper and under surface; leaf-cells pale throughout, very mamillose on the upper surface and smooth or papillose on the under side to the cancellinae, the median cells hexagonal to roundish, about 8 μ in diameter; teniolae one to three cells in from the margin, usually extending from the upper part of the base of the leaf to above the middle, and consisting of a double thickness of one or two rows of elongate, often highly mamillose cells; cancellinae mostly broad and more or less rounded above; inner perichaetial leaves rather longer than stem-leaves and with a smaller base, the archegonia and filiform paraphyses numerous; obclavate, eight- to ten-celled propagula sometimes occur in clusters at the apex of the costa. [FIG. 2.]

TYPE collected in the Sierra de Gavilanes, Santa Clara Province, Cuba, August, 1906, *Brothers Leon & Clement 6773* (herbarium of the New York Botanical Garden).

The peculiar cross-section of the leaf of this species is very similar to that of *C. Dozyanum* Mitt. of Java.

3. CALYMPERES EMERSUM C. Müll. Bull. Herb. Boiss. 5: 189. 1897

In broad, lax, dull-green tufts with stems about 1.5 cm. high; stem-leaves about 4 mm. long, mostly incurved, scarcely crispate when dry, from a somewhat wider, or in the lower leaves narrower, oblong or obovate, serrulate base extending into a broad, oblong-linear point, from not much longer than basal part to about twice longer, with rather abruptly acute, serrulate apex and costa vanishing just below apex or when bearing propagulae, excurrent and enlarged into a stout rough point with the propagulae on all sides near apex; costa in middle of leaf about one tenth the width of leaf, rough on both sides in upper half, in cross-section showing four to six guide-cells, stereid bands above and below and outer cells differentiated on both sides; blade of leaf highly mamillose and papillose on upper side, the under side not mamillose but finely papillose; cells throughout spreading leaf-blade distinct, scarcely or not elongate, angular to roundish, 7–8 μ in diameter, with one or sometimes two papillae on each surface; teniolae extending from or near the base to near the abruptly narrowed apex and only one or two cells in from margin in upper leaf, and four to eight cells in from margin at the broadest basal part; cancellinae often extending nearly one half up leaf next costa and terminating in acute angles; "theca hardly emergent, calyptra finely roughened at apex."—*C. Müller.* [FIG. 3.]

TYPE LOCALITY: Guatemala.

DISTRIBUTION: known only from the type locality and Deering Hammock, Cutler, Dade County, Florida, 1916, *J. K. Small.*

4. CALYMPERES DISCIFORME C. Müll. Linnaea **21**: 183. 1848
Calymperes Wulfschlaegelii Lorentz, Moosst. 168. 1864.

In dull or brownish green cushions with somewhat branching stems up to 1.5 cm. high; leaves, when dry, tubulose and crispate above, on lower stem about 2 mm., on upper stem 3.5 mm. long, from a broad, usually obovate, whitish, clasping base narrowed to a broadly lingulate or linear point one and one half to two times longer, with apex broadly acute or in those leaves bearing propagulae, with apex more elongate and narrowed; leaf-margin finely serrulate, nearly to base, thickened above; costa not quite percurrent or somewhat enlarged above and excurrent, rough on both sides to cancellinae or smoothish in lower part, in cross section showing about 6 guide-cells with stereid bands above and below and outer cells differentiated on upper side; leaf-cells above the cancellinae mostly 7 or 8 μ in diameter, slightly or not elongate, mamillose on both sides with more or less distinct papillae on upper blade; teniola extending to above middle of leaf, about 8 cells in from margin in upper basal part of leaf and 2 or 3 cells in from margin of blade above; cancellinae extending one third to two-fifths up leaf, broadly angular, often rounded above; perichaetial leaves about like upper stem-leaves; seta 4 or 5 mm. long; calyptra persistent, striate, very rough above. [FIG. 4.]

TYPE LOCALITY: Surinam.

DISTRIBUTION: Santo Domingo; also in northern South America. The Florida specimens which have been referred to the above belong either to *C. Richardi* or to *Syrrhopodon filigerus*.

5. CALYMPERES DONNELLII Aust. Bot. Gaz. **4**: 151. 1879
Calymperes rufescens Besch. Ann. Sci. Nat. VIII. **1**: 266. 1895.
Calymperes Brittoniae Besch. Ann. Sci. Nat. VIII. **1**: 278. 1895.
Syrrhopodon Smithii Besch. in Paris, Index, ed. 1, 1255. 1898.
Calymperes portoricense Ren. & Card. Bull. Soc. Bot. Belg. **41**[1]: 57. 1904.

In extensive, green mats with stems from 3 mm. to 1 cm. high; leaves incurved or crispate when dry, the lower 2.5–3 mm. long, the upper about 5 mm. long, from a mostly slightly broader, more or less ovate base one third to one fourth the entire length of leaf extending into an oblong-linear blade with broadly acute apex, or those bearing propagulae usually abruptly narrowed to a rough, stout point of variable length; leaf-margins incurved, doubly and irregularly serrate above, with thickened margin, below minutely serrulate; costa stout, often very rough on inner face above, and on back from apex to near the cancellinae, in cross-section showing about seven guide-cells with large stereid bands above and below and outer cells differentiated on both surfaces; cells throughout upper leaf mamillose and papillose, roundish, mostly 4–5 μ in diameter; teniolae distinct to the insertion of leaf, eight to twelve cells in from marign in broadest part of leaf, extending about one half up leaf and disappearing in the thickened border; cancellinae extending one third to one fourth up leaf, mostly terminating above in acute angles and composed of square to short rectangular cells; perichaetial leaves few, only about one half as long as upper stem-leaves, enclosing numerous, very long paraphyses; seta dark red, erect, 5 mm. long; capsule cylindric, about 2 mm. long; calyptra scabrous above; spores rough, about 18 μ in diameter. [FIG. 5.]

TYPE LOCALITY: Caloosa, Florida.

DISTRIBUTION: Florida (sterile), Cuba, Jamaica (fertile), Porto Rico and northern South America (Mt. Guayrapurina, *Spruce*, in Mitten Herbarium, fertile).

6. CALYMPERES NICARAGUENSE Ren. & Card. Bull. Soc. Bot. Belg. 33²: 117. 1894

Calymperes Carionis C. Müll. Bull. Herb. Boiss. 5: 189. 1897.

In broad, dusky green cushions with stems 1.5–2.5 cm. high, bearing crowded leaves up to 4.5 mm. long, crispate when dry; stem-leaves from a broadly obovate or obcuneate base with margins mostly serrulate, abruptly narrowed to a nearly linear point two or three times as long, with thickened, slightly serrulate border and serrulate, blunt apex; upper surface of leaf highly mamillose, under surface nearly smooth or somewhat papillose; costa not quite percurrent, often rough on both sides in upper half, mostly smooth below; leaf in cross-section near middle showing a semiterete costa with eight or ten guide-cells, stereid bands above and below, with outer cells differentiated and a leaf-border of a nearly cylindric band of rather small, not stereid cells; cells throughout upper part of leaf rather distinct, somewhat angular or roundish, the median about 6 μ in diameter; teniolae mostly quite distinct, eight or ten cells in from margin, extending from the lower extremity of the thickened border for only a short distance downward into the basal part of leaf; cancellinae very broad above, mostly terminating in broadly acute angles or somewhat rounded at the apex, scarcely as long as leaf-base; seta erect, 5–6 mm. long; capsule about 2.5 mm. long, cylindric; calyptra persistent, very rough above; spores rough, up to 20 μ in diameter. [FIG. 6.]

TYPE LOCALITY: Nicaragua.

DISTRIBUTION: Nicaragua and Guatemala.

7. CALYMPERES HERIBAUDI Paris & Broth. in E. & P. Nat. Pfl. 1[3]: 1189. 1909

In dark green cushions with stems about 1 cm. high; leaves flexuous or crispate when dry, up to 5 mm. long, from an ovate base about 1.5 mm. long with margins finely serrulate in upper half and mostly entire below, narrowed to a point two to three and one half times longer with thickened, somewhat doubly serrulate border extending from basal part to a little below the mostly blunt and serrulate apex; leaf-surface on upper side highly mamillose, on under side nearly smooth below and mostly papillose above; costa vanishing just below apex, smooth below, rough and often bearing propagulae on upper side near apex; cross-sections near middle of leaf show eight or nine guide-cells, stereid bands above and below, with outer cells differentiated, the blade of one layer of cells and a border of a cylindrical band of six to nine cells enclosing one or two stereid cells; cells throughout upper leaf mostly square to roundish, the median 6–7 μ in diameter; teniolae wanting; cancellinae usually extending highest up next costa and terminating in acute angles; fruit unknown. [FIG. 7.]

TYPE LOCALITY: Panama near David.

DISTRIBUTION: known only from the type locality.

This species is much like *C. nicaraguense* but has rather longer leaves, the basal margin more entire and without teniolae; also the thickened border contains a few stereid cells that seem to be wanting in *C. nicaraguense*, and the costa is mostly smooth on upper side.

8. **Calymperes Nashii** Williams, sp. nov.

In very thin, dusky green cushions or somewhat gregarious, with stems only 2 or 3 mm. high; leaves strongly incurved or crispate when dry, about 2.5 mm. long, oblong-linear from a slightly broader or not broader base; leaf entire with a thick, cylindric border of short-rectangular, green cells extending from a little below the apex to the erect or clasping basal part; costa nearly cylindric, about 65 μ wide one third up from base, papillose on both sides to cancellinae, usually shortly excurrent, slightly enlarged at the apex and bearing numerous, short, spindle-shaped propagula about 120 μ long, with six to eight transverse walls; cross-sections of costa show about four guide-cells, stereid bands above and below of rather large cells, and outer cells differentiated on upper side; leaf-cells of spreading blade mostly not elongate, the median 4–6 μ in diameter, mamillose on upper side, slightly or not mamillose but more or less papillose on under side; teniolae wanting; cancellinae extending about one fourth up leaf, truncate or somewhat rounded above, mostly four to six rows of cells wide on either side of costa and extending about one half way from costa to margin with the small green cells of blade above descending on outer side in a broad band to or near base; fruit unknown. [FIG. 8.]

TYPE collected in Hayti on trees at sea-level near Port Margot, August, 1903, *G. V. Nash 51* (herbarium of the New York Botanical Garden).

DISTRIBUTION: Hayti, Mona Island and Florida (on hammocks, Adams Key, Dade County, March, 1915, *Small & Mosier 5158*).

This species is much like some of the small forms of *C. Richardi* growing in similar situations, but teniolae are entirely wanting, the leaf-border is entire and the cancellinae are narrower.

9. CALYMPERES GUILDINGII Hook. & Grev. in Brewster, Edinb. Jour. Sci. **3**: 223. 1824

Syrrhopodon badius Schimp.; Besch. Ann. Sci. Nat. VI. **3**: 197. 1876.

Calymperes guadeloupensis Broth. Symb. Ant. **3**: 423. 1903.

In large tufts or mats with stems up to 3–4 cm. high; stem-leaves 4–5 mm. long, flexuous or crispate when dry, erect-spreading when moist, from an ovate or obovate, mostly much broader base narrowed to a linear-lanceolate point about three times longer, the upper surface mamillose, the under smooth, with leaf margins entire or nearly so all round and much thickened from apex to the clasping base; costa stout, nearly percurrent, smooth on both sides, often with propagulae on upper side near apex; cross-sections of leaf near middle show a nearly semiterete costa with five or six guide-cells, stereid bands above and below and outer cells differentiated, with a nearly cylindrical leaf-border composed of three to five stereid cells surrounded by seven or eight larger outer cells; leaf-cells throughout upper blade distinct, slightly elongate, 6–7 μ wide by 8–10 μ long; teniolae usually distinct in upper part of clasping base, four to eight cells in from margin, merging into the elongate cells of border toward base of leaf and upward soon terminating in the thickened leaf-border; cancellinae extending about one fourth up leaf, mostly terminating in acute angles or sometimes rounded or truncate; perichaetial leaves about like stem-leaves but with higher clasping base and green cells extending more or less downward between the cancellinae and costa; seta erect, 4–5 mm. long; capsule 2 mm. long, cylindric, with conical, short-beaked lid; calyptra plicate, scabrous above. [FIG. 9.]

TYPE LOCALITY: St. Vincent, British West Indies.

DISTRIBUTION: St. Kitts, Guadeloupe, St. Vincent, and Porto Rico.

EXSICCATI: Husnot, Pl. des Antilles, *135*, *195*.

10. CALYMPERES LONCHOPHYLLUM Schwaegr. Suppl. 1^2: 333. 1816

Syrrhopodon venezuelanus Mitt. Jour. Linn. Soc. **12**: 125. 1869.

Calymperes asperipes Besch. Ann. Sci. Nat. VIII. **1**: 277. 1895.

Dioicous, male plants much like the fertile plants, bearing several oblong flowers about 1 mm. long in the axils of the upper leaves, the perigonial leaves one half to three fourths mm. long, more or less ovate, acutely pointed, pale, costate, slightly serrulate above and enclosing five or six antheridia 0.4 mm. long with quite numerous, longer paraphyses: in low mats with tomentose stems mostly 3–5 mm. high, bearing crowded, ligulate, flexuous, rarely crispate leaves up to 15–18 mm. long; stem-leaves from a narrowly oval base with serrulate margins 0.75–1.5 mm. long, extending into a point ten to fifteen times longer, mostly slightly wider above than below, with thickened, doubly serrulate or sometimes nearly entire borders and acute, serrulate apex; costa nearly percurrent, smooth on both sides, without propagula; cross-sections of leaf about one half down show ten or twelve guide-cells in costa with accessory cells in one or two rows, stereid bands above and below, with outer cells differentiated, and leaf-blade often of a double layer of cells extending from costa to the thick, three-sided border; leaf-cells throughout spreading blade transversely elongate, mostly 4–5 μ by 6–8 μ, smooth on both sides; teniolae not extending into narrowed blade, and from distinct to almost or quite wanting in basal part; cancellinae nearly filling the basal part of leaf, mostly rounded or truncate above; outer perichaetial leaves much like stem-leaves but the base larger and irregularly serrate or incised above, enclosing a few very small inner leaves and numerous paraphyses; seta 10–12mm. long, often bent, slightly rough in upper half; capsule 2 mm. long; lid with beak one half the capsule in length; spores rough, up to 20 μ in diameter. [FIG. 10.]

TYPE LOCALITY: Guiana.

DISTRIBUTION: Martinique, Guadeloupe, Jamaica, Central and northern South America.

ILLUSTRATION: Schwaegr. Suppl. *pl. 98.*

11. CALYMPERES LEVYANUM Besch. Ann. Sci. Nat. VIII. 1: 290. 1895.

In habit somewhat like *C. lonchophyllum*, but stems longer, 1 cm. or more, and leaves shorter, 8–10 mm. long; stem-leaves from an oblong base, serrulate on margins, about 1 mm. long, narrowed into a ligulate-spatulate point six to eight times longer with broad, mostly acute, serrulate apex and thickened border serrulate above, becoming nearly or quite entire below the middle; costa not quite percurrent, smooth on both sides except near apex; leaves in cross-section showing costa with eight or ten guide-cells, an accessory row of four to five cells, stereid bands above and below with differentiated outer cells, and a leaf-blade of one layer of cells, with a cylindric to three-sided border of eight to ten rows of cells; leaf-cells rather obscure in upper leaf, roundish to slightly transversely elongate, mostly 3–4 μ in diameter and from nearly smooth to minutely papillose on both sides teniolae wanting; cancellinae nearly filling the ovate base, of mostly square cells, at apex rounded or sometimes acutely angled; fruit unknown. [FIG. 11.]

TYPE LOCALITY: Nicaragua.

DISTRIBUTION: known only from the type locality and Cuba.

12. **Calymperes fluviatile** Williams sp. nov.

Flowers and fruit unknown: growing in rather stiff, dark green, loose mats; stems simple, 2–3 cm. long, with inconspicuous radicles; in cross-section somewhat triangular, about 250 μ in diameter, showing a distinct central strand and outer walls composed of about three rows of thick-walled cells; leaves when dry subtubulose and incurved or somewhat crispate, when moist widely spreading, oblong-lingulate, entire, 3–3.5 mm. long by a little over 1 mm. wide about half way up the leaf, somewhat rounded to the scarcely acute apex and with very distinct teniolae of three or four thicknesses of cells and five or six cells wide extending from some little distance above the base to about an equal distance below the apex, with three to six rows of cells between the tenola and margin; costa about 100 μ wide a little above the base, nearly percurrent, in cross-section, showing five or six guide-cells, large stereid bands above and below them and outer cells somewhat differentiated; cells of blade in upper leaf mostly roundish or slightly elongate, mamillose on the ventral, flat on the dorsal side, the median cells 6–7 μ in diameter, gradually changing toward the base to the not very numerous rectangular cells which are more or less colored and never form distinct cancellinae. [FIG. 12.]

TYPE collected in the vicinity of Utuado, Porto Rico, on wet rocks, March, 1915, *E. G. Britton 5206* (herbarium of the New York Botanical Garden).

DISTRIBUTION: known only from type locality and La Juanita, near Las Marias, Porto Rico.

NEW YORK BOTANICAL GARDEN.

Explanation of Plates 15-17

PLATE 15

Cross-sections of *Syrrhopodon* made about halfway down the leaf.

FIG. 1. *Syrrhopodon rigidus* Hook. & Grev., from St. Vincent, × 235.
FIG. 2. *Syrrhopodon Bernoullii* C. Müll., from Panama, × 235.
FIG. 3. *Syrrhopodon floridanus* Sull., from Bermuda, × 235.
FIG. 4. *Syrrhopodon incompletus* Schwaegr., from Cuba, × 235.
FIG. 5. *Syrrhopodon Berterianus* (Brid.) C. Müll., from Hayti, × 350.
FIG. 6. *Syrrhopodon martinicensis* Broth., from Guadeloupe, × 235.
FIG. 7. *Syrrhopodon Gaudichaudii* Mont., from Isle of Pines, × 235.
FIG. 8. *Syrrhopodon inflexus* Mitt., from Colombia, × 235.
FIG. 9. *Syrrhopodon Husnoti* Besch., from Martinique, × 235.
FIG. 10. *Syrrhopodon flavescens* C. Müll., from Trinidad, × 235.

PLATE 16

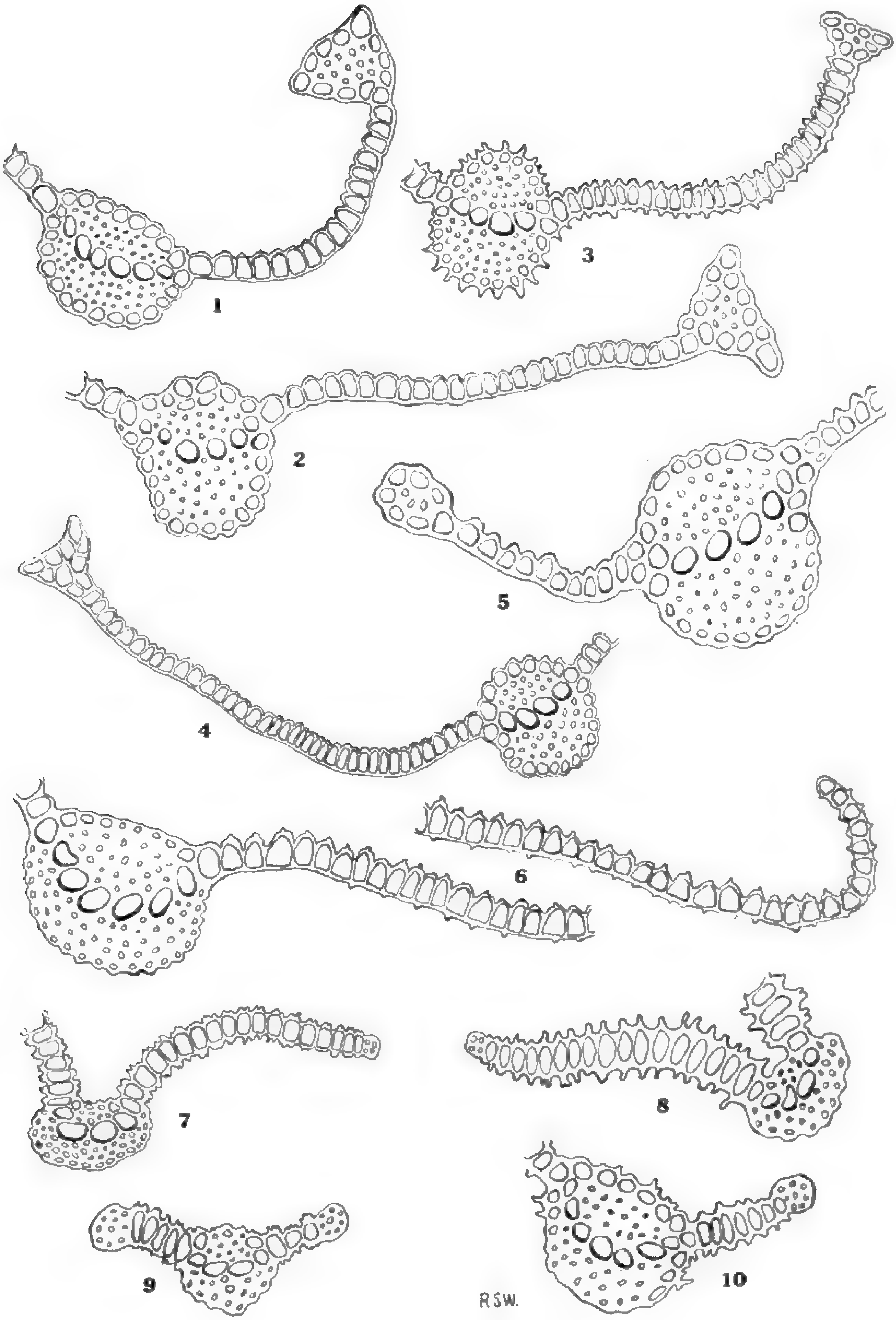
Cross-sections of *Syrrhopodon* made about half way down the leaf.

FIG. 11. *Syrrhopodon tenuifolius* (Sull.) Mitt., from Jamaica, × 235.
FIG. 12. *Syrrhopodon lycopodioides* (Sw.) C. Müll., from Jamaica, × 235.
FIG. 13. *Syrrhopodon recurvulus* Mitt., from Cuba, × 235.
FIG. 14. *Syrrhopodon graminicola* R. S. Williams, from Jamaica, × 350.
FIG. 15. *Syrrhopodon elongatus* Sull., from Cuba, × 235.
FIG. 16. *Syrrhopodon texanus* Sull., from Texas, × 235.
FIG. 17. *Syrrhopodon ligulatus* Mont., from Florida, × 350.
FIG. 18. *Syrrhopodon parasiticus* (Sw.) Besch., from Hayti, × 235.
FIG. 19. *Syrrhopodon filigerus* (Aust.) R. S. Williams, from Florida, × 350.

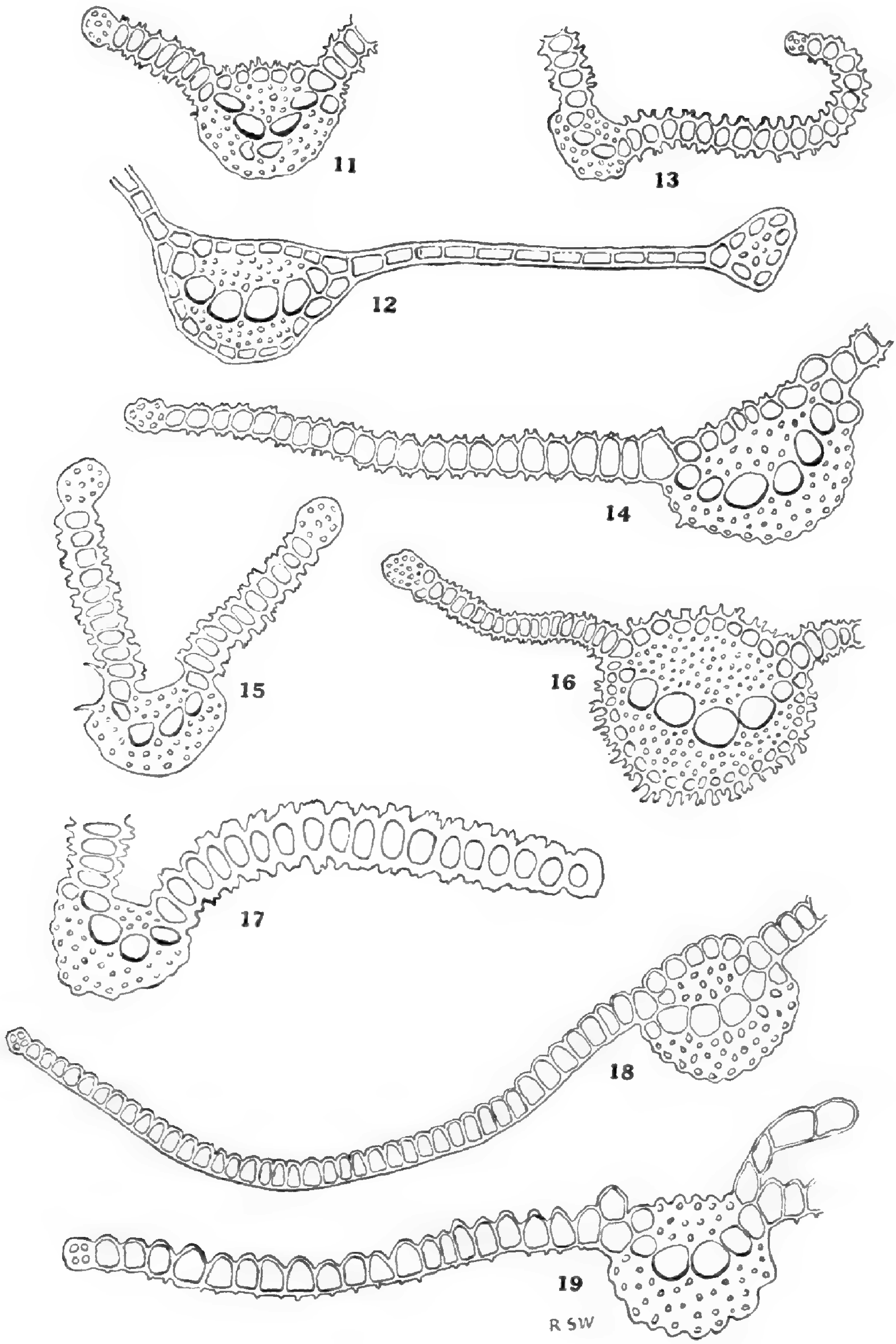
PLATE 17

Cross-sections of *Calymperes* made about halfway down the leaf.

