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TABLE OF CONTENTS

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PHYTOGEOGRAPHICAL NOTES ON THE ROCKY MOUNTAIN REGION—IV

FORESTS OF THE SUBALPINE AND MONTANE ZONES

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Phytogeographical notes on the Rocky Mountain region
IV. Forests of the Subalpine and Montane Zones*

P. A. RYDBERG

The mountain regions may be divided into four zones: (1) the ALPINE ZONE, above the timberline; (2) the SUBALPINE ZONE; (3) the MONTANE ZONE; (4) the FOOTHILL ZONE. These correspond to Dr. Merriam's ARCTIC, HUDSONIAN, CANADIAN, and TRANSITION life-zones, respectively. The Alpine Zone has already been discussed by me in three preceding papers. The Subalpine and Montane Zones are more or less mesophytic, while the Foothills are decidedly xerophytic. The characteristic trees of the last are the bull pines and nut-pines and the cedars, which there seldom form dense woods, but grow more or less scattered on the hillsides. The Subalpine and Montane Zones are characterized (with the exception of the exposed ridges and larger open valleys or "parks") by more or less dense woods of spruce, fir, pines and aspen. Many do not distinguish these two zones, and no definite line can be drawn between them. Most of the plants are common to both; the most characteristic tree of the Subalpine Zone, the Engelmann spruce, extends far down into the Montane Zone, and several of the principal components of the latter, especially the Douglas spruce, extend far up into the former. In general the division line may be placed at the upper limit of growth of the bull-pine and the lower of the subalpine fir. This varies considerably. In Colorado it may be placed at an altitude of 3,000 m. (10,000 ft.), in the Yellowstone National Park at 2,300–2,500 m. (7,500–8,000 ft.), in the Glazier Park Region of Montana at

* This article is not intended to present any new facts, but merely a summary. The only feature as far as I know that has never been presented in print in this form is the division line drawn between the Northern and Southern Rockies and the reasons for drawing it at that particular place. The distribution of the forest trees both altitudinally and geographically has been treated more extensively and in greater detail elsewhere, both in the various "tree books" and in the reports from the United States Forest Reserves, but a short resumé is always desirable.

about 2,000 m. (6,500 ft.), and in the Selkirk Mountains of British Columbia still lower.

A region which extends twenty degrees in latitude* will naturally not be homogeneous, as far as its vegetation is concerned. It also can be divided into two principal parts: the Northern and the Southern Rockies. In Wyoming, about where the Union Pacific Railroad is drawn across, there is a break in the high mountain chain. This break may be regarded as the division line between the Northern and the Southern Rockies.

The larger part of the Southern Rockies is within the state of Colorado, but they extend south into New Mexico to Santa Fe, and northward into Wyoming, where they are known as the Medicine Bow Mountains. West of the Southern Rockies and separated from them by the Green River basin are the Uintah and Wasatch Mountains. The former have practically the same flora as the Southern Rockies, but the western slope and southern end of the Wasatch Range partake of the floral nature of the isolated mountain chains of the Great Basin. The northern end of the Wasatch Mountains, the range enclosed by the horseshoe bend of the Bear River in southern Idaho, is the most northerly extension of the floral district of the Southern Rockies. It is here and across the Bear River in the Teton Mountains, not along the continental divide in Wyoming, that the floras of the Northern and Southern Rockies meet.

The Northern Rockies form an uninterrupted chain from Yukon Territory to the Wind River Mountains in Wyoming and the flora is practically homogeneous, except the western slope of the northern portion. To the Northern Rockies should also be counted several more or less isolated mountain ranges, as the Saw-tooth Mountains of central Idaho, the Tetons of western Wyoming, the Cypress Hills in Saskatchewan, several ranges in Montana, the Bighorn Mountains in northern Wyoming and the Black Hills and several smaller chains in their neighborhood. None of these except the Big Horns and the Tetons can be taken in account when the subalpine flora is considered. The Selkirk Mountains between the bends of the Upper Columbia River,

* My discussion in this paper refers only to the region between 35° and 55° latitude.

much closer to the Rockies, and separated from the Cascades by the Columbia and Frazer River valleys, have a flora resembling that of the Cascades as much as that of the Rockies. This Cascade flora, however, extends also to the western slopes of the Rockies in British Columbia and northern Montana as well as into the Bitter Root Mountains between that state and Idaho, although the Bitter Roots are separated from the Selkirks by the valleys of Kootenay River and Clark's Fork.

This division between Northern and Southern Rockies is not made merely on geographical grounds, i. e., because there is a break in the high mountain chain where the plains actually cross over the continental divide. The flora shows also many differences; this is especially the case with the more characteristic species, the trees. It is true that a number of these are common to the Northern and Southern Rockies, as, for instance, *Picea Engelmannii*, *Pinus scopulorum*, *Pinus Murrayana*, *Pinus flexilis*, *Pseudotsuga mucronata*, *Abies lasiocarpa*, *Sabina scopulorum*, *Betula fontinalis*, *Alnus tenuifolia*, and several species of *Crataegus*, *Salix*, and *Populus;* but others are not.

Pinus aristata, *P. edulis*, *Picea Parryana*, *Abies concolor*, *Sabina utahensis*, *S. monosperma*, *Populus Wislizeni*, *P. Fremontii*, *Fraxinus anomala*, and the oaks of the *Quercus Gambellii* and *Q. undulata* groups are characteristic of the Southern Rockies. Of these only *Picea Parryana* has been collected in what belongs to the Northern Rockies. The only authentic locality there that I know is in the Teton Mountains, and these are, as stated before, in the region where the two floras meet. *Abies concolor* extends into the Bear River Mountains but does not cross the line, although it is found much farther north in western Oregon. It has been reported from other parts of Idaho, but evidently has been confused with *A. grandis*, at least all specimens I have seen named *A. concolor* belong to that species. *Sabina utahensis* is found on the southwestern slopes of Wind River Mountains in the Green River basin, but this species belongs to the foothills and not to the mountains proper. The only oak found in the Northern Rocky Mountain region is *Quercus macrocarpa*, and this only in the Black Hills. It is not found in the Southern Rockies and it is an invader from the prairie region. The same can be said about *Ulmus americana* and *Ostrya virginiana*. There are still more trees of the Northern Rockies which are not found in the southern part, such as *Larix occidentalis*, *L. Lyallii*, *Abies grandis*, *Tsuga heterophylla*, *T. Mertensiana*, *Picea albertiana*, *Pinus monticola*, *P. albicaulis*, *Thuja plicata*, *Taxus brevifolia*, several species of *Betula* and *Salix*, *Populus trichocarpa*, *P. hastata*, and *P. Besseyana*. It is true that most of the conifers mentioned belong principally to the Selkirk-Bitter Root region, but this is not the case with *Picea albertiana* and *Pinus albicaulis*, which extend as far south as the Yellowstone Park. *Abies grandis* has also been reported from there, and *Pinus monticola* a little north thereof.

SUBALPINE ZONE OF THE SOUTHERN ROCKIES

The characteristic trees of the Subalpine Zone of the Southern Rockies are *Picea Engelmannii* and *Populus tremuloides*, with *Pinus aristata* and *Abies lasiocarpa* as secondary ones.

The ENGELMANN SPRUCE, or, as it is usually called in the Rockies, the white spruce, has its best development in Colorado at an altitude between 10,000 and 11,500 feet. It extends up to the timberline, 11,500–11,800 feet or rarely up to 12,000 feet. This region from about 10,000 feet to the timberline may therefore be regarded as the Subalpine Zone. The spruce grows often in pure stands, as in the La Sal Mountains, or mixed with the subalpine fir, *Abies lasiocarpa*, and the forests usually cover the northern slopes, except where the conditions are such that no trees can grow. In favorable localities it also grows on the southern slopes, there occasionally mixed with *Pinus aristata*. It is not confined, however, to the Subalpine Zone, but extends far down on the northern slopes into the Montane Zone as low as to 7,000 or 6,500 feet altitude. Here, as well as in the lower portion of the Subalpine Zone, it is often mixed with the Douglas or red fir, *Pseudotsuga mucronata*, the blue spruce, *Picea Parryana*, the balsam fir, *Abies concolor*, the limber pine, *Pinus flexilis*, and the lodge-pole pine, *Pinus Murrayana*. *Picea Engelmannii* extends throughout the northern Rocky Mountain region, but is not there so exclusively the tree characteristic of the Subalpine Zone.

The Engelmann spruce is a slender tree with narrow crown, therefore offering little resistance to the wind. The branches are short, slender and deflexed, therefore well adapted for shedding the falling snow. It is, hence, very well adapted to the severe climate of the mountain peaks. At the timberline it, as well as *Abies lasiocarpa*, becomes stunted, low, with the lower branches enormously elongated and closely pressed to the ground. The Engelmann spruce is a slow grower, naturally so on account of the poor and rocky soil and the severe climate. On a stump from a tree cut in the La Sal Mountains, measuring 26 inches, I counted over 260 annual rings. In very favorable conditions it may reach a height of 120 feet and a diameter of about 3 feet.

Next to the Engelmann spruce, the ASPEN is the most common tree in the Subalpine region of Colorado. It grows on both slopes, usually in groves, but sometimes mixed, and usually prefers rich soil. After the spruce wood has been destroyed by forest fires, it often takes possession of the ground, as its seeds germinate more quickly and it is a faster grower. It reaches its best development along streams and in springy places. It is seldom found up to an altitude of more than 11,000 feet and its height is seldom over 25 or 30 feet in this region.

The FOX-TAIL PINE, range pine, or prickle-cone pine, *Pinus aristata*, is the chief tree of the southern slopes of the Southern Rockies. It is not found in the Northern Rockies at all, but exists in the mountains of the Creat Basin and in the southern Sierra Nevada. It is a bulky tree, branched usually near the base. In favorable situations it sometimes reaches a height of 50 feet, with a trunk 3 feet in diameter. Near the timberline it becomes very gnarled, crooked, and twisted, with the branches short and few on the windward side and unproportionally developed on the leeward one. It never forms the depressed cushion-like or sugar-loaf-like growth of *Picea Engelmannii* or *Abies lasiocarpa* in similar situations. *Pinus aristata* is a characteristic tree of the Sulbapine Zone, only rarely found in the Montane Zone as low as 8,000 feet. If found there it grows mostly with *Pinus flexilis*, as it does sometimes in the Subalpine Zone.

The fourth of the trees of the Subalpine Zone is the SUBALPINE FIR, *Abies lasiocarpa*. It usually grows scattered among *Picea*

Engelmannii or at lower altitudes sometimes with *Pinus Murrayana*. It is usually a small tree, very rarely reaching 70 or 80 feet in height, with a trunk of 2 feet in diameter, the average good-sized tree being 45 or 50 feet high. It is found at an altitude of from about 9,000 feet to the timberline.

The limber pine, *Pinus flexilis*, belongs really to the Montane Zone, where it has its best development, but extends into the Subalpine Zone almost to the timberline.

SUBALPINE ZONE OF THE NORTHERN ROCKIES

As the Northern Rockies are of much larger extent than the Southern and the conditions are much more variable, the description of the different zones of one locality will poorly fit for all places. I shall therefore first select a fairly typical region near the center of the district and then contrast with this the outlying regions. The region selected is the main range of the Rockies in northern Montana. The Subalpine Zone in this region extends from an altitude of about 6,500 feet to the timberline. The most important tree is, as in the Southern Rockies, the Engelmann spruce (*Picea Engelmannii*), but it becomes less predominant, and the subalpine fir, *Abies lasiocarpa*, becomes more frequent. Both are characteristic of the northern exposures.

The ENGELMANN SPRUCE, just as in the Southern Rockies, is not limited to the Alpine Zone, but runs down through the Montane Zone to a little below 5,000 feet, and is there confined mostly to the northern slopes and valleys. In this region it sometimes reaches a height of 125 feet, with a trunk 3 feet in diameter. In some places especially on the west side of the Bitter Root Mountains, it is more or less supplanted by the next.

The SUBALPINE FIR, *Abies lasiocarpa*, grows between an altitude of 6,000 feet and timberline, rarely lower down. Under favorable conditions it reaches a height of 75 feet, with a trunk diameter of 2 feet.

The WHITE-BARKED PINE, or, as it is called in Montana, the nut pine, *Pinus albicaulis*, takes the place of *P. aristata* on the southern exposures, often growing scattered in grassy "parks." It resembles the same somewhat in growth, although it is more closely related to *P. flexilis*. It is a tree 20 to 40 feet high, with a trunk

1 to 4 feet thick. At the timberline it becomes low, crooked, and gnarled.

The LYALL'S LARCH, *Larix Lyallii*, is the most hardy tree of the region. In moist valleys it reaches higher up than either the spruce or the fir, and is more strictly a subalpine species than either, growing mostly above 7,500 feet altitude. In the main Rockies, it is not found south of latitude 48° 45′, but runs further south in the Bitter Root Mountains. It is mainly confined to the western slope of the Rockies, and crosses the main divide only north of Culver Glazier, latitude 48° 50′. It is a tree of slow growth, becoming 25 to 40 feet high and having a diameter of 2 to 4 feet.

The ASPEN plays here the same rôle as in the Southern Rockies, but is perhaps not so common.

In the lower portion of the Subalpine Zone, the lodge-pole pine, limber pine and Douglas fir are found on the drier slopes. In some places the former tree is the most common of all. The limber pine is rare on the west side of the divide.

In the Bitter Root Mountains the dividing line between the Subalpine and Montane Zones is slightly lower. The principal trees here are the same as in the main Rockies. The general distribution of the subalpine fir is above 4,800 feet in the northern part and 5,500 feet in the southern part, although it sometimes descends as low as 3,000 feet. Here it is much more common than *Picea Engelmannii* and is the characteristic tree of the Subalpine Zone. The latter grows mostly at 4,000 to 7,000 feet altitude. Lyall's larch is found along the main range of the Bitter Root Mountains to the headwaters of the south fork of the Clearwater River, latitude 45° 50′. *Pinus albicaulis* grows mostly above 6,000 feet altitude. *Pinus Murrayana* ascends to 8,000 feet and *Pseudotsuga mucronata* to 6,500 or 7,000 feet. *Pinus flexilis* is wanting. The first of these three species, i. e., *P. Murrayana*, is the most common tree on the eastern slopes of the Bitter Root Mountains and there makes up about ninety per cent. of the forest.

To the other subalpine trees are here added the ALPINE HEMLOCK, *Hesperopeuce Mertensiana*. It grows at an altitude of from 5,500 to 8,000 or even 9,000 feet. It is a tree of 60 to 100 feet in height and 3 to 6 feet in diameter with a greatly developed crown. It is not found in the main Rockies, at least not within the United States. It is not uncommon in the Selkirks and extends south in the Bitter Roots as far as to the divide between the north and middle forks of Clearwater River.

In the Yellowstone Park and in the Tetons, the Subalpine Zone begins at an altitude of 7,500 or 8,000 feet and the timberline is at an altitude of about 10,000 feet. The trees are the same as those of northern Montana, except that the Lyall larch is lacking and the lodge pole pine is more common near the lower border.

In the Big Horn Mountains both the Engelmann spruce and the subalpine fir are scarce and in most cases the upper limit of the lodge pole pine constitutes the timberline.

In the Black Hills a Subalpine Zone can scarcely be spoken of, as the highest mountains are less than 7,500 feet. The subalpine species of the Rockies are wholly lacking.

Montane Zone of the Southern Rockies

The upper and lower limits of the Montane Zone in Colorado are approximately at an altitude of 10,000 and 7,500 to 8,000 feet. The former is about the upper limit of *Pinus scopulorum*, the latter near the lower limit of *Pinus Murrayana*, and *Pseudotsuga mucronata* is rare below this altitude in Colorado. These three trees together with *Picea Engelmannii* are the most important timber trees of this zone.

The southern slopes of the mountains and the tops of the table lands are more or less xerophytic, and here the bull pine or yellow pine, *Pinus scopulorum*, and the Douglas or red fir, *Pseudotsuga mucronata*, are predominant. The northern slopes and more protected valleys and flats are decidedly mesophytic. The predominant tree on the northern slopes and in the valleys is the Engelmann spruce. The lodge-pole pine, *Pinus Murrayana*, is often found with the Engelmann spruce, but is often found on the upper plateaus in pure stands or mixed with the more xerophytic species.

The composition of the more *xerophytic forest* of the southern slopes is as follows:

The most important tree is perhaps the Bull Pine, *P. scopulo-*

rum, or, as it perhaps is more often known, *P. ponderosa scopulorum*. It is seldom found in Colorado above an altitude of 10,000 feet, which the writer regards as approximately the upper limit of the Montane Zone. It descends, however, far below the lower limit of this zone, even below an altitude of 5,000 feet; it is really in fact the only important tree of the foothills. It is a tree of wide distribution found nearly everywhere in the Montane and Foothill Zones of the whole Rocky Mountain region, as treated in this article. The only mountains I know of where it is lacking are the La Sal Mountains in eastern Utah, where the Douglas fir is also missing. The bull pine is a massive tree, sometimes becoming 110 to 125 feet in height and with a trunk almost 4 feet in diameter. A tree 3 feet in diameter is about 250 years old.

The DOUGLAS FIR, red fir, or red spruce, *Pseudotsuga mucronata*, is almost as important as the bull pine. It usually grows with the latter and reaches about the same size. It is common at an altitude of between 7,000 and 10,000 feet, but ascends sometimes as high up as 10,500 and very rarely up to nearly 11,000 feet, and descends seldom in the ravines as low as 6,000 feet. In the higher altitudes it mixes with *Pinus flexilis* and *P. aristata*, rarely with *Picea Engelmannii*, in the lower extremes it grows with the latter and *Abies concolor*. As to its geographical distribution, the Douglas fir has about as wide a distribution as any Rocky Mountain coniferous tree, the other widely distributed ones being *Picea Engelmannii* and *Pinus Murrayana*, and is surpassed among the trees only by the aspen. It ranges from Alberta and British Columbia to western Texas, northern Mexico and southern California.

The LODGE-POLE PINE comes next in importance. This is the most common conifer in the Montane Zone of the Northern Rockies, but is not so common nor so important in the Southern. It often grows in pure stands on gentle slopes or flats, but mixes also with other pines as well as with the Engelmann spruce. As the lodge-pole pine germinates more readily than the other conifers, it often takes possession of burnt-over areas, just as the aspen does. The young trees usually spring up close together and form almost impenetrable thickets. Standing so close together the trees grow very slowly in size and large trees are rare.

In open places they rarely reach a height of 50 feet and a trunk diameter of 2 feet or a little more. In Colorado the species grows at an altitude of 8,000 to 10,500 feet, sometimes descending below 8,000 feet and rarely reaching an altitude of 11,000 feet. Its range extends farther north than that of the *Pseudotsuga*, viz., up to Alaska, but not so far south.

The LIMBER PINE or white pine of Colorado, *Pinus flexilis*, is rather local, never plentiful, and as a rule mixed with other trees, mostly with *Pinus scopulorum* and *Pseudotsuga mucronata* at lower altitudes and with *Pinus aristata* at higher ones. It ranges from an altitude of 7,500 feet nearly up to timberline. It is therefore a tree common to the Subalpine and the Montane Zones. In general appearance it is intermediate between the foxtail pine and the bull pine and is often mistaken for either. It ranges from Alberta to western Texas and southern California.

The red cedar, *Sabina scopulorum*, belongs rather to the Foothill Zone, but ascends often to an altitude of 9,000 feet and grows associated with the bull pine.