FIG. 1. *Calymperes Richardi* C. Müll., from Guiana, × 200.
FIG. 2. *Calymperes cubensis* R. S. Williams, from Cuba, × 200.
FIG. 3. *Calymperes emersum* C. Müll., from Guatemala, × 300.
FIG. 4. *Calymperes disciforme* C. Müll., from Surinam, × 200.
FIG. 5. *Calymperes Donnellii* Aust., from Florida, × 300.
FIG. 6. *Calymperes nicaraguense* Ren. & Card., from Nicaragua, × 200.
FIG. 7. *Calymperes Heribaudi* Paris & Broth., from Panama, × 200.
FIG. 8. *Calymperes Nashii* R. S. Williams, from Hayti, × 300.
FIG. 9. *Calymperes Guildingii* Hook. & Grev., from St. Vincent, × 200.
FIG. 10. *Calymperes lonchophyllum* Schwaegr., from Guadeloupe, × 200.
FIG. 11. *Calymperes Levyanum* Besch., from Nicaragua, × 200.
FIG. 12. *Calymperes fluviatile* R. S. Williams, from Porto Rico, × 200.



WILLIAMS: SYRRHOPODON



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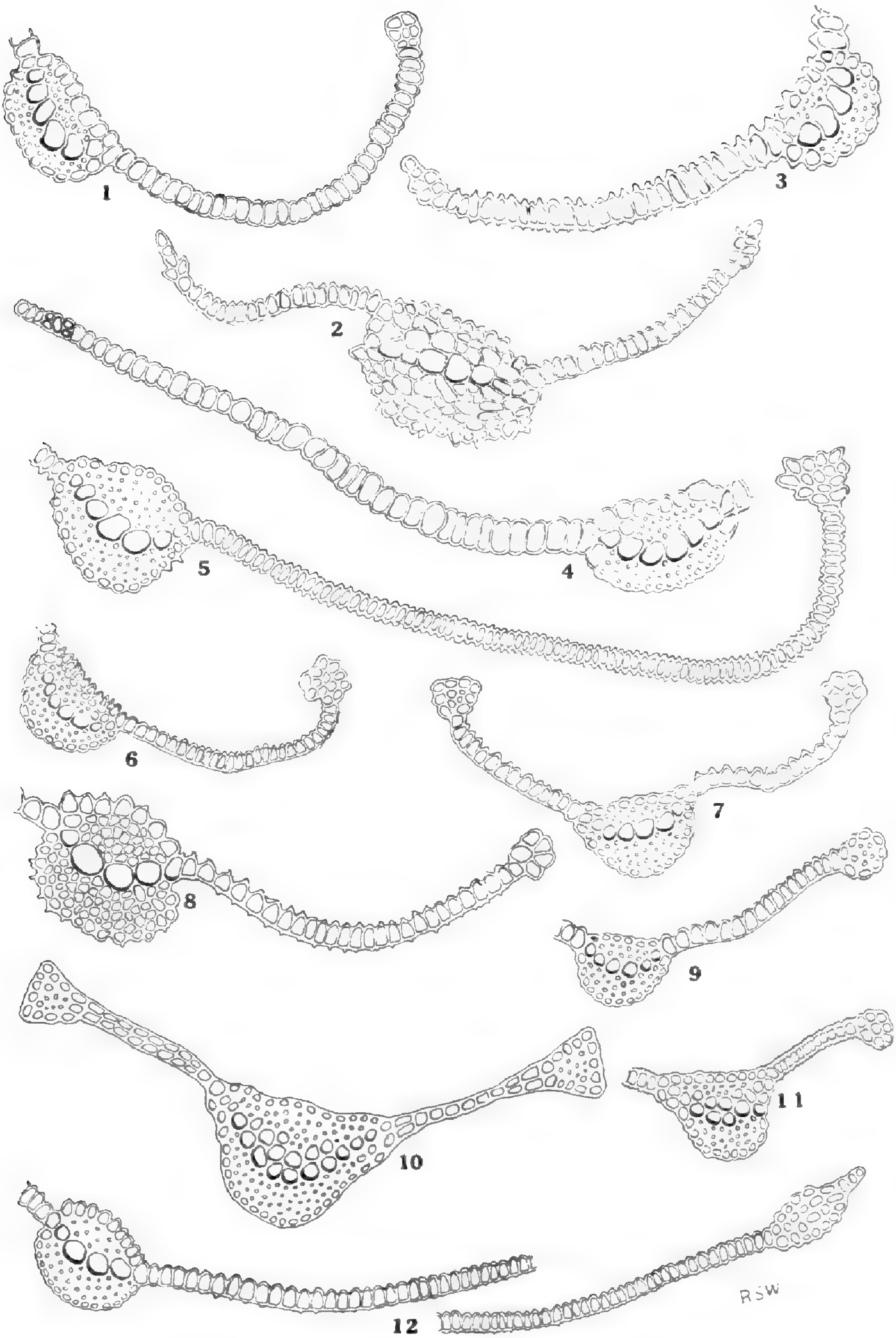

WILLIAMS: CALYMPERES

CONTRIBUTIONS FROM THE NEW YORK
BOTANICAL GARDEN—No. 224

PHYTOGEOGRAPHICAL NOTES ON THE ROCKY MOUNTAIN REGION
IX. WOODED FORMATIONS OF THE MONTANE ZONE OF THE SOUTHERN ROCKIES

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Phytogeographical notes on the Rocky Mountain region

IX. Wooded formations of the Montane Zone of the Southern Rockies

P. A. RYDBERG

The Montane or Canadian Zone extends in Central Colorado approximately between the altitudes of 2,500 and 3,000 m. In the upper part of the zone naturally many of the Subalpine plants are common and the lower part has been invaded by those of the foothills and plains. Many of these plants have been omitted in this discussion. As the Montane and Subalpine Zones are predominantly wooded, the plant associations are somewhat similar. In the open lands or grass-formations they are more unlike so far as the composition of the vegetation is concerned, the Montane being more like the plains and mesas of the Submontane Zone, and the Subalpine more like the Alpine Zone.

The principal forest trees of this zone are the following:—bull pine (*Pinus scopulorum*), lodge-pole pine (*P. Murrayana*), limber pine (*P. flexilis*), Douglas fir (*Pseudotsuga mucronata*), Engelmann spruce (*Picea Engelmannii*), Colorado blue spruce (*P. Parryana*), balsam fir (*Abies concolor*), narrow-leaved cottonwood (*Populus angustifolia*), balsam poplar (*P. balsamifera*), western black birch (*Betula fontinalis*), Rocky Mountain alder (*Alnus tenuifolia*), and smooth maple (*Acer glabrum*). These have been discussed in a previous paper.* To these may be added several species of willow, hawthorn, and chokecherry, which

* Bull. Torrey Club 42: 11-25. 1915.

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belong principally to the foothills. The following wooded formations may be distinguished, though elements of two or more are often mixed.

I. PINE FOREST

This consists mostly of a mixture of *Pinus scopulorum*, *Apinus flexilis* and *Pseudotsuga mucronata*. In some places, however, one or another of these species is predominant. This formation is limited mostly to the south slopes of the mountains, which are drier and hotter and where the soil is rather poor.

The last one of the three species mentioned seems to be more indifferent, however, to soil and moisture than the others, being found on the north as well as on the south slopes and associating with the pines as well as with the spruces, balsams, and aspens. To the three species are added in the northern part of the Southern Rockies the lodge-pole pine, *Pinus Murrayana*. In some places this forms pure stands, especially on burnt over areas, since it germinates readily and is quick in its growth.

Of the trees belonging to this formation, none is transcontinental or common to the Rockies and the Eastern Canadian Zone, three are common to the Rockies and the Pacific Highlands and one is endemic. Among the shrubs and herbs all four categories are found. As the transcontinentals and the eastern plants act much the same they will be treated together as an eastern element. Those marked "†" are found in the Southern Rockies only, not in the Northern. The nomenclature throughout follows the writer's "Flora of the Rocky Mountains and Adjacent Plains," New York, 1917.

1. Trees

a. Western

Pinus Murrayana
Apinus flexilis
Pseudotsuga mucronata

b. Endemic

Pinus scopulorum

2. Shrubs

a. Eastern or transcontinental

Rubus pubescens
Lepargyraea canadensis

Chamaepericlimenum canadense
Arctostaphylos Uva-ursi
Viburnum pauciflorum
Linnaea americana

b. Western

Odostemon Aquifolium
Ribes viscosissimum
Pachystima Myrsinites
Ceanothus velutinus
Gaultheria humifusa
Arctostaphylos platyphylla†

c. Endemic

Ceanothus Fendleri†
Vaccinium oreophilum

3. HERBS

a. Eastern or transcontinental

Oryzopsis asperifolia
Cinna latifolia
Avena striata
Poa compressa
Streptopus amplexifolius
Coeloglossum bracteatum
Lysiella obtusata
Peramium ophioides
Peramium decipiens
Cytherea bulbosa
Corallorrhiza multiflora
Viola Selkirkii
Viola renifolia
Viola canadensis
Aralia nudicaulis
Moneses uniflora
Pyrola asarifolia
Pyrola elliptica
Pyrola chlorantha
Erxlebenia minor
Ramischia secunda
Monotropa uniflora
Veronica serpyllifolia
Botrychium Lunaria
Botrychium neglectum
Thelypteris Dryopteris
Pteris aquilina

b. Western

Oryzopsis Bloomeri
Poa Olneyae
Piperia unalaschensis
Ophrys nephrophylla
Atragene columbiana
Actaea arguta
Ozomelis stauropetala
Micranthes arguta
Osmorrhiza obtusa
Chimaphila occidentalis
Pyrola picta
Pterospora Andromedea
Razoumofskya americana
Razoumofskya Douglasii
Arnica cordifolia
Hieracium albiflorum

c. Endemic

Stipa Porteri†
Stipa Richardsonii
Calamagrostis Scribneri
Poa tricholepis†
Anticlea coloradensis†
Disporum trachycarpum
Trautvetteria media†
Atragene tenuiloba
Actaea viridiflora†
Ozomelis stenopetala†
Ozomelis Parryi†
Drymocallis fissa
Thermopsis pinetorum†
Thermopsis diversicarpa†
Atelophragma aboriginum
Atelophragma Macounii
Aragallus Richardsonii
Hedysarum boreale
Viola scopulorum
Osmorrhiza intermedia
Primula Parryi
Androsace pinetorum†
Pentstemon secundiflorus†
Pentstemon virens†
Erigeron superbus†
Anaphalis subalpina
Arnica pumila
Arnica sylvatica†
Notholaena Fendleri†
Selaginella Underwoodii†

II. SPRUCE FOREST

This is mostly confined to the north slopes of the mountains, which are much cooler and moister than the south slopes. As in the Subalpine Zone, the principal tree is the Englemann spruce, *Picea Engelmannii.* In some places this forms pure stands but usually it is mixed with the balsam fir, *Abies concolor*, the Colorado blue spruce, *Picea Parryana*, and the Douglas fir, *Pseudotsuga mucronata;* and, in the northern part, sometimes with the lodgepole pine, *Pinus Murrayana.* The undergrowth is much the same as in the Pine Forest, and no attempt has been made to distinguish the undergrowth of the Pine Forest from that of the Spruce Forest.

III. ASPEN GROVES

These are found on richer more gentle slopes, both on the south and the north side of the mountains, but on the former only where there is a certain amount of moisture. The principal tree is the quaking aspen, *Populus tremuloides*, which I count as a transcontinental tree, as the western form, *P. aurea* Tidestrom, is so closely related to the eastern. The trees of the southern Rockies belong evidently to the latter, but in the Northern Rockies it is unknown where the range of one ends and that of the other begins. The vegetation consists mainly of the following plants:

1. TREES AND SHRUBS

a. Eastern and transcontinental

Populus tremuloides
Salix Bebbiana
Betula papyrifera
Rosa Bourgeauiana
Distegia involucrata

b. Western

Salix Scouleriana
Ribes viscosissimum
Rubacer parviflorum
Rubus melanolasius
Sorbus scopulina
Vaccinium scoparium

c. Endemic

Salix perrostrata
Edwinia americana†
Ribes coloradense†
Ribes Wolfii†
Opulaster glabratus†
Sericotheca microphylla†
Rosa Engelmannii
Rosa melina†
Rosa Woodsii
Sambucus microbotrys†
Sambucus melanocarpa

2. HERBS

a. Eastern and transcontinental

Phleum alpinum
Agrostis oreophila
Avena striata
Danthonia spicata
Poa crocata
Bromus Richardsonii
Agropyrum Richardsonii
Vagnera stellata
Ranunculus micranthus
Fragaria americana
Tium alpinum
Viola canadensis
Heracleum lanatum
Aralia nudicaulis
Pedicularis canadensis
Galium boreale
Erigeron droebachiensis
Botrychium simplex
Botrychium neglectum
Botrychium virginianum
Botrychium silaifolium
Polystichum Lonchitis

b. Western

Festuca subulata
Elymus glaucus
Veratrum speciosum
Vagnera amplexicaulis
Vagnera liliacea
Trillium ovatum
Thalictrum sparsiflorum
Aquilegia coerulea
Fragaria bracteata
Geranium viscosissimum

Geranium Richardsonii
Hypericum formosum†
Osmorrhiza obtusa
Glycosma occidentalis
Ligusticum tenuifolium
Pseudocymopterus sylvaticus
Conioselinum scopulorum
Polemonium occidentale
Collinsia parviflora
Pedicularis racemosa
Aster Geyeri
Erigeron macranthus
Erigeron speciosus
Erigeron conspicuus
Achillea lanulosa
Polypodium hesperium

c. Endemic

Stipa Scribneri†
Oryzopsis micrantha
Poa Vaseyana†
Poa longipedunculata
Festuca sororia†
Agropygron Richardsonii
Anticlea coloradensis†
Lilium montanum
Disporum trachycarpum
Alsine Curtisii
Silene Scouleri†
Silene Hallii†
Thalictrum venulosum
Thalictrum megacarpum
Thalictrum Fendleri†
Thalictrum stipitatum†
Viorna Scottii†
Viorna Jonesii
Atragene tenuiloba
Aquilegia elegantula†
Delphinium Barbeyi†
Aconitum columbianum
Sophia incisa
Sophia procera
Heuchera parviflora
Potentilla juncunda
Fragaria glauca
Drymocallis fissa
Sieversia grisea
Sieversia ciliata
Lupinus alpestris
Lupinus pulcherrimus
Lupinus humicola
Atelophragma Macounii
Homalobus oblongifolius†
Aragallus deflexus
Hedysarum marginatum†
Lathyrus laetevirens†
Lathyrus leucanthus†
Lathyrus arizonicus†
Ligusticum Porteri†
Ligusticum brevilobum†
Ligusticum affine
Harbouria trachypleura†
Pseudocymopterus montanus†
Pseudocymopterus tenuifolius†
Pseudocymopterus multifidus†
Conioselinum coloradense†
Polemonium delicatum†
Polemonium Archibaldae†
Polemonium molle†
Polemonium robustum†
Polemonium foliosissimum†
Mertensia ciliata†
Castilleja Crista-galli
Castilleja cognata†

Castilleja confusa
Castilleja rhexifolia
Castilleja trinervis
Pedicularis Parryi
Pedicularis crenulata†
Galium flaviflorum†
Oreochrysum Parryi†
Eucephalus wasatchensis†
Eucephalus glaucus†
Eucephalus formosus†
Aster adscendens
Erigeron yellowstonensis
Erigeron subtrinervis
Antennaria viscidula
Anaphalis subalpina
Helianthella Parryi†
Arnica macilenta†

IV. POPLAR GROVES

These are found in the narrower valleys and cañons, where there is a certain amount of moisture, but where the ground is comparatively well drained. The principal tree is the narrow-leaved poplar or cottonwood, *Populus angustifolia*. Another common tree is *Salix Scouleriana*, and Young* has called this formation the *Populus angustifolia—Salix Nuttallii* Formation.

Another common tree is the smooth maple, *Acer glabrum*. The balsam poplar, *Populus balsamifera*, has been collected in a few places in Colorado, and the canoe birch, *Betula papyrifera* (*B. Andrewsii*), has been collected in one cañon. Some of the evergreens have also partly invaded this formation, as *Pseudotsuga mucronata* and *Abies concolor*, and a few species of hawthorn are found in the lower part of the zone. In the Foothills (Submontane Zone) the narrow-leaved cottonwood is replaced mostly by *Populus acuminata* and *P. Sargentii*. The undershrub and herbaceous vegetation contains many species found in the Aspen Groves.

1. TREES AND SHRUBS

a. Eastern

Populus balsamifera
Salix Bebbiana
Betula papyrifera
Dasiphora fruticosa

b. Western

Pseudotsuga mucronata
Salix Scouleriana
Ribes viscosissimum
Cercocarpus ledifolius
Rubacer parviflorum
Rubus melanolasius

* Bot. Gaz. 44: 334–336. 1907.

c. Endemic

Populus angustifolia
Salix lutea
Salix padophylla
Salix perrostrata
Betula fontinalis
Edwinia americana†
Ribes coloradense†
Ribes Wolfii†
Opulaster monogynus†
Opulaster glabratus†
Sericotheca microphylla†
Rosa Engelmannii
Rosa melina
Rosa Woodsii
Sambucus microbotrys†
Sambucus melanocarpa
Sambucus neomexicana†

2. HERBS

a. Eastern or transcontinental

Torresia odorata
Phleum alpinum
Agrostis hyemalis
Calamagrostis canadensis
Dactylis glomerata
Poa crocata
Festuca rubra
Bromus ciliatus
Vagnera stellata
Chenopodium Botrys
Blitum capitatum
Claytonia virginica
Moeringia lateriflora
Moeringia macrophylla
Fragaria americana
Prunella vulgaris
Specularia perfoliata
Aster laevis
Erigeron droebachiensis
Filix fragilis

b. Western

Calamagrostis luxurians
Bromus polyanthus
Elymus glaucus
Ranunculus Douglasii
Ranunculus Bongardi
Aquilegia coerulea
Delphinum Nelsonii
Fragaria bracteata
Drymocallis corymbosa
Thermopsis montana
Lupinus tenellus
Geranium Richardsonii
Geranium viscosissimum
Glycosma occidentalis
Apocynum ambigens
Castilleja lancifolia
Erigeron macranthus
Aster Geyeri
Achillea lanulosa
Senecio pseudaureus

c. Endemic

Poa reflexa
Agropyron Richardsonii
Lilium montanum
Disporum trachycarpum

Chenopodium Fremontii
Silene Scouleri
Thalictrum megacarpum
Atragene tenuiloba
Ranunculus Earlei†
Delphinum robustum†
Delphinum elongatum
Delphinum ramosum†
Sophia leptophylla
Sophia incisa†
Sophia procera†
Fragaria glauca
Lupinus floribundus†
Lupinus parviflorus
Lupinus pulcherrimus
Lupinus humicola
Homalobus tenellus
Lathyrus brachycalyx†
Lathyrus leucanthus†
Lathyrus arizonicus†
Sidalcea candida†
Oxypolis Fendleri†
Apocynum scopulorum
Polemonium foliosissimum†
Hydrophyllum Fendleri†
Agastache pallidiflora†
Agastache urticifolia
Moldavica parviflora
Scrophularia occidentalis
Castilleja Crista-galli
Castilleja rhexifolia
Castilleja sulphurea
Pedicularis Grayi†
Galium flaviflorum†
Valeriana micrantha
Eucephalus glaucus†
Aster ciliomarginatus
Aster adscendens
Erigeron yellowstonensis
Erigeron superbus†
Helianthella quinquenervis
Anaphalis subalpina
Arnica subplumosa

V. ALDER–WILLOW SWAMPS

These are found in the wetter parts of the valleys, where the drainage is rather poor. They contain many of the species found in the preceding formation but also many belonging to the Sedge Bog. The most important woods belonging to the formation are the Rocky Mountain alder, *Alnus tenuifolia*, the western black birch, *Betula fontinalis*, and several species of willows. In the upper part of the zone, the formation becomes more and more like the willow bogs of the Subalpine Zone.*

1. TREES AND SHRUBS

a. Eastern

Salix chlorophylla
Salix cordata

* See Bull. Torrey Club 44: 449–450. 1917.

Betula glandulosa
Dasiphora fruticosa
Distegia involucrata

b. Western

Salix Scouleriana
Salix glaucops
Alnus tenuifolia
Kalmia microphylla

c. Endemic

Salix padophylla
Salix monticola
Salix Wolfii
Salix irrorata†
Salix perrostrata
Salix pachnophora†
Salix brachycarpa
Betula fontinalis
Svida instolonea
Negundo Kingii†
Sambucus microbotrys†
Sambucus melanocarpa
Sambucus neomexicana†

2. HERBS

a. Eastern and transcontinental

Calamagrostis canadensis
Panicularia nervata
Eleocharis palustris
Eleocharis acicularis
Streptopus amplexifolius
Alsine alpestris
Alsine crassifolia
Alsine borealis
Sisymbrium Nasturtium-aquaticum
Cardamine pennsylvanica
Geum rivale
Heracleum lanatum
Mimulus moschatus
Veronica americana
Elephantella groenlandica
Senecio pauciflorus
Nabalus racemosus
Equisetum arvense

b. Western

Poa leptocoma
Elymus glaucus
Veratrum speciosum
Limnorchis stricta
Limnorchis viridiflora
Limnorchis borealis
Thalictrum sparsiflorum
Ranunculus Douglasii
Ranunculus Bongardi
Trollius albiflorus
Parnassia fimbriata
Geum oregonense
Circaea pacifica
Mimulus Langsdorfii
Mimulus Lewisii
Pedicularis bracteosa
Galium subbiflorum
Senecio triangularis

Senecio pseudaureus
Athyrium cyclosorum

c. Endemic

Poa reflexa
Panicularia pauciflora
Juncus truncatus
Allium brevistylum
Disporum trachycarpum
Limnorchis purpurascens†
Corallorrhiza ochroleuca
Corallorrhiza Vreelandii†
Rumex subalpinus†
Alsine Curtisii†
Thalictrum megacarpum
Thalictrum Fendleri†
Ranunculus Earlei†
Caltha rotundifolia†
Aconitum columbianum
Cardamine cordifolia†
Cardamine infausta†
Parnassia rivularis†
Geum decurrens†
Sidalcea candida†
Phymosia Crandallii†
Phymosia rivularis
Phymosia grandiflora†
Mertensia ciliata†
Scutellaria Brittoni†
Castilleja sulphurea
Pedicularis Grayii†
Galium flaviflorum†
Aster Canbyi†
Rudbeckia ampla
Senecio nephrophyllus†

VI. COPSES

Besides the shrubby willows included in the preceding formation, there are also shrubberries on dryer ground. These are found partly along the edges of the Aspen and Poplar Groves, the Willow Swamps and even the pinewoods, partly on dryer river-banks, and partly on the hillsides. Though the species of shrubs are not so many, the herbaceous flora associated with them is richer in species than that of either the woods or the meadows. In fact these copses contain many belonging to either and besides many of its own. Many of those belonging mainly to the woods or to the meadows are here omitted.

1. SHRUBS

a. Eastern

Dasiphora fruticosa

b. Western

Cerocarpus ledifolius
Rubacer parviflorum
Rubus melanolasius
Vaccinum scoparium

c. Endemic

Salix perrostrata
Salix brachycarpa
Atragene pseudoalpina†
Edwinia americana†
Edwinia macrocalyx†
Fendlera falcata†
Opulaster monogynus†
Opulaster alternans†
Chamaebatiaria Millefolium†
Sericotheca microphylla
Cercocarpus montanus
Oreobatus deliciosus†
Rosa melina†
Rosa aciculata†
Rosa manca†
Amelanchier oreophila†
Amelanchier Bakeri†
Amelanchier prunifolia†
Ceonothus velutinus
Vaccinium oreophilum

2. HERBS

a. Eastern

Panicum huachucae
Allium sibiricum
Vagnera stellata
Vagnera stellata
Bilderdykia Convolvulus
Moehringia latifolia
Moehringia macrophylla
Vicia trifida
Vicia americana
Xanthoxalis Bushii
Apocynum androsaemifolium
Clinopodium vulgare†
Pedicularis canadensis
Galium boreale
Specularia perfoliata

b. Western

Melica bella
Hesperochloa Kingii
Aquilegia coerulea
Lithophragma bulbifera
Lithophragma parviflora
Drymocallis corymbosa
Drymocallis glandulosa
Lupinus tenellus
Thermopsis montana
Linum Lewisii
Glycosma occidentalis
Apocynum ambigens
Gilia aggregata
Gilia pulchella
Hydrophyllum capitatum
Phacelia sericea
Lappula floribunda
Collinsia parviflora
Castilleja lancifolia
Erigeron macranthus
Balsamorrhiza sagittata
Achillea lanulosa
Artemisia Michauxiana

c. Endemic

Stipa Scribneri†
Orzyopsis micranatha
Poa reflexa
Poa rupicola
Agropyrum Richardsonii
Disporum trachycarpum
Lilium montanum
Polygonum Engelmannii
Silene Scouleri
Atragene pseudoalpina†
Capnoides Brandegei†
Sophia magna†
Sophia andrenarum
Sophia leptostylis†
Draba spectabilis†
Draba Helleriana†
Hesperidanthus linarifolius†
Heuchera bracteata†
Heuchera Hallii†
Heuchera utahensis†
Heuchera parvifolia
Potentilla glaucophylla
Fragaria glauca
Lupinus floribundus†
Lupinus parviflorus
Tium scopulorum†
Homolobus decurrens†
Homolobus tenuifolius
Hedysarum utahense†
Lathyrus laetivirens
Lathyrus leucanthus†
Lathyrus arizonicus†
Viola montanensis
Ligusticum brevilobum†
Amarella heterosepala†
Amarella scopulorum
Dasystephana Parryi†
Phacelia ciliata
Dasystephana affinis
Dasystephana Forwoodii
Apocynum scopulorum
Polemonium albiflorum†
Hydrophyllum Fendleri†
Mertensia lanceolata
Agastache pallidiflora†
Agastache urticifolia
Moldavica parviflora
Scrophularia occidentalis
Penstemon strictus†
Penstemon unilateralis†
Penstemon Rydbergii
Penstemon virens
Penstemon Leonardi†
Penstemon Torreyi†
Castilleja Crista-galli
Castilleja rhexifolia
Pedicularis crenulata
Valeriana trachycarpa†
Valeriana micrantha
Coleosanthus umbellatus†
Coleosanthus albicaulis†
Macronema obtusum†
Eucephalus glaucus
Aster subgriseus†
Aster ciliomarginatus
Aster adscendens
Erigeron incanescens†
Erigeron Smithii
Helianthella Parryi†
Senecio ambrosioides
Senecio multicapitatus†
Heteropleura Fendleri†
Agoseris agrestis†

VII. SAGEBRUSH

To the woody formations may also be added the Sagebrush lands. These are more characteristic of the Submontane Zone, but are also found in the Montane Zone above as well as in the Sonoran below. The most important shrub is *Artemisia tridentata*, which is found in all three zones. So also is *A. cana*, but the other sagebrushes are most common in the higher zones. As the sage lands are open formations, the undergrowth is mostly the same as in the dry valleys and on the tablelands. Only a few plants rather characteristic of this formation will be mentioned.

1. SHRUBS

Chrysathamnus filifolius
Artemisia cana
Artemisia tridentata
Artemisia nova
Artemisia tripartita

2. HERBS

Eriogonum cernuum
Penstemon cyathophorus
Penstemon xylus
Penstemon teuchrioides
Castilleja flava

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By NATHANIEL LORD BRITTON

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Descriptions of Cuban Plants New to Science

NATHANIEL LORD BRITTON

The following descriptions of plants new to the Cuban Flora are drawn mostly from specimens collected in recent years on the several expeditions made under the auspices of the New York Botanical Garden and from those collected by Brother Léon of the College of La Salle, Vedado, Havana, and his associates. Brother Léon has contributed descriptions of some grasses; Dr. John H. Barnhart the Lentibulariaceae; Dr. Francis W. Pennell the Scrophulariaceae; Dr. S. F. Blake has cooperated with some Carduaceae; Dr. Rydberg has contributed a new genus of Fabaceae and Mr. Percy Wilson has assisted at many points.

Family POACEAE

Paspalum Rocanum *Fr.* Léon, sp. nov.

Perennial from a short rhizome; stems simple, erect or ascending, 40–60 cm. long, sometimes more; nodes appressed-pubescent; sheaths glabrous, sometimes papillose-ciliate, the lower ones overlapping and often purplish; ligule membranaceous, 2.4–2.8 mm. long; blades glabrous on both surfaces, conduplicate, acuminate and involute towards apex, rarely flat, up to 25 cm. long, 2–8 mm. wide, firm, erect, somewhat curved; racemes 2 to 4, somewhat divergent, straight or curved, 5–9 cm. long, the common axis 2–4.5 cm. long; rachis 1.5–2 mm. broad, with long hairs at base, otherwise glabrous; spikelets normally in pairs, sometimes crowded, one of the pedicels as long as or longer than the spikelet; spikelets yellowish-green, becoming rufous at maturity, glabrous, 2.1–2.5 mm. long, 1.3–1.6 mm. wide, oval to obovate; glume and sterile lemma equal, short-pointed, 3-nerved; fruit pale, minutely roughened.

Palm barren, sabana de Motembo, Santa Clara (*Léon & Roca 8233*), is the type, preserved in Colegio De La Salle Herbarium, Vedado, Havana.

Sabana del Jacán, near San Miguel de los Baños, Matanzas (*Léon & Roca 8871*).

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Paspalum Edmondi *Fr.* Léon, sp. nov.

A small tufted perennial with short rhizomes and numerous slender pubescent leafy branching stolons; stems simple, very slender, compressed, glabrous, 2–6 cm. long; leaves crowded at the base; sheaths pilose; ligule membranaceous, 0.5–1 mm. long; blades lanceolate to linear, pilose on the upper surface towards the base and near the lower margins, glabrous beneath, 1–1.5 cm. long, sometimes up to 6 cm. long in the specimens grown in a rich soil, 1–2 mm. wide, flat or somewhat involute towards apex; racemes solitary, up to 12 mm. long, usually about 6 mm., with a tuft of hairs at the base; rachis 0.5–0.7 mm. wide, glabrous; pedicels shorter than the spikelets; spikelets solitary, with a short wing along the pedicel, somewhat imbricate, 1.5–2 mm. long, 1–1.2 mm. wide, ovate, abruptly acuminate-pointed; first glume wanting, second glume glabrous, often transversely wrinkled, 7-nerved, conspicuously pointed; sterile lemma glabrous, more or less deeply hollowed between the strongly elevated, rugose, sometimes tubercled margins, nearly as long-pointed as the second glume; fruit blunt, brown, slightly papillose, 1.4 mm. long, 1 mm. wide.

Palm barren, sabana de Motembo, Santa Clara (*Léon & Edmond 8607*).

Specimens from the same locality were transplanted in Vedado, Havana (*Léon & Edmond 8682*). The type specimens are preserved in the Colegio De La Salle Herbarium, Vedado, Havana.

Paspalum acutifolium *Fr.* Léon, sp. nov.

Perennial, tufted; culms simple, erect or ascending, glabrous, compressed, nearly naked, much exceeding the leaves, these densely crowded at the base; nodes clothed with long white hairs; sheaths striate, keeled, mostly overlapping, glabrous, sometimes sparsely hispid towards the summit, hirsute-ciliate, the upper ones bladeless or nearly so; ligule membranaceous up to 2 mm. long; blades firm, rarely over 15 cm. long, 4–8 mm. wide, sparsely papillose-hispid on both surfaces and the margin when young, mostly flat or conduplicate, sometimes twisted, involute towards apex, the middle nerve prominent beneath; inflorescence terminal; racemes 2 to 4, the common axis 1–3.5 cm. long, with long white hairs at base; racemes straight or slightly curved, divergent, rarely spreading; rachis about 1 mm. wide, bearing a few long hairs at the base, otherwise glabrous; spikelets normally in pairs, crowded towards the summit, only one developed in the lower pairs, the other rudimentary or wanting; spikelets about twice as long as the pedicel, elliptic, 1.6–1.8 mm. long, 1 mm. wide, more or less crimson; second glume and sterile lemma subequal, with some spreading hairs near the margin, otherwise glabrous; fruit pale, somewhat exceeding the second glume at maturity; palea somewhat papillose-roughened.

Palm barren, sabana de Motembo, Santa Clara (*Léon & Roca 8164*). The type specimen is preserved in the Colegio De La Salle Herbarium, Vedado, Havana.

Family CYPERACEAE

Cyperus camagueyensis Britton, sp. nov.

Perennial; culms tufted, slender, smooth, trigonous, erect, 3–6 dm. high. Basal leaves much shorter than the culm, 1–1.5 dm, long, 3 mm. wide or less, those of the involucre several, the longer ones much surpassing the simple, several-rayed umbel; umbel-rays very slender, 5 cm. long or less; spikelets loosely spicate, 1.5–3 cm. long, flat, many-flowered, the rachis angular, wingless, persistent after the scales have fallen; scales oblong-lanceolate, brown, appressed, acute, 1.5 mm. long; stamens 2 or 3; style-branches 2, filiform; achenes oblong, grey, smooth, apiculate, 0.75 mm. long, nearly 0.5 mm. thick, persistent.

Vicinity of La Gloria, Camaguey (*Shafer 196*).

Cyperus Underwoodii Britton, sp. nov.

Culms densely tufted, slender but rigid, erect, arching or recurved, 1–4 dm. long. Basal leaves 1–5 cm. long, or reduced to sheaths, those of the involucre 1–3, the longest about 7 cm. long or shorter, sometimes only 1 cm. long or less; spikelets few or several in a dense terminal cluster, nearly terete, 5–10 mm. long, few-flowered; scales brown, striate, oval, obtusish, appressed, about 2 mm. long; achene linear-oblong, trigonous, apiculate, 2 mm. long, about 0.5 mm. thick.

Dry soil, vicinity of Santiago, Oriente (*Underwood 1694*).

Eleocharis Shaferi Britton, sp. nov.

Perennial; culms capillary, weak, densely tufted, about 2 dm. long; upper sheath apparently not scarious; spikelet oblong, 4–5 mm. long, 1–1.5 mm. thick, acute, few-flowered; scales pale, appressed, obtuse or obtusish, oblong or oblong-lanceolate, appressed, the lower one 2–2.5 mm. long, shorter than the upper ones; bristles 4–6, brownish, about as long as the achene and tubercle; style-branches 2; achene black, lenticular, oblong, 1 mm. long; tubercle sharply conic, one-fourth as long as the achene.

Bog-holes in wet thicket, Sierra Nipe near Woodfred, Oriente (*Shafer 3414*).

Eleocharis minutissima Britton, sp. nov.

Culms capillary, weak, densely tufted and matted, only 1.5–3 cm. high. Spikelets ovoid, 2–4-flowered, acute, 1 mm. long; scales ovate, acute, with a narrow dark brown central band and broad hyaline margins; achene 0.25 mm. long, cancellate and longitudinally ribbed, gray, oblong-ovoid; tubercle black, low-conic; bristles none.

Border of a lagoon near Pinar del Rio (*Britton & Gager 6965*).

Fimbristylis ophiticola Britton, sp. nov.

Perennial; culms tufted, glabrous, 5 cm. high or higher. Leaves mostly basal, shorter than the culm; spikelet solitary (or sometimes 2?), ovate, flat, several-flowered, acutish, 6–12 mm. long, 2–4 mm. wide; scales ovate, somewhat spreading, yellow-brown, shining, acute or acutish, faintly nerved, readily deciduous from the deeply pitted rachis; style-branches 2; style compressed pubescent. deciduous; achene obovate, nearly white, 0.5 mm. long, flat, longitudinally striate and transversely barred.

Serpentine palm-barren, between Camaguey and Santayana, Camaguey (*Britton 2429, type*); a plant from the vicinity of Guanabacoa, Havana (*Father Roca No. 1*), much larger than the type specimen but without achenes, may belong here.

Family AMARYLLIDACEAE

Hymenocallis praticola Britton & Wilson, sp. nov.

Leaves linear-lanceolate, 3–3.8 dm. long, 1.5–2.8 cm. broad, acute at the apex, gradually narrowing below, sessile. Scape slender, 2–3 dm. tall; flowers 6 or 7 in an umbel, sessile; outer spathe-valves deltoid-lanceolate, 3.5–4.5 cm. long; perianth-tube slender, 7–11 cm. long, the lobes linear, 6.5–9 cm. long, shorter than the tube; staminal crown funnel-shaped, 2–2.5 cm. high, toothed on the edge between the free tips of the filaments, which are 3–4 cm. long; anthers linear, 1.2–1.5 cm. long; style slender, longer than the anthers.

Wet savanna, Sagua, Santa Clara (*Britton & Wilson 370, type*); also collected at Cieneguita, Santa Clara (*Combs 345*).

Family ORCHIDACEAE

Vanilla savannarum Britton, sp. nov.

Climbing on palms; stem slender, branched, 6 m. long or longer. Leaves ovate to ovate-lanceolate, 6–10 cm. long, 3–5 cm. wide, bluntly acute or obtuse at the apex, rounded at the base, many-veined, the petioles about 5 mm. long; peduncles short, 4–8 cm. long, leafy-bracted; spike 6 cm. long or less, densely several–many-flowered; capsules sub-cylindric, sessile, 4–5 cm. long.

On *Copernicia,* savannas near Camaguey (*Britton & Cowell 13120, type*); on *Copernicia,* barren savannas southeast of Holguin, Oriente (*Shafer 2944*); on *Copernicia,* savanna south of Sierra Cubitas, Camaguey (*Shafer 1831*); on palmetto, between La Gloria and Columbia, Camaguey (*Shafer 615*); on palmetto, Jatovieja, Cayo Sabinal, Camaguey (*Shafer 1072*).

Family PIPERACEAE

Peperomia similis Britton, sp. nov.

Stem rather slender, creeping, sparingly branched, 4 dm. long or longer, about 2 mm. thick, sparingly pubescent in lines of curled hairs. Leaves alternate, firm in texture, orbicular-ovate, 3 cm. long or less, glabrous or nearly so, copiously black-dotted, obtuse or acutish at the apex, rounded or subtruncate at the base, inconspicuously 5-nerved, the rather stout petioles 3–8 mm. long; young spikes terminal, solitary, short-peduncled, about 8 cm. long and 2 mm. thick, the bracts rounded.

On a rock, bank of arroyo, Sierra del Indio, San Diego de los Baños, Pinar del Rio (*Brothers Léon and Charles 4984*).

Peperomia cueroensis Britton, sp. nov.

Peperomia spathophylla monteverdensis C. DC. in Urban, Symb. Ant. 3: 228. 1902.

Stems stout, branched, 3 dm. long or less. Leaves thick and firm, elliptic to ovate or obovate, 3–7 cm. long, obtuse or some of them acute at the apex, narrowed or obtuse at the base, faintly 3-nerved, loosely pubescent when young, soon glabrous, not black-punctate; spikes solitary, very long, terminal, about 25 cm. long, 2–2.5 mm. thick; bracts oval, distant.

Mountains of Oriente; type collected on rocks in a ravine, 420 m. altitude, near El Cuero, Oriente (*Britton & Cowell 12761*).

As grown at The New York Botanical Garden, the young leaves are always pubescent, but become glabrous soon after reaching their full size.

Family URTICACEAE

Pilea sumideroensis Britton, sp. nov.

Fleshy, bushy, glabrous, branched, 2.5–4 dm. high, the branches stout, ascending, the main stem nearly 1 cm. thick. Leaves thick, fleshy, obovate, 6–18 mm. long, entire, obscurely pinnately about 5-veined, rounded at the apex, cuneate at the base, the margins revolute, the upper surface densely covered with linear raphides, the under surface finely reticulate when dry, the very slender petiole 9 mm. long or less.

Top of high cliff, limestone hills, vicinity of Sumidero, Pinar del Rio (*Shafer 13816*). Described from sterile specimens, but apparently not referable to any previously known species.

Pilea (?) **carnosa** Britton, sp. nov.

Shrubby, erect, fleshy, 5 dm. high, the stems white. Leaves thick, nearly orbicular, 6–12 mm. broad, faintly 3-nerved, rounded at the apex, rather abruptly narrowed at base into slender petioles 8 mm. long or less.

Cliff, at 160 m. altitude, Ensenada de Mora, Oriente (*Britton, Cowell & Shafer 12967*).

A curious plant, referred to this genus with hesitation.

Pilea sevillensis Britton, sp. nov.

A slender vine, 3 dm. long or longer, creeping on the bark of trees, somewhat branched, the young twigs and petioles sparingly pubescent. Leaves oval or suborbicular, 1.5 cm. long or less, those of each pair nearly of the same size, 3-nerved, entire, rounded at the apex, obtuse at the base, the linear raphides inconspicuous above, prominent and loosely scattered beneath, the slender petioles 5–12 mm. long; stipules semi-orbicular, 2–3 mm. broad; cymes few-flowered, shorter than the leaves; achene about 1.5 mm. long.

Cañon, Upper Guama River, Sevilla Estate, near Santiago, Oriente (*Taylor 183*).

Pilea trinitensis Britton, sp. nov.

Decumbent, glabrous or minutely puberulent, branched, about 7 dm. long. Leaf-pairs, unequal; petioles slender, those of the larger leaves 2–4 cm. long; leaf-blades oblong-lanceolate, 7 cm. long or less, 3-nerved, entire, ciliate, acuminate at the apex, acute or obtuse at the base, rather thin in texture, the underside densely covered with minute linear raphides, the upper surface minutely papillose; staminate inflorescence glomerate-paniculate, nearly as long as the upper leaves; pistillate flowers paniculate, the panicles much shorter than the leaves.

On rocks, Los Cocos, near Siguanea, Trinidad Mountains, Santa Clara, 430 meters altitude (*Britton & Wilson 5075*).

Pilea neglecta Britton, sp. nov.

Stem slender, densely covered with linear raphides. Leaves oblong to oblong-lanceolate, membranous, acute, entire, 3-veined, glabrous, the pairs unequal in size and unequally petioled; larger leaves 5 cm. long, 1.5 cm. wide, with petioles 1 cm. long; smaller leaves 2.5 cm. long, 1–1.2 cm. wide, with petioles 3 mm. long; raphides of upper leaf-surfaces linear-filiform, very numerous and approximate, those of under leaf-surfaces thicker, bright white, numerous, but not close together; peduncles filiform, about as long as the longer petioles; inflorescence paniculate, much shorter than the leaves, the flowers sessile in small clusters; achene oval, apiculate, scarcely 0.5 mm. long.

Cuba, *C. Wright 2233*, in part, in herbarium of the Missouri Botanical Garden.

Pilea siguaneana Britton, sp. nov.

Stems stout, decumbent, 3–5 dm. long, glabrous. Leaf-pairs equal or nearly so; leaves lanceolate or oblong-lanceolate, entire, 3-nerved, 6–10 cm. long, 2–4 cm. wide, long-acuminate at the apex, obtuse or rounded at the base, the upper side covered with minute linear raphides, the underside bearing oblong, thick, white raphides, scattered or somewhat clustered; petioles 1–2 cm. long; staminate flowers densely capitate in globose heads about 6 mm. in diameter, on slender axillary peduncles 1–2 cm. long.

Bed of stream, Siguanea, Trinidad Mountains, Santa Clara, 400 meters altitude (*Britton & Wilson 4979*).

Pilea Clementis Britton, sp. nov.

Woody; stems ascending or straggling, simple or branched, 3–4 dm. long. Leaf-pairs nearly equal, but their petioles unequal in length; blades ovate-lanceolate, entire, 4–6 cm. long, 2 cm. wide or less, acuminate at the apex, rounded or obtuse at the base, strongly 3-veined with a very slender vein on each side near the margin; staminate flowers subcapitate at the ends of filiform peduncles which are mostly as long as the petioles or longer, the heads about 6 mm. in diameter; pistillate flowers in small panicles on peduncles much shorter than the petioles; achene compressed, ovate, acute, pale, about 0.5 mm. long.

River-banks, Banao Mountains, Santa Clara (*Brothers Léon and Clement 4055, type; 5342*).

Pilea bullata Britton, sp. nov.

Erect-decumbent, with rather stout, pilose-pubescent stems 1–2.5 dm. long. Leaves ovate, 4 cm. long or less, coarsely crenate, obtuse or bluntly acute at the apex, obtuse or rounded at the base, glabrous and with very numerous, approximate, minute, linear raphides above, pilose-pubescent on the prominent veins beneath, the unequal pilose petioles 2 cm. long or less; stipules ovate, about 3 mm. long; inflorescence glomerate-paniculate, as long as the leaves or shorter; achene ovate, acute, about 0.5 mm. long.

Damp woods among stones, between Bahia Honda and El Rosario, Pinar del Rio (*Shafer 12018*).

Family PORTULACACEAE

Portulaca cubensis Britton & Wilson, sp. nov.

Perennial, 2–7 cm. high. Leaves oblong to elliptic, 3–4.5 mm. long, 1–2 mm. broad, rounded at the apex, acutish at the base, fleshy, the axils sparingly short-pilose; flowers mostly solitary; corolla yellow; sepals ovate-lanceolate, 5–5.5 mm. long, 3 mm. broad at the base; petals obovate, 8–10 mm. long, 2–3.5 mm. broad, rounded at the apex, cuneate at the base; capsule circumsessile at about the middle; seeds blackish.

Type collected in palm-barrens, Motembo, Santa Clara (*Léon & Roca 8419*).

Family MENISPERMACEAE

Hyperbaena acutifola Britton, sp. nov.

A small tree with slender gray twigs. Leaves oblong-elliptic, coriaceous, 4–9 cm. long, 2–4 cm. wide, finely reticulate-veined on both sides with the midvein rather prominent, sharply acute at the apex, narrowed at the base, the petiole 8–16 mm. long; inflorescence lateral, shorter than the leaves, pubescent; fruit compressed subglobose, black, about 12 mm. in diameter and 8 mm. thick.

Dry soil between Banao and Rincon, Santa Clara (*Shafer 12177*).

Hyperbaena littoralis Britton, sp. nov.

A tree 5–8 m. high, or shrubby, the twigs slender. Leaves oval to suborbicular, coriaceous, shining, 3.5–8 cm. long, 3–5 cm. wide, finely reticulate-veined on both sides, with the midvein rather prominent, rounded, mucronate or rarely acute at the apex, obtuse or somewhat narrowed at the base, the petiole 5–10 mm. long; inflorescence lateral, pubescent, shorter than the leaves; flowers sessile, green, about 2 mm. broad; fruit black, much compressed, about 1 cm. in diameter.

Coastal woods, hills and thickets, Oriente, Camaguey, Santa Clara. Type from Guajimica, Santa Clara (*Britton, Earle & Wilson 5991*).

Family ANNONACEAE

Xylopia Roigii P. Wilson, sp. nov.

A shrub or small tree, the young twigs brown, strigillose with short, appressed hairs; leaves oblong-elliptic or obovate, 3.5–7 cm. long, 1–2.4 cm. broad, rounded or somewhat acutish at the apex, cuneate at the base, glabrous and somewhat lustrous above, dull and minutely strigillose beneath with short, appressed hairs, short-petioled; flowers immature; calyx about 4 mm. broad, the lobes triangular; outer petals oblong, 9–11 mm. long, 2.5–3 mm. broad, densely sericeous on the back, the inner petals narrower; carpels (mature?) ellipsoid, about 2.5 cm. long, 1.4 cm. broad, glabrous.

Thickets, Baracoa, Oriente (*Roig 99*).

Family LAURACEAE

Persea Shaferi P. Wilson, sp. nov.

A slender shrub 2 m. high, with puberulent twigs. Leaves oblong-elliptic or oblong-obovate, 4.5–7.5 cm. long, 1.5–2.5 cm. broad, acutish or obtuse at the apex, acute at the base, glabrous above, the midvein impressed, the lateral veins puberulent and rather indistinctly reticulate-veined beneath; inflorescence 8 cm.

long, the branches puberulent; fruit (immature) subglobose, 9 mm. in diameter.

Type collected at Camp La Gloria, south of Sierra Moa, Oriente (*Shafer 8248*).

Family CAESALPINIACEAE

Cassia benitoensis Britton & Wilson, sp. nov.

Shrub 1–3 m. tall; young twigs, petioles and rachis pubescent with short, stiff, incurved hairs. Leaves 5–9 cm. long, glandular, the gland slender, 2 mm. high, situated between the leaflets of the lowest pair; petioles and rachis narrowly grooved; stipules lanceolate, 6–7 mm. long, acuminate; leaflets 5–6 pairs, oblong-elliptic or elliptic, 1.5–2.4 cm. long, 1–1.2 cm. broad, rounded and mucronulate at the apex, rounded and inequilateral at the base, the margins ciliate; pods flat, 14 cm. long, 8 mm. broad.

Along rocky stream, vicinity of Camp San Benito, Oriente (*Shafer 4072*).

Caesalpinia subglauca Britton, sp. nov.

An unarmed shrub, 2.5 m. high, the twigs glabrous. Leaves bipinnate; petiole rather stout, 1–1.5 cm. long; pinnae 5 or 7, the lower opposite or alternate, 5–10 cm. long, the rachis loosely pubescent; leaflets 9–15, sessile, coriaceous, glabrous, oblong-ovate to ovate-orbicular, 1–2.5 cm. long, 7–15 mm. wide, strongly reticulate-veined above, pale and subglaucous beneath, the apex rounded or emarginate, the base rounded or subcordate, oblique; fruiting pedicels stout, about 2 cm. long; pods flat, thin, puberulent, obliquely oblong, dehiscent, 3–5 cm. long, about 1.5 cm. wide, sharply beaked.