The composition of the *mesophytic forest* of the northern slopes consists of the following trees:

The principal tree here, as in the Subalpine Zone, is the ENGELMANN SPRUCE, which has been discussed already.

The subalpine fir is found mostly in the transition region between 9,500 and 10,000 feet, rarely as low as 9,000 feet altitude.

The BALSAM FIR or Colorado white fir, *Abies concolor*, takes its place at lower altitudes, viz., between 8,000 and 9,000 feet. It is a tall symmetrical tree with short horizontal branches, sometimes reaching a height of 250 feet. Its geographical distribution extends over the Southern Rockies, Sierra Nevada and other mountains of California, north to the Siskiyou Mountains of Oregon, but it is not found in the Northern Rockies.

The Douglas fir and the lodge-pole pine are also mixed occasionally with the Engelmann spruce.

Along the water-courses the composition of the forest is as follows:

The COLORADO BLUE SPRUCE, *Picea Parryana*, is growing along the water courses in the region mostly occupied by the bull pine and Douglas fir. It is therefore often found on the southern slopes. It needs a good deal of moisture, but at the same time prefers an open forest, and stands less shade than the Engelmann spruce. This explains perhaps why it succeeds better as a planted tree in the Eastern States than any other western species. It ranges in altitudes from 6,500–9,000 feet or sometimes 10,000 feet, but descends into the foothills only in the valleys. It grows to the height of 90 feet and a trunk diameter of 2½ feet, or becomes rarely 100 feet high and 4 feet thick. It is limited to the Southern Rockies, and has been collected, as far as I know, only at one locality in what I regard as belonging to the Northern Rockies, viz., the Teton Mountains of western Wyoming.

The NARROW-LEAVED COTTONWOOD, *Populus angustifolia*, grows along the streams throughout the foothills as well as the Montane Zone, in other words at an altitude between 5,000 to 10,000 feet, or rarely as high as 10,500 feet. It becomes sometimes 50 feet high with a trunk nearly 2 feet in diameter, but this size is extremely rare. Individuals with somewhat broader leaves are sometimes mistaken for the balsam poplar, *P. balsamifera*. *Populus angustifolia* is distributed from North Dakota and Washington to New Mexico and California. The BALSAM POPLAR, *Populus balsamifera*, is rare in Colorado and belongs to the northern Rockies. It has about the same altitudinal distribution as the preceding and attains the same size or a little larger.

The WESTERN BLACK BIRCH, *Betula fontinalis*, and the ROCKY MOUNTAIN ALDER, *Alnus tenuifolia*, grow in similar situations, but never become trees of any large size. They are found throughout the Rocky Mountain region, in Colorado growing at an altitude between 5,500 and 9,000 feet, the latter sometimes reaching 10,000 feet.

Several species of willows are also found but most of these are mere shrubs.

The hawthorns (several species of *Crataegus*) and chokecherry, *Prunus melanocarpa*, enter the lower valleys but belong really to the foothills or Great Plains.

MONTANE ZONE OF THE NORTHERN ROCKIES

The Montane Zone of the Rockies in northern Montana contains more species than in Colorado, especially on the western side of the continental divide. On the eastern side the species are somewhat the same, but the proportion is different.

Eastern slope

The most common tree is the lodge-pole pine, growing on the dryer ridges from 5,000 to 8,000 feet altitude. It grows often in pure stands or mixed with Douglas fir and limber pine.

The Rocky Mountain bull pine, *Pinus scopulorum*, if found at all, is limited to the foothills or the mountain sides bordering thereon.

In the valleys with northeastern or northern exposure, the Engelmann spruce often is mixed with red fir and the ALBERTA SPRUCE, *Picea albertiana*. The latter is not generally distinguished from *Picea Engelmannii* or else mistaken for the eastern white spruce, *Picea canadensis*, which is not found in Montana, and further south for the blue spruce, *P. Parryana*. It much resembles the Engelmann spruce, but the twigs are glabrous and the cone-scales more rounded. The Engelmann spruce runs down as low as 6,000 feet altitude.

The deciduous trees are found mostly along the water courses. The most important are *Populus balsamifera* and *P. angustifolia*, *Betula papyrifera* and *Betula fontinalis*, *Alnus tenuifolia* and a few willows.

Western slope

The southern exposure is, as in the Southern Rockies, more xerophytic and this is mostly occupied by the lodge pole pine and the Douglas fir, ranging at an altitude between 3,000 or 4,000 to 7,000 or 8,000 feet. Below 4,000 feet the forest consists mostly of the WESTERN YELLOW PINE, *Pinus ponderosa*. This is closely related to *P. scopulorum* but has longer leaves and cones. Many regard the latter as a variety of the former. *P. ponderosa* is practically limited to the Pacific slope and has been reported from very few localities east of the divide. Contrary to its southeastern relative, it is found on rich soil. It belongs to the Arid Transition Zone of Washington and enters the Montane Zone only at its upper limit. It is a tree often over 200 feet high and with a trunk 5–8 feet in diameter.

On the northern exposures and in the canyons, the Engelmann spruce and the Subalpine fir in the upper part are common; but at an altitude of 5,000 or 6,000 feet, are met with the western tamarack or larch, silver fir, western hemlock, white cedar and western white pine.

The WESTERN TAMARACK, or LARCH, *Larix occidentalis*, grows at an altitude of from 3,000 to 6,000 feet or rarely 7,000 feet, and always close to the water courses. It is a tree 60–150 feet high and 2–4 feet in diameter. Further west it sometimes attains a height of 250 feet and 6–8 feet in diameter. It ranges from British Columbia to western Montana and Oregon, east of the Cascades. No station east of the divide has been recorded, as far as the writer knows.

The SILVER FIR, *Abies grandis*, grows up to an altitude of 6,000 feet, rarely 7,000 feet. Near the Pacific coast it attains a height of 250–300 feet and a diameter of 4 feet, but in the mountains it seldom becomes more than 100 feet high and 2 feet thick. Its distribution is from Vancouver Island to western Montana, Idaho and northern California. It hardly crosses the Continental Divide in northern Montana, but has been reported from the Yellowstone National Park.

The WESTERN HEMLOCK, *Tsuga heterophylla*, grows up to an altitude of 6,000 feet. On the coast it becomes a tree 200 feet high. It is distributed from British Columbia and western Montana to central California. It, as well as the next, barely crosses the Continental Divide north of St. Mary's Lake.

The WHITE CEDAR, or western arbor-vitae, *Thuya plicata*, grows also up to about 6,000 feet. It is a tree sometimes 200 feet high and with buttresses 15 feet in diameter, but in Montana it is much smaller. Its distribution extends from Alaska to western Montana and northern California.

The MOUNTAIN WHITE PINE, *Pinus monticola*, extends to about the same altitude in Montana, but much higher in California. It is generally a tree 100 feet high and 4–5 feet in diameter, rarely larger. It grows mostly on bottom-lands and along streams. Its distribution is from British Columbia and northwestern Montana to Kern County, California. It is not found east of the divide in northern Montana, but has been reported in southern Montana from the valleys of Davis and Slough Creeks north of the Yellowstone National Park.

The deciduous trees belonging to this zone grow all along the water courses. They are: the cottonwoods, *Populus trichocarpa*, the tallest deciduous trees of America, *P. hastata*, *P. Besseyana*, *P. balsamifera*, *P. angustifolia* (rare on the west side), and *P. tremuloides* (the three first are seldom found east of the divide); further, such willows as *Salix Lyallii*, *S. sessilifolia*, *S. Mackenzieana*, *S. Scouleriana*, and several others, scarcely becoming trees; the birches, *Betula papyrifera*, *B. fontinalis*, *B. Piperi*, *B. subcordata*, and *B. occidentalis;* alders, *Alnus tenuifolia;* several species of *Crataegus* and *Amelanchier*, etc.

The Montane Zone in the Canadian Rockies is practically the same, but both its upper and lower limits are found gradually lower and lower down the mountains the further north one goes.

In the Bitter Root Mountains, it resembles much that of the western slope of the Rockies. To the conifers are added the PACIFIC YEW, *Taxus brevifolia*, which often becomes only an insignificant shrub. The extent of the Zone is between 4,000 and 5,800 feet altitude and the most important trees here on the northern exposures are the mountain white pine, *Pinus monticola*, which, however, extends in the valleys as far down as 2,000 feet altitude, and *Larix occidentalis*. On the southern exposures, *P. ponderosa* and *Pseudotsuga mucronata* are predominant.

In the Yellowstone National Park and mountains north thereof, about half of the coniferous flora consists of the lodge-pole pine. Otherwise the conditions are the same as on the eastern slope in northern Montana, that is with a small amount of *Picea Engelmannii* and *P. albertiana* on the northern exposures; *Pinus flexilis* and *P. ponderosa* on the southern exposures, but the latter two only near the lower limit; some *Pseudotsuga* on both, and aspen and cottonwood along the water courses. On the level plateaus of the Yellowstone National Park the forest consists of pure stand of *Pinus Murrayana*. A small number of *Pinus monticola* has been found on Davis Creek and Slough Creek in southern Montana and *Abies grandis* has been reported from Yellowstone Park.

In the Big Horn Mountains the coniferous forest is represented by but four species: *Pinus Murrayana*, *P. flexilis*, *Picea Engelmannii* and *Pseudotsuga mucronata*, of which the first makes up perhaps ninety per cent. of all.

The forest in the Black Hills consists mostly of bull pine, *Pinus scopulorum*. On the northern exposure of Harney Peak and the northern end of the limestone district above an altitude of 4,500 feet, there is some spruce, but it is not *Picea Engelmannii* but a form of the white spruce, *Picea canadensis*, with unusually short cones. This attains a height of about 100 feet and a diameter of nearly three feet. *Betula papyrifera*, *B. fontinalis*, *Populus angustifolia* and *P. tremuloides* are present. In the Foothill Zone are added *Quercus macrocarpa*, *Negundo interius*, *Populus Sargentii*, *P. acuminata*, *Ulmus americana*, *Ostrya virginiana*, and *Sabina scopulorum*. From this can be seen that the Black Hills do not represent a typical part of the Northern Rockies, as their forest flora contains fully as many species belonging to the eastern United States.

NEW YORK BOTANICAL GARDEN

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MOSSES OF BERMUDA

ELIZABETH GERTRUDE BRITTON

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Mosses of Bermuda

ELIZABETH G. BRITTON

(WITH PLATES 6 AND 7)

There has been no list of the mosses of Bermuda published since 1885,* when William Mitten studied the collections made by the Challenger Expedition and enumerated five genera and eight species, of which two were described as new. One of these, *Trichostomum bermudanum* Mitt., has proved to be endemic and two others, *Tortula melanocarpa* Mitt. and *Isopterygium tenerum* Mitt., have been referred to older names. No localities were recorded.

A taxonomic study of the flora of Bermuda was undertaken by the New York Botanical Garden in 1905† in cooperation with the Academy of Natural Sciences of Philadelphia, and several visits have been made by Mr. Stewardson Brown and Dr. and Mrs. N. L. Britton at various times of the year in pursuit of this investigation. These have yielded twenty genera and twenty-eight species of mosses and added another endemic species, *Campylopus bermudianus*. It will thus be seen that the island is not rich in mosses and the most widely distributed species is *Trichostomum bermudanum* which occurs rather commonly on stone walls and limestone rocks, particularly in shady moist places. A few of the rarer species are likely to become extinct with the clearing, burning and cultivation of the marshes, notably the species of *Sphagnum*, *Campylopus*, *Syrrhopodon* and *Isopterygium;* a few others are only to be found in a few deep dark crevices and caves in the parish of Hamilton. Besides the two endemic species, there are eight cosmopolitan ones belonging to the five genera *Bryum*, *Eucladium*, *Funaria*, *Hymenostylium*, and

* Voyage of H. M. S. Challenger, pp. 89–92. 1885.

† Bermuda in September, Jour. N. Y. Bot Gard. 6: 153–158. 1905; Botanical Exploration in Bermuda, Jour. N. Y. Bot. Gard. 13: 189–194. 1912; Gardens of Bermuda, Jour. N. Y. Bot. Gard. 14: 172. 1913; Jour. N. Y. Bot. Gard. 15: 148. 1914.

Weisia; six having a wide range in temperate North America, Europe and Asia, belonging to the genera *Amblystegium*, *Anomodon*, *Isopterygium*, *Leucobryum*, and *Sphagnum;* and ten species of subtropical or tropical distribution: most of these are not known to occur except in America and represent the eight genera *Cyclodictyon*, *Fissidens*, *Gyroweisia*, *Rhacopilum*, *Sematophyllum*, *Syrrhopodon*, *Thuidium*, and *Tortula*.

Dr. Evans has listed* twenty genera and twenty-two species of the Hepaticae and has since reported two species of *Anthoceros*,† thus bringing the total number of bryophytes to forty-one genera and fifty-two species, the number being almost equally divided between hepatics and mosses. None of the Hepaticae are endemic.

In the following enumeration, unless otherwise stated, the specimens cited by number were collected by Mr. Stewardson Brown or Dr. and Mrs. N. L. Britton; a few were collected by Dr. M. A. Howe in July, 1900.

1. SPHAGNUM MAGELLANICUM Brid.

Sphagnum medium Limpr. Not *Sphagnum cymbifolium* Ehrh. as listed by the Challenger Expedition.

Devonshire Marsh, *M. A. Howe.*

2. SPHAGNUM CUSPIDATUM SERRATUM Schliep.

Sphagnum trinitense C. Müll.

Devonshire Marsh, *M. A. Howe;* Pembroke Marsh, *340*, *417*.

3. CAMPYLOPUS BERMUDIANUS R. S. Williams.

On damp ground in shade of palmetto, Paget Marsh, *651*, *1138*, *1872*.

4. LEUCOBRYUM GLAUCUM (L.) Schimp.

Devonshire Marsh, *M. A. Howe 376;* Paget Marsh, on the ground under shade of palmetto, *1860*.

5. FISSIDENS GARBERI Lesq. & James.

On rocks near Harrington House, *548a;* gully, Abbot's Cliff, *893*, *951*, *1859*.

* Bull. Torrey Club 33: 129–135. *pl. 6.* 1906.

† Brylogist 13: 36. 1910; 16: 55. 1913.

6. FISSIDENS MINUTULUS Sull.

Calcareous rocks, gully near Tuckerstown, *322;* on stones in shade, Church Cave; also on Abbot's Cliff, mixed with *893* and *951*.

7. FISSIDENS TAXIFOLIUS (L.) Hedw.

On the ground in woods near Walsingham Caves, *M. A. Howe*, also *284*.

8. SYRRHOPODON FLORIDANUS Sull. (PLATE 6.)

On base of palmetto in dense mats, sterile; propagating by gemmae from the tips of the leaves. Devonshire Marsh, *M.A. Howe;* Paget Marsh *233*, *655*, *656*, *1856*.

9. WEISIA VIRIDULA (L.) Hedw.

Castle Harbor, Walsingham, *430a*.

10. WEISIA LONGISETA Lesq. & James.

Near Harrington House, *432;* on rocks, Walsingham, *485;* near Tuckerstown, *501*.

11. GYROWEISIA BARBULA (Schwaegr.) Par.

Tortula melanocarpa Mitt. (Challenger Report.)

On rocks near Tuckerstown, *502;* roadside rocks near Paynter's Vale, *517;* also near Harrington House, *549*.

12. EUCLADIUM VERTICILLATUM (L.) Br. & Sch.

Tortula verticillata Mitt. (Challenger Report.)

Wet limestone rocks, Smuggler's Cave, *M. A. Howe;* Church Cave, *271;* walls of Cooper's Hole, Paynter's Vale.

13. HYMENOSTYLIUM CURVIROSTRE (Ehrh.) Lindb.

Under dripping limestone rocks forming calcareous tufa, Church Cave; Walsingham Cave, *1193*.

14. TRICHOSTOMUM BERMUDANUM Mitt.

"In extensive patches on calcareous sand" without locality, Challenger Expedition; on stone wall, Hamilton, *M. A. Howe;* rocks, north shore, *62;* Devonshire Marsh, *97;* rocks and stone walls near Harrington House, *442a*, *833;* Paget Sand Hills, *620;* on the ground, Paynter's Vale, *805*, *808;* Hall's Island, Harrington Sound, *894;* Abbot's Cliff, *926;* St. David's Island, *1064*, *2082;* Montrose, *2214*.

15. TORTULA AGRARIA (Sw.) Sw.

On calcareous rocks near Paynter's Vale, *466;* also near Harrington House, *548.*

16. FUNARIA HYGROMETRICA (L.) Sibth.

On rocks near Harrington House, *551.*

17. FUNARIA FLAVICANS Michx.

Without definite station, *Mrs. W. E. Damon,* 1888.

18. BRYUM DICHOTOMUM Hedw.

Without definite station, Challenger Expedition.

19. BRYUM CAPILLARE L.

Fruiting plants were collected on rocks near Paynter's Vale, *465;* sterile specimens, propagating by gemmae, were found in Paget Marsh, *227;* gully in Abbot's Cliff, *928;* on the side of a cistern, the Flats, *A. B. Hervey,* 1913.

20. BRYUM CRUEGERI Hampe.

Sterile specimens, on stones, Devonshire Marsh, *160.*

21. CYCLODICTYON VARIANS (Sull.) Broth.

On damp rocks in shade, Walsingham Cave, *283;* Church Cave, *801, 1089.*

22. RHACOPILUM TOMENTOSUM (Sw.) Brid. (PLATE 7.)

Without definite station, Challenger Expedition; shaded rocks, fruiting, gully and cave, Paynter's Vale, *326;* Church Cave, *503, 507, 510, 1091;* Gully near Tuckerstown, *515;* Abbot's Cliff, *892, 1857.*

23. ANOMODON ROSTRATUS (Hedw.) Schimp.

A lax sterile form of this species has been found on shaded rocks at a cave near Harrington House, *558,* at Paynter's Vale, *806,* and on Abbot's Cliff, *1877.*

24. HAPLOCLADIUM MICROPHYLLUM (Sw.) Broth.

On shaded rocks, Abbot's Cliff, *890, 925, 926;* Church Cave, *1092.*

25. THUIDIUM MINUTULUM (Hedw.) Br. & Sch.

In gully, Paynter's Vale, *361.*

26. AMBLYSTEGIUM VARIUM (Hedw.) Lindb.

Damp rocks, Church Cave, fruiting, *509*, *804*, *1093;* shaded rocks, Paynter's Vale, *806* in part.

27. ISOPTERYGIUM MICANS (Sw.) Mitt.

Isopterygium tenerum Mitt. (Challenger Report.)

On root-stocks of *Osmunda cinnamomea*, and on old stumps, Devonshire Marsh, *44*, *568*, *809*, *812;* at base of palmetto, Paget Marsh, *647*, *1855;* Pembroke Marsh, *626;* Warwick Marsh, *623*.

28. SEMATOPHYLLUM ADNATUM (Michx.) E. G. Britton.

On cedar tree, Walsingham Cave, *282;* on rotten wood, near cave, Paynter's Vale, *1117*.

Explanation of plates 6, 7

PLATE 6. SYRRHOPODON FLORIDANUS Sull.

Drawings made with a magnification twice the diameter reproduced on the plate.

FIG. 1. Plant, natural size.

FIG. 2. Plant enlarged.

FIG. 3. Cross section of stem, ×120.

FIGS. 4–7. Leaves, ×18½.

FIG. 8. A portion of base of leaf showing curve, ×87½.

FIG. 9. Apex of leaf showing end of costa, ×120.

FIG. 10. The large hyaline cells of basilar portion of leaf, ×500.