Hillside thicket, near Santiago, Oriente (*Britton & Cowell 12596*).

Caesalpinia myabensis Britton, sp. nov.

A shrub about 1.3 m. high, with slender gray branches, the young twigs densely short-pubescent. Leaves bipinnate, the petiole and rachis densely short-pubescent; petiole 1–1.5 cm. long; pinnae 5–7, opposite, 3–5 cm. long; leaflets 7–17, sessile, coriaceous, loosely pubescent, dark-green and shining above, pale, dull and pubescent on the midvein beneath, strongly pinnately veined, 6–12 mm. long; inflorescence racemose; fruiting pedicels erect, slender, pubescent, 2–2.5 cm. long; pods obliquely oblong, spreading, about 3 cm. long, 1–1.3 cm. wide, subulate-tipped, puberulent.

Dry hill, between Holguin and Myabe, Oriente (*Shafer 1403*).

Caesalpinia Hornei Britton, sp. nov.

A shrub with unarmed branches; the twigs, petioles and rachis pubescent with short incurved hairs. Leaves bipinnate; petioles rather slender, 1.5–1.7 cm. long; pinnae 5–7, opposite, 5.5–7.5 cm. long; leaflets 7–11, broadly oblong to somewhat oblong-ovate, 1.5–2.5 cm. long, and 0.9–1.5 cm. broad, rounded and emarginate at the apex, truncate and more or less inequilateral at the base, sessile, reticulate-veined on both surfaces, glabrous and somewhat lustrous above, paler and dull beneath; inflorescence racemose; flowering pedicels erect, slender, loosely pubescent, about 2 cm. long; corolla yellow, 2–2.4 cm. broad; petals obovâte, 1–1.2 cm. long, 8–10 mm. broad.

Savanna, Ciego de Avila, Camaguey (*Horne 95*).

Family FABACEAE

Harpalyce macrocarpa Britton & Wilson, sp. nov.

A tree 4 m. high, or more, with slender, spreading branches, the twigs, petioles and rachis densely puberulent with ferruginous hairs. Leaves odd-pinnate, 10–14 cm. long, the petioles 1–2 cm. long; leaflets 11–15, oblong to oblong-elliptic, 2.2–3.8 cm. long, 1–1.5 cm. broad, rounded and emarginate at the apex, rounded and often subcordate at the base, short-petioled, coriaceous, glabrous and rather dull above, the veins slender and rather indistinct, finely reticulate-veined and glandular beneath, glabrous with the exception of the midvein; legume spatulate-oblanceolate, 5–6 cm. long, 1.5 cm. broad near the apex, more or less curved, glabrous.

Border of arroyo, palm barren, Santa Clara (*Britton & Cowell 13284*).

Harpalyce villosa Britton & Wilson, sp. nov.

A tree 3–4 m. high, with rather stout grayish branches, the twigs, petioles, rachis and under surface of the leaflets densely short-villous with ferruginous hairs when young. Leaves 6–7.5 cm. long, the petioles about 1.5 cm. long; leaflets oblong or elliptic-oblong, 2–2.7 cm. long, 0.6–1.2 cm. broad, rounded and emarginate at the apex, rounded at the base, short-petioluled, thick-coriaceous, dark-green, glabrous and shining above, paler, indistinctly veined and conspicuously impressed glandular beneath, glabrescent in age with the exception of the midvein; legume oblong, 4 cm. long, 1–1.2 cm. broad, pointed at both ends; seeds ovate, 5 mm. long, 4–4.5 mm. broad.

Among rocks along stream, vicinity of Camp San Benito, Oriente (*Shafer 4089*); also collected at Moa, Baracoa (*Roig 43*).

BEMBICIDIUM Rydberg, gen. nov.

A low unarmed shrub. Leaves abruptly pinnate; stipules lanceolate, persistent; petiole and rachis broadly winged, the wings discontinuous, the rachis slightly produced above the uppermost leaflets; leaflets entire, coriaceous without veins, the midrib prominent beneath, obsolete above; stipels obsolete. Flowers solitary in the axils. Calyx turbinate, as broad as long, with two broad, subequal, acute lips; corolla purplish, with subequal petals. Banner obovate, slightly retuse, gradually tapering into the short broad claw. Wings and keel-petals equal in length and shape, the blades obliquely oblanceolate, rounded at the apex, slightly auricled at the base; claws short, straight, the blades of the keel-petals united at the middle only. Ovary slightly stipitate, linear, many-ovuled; style glabrous, bent inward at the base, slightly arcuate, not hooked at the apex; stigma minute, terminal. Fruit unknown. [Name Greek, a little top, from the small top-shaped flower buds.] A monotypic genus.

Bembicidium cubense Rydberg, sp. nov.

A shrub 5–6 dm. tall, the branches and twigs clothed with appressed, ferruginous hairs. Leaves equally pinnate, 0.7–2 cm. long, short-petioled, glabrous, the rachis prominently winged; leaflets 2–6, oblong to elliptic or somewhat obovate, rounded at the apex, often somewhat inequilaterally rounded at the base, sessile, dark-green, wrinkled and veinless above, brownish beneath, the midvein rather prominent, the lateral veins indistinct; margin revolute; corolla 1–3 cm. long; blade of the standard obovate; wings oblanceolate; keel-petals obanceolate, 1 cm. long.

Mountain woods, vicinity of Baracoa, Oriente (*Shafer 4284*).

Notodon cayensis Britton & Wilson, sp. nov.

A shrub 1–2 m. tall, with grayish-brown, puberulent branches, the young twigs pubescent with appressed, ferruginous hairs. Leaves equally pinnate, 1–1.5 cm. long, short-petioled, glabrous, the rachis narrowly winged; leaflets 2 or 4, obovate, 6–11 mm. long, 2–4 mm. broad above the middle, rounded at the apex, cuneate at the base, sessile, green and with few inconspicuous veins or veinless above, whitish and veinless beneath, the margin strongly revolute; peduncles axillary, 4–5 mm. long, slender; calyx glabrous, broadly campanulate, 4- or 5-toothed; corolla "bluish"; blade of the standard rounded, obovate, retuse at the apex, 5 mm. broad; wings oblanceolate, with a small basal lobe; keel-petals oblanceolate, 1 cm. long; pod unknown.

Cayo Guajaba, Camaguey (*Shafer 658 and 2823*).

Notodon savannarum Britton & Wilson, sp. nov.

A shrub 0.5–2.5 m. high, the branches stiff, the young shoots finely pubescent. Stipules minute; leaves 1.5 cm. long or less, evenly pinnate, short-petioled, glabrous, the rachis winged between the 2–4 pairs of opposite, sessile leaflets and terminating in a short tip; leaflets coriaceous, obovate or oblong-obovate, 4–8 mm. long, rounded at the apex, obtuse at the base, dark green and veinless above, nearly white and rather strongly pinnately few-veined beneath; stipels none; peduncles axillary, solitary, slender, glabrous, 5–8 mm. long; calyx glabrous, broadly campanulate, subtruncate and minutely 5-toothed, about 2 mm. long; corolla rose-purple, about 1 cm. long; pods (immature) 2.5–4 cm. long, 3–4 mm. broad.

Rocky soil, savannas near Camaguey (*Britton & Cowell 13149*.)

CAÑIZARESIA Britton, gen. nov.

A shrub, with alternate, short-petioled, unevenly pinnate leaves, the small opposite leaflets coriaceous, the stipules obsolete, the flowers in short axillary racemes, the bracts early deciduous, the pedicels short. Calyx subcampanulate, its teeth short, obtuse, nearly equal, the two upper ones partly united. Standard broadly ovate, rounded at the apex, subtruncate at the base, short-clawed, unappendaged; wings oblong, long-clawed; keel long-clawed, arcuate, about as long as the wings, 2-lobed at the base. Stamens 10 (9 and 1); filaments filiform; anthers ovate, versatile. Ovary narrowly subcylindric, sessile, puberulent; style nearly as long as the ovary, curved near the base; stigma small, sub-capitate. Legume short-stipitate, indehiscent, linear, with four narrow subcoriaceous wings, more or less constricted between the nearly sessile ovate seeds. [In honor of Professor Felipe Garcia Cañizares.] A monotypic genus.

Canizaresia cubensis (Urban) Britton, comb. nov.

Piscidia cubensis Urban, Symb. Ant. **7**: 229. 1912.

Barren rocky savannas, Oriente, Camaguey, Santa Clara. Endemic.

Bradburya lobata Britton & Wilson, sp. nov.

Stems twining, glabrous or sparingly pubescent with rather long, whitish hairs. Leaflets 3, hastate-ovate with rounded lobes, 4–9.5 cm. long, 2–9 cm. broad, abruptly short-acuminate or acute at the apex, subtruncate or somewhat rounded at the base, short-petioled, glabrous or sparingly pubescent on the veins; peduncles few-flowered; bracts lanceolate or lanceolate-ovate, several times longer than the calyx, acuminate at the apex; calyx puberulent, the lobes short; corolla purple; standard orbicular, 3.5 cm. high, 4.5 cm. wide, pilose on the back with appressed, ferruginous hairs; pods linear, 12–15 cm. long, 8 mm. wide; seeds 4–4.5 mm. long, 3 mm. wide, black.

Waste places, Vedado, Havana (*Léon & de Cubas 8507*).

Erythrina venosa Britton & Wilson, sp. nov.

A small tree, 6 m. high, with grayish or yellowish-gray glabrous twigs, which are often closely armed with rather stout, straight prickles 2–7 mm. long. Leaves 5–10 cm. long, the petioles slender, puberulent, 3–5 cm. long; leaflets 3, ovate to broadly ovate, 2–4.5 cm. long, 1.5–3.5 cm. broad, obtuse or occasionally rounded at the apex, often obliquely rounded at the base, glabrous and finely reticulate-veined above, coarsely reticulate-vined beneath, the veins loosely pilose; short-petioluled; flowers immature; calyx broadly campanulate, puberulent; standard oval, 2 cm. long, 1.2 cm. broad, dark red; keel-petals obovate or obliquely obovate, 6–7 mm. long, 2.5–3 mm. broad, free, the wings obovate or obliquely obovate.

La Perla, Oriente (*Shafer 8540*).

Phaseolus savannarum Britton & Wilson, sp. nov.

Stems pubescent with more or less reflexed hairs, erect or ascending from a perennial rootstock, the peduncles elongate, much exceeding the leaves. Leaflets oblong-linear to oblong-ovate, 1–4 cm. long, 0.3–1 cm. broad, acute or occasionally rounded at the apex, rounded at the base, papillose and more or less densely pubescent above with mostly appressed hairs, appressed-pubescent beneath, coriaceous, the margin ciliate; racemes simple; flowers short-pedicelled; calyx campanulate, 2–3 cm. long, appressed-puberulent, the lobes triangular to triangular-ovate; corolla pink; wings 2–2.5 cm. long, the standard 1–1.5 cm. broad; legume linear, 4–6 cm. long, 3 mm. broad, appressed-puberulent; seeds 2.5 mm. long, 1.5 mm. broad.

Savannas, pine lands and palm barrens, Camaguey, Santa Clara, Matanzas, Pinar del Rio and Isle of Pines. Type from Herradura, Pinar del Rio (*Earle 632*).

Family ERYTHROXYLACEAE

Erythroxylon Roigii Britton & Wilson, sp. nov.

A glabrous shrub, 2–2.5 m. high, with slender twigs. Leaves elliptic, 5–7 cm. long, 2–3.5 cm. wide, obtuse and short-apiculate at the apex, acute at the base, sub-coriaceous, greenish-brown, lustrous and rather obscurely reticulate-veined above, rusty-brown and reticulate-veined beneath; petioles slender, 7 mm. long; drupes ellipsoid, 11–13 mm. long, 4.5–5 mm. thick.

Type collected at Caleta Grande, Isle of Pines (*Roig & Cremata 1856*).

Erythroxylon coriaceum Britton & Wilson, sp. nov.

A small tree, 5–7 m. high, with rather stiff gray branches. Leaves elliptic-obovate to obovate, 2.5–5.5 cm. long, 1.5–3.4 cm. broad, rounded and often emarginate at the apex, obtuse or somewhat acute at the base, coriaceous, indistinctly veined, dark green above, paler beneath, the margin revolute; petioles 5–7 mm. long; stipules triangular, 2–3 mm. long; buds several together in the axils, on short pedicels; calyx-lobes ovate, acute; drupes (undeveloped?) narrowly oblong, about 1 cm. long, orange-red.

Type collected on bank of Rio Guayabo, above the falls, Oriente (*Shafer 3601*).

Family BURSERACEAE

Elaphrium Shaferi Britton & Wilson, sp. nov.

A glabrous tree 6 m. in height; bark of the trunk reddish-brown, easily peeling off in thin sheets; branches brown; leaves simple, narrowly deltoid-lanceolate, 4–8 cm. long, 1–1.8 mm. broad at the base, acuminate at the apex, rounded and cordate at the base, reticulate-veined above, the lateral veins nearly at right angles to the midvein; reticulate-veined beneath; petioles slender, 1–1.5 cm. long; inflorescence about 1–1.5 cm. long; drupes obovoid, 6.5–7 mm. long, 5 mm. broad.

In dry rocky places, La Guira, north of Sumidero, Pinar del Rio (*Shafer 13751*).

Family MALPIGHIACEAE

Bunchosia Leonis Britton & Wilson, sp. nov.

Shrub 1 m. tall, with grayish-brown twigs. Leaves obovate, 1–3.2 cm. long, rounded and emarginate at the apex, cuneate at the base, coriaceous, lustrous above, dull beneath, glabrous in age, short-petioled; flowering pedicels pubescent; corolla about 1–1.3 cm. broad; sepals ovate, 2.5 mm. long, ciliate, the glands one-half the length of the sepal body; larger petals 5–5.5 mm. long, the blades suborbicular, toothed; ovary and style glabrous; drupes 1.6–2 cm. long.

Type collected in coastal thicket, Playa del Chivo, Havana (*Léon 7214*).

Family EUPHORBIACEAE

Andrachne (?) **cuneifolia** Britton, sp. nov.

A glabrous shrub 1–2 m. high, with slender elongated leafy branches. Leaves obovate, cuneate, 5–12 mm. long, rounded at the apex, delicately pinnately veined, dark green and shining above, pale green and dull beneath, the petiole about 1 mm. long; stipules minute; fruiting pedicels about 14 mm. long, the six persistent oblong sepals about 1 mm. long.

Punta Maisi, Oriente: southern and southwestern Porto Rico. Type from a dry hillside, Coamo Springs, Porto Rico (*Underwood & Griggs 545*).

RAMSDENIA Britton, gen. nov.

Monoecious shrubs, with flattened branches, distichous, emarginate, orbicular or obovate leaves, or those of primary branches reduced to scales, the apetalous flowers solitary or 2 together in the axils, the pistillate few. Sepals 5, coriaceous. Stamens 5, the filaments connate, the anthers extrorse. Styles several-cleft. [In honor of Charles T. Ramsden, distinguished Cuban zoologist.]

Type species: *Phyllanthus excisus* Urban.

Ramsdenia excisa (Urban) Britton, comb. nov.

Phyllanthus excisus Urban, Repertorium **13**: 449. 1914.

In rich woods, Navas to Camp Buena Vista, Oriente. Endemic. A shrub about 3 m. high.

Ramsdenia incrustata (Urban) Britton, comb. nov.

Phyllanthus incrustatus Urban, Repertorium **13**: 449. 1914.

Moist woods, mountains of northern Oriente. Endemic.

Orbicularia scopulorum Britton, sp. nov.

A shrub, 2 m. high, with slender, ascending branches and very slender leafy twigs; stipules setaceous, deflexed, 3–4 mm. long; leaves spatulate-obovate, 5–7 mm. long, nearly sessile, distichous, minutely foveolate and inconspicuously veined above, distinctly pinnately veined beneath, rounded at the apex, cuneate at the base; flowers and fruit unknown.

Rocky thickets near Camp Toa, Oriente, at about 400 m. altitude (*Shafer 4006*).

Orbicularia foveolata Britton, sp. nov.

A vine-like shrub, with short, ascending branches, the twigs very slender. Stipules subsetaceous, about 1 mm. long. Leaves coriaceous, orbicular-obovate or elliptic-orbicular, nearly sessile, 8–12 mm. long, shining, inconspicuously veined and distinctly foveolate above, dull, and prominently veined beneath, rounded at the apex, obtuse at the base; flowers and fruit unknown.

Camp La Gloria, south of Sierra Moa, Oriente (*Shafer 8271*).

ROIGIA Britton, gen. nov.

A shrub with dimorphous branches, the narrowly spatulate, entire leaves spirally arranged on the short secondary branches, the staminate flowers long-peduncled, solitary in the axils. Staminate flowers with a 6-parted calyx, the segments obovate, rounded, erose; stamens 10, the filaments united into a long column, free above; anthers suborbicular. [In honor of Juan T. Roig, enthusiastic Cuban botanist.] A monotypic genus.

Roigia comosa (Urban) Britton, comb. nov.

Phyllanthus comosus Urban, Repertorium **13**: 451. 1914.

Dry rocky soil, serpentine hills near mouth of Rio Yamaniguey, Oriente. Endemic.

Conami (?) **ovalifolia** Britton, sp. nov.

A glabrous undershrub, 1 m. high or less, the stem rather stout, the branches mostly simple, elongated, slender, compressed and somewhat angled. Leaves chartaceous, distichous, oval to elliptic, 4–8 cm. long, 2–4 cm. wide, rounded at the apex, obtuse or narrowed at the base, pinnately veined; stipules clustered at the end of the stem, lanceolate, acuminate, striate, 1–1.5 cm. long; flowers fascicled in the axils, reddish, the slender pedicels 3–6 mm. long; perianth-segments 4, those of pistillate flowers suborbicular, rounded, about 4 mm. long, larger than the staminate; styles united; stigmas 3, short, spreading; filaments united; anthers 2.

Valleys, northern Oriente: type collected between Yamuri Arriba and Bermejal (*Shafer 8446*).

DIMORPHOCLADIUM Britton, gen. nov.

A shrub, with dimorphous branches and leaves. Primary branches stout, terete, their leaves oblong-spatulate, densely arranged spirally. Secondary branches very slender, compressed, their small oblong-obovate leaves distichous. Staminate flowers pedicelled, clustered in the axils; sepals 5, ovate. Stamens 4, the filaments connate, the anthers free, subquadrate. [Greek, dimorphous branches.] A monotypic genus.

Dimorphocladium formosum (Urban) Britton, comb. nov.

Phyllanthus formosus Urban, Repertorium **13**: 451. 1914.

Thickets between Camp La Barga and Camp San Benito, Oriente. Endemic. A shrub 4–6 dm. high, the flowers pink.

Phyllanthus Selbyi Britton & Wilson, sp. nov.

A glabrous, perennial herb, 4 dm. tall, with ascending, slightly flexuose, woody branches; the slender leafy twigs 1.5–3 cm. long. Leaves elliptic to oval, 2–2.5 mm. long, 1.3–1.6 mm. broad, obtuse at the apex, rounded or somewhat truncate at the base, short-petioled, coriaceous, veinless or nearly so; stipules linear-lanceolate, 1 mm. long; flowers monoecious; pistillate flowers short-pedicelled, the sepals obovate, 1.3–1.5 mm. long, 0.5 mm. broad; ovary depressed-globose; styles 3, forked near the top; staminate flowers short-pedicelled, the sepals broadly ovate, 1.2 mm. long, 0.9–1 mm. broad; filaments united with a short column; anthers 3; capsule depressed-globose, about 1.8 mm. broad; seeds brown, about 1 mm. long, transversely striate.

White sand, vicinity of San Pedro, Isle of Pines (*Britton, Wilson & Selby 14157*).

Phyllanthus dimorphus Britton & Wilson, sp. nov.

A glabrous perennial herb, 5–6 dm. tall, with slender woody stems branching mostly near the apex, the slender branches straight, ascending or spreading, 8–14 cm. long. Leaves oblong or elliptic-oblong, 5–9 mm. long, 2–2.5 mm. broad, short-petioled, rounded or occasionally somewhat acutish at the apex, rounded at the base, dark-green above, paler beneath; stipules narrowly lanceolate, 1–1.5 mm. long, purplish-black; flowers dioecious; pistillate flowers slender-pedicelled, their sepals obovate to broadly obovate, 2 mm. long, 1–1.5 mm. broad, rounded at the apex; styles of flowers of some plants 3, slender, forked above the middle; of other plants united into a column about 1 mm. long, the stigma orbicular, peltate, entire; staminate flowers not seen.

Grassy hill between El Porvenir and Aguacate, Trinidad mountains, Santa Clara, 700–900 m. altitude (*Britton & Wilson 5350*).

Croton cueroensis Britton & Wilson, sp. nov.

Shrub 2 m. tall; the twigs and petioles densely ferruginous-hispid with stellate hairs when young, grayish in age. Leaves broadly ovate to suborbicular, 1.8–3.4 cm. long, 1.5–2.8 cm. broad, more or less soft pubescent above with stellate hairs, stellate-canescent beneath; petioles 0.8–1.5 cm. long; stipules subulate, broadening at the base, 7–11.5 mm. long; buds subglobose, flattened; sepals of the staminate flowers ovate; filaments tomentose; capsule densely stellate-tomentose; seed short-ovoid, 3.5 mm. long, 3 mm. broad, grayish.

Vicinity of El Cuero, Oriente (*Britton & Cowell 12735*).

Differing from *C. spiralis* Muell. Arg. in the long, subulate stipule which is not coiled at the base, also by the stellate hairs of the upper surface, which are long-rayed.

Argythamnia cubensis Britton & Wilson, sp. nov.

A small shrub with brownish or purplish-brown decumbent branches; leaves elliptic to oval or obovate, 1–2.5 cm. long, 0.5–1.4 cm. broad, rounded or acute at the apex, acute at the base, entire or crenulate, short-petioled, purplish-brown and more or less strigillose on both surfaces; staminate flowers about 2 mm. broad; sepals 5, lanceolate, 1–1.2 mm. long, 0.5 mm. broad; petals 5, ovate, 1–1.1 mm. long, 0.5–0.6 mm. broad; stamens 5, the filaments distinct; sepals of the pistillate flowers 5, ovate, acuminate at the apex; styles 3, distinct, bifid; capsule about 3 mm. in diameter; seeds subglobose, 1.1–1.2 mm. broad, reticulated.

Rocky coastal hills, vicinity of El Morro, Santiago Bay, Oriente (*Britton & Cowell 12580*).

Lasiocroton gracilis Britton & Wilson, sp. nov.

Shrub, the young twigs clothed with minute, ferruginous, stellate hairs; leaves ovate, 3–3.5 cm. long, 1.4–2.5 cm. broad, acute to short-acuminate at the apex, rounded or subcordate at the base, short-petioled, those on the branches oblong-elliptic, 1–1.5 cm. long, 0.5 cm. broad, all entire and glabrous or nearly so above, beneath reticulate-veined and densely stellate-pubescent with whitish hairs; inflorescence slender, 3–5 cm. long, loosely flowered; petals of the staminate flowers ovate-lanceolate, 2 mm. long, 1 mm. broad, acute at the apex, densely pubescent on the back; fruit not seen.

Type collected in the vicinity of Santiago, Oriente (*Pollard & Palmer 281*).

Lasiocroton (?) **cordifolius** Britton & Wilson, sp. nov.

A shrub 2–2.5 m. tall, the young twigs densely clothed with short, ferruginous, stellate hairs; leaves broadly ovate-oval to oval, 7–14 cm. long, 4.5–10.5 cm. broad, obtuse, acute or short-acuminate at the apex, rounded and cordate at the base, entire, above glabrous; the veins rather inconspicuous, beneath stellate-pubescent with whitish hairs, the midvein and lateral veins prominent; petioles 4–5.5 cm. long, densely short-stellate pubescent; flowers and fruit not seen.

Along stream in the Pinales southeast of Paso Estancia, Oriente (*Shafer 1724*).

Pera longipes Britton & Wilson, sp. nov.

A shrub about 3 m. high, with slender, ascending, glabrous twigs. Leaves alternate, obovate, coriaceous, 3–7 cm. long, 1–3 cm. wide, green on both sides, elepidote, rounded or emarginate at the apex, cuneate at the base, faintly pinnately few-veined, the stout petiole 1.5–2.5 mm. long; staminate inflorescence long-peduncled, subglobose, 1-bracted, about 4 mm. in diameter, sparingly lepidote; peduncle weak, curved or flexuous, 1.5–2 cm. long; bract ovate-orbicular, rounded, lepidote, 1.5 mm. long.

Dry serpentine thickets, between Navas and Camp Buena Vista, Oriente, at 650 meters altitude (*Shafer 4416*).

Pera pallidifolia Britton & Wilson, sp. nov.

A shrub, 2–2.6 m. high, with slender, ascending twigs. Leaves alternate, oblong-oblanceolate, subcoriaceous, 4–8 cm.

long, 1–2.2 cm. wide, pale green on both sides, pinnately few-veined, elepidote, obtuse or rounded at the apex, narrowed at the base, the rather slender petioles 5–10 mm. long; peduncles of the staminate inflorescence straight, lepidote, 6–8 mm. long; staminate involucre 1-bracted or with a second minute bract, rather densely lepidote, depressed-globose, about 2 mm. in diameter.

Dry hillsides between Rio Yamaniguey and Camp Toa, Oriente, at 400 meters altitude (*Shafer 4183*).

Sapium cubense Britton & Wilson, sp. nov.

A glabrous milky shub or a small tree up to 6 m. high, the slender twigs subterete. Leaves subcoriaceous, oblong to oblong-obovate, 8 cm. long or less, 1.5–3 cm. wide, acute or obtuse at the apex, narrowed or subcuneate at the base, glandular-crenulate, the midvein prominent, the lateral venation obscure, the slender, eglandular petiole 8–15 mm. long; spikes slender, interrupted, axillary, about as long as the leaves or shorter; calyx about 1 mm. long; filaments 2–3 times as long as the calyx; valves of the capsule about 7 mm. long.

Woods and thickets, northern Oriente. Type from near Woodfred, Sierra Nipe (*Shafer 3607*).

Acalypha Hutchinsonii Britton, sp. nov.

Perennial, apparently dioecious, depressed, velvety-pubescent, branched, the branches slender, prostrate or ascending, 4–8 cm. long. Leaves ovate-orbicular, 5–15 mm. long, crenate-serrate, obtuse or acutish at the apex, subtruncate at the base, the petioles 1–3 mm. long; staminate spike short-peduncled, 6–9 mm. long.

Rocks on the coast of southern Santa Clara (*Britton, Earle & Wilson 5907*).

The species appears to be distinct from any of those described by Prain and Hutchinson in Kew Bulletin **1913**: 1–28.

Family CYRILLACEAE

Cyrilla cubensis P. Wilson, sp. nov.

A glabrous shrub 1–2 m. tall, with grayish more or less angled twigs. Leaves elliptic-obovate, 1.5–3 cm. long, 0.9–2 cm. broad, rigidly coriaceous, rounded and emarginate at the apex, acute or rounded at the base, dark green and shining above, the veins rather inconspicuous, paler, papillose and reticulate-veined beneath; midrib impressed above, prominent beneath; racemes stout, 3.5–4 cm. long, many-flowered, erect, glabrous; bracts narrowly lanceolate, 1.5 mm. long; pedicels 2.5–3 mm. long; calyx-lobes ovate-lanceolate, short-acuminate; petals elliptic or elliptic-ovate, 3–3.2 mm. long, 1.2 mm. broad, acute; stamens about half as long as the petals; ovary glabrous.

Mountains of Oriente (*Shafer 4140, type; 4109, 4060*).

Family ILICACEAE

Ilex Shaferi Britton & Wilson, sp. nov.

A small shrub, 1–3 m. high, with grayish branches and puberulent twigs. Leaves obovate, 0.6–1.4 cm. long, 0.5–0.8 cm. broad, with entire revolute margins, rounded and often emarginate at the apex, cuneate at the base, short-petioled, glabrous, shining and obscurely veined above, paler, lustrous and obscurely veined beneath; fruit subglobose, solitary in the axils of the leaves, 6–7 mm. long, 5–7 mm. in diameter, dark red.

Mountains of Oriente (*Shafer 8041, type; 4065 and 4126*).

Ilex Clementis Britton & Wilson, sp. nov.

A shrub several meters high. Leaves elliptic to ovate-oval or somewhat obovate, 4.5–9 cm. long, 2.5–5 cm. broad, rounded or acutish and usually apiculate at the apex, cuneate or rounded at the base, entire, glabrous, dull above, the midvein impressed, reticulate-veined and paler beneath; pedicels minutely puberulent, 3–5 mm. long; staminate flowers fascicled in the axils of the leaves; sepals 4, suborbicular, 1.5–2 mm. broad, strongly imbricate, ciliate; corolla lobes 4, elliptic to oval, 2–2.2 mm. long; fruit unknown.

Mountains of Santa Clara (*Brothers Léon and Clement 6645, type; 6558, 6669 and 6694*).

Family HIPPOCRATEACEAE

Salacia (?) **nipensis** Britton, sp. nov.

A woody vine, sometimes 3 m. long, the twigs warty. Leaves coriaceous, glabrous, entire, elongate-lanceolate, 6–18 cm. long, 1.5–4 cm. wide, obtuse at the apex, cordate at the base, pinnately veined, the midvein prominent, the lateral venation obscure; petioles stout, only 2 mm. long; fruit oblong, obtuse, slightly narrowed towards the base, about 4 cm. long and 1.5 cm. in diameter, scurfy; sepals persistent, suborbicular, about 3 mm. broad.

Dry, rocky hillside, Sierra Nipe, Piedra Gorda to Woodfred, Oriente (*Shafer 3183*).

Family RHAMNACEAE

Sarcomphalus cubensis Britton, sp. nov.

A glabrous tree about 10 m. high, the twigs rather stout, stiff, somewhat angled. Leaves borne on short spurs, elliptic or obovate-elliptic, slightly fleshy, 1.5–3.5 cm. long, rounded or emarginate at the apex, obtuse or somewhat narrowed at the base, faintly pinnately veined with the lower pair of veins the strongest, the midvein rather prominent beneath, the slender petioles 3–5 mm. long; fruiting pedicels very slender, 8–12 mm. long; fruit ovoid, 6–8 mm. long, short-tipped, about 3 times as long as the calyx.

Coastal thickets, Oriente, Santa Clara. Type from Punta Piedra, Nipe Bay, Oriente (*Britton & Cowell 12486*).

Rhamnidium (?) **oblongifolium** Britton & Wilson, sp. nov.

A shrub 1 m. tall, with puberulent twigs; leaves oblong, occasionally somewhat elliptic-oblong, 0.9–2.5 cm. long, 3–6 mm. broad, rounded and emarginate at the apex, obtuse at the base, entire, green and lustrous above, whitish and conspicuously black-dotted beneath, glabrous; petioles 1–2.5 mm. long, puberulent; flower-clusters axillary, long-peduncled; sepals triangular-ovate, acuminate, glabrous, glandular-dotted; petals broadly triangular-obovate; filaments subulate; anthers ovate; ovary ovoid, glabrous, black-dotted.

Rocky hill, palm barren, Santa Clara (*Britton & Cowell 13311*).

Rhamnidium (?) **orbiculatum** Britton & Wilson, sp. nov.

An erect shrub, 2 m. tall, with grayish-brown, glabrous twigs; leaves oval to orbicular-oval, 1.5–2.5 cm. long, 1.5–2.4 cm. broad, rounded and emarginate at the apex, rounded at the base, lustrous, reticulate-veined and black-dotted above, paler, black-dotted and dull beneath, glabrous; petioles 5–6 mm. long; flower-clusters axillary, long-peduncled; sepals ovate, glabrous, black-dotted; petals present; filaments short, anthers ovate.

Dry soil, savannas near Camaguey (*Britton & Cowell 13188*).

Rhamnidium Rocanum Britton & Wilson, sp. nov.

A shrub with slender grayish-brown puberulent twigs. Leaves oblong-elliptic, 7–10 cm. long, 2.4–3.5 cm. broad, rounded or occasionally acutish and mucronulate at the apex, rounded at the base, entire, glabrous, reticulate-veined and tuberculate above, sparingly puberulent and conspicuously black-dotted beneath; petioles 6–8 mm. long; flower-clusters axillary, on peduncles about 1 cm. long; flowers immature; sepals triangular-ovate, acute, glandular-dotted; petals orbicular-obovate; filaments subulate, glabrous; anthers ovate; ovary ovoid, compressed, glabrous, glandular-dotted.

In woods, Banao Mountains, Santa Clara (*Léon & Roca 8052*).

Family VITACEAE

Cissus Torreana Britton & Wilson, sp. nov.

A vine several meters long, with loosely hirsute, winged branches; leaves 3-foliolate; petioles 8–10 cm. long, winged; leaflets membranaceous, elliptic-ovate to obliquely ovate, 8–11 cm. long, 5–7 cm. broad, acuminate at the apex, obliquely rounded or acutish at the base, puberulent above, loosely hirsute on the veins beneath, the margin serrulate; petiolules about 1.5 cm. long, hirsute; flowers and fruit not seen.

Type from Sierra del Grillo, Madruga, Havana (*Léon & de la Torre 6345*).

Family MALVACEAE

Malache calcicola Britton, sp. nov.

A shrub, 2 m. high, the twigs, petioles and leaf-surfaces densely puberulent and bearing scattered, large stellate hairs. Leaves ovate-orbicular, 1–3 cm. long, irregularly dentate and mostly 3-lobed, acute or acuminate at the apex, cordate at the base, green above, nearly white beneath; the petioles shorter than the blades; flowers solitary, slender-peduncled, the peduncles jointed somewhat below the calyx; bractlets 5, linear, puberulent, appressed, a little shorter than the calyx; calyx puberulent and stellate-pubescent 5-lobed, 6–7 mm. long, its lobes ovate, acute; petals red, strongly veined, about twice as long as the calyx; stamen-column about twice as long as the petals; style-branches 10, slender, 2 cm. long; carpels 5, dry coriaceous, irregularly rugose-crested on the sides, sharply and narrowly winged on the back, short-beaked, 6 mm. long, 1-seeded, dehiscent; seed obliquely ovoid, brown, shining, smooth, 3 mm. long.

Base of cliff, Rio San Juan, Santa Clara (*Britton, Earle & Wilson 5905*.)

Maga cubensis Britton & Wilson, sp. nov.

A tree, up to 15 m. high, the stout twigs densely and finely lepidote. Leaves ovate-orbicular, deeply cordate, acute or acuminate, coriaceous, entire, 6–12 cm. long, strongly palmately 5–7-veined, the veins enlarged and united at the base beneath, dull and finely reticulate-veined above, densely and finely lepidote beneath, the terete, lepidote petioles 10 cm. long or less; flowers solitary or clustered, on stout, lepidote peduncles 1–6 cm. long; calyx subcampanulate, lepidote, about 12 mm. long, nearly truncate, with 5 subulate teeth, circumscissile at the base and wholly deciduous; petals brown-yellow, rounded, finely many-veined, about 3 mm. long, densely lepidote without; stamen-column about twice as long as the petals; stamens yellow.

Coastal thickets, and low woodlands, Camaguey; Santa Clara. Type from Punta Diablo, Cienfuegos Bay, Santa Clara (*Britton & Wilson 6045*).

Family STERCULIACEAE

Melochia savannarum Britton, sp. nov.

A low, more or less prostrate undershrub, the young branches finely stellate-pubescent, often with simple hairs intermixed; leaves ovate to broadly oval, 1–2 cm. long, 0.7–2 cm. broad, acute or rounded at the apex, truncate, rounded or cordate at the base, rather coarsely serrate, glabrous or loosely pubescent above with simple and stellate hairs, more or less pubescent beneath; petioles 3–5 mm. long; flowers short-pedicelled; calyx-teeth triangular-subulate; petals narrowly obovate, 6.5–7 mm. long, 1.5–2 mm. broad; ovary tomentose.

Savannas and along streams, Pinar del Rio. Type from Herradura, Pinar del Rio (*Earle 639*).

Recorded by Grisebach as *M. melissifolia* Benth. and referred by Wright to *M. hirsuta* Cav.

Melochia nipensis Britton, sp. nov.

Perennial; herbaceous with a deep slender tap-root, branches ascending or spreading, very slender, villous and tomentose, 2.5 dm. long or less. Leaves oval or oblong, 6–16 mm. long, 4–7 mm. wide, tomentose on both sides, obtuse at the apex, somewhat narrowed at the base, serrulate, the villous petioles 2.5 mm. long or less; flowers few, glomerate; bracts narrowly linear; calyx about 3 mm. long, its lance-subulate teeth about as long as the tube; petals spatulate, yellow, 3 mm. long.

Pinelands, Sierra Nipe, near Woodfred, Oriente (*Shafer 3294*).

Family OCHNACEAE

Ouratea affinis Britton, sp. nov.

A tree 3–5 m. high, the twigs slender, gray. Leaves coriaceous, lanceolate or oblong-lanceolate, 4–7 cm. long, 2 cm. wide or less, entire, acuminate at the apex, obtuse or narrowed at the base, dull, faintly and closely pinnately straite-nerved, the midvein rather prominent; petioles 3–6 mm. long; fruiting pedicels 2–6 mm. long; receptacle subglobose, 5–6 mm. in diameter.

Mountains of northern Oriente. Type from Rio Naranja at 450–550 m. altitude (*Shafer 3869*).

Ouratea Roigii Britton, sp. nov.

Twigs gray, slender. Leaves lanceolate, chartaceous, dull, 4–7 cm. long, 1.5–2.5 cm. wide, acuminate at the apex, narrowed or rounded at the base, pinnately veined and reticulated, the venation rather prominent beneath, the petioles 4–8 mm. long; fruiting pedicels 2–4 cm. long; receptacle subglobose, about 6 mm. in diameter.

Canete, Baracoa, Oriente (*Roig 67*).

Family MARCGRAVIACEAE

Marcgravia calcicola Britton, sp. nov.

Barren climbing branches very slender, 3 dm. long or longer, their leaves sessile, ovate, cordate, acute, about 2 cm. long. Flowering branches slender, gray, their leaves oblong, 5–6 cm. long, 12–20 mm. wide, acute at both ends, the midvein prominent beneath, impressed above, the lateral venation wholly obscure, the petioles 1–2 mm. long, uppermost leaves ovate, 2–3 cm. long; raceme short, several–many-flowered; pedicels rather stout, thickened upward, 1–1.5 cm. long; sepals suborbicular, rounded; corolla-bud rounded; sterile pedicels incurved, 1 cm. long or less; bracts galeate, compressed, 6 mm. broad.

Limestone cliffs, Baños San Vicente, Pinar del Rio (*Britton & Gager 7412*).

Family THEACEAE

Haemocharis benitoensis Britton & Wilson, sp. nov.

A straggling shrub, 1–2 m. high, with slender branches, the twigs pilose with appressed hairs; leaves obovate, 3–5 cm. long, 1–1.6 cm. broad, rounded at the apex, cuneate at the base, yellowish-green and glabrous above, the midvein impressed, paler and often loosely pilose beneath, the midvein prominent, the lateral veins indistinct; margin more or less revolute; petioles slender, 5–7 mm. long, pilose; sepals suborbicular, 3 mm. long, appressed-pilose on the back; petals elliptic-obovate or obovate, 1 cm. long, 5–6 mm. broad, "white"; ovary appressed-pilose.

Type from thicket, vicinity of Camp San Benito, Oriente (*Shafer 4063*).

Family CLUSIACEAE

Rheedia brevipes Britton, sp. nov.

A tree about 4 m. high, the twigs short; leaves opposite, borne in 2–4 pairs near the ends of the twigs, rigid, oblong-lanceolate to ovate-lanceolate, 4–6 cm. long, 1–2.5 cm. wide, pinnately veined, acuminate, spinulose-tipped, narrowed or obtuse at the base, the stout petiole about 3 mm. long; staminate flowers solitary or few together on pedicels 3 mm. long; flower-bud subglobose, 2.5–3 mm. in diameter; sepals suborbicular, rounded.

Bank of arroyo, between Santa Clara and Manicaragua, Santa Clara (*Britton & Cowell 10262*).

Clusia callosa Britton & Wilson, sp. nov.

A glabrous shrub, 2–3 m. tall, with rather thick, more or less angled, grayish, branches; leaves broadly obovate, 4–6.5 cm. long, 2.7–4.5 cm. broad, rigid-coriaceous, rounded at the apex, obtuse at the base, lustrous above, the veins rather indistinct, paler beneath and conspicuously black glandular-dotted, the midvein prominent, vanishing at or above the middle, the lateral veins obscure or indistinct, the margin revolute and conspicuously thickened; inflorescence terminal, 6–7 cm. long; stigmas 5; fruit subglobose or globose-obovoid, 1.5 cm. long, 1.2–1.5 cm. broad.

Type from Camp La Gloria, south of Sierra Moa, Oriente (*Shafer 8206*).

Family HYPERICACEAE

Hypericum ophiticola Britton, sp. nov.

Perennial by a deep slender root, much branched, the stems angular, slender, prostrate or ascending, 5–15 cm. long, the branches short, ascending or erect, rather densely leafy. Leaves oblanceolate, 2–2.5 mm. long, sessile, rounded at the apex, narrowed at the base, 1-nerved, black-punctate; flowers terminal, solitary, short-peduncled; sepals obovate-oblong, apiculate, 1-nerved, 2.5 mm. long; capsule oblong, 3-valved, about as long as the sepals.

Hillside, serpentine palm barren, Santa Clara (*Britton & Wilson 6140*).

Family FLACOURTIACEAE

Myroxylon (?) **rhombifolium** Britton & Wilson, sp. nov.

A shrub about 1 m. high, with very slender, elongated, puberulent branches, each node with an acicular spine 8–12 mm. long, Leaves coriaceous, rhombic, 6–10 mm. broad, about as long as wide, 2–5-toothed, strongly veined on both sides, the venation somewhat reticulated, dark green and shining above, pale green beneath, glabrous, the petioles 0.5–1 mm. long; flowers and fruit unknown.

Coe's Camp, Ensenada de Siguanea, Isle of Pines (*Britton & Wilson 14880*).

Lunania subcoriacea Britton & Wilson, sp. nov.

A shrub, about 3 m. high, with slender gray terete branches. Leaves oblong-lanceolate, subcoriaceous, glabrous, 12–17 cm. long, 4–5 cm. wide, acute or short-acuminate at the apex, obtuse or rounded at the base, the rather stout petioles 1–1.5 cm. long; raceme peduncled, about 10 cm. long, glabrous; pedicels 4.5–5 mm. long, jointed near the base, glabrous; sepals orbicular or suborbicular, 4.5 mm. broad, concave; filaments subulate; disk fleshy; ovary ovoid.

Rich woods, alluvial valley of Rio Yamaniguey, Oriente (*Shafer 4204*).

Lunania elongata Britton & Wilson, sp. nov.

Branches slender, elongated, puberulent when young, gray, terete. Leaves lanceolate or oblong-lanceolate, membranous, glabrous, 5–15 cm. long, 3 cm. wide or less, acuminate at the apex, rounded or subcordate at the base, the slender petioles 8–20 mm. long, puberulent when young; raceme long-peduncled, narrow, puberulent, many-flowered, 10–18 cm. long; pedicels 2–3 mm. long, jointed above the base, puberulent; sepals orbicular, 4 mm. broad, concave; stamens about 10; disk fleshy; ovary elliptic-ovoid.

Sierra de las Divisiones, Sancti Spiritus mountains, Santa Clara (*Léon and Clement 6598*).

Family THYMELAEACEAE

Daphnopsis oblongifolia Britton & Wilson, sp. nov.

A shrub 1–2 m. or more high, with slender branches, the young growth appressed-puberulent. Leaves linear-oblong to oblong or somewhat elliptic-oblong, 2–5.5 cm. long, 4–7 mm. broad, obtuse or acutish at the apex, acute at the base, short-petioled, entire, revolute-margined, the veins anastomosing and nearly parallel to the midrib; inflorescence short-peduncled, few-flowered; pedicels 2–2.5 mm. long, staminate flowers with calyx-tube short, the lobes ovate.

Type from palm barren, Santa Clara (*Britton & Cowell 13301*).

Family MYRTACEAE

Psidium nummularioides Britton & Wilson, sp. nov.

A small tree, with slender, gray, terete, glabrous twigs. Leaves orbicular or ovate, coriaceous, glabrous, 8–15 mm. long, rounded or obtuse at the apex, rounded or subcordate at the base, bright green and finely reticulate-veined on both surfaces, the midvein rather prominent, the stout petioles about 1 mm. long; pedicels axillary, solitary, slender, ascending, 1.5 cm. long; calyx-lobes suborbicular, 2–2.5 mm. long, 3–3.5 mm. broad, glabrous; young fruit ellipsoid, 8 mm. long, 5–6 mm. in diameter.

Coral limestone bench, Guantanamo Bay, Oriente (*Britton 2046*).

Psidium (?) **navasense** Britton & Wilson, sp. nov.

A glabrous shrub, about 1.3 m. high, the slender twigs terete. Leaves oblong-lanceolate or ovate-lanceolate, subcoriaceous, 5–7 cm. long, dull, bluntly acuminate at the apex, obtuse at the base, rather strongly pinnately veined with the veins united near the margin, the midvein impressed above, prominent beneath, the stout petioles about 2 mm. long; young fruits axillary, solitary, subglobose, about 7 mm. in diameter, on peduncles 6–8 mm. long; calyx-lobes suborbicular, 2 mm. long, 2–2.5 mm. broad; berry subglobose, 6 mm. in diameter.

Moist woods between Navas and Camp Buena Vista, Oriente, 650 m. altitude (*Shafer 4444*).

Psidium bullatum Britton & Wilson, sp. nov.

A shrub or a tree up to 5 m. high, the young twigs densely short-pubescent, terete. Leaves ovate or ovate-elliptic, 3–5 cm.

long, mostly obtuse at the apex, rounded or subcordate at the base, revolute-margined, very short-petioled, when young thin, densely puberulent above, white-tomentulose and black-dotted beneath, when old coriaceous, glabrous and shining with the veins deeply impressed above, dull, glabrate, with the veins very prominent beneath; flowers axillary or lateral on rather stout pubescent peduncles, 1.5–3 cm. long, 2-bracted at the summit, the bracts ovate-oblong, 4 mm. long, deciduous; calyx densely white-tomentulose and black-dotted, 6 mm. long, open in the bud; petals white, somewhat longer than the calyx; ovary 2-celled; fruit ellipsoid, about 1 cm. long, the calyx persistent.

Palm barrens, Camaguey, Santa Clara. Type from Santa Clara (*Britton & Cowell 13328*).

Psidium (?) **ophiticola** Britton & Wilson, sp. nov.

A shrub, about 2 dm. high, the twigs densely tomentulose, terete. Leaves mostly elliptic, coriaceous, 4 cm. long or less, rounded or retuse at the apex, rounded or obtuse at the base, obsoletely veined and glabrous above when old, densely whitish-tomentulose and with pinnate venation beneath, the short stout petioles 1–2 mm. long; flowers solitary in the upper axils; peduncles slender, puberulent, 2–4 cm. long; calyx-lobes elliptic to ovate, 4 mm. long, 3 mm. broad, tomentose; petals oval, 6 mm. long, 4.5 mm. broad.

Dry rocky soil, serpentine hills near mouth of the Rio Yamaniguey, Oriente (*Shafer 4278*).

Psidium saxicola Britton & Wilson, sp. nov.

A shrub, 1 m. high, with terete, nearly erect, densely short-pubescent branches. Leaves ovate or elliptic-ovate, subcoriaceous, very nearly sessile, densely copiously punctate, acute or obtuse at the apex, subcordate or rounded at the base, glabrous and indistinctly veined above, pubescent on the rather prominent veins beneath, the midvein impressed above, elevated on the underside; flowers solitary in the axils; peduncles short-pubescent, 2–6 cm. long; bractlets 2, subfoliaceous, ovate-oblong, pubescent, 4–7 mm. long; ovary pubescent; calyx-lobes tomentose, elliptic-ovate to oval, 3.5 mm. long, 3 mm. broad, ciliate; petals broadly obovate to suborbicular, 8.5–9 mm. long, 6.5–7 mm. broad; young fruit oblong, pubescent, 9 mm. long.

Rocky coastal hills, Santiago Bay. Oriente. Type from El Morro (*Britton & Cowell 12544*).

Calyptranthes Clementis Britton & Wilson, sp. nov.

A shrub, 2–3 m. high; young twigs terete, densely brown-pilose, the older ones glabrous. Leaves subcoriaceous, elliptic-lanceolate, 5–8 cm. long, 3 cm. wide or less, rather distinctly pinnately veined with the midvein slightly impressed above and prominent beneath, the upper surface glabrous, dull green, the under surface pale, densely pilose when young, glabrous when old, the apex long-acuminate, the base rounded or obtuse, the stout petioles 2–4 mm. long; peduncles 0.6–1.8 cm. long, pilose with brownish hairs; heads densely bracted, the bracts brown-pilose, the outer bracts lanceolate, 6–7.5 mm. long, 2.8–3 mm. broad, pinnately-veined, the inner ones smaller; hypanthium densely brown-pilose; fruit (immature) subglobose, 7 mm. in diameter, tuberculate, sparingly pilose.

Loma de Ponciano, Sancti Spiritus mountains, Santa Clara, about 750 m. altitude (*Léon & Clement 6680*).

Calyptranthes Caroli Britton & Wilson, sp. nov.

A shrub, about 3 m. high, the young twigs terete, loosely brown-pilose with spreading hairs, glabrous in age. Leaves subcoriaceous, narrowly elongate-lanceolate, 5–9.5 cm. long, 1.4–1.8 cm. wide, finely pinnately-veined above, reticulate-veined beneath, the midvein not or slightly elevated above, prominent beneath, the upper and lower leaf-surfaces brown-pilose when young, glabrous in age, the apex long-acuminate, the base rounded; petioles 5–7 mm. long, channelled above, pilose; heads many-flowered, sessile or nearly so, few-bracted, the bracts lanceolate, 8–9 mm. long, 3 mm. broad, keeled on the back, loosely pilose; hypanthium densely brown-pilose; fruit unknown.

Banks of Arroyo Ahoga Caballos between Catalina and Caimito, Pinar del Rio, 100–150 m. altitude (*Léon & Charles 4895*).

Calyptranthes clarensis Britton & Wilson, sp. nov.