FIG. 11. Cells of the basilar and median portions of leaf taken from the upper edge of the hyaline group, represented in Figs. 4, 5, and 7, by dotted lines, ×500.

FIG. 12. Marginal cells, ×500.

FIGS. 13, 14. Median cells, ×500.

FIG. 15. Portion of ventral surface of leaf from costa to margin, ×210.

FIG. 16. Su.face view of double margin from median portion of leaf, ×120.

FIGS. 17, 18, 19. Cross sections of double margin, 17, 18, ×270; 19 ×210.

FIG. 20. Surface view of lower portion of costa, ×120.

FIG. 21. Surface view of upper portion of costa showing papillae, ×120.

FIG. 22. Cross section of lower portion of leaf, ×120.

FIG. 23. Portion of same with higher magnification, ×210.

FIG. 24. Cross section of upper portion of leaf, ×210.

FIGS. 25, 26. Cross sections of costa showing papillae on costa and the cells of the upper portion of leaf, ×210.

FIG. 27. Apex of leaf with gemmae and filaments arising from both the dorsal and ventral surface of costa tip, ×87½.

FIG. 28. Filaments arising from cells of the costa in median portion, ×120.

FIG. 29. Filament arising from a cell of the basilar portion of costa, ×87½.

FIG. 30. Filaments arising from median cells near double margin, ×87½.

FIG. 31. Gemma arising from a median cell, ×87½.

FIGS. 32–34. Gemmae, ×87½.

PLATE 7. RHACOPILUM TOMENTOSUM (Sw.) Brid.

The figures were drawn with a magnification three times greater than that indicated and the resulting figures were reduced to one third.

FIG. 1. Plant, natural size.
FIG. 2. Branch showing arrangement of large and small leaves, $\times 6\frac{2}{3}$.
FIG. 3. Large leaf, $\times 12\frac{1}{3}$.
FIG. 4. Small leaf, $\times 12\frac{1}{3}$.
FIG. 5. Apex of large leaf showing excurrent costa, $\times 80$.
FIG. 6. Basal cells of large leaf, $\times 80$.
FIG. 7. Median cells of large leaf, $\times 195$.
FIG. 8. Surface view showing papillae, $\times 333\frac{1}{3}$.
FIG. 9. Cross section of leaf, $\times 138\frac{1}{3}$.
FIG. 10. Cross section of stem, $\times 80$.
FIG. 11. Perichaetial bud, $\times 19\frac{2}{3}$.
FIG. 12. Capsule, $\times 4\frac{2}{3}$.
FIG. 13. Portion of capsule with lid and calyptra, $\times 10$.
FIG. 14. Peristome, $\times 80$.
FIG. 15. Annulus, $\times 80$.
FIG. 16. Spores, $\times 80$.

SYRRHOPODON FLORIDANUS SULL.

RHACOPILUM TOMENTOSUM (Sw.) BRID.

CONTRIBUTIONS FROM THE NEW YORK
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NOTES ON ROSACEAE—IX

P. A. RYDBERG

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Notes on Rosaceae — IX

P. A. RYDBERG

DALIBARDA

Dr. Focke includes this genus in *Rubus*, making it a subgenus under the same. In this subgenus, he includes *R. lasiococcus*, *R. Fockeanus*, *R. pedatus* and *R. Gunnianus*. None of these species are related to *Dalibarda repens* L. The latter differs from all species which have been included in *Rubus*, by the practically dry fruit, the essentially monoecious flowers, of which the pistillate ones are apetalous. Dr. Focke describes the flowers as being "both perfect sterile and cleistogamous fruiting." The essentially staminate petaliferous flowers have only rudimentary pistils. The basal apetalous flowers, I think, hardly could be called cleistogamous, as I have found no polleniferous anthers, and think that they are pollinated from the staminate petaliferous flowers. This is something which needs further investigation.

RUBACER

Dr. Greene* restored the generic name *Bossekia* Necker for this genus. It is true that *Rubus odoratus* L. was probably a part of Necker's genus, but *Bossekia* was not properly published under the American Code. The paragraph concerning the publication of generic names reads as follows:

"Canon 10. A generic or subgeneric name is published when it has been printed and distributed: (1) with a generic or specific description (or in paleobotany, a figure) and a binomial specific name; (2) with a generic and specific name and the citation of a previously published description; (3) with a reference to a specific description, which is associable by citation with a previously published binomial species."

As Necker's Elementa does not contain any specific names, *Bossekia* could not have been published under proviso No. 1 or No. 2. It remains to see if it was published under No. 3. Necker

* Leaflets 1: 210 and 230. 1906.

refers to it some simple-leaved species of *Rubus* of Linnaeus, but he does not refer to any special work of Linnaeus. Dr. Greene claims that it was to Species Plantarum, but this is very unlikely. Wherever Necker refers to any work of "Linnaeus," the reference is to the 14th edition of the Systema, which was published six years before Necker's Elementa. This was not a work of Linnaeus, but of Murray. There is in Necker's Elementa under *Bossekia* no "reference to a specific description, which is *associable by citation* with a previously published binomial species." Hence *Bossekia* is not properly published according to the American Code.

Dr. Greene in defending *Bossekia* and attacking *Rubacer* published four pages of sarcastic criticism. Immediately I wrote an article quite as sarcastic in answer, but decided that it was not worth while to publish it, as Dr. Greene's article was an example of either insincerity or hasty carelessness. As example may only be given, Dr. Greene in two places claimed that *Rubacer* meant red maple. A linguist like Dr. Greene knows that the final *r* in *ruber*, red, is a part of the stem of the word and if red maple was meant the word should have been *Rubracer* and not *Rubacer*. Neither did I intend with the name *Rubacer* maple-leaved raspberry, but raspberry maple, which is just as good.

Dr. Greene devotes almost a page to *Rubus moluccanus*, with eight mostly silly questions.* There is no need to answer them in full. Anyone who has access to Rumphius can see from the figure that his *Rubus moluccanus* and his *Rubus moluccanus parvifolius* are not drawn from stages of the same species. Neither were the names given by Rumphius intended to be specific and varietal names as we now apply them. *Rubus parvifolius* L., based on the latter, is not a blackberry but a raspberry related to *R. rosaeflorus*. See Focke.† *Rubus moluccanus*, on the contrary, is a species of the maple-leaved blackberries of Asia of the subgenus *Malacobatus*. Rumphius's figure of *R. moluccanus* shows the plant in fruit. It does not, therefore, represent a seedling state of *R. parvifolius*. Did Dr. Greene investigate these facts before he asked his questions?

Rubus parviflorus Nutt., the earliest name for *Rubacer parvi-*

* See Leaflets 1: 233. 1906.

† Bibl. Bot. 17^{72}: 150. 1911.

florus (Nutt.) Rydb., was a misnomer, for the species has one of the largest flowers found in the whole tribe. Nuttall's specimens from Lake Huron must have had unusually small flowers, and probably Nuttall compared it with *R. odoratus* L., its nearest relative, but the specific name *parviflorus* was under all circumstances an unhappy selection. *Rubus nutkanus* Moc. is the name which has usually been applied to this species. It may, however, belong to *Rubacer tomentosus*, which is perhaps more common on the Nootka Sound. There is little to say about the other synonyms given under this species, except *Rubus Roezli* Regel, which does not belong here but to *Oreobatus deliciosus*, as the figure in Gartenflora shows.

Heller took up the name *Rubacer velutinus* for *R. tomentosus* Rydb., which he based on *R. velutinus* Hook., an untenable name, being preoccupied by *R. velutinus* Vest.

OREOBATUS

This name was not based on the subgeneric name *Orobatus* Focke (meaning the same, but not properly formed) as I had overlooked the same, but this fact does not invalidate it as a generic name.

Dr. Otto Kuntze reduces the whole genus to varieties of *Rubus odoratus* L. It shows how superficial he was, paying in this case attention only to leaf-forms and not to the structure of the flower and fruit. Professor A. Nelson fell into the same error, but in less degree, when he made *Oreobatus deliciosus* a species of *Bossekia*. There are only two alternatives in this case. Either *Oreobatus* and *Rubacer* (*Bossekia*) must be regarded as distinct genera or else both retained in *Rubus*.

Oreobatus neomexicanus (A. Gray) Rydb. (*Rubus neomexicanus* A. Gray) has often been regarded as a variety or even as a synonym of *O. deliciosus*. I think, however, that it is well distinct.

Oreobatus rubicundus was lately described by Wooton and Standley. It is closely related to *O. neomexicanus*, but has smaller leaves, flowers and fruit, and nearly glabrous leaves. The pubescence on the petioles is appressed. I have seen no specimens of this except those cited in the original publication.

Oreobatus trilobus (Seringe) Rydb. is a fourth species of the genus. The variety *Rubus trilobus guatemalensis* Focke is of little value. The characters given are not distinctive. The shorter terminal lobe of the leaves is only occasional and found only rarely even in specimens from Guatemala, and the color of the petals, as far as I have been able to find, is always purple.

CHIAPAS: *Ghiesbreght, 97, 509.*

OAXACA: Sierra Filipe, *Pringle 4670; Liebmann; E. W. Nelson 1172;* 18 miles southwest of the city of Oaxaca, *Nelson 1413.*

VERA CRUZ: Orizaba, *Seaton 252.*

PUEBLA: Boca del Monte, *Purpus 2453.*

GUATEMALA: Volcan d'Agua, *Maxon & Hay 3676, 3744; Pittier 32; Shannon 3631.*

RUBUS

LIMITATION OF THE GENUS AND SYNONYMS

The only two botanists who have tried to divide *Rubus* into several genera are Rafinesque and Greene. Some of the proposed genera are habitually fairly distinct, but there are no essential differentiations in the flower and fruit, on which generic lines could be based. Some of the Asiatic and South American species may represent distinct genera, but, as far as the North American (and also European) species are concerned, there is none that in my mind is different enough from the general type to make its separation as a genus warranted, except those removed to *Dalibarda*, *Rubacer*, and *Oreobatus*.

Cylactis was the first genus proposed by Rafinesque. Its type was *Cylactis lyncimontana* or *C. montana* Raf., which is the same as *Rubus pubescens* Raf., *R. triflorus* Richards, and *R. americanus* (Pers.) Britton. This is a raspberry as far as the flowers (except the filament) are concerned. The fruit approaches the raspberries in color and flavor, but does not separate as a cap or thimble. It is a dewberry as to the habit, but the receptacle is not fleshy. It differs from both dewberries and raspberries in the wholly unarmed plant, the broad and almost free stipules, and the dilated filaments, three-toothed at the apex, the longer middle tooth bearing the anther. The lack of armature (prickles or bristles) is no generic character, for both the closely related

R. saxatilis and *R. transmontanus* are more or less bristly. Neither is the width of the stipules. The structure of the filaments separates the species of the *R. arcticus* and *R. saxatilis* groups from all other American species of *Rubus*, but in *R. saxatilis* and *R. transmontanus* this character is less marked. The latter connects the group with the raspberries, the former with the dewberries of Europe.

Dyctisperma, *Cumbata*, and *Ametron* of Rafinesque were based on Asiatic species usually regarded as blackberries and naturally will not be discussed here.

Ampomele Raf. was based on an Asiatic raspberry.

Selnorition Raf. was based on American and European dewberries including also *R. saxatilis*. It has no generic value.

Manteia Raf. was based on *Rubus stellatus*, a species which is, notwithstanding its merely lobed leaves, so closely related to *R. acaulis* with three-foliolate leaves that many botanists regard them as belonging to the same species. The structure of the fruit and the flowers is identical. The latter apparently grades into *R. arcticus*, which on the other hand connects with *R. pubescens*. These species are also connected by hybrids. *Manteia* could not be regarded as a distinct genus from *Cylactis*.

Batidaea (Dumort.) Greene was based on the red raspberries with *R. idaeus* as the type. If we had no other species of *Rubus* than the raspberries and the blackberries, I would be willing to accept this genus. As stated above, *R. pubescens* combines characters of the raspberries and dewberries (= decumbent blackberries), but there are Mexican species of *Rubus*, as for instance *R. scandens* and *R. fagifolius*, which are blackberries in every respect except the fruit. The receptacle is practically dry and the drupelets fall off separately. So they do also in a West Indian blackberry, *R. jamaicensis*. In some Asiatic species, usually regarded as raspberries, the fruit does not "come off as a thimble." *Rubus ellipticus* is so like a Mexican group of blackberries in both habit and flowers that anyone not knowing its raspberry fruit would place it in that group and next to *R. adenotrichos*.

It is, therefore, impossible to draw a line between blackberries and raspberries, which also hybridize not seldom in Europe.

As far as I can interpret the American Code, the type of

Rubus with Linnaeus should be *R. idaeus*, and if I had separated the raspberries and blackberries generically, I would have adopted *Rubus* as the generic name of the former. Dr. Greene does not accept the Linnaeus Species Plantarum as the starting point of botanical nomenclature, and on that ground probably had valid reasons for a different interpretation. The validity of the proposed species of *Batidaea* I shall discuss later.

Melanobatus Greene has no foundation as a genus separate from *Batidaea*. The only characters given by Greene distinguishing the two genera are the pulp of the fruit and the reticulation of the pyrenes. The former is said to be soft, very juicy and perishable in *Batidaea* and scanty, firm rather than watery, in *Melanobatus*. *Rubus idaeus aculeatissimus* of Siberia according to Focke has almost dry fruit. Regarding the keel on the back of the putamen, it is not very prominent in *R. leucodermis* and not found at all in *R. Pringlei* Rydb. (*R. occidentalis grandiflorus* Focke). The leaves are said to be "pinnately (rarely pedately) 3–5-foliate." As far as I know, whenever the leaflets are more than three in the black raspberries, the leaves are pedately compound with the terminal leaflet long-petioluled. Someone may ask the question if this also applies to *Melanobatus neglectus* (Peck) Greene and *Melanobatus michiganus* Greene. No, not always, but these I understand as forms of *R. occidentalis* × *strigosus*,* and the occasional pinnately five-foliolate leaves are an inheritance from the other parent, *R. strigosus*.

Paramena Greene has *R. spectabilis* Pursh for the type. This can not be separated generically from the other raspberries. It is closely related to *R. rosaefolius*, although this relationship has not been pointed out so far as I know. There are all kinds of gradations between the *R. rosaefolius* group and the *R. idaeus* group.

Cardiobatus Greene was based on *Rubus nivalis* Dougl. No character of generic value has been pointed out by Dr. Greene. He himself stated: "Technically, a true blackberry" [I do not know if it has a fleshy receptacle, but I doubt it]. The best character to separate it from the dewberries is the broad, almost

* The hybridity of *R. neglectus* is satisfactorily proven, as the hybrid has been produced artificially and does not differ from the wild plant.

free stipules. Greene describes the petals as rose-red, showy. As far as I have been able to find they are white.

Psychrobatia Greene was based on *Rubus pedatus* Smith. This is the best of the genera proposed by Dr. Greene. The pedately compound leaves are a striking character, but known in many blackberries and the black raspberries. The statement made by Dr. Greene, that only two carpels mature, is erroneous, for there are usually more than two, although always few. They are large and as far as I understand substipitate, i. e., tapering at the base, a character not found in any other species; but I have not thought it important enough to give the plant generic rank.

Comarobatia Greene was based on *Rubus lasiococcus* A. Gray. The habit is that of *R. pedatus* and other unarmed species, the leaves like those of *R. stellatus* for which it had been mistaken. The fruit is that of a dewberry, although the drupelets are few and pubescent; but pubescent fruit we find in the raspberries, in *Rubus ursinus* and some of its relatives, and in many Mexican species of blackberries.

Greene also restores the pre-Linnaean genus *Chamaemorus* Clusius. At first glance this seems a fairly good genus, but the habit is that of the *R. arcticus* group, especially *R. stellatus*, which also has simple leaves. *Rubus Chamaemorus* is a dioecious plant. All the species of the *R. arcticus* group have a tendency to be polygamo-dioecious. In the structure of the fruit and the stipules, there is little difference. In the broad spreading petals and not dilated filaments it differs, however, but in this respect it agrees with most blackberries.

Greene admits two species, *Chamaemorus anglica* and *C. norwegica*, both credited to Clusius; but Clusius did not have these names in the form given. The first is found only in the margin opposite a fictitious illustration under the name *C. anglicana*, and the latter is spelled in the heading *Chamaemorus norwagica* and in the margin as *C. Norvvagica*. Such a way of citation is careless; but Dr. Greene may claim that he intended an improvement of form and spelling, as *anglica* is a better and more common form than *anglicana* and an *e* in the second syllable of *norwegica* is better than an *a*. But why not make the improvement complete and spell the latter with a *v* instead of a *w*, as the latter character was unknown to Latin?

None of these genera I regard as distinct enough from *Rubus* proper to retain their generic rank.

GROUPS AND SPECIES OF RUBUS

CHAMAEMORI

This contains only one species, *R. Chamaemorus* L. The figure of *Chamaemorus anglicana* in Clusius' Historia is fictitious. No such plant is found in England. See further notes above under *Chamaemorus.*

LASIOCOCCI

As far as I know this group is also monotypic, the species being *R. lasiococcus* A. Gray. It is the same as the genus *Comarobatia* Greene [see above], and a part of Focke's subgenus *Dalibarda.*

PEDATI

This contains only one species, *R. pedatus*, unless *R. Fockeanus* and *R. Gunnianus* of China and Tasmania might be referred here. It is also a part of Focke's subgenus *Dalibarda* and the genus *Psychrobatia* Greene.

ARCTICI

This consists of *R. stellatus*, *R. acaulis*, and *R. arcticus*. It is the same as the series *Arctici* of Focke's subgenus *Cylactis*, and the genus *Manteia* Raf.

Rubus stellatus Smith. Except as to the three-lobed instead of three-foliolate leaves there is little difference between this species and *R. acaulis.* If the latter should be united with *R. arcticus*, I see no reason why *R. stellatus* should not be included there also.

Rubus acaulis Michx. and *R. arcticus* L. Most of the American material labeled *R. arcticus* L. belongs to *R. acaulis.* It is also the same as *R. pistillatus* Smith. Smith stated that he had seen it and *R. arcticus* cultivated together and that they remained distinct. Seringe also regarded them as distinct. *Rubus acaulis* is found neither in Europe nor in Asia except in the extreme eastern part, and *R. arcticus* is not found on the North American arctic coast or in Alaska. It is in the region where both are found, viz., in Labrador, Quebec, and apparently also the Canadian Rockies, where there is some trouble in distinguishing them, on account of intermediate forms. May these not be hybrids?

SAXATILES

Rubus saxatilis L. No authentic specimens of this have been collected on the North American continent, but on this side of the Atlantic Ocean it is found only in southern Greenland. A sterile branch that may belong here was collected by Bicknell at Piedmont, Quebec.

Rubus pubescens Raf. seems to be the oldest specific name for the species usually known as *R. triflorus* Richardson or *R. americanus* (Pers.) Britton. Rafinesque based his species on *Rubus saxatilis canadensis* Michx. Evidently he did not know the plant, for eight years later he proposed a new genus based on what he supposed to be a new discovery of his. In the same year, 1819, the species was published both as *Cylactis lyncemontana* and *C. montana*. Seringe also thought there were two distinct species. His *R. mucronatus* is the same as *R. pubescens* Raf. and *R. aegopodioides* was based on *Cylactis montana* Raf. Torrey adopted Michaux's varietal name as specific and Britton did the same with that of Persoon, but both *Rubus canadensis* and *R. americanus* had been used previously.

Rubus transmontanus Focke. Focke proposed this name, as he thought, instead of the untenable *R. hesperius* Piper, but his description does not fit the latter at all. *R. hesperius* is a black raspberry, closely related to *R. occidentalis*, but the leaves are without tomentum beneath. The stem is armed with curved prickles as in that species. The plant described by Focke is, from the description, closely related to *R. pubescens*, but the stem is more or less prickly or bristly. The specimen cited below is the only one seen which fits the description. This may be a hybrid between *R. pubescens* and some species of the *R. strigosus* relatives. Focke gives as distribution, eastern Washington and the banks of the Columbia River at Revelstoke, British Columbia. The first part of the range may have been taken from the actual *R. hesperius* Piper, and the specimens which Focke described were probably from Revelstoke.

BRITISH COLUMBIA: near mouth of Dowrie Creek, 1905, *Shaw 1117*.

GLABRATI

This group comprises the subgenera *Chamaebatus* and *Orobatus* of Focke, which I can not separate, the former comprising the more dwarf and simple-leaved species; but many of the *Orobati* have also simple leaves, and *R. pumilis* has sometimes three-foliolate ones. The species mentioned is the type of Greene's genus *Cardiobatus.*

Rubus pumilus Focke must be a very local species. The only specimens I have seen (the type has not been available) are the following:

MEXICO: Ixtaccituatle, 1903, *Purpus 241.*

CHIHUAHUA: Mt. Mohinora, 1898, *Nelson 4863.*

Rubus nivalis Dougl. Mr. J. M. Macoun thought that the descriptions of this species in Hooker's Flora Boreali-Ameircana and in Howell's Flora of Northwestern America did not apply to the same species and substituted the name *R. pacificus* for the latter. I can not see why Howell's description does not apply to *R. nivalis* Dougl. Focke has the same idea of *R. nivalis* Dougl. as myself.

Rubus glabratus H.B.K. This species of wide distribution in the Andes of South America has been reported from Costa Rica (*Pittier 167*); but I have seen no specimens from there, neither had Dr. Focke.

ROSAEFOLII

This group comprises the *Spectabiles, Rosaefolii,* and perhaps some other sections of Focke's subgenus *Idaeobatus.* The *Spectabiles* constitute the Greenean genus *Paramena* as originally constituted, but its author on some subsequent pages extended the genus to include simple-leaved species of the section *Corchorifolii* of Focke.

Rubus spectabilis Pursh. This is usually described as being unarmed. Occasionally, however, it has a few small straight prickles. Prickles are more common in the next species.

Rubus franciscanus Rydb. This has been mistaken for *R. Menziesii* Hook., which, however, is the same as *R. ursinus,* as pointed out by Dr. Focke. This mistake depended perhaps on the suggestion made in Hooker's Flora that the petals were probably red. Watson, therefore, named the present species *R. spectabilis Menziesii* and Greene included it in *Parmena* under the name *P. Menziesii.*

Rubus rosaefolius has been collected growing spontaneously on several of the West Indian islands, such as Guadeloupe, St. Kitts, and Porto Rico.

IDAEI

This group consists of the section *Idaeanthi* of Focke's subgenus *Iaeobatus* and Greene's genera *Melanobatus* and *Batidaea*. Greene admitted seven species of the former and eighteen species of the latter, if *Rubus idaeus*, which he evidently regarded as the type but did not name under *Batidaea*, is counted. It is impossible for me to follow him in the segregation of these species of *Batidaea*. Many of them are based on only occasional or abnormal forms or mere individual variation. Except two of his species of *Batidaea* (viz., *B. arizonica* and *B. Itascica*) and *Rubus idaeus*, they may all be regarded as geographical varieties or subspecies of *R. strigosus*. *Batidaea arizonica* Greene is the best of all the species proposed and, in whatever way the others may be treated, this I think should under all circumstances be regarded as a distinct species. *Batidaea Itascica* Greene was based on one single specimen which I can but refer to the European *Rubus idaeus*, which is escaped in this country. See further remarks under the different species of the group.

Rubus phoenicolasius Maxim. This is in cultivation and has been naturalized in the eastern States. It is distinguished from our native species in the densely red-bristly stem and the small red incurved petals. The following specimens have been seen:

NEW YORK: Spuyten Duyvil, *Rydberg.*

NEW JERSEY: Little Silver, 1890, *Lorett;* Atlantic Highlands, 1906, *Britton & Hollick.*

CONNECTICUT: Fairfield, *Eames 5532.*

DISTRICT OF COLUMBIA: Eckington, 1897, *Irwin.*

PENNSYLVANIA: Lancaster County, 1911, *Carter.*

Rubus ellipticus Smith. This is also in cultivation in warmer parts of North America and has established itself in the West Indies. If it were not for the yellow fruit, which comes off as a thimble, this species would be included in the *Adenotrichi* group of blackberries. To this belongs the following specimen:

JAMAICA: Cinchona, 1905, *Harris 9131.*

Rubus glaucus Benth. This was originally described from Ecuador, but has since been found in Colombia and Costa Rica.

Specimens which I refer here rather than to *R. eriocarpus* have been collected in Mexico. These are not typical and may represent a distinct species, closer, however, to *R. glaucus* than to *R. eriocarpus*.

COSTA RICA: Buena Vista, 1903, *Cook & Doyle 36;* 1874, *O. Kuntze.*

GUATEMALA: Tres Cruces, 1889, *John Donnell Smith 1622.*

Specimens collected near Cuernavaca, State of Morales, Mexico, by Rose and Hough are remarkable, not only for the station at which they were collected, this being much further north than the formerly known range extended, but also for the large size of the leaves, the leaflets of some of the leaves of the stem being up to 15 cm. long, and for the more glandular pedicels.

MORELOS: Cuernavaca, May 27–30, 1899, *Rose & Hough 4410, 4414.*

Rubus eriocarpus Liebm. This as well as the preceding has been determined as *R. occidentalis*, which is not found in any part of Mexico or Central America. All so named belong to one of the three species of *R. glaucus*, *R. eriocarpus*, or *R. Pringlei*. The following specimens belong to *R. eriocarpus:*

VERA CRUZ: Vera Cruz, 1901, *Rose & Hay 6183;* San Miguel del Soldado, 1899, *Pringle 8113;* Jalapa, 1899, *Rose & Hough.*

OAXACA: Chinantla, *Liebman 1692.*

PANAMA: El Boquette, 1911, *Pittier 3135.*

Rubus Pringlei Rydb. This has also been confused with *R. occidentalis.* Focke in 1891 described it as var. *grandiflora*, but twenty years later, having evidently forgotten its first name, redescribed it as var. *mexicana.* It is evidently the same as described in 1839 by Schlechtendal as var. *incisus*, but neither of these varietal names could be used as specific. Therefore, I took the pleasure of naming the species after Mr. C. G. Pringle, who has collected the best specimens of this I have seen.

HIDALGO: Pachuca, 1899, *Rose & Hough 4463;* 1901, *Rose & Hay 5553.*

OAXACA: Sierra de San Felipe, *Pringle 4686;* Salazar, 1903, *Rose & Painter 7008.*

MEXICO: between Toluca and Mexico City, June 28, 1910, *Rusby 317.*

Rubus occidentalis L. This is confined to the United States and Canada, east of the Rocky Mountains. Specimens from the west which have been referred to *R. occidentalis* belong to *R. leucodermis* Dougl., *R. glaucifolius* Kellogg, or *R. bernardinus* (Greene) Rydb. This was made the type of the genus *Melanobatus* Greene.

Rubus leucodermis Dougl. *Melanobatus leucodermis* Greene. This takes the place of *R. occidentalis* west of the Rockies from British Columbia and Montana to Utah and central California. In southern California its place is taken by *R. bernardinus*.

Rubus glaucifolius Kellogg. Kellogg's specific name was adopted by Dr. Greene under *Melanobatus*, but the only specimens seen labeled *M. glaucifolius* in Greene's handwriting are in his private herbarium and were collected by himself at Eureka, Siskiyou County. These specimens belong to *R. leucodermis*. *R. occidentalis* and *R. leucodermis* are never glandular, while *R. glaucifolius* and *R. bernardinus* are so in the inflorescence. The following specimens belong here.

California: Mt. Sanedrin, Lake County, 1902, *Heller 6040;* Emigrant Gap, 1882, *M. E. Jones, 3309;* Forest Ranch 1896, *Mrs. Austin 113;* Mt. Pleasant, Spanish Peak Range, 1909, *Leiberg 5161.*

Oregon: Rabbit Ears, south slope of Umpagre Divide, *Applegate 2643.*

Rubus bernardinus (Greene) Rydb., *Melanobatus bernardinus* Greene. This is closely related to *R. glaucifolius* and perhaps not specifically distinct. Its range is, however, much more southern. Rusby's specimens from New Mexico are referred here doubtfully. They are from a locality so far from the known range of the species and no specimens of a black raspberry have been found anywhere between Southern California and Rusby's station. To *R. bernardinus* belong:

California: San Bernardino Mountains, 1901, *Parish 5046;* Strains Camp, Los Angeles County, 1902, *Abrams 2584;* Los Angeles County, 1899, *Chamberlain.*

New Mexico: Mogollon Mountains, July 15, 1881, *Rusby 123.*

Rubus nigerrimus (Greene) Rydb. This was originally described as *R. hesperius* by Piper. As that name was preoccupied, Focke in 1911, substituted *R. transmontanus*, but misapplied the name to another species related to *R. pubescens*. In the meantime Dr. Greene had named it *Melanobatus nigerrimus*.* It is more closely related to the eastern *R. occidentalis* than to the western *R. leucodermis*, but differs from both in the lack of tomentum. The following specimens have been seen:

WASHINGTON: Wawawai, 1894, *Piper 1788;* 1897, *Piper;* Alamota, 1894, *Piper 1553;* damp woods, Columbia River, West Kickitat County, 1883, *Suksdorf* (both in flowers and fruit).

Rubus idaeus L. This European species is sometimes cultivated in this country and has occasionally established itself. It has not a trace of glandular bristles. The inflorescence has small weak prickles, sometimes bristle-like but never gland-bearing. In cultivation forms are found with the habit of *R. idaeus* with a few glandular hairs, but these forms are to be regarded as hybrids between it and *R. strigosus*. *Batidaea Itascica* Greene is evidently a synonym of this species. The following specimens belong here:

NEW YORK: 1879, *L. F. Ward.*

WASHINGTON: Watesburg, 1897, *Horner 160.*

MINNESOTA: Lake Itasca, *Sandberg 1173* (type of *Batidaea Itascica* Greene).

CONNECTICUT: Bridgeport, *Eames 5053a.*

NORTH DAKOTA: Minot, 1907, *Lunell.*

Rubus melanotrachys Focke. This was described seventeen years ago by Focke. In the same article he treats it both as a species and as a subspecies of *R. idaeus*. Of all the North American forms this is closest to *R. idaeus*, being non-glandular, but the young branches, petioles and inflorescence are sparingly pilose or glabrate, instead of finely tomentose. The only specimen seen by me is the following, which has been referred to *R. idaeus* by Fernald.†

IDAHO: Cedar Mountain, Latah County, *Piper 2879.*

Rubus arizonicus (Greene) Rydb. (*Batidaea arizonica* Greene).

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* The other two species of *Melanobatus* of Greene, viz., *M. neglectus* and *M. michiganus*, are based on a hybrid, *R. occidentalis* × *strigosus* (*R. neglectus* Peck), the former being the more common form, resembling most one parent, *R. occidentalis*, while the latter represents the form more like *R. strigosus*.

† See Rhodora 2: 198. 1900.

This is the best species of *Batidaea* proposed by Greene. It is characterized by the toothing of the leaves and by the fact that the leaves of the floral branches are usually pinnately 5-foliolate, while in all the other species they are, as a rule, 3-foliolate or simple.

Arizona: Fly Peak, *Blumer 1260; Jones 6056d;* San Francisco Mountains, *MacDougal 258, 373; Toumey 116; Pearson 329; Coville 1125, 1054; Wooton; Leiberg 5756;* Santa Catalina Mountains, *Livingston & Thornber;* Huachuca Mountains, *Goodding 145, 325.*

New Mexico: *Standley 7705, 6707, 6138; Goldman 1672, 1598;* Mogollon Mountains, *Metcalfe 373;* Hillsboro Peak, Black Range, *Metcalfe 1202;* Chloride, 1909, *Goldman 1759;* Capitan Mountains, 1903, *Grant 76;* Winsor's Ranch, 1908, *Standley 4090.*

Chihuahua: Colonia Garcia, *Townsend & Barber 87.*

Rubus strigosus Michx. To my mind there is no doubt that this species is specifically distinct from *R. idaeus* L. Fernald in discussing the occurrence of *R. idaeus anomalus* Arrh. in America* treated also of the relationship of *R. strigosus* and *R. idaeus* and made the statement: "Upon this character—the presence or absence of glands—rests the separation of the American *Rubus strigosus* and the European *R. idaeus.*" While this is the most striking difference, it is not the only one. *R. idaeus* never has glands, *R. strigosus* is exceedingly rarely, if ever, without some trace of glands of some kind. The prickles in the inflorescence and on the petioles of *R. idaeus,* although weak, nearly always are somewhat flattened and slightly curved. This is never the case in *R. strigosus.* If the latter is without glands, it is without prickles and bristles. In *Rubus idaeus* the young stems, rachis and petioles of the leaves, peduncles and pedicels are more or less finely tomentulose. This is not the case in the typical eastern *R. strigosus.* In the high northern plant (*Batidaea subarctica* Greene), which has been included in *R. strigosus,* the inflorescence is pubsecent but not of the fine character found in *R. strigosus.* Fernald claims that the American plant sometimes is without glands, and cites two specimens, *John Macoun 4550* and *Rydberg 657.* I have not seen the former, but there are specimens of

* Rhodora 2: 195–200. 1900.

the latter in the herbarium of Columbia University, in that of the New York Botanical Garden, and in the United States National Herbarium. All these specimens are apparently glandless, but a closer examination shows there are some minute glands, mostly sessile, both on the pedicels and the hypanthium. They represent a rather abnormal form belonging to the western so-called *R. strigosus*, i. e., *R. melanolasius* Focke, and constitute the type of *Batidaea dacotica* Greene. Fernald also cites *Piper 2879* as a specimen also approaching *R. idaeus*. This number belongs to *Rubus melanotrachys* Focke. Fernald evidently overlooked the difference in the pubescence of the inflorescence, which is pilose instead of tomentulose. He also stated: "Often, too, shrubs growing in shade show a strong tendency to lose not only the glands of the calyx, but the white pubescence ordinarily characteristic of the leaves." This is perfectly true and in both *R. idaeus* and *R. strigosus* the leaves are sometimes almost without tomentum. The two specimens cited, however, were a somewhat unfortunate selection, for both *Piper 2268* and *Sandberg, MacDougal & Heller 259*, belong to *Batidaea peramoena* Greene, which should be separated from *R. strigosus*, at least as a variety. The sepals are of a different shape, much narrower than in the eastern *R. strigosus*. No typical *R. strigosus* with rather firm rugose leaves, dark green above, is found in the Rockies or west thereof. All the following species may be regarded by conservative botanists as varieties of *Rubus strigosus*, though this as well as *R. arizonicus* and *R. melanotrachys* must be regarded as distinct from *R. idaeus*. Robinson and Fernald in the New Gray's Manual adopt the name *Rubus idaeus aculeatissimus* Regel & Tiling for *R. strigosus* Michx., which was unwarranted, for Regel and Tiling's variety is the same as *R. sachalinensis* Lev.,* a species or subspecies with almost dry fruit and limited to eastern Asia.

Batidaea heterodoxa Greene is but a form of *R. strigosus*, and one that is not uncommon with the upper leaves, simple and three-lobed. It has nothing to do with *Rubus Egglestonii* Blanchard or what Fernald regarded as *R. idaeus anomalus* Fries, of which it is given as a synonym in Gray's New Manual. *Batidaea elegantula* Greene is in my opinion a rather typical *R. strigosus*, while *B.*

* See Focke, Bibl. Bot. 17^{72}: 210. 1911.

amplissima Greene is a shade-form with coarser teeth and in age practically no tomentum on the lower surface of the leaves. The younger leaves of the type specimen, however, are tomentose beneath.

Rubus melanolasius Focke is the Rocky Mountain representative of *R. strigosus*. If it should be treated as a species or a geographical variety of *R. strigosus* is questionable. It is low in stature, much more bristly and glandular, some of the bristles are often stout, prickle-like, and more or less flattened but straight; the leaves are thinner, light green above, the sepals are shorter and broader, and the fruit is much more acid. It is rather variable. *Batidaea Sandbergii* is the typical form; *B. laetissima* Greene, a paler plant with light green foliage, from exposed situations in Colorado; *B. dacotica* Greene, a nearly glandless form, and *B. unicolor*, a shade form almost without tomentum on the lower surface of the leaves; none of them worth even a varietal name, scarcely worth mentioning as a form.

Rubus acalyphaceus (Greene) Rydb. This was based on *Batidaea acalyphacea* Greene. It is very problematic if this should be regarded as distinct from the last species as the only difference is the pubescent stems. If it were not for the fact that these pubescent specimens are found in only a part of the range of *R. melanolasius*, I should have regarded *B. acalyphacea* as another synonym of that species. *Batidaea subcordata* Greene is the more common form of the same. It is the more appropriate name of the species and represents the normal form, and would have been used if the name *B. acalyphacea* had not had page priority.

Batidaea cataphracta Greene is intermediate between *B. acalyphacea* and *B. subcordata* but depauperate and densely white tomentose on the lower surface of the leaves. *B. filipendula* Greene is a light-colored form, depauperate, with more slender pedicels.

WYOMING: Silver Gate, Yellowstone Park, 1900, *Mearns 2353;* Lower Golden Gate, *Mearns 2553;* Leucite Hills, 1901, *Merrill & Wilcox 677*.

UTAH: Dyer Mine, 1902, *Goodding 1260*.

NEVADA: Clover Mountains, 1908, *Heller 9232*.

IDAHO: Trinity Lake region, 1910, *Macbride 659*.