A shrub or small tree, up to 3 m. high or a little higher; young twigs subterete, pilose with short, mostly appressed hairs, glabrous in age. Leaves subcoriaceous, elliptic-lanceolate or elliptic-oblanceolate, 2–4 cm. long, 7–14 mm. wide, rather indistinctly pinnately veined on both surfaces, the midvein impressed above, prominent beneath, the upper surface glabrous or nearly so, the lower surface appressed-pilose when young, glabrous or nearly so in age, acuminate at the apex, cuneate at the base; petioles 2–2.5 mm. long; inflorescence 1–3-flowered; peduncles 2–2.5 cm. long, slender, puberulent with appressed hairs when young, glabrous or nearly so in age; hypanthium appressed brown-pilose; fruit unknown.

Sierra del Caballete, Sancti Spiritus mountains, Santa Clara, at 800–850 m. altitude (*Léon & Clement 6540*).

Eugenia Cowellii Britton & Wilson, sp. nov.

A shrub, 1–2 m. high, the slender gray twigs puberulent when young, soon glabrous. Leaves oblong to orbicular-elliptic, coriaceous, very small, only 4–7 mm. long, rounded at both ends, tuberculate and veinless above, black-punctate and with the midvein rather prominent beneath, the petioles about 1 mm. long; fruit subglobose or ellipsoid, red, about 9 mm. long.

Coastal rocks, southern Oriente. Type collected at Cabañas Bay (*Britton & Cowell 12716*).

Eugenia (?) **cabanasensis** Britton & Wilson, sp. nov.

A tree 6 m. high, the numerous slender twigs gray, glabrous. Leaves oblong-obovate, coriaceous, light green, 8–15 mm. long, 4–6 mm. wide, rounded at the apex, narrowed or cuneate at the base, smooth, shining and with the midvein impressed above, dull, copiously tuberculate-punctate and with the midvein rather prominent beneath, the internal venation wholly obscure, the petioles about 1 mm. long; flowers and fruit unknown.

Rocky hillside, Cabañas Bay, southern Oriente (*Britton & Cowell 12820*).

Eugeina moensis Britton & Wilson, sp. nov.

A shrub or a slender tree up to 5 m. high, glabrous throughout, the slender twigs densely leafy. Leaves narrowly oblong or linear-oblong, 2.5–4 cm. long, 6–10 mm. wide, rounded or obtuse at the apex, narrowed at the base, tuberculate-punctate on both sides, the midvein lightly impressed above, faint beneath, the lateral venation almost wholly obscure, the rather stout petioles 4–7 mm. long; flowers axillary, solitary, on filiform peduncles about 2 cm. long; calyx about 2.5 mm. long, its lobes ovate; young fruit narrowly oblong, 6 mm. long.

Rocky banks of mountain stream, Camp La Gloria, south of Sierra Moa (*Shafer 8100*).

A shrub with similar foliage, but with the leaves nearly smooth on both sides and the midvein prominent beneath, growing along a rocky river near Camp San Benito, Oriente, at 900 meters elevation, may be a related species.

Eugenia havanensis Britton & Wilson, sp. nov.

A shrub about 2 m. high, the young twigs glabrous or slightly puberulent. Leaves obovate to elliptic or oval, 2.5–3.8 cm. long, 1.5–2.3 cm. broad, rounded at the apex, acute at the base, above rather light green, lustrous and finely tuberculate-glandular when young, dark green and smooth or nearly so in age, beneath glabrous, paler and finely tuberculate-glandular, the midrib prominent; flowers axillary, solitary; pedicels slender, 1–3 cm. long, glabrous or slightly pubescent; calyx-tube about 3 mm. long, puberulent with appressed whitish hairs, its lobes unequal, rounded-ovate to suborbicular, ciliolate; petals obovate, 8 mm. long, 5–5.5 mm. broad, ciliolate.

On hills, Havana. Type collected at Cuabal north of Minas (*Léon & Roca 6212*). Possibly a species of *Psidium*.

Eugenia varia Britton & Wilson, sp. nov.

A low shrub, only about 2 dm. high, some of the branches decumbent and radicant; young twigs puberulent, the older ones gray and glabrous. Leaves chartaceous, various in form, ovate to elliptic or suborbicular, 2 cm. long or less, acute, obtuse or rounded at the apex, mostly rounded at the base, distinctly pinnately veined, the upper surface tuberculate, the petioles 1–1.5 mm. long; flowers few or solitary, mostly in the upper axils; pedicels puberulent, 3 mm. long or less; calyx 1–1.2 mm. long, sparingly pubescent, its lobes rounded-ovate to ovate, obtuse or acutish at the apex, ciliate; petals oval to suborbicular, 1.8–2 mm. long, 1.7–2 mm. broad, rounded at the apex; fruit subglobose, 5 mm. long.

Banks, Pinar del Rio. Type collected between San Diego and La Palma (*Léon 5158*).

Eugenia (?) **Earlei** Britton & Wilson, sp. nov.

A shrub about 2 m. high, with short terete glabrous twigs. Leaves elliptic or ovate-elliptic, chartaceous, 2.5–4 cm. long, 3 cm. wide or less, distinctly pinnately veined, obtuse, rounded or bluntly acute at the apex, obtuse at the base, bright green, shining, somewhat tuberculate above and with impressed midvein, pale green, dull and with midvein prominent beneath, the stout petioles about 1 mm. long.

Valley near Guanabana, Trinidad Mountains, Santa Clara, 260 m. altitude (*Britton, Earle & Wilson, 4771*).

Eugenia Rocana Britton & Wilson, sp. nov.

A shrub, about 2 m. high, the slender young twigs puberulent, the older ones gray, terete, glabrous. Leaves oblong or oblong-lanceolate, subcoriaceous, 2.5 cm. long or less, acute at the apex, obtuse at the base, the midvein impressed above, prominent beneath, the lateral venation delicate, not prominent, the upper surface tuberculate, the puberulent petioles about 1 mm. long; flowers solitary or few together and nearly sessile; calyx 1.5 mm. long, densely whitish-pubescent with appressed hairs, its lobes triangular to triangular-ovate, 2–2.5 mm. long, acuminate.

Rocky summit of Sierra de Anafe, Havana (*Léon & Roca 7142*).

Eugenia clarensis Britton & Wilson, sp. nov.

A tree about 6 m. high, the slender young twigs puberulent. Leaves oblong or oblong-oblanceolate, subcoriaceous, 2.8 cm. long or less, 6–10 mm. wide, acute at the apex, mostly obtuse at the base, the midvein impressed above, prominent beneath, the lateral venation wholly obscure, the upper surface tuberculate, the stout petioles about 1.5 mm. long; flowers axillary, solitary or in 2–4-flowered clusters; pedicels 2–4 mm. long, pubescent; bractlets lanceolate; calyx-tube whitish-pubescent with long hairs, 2 mm. long, its lobes ovate, acuminate at the apex, ciliate; petals oval, 5 mm. long, 3 mm. broad, rounded at the apex.

Woods, Pitajones, Santa Clara (*Shafer 12275*).

Eugenia anafensis Britton & Wilson, sp. nov.

A shrub about 2 m. high, the young twigs slender, densely puberulent. Leaves oblong or oblong-lanceolate, chartaceous, glabrous, 3–5 cm. long, 9–18 mm. wide, acute or short-acuminate at the apex, obtuse or narrowed at the base, the midvein impressed above, prominent beneath, the lateral venation delicate, not prominent, the upper surface tuberculate; flowers solitary and very nearly sessile in the axils; fruit subglobose, about 8 mm. in diameter, the persistent calyx-lobes triangular to triangular-ovate, 2.5 mm. long, acute.

Rocky hillside, Sierra de Anafe, Pinar del Rio (*Wilson 11587*).

Eugenia ignota Britton & Wilson, sp. nov.

A shrub about 3 m. high, the young twigs, inflorescence and veins of the young leaves appressed-pubescent. Leaves oblong to elliptic, thin-chartaceous, 3 cm. long or less, 8–16 mm. wide, acute at the apex, narrowed or obtuse at the base, rather distinctly pinnately veined, smooth and glabrous above, punctate and with some scattered hairs beneath, the midvein impressed in the upper surface, prominent on the lower, the puberulent petioles 1–2 mm. long; flowers few, in small bracteolate axillary clusters; pedicels 2–3.5 mm. long; calyx about 1.5 mm. long, pubescent with scattered, appressed hairs, its lobes rounded-ovate, acute or short-acuminate.

Coastal plain, San Juan, Isle of Pines (*Britton & Wilson 15455*).

Eugenia Bakeri Britton & Wilson, sp. nov.

Young twigs puberulent, slender, terete, soon becoming glabrous. Leaves oblong to oblong-lanceolate, coriaceous, 2–3.5 cm. long, acute or short-acuminate at the apex, narrowed at the base, shining, copiously impressed-punctate with impressed midvein but otherwise nerveless above, dull, pinnately veined and with midvein prominent beneath, the stout petioles about 1 mm. long; flowers solitary or 2 or 3 together in the axils, sessile; calyx 2 mm. long, more or less loosely pubescent with brownish hairs, its lobes rounded-ovate to oval, obtuse or rounded at the apex.

Santa Catalina, Pinar del Rio (*Baker 969*).

A barren specimen with similar foliage but with leaves rounded at base, from Rio Guao, Pinar del Rio (*Britton & Cowell 10102*), may represent this species or a related one.

Family MELASTOMACEAE

Tamonea (?) **moensis** Britton, sp. nov.

A glabrous shrub or small tree. Leaves coriaceous, elliptic or ovate-elliptic, acute or acuminate at the apex, narrowed at the base, entire, 4.5–7 cm. long, 3-nerved, the 2 lateral veins arising just above the base, the veins impressed above, prominent beneath, the secondary venation delicate, the rather stout petioles 6–9 mm. long; panicle loosely few-flowered; pedicels slender, 10–14 mm. long; fruit globose, glabrous, about 7 mm. in diameter, the persistent calyx-limb truncate.

Camp La Gloria, south of Sierra Moa, Oriente (*Shafer 8073, type; 8038*).

Calycogonium saxicola Britton & Wilson, sp. nov.

A low shrub, about 6 dm. high, the young twigs, petioles and leaf-blades finely scurfy. Leaves subcoriaceous, bright green, shining, ovate to elliptic, 1–2.5 cm. long, acute or acuminate at the apex, mostly narrowed at the base, 3-nerved, the lateral veins arising just above the base, the secondary venation indistinct, glabrous on both sides when old, except for a tuft of short hairs in the axils of the lateral veins; flowers 5-parted, solitary or 2 together at the end of a peduncle, 1–1.5 cm. long; pedicels filiform, 5–10 mm. long; calyx-tube terete, subcampanulate, 5 mm. long, its 5 subulate teeth 2–2.5 mm. long; anthers a little shorter than the filaments; petals white, obovate, obtuse, 7–8 mm. long; fruit black, subglobose, about 6 mm. in diameter.

Rocks, vicinity of Sumidero, Pinar del Rio. Type from Sierra Caliente (*Shafer 13770*).

Pachyanthus Clementis P. Wilson, sp. nov.

A shrub with densely ferruginous twigs and branches. Leaves ovate-lanceolate, 9–12 cm. long, 3.5–4.5 cm. broad, glabrous or nearly so above, pubescent beneath with stellate hairs, cordate at the base, acuminate at the apex, coriaceous, petioled, 3–5-nerved, the veins and lateral nerves prominent beneath, slightly impressed above; inflorescence peduncled; calyx urn-shaped, 7–8 mm. long, 4–5 mm. broad, densely pubescent with rather long shaggy hairs, the lobes long-acuminate.

Loma Los Helechales, Banao Mountains, Santa Clara (*Léon & Clement 5399*).

Pachyanthus mantuensis Britton & Wilson, sp. nov.

A shrub 1 m. high or less, the branches, twigs and calyx densely scurfy with brownish stellate scales. Leaves 4–8 cm. long, 2–3.6 cm. broad, elliptic to elliptic-ovate, obtuse at the apex, rounded and subcordate at the base, yellowish green, punctate and glabrous or nearly so above, slightly paler and scurfy especially on the veins beneath, coriaceous; pedicels 1–1.5 cm. long; calyx urn-shaped, the lobes with a short keel on the back near the apex; petals ovate-oval to oval, 12 mm. long, 7–8 mm. broad, rounded at the apex, puberulent.

Dry prairie land, between Guane and Mantua, Pinar del Rio (*Shafer 11229*).

Ossaea Shaferi Britton & Wilson, sp. nov.

A shrub 1–2 m. high, with densely hirsute twigs, leaves and inflorescence. Leaves ovate to ovate-lanceolate, 4–9 cm. long, 5-nerved, acute or acuminate at the apex, rounded or obtuse at the base, the upper surface densely and finely tuberculate, each tubercle bearing a stiff bristly hair; veins of the under leaf-surface strong and elevated, two of the lateral ones arising from near the base, the other two arising from above the base; petioles stout, 2 cm. long or less; flowers 2–4, sessile at the end of a short stout peduncle, or some of them solitary; calyx densely hirsute, its 5 lobes subulate, long-ciliate, about 3 mm. long; fruit densely hirsute.

Thickets, mountains of northern Oriente. Type from Camp La Gloria, south of Sierra Moa (*Shafer 8152*).

Ossaea navasensis Britton & Wilson, sp. nov.

A shrub about 2 m. high, with reddish or reddish-brown scurfy twigs and petioles. Leaves lanceolate-ovate to ovate, 3–5 cm. long, 1.3–2 cm. broad, 3-nerved, acuminate at the apex, acute at the base, glabrous and dull above, the primary veins impressed, paler beneath, the primary veins rather prominent; petioles 5–11 mm. long, ciliate; flowers axillary, solitary or few, sessile; calyx-lobes 4, linear-lanceolate, long-ciliate; petals acute.

Dense woods, trail, Navas to Camp Buena Vista, Oriente (*Shafer 4449*).

Ossaea nipensis Britton & Wilson, sp. nov.

A shrub 1 m. high, with brownish or reddish-brown scurfy twigs and petioles. Leaves ovate, 1.5–3 cm. long, 7–18 mm. broad, 3-nerved, acute to short-acuminate at the apex, the tip obtuse, rounded or somewhat acutish at the base, dark green, and glabrous above, the primary veins impressed, brown and somewhat scurfy beneath, the veins rather prominently elevated; petioles 4–6 mm. long, slender; flowers solitary or few, subsessile; calyx-lobes 4, minute, broadly triangular, acute; petals oblong-elliptic, 1.5 mm. long, 0.8 mm. broad, acute; young fruit subglobose, 2 mm. in diameter.

Rich woods, Sierra Nipe, near Woodfred, Oriente (*Shafer 3439*).

Family ERICACEAE

Kalmiella simulata Britton & Wilson, sp. nov.

A shrub 6–9 dm. tall, with glabrous foliage and puberulent branches; leaves thick, lanceolate-subulate on account of the strongly revolute margins, 5–6 mm. long, 1–1.5 mm. broad, bright green and shining above, paler beneath, sessile; pedicels longer than the leaves, sparsely glandular-pilose; sepals lanceolate, 5 mm. long, obtuse or acutish, glabrous; corolla pinkish-white, 12–13 mm. broad; filaments pubescent near the base; capsule immature.

White sandy places, vicinity of Los Indios, Isle of Pines (*Britton & Wilson 14205*).

Family APOCYNACEAE

Rauwolfia linearifolia Britton & Wilson, sp. nov.

A glabrous shrub 4.5 dm. high, with slender grayish branches. Leaves in whorls of 3's, linear, 4–6.5 cm. long, 3–4 mm. wide, dark green above, paler beneath, the midvein prominent on both surfaces, the lateral veins indistinct; calyx-lobes lanceolate, 1–1.5 mm. long, acute to acuminate; corolla purplish, its tube slender, 7–9 mm. long, the lobes elliptic, 4 mm. long, 1.3 mm. wide; ovary immersed in a cup-shaped disk; style filiform; carpels two, united at the base, one carpel sometimes abortive.

Type collected on limestone hill, Paso Estancia to the Pinales, Oriente (*Shafer 1754*).

Echites minima Britton & Wilson, sp. nov.

Stems slender, twining, puberulent. Leaves oblong, 1–2 cm. long, 4–5 mm. broad, acuminate at the apex, rounded and cordate at the base, glabrous, short-petioled, the midvein indistinct above, prominent beneath; calyx-lobes elliptic-lanceolate to elliptic, 2–2.5 mm. long, 1–1.1 mm. broad, acuminate at the apex; corolla-tube 3–3.5 mm. long, the lobes suborbicular, light yellow, 3.5 mm. long, 4 mm. broad.

In dry grassy places, barren savannas southeast of Holguin, Oriente (*Shafer 2955*).

An incomplete specimen from savannas between Queen City and Minas, Camaguey (*Shafer 2928*), is referred to this species with doubt.

Family CONVOLVULACEAE

Exogonium incertum Britton, sp. nov.

Vine, slender, glabrous up to 8 dm. long or longer. Leaves unknown; corymbs few–several-flowered, short-peduncled; pedicels 5–12 mm. long; sepals about 6 mm. long, elliptic-ovate, obtuse or rounded; corolla tubular-funnelform, glabrous, pink with a purple throat, 3–4 cm. long, its tube very narrow within the calyx, gradually enlarged above, its limb about 1.5 cm. broad; capsule ovoid-globose, 8 mm. long; seeds oblong, with long brown hairs.

Hillsides, northwestern Oriente. Type from Loma Pilon, in eruptive mountains near Holguin (*Shafer 1235*).

Family HYDROPHYLLACEAE

Nama cubana P. Wilson, sp. nov.

A spiny shrub 2–3.5 dm. tall, with puberulent twigs. Leaves obovate or somewhat obovate-spatulate, 1–2.5 cm. long, 3–6 mm. broad, glabrous or nearly so, rounded or acutish at the apex, cuneate at the base, short-petioled; sepals ovate, 5–7 mm. long, 3.5–5 mm. broad, acute or rounded at the apex, glabrous; capsule subglobose, 3–3.5 mm. long, glabrous; styles mostly 3, shorter than the sepals.

In mud, Columbia, Camaguey (*Shafer 619*).

Family CORDIACEAE

Varronia Shaferi Britton, sp. nov.

Shrub-like, branched, the twigs, petioles and peduncles appressed-pubescent, scabrous. Leaves oblong or oblong-lanceolate, coriaceous, entire, 8 cm. long or less, 2–4 cm. wide, acute or acuminate at the apex, narrowed and acute at the base, shining and glabrous or nearly so above, short-pubescent beneath, the veins impressed above, prominent beneath, the rather stout petioles 1–2 cm. long; peduncles terminal, rather stout, 5–8 cm. long; flowers densely short-spicate; spikes 1.5–3 cm. long, about 1 cm. thick; calyx strigose, about 6 mm. long, its triangular lobes tapering into a linear, caudate tip; corolla 3.5–4 mm. long, white, a little longer than the calyx-tube, its lobes short, rounded; fruit oval, about 7 mm. long.

Moist woods between Navas and Camp Buena Vista, Oriente, at 650 meters altitude (*Shafer 4448*).

Bourreria Taylori Britton, sp. nov.

A tree, 5–8 m. high, the young twigs and inflorescence loosely pilose. Leaves spatulate-oblanceolate, subcoriaceous, 3–7 cm. long, 2 cm. wide or less, obtuse or rounded at the apex, cuneate at the base, smooth, glabrous and reticulate-veined above, sparingly pilose beneath, the petioles 2–4 mm. long; inflorescence paniculate, several-flowered; calyx oblong-campanulate, densely pilose, about 6 mm. long, its teeth triangular, acute; styles united to above the middle, stout; fruit orange-red, globose, about 8 mm. in diameter.

Sevilla Estate, near Santiago, Oriente, at 260 m. elevation (*Taylor 431*).

Rochefortia stellata Britton & Wilson, sp. nov.

A tree, 5 m. high, with grayish, flexuose branches and puberulent spiny twigs. Leaves elliptic, subcoriaceous, brittle, 1.5–2.8 cm. long, 1.2–1.8 cm. wide, rounded and occasionally slightly emarginate at the apex, rounded at the base, short-petioled, lustrous and glabrous or with few scattered stellate hairs above, densely puberulent beneath with grayish, stellate hairs; flowers solitary or several, axillary, short-pedicelled; calyx densely stellate-tomentulose, the lobes triangular-ovate; corolla-tube short, the lobes elliptic-ovate to elliptic, 4 mm. long, 2.5 mm. wide, ciliolate; ovary glabrous, the styles separate to near the base, pubescent; young fruit subglobose, 6 mm. in diameter, glabrous.

Coastal thicket, Ensenada Cabanita, Oriente (*Britton & Cowell 12634*).

Rochefortia cubensis Britton & Wilson, sp. nov.

A shrub with brownish-gray, puberulent, spiny twigs. Leaves elliptic, chartaceous, 6–9 mm. long, 3–6 mm. wide, rounded at both ends, the base occasionally somewhat inequilateral, pubescent above with simple, scattered, appressed hairs, glabrous or nearly so beneath, short-petioled; calyx-lobes ovate, ciliate, 2.5 mm. long; fruit subglobose, 4.5 mm. in diameter, yellowish-red.

Thicket east of Playa de Marianao (*Léon 7228*).

Family VERBENACEAE

Duranta arida Britton & Wilson, sp. nov.

A strict shrub, 1–3 m. high, the slender twigs and branches of the inflorescence puberulent. Leaves obovate to elliptic or oval, 0.6–1.5 cm. long, 0.5–0.9 cm. wide, acute or rounded at the apex, cuneate or obtuse at the base, entire or minutely and sparingly denticulate above the middle, dark green, glabrous and inconspicuously veined above, paler and glabrous beneath, the lateral veins three or four on each side of the midvein; petioles 1–2 mm. long, slender; fruit subglobose, 5 mm. in diameter, on pedicels 1 mm. long.

Thickets, Sabana to Maisi, Oriente (*Shafer 7904, type; 7911*).

Callicarpa Shaferi Britton & Wilson, sp. nov.

A shrub up to 3.3 m. high, the twigs, petioles, under leaf-surfaces and inflorescence densely white stellate-scurfy. Leaves oblong, oblong-lanceolate or oblong-oblanceolate, chartaceous, 3–8 cm. long, 1–3 cm. wide, entire or very nearly so, acute, obtuse or rounded at the apex, obtuse, subtruncate or narrowed at the base, dark green, finely reticulate-veined and glabrous above, strongly reticulate-veined beneath, the slender petioles 5–12 mm. long; cymes small, peduncled, much shorter than the leaves; pedicels very short; calyx obconic, white stellate-scurfy, 1.5 mm. wide, the lobes very short, broadly triangular; corolla pink, 3–3.5 mm. long, the lobes oval, rounded at the apex; filaments filiform, exserted; fruit subglobose, scurfy, blue, 3.5–4 mm. in diameter.

Limestone hills and plains, Pinar del Rio and Isle of Pines. Type from limestone hills, vicinity of Sumidero, Pinar del Rio (*Shafer 13526*).

Callicarpa Wrightii Britton & Wilson, sp. nov.

A shrub, 6–12 dm. high, the twigs, petioles and inflorescence densely brown stellate-scurfy. Leaves obovate to elliptic or oblong, membranous, 7–12 cm. long, 1.5–5 cm. wide, crenate-serrate at least above the middle, acuminate at the apex, cuneate at the base, dark green, glabrous and inconspicuously veined above, green, sparingly stellate on the principal veins, lightly reticulate-veined and copiously resinous-dotted beneath, the petioles 5–9 mm. long; cymes few-flowered, short-peduncled, much shorter than the leaves, sometimes not longer than the petioles; fruit greenish, about 5 mm. in diameter, on pedicels about 1.5 mm. long.

Valleys and hillsides, northern Oriente. Type from Moa Bay, east of Rio Moa (*Shafer 8308A*).

Callicarpa cuneifolia Britton & Wilson, sp. nov.

A shrub up to 2 m. high, the twigs, petioles, under leaf-surfaces and branches of the inflorescence densely stellate-pubescent with ferruginous hairs. Leaves obovate or elliptic, chartaceous, 4–7 cm. long, 1.5–3 cm. wide, crenulate, acute or acuminate at the apex, cuneate at the base, dark-green and somewhat scabrous above, the midvein strongly impressed, reticulate-veined and finely glandular beneath, the petioles about 6 mm. long; cymes small, peduncled, shorter than the leaves; pedicels 1.5–2 mm. long; calyx 3 mm. broad; fruit subglobose, 4 mm. in diameter, puberulent when young, glandular.

Hillsides and pine woods, northern Oriente. Type from a dry serpentine hill, Loma Santa Teresa, near El Yunque (*Shafer 7741*).

Callicarpa nipensis Britton & Wilson, sp. nov.

A shrub about 6 dm. high, the twigs, inflorescence, petioles and under leaf-surfaces densely brown stellate-tomentose. Leaves linear-oblong, coriaceous, entire or very slightly repand, 12 cm. long or less, 8–18 mm. wide, acute at the apex, narrowed at the base, tapering gradually from near the middle to both ends, dark green and minutely setulose with impressed venation above, strongly elevated-veined beneath, the rather stout petioles 6–9 mm. long; cymes peduncled, shorter than the leaves, several-flowered; fruit blue, compressed, short-pubescent, about 7 mm. broad.

Border of pinelands, Sierra Nipe, near Woodfred, Oriente, 450–550 meters altitude (*Shafer 3026*).

Vitex Clementis Britton & Wilson, sp. nov.