Rubus peramoenus (Greene) Rydb., based on *Batidaea peramoena* Greene, differs from *R. melanolasius* in the more slender habit, in the less numerous bristles, but above all in the narrower, gradually long-acuminate sepals. The leaves are thin, almost without tomentum beneath. It is represented by specimens from

IDAHO: *Leiberg 1105; Sandberg, MacDougal & Heller 259.*

MONTANA: *Kirkwood & MacDougal 263, 264.*

OREGON: *Brown 85, 88; Cusick 1729; Sheldon 8161.*

WASHINGTON: Spokane, *Piper 2268.*

BRITISH COLUMBIA: *Dawson 7040.*

Rubus viburnifolius (Greene) Rydb., *Batidaea viburnifolia* Greene, differs from the last only in being lower, densely bristly, leaves strongly plicate and strongly veined. It therefore stands nearer *R. melanolasius* than *R. peramoenus* does, but it has the narrow sepals of the latter species. It may be a high mountain and subarctic form of *R. peramoenus.*

The following specimens belong here:

BRITISH COLUMBIA: Glazier, 1909, *Rusby;* Similkameen River, *J. M. Macoun 69970;* Emerald Lake, *Shaw 136;* Roger's Pass, 1904, *Shaw 472.*

ALASKA: Lake Illiamna region, 1902, *Gorman 26;* Rampart, 1901, *Jones 44, 36;* Kenai, 1901, *Nielson 47;* Yukon River, 1903, *Hollick.*

YUKON: fifty miles above Stuart River, 1899, *Gorman 1093;* Hunter Creek, *John Macoun 58470;* Dawson, *Williams 1; Tarleton 162b.*

MONTANA: Gallatin River, 1905, *Blankinship 163;* Midvale, *Umbach 373.*

ALBERTA: base of Tunnel Mountain, 1897, *McCalla 2096;* Lake Louise, *J. M. Macoun 65104.*

Rubus subarcticus (Greene) Rydb., *Batidaea subarctica* Greene. Most of the high northern specimens of what have been called *R. strigosus* have more or less pubescence on the inflorescence and young parts of the stem and branches; the stem is also much more glandular-bristly, and the sepals broader, shorter and more abruptly acuminate. If these forms should be separate from *R. strigosus* or not is hard to tell. I hesitated for a long time in giving them a name, but I found that they grew commonly in

Alaska and Yukon, and that *Batidaea subarctica* Greene was based upon them. I therefore admitted this as a questionable species. It is probably the same as *Rubus idaeus canadensis* Richards. Numerous specimens have been seen from Alaska, Yukon, and Athabasca, where it is the common species. The following eastern specimens also belong here:

NEWFOUNDLAND: 1894, *Robinson & Schrenk; Waghorne; Howe & Lang 919; Sornberger 223;* St. Johns, *Williamson 814.*

LABRADOR: Lanse au Clair, 1894, *Waghorne.*

ST. PIERRE: Bois Brulé, *Arsène.*

QUEBEC: Seven Islands, *C. B. Robinson 864;* Bic, *Williamson 1217.*

NOVA SCOTIA: Yarmouth, *Howe & Lang 71.*

MICHIGAN: Houghton, 1893, *Ely.*

MINNESOTA: Duluth, *Rydberg 8305.*

Rubus carolinianus Rydb. All the specimens referred to *R. strigosus* from the mountains of North Carolina differ from the ordinary *R. strigosus* of the northern states in the densely retrorsely glandular hispid and also puberulent stem. Besides, I have seen no specimens whatever of any red raspberry from any station between northern Virginia and the mountains of North Carolina. *R. carolinianus* may be nothing more than a geographical variety of *R. strigosus*, but as it evidently stands in the same relation to it as *R. melanolasius*, *R. peramoenus*, *R. viburnifolius*, and *R. subarcticus*, I admitted it as a species in the North American Flora.

NORTH CAROLINA: Mt. Mitchell, 1897, *Biltmore Herbarium 5685;* Black Mountain, 1853, *Gibbes;* Andrews Bold, Great Smoky Mountains, *Beardslee & Kofoid.*

Rubus Egglestonii Blanchard. This was first recorded as *R. idaeus anomalus* Arrh. by Fernald,* but it is not the same as the European plant. Mr. Blanchard† points out that it stands in somewhat the same relation to *R. strigosus* that var. *anomalus* does to *R. idaeus*, glandular hairs being present in *R. strigosus* and *R. Egglestonii*, but absent in *R. idaeus* and the var. *anomalus*. The latter is closely related to *R. idaeus*, differing in no respect from *R. idaeus* except in the usually simple, entire or lobed and rounded

* Rhodora 2: 195. 1900.

† Torreya 7: 140. 1907.

leaves (or leaflets if the leaf happens to be compound, which is seldom the case). *Rubus Egglestonii* differs more from *R. strigosus*, viz., in the elliptic, obtuse, merely mucronate sepals, the slender habit, and small leaves. In my opinion, it is a distinct species, perhaps derived from *R. strigosus*, or perhaps a hybrid between the latter and *Dalibarda repens* L. The rarity of well-developed fruit and the poorly developed pistils would suggest hybrid origin. Botanists who have the chance of seeing it in the field are urged to follow up this suggestion.

URTICIFOLII

Rubus trichomallus Schlecht. This has been merged into *R. urticifolius* and Dr. Focke still regards it as synonymous with that species, but I think that it should be held distinct. The South American plant has a compact inflorescence and ovate sepals, which are soon reflexed. The Mexican and Central American plants on the contrary have a looser inflorescence, ovate, lanceolate sepals, closing around the young fruit, and only in age becoming spreading. The following specimens belong to *R. trichomallus:*

COSTA RICA: Santiago (east of Cartago), April 20, 1906, *Maxon 81;* Vulcan Irazu, June 1874, *O. Kuntze* (labeled *R. costaricanus*); Turrialva, June 21, 1874, *O. Kuntze 2245*.

Rubus ferrugineus Wikst. This seems to have been a lost species. However, it has been collected again on the same island from which it was originally described, viz., Guadeloupe, but it has been mistaken for *R. jamaicensis*, from which it is easily distinguished by the long, non-glandular hairs on the stem. Only one typical specimen has been collected outside of Guadeloupe, and strange enough, this comes from Mexico. A plant very closely related to it if not the same species is common in northern South America, but in this the inflorescence is more open and the sepals narrower. If not to be referred to *R. ferrugineus* it represents an undescribed species. The following specimens are referred to *R. ferrugineus*.

GUADELOUPE: 1893, *Père Duss 2215*.

MEXICO: near Tunbala, Chiapas, October 26, 1895, *E. W. Nelson 3305*.

ADENOTRICHI

Rubus adenotrichos is characterized by its long glandular hairs on the stem, its strongly armed petioles and petiolules, glabrous drupelets and rather broad leaflets, densely tomentose beneath. In the Torrey herbarium there is a duplicate of the type. In the herbarium of the New York Botanical Garden there is one of Liebmann's specimens with still broader leaflets, and shorter glandular hairs, approaching *R. costaricanus*, with which species this has been confused. Otto Kuntze referred his specimens to that species, but collected, also, specimens of the true *R. costaricanus*. The following specimens belong here:

VERA CRUZ: Jalapa, *Schiede* (type); Orizaba, 1853, *Fred Mueller 3001;* near Jalapa, 1900, *Pringle 8346* (erroneously named *R. coriifolius*); Mirador, 1841–43, *Liebmann 1675*.

OAXACA: Sierra de San Felipe, 1894, *Pringle 4695*.

COSTA RICA: June, 1874, *O. Kuntze;* Cartago, August 24, 1874, *O. Kuntze 2207*.

Rubus costaricanus differs from *R. adenotrichos* in the broader leaflets, more than half as broad as long, the short glandular hairs, scarcely longer than the other pubescence, the dense inflorescence and the few large drupelets. The New York Botanical Garden has received from Copenhagen a duplicate from Professor Oersted's collection. This is duplicated by the specimens collected by Otto Kuntze.

COSTA RICA: Cartago, 1845–48, *Oersted 1689;* Costa Rica, June, 1874, *O. Kuntze;* Turrialva, June 21, *O. Kuntze 2235;* Vulcan Irazu and Cartago, June 1874, *O. Kuntze;* Hacienda Belmira, near Santa Maria de Dota, 1898, *Tonduz 11615, 1450;* Parrita Grande du Copey, 1898, *Tonduz 11726* in part.

Rubus Verae-Crucis Rydb., described in the North American Flora, is related to *R. adenotrichos*, but differs in the pubescence, the leaves being nearly glabrous beneath and the stem with short glandular hairs. The species is only known from the type locality. New shoots were also collected in 1899, *Rose & Hough 4295*. Besides these I have seen only the following specimen, *Pringle 8177*.

Rubus irasuensis Liebm. The New York Botanical Garden has received from Copenhagen a specimen from Professor Liebmann's type collection of this species. The species is more common than expected, having been confused with both *R. adenotrichos* and *R. poliophyllus.* It is related to the former, but the glandular hairs of the stem are much shorter, scarcely longer than the other pubescence and the drupelets are slightly hairy at the apex. The following specimens belong to it:

COSTA RICA: Mount Irazu, 1847, *Oersted 1699;* Parrita Grande du Copey, 1898, *Tonduz 11726* in part; San Francisco de Guadeloupe, February 1893, *Tonduz 7304.*

GUATEMALA: Mizco, Dept. Guatemala, February, 1892, *John Donnell Smith 2534* (labeled *Rubus adenotrichos* var. *floribus roseis*); Volcan de Fuego, Dept. Zacatepeques, March 1892, *2535* (this was determined as *R. poliophyllus*); Antigua, February 1908, *Kellerman 7455;* Volcan d'Agua, February 15, 1905, *Kellerman 4775;* Ravanal, August 15, 1860, *Sutton Hayes.*

Rubus miser Liebm. seems not to have been collected since Oersted's time in Costa Rica. The only specimen seen resembling it comes from Guatemala and in this many of the leaves are five-foliolate. The species differs from *R. adenotrichos* in the small racemose inflorescence and the short glandular hairs.

COSTA RICA: Cartago, 1845–48, *Oersted 1700.*

GUATEMALA: Sapote, Dept. Guatemala, March, 1890, *John Donnell Smith 1972.*

SCANDENTES

Rubus scandens Liebm. This species is well described by Liebmann, but for some reason it has seldom been correctly identified, perhaps on account of the description of the fruit. Liebmann describes this as being red, with few drupelets falling off separately. In Liebmann's specimens, of which one is in the herbarium of the New York Botanical Garden, the drupelets are a dozen or less mostly fallen off. Dr. Focke describes the fruit as being red or dark purple and composed of six to eight large drupelets. In Nelson's specimens the drupelets are up to twenty, but the plants are in other respects identical with Liebmann's specimens. The following specimens have been seen:

VERA CRUZ: Mirador, March, 1841, *Liebmann 1701;* same locality, February 1894, *E. W. Nelson 194;* Zacuapan, January 1905, *Purpus 2953;* Canton de Huatusco, December, 1898, *Conzatti.*

Rubus fagifolius Cham. & Schlecht. I have seen no specimens of this species, but both Schlechtendahl's and Liebmann's descriptions, as well as the illustration given by Focke, show clearly that it is closely related to, but perfectly distinct from, *R. scandens.*

Floribundi

Rubus philyrophyllus Rydb. This species was first described as *R. tiliaceus* by Liebmann, but afterwards the name was changed to *R. tiliaefolius* by Dr. Focke on account of the earlier *R. tiliaceus* Smith. When proposing the new name Dr. Focke knew that there was a *Rubus tiliaefolius* Weihe, but he claims that the latter is a synonym and hence the name is available. There is a difference of opinion concerning this fact, and some authors regard also *R. tiliaceus* Smith as a synonym, which would make *R. tiliaceus* Liebm. available. The use of homonyms will always cause confusions and an unstable nomenclature. The permitting of the use of homonyms is one of the few features which makes it impossible for me conscientiously to subscribe to the, in general, excellent Vienna Code. I have seen no specimens, only a photograph of Liebmann's type. The leaf-form is, however, very distinct. Only two species and these of the *R. sapidus* group have leaflets approaching those of this species in outline, but in both the fruit is glabrous.

Rubus Liebmannii Focke. The specimens collected at Cerro de Sempoaltepec, Oaxaca, were included in *R. tiliaceus* by Professor Liebmann. The leaves of these specimens are quite different from those of the type of *R. tiliaceus.* In the herbarium of the New York Botanical Garden there are two photographs, one from the specimen in Liebmann's herbarium with Dr. Focke's label on it, the other from the specimen in Dr. Focke's own herbarium. The following specimens, which agree with these photographs as well as with Focke's description, I refer to this species.

Oaxaca: northwestern slope of Mt. Zempoaltepec, July 10, 1894, *E. W. Nelson 675.*

Vera Cruz: Orizaba, 1853, *Fred Mueller 1341.*

Rubus coriifolius Liebm. was described by Liebmann as having few carpels and rose-colored petals. One of Liebmann's specimens in fruit is found in the herbarium of the New York Botanical

Garden, and in this the drupelets are eight to ten, but in Pringle's specimen from Orizaba, they are twelve to twenty. The petals are about as large as those of *R. Schiedeanus*. They were described as pink, but they are often pure white. The following specimens I refer to this species:

VERA CRUZ: Mirador, February, 1842, *Liebmann 1688;* hill near Orizaba, February 3, 1895, *Pringle 5925*.

OAXACA: Totontepec, July 15, 1894, *E. W. Nelson 773;* between Juquila and Nopala, March 4, 1895, *2424*.

Rubus Schiedeanus Steud. This differs from the preceding species mainly in the toothing of the leaflets. In this the teeth are very small, more distant or obsolete; in *R. coriifolius* they are irregular, large and sharp, lanceolate, close together and directed forward. I have seen only the following specimens:

VERA CRUZ: Mirador, February, 1842, *Liebmann 1705;* near Jalapa, April 2, 1899, *Pringle 8086*.

Rubus macrogongylus Focke. In the original description Dr. Focke does not cite any specimens. Some time ago I wrote him and he kindly sent me a photograph of the type and wrote a letter, from which I hereby give the following extract: "The best characteristic for *Rubus macrogongylus* is or seems to be the shape of the fruit, which is *elongated* and consists of about 100 or more perfect carpels. In the flowering branches most of the leaves are quinate. The sepals are loosely reflexed in flower, afterwards they embrace the base of the fruit. At first I saw such plants in Donnell Smith Guatem., 4472, but the materials were not sufficient for describing and naming them. I suggest that Donnell Smith Guatem. 4178 will prove to be a form of the same species. Some years ago I met with, in the Berlin Herbarium, several flowering or fruiting specimens from Mexico. The panicle in these plants was much more developed than in the Guatemala ones, but I cannot distinguish leaves, tomentum, serrature, flowers or fruits. I send a photo of a flowering branch from Mexico. I think that the Mexican specimens represent the true face of the species, and that those from Guatemala are somewhat scraggy forms."

The photograph was labeled "*Rubus macrogongylus* Focke, S. Mexico Ex hb. Berlin." There was no indication of the collector or date. Besides the two numbers of Captain John Donnell Smith's collection, cited by Focke in his letter, I have seen only a fragment, which I refer doubtfully here.

GUATEMALA: 1906, *Kellerman 5217*. (This was determined as *Rubus guyanensis*, to which it evidently does not belong.)

Rubus Smithii Rydb. This was orignally described as *R. poliophyllus* by Focke, but there is an older *R. poliophyllus* O. Kuntze. As it was based on *R. coriifolius* Focke in Enumeratio Plantae Guatemalensis, which appeared without description, *John Donnell Smith 2141* must be regarded as the type. Focke also cites *Seler 879* from Atlamaltatle, Hidalgo, Mexico, and *Smith 2533* and *2535* from Guatemala. The last number, at least as represented in Captain Smith's herbarium, does not belong to the same species as the others, but to *R. irazuensis* Liebm. Also *Kellerman 4775*, from Guatemala, and *Tonduz 11726*, from Costa Rica, both named *R. poliophyllus* belong to *R. irasuensis*. *Pittier 2281* and *Tonduz 7837* both from Costa Rica and both named *R. poliophyllus* belong to *R. Pittieri*.

Rubus Uhdeanus Focke. In the herbarium of the New York Botanical Garden, there are two photographs of and scraps from the type collection of this species, kindly sent us from the Royal Botanic Garden at Berlin. Besides these I have seen no specimens that could be referred to this species except the following:

MEXICO: Sierra de Ajusco, *Pringle 8279*.

Rubus Pittieri Rydb. This is somewhat related to *R. Uhdeanus*, having the same pubescence and more or less glandular inflorescence, but the branches and petioles are densely villous and the inflorescence more distinctly prickly. The plant therefore approaches the *R. sapidus* group, if it should not be included in the same; the plant, however, judging from the specimen seen, does not climb over bushes and rocks but is an erect shrub. In some respects it resembles *R. coriifolius*, but the petals are much smaller, and the drupelets smaller and more numerous. Dr. Focke refers the type number of this species to *R. poliophyllus* Focke, i. e., *R. Smithii* Rydb., to which disposition I cannot agree. The following specimens belong here:

COSTA RICA: Paramos de l'Abejonal, May 4, 1890, *Pittier 2281*; same locality, April, 1893, *Tonduz 7837*.

Rubus abundus Rydb. This name was substituted for *R. floribundus* H.B.K., which is a homonym. This has been reported for Central America, but I have not seen any material from there; I have, however, seen several specimens from Venezuela and Colombia. Otto Kuntze collected the species near Caracas, but referred it to varieties of *R. jamaicensis.* The following varietal names appear on his labels: *floribundus*, *normalis*, and *nudicaulis*. Though related to *R. jamaicensis*, it is easily distinguished from the same by its densely villous-velutinous leaves, which are deeply cordate at the base and never white on the lower side, and by its dense inflorescence and ovate, instead of lanceolate, sepals. Dr. Focke described a subspecies *Selerianus* of this species from material collected in Mexico, *Seler 2096*, which I have not seen.

Rubus laxus Rydb. was described in the North American Flora. It was also described by Dr. Focke as *Rubus adenotrichos leptaleos*,* but is not related to *R. adenotrichos.* It is related to the preceding, but differs in the open inflorescence, divergent branches of the same, the smaller flowers, the narrower and less or not at all cordate leaflets and shorter and finer pubescence. Specimens seen are the following:

GUATEMALA: Zamorora, Dept. Santa Rosa, *Heyde & Lux 4474;* Volcan Jumaytepeque, Santa Rosa, *Heyde & Lux 4473.*

Rubus jamaicensis L. This seems to be confined to the island of Jamaica. Specimens so named from South America belong to *R. abundus*, *R. alpinus*, or other related species. Mr. John Hart, Superintendent of the Cinchona Plantation, has collected specimens with the terminal leaflet of the lower leaves very broadly cordate and the inflorescence more compact. These approach somewhat *R. abundus.*

Rubus alpinus Macf. Unfortunately, I have not seen the original description published by Macfadyen. The descriptions given by Grisebach and by Focke do not fully agree. The former describes the plant, as well as *R. jamaicensis*, as shrubby, trailing, and the drupelets as numerous; the latter describes the plant as climbing and the drupelets as twenty to thirty. The plant found in Jamaica and the only one which agrees in any way with the descriptions of *R. alpinus* is a plant closely

* Bib. Bot. 83: 70. 1914.

related to *R. jamaicensis*, but without the white tomentum on the lower surface of the leaves and being in all respects less pubescent. This has the same habit as *R. jamaicensis*, being reclining over bushes. Grisebach compares it with *R. fagifolius*. This was probably the reason why Focke transferred it to his subgenus *Lampobatus* and associated it with *R. fagifolius* and *R. scandens*. For my part it seems as if the Jamaican plant was unknown to Dr. Focke. Under any circumstances, the plant which I take for *R. alpinus* is the same as *R. guyanensis* Focke. At least I have not been able to find any differences. A photograph and some fragments of the type of *R. guyanensis* were kindly sent me from the Botanical Garden at Berlin and these are exactly like Shreve's specimens of *R. alpinus* from Cinchona, Jamaica. Other specimens from Guiana are the same. Otto Kuntze's specimens from Venezuela are similar but more pubescent, at least on the veins of the under side of the leaves. Specimens collected near Cinchona, *Harris 9141*, have the leaves more pubescent beneath, and may be hybrids with *R. jamaicensis*.

Rubus vulcanicola (J. D. Smith) Rydb. is closely related to the preceding and mainly distinguished by the mostly five-foliolate and more shining leaves, and longer pink or rose petals. I have seen the following specimens:

COSTA RICA: Volcan Poas, March 1896, *John Donnell Smith 6495;* 1896, *Tonduz 10907;* Rancho del Achiote, Volcan Poas, 1889, *Pittier 806;* Volcan Barba, 1890, *Tonduz 2120.*

SAPIDI

Rubus Nelsonii Rydb. is probably related to *R. sapidus* but differs from that species as well as from its other relatives in the narrower, long-acuminate leaflets, and also in its terete stem. It is known only from the two sheets of the type collection.

Rubus amplior Rydb. is related to *R. sapidus*, but differs in the terete stem, the dark green and firm leaflets, these being less cordate, and having broader teeth. Known only from the type collection.

Rubus Palmeri Rydb. is closely related to *R. sapidus*, but the leaves are lighter green, the inflorescence somewhat glandular, as well as villous-tomentose and the teeth of the leaves are broader and shorter, and less strongly directed forward. To this species belong:

DURANGO: San Ramón, 1906, *Palmer 78*.

JALISCO: mountains near Talpa, March 7, 1897, *E. W. Nelson 4019;* between Dolores and Santa Gertrudis, August 7, 1897, *Rose 2039*.

Rubus sapidus Schlecht. A duplicate of the type of this species is in the Torrey herbarium. Typical specimens have been collected near the type station (Jalapa), *Pringle 8071*. These were wrongly determined as *R. humistratus* Steud., which species belongs to another group of the genus. Dr. Focke has included *R. sapidus* in the *Suberecti*, in which section he also included our *Arguti*. *R. sapidus* has subcoriaceous leaves, as most Mexican species have, and is not an erect plant.

Rubus Tuerckheimii Rydb. This is evidently also related to *R. sapidus*, but differs from all the species of this group in the small petals. It is perhaps most closely related to *R. amplior*, but differs in the finer and more regular toothing of the leaflets, the more numerous flowers and the small petals. Known only from the type.

Rubus alnifolius Rydb. was referred to the *Sapidi*, but is not closely related to any of the species of the group. It is characterized by the racemose inflorescence and the coriaceous leaflets, obtuse or rounded at both ends. It is only known from the type collection.

DURI

Rubus durus Sauvalle. This is characterized by its narrow inflorescence, coriaceous, shining leaflets, which are mucronate-serrulate and glabrous on both sides or nearly so beneath. Focke describes a variety *Grisebachii* with the leaves ferrugineous-villous beneath. This is unknown to me. I have seen but the following specimen of the species:

CUBA: *Wright 2410*.

Rubus florulentus Focke. This differs from the preceding in the open corymbiform inflorescence and glabrous drupelets, and larger petals. To it belongs:

PORTO RICO: Adjuntas, 1885, *Sintenis 4100*.

Rubus Eggersii (Focke) Rydb. *R. florulentus Eggersii* Focke.

This I think distinct from *R. florulentus*. Its leaves are similar but not so shining, and they are densely ferrugineous-pubescent beneath.

SANTO DOMINGO: near Constanza, 1910, *Von Tuerckheim 2913*.

Rubus domingensis Focke. I have seen no typical material of this species, but the following was so named by Dr. Focke. It does not exactly agree with the description, but may be rightly determined. If so, *R. domingensis* has less coriaceous leaves than the rest of the group.

SANTO DOMINGO: near Constanzia, 1910, *Von Tuerckheim 3140*.

URSINI

Rubus ursinus Cham. & Schlecht. All the species of blackberries on the Pacific coast have usually been included in this species. If so, the species must be a very variable one. The plants of the Columbia valley have glabrous, subglobose fruit, thin only sparingly pubescent leaves, and the leaves of the young shoots are rarely unifoliolate. The common plant of southern California has pubescent elongate fruit, thick leaves, densely pubescent beneath, and those of the new shoots usually unifoliolate. These two forms represent respectively *R. macropetalus* Dougl. and *R. ursinus* Cham. & Schlecht. But all plants of southern and central California do not have thick leaves and occasionally plants are found that have glabrous fruit. These, however, do not have the habit and globose fruit of *R. macropetalus*. These variations have caused most botanists to regard all as forms of one species. I think that a better solution is to admit at least five species of this group on the Pacific coast. If so, what names are they to have?

The southern Californian plant mentioned above is *Rubus ursinus* Cham. & Schlecht. The type was from the vicinity of San Francisco, near the northern limit of the species. Dr. Focke has pointed out that *R. Menziesii* Hook. is the same and not the plant related to *R. spectabilis*, which Dr. Watson called *R. spectabilis Menziesii*. The confusion has probably been caused by the fact that Dr. Hooker suggested that the flowers were pink. The rest of the description, however, agrees better with *R. ursinus*. The type of *R. Menziesii* was also from San Francisco, where the other species grows. *R. ursinus* is the most common of the species in the southern part of the Pacific slope. Dr. Focke in his final monograph in Bibliotheca Botanica calls it *R. ursinus Menziesii*, making *R. macropetalus* the typical *R. ursinus*.

Rubus vitifolius Cham. & Schlecht. was described from a branch bearing only unifoliolate leaves, but the description of their texture and pubescence does not agree with the common plant. As there is a thin-leaved and less pubescent plant with pubescent fruit growing in the region, and this agrees with the description of *R. vitifolius*, I adopted that name without hesitation. It is also without much doubt *R. ursinus glabratus* Presl. It is represented by the following specimens:

CALIFORNIA: San Francisquito Creek, Santa Clara County, 1902, *Abrams 2435;* Mt. Tamalpais, 1905, *Rydberg 6245;* Albion Ridge, Mendocino County, 1903, *McMurphy 275;* Crystal Spring Lake, 1903, *Elmer 4664;* Stanford University, 1902, *Baker 857;* without locality, *Kellogg & Harford 223;* San Bernardino, *Parish 292;* Mount Shasta, 1892, *Palmer 2570.*

Rubus Helleri Rydb. As stated before, the common plant of the Columbia region has glabrous fruit, but a few specimens collected in that region have finely pubescent fruit and these have the leaves much darker-green above and of a firmer texture. These specimens are all from stations west of the Cascades. I believe they represent a distinct species. As I found no available name for it, I dedicated it to Mr. Heller, who has collected the best specimens of the same.

WASHINGTON: Montesano, 1898, *Heller 3990.*

BRITISH COLUMBIA: Alberni, Vancouver Island, 1907, *Rosendahl 2041.*

Rubus Eastwoodianus Rydb. Not all the blackberries of California have pubescent fruit. The glabrous-fruited specimens do not belong, however, to *R. macropetalus*, for the fruit is very much elongate and the leaflets are of a different shape. I think they belong to a distinct species, which I had the pleasure to name after one of the most enthusiastic and indefatigable botanists of the western coast, who also acted as my guide on Mount Tamalpais, when the type was collected.

CALIFORNIA: Mount Tamalpais, 1905, *Rydberg 6238;* Pasadena, 1903, *George B. Grant 3670*, doubtfully referred here; so also Jomacha, San Diego County, *Chandler 5225* in small part only.

Rubus macropetalus Dougl. This was mainly described from the staminate plant, while *Rubus myriacanthus* Dougl., described at the same place, is characterized from a more than usually prickly pistillate individual.

LACINIATI

Rubus laciniatus Willd. The origin of this species seems to be unknown. It has been cultivated more than a century at least, is not unknown in gardens, and has become naturalized at many places. The following specimens may be recorded:

WASHINGTON: Chehalis River, 1897, *Lamb 1244;* Quiniault Valley, 1902, *Conard 216;* Montesano, 1898, *Heller 4001.*

OREGON: Forest Grove, 1894, *Lloyd;* Oregon, 1903, *Lunell.*

BRITISH COLUMBIA: vicinity of Nanaimo, Vancouver Island, 1908, *John Macoun 19659;* Victoria, *John Macoun 19658.*

PENNSYLVANIA: Point Pleasant, 1898, *Fretz;* Bethlehem, 1905, *Rau.*

DISCOLORES

Rubus Linkianus Ser. This is usually known as *Rubus fruticosus* among gardeners but has little to do with the original *R. fruticosus* L., which belongs to another group of blackberries. *R. Linkianus* has usually double flowers in cultivation and most escaped plants also bear such; the simple-flowered state is found in the United States only as a ballast plant.

NEW JERSEY: Camden, 1897, *Pollard* (ballast).

MARYLAND: Frederickstown, 1816, *Commons.*

Rubus cuneifolius Pursh has an extensive distribution from Connecticut to Florida but is practically confined to the coastal plains.

ARGUTI

Rubus sativus (Bailey) Brainerd. This was originally described as *R. nigrobaccus sativus.* President Brainerd raised it to specific rank, although the plant he really had in mind was not this but another species which I have named *R. Brainerdi* after him. Mr. Blanchard regards it as a cultivated form of *R. nigrobaccus*, but the plant is found in the wild state, although not very common. It may have arisen through the crossing between *R. nigrobaccus* with *R. frondosus* or *R. Baileyanus*, but it is now found further north than either of these two species. It resembles much *R. Baileyanus* × *nigrobaccus* in the leaf-form, but has more coarsely toothed leaflets and an erect stem. The following specimens belong here:

PRINCE EDWARD ISLAND: between Summerside and Miscouche, 1909, *Blanchard 801* (sheet 2).

QUEBEC: Kingsmere Lake, 1906, *Rydberg 7944*.

ONTARIO: Ottawa, 1906, *Rydberg 7926*.

MAINE: Calais, 1909, *Blanchard 502;* Brownsville, *Blanchard 503*.

NOVA SCOTIA: Granville, 1909, *Blanchard 706;* Kentville, *Blanchard 707*.

NEW BRUNSWICK: Marysville, 1909, *Blanchard 601*.

CONNECTICUT: Southington, 1906, *Blanchard 97* (set 4); Portland, *Blanchard 97* (set 5); Meriden, 1904, *Andrews 18;* Southington, *Andrews 4*.

VERMONT: cultivated, *Blanchard 212;* Mendon, 1899, *Eggleston 1220*.

NEW JERSEY: Newfoundland, 1908, *Mackenzie 3126;* Lucceasunna, 1909, *Mackenzie 4149;* Mt. Arlington, *Mackenzie 1393;* Budd's Lake, *Mackenzie 1517, 1519*.

In some cases specimens are found intermediate between this and *R. nigrobaccus*. They may be hybrids, but as I have not studied these specimens in the field, no attempt has been made to segregate the hybrids.

Rubus nigrobaccus Bailey. This has been known since about a hundred years ago as *R. villosus*, having been mistaken for *R. villosus* Ait., which, however, is antedated by *R. villosus* Thunb. Who was first responsible for the error is hard to tell. Both Michaux and Pursh might have had this plant in mind, but both practically copied Aiton's description. Pursh, however, makes the following remarks: "Known by the name Black-berries," which would suggest this or *R. argutus* rather than *R. procumbens* or *R. plicatifolius*. The same year that Pursh published his Flora, although a little later, Bigelow's Florula Bostoniensis appeared, and here there is no doubt about what plant the author had in mind. Since that time the plant was known as *R. villosus* until Professor Bailey saw the type of Aiton's *R. villosus* and proposed the new name for this. There may be another older name that some people would regard as available. Babington in Gardener's Chronicle,* objects to the fact that gardeners have distributed a "well-known" plant under a new name, *R. americanus*. He claimed: "It is singular that nurserymen will so often issue plants with new names when old and authentic ones exist, and may be discovered without much difficulty. The Blackberry issued under the name of *R. americanus* is the *R. villosus* of Aiton (Hort. Kew., ed. 1, vol. ii., p. 210), and well known under that name to American botanists, as I learn from Dr. Asa Gray. Why give a new name when one already exists? Why give us all the trouble which we have had to find out its real name? But there is a curious point connected with this issue under the name of *R. americanus*. In most cases *R. laciniatus* came with it, and is, as far as I have seen, the prolific fruiting plant. So we have two quite distinct plants issued together under one, and that a new name. Can nothing be done to put an end to these things? They can hardly be of any benefit to the tradesmen, even if that were any excuse."

The plant regarded as *R. villosus* by Gray and other American authors was not the same as *R. villosus* Ait. The plant, therefore, that Babington had in mind was our *R. nigrobaccus*. As a synonym is given under *R. americanus*, it is published according to the American Code, but which plant does it belong to, *R. villosus* Aiton or *R. villosus* of Bigelow and of Gray? This *R. americanus* is older than *R. americanus* Britton and therefore available. If regarded as the same as *R. villosus* Ait., which is cited as a synonym, it should take its place as that is antedated by *R. villosus* Thunb. It should then replace the later *R. plicatifolius* Blanchard, which is the same. If regarded as the same as *R. villosus*, as understood by Bigelow and Gray, it would replace *R. nigrobaccus* Bailey. But whom should we cite as the author of *R. americanus*? We could not very well cite Babington, who strenuously objected to the name. The best to do is therefore to regard *R. americanus* Hort. as "merely incidentally mentioned."

Blanchard, followed by Fernald, Britton, Bicknell, and Brainerd, has adopted *R. allegheniensis* Porter for this species. *R. allegheniensis* was based on *R. villosus montanus* Porter. When

* III. **2**: 99. 1887.

Dr. Porter described this variety and compared it with *R. villosus* he did not mean by the latter *R. Andrewsianus* or *R. argutus*, for the glandular plant was well known to him. Even Professor Bailey held *R. allegheniensis* distinct. When Dr. Porter pointed out as the only differences the narrow dry fruit with its peculiar aroma and did not mention the presence of glands, it is evident enough that both were glandular, for Dr. Porter was too acute an observer not to notice the difference in pubescence between *R. nigrobaccus* and *R. argutus*. I am inclined rather to follow Porter's and Bailey's view and regard *R. allegheniensis* as a distinct species. Furthermore, Mr. Mackenzie, who is well acquainted with *R. nigrobaccus*, has collected *R. allegheniensis* in New Jersey and distributed it under a manuscript name, regarding it as distinct. The latter differs in the slender terete stem, the narrower leaflets on the new shoots usually acute instead of rounded or subcordate at the base, the narrower and drier fruit and the conspicuous yellow glands and smaller flowers. It is a rare plant, suggesting somewhat *R. canadensis* or *R. Randii*. Dr. Britton, noticing that the figures of *R. allegheniensis* in the first edition of the Illustrated Flora, poorly represented the common, glandular high blackberry had a new illustration made, evidently overlooking the fact that the original illustration was made from the type of *R. allegheniensis* Porter. As it is, *Fig. 1899* in the first edition illustrates the original *R. allegheniensis*, while *Fig. 2300* in the second edition is a good illustration of *R. nigrobaccus*.

Sometimes, especially in the north, *R. nigrobaccus* has a leafy-bracted inflorescence and then receives a very different aspect. Such specimens in flower may be taken for a distinct species, but there is no difference in the pubescence or in the leaf forms. It might be mistaken for a hybrid with *R. frondosus*, but that species is unknown in the region where these forms are most common. Such specimens are:

QUEBEC: island in Gatineau River, near Chelsea, 1906, *Rydberg 7933*.

ONTARIO: Ottawa, 1903, *Macoun 59967*.

NOVA SCOTIA: Yarmouth, 1901, *Howe & Lang 89, 107;* Halifax Harbor, *Howe & Lang 1594*.

Rubus allegheniensis Porter. See discussion under *R. nigro-*

baccus. It is a less robust plant than that species and suggests somewhat a slender depauperate woodland form of *R. nigrobaccus*, but the stem is perfectly terete, the sepals narrowly lanceolate and the fruit is elongate, tapering above, and of many small, rather dry drupelets. The plant also suggests a hybrid between *R. nigrobaccus* and *R. Randii*, but the latter species is not found in the region of *R. allegheniensis*. It is not at all the same plant as the hybrid collected by me in the Adirondacks.

Rubus argutus Link. The most distinct of the species of *Rubus* described by Blanchard is *R. Andrewsianus*. It is one of the most common and most widely distributed of our blackberries. It was not a "new" species, however, and was called *R. fruticosus* by Marshall. The trouble has been that it has been confused with *R. villosus* of American authors, that is with *R. nigrobaccus*. Blanchard has done us the great service of pointing out the distinctiveness of the two. His name is, however, not the oldest available name, for it is the same as *R. argutus* Link. Link's description is incomplete, for he evidently did not describe the new shoots in his diagnosis. Mr. Blanchard is not willing to admit that *R. Andrewsianus* is the same as *R. argutus* and claims that at best the latter is an abnormal form of the former. Professor Bailey has kindly sent me a photograph, taken from the type at Berlin. This photograph shows plainly the strongly angled, almost grooved stem and stout prickles, characteristic of *R. Andrewsianus*, and to my mind there is no doubt concerning the identity of the two. Even if *R. argutus* should not be the same, *R. Andrewsianus* is not the oldest available name, for *R. floricomus*, described by Blanchard himself a year earlier, cannot be distinguished from *R. Andrewsianus*.

Rubus floridus Tratt. is closely related to *R. argutus* and represents it in the south. Mr. Blanchard does not distinguish the two. *R. floridus* as a rule, however, is rather distinct, has thinner leaflets with finer pubescence, those of the new shoots usually narrower and more finely toothed; the prickles are also more curved and more flattened and the branches terete. The species may hybridize, which may explain the intermediate form from regions where their ranges overlap.

Rubus betulifolius Small is closely related to *R. floridus*, but the leaves are still thinner and glabrous or nearly so. Slender forms, in which the branches are arching, resemble also somewhat *R. lucidus*, but the leaves are not persistent, not so shining and much thinner. The following specimens belong here.

ALABAMA: Auburn, 1898, *Baker 1590;* Spring Hill, 1909, *Mackenzie 4018;* Mobile, 1899, *Earle 2014.*

NORTH CAROLINA: Lake Catherine, *House 4517.*

ILLINOIS: National Stock Yard (opposite St. Louis), 1878, *Eggert.*

Rubus frondosus Bigelow has been misunderstood and not well known, probably because there were so few specimens in the herbaria. Mr. Blanchard had done a good deal in clearing up the confusion. *R. frondosus* is not so rare, however, as supposed, and has a rather wide range, extending as far west as Kansas and Iowa. The range north and south, however, is not so wide, only from Massachusetts to Virginia. It is evidently confined to the hardwood belt. *R. philadelphicus* is but a small-leaved form of the same.

Rubus recurvans Blanch. I cannot distinguish *R. arundelanus* Blanch. and *R. Jeckylanus* from the same. *R. recurvans* itself is not a very strong species, being closely related to *R. frondosus.* Mr. Bicknell does not regard it as distinct. *R. recurvans* has a more northern distribution, but the two come together in southern New England and New York.

Rubus Brainerdi Rydb. This plant Professor Brainerd had in mind when he raised *R. nigrobaccus sativus* Bailey to specific rank. It has nothing to do with *R. nigrobaccus sativus*, however. Its relationship is with *R. frondosus* on one hand and *R. Baileyanus* on the other. It cannot very well be a hybrid of the two, for the type station is practically outside the range of both species. Professor Brainerd regards it as a form of *R. recurvans.* The following specimens have been collected.

VERMONT: Otter Creek, Wrybridge, 1899, *Brainerd;* Twin Mountain, West Rutland, 1900, *Eggleston 2005;* 1899, *Eggleston 1209, 2661;* Weybridge, 1902, *Eggleston 2893.*

Rubus pergratus Blanch. This seemed to me for a long time as the hybrid of *R. canadensis* and *R. nigrobaccus* and it resembles in many points that hybrid, but both Mr. Blanchard and Professor

Brainerd, who have studied the plant in the field, claim that it is perfectly distinct, rather common and well-fruiting, and the latter stated to me that it did not act as a hybrid. Furthermore, it is found higher up in the mountains than *R. nigrobaccus.* It differs from *R. canadensis* × *nigrobaccus* in being almost glandless. If glands are present, they are sessile or subsessile. It may have originated as a hybrid, but evidently now is an established species. *R. orarius* Blanch., I think, should be referred here. The only difference is the somewhat broader leaflets.

Rubus amicalis Blanch. This was first described as *R. amabilis*, which name, however, was preoccupied and *R. amicalis* was substituted. It is closely related to *R. canadensis*, but is best kept distinct, although the characters are not very strong. It has a very limited distribution in the north. The following specimens belong to it.