Young twigs rather slender, densely tomentulose. Leaves 3-foliolate; petioles slender, tomentulose, 2–7 cm. long; petiolules 2 cm. long or less; leaflets oblong-elliptic, 6–10 cm. long, rather thin, acute or obtuse at the apex, narrowed at the base, glabrous above, or nearly so, except upon the impressed veins, densely tomentulose and with elevated veins beneath; cymes several or numerous, panicled, few–several-flowered, tomentulose; pedicels 2–5 mm. long; calyx short-campanulate, about 6 mm. broad, its lobes suborbicular, ciliate; corolla purple, 1.5–1.7 cm. broad, villous on the outside, its lobes very unequal, its tube 6 mm. long.

Coastal thickets, Santiago, Oriente (*Clement 168, type*); collected also at Cabo Cruz, as shown by a specimen from the Sauvalle Herbarium.

Pseudocarpidium Shaferi Britton, sp. nov.

A shrub or small tree up to 4 m. high, the young twigs, petioles and under leaf-surfaces whitish-tomentulose. Leaves oblong, or oblong-oblanceolate, coriaceous, 3.5 cm. long or less, 6–10 mm. wide, entire, or rarely with 1 or 2 spinulose teeth, acute and spinulose-tipped, the base subcuneate, the principal veins delicate above, rather prominent beneath, the upper surface dark green, glabrous, densely and finely reticulate-veined; panicle slender, puberulent, a little longer than the leaves; calyx 2 mm. long, its ovate, sharply acute lobes somewhat shorter than the tube; corolla puberulent, about 5 mm. long; fruit densely pubescent, 4-lobed, depressed, 4–6 mm. broad.

Coastal thickets between Sabana and Maisi, Oriente (*Shafer 7901*).

Clerodendrum anafense Britton & Wilson, sp. nov.

A tree up to 10 m. high, the twigs and petioles very minutely and sparsely hispidulous. Leaves elliptic or somewhat elliptic-obovate, 4–9 cm. long, 2–4.5 cm. wide, obtuse or acute at the apex, rounded or acutish at the base, light green and glabrous, or minutely and obscurely hispidulous on the mid-vein above, paler, coarsely reticulate-veined and glabrous beneath, entire, coriaceous, short-petioled; calyx campanulate, 3.5–4 mm. wide, subtruncate at the apex, glabrous; corolla 2–2.5 cm. long, white, the lobes oblanceolate to obovate; filaments filiform, exserted; anthers narrowly ovate or elliptic.

Rocky hillsides, Sierra de Anafe, Pinar del Rio (*Wilson & Léon 11466*).

Clerodendrum camagueyense Britton & Wilson, sp. nov.

A shrub 1–1.2 m. high, the twigs and petioles tuberculate and minutely hispidulous with mostly appressed hairs. Leaves obovate or elliptic-obovate, 7–11 cm. long, 3.5–6 cm. wide, dark green, lustrous and hispidulous on the veins above, the secondary veins inconspicuous, paler, coarsely reticulate-veined and minutely hispidulous on the veins beneath, the margin denticulate; petioles 1 cm. long; calyx narrowly campanulate, subtruncate at the apex, glabrous; corolla about 4 cm. long, white, the lobes oblanceolate; stamens exserted.

Savanna south of Sierra Cubitas, Camaguey (*Shafer 496*).

Family LAMIACEAE

Salvia scabrata Britton & Wilson, sp. nov.

A more or less straggling shrub, 1–1.2 m. tall, with hispid twigs. Leaves obovate, 4–6 cm. long, 1.5–2.2 cm. broad, obtuse or acutish at the apex, cuneate at the base, dull and glabrous above, paler and conspicuously punctate beneath, crenulate-serrate; petioles about 7 mm. long, hispid; racemes axillary, the verticels 3–5 cm. apart, few-flowered; pedicels 5–6 mm. long; calyx 11–12 mm. long, its lobes ciliolate, acute; corolla red or scarlet, 2–2.5 cm. long, tomentose.

Mountains of northern Oriente. Type from along a rocky river, near Camp San Benito, 900 m. altitude (*Shafer 4075*).

Salvia cubensis Britton & Wilson, sp. nov.

A more or less erect shrub, 1–1.5 m. tall, with puberulent twigs. Leaves oblanceolate or lanceolate, 4–9 cm. long, 1.2–2.5

cm. broad, obtuse to acute or acuminate at the apex, cuneate at the base, dull and glabrous above, paler beneath, punctate and serrulate or nearly entire, short-petioled; racemes terminal, the verticels 5–12 mm. apart; pedicels 2–3 mm. long, puberulent; calyx 5–7 mm. long, its lobes acuminate; ciliolate; corolla scarlet, 1.8–2.2 cm. long, tomentose.

Rocky places, mountains of northern Oriente. Type from along shaded stream near base of Loma Mensura, about 680 m. altitude (*Shafer 3766*).

Hyptis Shaferi Britton, sp. nov.

Creeping, rooting at the nodes, branched or simple, 1 m. long or less, sparingly and loosely pubescent or glabrate. Leaves ovate or orbicular-ovate, irregularly dentate, 2–5 cm. long, acute or obtuse at the apex, narrowed or cuneate at the base, the petioles 2–8 mm. long; heads peduncled, solitary in the axils, depressed-globose, densely many-flowered, 1.5–2.2 cm. in diameter; peduncles slender, 1–5 cm. long; involucre-bracts oblong-lanceolate, acute or acutish, veiny, spreading, 6–8 mm. long; calyx tubular, 7–8 mm. long, its subulate ciliate teeth about one-half as long as the tube; corolla white or pinkish.

Grassy places, Pinar del Rio. Type from between Mantua and Arroyos (*Shafer 11248*).

Hyptis rivularis Britton, sp. nov.

Erect, much branched, slender, but stiff, densely puberulent, 1.3 m. high, the branches slender. Leaves of the stem not seen; leaves of the branches opposite, oblong-oblanceolate, 10–15 mm. long, puberulent on both sides, few-dentate, acutish at the apex, cuneate at the base, the petioles 1–2 mm. long; flowers opposite or verticillate in the axils; fruiting pedicels about 1 mm. long, filiform; fruiting calyx densely puberulent, oblong, faintly veined, about 4 mm. long, the lanceolate subulate teeth about one-half as long as the tube.

River bank, Trinidad, Santa Clara (*Britton & Wilson 5567*).

Family SOLANACEAE

Physalis ignota Britton, sp. nov.

Annual; stem branched, often zigzag, angled and more or less densely villous with short hairs. Leaves ovate, 4–15 cm. long, 3–10 cm. wide, oblique and cuneate or somewhat rounded at the base, acute to acuminate at the apex, entire or somewhat repand-dentate, puberulent at least on the veins, long-petioled; peduncles 5–7 mm. long, erect, in fruit 9–12 mm. long, reflexed; calyx 3.5 mm. long, densely short-villous, the lobes lanceolate, about as long as the tube; corolla campanulate, short-pilose, 5–5.6 mm. wide, yellow, without a dark center; fruiting calyx ovoid, 3–4.5 cm. long, 2.5–3 cm. wide, angled.

Waste places and river banks, Camaguey, Santa Clara and Havana (type, *Britton & Wilson 5767*); Guatemala.

Solanum moense Britton & Wilson, sp. nov.

A straggling tree 3 m. high, the slender twigs and branches armed with brownish prickles 2–2.5 mm. long, hispid with ferruginous, stalked, stellate hairs. Leaves oblong to elliptic, 6–9 cm. long, 2.2–3.5 cm. broad, acute to acuminate at the apex, somewhat inequilateral and rounded at the base, entire with the margin more or less revolute, lustrous and with few slender brownish prickles above, the midvein and primary veins impressed, paler, dull and hispid beneath with stalked stellate hairs, the midvein and primary veins prominent; petioles 4–5 mm. long; peduncles 3.5 cm. long, stellate-hispid; fruiting calyx 2 cm. wide; berries globose, 2.5 cm. in diameter; seeds suborbicular, 4 mm. long, 5 mm. broad, flattened.

Thickets, Camp La Gloria, south of Sierra Moa, Oriente (*Shafer 8125*).

Cestrum Wrightianum P. Wilson, sp. nov.

A shrub about 1 m. high, the branches conspicuously tomentose with branching star-like hairs. Leaves ovate, 5–8.5 cm. long, 2.5–4.8 cm. broad, short-acuminate at the apex, rounded and more or less subcordate at the base, sparingly tomentose on both surfaces when young with ferruginous star-like hairs; petioles 5–9 mm. long, tomentose; inflorescence shorter than the leaves; calyx cylindric, tomentose, its lobes triangular, about 1 mm. long; corolla 1.9–2.2 cm. long, the tube rather slender, the lobes lanceolate, 5–6 mm. long, acuminate; filaments slender, pilose, adnate to a little above the middle of the corolla-tube; style slender; stigma subcapitate, included.

Cuba (*C. Wright 386*, herb. N. Y. Botanical Garden).

Cestrum Taylori Britton & Wilson, sp. nov.

A glabrous tree, 5–8 m. high, with slender pale brown twigs. Leaves elliptic to somewhat elliptic-lanceolate, 13–15 cm. long, 5–5.5 cm. broad, acute at the apex, acutish or somewhat rounded at the base, glabrous and finely reticulate-veined on both surfaces; petioles 1.3–1.6 cm. long; flowers solitary or several, axillary; calyx cylindric, about 1 cm. long, glabrous; corolla greenish-yellow, 7–8 cm. long, the tube slender, sparingly pilose within, especially near the base, the lanceolate lobes 1.2–1.5 cm. long; filaments linear, adnate to the corolla-tube nearly to its throat; anthers elliptic to somewhat elliptic-ovate; style linear, 7–7.5 cm. long, glabrous; stigma subcapitate.

Trail, Magdalena to Sierra Maestra, Oriente (*Taylor 439*).

Cestrum pinetorum Britton, sp. nov.

A glabrous shrub about 1 m. tall, with slender brownish twigs. Leaves oblong-oblanceolate to obovate, or somewhat oblong-lanceolate, 4–6.5 cm. long, 0.9–1.5 cm. broad, obtuse or acutish at the apex, cuneate at the base, dark green and often obscurely veined above, paler and obscurely veined beneath, the petioles 2–5 mm. long; panicles axillary or terminal; fruiting calyx campanulate, about 5 mm. long, subsessile, its lobes triangular-ovate, 1–1.5 mm. long; fruit obovoid to obovoid-ellipsoid, 6–7 mm. long, 5 mm. broad, purplish-black.

Open pine woods, Sierra Nipe, near Woodfred, Oriente (*Shafer 3031*).

Brunfelsia Shaferi Britton & Wilson, sp. nov.

A shrub 0.5–2 m. tall, with glabrous or somewhat puberulent brownish twigs. Leaves oblong to elliptic-oblong, oblong-oblanceolate or oblong-obovate, 3–7.5 cm. long, 0.8–1.5 cm. broad, rounded or acutish at the apex, cuneate at the base, dark green, glabrous and indistinctly veined above, the midvein impressed, paler and glabrous beneath, the midvein prominent; petioles 2–5 mm. long; calyx coriaceous, glabrous, the lobes oblong-ovate to ovate, about 3 mm. long; berry subglobose, 1–1.2 cm. in diameter, sessile or subsessile, glabrous.

Plancha trail, Mensura to Woodfred, Oriente (*Shafer 3870*).

Brunfelsia clarensis Britton & Wilson, sp. nov.

A shrub 1 m. or more high, with nearly glabrous twigs. Leaves obovate to broadly elliptic-obovate, 5–10 cm. long, 2.5–4.5 cm. broad, rounded or acutish at the apex, acute at the base, glabrous or very minutely hispidulous above with scattered hairs, minutely hispidulous to glabrous beneath, the primary veins slender and rather indistinct; petioles 1–1.4 cm. long; calyx coriaceous, glabrous, the lobes ovate, 4 mm. long; berry subglobose, about 1 cm. in diameter, long-pedicelled.

Mordazo, Santa Clara (*Léon & Cazanas 5928*).

Family SCROPHULARIACEAE

CHEILOPHYLLUM Pennell, gen. nov.

Stems extensively spreading, repent, much branched, four-angled, the angles narrowly winged, and with scattered, minute gland-tipped hairs. Leaves opposite, sessile, ovate, cuneate at base, slightly dentate, acutish, glandular-dotted, glabrous, the margin slightly recurved and thickened, 0.7–0.9 cm. long. Pedicels 3–5 mm. long, pubescent with gland-tipped hairs, not bracteolate. Sepals five, lance-linear, alike. Corolla 3 mm. long, white, campanulate, the lobes about equaling the tube, the two posterior united throughout; the tube pubescent within on all sides. Filaments four, glabrous, the posterior pair slightly shorter; anthers glabrous. Style glabrous. Stigmas distinct. Capsule 2–2.5 mm. long, ovate in outline, acute, glabrous, septicidal and loculicidal; the coalesced placentae thick, persisting, about one-half the length of the capsule. Seeds 2–3 mm. long, short-oblong, ridged, minutely reticulate, brownish-black. [Name from χειλος, margin, and φυλλον, leaf.]

This monotypic genus is remote from *Stemodia*, which consists of erect herbs, with anther-sacs separated on arms of the connective and with longitudinally striate seeds. Its uniform sepals readily distinguish *Cheilophyllum* from the group of genera usually called *Herpestis*.

Cheilophyllum radicans (Griseb.) Pennell, comb. nov.

Stemodia radicans Griseb. Cat. Pl. Cub. 182. 1866.

Palm barrens, Santa Clara, Havana; Jamaica.

SILVINULA Pennell, gen. nov.

Stems extensively spreading, repent, much branched, terete, strigose pubescent with ascending hairs. Leaves opposite, sessile, elliptic-oval, entire, obtuse, slightly pubescent on the margins and midrib, glandular-dotted, 0.8–1 cm. long. Pedicels 1–2 mm. long, pubescent, at apex with two minute subulate bractlets. Sepals five, dissimilar; the three outer oblong-ovate, firm, conspicuously ridged, the two inner nearly linear, thin, obscurely veined. Corolla 10 mm. long, blue, nearly salverform, the lobes spreading, nearly orbicular, much shorter than the narrow tube, the two posterior united over ⅔ length; glabrous throughout. Filaments four, glabrous, the posterior pair slightly shorter; anthers glabrous. Style glabrous. Stigmas distinct. Capsule 3 mm. long, ellipsoid in outline, obtuse, glabrous, ridged, septicidal and loculicidal; the coalesced placentae and septum thin, persistent, plate-like, extending the entire length of the capsule. Seeds 3–4 mm. long, irregularly oblong, reticulate, yellowish-brown. [Named because of its resemblance to *Silvia* Benth., a Mexican genus.]

This monotypic genus is distinguished from all other segregates of *Herpestis* by the form of the corolla, and by the thick-walled, ridged capsule.

Silvinula humifusa (Griseb.) Pennell, comb. nov.

Herpestis humifusa Griseb. Cat. Pl. Cub. 183. 1866.

Muddy borders of brooks and lagoons, Santa Clara, Pinar del Rio, Isle of Pines. Endemic.

Caconapea stemodioides Pennell, sp. nov.

Stem 3–4 dm. tall, obtusely four-angled, glabrous. Leaves 4–5 cm. long, 0.5–0.8 cm. wide, narrowly lanceolate, serrate, long-attenuate to the narrow but clasping base, glabrous, with many glandular dots. Pedicels one to three to an axil, 1–1.5 mm. long, punctate with sessile glands. Bractlets two, filiform-subulate, 1.5–2 mm. long, placed immediately below calyx. Sepals: outermost 7 mm. long, broadly ovate, rounded at base, two median nearly as long, narrower, somewhat one-sided, these three obtuse to acutish, rugosely reticulate-veined, green, glabrous, the two innermost lanceolate-linear, attenuate at apex, with evident midrib, broadly hyaline, obscurely ciliolate. Corolla 5–6 mm. long, posterior lobes united about 2/5 length, pubescent within tube, especially on the anterior side, glabrous over bases of posterior lobes; "white." Filaments glabrous, the postero-lateral pair somewhat shorter, its anthers equaling those of the antero-lateral pair; posterior filament completely lost. Style glabrous, stigmas distinct. Capsule 3.5–4 mm. long, ovoid-oblong, punctate with sessile glands, dehiscing loculicidally and septicidally, the lateral portions of the septum adherent to the capsule-walls. Placentae rounded, protruding into the cells, coalescent with the persistent median part of the septum. Seeds 0.3 mm. long, oblong-cylindric, truncate at each end, nearly black, longitudinally ridged and with obscure cross-reticulations.

Type, river woods, vicinity of San Pedro, Isle of Pines, collected in flower and fruit, February 15–17, 1916 (*Britton, Wilson & Selby 14459*).

Nearest to **Caconapea decumbens** (Fernald) Pennell, comb. nov. [*Herpestis decumbens* Fernald Proc. Am. Acad. **33**: 91. 1897] of Mexico, which, however, has sepals reaching 8–9 mm. long, obscurely reticulate (not rugose), corolla 8 mm. long, anther-sacs over twice as large (0.8 mm. long), and seeds nearly as wide as long and with prominent cross-reticulations.

NAIADOTHRIX Pennell, gen. nov.

Stems submersed, long, much branched, glabrous or puberulent, terete. Leaves opposite, divided so as to appear whorled, and with ultimate filiform segments. Pedicels longer than the calyx, not bracteolate. Sepals five, alike or slightly unequal. Corolla blue, campanulate-personate, pubescent within on anterior side, the lobes about equaling the tube, the two posterior lobes united over one half length. Filaments four, glabrous, the posterior pair shorter. Anthers glabrous. A circle of bristles surrounding the base of the ovary. Style glabrous. Stigmas distinct. Capsule oblong, thin-walled, glabrous, septicidal and tardily loculicidal. Coalesced placentae and septum rather thick, little over one-half length of capsule. Seeds oblong, reticulate. [Name from Ναιας, a water-nymph, and Θριξ, hair, in allusion to the finely divided leaves.]

Type species: *Naiadothrix longipes* Pennell.

Leaves, bristles surrounding ovary, and aquatic habit sharply distinguish *Naiadothrix* from all other segregates of *Herpestis*.

Naiadothrix longipes Pennell, sp. nov.

Stems, pedicels and calyx obscurely glandular-granulose. Leaves 2–2.5 cm. long, three-branched from base, each branch and its pinnate segments filiform. Pedicels 35–50 mm. long. Sepals nearly uniform, lanceolate-linear, 3 mm. long. Corolla 6–7 mm. long, glabrous within, at least the posterior lobes blue (the anterior probably yellowish). Capsule 2 mm. long. Seeds 0.7–0.8 mm. long, brown.

Type submerged in water, Laguna Jovero and vicinity, Pinar del Rio, collected in flower and fruit, December 5–7, 1911 (*J. A. Shafer 10829*).

Submerged in lagoons, Pinar de Rio and Isle of Pines. Endemic.

Nearest to **Naiadothrix reflexa** (Benth.) Pennell, comb. nov. [*Herpestis reflexa* Benth. in DC. Prod. **10**: 399. 1846] of Brazil, which differs in being puberulent, and in having shorter pedicels and longer calyx. **Naiadothrix myriophylloides** (Benth.) Pennell, comb. nov. [*Herpestis myriophylloides* Benth. *l. c.*, 398. 1846], of Brazil, is the only other known species of the genus.

ENCOPELLA Pennell, nom. nov.

ENCOPA Griseb. Cat. Pl. Cub. 184. 1866. Not ENCOPEA, Presl, Bot. Bemerk. 83. 1844.

Type species: *Encopa tenuifolia* Griseb.

Encopella tenuifolia (Griseb.) Pennell, comb. nov.

Encopa tenuifolia Griseb. Cat. Pl. Cub. 184. 1866.

Sandy shores of lagoons, Santa Clara, Pinar del Rio and Isle of Pines. Endemic.

ANISANTHERINA Pennell, gen. nov.

Stem erect, 1–4 dm. tall, branching, hirsute-pubescent with reflexed-spreading dark-jointed hairs. Leaves opposite, sessile, linear, sparingly minutely lobed, scabro-pubescent above, 4–6.5 cm. long. Pedicels 25–35 (–45) mm. long, bibracteolate about the middle. Calyx of 5 united sepals, the lobes shorter than the tube. Corolla 12–14 mm. long, pinkish (not seen fresh), the lobes much shorter than the tube, the two posterior united only at base; within glabrous proximally, but pubescent over the bases of the posterior lobes. Filaments 4, lanate distally, the posterior pair shorter; anther-sacs unequal, the outer one smaller, glabrous. Style glabrous. Stigma linear, consisting of two lines, one down each side of style-apex. Capsule 7–8 mm. long, globose with a mucro, glabrous, loculicidal and septicidal. Seeds 0.6–0.8 mm. long, oblong-linear, reticulate, dark-brown, wingless. [Name from ανισος, unequal, and ανθηρα, anther.]

This monotypic genus resembles *Agalinis,* which however has both anther-sacs alike, pedicels not bracteolate, and seeds wider.

Anisantherina hispidula (Mart.) Pennell, comb. nov.

Gerardia hispidula Mart. Nov. Gen. et Sp. **3**: 13. 1829.

Moist savannas and borders of lagoons in pineland, Santa Clara, Pinar del Rio, Isle of Pines; Panama; Brazil.

Family BIGNONIACEAE

Tabebuia camagueyensis Britton & Wilson, sp. nov.

A shrub or a small tree up to 7 m. high, the twigs lepidote. Petioles 1–2.5 cm. long; leaves 5–1-foliolate, glabrous; leaflets chartaceous, elliptic to oblong or obovate, more or less lepidote, 4–6 cm. long, rounded or emarginate at the apex, mostly narrowed at the base, dark green and dull above, pale green beneath; flowers few together on rather stout pedicels 1.5–2.5 cm. long; bractlets subulate, 4 mm. long; calyx narrowly campanulate, about 15 mm. long, obliquely toothed; corolla light pink to rose, campanulate, about 6 cm. long; capsule linear, slightly curved, short-beaked, 9–15 cm. long, about 6 mm. thick.

Savannas near Camaguey (*Britton & Cowell 13110*).

Tabebuia savannarum Britton, sp. nov.

A small tree, about 4 m. high, the twigs clothed, below the leaves, with linear, lepidote scales 4–5 mm. long. Leaves simple, oblong-obovate, entire, 1.5–3 cm. long, chartaceous or subcoriaceous, shining with impressed midvein above, dull, with prominent midvein and finely reticulated beneath, the petioles 4–5 mm. long; flowers few, on pedicels about 5 mm. long; calyx narrowly campanulate, 8–10 mm. long, 2-lobed, the lobes acute; corolla pink, about 4 mm. long.

Savannas near Camaguey (*Britton & Cowell 13202*).

Tabebuia Cowellii Britton, sp. nov.

A tree 7–10 m. high, the twigs stout, short, bearing several or numerous thick ovate to lanceolate scales 1–2 mm. long below the leaves. Leaves oblanceolate to oblong-oblanceolate or some of them obovate, coriaceous, 1.5–5 cm. long, finely lepidote, inconspicuously finely reticulate-veined beneath, retuse or rounded at the apex, cuneate at the base, the midvein prominent beneath, the petiole 3 mm. long or less; flowers few together or solitary; pedicels 3–5 mm. long; calyx narrowly campanulate, 5–6 mm. long, loosely lepidote, unequally 5-toothed, the teeth ovate; corolla pink, 4–5 cm. long; capsule linear, straight, 10–13 cm. long.

Hillsides and plains, southern Oriente, along the coast. Type from Conde Beach, Guantanamo Bay (*Britton 2132*).

COTEMA Britton & Wilson, gen. nov.

Trees, with 1–5-foliolate slender-petioled leaves, and rather large, long-pedicelled lateral or axillary flowers, solitary or few together. Calyx cylindric-campanulate, irregularly 2–4-toothed. Corolla oblique, funnelform-campanulate, unequally 5-lobed, vertically flattened, its lobes reflexed. Fertile stamens 4, didymamous, exserted; filaments slender; anther-sacs reflexed; sterile filament slender. Capsule terete, elongated, curved or coiled. Seeds oblong, thin, winged at each end. [Name an anagram of *Tecoma.*]

About 4 species, natives of eastern Cuba.

Type species: *Tecoma spiralis* C. Wright.

Cotema spiralis (C. Wright) Britton & Wilson, comb. nov.

Tecoma spiralis C. Wright; Griseb. Cat. Pl. Cub. 194. 1866.

Eastern Cuba (*C. Wright 3038*).

Cotema woodfredensis Britton, sp. nov.

A tree up to 6 or 7 m. high. Leaves 3–5-foliolate; petioles slender, 2.5–5 cm. long; petiolules slender, 8–25 mm. long; leaflets subcoriaceous, obovate, the larger ones 5–7 cm. long, 2–5 cm. wide, all crenate above the middle, rounded or obtuse at the apex, narrowed or cuneate at the base, finely reticulate-veined and lepidote-punctate on both sides, shining above, rather dull beneath, turning dark in drying; capsule curved, greatly elongated, about 4 dm. long, beaked.

Rocky hillside, Sierra Nipe, between Piedra Gorda and Woodfred, Oriente (*Shafer 3320*).

Cotema apiculata Britton, sp. nov.