NOVA SCOTIA: Digby 1909, *Blanchard 714;* road from Brazil Lake to Ohio, *Blanchard 713;* Kentville, *Blanchard 716;* Bridgetown, *Blanchard 715;* Pictou, *Blanchard 717;* between Antigonish and Lochaber, 1906, *C. B. Robinson 468;* Maybou. *C. B. Robinson 232.*

NEW BRUNSWICK: St. Stephens, 1909, *Blanchard 607;* Painsic Junction, *Blanchard 602;* Grand Bay, *Blanchard 609.*

MAINE: Kennebunk, 1905, *Blanchard 75;* Isle au Haut, 1909, *Arthur 50, 58.*

To this species I also refer some odd forms from Newfoundland with nearly unarmed stems 1–1.5 cm. in diameter, coarser toothed leaves and leafy inflorescence. Such are:

NEWFOUNDLAND: Topsail, 1901, *Howe & Lang, 1232, 1330.*

Rubus canadensis L. The history of this species has been given by Bailey and Blanchard, so nothing more needs to be said. *R. Millspaughi* Britton was based on southern specimens. These cannot be separated from the northern plant, not even as a variety.

Rubus elegantulus Blanch. This might be of a hybrid origin, the parents being *R. canadensis* and *R. nigricans* or *R. vermontanus*, but it is now a well established species and differs in many respects from the hybrids of those species. The stem is armed with weak prickles rather than bristles, and these are confined to the angles of the stem. It resembles *R. canadensis* × *nigricans* most, but the inflorescence does not have the gland-bearing bristles of the inflorescence of nearly all of the *R. nigricans* hybrids.

VERMONT: Londonderry, *Blanchard 248, 249;* Westminster, *Blanchard 185;* South Windham, *Blanchard 215, 216;* Strattom, *Blanchard 217;* Townsend, *Blanchard 214.*

NEW HAMPSHIRE: Alstead and Windham, *Blanchard 60, 220, 218.*

MAINE: Isle au Haut, 1909, *Arthur 51.*

MASSACHUSETTS: Southwick, *Blanchard 253.*

Rubus Randii (Bailey) Rydb. This may be a form or variety of *R. canadensis*, but to me it seems unlikely. The slender subherbaceous habit and light-green leaves and usually light-colored stem suggest distinctiveness enough, especially as I have seen them both growing in the same localities in the Little Moose Lake region of the Adirondacks.

NOVA SCOTIA: Halifax Harbor, 1901, *Howe & Lang 1578.*

MAINE: Mount Desert Island, *Rand & Redfield.*

VERMONT: Middlebury, 1899, *Brainerd;* Putney, 1902, *Blanchard 188;* Abby Pond, Ripton, 1898, *Brainerd;* Rutland 1900, *Eggleston 1994.*

MASSACHUSETTS: Dalton, 1903, *Blanchard 238.*

NEW YORK: Tannersville, 1906, *Rydberg 8018;* East Lake, Little Moose Lake region, *Rydberg 7866;* Lime Kiln Falls, *Rydberg 7894.*

PROCUMBENTES

Rubus cymosus Rydb. Until lately there was in southern Mexico only one species of *Rubus* of the northern dewberry type with thin deciduous few-nerved leaves, viz., *R. humistratus*. *R. cymosus*, however, cannot be confused with *R. humistratus*, for in the former the prickles are stout, flat, and strongly curved, but in the latter, straight and slender;. in the former the flowers are several and cymose, in the latter usually solitary. *R. cymosus* is known only from the type collection.

Rubus oligospermus Thornber. This has been known for half a century, but has been confused with *R. trivialis* and *R. humifusus*. It does not have the solitary flowers of these two species, however, nor the evergreen leaves of *R. trivialis*, nor the slender habit and the weak straight prickles of *R. humifusus*. It was first collected by Thurber on the Mexican Boundary Survey. The following specimens belong to it.

DURANGO: City of Durango and vicinity, 1896, *Palmer 10.*

ARIZONA: Santa Rita Mountains, 1881, *Pringle;* Santa Catalina Mountains, 1881, *Pringle;* 1908, *Livingston & Thornber;* Huachuca Mountains, 1909, *Goodding 439.*

SAN LUIS POTOSI: *Schaffner 105, 474;* 1878, *Parry & Palmer 224.*

SONORA: Nogales, 1893, *Mearns 2640.*

Rubus rhodophyllus Rydb. This is a rare species and might have been taken for a prostrate form or a hybrid of *R. argutus*, but that species is not found in Mississippi. As it was for years known from only one collection, it might have been considered a freak, if it had not also been collected in Florida.

MISSISSIPPI: Point St. Martin, 1898, *Tracy 4107.*

FLORIDA: Duval County, 1894, *Fredholm, 458.*

Rubus invisus Bailey is a rather local and variable species and acts in certain ways as a hybrid. One of the parents might be *R. procumbens* or *R. Baileyanus*, but I know of no species that could be suggested as the other parent, as the coarse rather regular toothing of the leaves is unique. The following specimens belong here:

ONTARIO: Niagara Falls, 1901, *Macoun 34777.*

MASSACHUSETTS: Northampton, 1904, *Andrews 40.*

VIRGINIA: near Luray, 1901, *Steele 194.*

NORTH CAROLINA: Biltmore, 1896, *Biltmore herbarium 7994^e.* (This was originally labeled *R. Baileyanus* Britt. Later somebody has written in lead pencil, *R. Boyntoni* Ashe.)

Rubus Baileyanus Britton is not a very uncommon species, although its range north and south is rather narrow. It resembles in that respect *R. frondosus*, which represents it among the erect blackberries. The broad cordate or subcordate terminal leaflets of the new shoots, the thin pubescent leaves, the large unifoliolate leaves of the inflorescence and the more or less glandular pedicels distinguish this from all the dewberries, except *R. invisus*, from which it differs in the toothing of the leaves.

Rubus arenicola Blanch. This is a rather local species and may be of hybrid origin, but I do not know what parents to suggest. It is related to *R. Baileyanus* and *R. procumbens*. The former is not found in the region where *R. arenicola* grows. It could be a hybrid between *R. procumbens* and *R. hispidus*, if the leaves were not rather densely hairy. It is, therefore, best to regard it as a distinct species.

NOVA SCOTIA: Granville, *Blanchard 731.*

ONTARIO: Humber River, *J. White 73076.*

MAINE: York Beach Summit, 1909, *Blanchard 515;* Kennebunk, 1905, *Blanchard 63.*

Rubus plicatifolius Blanch. This was first described by Aiton as *R. villosus*, but there is an older *R. villosus* of Thunberg, and the name is therefore not available. In this country the name *R. villosus* Ait. has usually been applied to *R. nigrobaccus*, sometimes to *R. argutus*. Professor Bailey discovered that the original *R. villosus* Ait. was not a blackberry but a dewberry. Aiton's plant has decidedly pubescent leaves, but Professor Bailey did not think this character was very important and therefore regarded it as a form of *R. procumbens* to which he applied the name *R. villosus*. *R. plicatifolius* is a northern plant, in the southern part of the range, limited to the mountain regions.

QUEBEC: island in Gatineau River, near Chelsea, 1906, *Rydberg 7941, 7932;* Kingsmere Lake, *Rydberg 7942.*

NOVA SCOTIA: Annapolis 1909, *Blanchard 732;* Dartmouth, *729.*

MAINE: Wells Beach, 1905, *Blanchard 64;* Bingham, *511;* Veazie, 1905, *Knight.*

NEW YORK: Tannersville, 1906 and 1908, *Rydberg 7959, 7980, 7963, 8018.*

NEW JERSEY: Budds Lake, 1905, *Mackenzie 1333.*

MINNESOTA: Centerville 1891, *Sandberg 697;* Basswood Lake, 1891, *F. E. Wood.*

Rubus aboriginum Rydb. resembles in many respects *R. Baileyanus*, especially in the texture and pubescence of the leaves, the foliaceous inflorescence, and the large flowers, but differs in the absence of glandular hairs, and in the ovate instead of broadly cordate terminal leaflet of the new shoots. The leaves of the inflorescence are not so broad.

OKLAHOMA: "Indian Territory," chiefly on the False Washita between Fort Cobb and Fort Arbuckle, 1868, *Palmer 68, 69.*

KANSAS: Riley County, 1895, *Norton 136;* Pottawatomie County, 1895, *Hitchcock 971.*

Rubus heterophyllus Willd. This is related to *R. procumbens*, but differs in the incised toothing of the leaves. It is not so common. *R. heterophyllus* was for a long time a so-called "lost" species. Nobody seemed to know what it was. Bailey thought that it must have been a hybrid of *R. procumbens*. For some time, I held the opinion that it must be either *R. procumbens* or else *R. villosus michiganensis* Card. The latter was described independently by Blanchard as a species under the name *R. geophilus*, though the type of the latter has less harsh leaves than usual. A photograph of the type of *R. heterophyllus* was kindly sent me from the Botanical Garden at Berlin, and this shows, without doubt, that it is the same as *R. villosus michiganensis* and *R. geophilus*.

Rubus flagellaris Willd. This species has also been lost for about one hundred years. Professor Bailey thought that it was not American, at least no specimens had he seen in any of the herbaria, and I have not seen any but those collected by Mr. Bicknell, who rediscovered it on Long Island and Nantucket Island. Some of his specimens match closely the illustration prepared by Professor Bailey from the type. It also agrees with Willdenow's description.

Rubus procumbens Muhl. This name appears first in Muhlenberg's catalogue of 1813, without a description. It was given as a synonym under *R. trivialis* in Bigelow's Florula Bostoniensis in 1914, Bigelow mistaking this species for *R. trivialis* Michx. The first description under the name *R. procumbens* appeared in Barton's Flora of Philadelphia. Torrey and Gray mistook it for *Rubus canadensis*. This mistake was pointed out by Professor Bailey, who adopted the name *R. villosus* Ait., not believing that the more pubescent plant, *R. plicatifolius*, was distinct. *R. villosus*, however, is not available, as there was an older *R. villosus* Thunb. I myself thought that *R. procumbens* Muhl. was the pubescent plant, wherefore I redescribed the present species under the name *R. subuniflorus*. It is evident, however, that Barton described the glabrate plant. *R. procumbens* is the most widely distributed of our dewberries.

Rubus Enslenii Tratt. This is mainly a southern species extending along the coast as far up as to Nantucket Island.

Bailey regarded this and *R. Baileyanus* identical, and Mr. Blanchard includes it in *R. procumbens*. Mr. Bicknell and myself think it distinct. It has the thin leaves of *R. Baileyanus*, but they are narrower and almost glabrous. The leaves of the new shoots are often but three-foliolate and the shoots themselves are often erect at first. The thin leaflets of a different shape distinguish them. In the southern states it is, next to *R. trivialis*, the most common dewberry. The following northern specimens belong to it.

MISSOURI: Forest Hill Cemetery, Jackson County, 1897, *Mackenzie;* Butler County, 1905, *Bush 2562 B;* St. Louis, 1878, *Eggert.*

NEW YORK: Bronx Park, 1906, *P. Wilson.*

MASSACHUSETTS: Pine Grove, Nantucket Island, 1908, *Bicknell 14;* below the cliff, Nantucket Island, *Bicknell 13.*

Rubus huministratus Steud. This species was first described under the name *R. humifusus*. As that name had already been used, Steudel substituted *R. humistratus*. It is easily distinguished from the other Mexican species by its slender habit, weak prickles and solitary flowers.

OAXACA: Puerto de Laskopa, 1842, *Liebman 1625.*

VERA CRUZ: Jalapa, 1899, *Rose & Hough 4364, 4935.*

HISPIDI

Rubus nigricans Rydb. This was first described as *R. hispidus erectus* by Professor Peck. Dr. Britton thought that it was identical with *R. setosus* Bigelow, but in separating the specimens in the Torrey herbarium, he placed some specimens collected by Bigelow with *R. hispidus*, not noticing that these were part of the type of *R. setosus*. Britton has been followed by Blanchard, Brainerd, and others. *R. setosus* is in reality closer to *R. hispidus* (except for the semi-persistent leaves of the latter) than to *R. nigricans*. Fernald, in the new Gray's Manual, has misunderstood *R. nigricans* and adopted the name for *R. vermontanus*. *R. Groutianus* I regard as a nearly glandless form of this species.

Rubus setosus was described in the second edition of Bigelow's Florula Bostoniensis. Dr. Britton for some time regarded this as the same as *R. nigricans* but later adopted Bicknell's view that it was a hybrid between that and *R. hispidus*. Blanchard and

Brainerd still regard it as the same as *R. nigricans*. The two are species, however, not quite identical. *R. setosus*, of which there are two sheets from the original collection in the Torrey herbarium, is a more slender plant with racemose inflorescence and thinner leaves. The flowers themselves resemble more those of *R. hispidus*. I would have been inclined to regard *R. setosus* as a freak or local form, if I had not collected the same form myself and been unable to refer the specimens to either *R. hispidus* or *R. nigricans*. The following I take to belong here:

New York: Tom Peck's Pond, near Lake Placid, 1906, *Rydberg 7952;* Long Pond, *Rydberg 7949, 7948;* Lime Kiln Falls, vicinity of Little Moose Lake, *Rydberg 7895;* Twin Lakes, *Rydberg 7823.*

Connecticut: Southington, 1904, *Andrews 25.*

Rubus vermontanus Blanch. As said before this was mistaken for *R. nigricans* by Fernald, but is evidently distinct. It is a species confined to the northern woods.

Vermont: Ripton, 1897, *Brainerd 201;* South Wadsboro and Grafton, 1902, *Blanchard 176;* Lily Pond, Westminster, *Blanchard 2;* West Jamaica and Ripton, 1902, *Blanchard 176;* Londonderry, 1903, *Blanchard 245;* Brookline, 1902, *Blanchard 58* (set 1); Grafton and Rockingham *Blanchard 58;* Mendon and Wallingford, 1900, *Eggleston 2007, 2006, 2857, 2858.*

Canada: *Macoun 5793, 6097, 19072.*

Rubus hispidus L. This species is very well known and nothing further needs to be said.

Triviales

Rubus lucidus Rydb. This is the same as *R. trivialis β.* of Hooker's Compendium and *R. persistens*, partly, of Small's Flora. The latter was based on this and some hybrid forms. Unfortunately, one of the latter was assigned as the type, and hence this species needed another name. It has also been confused with *R. trivialis*, but never bears any bristles, and the flowers are seldom solitary as in that species. The following specimens belong here:

Florida: Dunedin, 1900, *Tracy 6855;* Tampa, 1903, *Britton, Britton & Shafer 19.*

Alabama: Auburn, 1897, *Earle & Baker* (mixed with *R. trivialis*).

MISSISSIPPI: Biloxi, 1898, *Tracy 4106.*

SOUTH CAROLINA: Hilton Head, 1864, *Eaton.*

Rubus trivialis Michx. is well known, although *R. lucidus* and *R. carpinifolius* have been mistaken for it. It is very variable as to the width of the leaflets. A peculiar form with narrowly lanceolate leaflets has been collected in Louisiana and Mississippi. It may represent a distinct species, but the material is too meager. The specimens of this form are the following:

LOUISIANA: Cat Island, Mississippi Delta, 1900, *Lloyd & Tracy 263.*

MISSISSIPPI: Biloxi, 1898, *Tracy 4114.*

Rubus carpinifolius Rydb. This is closely related to *R. lucidus*, but differs in the double-toothed leaflets of the new shoots. It is also sometimes as bristly as *R. trivialis.* The following specimens belong here:

TEXAS: New Brunnfels, 1850, *Lindheimer 791;* San Antonio, 1853, *Thurber;* Gillespie County, *Jermey* (named *R. occidentalis*); San Felipe, 1839, *Lindheimer.*

ARKANSAS: Fort Smith, 1853, *Bigelow* (Whipple Exp.).

MISSOURI: Eagle Rock, 1896, *Bush 18;* White River, 1896, *Mackenzie.*

LOUISIANA: Alexandria, 1899, *Ball 428.*

Rubus rubrisetus Rydb. is a very rare and local species. Only the following specimens have been seen:

MISSOURI: St. Louis, 1874, *O. Kuntze 2789; Bush 116.*

LOUISIANA: 1885, *Poggenburg; Biltmore herbarium 4488*^{c}.

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STUDIES OF WEST INDIAN PLANTS—VI

NATHANIEL LORD BRITTON

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Studies of West Indian plants—VI

NATHANIEL LORD BRITTON

35. THE GENUS COCCOLOBIS IN CUBA

A. Leaves 2–13 mm. long; inflorescence one- to three-flowered [RHIGIA].
  Leaves spinulose-mucronate. 1. *C. armata.*
  Leaves emarginate at both ends. 2. *C. microphylla.*
B. Leaves 2 cm. long or longer; inflorescence many-flowered.
  1. Leaves spinulosemucronate.
    Racemes loosely flowered; leaves acute. 3. *C. pilonis.*
    Racemes densely flowered; leaves acuminate. 4. *C. woodfredensis.*
  2. Leaves not spinulose-mucronate.
    Leaves very large, suborbicular, deeply cordate; fruit large; halophytic tree or shrub. 5. *C. Uvifera.*
    Leaves smaller, rarely cordate; fruit small; mesophytes.
      Pedicels filiform, in fruit 8-12 mm. long, as long as the fruit or longer.
        Leaves flat, their margins not revolute. 6. *C. coriacea.*
        Leaves bullate, their margins strongly revolute. 7. *C. Cowellii.*
      Pedicels shorter than the fruit.
        Rachis of the raceme glabrous.
          Leaves almost veinless above, few-veined beneath, rounded, or emarginate. 8. *C. nipensis.*
          Leaves reticulate-veined on both sides.
            Fruiting pedicels 2.5–4 mm. long; fruit 8–12 mm. long. 9. *C. laurifolia.*
            Fruiting pedicels 1.5 mm. long or less; fruit smaller.
              Leaves obtuse or emarginate at apex, obtuse at base. 10. *C. retusa.*
              Leaves acuminate or acute.
                Leaves acuminate at both ends. 11. *C. cubensis.*
                Leaves acute at apex, oblique at base. 12. *C. colomensis.*

Rachis of the raceme puberulent or pubescent (or glabrous in *C. Wrightii* ?).
Raceme stout, 8–20 cm. long; leaves 8–17 cm. long; flowers sessile.
Leaves loosely reticulate-veined; flowers white. 13. *C. costata.*
Leaves densely reticulate-veined; flowers bright red. 14. *C. Shaferi.*
Raceme slender, shorter; leaves smaller.
Leaves not reticulate-veined above.
Raceme geniculate. 15. *C. geniculata.*
Raceme not geniculate.
Fruiting pedicels less than 0.5 mm. long. 16. *C. rufescens.*
Fruiting pedicels 1–2 mm. long.
Leaf-margins reflexed. 17. *C. reflexa.*
Leaf-margins not reflexed. 18. *C. praecox.*
Leaves reticulate-veined above.
Leaves short-acuminate. 19. *C. benitensis.*
Leaves acute or obtuse.
Pedicels 0.8 mm. long or less.
Leaves coriaceous, oblong-lanceolate, 5 cm. long or less. 20. *C. pallida.*
Leaves chartaceous, ovate or elliptic, larger.
Racemes as long as the leaves or longer; petioles 5–10 mm. long. 21. *C. diversifolia.*
Racemes shorter than the leaves; petioles 3 mm. long or less. 22. *C. brevipes.*
Fruiting pedicels 1.5–3 mm. long. 23. *C. Wrightii.*

1. C. ARMATA C. Wright; Griseb. Cat. Pl. Cub. 62, 283. 1866

TYPE LOCALITY: Near San Marco.