A tree about 5 m. high. Leaves 5-foliolate; petioles rather stout, 4–6 cm. long; leaflets coriaceous, dark green, elliptic to elliptic-obovate, 6–9 cm. long, 3–5 cm. wide, crenate, rounded and apiculate at the apex, obtuse or rounded at the base, strongly reticulate-veined and loosely lepidote-punctate on both sides, the petiolules 2–3 cm. long; peduncles lateral, solitary or 2 together, stout, 3–5 cm. long; calyx deciduous; capsule about 3 dm. long, 5–6 mm. thick, coiled or curved.

Edge of pineland thickets, between Rio Yamaniguey and Camp Toa, Oriente, at 400 meters altitude (*Shafer 4179*).

A barren specimen from Pinar de El Purio, Cabonico, Oriente (*Roig 134*), is referred to this species with hesitation.

Cotema holguinensis Britton, sp. nov.

A tree up to 8 m. high. Leaves 3–5-foliolate; petioles slender, 1–5 cm. long; petiolules slender, 2 cm. long or less; leaflets firm-chartaceous, lepidote, elliptic to obovate, 2.5–6 cm. long, 3.5 cm. wide or less, crenate near the apex, or entire, obtuse or rounded at the apex, obtuse or subcordate at the base, reticulate-veined above and faintly so beneath, the primary venation rather prominent on both sides; flowers 2 or 3 together in lateral clusters; pedicels slender, 3–4 cm. long; flower-buds apiculate; calyx 1.5 cm. long; "corolla yellow"; capsule curved, elongated, about 2.5 dm. long.

Vicinity of Holguin, Oriente. Type collected between Holguin and Cacocum (*Shafer 1550*).

Family GESNERIACEAE

Gesneria yamuriensis Britton & Wilson, sp. nov.

A slow shrub. Leaves clustered near the apex of the stem, membranous, oblanceolate, 7–12 cm. long, 2.5–4.5 cm. broad, acute to acuminate at the apex, cuneate at the base, sessile, rugose, the veins impressed above, prominent beneath; inflorescence corymbiform, the peduncles axillary, many-flowered; pedicels filiform, 3–4 cm. long, glabrous or slightly pubescent; calyx-lobes linear, 1 cm. long, glabrous, the tube 10-ribbed, 4.5–5 mm. long; corolla scarlet, tubular, 3.5–4 cm. long, glabrous.

Coastal cliffs, Oriente. Type from face of cliff near Rio Yamuri (*Shafer 7786*). Related to *G. purpurascens* Urban.

Gesneria nipensis Britton & Wilson, sp. nov.

An erect shrub, 3–12 dm. high, the twigs, petioles and peduncles scabrous. Leaves coriaceous, oblanceolate, 6–11 cm. long, 1.7–2.7 cm. broad, acute to short-acuminate at the apex, cuneate at the base, dull and scabrous above, rufescent beneath, especially when young, faintly few-veined with the midvein impressed above and prominent beneath, the margin revolute, entire or slightly crenulate; petioles 1.5–1.7 cm. long; peduncles axillary, 6–8 cm. long, 2–3-flowered; calyx-lobes lanceolate, 3 mm. long; corolla tubular, yellow, 1.5 cm. long, verrucose; capsule narrowly obovoid, ecostate, 8–9 mm. long, 5 mm. broad, finely verrucose.

Wet shady woods. Type from Sierra Nipe, near Woodfred, Oriente (*Shafer 3201*).

Gesneria clarensis Britton & Wilson, sp. nov.

A tall shrub with slender grayish-brown branches, the twigs and petioles minutely scabrous. Leaves subcoriaceous, obovate, 7–10 cm. long, 3–4.4 cm. broad, rounded or acutish at the apex, broadly cuneate at the base, glabrous above, rufescent and minutely papillose beneath, the margin entire or serrulate; petioles 1–1.5 cm. long; peduncles axillary, 1-flowered, together with the angled pedicel, 1–2 cm. long; calyx-lobes linear, 7–8 mm. long; capsule obpyramidal, 5 mm. long, prominently 5-ribbed.

Mountains of Santa Clara. Type from Sierra del Caballete, Sancti Spiritus mountains (*Léon & Clement 6504*).

Family LENTIBULARIACEAE

Pinguicula lignicola Barnhart, sp. nov.

An epiphyte, growing on twigs of trees and shrubs. Leaves numerous in a dense rosette, sessile, linear-spatulate, entire, about 1 cm. long, minutely glandular-hairy but otherwise glabrous, withering-persistent; scapes solitary or few, filiform, weak, 2–4 cm. long; calyx about 2 mm. long, the lobes obtuse, united to above the middle, the two lowest almost to the apex; corolla 1–1.3 cm. long, white, the lobes subequal, about as long as the tube, obtuse, overlapping, the spur at a right angle with the tube, less than 2 mm. long, saccate, obtuse; capsule not seen.

Oriente: Vicinity of Camp San Benito, February 24, 1910 (*Shafer 4031, type*); Camp La Gloria, December 24–30, 1910 (*Shafer 8065*); "La Yberia," a mining claim west of Baracoa, September 8, 1909 (*Charles T. Ramsden*).

Pinguicula benedicta Barnhart, sp. nov.

Leaves few or numerous in a dense rosette, sessile or nearly so, obovate to nearly orbicular, flat, entire, obtuse, 1–2 cm. long, minutely glandular-hairy above, glabrous beneath; scapes usually solitary, filiform, weak, 7–8 cm. long; calyx about 3 mm. long, strongly 2-lipped, the lips nearly distinct, the 3 lobes of the upper lip united to about the middle, the 2 lobes of the lower lip almost to the apex, all obtuse; corolla 2–2.5 cm. long, dark blue, distinctly 2-lipped, the 2-lobed upper lip much shorter than the 3-lobed lower one, the 5 lobes all oblong, entire, overlapping, the spur continuous with the tube, 0.5–0.75 cm. long, cylindric, obtuse; capsule not seen.

Oriente: Trail, Camp La Barga to Camp San Benito, February 22–26, 1910 (*Shafer 4025*, type); "La Yberia," a mining claim west of Baracoa, September 8, 1909 (*Charles T. Ramsden*).

Utricularia mixta Barnhart, sp. nov.

Stems slender, horizontal, submersed, free-floating except at the single point of attachment, up to 1 m. long, the older internodes 5–10 cm. long; leaves alternate, but forked from the very base and thus appearing opposite, each fork pinnately decompound with filiform segments, 10–20 cm. long, one fork usually much more copiously bladder-bearing than the other; mature bladders 1–1.5 mm. in diameter; scapes solitary, borne at alternating nodes, erect, 8–25 cm. long, very slender, less than 2 mm. thick, 6–12-flowered; scales none, or sometimes 1 or 2, like empty bracts, near the base of the raceme; bracts ovate, acute, 2–3 mm. long, concave and often sheathing the pedicels; pedicels 3–8 mm. long, at first erect but strongly recurved at maturity; calyx-lobes subequal, ovate, obtuse or acute, or the lower emarginate, about 2 mm. long, slightly accrescent and spreading under the mature fruit; corolla yellow, the upper lip subtriangular, emarginate, about 3 mm. long and broad, the lower lip rounded, truncate or slightly emarginate, broader than long, 5–7 mm. long, 10–12 mm. broad, the palate prominent, faintly 2-lobed, the spur conic-subulate, porrect, slightly shorter than the lower lip; ovules numerous; capsule spheric, 2–4 mm. in diameter, apiculate by the remains of the stigma; seeds by abortion few, 7–10, flat, peltate, winged all around, large for the genus, the body lenticular, about 2 mm. in diameter, the wing up to 0.5 mm. wide.

Type collected on muddy borders of a lagoon, Vivijagua, Isle of Pines, February 28–29, 1916 (*Britton, Britton & Wilson 15014*).

In quiet water, Santa Clara, Pinar del Rio and Isle of Pines; distributed by Wright as *U. foliosa* (*2895*) (true *U. foliosa* is *Wright 2895a,* distributed as *U. foliosa oligosperma*); Colombia; Brazil.

Family ACANTHACEAE

Tubiflora Shaferi P. Wilson, sp. nov.

Leaves basal, oblanceolate, runcinate-dentate, 2.5–5 cm. long, 0.8–1.3 cm. wide, deep-green and more or less densely pilose, especially when young, short-petioled; scapes 3–6 cm. long, slender, clothed with appressed, imbricated, acute, scale-like leaves 3 mm. long; spikes 1–2 cm. long, the bracts ovate, rigid, 3.5–4 mm. long, 1.8–2 mm. broad, obtuse or acutish at the apex, not keeled on the back, ciliate, appressed-pilose above within.

Pinelands, Sierra Nipe, near Woodfred, Oriente (*Shafer 3562*).

Family RUBIACEAE

Machaeonia minutifolia Britton & Wilson, sp. nov.

A shrub about 2 m. high, the twigs spiniform, slender, sparingly leafy, finely pubescent when young, soon becoming glabrous, the old branches stout, light gray. Leaves elliptic or suborbicular to elliptic-obovate, somewhat conduplicate, 1–2 mm. long, ciliate, rounded at the apex, very nearly sessile; flowers glabrous, sessile or very nearly so in the cymes; calyx-lobes rounded, about as long as the tube; corolla white, about 1.5 mm. long, its lobes obtuse; style about as long as the calyx-lobes; stigmas 2, short.

Palm barren, between Camaguey and Santayana (*Britton 2397*).

Scolosanthus lucidus Britton, sp. nov.

A shrub about 1 m. high, with slender, terete, rough-puberulent, resinous branches. Leaves ovate-orbicular, coriaceous, 8–13 mm. long, shining, nearly sessile, mucronate at the apex, rounded at the base, dark green with the midvein impressed above, dull green with midvein somewhat elevated beneath, the lateral venation wholly obscure, the margin revolute; calyx-lobes suborbicular, 0.8 mm. broad, minutely hispidulous; corolla not seen; fruit (immature) subglobose, 4 mm. in diameter, greenish.

Moa Bay, east of Rio Moa, Oriente (*Shafer 8355, type*); collected in the same region by Roig (*60*), and also collected in Cuba by Wright and mixed with *Scolosanthus Wrightianus* (*2660 in part*).

Psychotria Clementis Britton, sp. nov.

A shrub about 2 m. high, glabrous throughout. Leaves membranous, narrowly obovate or oblanceolate, 8–16 cm. long, rather strongly veined with the veins spreading-ascending, acuminate at the apex, cuneate at the base, the slender petioles 1 cm. long or less; stipules broadly lanceolate, acuminate, incised and ciliate, united below, about 8 mm. long; fruiting panicle corymbiform, about 7 cm. broad; fruiting pedicels 5 mm. long or less; fruit oblong, 7 mm. long, about 5 mm. thick, grooved, capped by the short calyx-limb.

Sierra del Caballete, Sancti Spiritus mountains, Santa Clara (*Léon & Clement 6522*).

Psychotria bermejalensis Britton, sp. nov.

A shrub about 2 m. high, the slender branches glabrous. Leaves elliptic, glabrous, rather thin, 5–10 cm. long, the veins distant, impressed above, prominent beneath, the apex acute or short-acuminate, the base narrowed or obtuse, the rather stout puberulent petioles 8–15 mm. long; stipules ovate, about 5 mm. long; panicles terminal, peduncled, 4–5 cm. long in fruit, glabrous; fruiting pedicels 2–5 mm. long; fruit globose, small, about 3 mm. in diameter, rather deeply grooved, red.

Between Yamuri Arriba and Bermejal, Oriente (*Shafer 8442*).

Psychotria moensis Britton & Wilson, sp. nov.

A straggling shrub, the twigs terete, puberulent when young, flexuous, rather stout, the internodes short. Leaves clustered near the ends of the twigs, subcoriaceous, oblanceolate, glabrous, 2–4 cm. long, 1.5 cm. wide or less, rounded or obtuse at the apex, cuneate at the base, rather strongly pinnately few-veined and with the midvein prominent beneath, very inconspicuously veined with the midvein impressed above, the stout petioles 1–2 mm. long; stipules distinct, about 4 mm. long, deciduous; inflorescence terminal, few-flowered; peduncle rather stout, 1–2 cm. long; fruiting pedicels about 5 mm. long; bractlets minute; fruit (immature) subglobose, a little longer than thick, about 5 mm. in diameter, the persistent calyx-tube about 0.5 mm. long.

Camp La Gloria, south of Sierra Moa, Oriente (*Shafer 8273*).

Psychotria toensis Britton & Wilson, sp. nov.

A shrub 3–9 dm. high, the slender brown twigs puberulent when young. Leaves lanceolate to elliptic-lanceolate, 2–5.5 cm. long, 0.7–2 cm. wide, acute to acuminate at the apex, cuneate at the base, glabrous above, the midvein slightly elevated, the lateral veins prominent; free tips of the stipules oblong, 2–2.5 mm. long, acute; inflorescence terminal, the peduncle 1.5–3 cm. long, puberulent; corymbs trichotomous, 1–1.5 cm. long, ebracteate; prophyllae oblong-lanceolate, 3 mm. long, 1 mm. wide, puberulent; flowers sessile; calyx-tube puberulent, the lobes triangular or triangular-ovate; corolla 12–13 mm. long, the lobes oblong to oblong-lanceolate, acute; fruit 4 mm. broad, contracted at the commissure.

Moist rocky places along trail, Rio Yamaniguey to Camp Toa, Oriente (*Shafer 4009*).

Mitracarpum Fortunii Britton & Wilson, sp. nov.

Annual. Stems branched at the base, the branches slender, erect, 6–9 cm. long, puberulent with incurved hairs. Leaves oblong, 6–10 mm. long, 2–3.5 mm. broad, acute at the apex, smooth or nearly so, obscurely nerved, sessile, the margin more or less revolute; corolla white, the tube about 1 mm. long, the lobes elliptic-ovate, about as long as the tube; capsule circumscissile.

Loma de Motembo, Santa Clara (*Léon, Edmund & Fortun 8601*).

Family CARDUACEAE

Aster Leonis Britton, sp. nov.

Branched, 3 dm. high, the branches slender, densely short-pubescent. Leaves finely pubescent and scabrous, those of the branches linear or linear-oblong, entire, acute or acuminate, sessile, 2–5 cm. long, those of the branchlets similar, much smaller; heads mostly solitary at the ends of the branchlets; involucre subhemispheric, 4–5 mm. high, its bracts linear-spatulate, ciliate, their green tips acutish; rays pink, about 1.5 cm. long.

Marshes, west of Batabano, Havana (*Léon & Cazanas 5753*).

Gundlachia apiculata Britton & Blake, sp. nov.

Shrub 1 meter high, resinous, the stout angulate stem branched above, tuberculate-strigillose, the branches erect. Leaves oblong-oblanceolate, 2.2–3.2 cm. long, 5–7 mm. wide, apiculate at the rounded apex, cuneate at base, alternate, sessile, coriaceous, entire, triplinerved and somewhat reticulate, punctate, more or less vernicose-resinous; heads about 4 in a terminal cluster, equaled by the leaves; disk turbinate, 5–6 mm. high, 3.5 mm. wide; involucre about 4-seriate, graduated, 4–5 mm. high, the phyllaries ovate-oblong, acute, appressed, indurated, scarious-margined, with darker subherbaceous glandular and glandular-ciliolate tips; rays about 2, white, oval, about 2 mm. long; disk-corollas about 4, sparsely pilose toward tip of tube, 4.8 mm. long, the tube 1.6 mm., the teeth 2 mm. long; achenes (immature) hispidulous, 1.5 mm. long; pappus dull white, 4 mm. long, the outer bristels shorter.

Camp La Gloria, south of Sierra Moa, Oriente (*Shafer 8053*).

Distinguished by its few heads and elliptic-obovate tripli-nerved leaves.

Gundlachia foliosa Britton & Blake, sp. nov.

Shrub, 0.3 to 1.3 meters high, somewhat glutinous, the stout erect striate branches tuberculate-strigillose, densely leafy, simple, or branched only in the inflorescence. Leaves obovate, 1.2–1.8 cm. long, 6–10 mm. wide, usually apiculate at the rounded apex, rounded at base, alternate, erect, uniform, sessile, coriaceous, triplinerved, punctate, dull green both sides, glabrous; heads in dense terminal panicles of about 8 or 10, equaling or slightly exceeding the leaves; pedicels sparsely hispidulous, 1–2 mm. long; heads 6 mm. wide; disk turbinate, 6 mm. high, 3.5 mm. wide; involucre about 5-seriate, graduated, 5 mm. high, the phyllaries lance-ovate (outer) to oblong, acute to acuminate, appressed, indurated and scarious-margined with dark subherbaceous tips, sparsely glandular-hispidulous at apex; rays 2, white, oval, tridenticulate, 3.2 mm. long; disk-corollas 3, hispid-pilose at base of throat, 4.5–4.8 mm. long, the slender tube 1.5 mm., the lanceolate recurved teeth 2–2.5 mm. long; achenes oblong-cylindric, 5-angled, hispidulous, 2 mm. long; pappus dull white, 4 mm. long, the outer bristles shorter.

On dryish rocks, Camp La Gloria, across Sierra Moa, to Moa Bay, Oriente (*Shafer 8280*).

Readily recognized by its small crowded obovate leaves.

Gundlachia cubana Britton & Blake, sp. nov.

Low shrub, growing in clumps, branched, more or less resinous, the stem stoutish, densely tuberculate on the angles, densely leafy. Leaves narrowly oblanceolate, 1.7–2.7 cm. long, 2.5–4 mm. wide, acute, narrowed to the sessile base, alternate, coriaceous, entire, 1-nerved, punctate, glabrous, dull green; panicles terminal, sessile, about 8-headed, equaled or slightly exceeded by the leaves; pedicels 1 to 8 mm. long; heads turbinate, about 7 mm. wide; disk 6 mm. high, 4–5 mm. wide; involucre about 4-seriate, graduated, 4.5 mm. high, the phyllaries lance-ovate, acuminate, indurated, scarious-margined, the subherbaceous glandular-hispidulous and ciliolate tips somewhat recurved in age; rays 4, white, oval, 4 mm. long; disk-corollas 5, sparsely pilose at base of throat, 4.5 mm. long, the tube 1.5 mm., the teeth 2.2 mm.; achenes obovoid, densely hispid-pilose, 1–1.4 mm. long; pappus dull white, 4 mm. long, the outer bristles shorter.

Northern Oriente. Type collected by water near mangroves, mouth of Rio Yamaniguey (*Shafer 4255*).

Erigeron Taylori Britton & Wilson, sp. nov.

Diminutive, glabrous. Scapes filiform, prostrate or spreading, only 3 cm. long or less, monocephalous, bearing several oblong or oblanceolate scales about 1 mm. long; basal leaves tufted, spatulate, entire, obtuse or rounded, the blade 2–4 mm. broad, the slender petiole 15 mm. long or less; involucre 2 mm. long, its linear-lanceolate, acute or acuminate bracts reflexed in age and persistent; receptacle foveolate; rays white; ligule linear, 1.6–1.8 mm. long; achenes ellipsoid-cuneiform, 0.5 mm. long, hirsute with short hairs; pappus about twice as long as the achene.

Upper Guama River, Sevilla Estate, near Santiago, Oriente (*Taylor 181*), forming moss-like patches.

Erigeron Earlei Britton & Wilson, sp. nov.

Loosely hirsute; stems solitary or few together, slender, erect, about 2.5 dm. high, few-branched above. Leaves membranous, the basal and lower ones spatulate or oblanceolate, 3–4.5 cm. long, obtuse or rounded at the apex, coarsely crenate, narrowed into margined petioles or sessile, or the lowest with slender petioles 1–2 cm. long, the uppermost oblong, acute, entire, 1–2 cm. long, sessile; heads several, slender-peduncled, the peduncles bearing 1–3 linear or lanceolate bracts 1–4 mm. long; involucre subhemispheric, 4 mm. high, its bracts in about 2 series, linear-lanceolate, acuminate, the outer ones pilose, somewhat shorter than the inner, all reflexed in age and persistent; rays white; ligule linear, 1.5–1.7 mm. long; achenes oblong-ellipsoid, 0.6 mm. long, hirsute; pappus 2–3 times as long as the achene.

Rocky river-bed, Hanabanilla Falls, Trinidad Mountains, Santa Clara (*Britton, Earle & Wilson 4843*).

Borrichia cubana Britton & Blake, sp. nov.

Shrub, oppositely branched, the stem and branches sparsely appressed-pilose, glabrate. Leaves opposite, the blades oblanceolate to spatulate-obovate, 3–3.8 cm. long, 5–11 mm. wide, mucronate-apiculate at the rounded apex, cuneately narrowed into the petiole, entire or sparsely spinulose-toothed below, coriaceous, obscurely triplinerved, canescent-lanate both sides; petioles narrowly margined, broadened and connate at base, 6–10 mm. long; peduncles terminal, rather sparsely appressed-pilose, thickened above, 5–7 cm. long; heads 2.2 cm. wide; disk subglobose, 1–1.2 cm. thick; involucre about 4-seriate, graduated, 8–9 mm. high, the outer phyllaries deltoid-ovate, acute and weakly mucronulate, with indurated base and spreading canescent-lanate apex, the inner broader, ciliate, otherwise subglabrous, with cuspidate-mucronate spreading tips about 2 mm. long; rays about 15, yellow, oval, 6 mm. long; disk-corollas yellow, slender, glabrous, 5.8 mm. long; pales similar to the outer phyllaries, broad, indurated, ribbed, with erect stiffly mucronulate tips about 1 mm. long; achenes quadrangular, black, glabrous, 3 mm. long; pappus a thickened angulate crown 0.8 mm. long.

Swamp near Atares Castle, Havana, June, 1917 (*Léon 7244*).

Nearest *B. frutescens* (L.) DC., but easily distinguished by its merely short-cuspidate outer phyllaries and pales.

Spilanthes montana Britton & Blake, sp. nov.

Shrub about 5 dm. high, sparsely dichotomously branched, the stem stout, angulate, densely leafy, the branches erect, the internodes mostly 4–10 mm. long. Leaves opposite, the blades lanceolate, 2.5–4 cm. long, 4–8 mm. wide, narrowed to an obtuse apex, cuneate at base, entire, coriaceous, slightly revolute, tripli-nerved, glabrous, shining above, duller beneath; petioles scarcely margined, 2–5 mm. long; peduncles terminal and axillary, monocephalous, glabrous, striate, 16–34 cm. long, sometimes bearing two spatulate denticulate bracts 4 mm. long below the head; heads discoid, subglobose to ovoid-subglobose, rounded, 6–10 mm. high, 9–10 mm. thick; involucre 3-seriate, slightly graduated, 5–6 mm. high, the phyllaries oblong or oval-oblong, rounded, denticulate-erose above, sparsely glandular-ciliolate below, thick-herbaceous with subscarious margin, papillose on back, obscurely nerved; disk-corollas white, 3.2 mm. long, sparsely papillose-glandular below, with short obscure tube; pales blunt, erose-denticulate above, papillose-glandular on keel throughout and sparsely hispid-pilose below; achenes (not quite mature) oblong-obovate, 3 mm. long, ciliate; awns 2, unequal, ciliate, 2–2.8 mm. long.

Top of Cajalbana, near the fall of the arroyo, Pinar del Rio, Cuba, April 6, 1915 (*Léon & Charles 4936*).

Related to *S. insipida* Jacq. and *S. pauciceps* (Griseb.) Blake, but readily distinguished by its densely leafy stems and lanceolate entire leaves.

Chaptalia comptonioides Britton & Wilson, sp. nov.

Leaves several or numerous, deeply pinnatifid, spatulate-oblanceolate in outline, 3–15 cm. long, short-petioled, obtuse or acutish, membranous, the upper surface dark green, glabrous or somewhat floccose, the under surface densely white-lanate, the ovate terminal lobe larger than the semicircular lateral ones; scape slender, floccose at least above, 2 dm. high or less; involucre subhemispheric, 9–11 mm. high, its linear bracts acute or acuminate, white-tomentulose with a green midvein; achene fusiform, minutely hispidulous, brown, the angles white, the filiform beak about as long as the body; pappus longer than the beak, pale brownish-white.

River-cliffs, Enseneda de Mora, Oriente (*Britton, Cowell & Shafer 12937*).

Chaptalia Shaferi Britton & Wilson, sp. nov.

Leaves 3–8 cm. long, lyrate or lyrate-pinnatified, short-petioled or sessile, obtuse or acutish, the terminal lobe much larger than the others, the upper surface dark green, glabrous, the under surface densely white-lanate; scape very slender, glabrous below, slightly tomentose above, 2 dm. long or less; involucre subcampanulate, about 5 mm. high, its bracts linear, acute, glabrous; achenes fusiform, minutely hispidulous, brown, the slender beak about half as long as the body; pappus longer than the achene, brownish-white.

River-banks and wet rocks, Oriente. Type from sandy bank of Rio Yamaniguey (*Shafer 4203*). Confused in C. Wright's collection with *C. stenocephala* Griseb., and with *C. pumila* of Jamaica.

Chaptalia Rocana Britton & Wilson, sp. nov.

Leaves several, membranous, spatulate-oblanceolate, 15 cm. long or less, repand-pinnatifid, crenate, or some of the smaller ones entire, acute or obtuse, dark green and glabrous or nearly so above, white-lanulose beneath, the petioles sometimes as long as the blades; scapes nearly filiform, 5–10 cm. long, floccose or becoming glabrous; involucre subhemispheric, 6–7 mm. long, its bracts linear, acuminate, glabrate; achenes (immature) filiform, minutely hispidulous, brown, the short beak less than one quarter the length of the body; pappus longer than the achene, brownish-white.

Mountains of southern Santa Clara. Type from stones in Rio Caracusey, Banao Mountains (*Léon & Roca 7904*).