DISTRIBUTION: Dry, rocky hills, Oriente, Santa Clara. Endemic.

The plant becomes much larger than the original description indicates; on the Rio San Juan, Santa Clara, it forms a tree 6 m. high, and on the United States Naval Station, Guantanamo Bay, Oriente, trees up to 10 m. high were observed.

2. C. MICROPHYLLA C. Wright; Griseb. Cat. Pl. Cub. 62. 1866

TYPE LOCALITY: Western Cuba.

DISTRIBUTION: Coastal thickets, Santa Clara, Pinar del Rio. Endemic.

At Coloma, Pinar del Rio, forms a virgate tree 5 m. high.

3. C. PILONIS Urban, Repert. 13: 445. 1914

TYPE LOCALITY: Loma Pilon, near Holguin, Oriente.

DISTRIBUTION: Barren rocky soil, Oriente, Santa Clara (?). Endemic.

The Santa Clara specimens, collected near the city of Santa Clara (*Britton & Wilson 6189*, *Britton & Cowell 13325*), are in foliage only and thus not determinable with certainty.

Both this species and the following one are related to *C. flavescens* Jacq., of Hispaniola. The type is from a shrub 1.6 m. high.

4. **Coccolobis woodfredensis** sp. nov.

Similar to *C. pilonis*, and to *C. flavescens* Jacq. (of Hispaniola), the leaves spinulose-mucronate. A shrub, 6 m. high, glabrous throughout, the rather stout branches zig-zag; leaves coriaceous, ovate to ovate-lanceolate, 3–6 cm. long, shining above, dull beneath, inconspicuously veined, the under surface very finely reticulated, the apex spinulose-mucronate, the base rounded, obtuse or subcordate, the stout petioles scarcely 2 mm. long; racemes very narrow, 3–4 cm. long, densely many-flowered; fruiting pedicels about 1 mm. long; old fruit ovoid, acutish, 4 mm. long, 2 mm. thick.

Dry rocky hillside, between Piedra Gorda and Woodfred, Sierra Nipe, Oriente, 400–500 m. alt. (*Shafer 3180*).

5. C. UVIFERA (L.) Jacq. Enum. 19. 1760

TYPE LOCALITY: Shores of the Caribbean Sea.

DISTRIBUTION: Coastal thickets, all provinces and Isle of Pines; occasionally on hillsides back from the coasts: Florida; West Indies; continental tropical America.

6. C. CORIACEA A. Rich. in Sagra, Hist. Cub. 11: 184. 1850

C. calobotrys Meisn. in DC. Prodr. 14: 157. 1857.

TYPE LOCALITY: Vuelta de Abajo, Cuba.

DISTRIBUTION: Pinar del Rio (?), Havana, mountains of Oriente. Endemic.

Meisner cites Sagra's Nos. 290 and 544, on which he based *C. calobotrys*, from the vicinity of Havana, but the plant is not known to grow in Havana Province. I have not seen the type specimens. A specimen from Ensenada de Mora, Oriente (*Britton, Cowell & Shafer 13003*), is from a slender tree 7 m. high.

7. **Coccolobis Cowellii** sp. nov.

A glabrous shrub, 1.5 m. high, with few, stout, ascending branches. Leaves thick-coriaceous, shining, deeply cordate at the nearly sessile base, bullate, with strongly revolute margins, diversiform, some ovate to ovate-elliptic, 5–9 cm. long, rounded at the apex, some elongated-lanceolate, attenuate-acuminate, 10–18 cm. long; principal venation impressed above, prominent beneath; ultimate venation obscure on both surfaces; racemes terminal, nearly sessile, 1–3 dm. long, the rachis and pedicels glabrous; pedicels filiform, 3–6 mm. long, spreading; bracts scarcely 1 mm. long, ovate, acute, about as long as the nearly truncate ochreolae; flowers bright red, 3 mm. long; perianth-lobes oblong, obtuse; fruit ovoid, acute, 4 mm. long, crowned by the calyx-lobes.

Barren rocky soil, savannas near Camaguey (*Britton & Cowell 13151*).

8. C. NIPENSIS Urban, Repert. **13**: 445. 1914

TYPE LOCALITY: Pine lands, 500–650 m. alt., Sierra Nipe, near Woodfred, Oriente.

DISTRIBUTION: Mountains of northern Oriente. Endemic.

This species is noted by Dr. Shafer as forming a tree up to 10 m. high.

9. C. LAURIFOLIA Jacq. Hort. Schoen. 3: 9. *pl. 267*. 1798

C. floridana Meisn. in DC. Prodr. **14**: 165. 1857.

TYPE LOCALITY: Caracas.

DISTRIBUTION: Thickets and woodlands at lower elevations near the coasts, Oriente, Camaguey, Matanzas, Isle of Pines: Florida; Bahamas; Jamaica; Hispaniola to St. Croix; Venezuela.

10. C. RETUSA Griseb. Cat. Pl. Cub. 61. 1866

C. leoganensis parvifolia Griseb. Cat. Pl. Cub. 61. 1866. Hyponym.

TYPE LOCALITY: Eastern Cuba.

DISTRIBUTION: Thickets and hillsides, Oriente, Santa Clara, Pinar del Rio: Hispaniola (?).

11. C. CUBENSIS Meisn. in DC. Prodr. 14: 162. 1857

TYPE LOCALITY: Cuba [near Santiago].

DISTRIBUTION: Oriente. Endemic.

Dr. Shafer's *4229*, from rich woods in the alluvial valley of Rio Yamaniguey, northern Oriente, referred to this species from description, is from a tree 5 m. high.

12. **Coccolobis colomensis** sp. nov.

A glabrous shrub, 2 m. high, with slender twigs. Leaves chartaceous, ovate to elliptic, 4–10 cm. long, bluntly acute at the apex, obliquely obtuse at the base, strongly reticulate-veined and shining on both sides, the rather stout petioles 6–10 mm. long; racemes glabrous, terminal, nodding, much shorter than the leaves, 5 cm. long or less; ochreolae less than 0.5 mm. long; pedicels about 1.5 mm. long, spreading; flowers about 1 mm. long, the ovate perianth-lobes as long as the tube; anthers not exserted; young fruit ovoid, about 3.5 mm. long, short-coronate.

Marsh near Coloma, Pinar del Rio (*Britton & Gager 7037*).

13. C. COSTATA C. Wright; Sauvalle, Anales Acad. Habana 7: 343. 1870

C. leoganensis cordata Griseb. Cat. Pl. Cub. 61. 1866. Hyponym.

TYPE LOCALITY: Cuba [*C. Wright 1393*, eastern Cuba].

DISTRIBUTION: Mountains of Oriente; Porto Rico.

Dr. Shafer's *3084*, which satisfactorily matches *Wright 1393*, is from a tree 8 m. high, at 400–500 m. alt. on the Sierra Nipe, in dry rocky thickets; he noted the flowers as white and the fruit red-black.

14. **Coccolobis Shaferi** sp. nov.

A shrub or small tree up to 4 m. high, the twigs and leaves glabrous. Leaves coriaceous, ovate or ovate-elliptic to lanceolate, 12 cm. long or less, strongly and rather densely reticulate-veined on both sides, obtuse, acute or acuminate at the apex, cordate at the base, the stout petioles about 1 cm. long; spikes dense, slender, 6–12 cm. long, the rachis, bracts and ochreolae puberulent; flowers bright red, sessile, about 5 long, the short perianth-lobes rounded.

Hillsides and thickets, northern Oriente.

Type, *Shafer 4165*, from between Camp Toa and Camp La Barga, 400–450 m. alt.

15. C. GENICULATA Lindau, Bot. Jahrb. **13**: 141. 1891

TYPE LOCALITY: Near Puerto Principe, Cuba.

DISTRIBUTION: Known only from the type locality.

Referred by Grisebach to *C. punctata parvifolia* Griseb.

16. C. RUFESCENS C. Wright; Sauvalle, Anales Acad. Habana **7**: 343. 1870

C. punctata parvifolia Griseb. Mem. Am. Acad. II. **8**: 175. 1860.
C. rufescens longifolia Lindau, Bot. Jahrb. **13**: 143. 1891.

TYPE LOCALITY: Cuba.

DISTRIBUTION: Mountains of Oriente. Endemic.

17. C. REFLEXA Lindau, Bot. Jahrb. **13**: 141. 1891

TYPE LOCALITY: Cuba [*Wright 2256*].

DISTRIBUTION: *Britton & Cowell 13115*, from a tree 6 m. high, in savannas near Camaguey, appears to be the same as *Wright 2256*.

18. C. PRAECOX C. Wright; Lindau, Bot. Jahrb. **13**: 142. 1891

TYPE LOCALITY: Cuba.

DISTRIBUTION: Known only from the type specimens (*Wright 2253*).

19. **Coccolobis benitensis** sp. nov.

A much-branched shrub, up to 2 m. high, the twigs more or less tortuous, glabrous. Leaves coriaceous, ovate, or elliptic-ovate, 1.5–7 cm. long, glabrous, punctate, short-acuminate at the apex, rounded or obtuse at the base, densely prominently reticulate-veined on both sides, the primary veins prominent beneath, the petioles 1.5–4.5 mm. long; spike-like racemes very slender, short-stalked, 4 cm. long or less, the ochreae and rachis puberulent; flowering pedicels scarcely longer than the ochreolae, 0.5 mm. long or less; fruiting pedicels 1–1.5 mm. long; perianth (young) about

0.5 mm. long; fruit ovate-ellipsoid, 5–6 mm. long, about 3 mm. thick, dark red.

Wet mountains of northern Oriente. Type from vicinity of Camp San Benito, 900 m. alt. (*Shafer 4049*).

20. C. PALLIDA C. Wright; Griseb. Cat. Pl. Cub. 61. 1866

TYPE LOCALITY: Western Cuba, near San Marco.

DISTRIBUTION: Known only from the type locality [*Wright 2254*].

21. C. DIVERSIFOLIA Jacq. Enum. 19. 1760

TYPE LOCALITY: Caribbean Islands.

DISTRIBUTION: Cuba, collected by Read, according to Lindau: Bahamas; Jamaica; Hispaniola; Porto Rico; Vieques; St. Thomas; St. Jan; St. Croix; Saba; Anguilla (?); Antigua; Montserrat; Guadeloupe; Dominica; Martinique; St. Lucia; Barbadoes; Bonaire; Curaçao; Aruba. Planted in Bermuda.

22. **Coccolobis brevipes** sp. nov.

Twigs slender, densely puberulent. Leaves chartaceous, elliptic, 3–7 cm. long, bluntly acute at the apex, obliquely narrowed or rounded at the base, shining above, glaucescent beneath, glabrous and strongly reticulate-veined on both sides, the principal veins prominent beneath; petioles stout, 2–3 mm. long; racemes terminal, about 5 cm. long, densely puberulent; bracts puberulent, acute, scarcely 1 mm. long; ochreolae about as long as the bracts; flowering pedicels 0.5–0.8 mm. long; flowers about 1.5 mm. long, the perianth-lobes ovate.

Cuba (*Wright 2257* in herbarium of the Missouri Botanical Garden). Lindau, in Bot. Jahrb. **13**: 152, cites this number as part of *C. Wrightii* Lindau, but the specimen here described is different from *Wright 1395*, the type of *C. Wrightii*.

C. brevipes is similar to *C. rufescens* C. Wright in leaf-form and pubescence, but the venation is quite different.

23. C. WRIGHTII Lindau, Bot. Jahrb. **13**: 151. 1891

TYPE LOCALITY: Near Monte Verde, Oriente.

DISTRIBUTION: Mountains of northern Oriente.

Referred by Grisebach to *C. tenuifolia* L.

36. ADDITIONAL SPECIES OF TABEBUIA Gomez

The type species is *Bignonia Tabebuya* Vell., of Brazil, a species with simple leaves. It is not possible to separate the group into two genera, the one with simple, the other with compound leaves, as has been proposed by several authors,* calling the compound-leaved species Tecomas, and the true type of *Tecoma* Juss. is *Bignonia stans* L. (*Tecoma stans* HBK., *Stenolobium stans* Seem.). The two-lipped calyx of the type species of *Tabebuia* is not constant through the group.

Tabebuia Brooksiana sp. nov.

A tree, up to 30 m. high. Leaves 4–7-foliolate; petioles 12 cm. long or less; petioles slender, 1–4 cm. long; leaflets oblong, oblong-lanceolate or oblong-oblanceolate, chartaceous, 5–12 cm. long, 4 cm. wide or less, faintly shining above with the veins impressed, dull, mostly finely reticulate-veined when mature, and lepidote beneath, with the midvein and lateral veins prominent, obtuse, acute or retuse at the apex, the base obtuse or acutish; flowers clustered; calyx 2-lipped, 10–15 mm. long; corolla pink, 5–6 cm. long, the tube about 5 mm. long, the narrowly campanulate throat about 3.5 cm. long, the limb about 1.5 cm. long, its undulate lobes ciliolate.

Woodlands, provinces of Oriente and Camaguey, Cuba, from sea-level up to 350 m. altitude. Type from Ensenada de Mora, Oriente (*Britton, Cowell & Shafer 12985*). Referred by Grisebach to *Tecoma Leucoxylon* Mart. and to *T. Leucoxylon reticularis* Griseb. The species is named in honor of Mr. Theodore Brooks of Guantanamo, who has rendered important aid to scientific exploration. *Tecoma heptaphylla* A. Rich. in Sagra, Hist. Cub. 11: 106 (not Martius), described as with 7-foliolate leaves from Vuelta de Abajo (Pinar del Rio), Cuba, is not known to me; I have seen no species with 7-foliolate leaves from western Cuba.

Tabebuia Shaferi sp. nov.

A tree, up to 10 m. high. Larger leaves 6–8-foliolate; petioles 3–4 cm. long; petiolules 2 cm. long or less; leaflets ovate-oblong to suborbicular, chartaceous, the larger 6 cm. long, 3–5 cm. wide, dark green above, paler beneath, minutely and densely reticulated

* See Urban, Symb. Ant. 7: 377.

on both sides, the midvein impressed above, prominent beneath, the apex rounded or obtuse, the base subcordate; "flowers pinkish"; capsule 12 cm. long; seeds 5 mm. long, 7 mm. wide, the wings 5 mm. wide.

Along a small stream in the Pinales southeast of Paso Estancia, Oriente, Cuba (*Shafer 1710a*). Apparently the same as *C. Wright 3043*, referred by Grisebach to *Tecoma Leucoxylon* Mart., *forma foliolis latioribus*.

Tabebuia pachyphylla sp. nov.

A tree, up to 12 m. high. Petioles stout, 6–8 cm. long; petiololes stout, 4 cm. long or less; leaflets 5–7, oblong to ovate-oblong, coriaceous, 5–12 cm. long, 2.5–6 cm. wide, lustrous above, dull and densely minutely reticulate-veined beneath, the midvein prominent, the lateral veins slender, the apex bluntly acute, the base rounded or subcordate; flowers pink, clustered; calyx 15 mm. long, bluntly lobed; corolla pink, glabrous, about 5 cm. long, its narrow throat about twice as long as the limb, its lobes rounded.

Mountains of northeastern Cuba. Type specimen collected at Arroyo del Medio, Sierra Nipe, Oriente, Cuba, 450–550 m. alt. (*Shafer 3645*).

Tabebuia trinitensis sp. nov.

A tree up to 10 m. high. Leaves 4-foliolate or 5-foliolate; petioles slender, 8–11 cm. long; petiolules slender, 4 cm. long or less; leaflets thin-chartaceous, oblong or oblong-lanceolate, dark green above, paler and lepidote beneath, the larger ones 11–15 cm. long, 3–4 cm. wide, bluntly acute or acuminate at the apex, obtuse at the base, finely reticulate-veined and the primary venation rather prominent on both sides.

Hanabanilla Falls, Trinidad Mountains, province of Santa Clara, Cuba (*Britton, Earle & Wilson 4866*).

The description is from leaf-specimens only but these indicate that the tree is a species distinct from all others of Cuba. The ultimate venation and texture of the leaflets differentiate it from *T. Brooksiana* Britton.

Tabebuia calcicola sp. nov.

A slender tree, up to 6 m. high. Leaves 2–5-foliolate; petioles stout, lepidote, 4–5 cm. long; petiolules lepidote, 1.5 cm. long or less; leaflets coriaceous, light green, ovate to ovate-oblong, 3.5–8 cm. long, 5 cm. wide or less, acute or bluntish at the apex, rounded at the base, finely reticulate veined and densely lepidote on both sides, the primary venation impressed above, prominent beneath; flowers clustered; pedicels stout; calyx 12–14 mm. long, shortly 2-lipped; corolla about 5 cm. long, the tube about 5 mm. long, the campanulate white throat 3 cm. long, the pink limb about 1.5 cm. long, the undulate lobes ciliolate; capsule 10–14 cm. long.

Limestone rocks and cliffs, province of Pinar del Rio, Cuba. Type collected near Guane (*Britton & Cowell 9772*).

Tabebuia moaensis sp. nov.

A shrub, about 1 m. high. Leaves 3–5-foliolate; petioles stout, 2 cm. long or less; petiolules rather stout, 4–15 mm. long; leaflets elliptic to obovate, coriaceous, 3–5 cm. long, 1–2 cm. wide, lustrous above, dull and minutely reticulate-veined beneath, the primary venation not very prominent; calyx 10 mm. long, 2-lipped; corolla pink, about 4 cm. long, its rounded lobes ciliolate.

Camp La Gloria, south of Sierra Moa, Oriente, Cuba (*Shafer 8264*). This is, apparently, the same as *C. Wright 3047*, referred by Grisebach to *Tecoma haemantha*.

Tabebuia pinetorum sp. nov.

A shrub, about 2.6 m. high. Leaves 3-foliolate or 4-foliolate; petioles very stout, only 3 cm. long or less, petiolules stout, 3–8 mm. long; leaflets elliptic or ovate-elliptic, coriaceous, 5–14 cm. long, 2.5–8 cm. wide, shining above, obtuse, rounded or bluntly short-pointed at the apex, obliquely cordate at the base, dull, lepidote and finely reticulate-veined beneath, the primary venation impressed above, prominent beneath; peduncles stout; calyx 12 mm. long, somewhat 2-lipped; "flowers lilac"; pod 11 cm. long, about 1 cm. thick.

Pine woods, Baracoa, Oriente, Cuba (*Underwood & Earle 1362*).

Tabebuia arimaoensis sp. nov.

A small tree with slender, whitish twigs. Leaves 3-foliolate; petioles slender, 1–2.5 cm. long; leaflets subcoriaceous, shining above, with the midvein impressed dull beneath with the midvein prominent, lepidote on both sides, acute, the terminal one with a petiolule 2–5 mm. long, cuneate-oblanceolate, 4–5 cm. long, 8–12 mm. wide, the lateral ones sessile, narrowly oblong, inequilateral, obliquely narrowed at the base. Flowers and fruit unknown.

Rocky hillside, Rio Arimao, province of Santa Clara, Cuba (*Britton & Wilson 5797*).

Tabebuia arenicola sp. nov.

A tree 7 m. high. Leaves 3-foliolate; petioles slender, 1–2.5 cm. long; leaflets subcoriaceous, shining, sparingly lepidote, and obscurely veined above, dull, closely lepidote and with prominent midvein and slender lateral veins beneath, inconspicuously reticulate-veined, obtuse or emarginate at the apex, the terminal one oblanceolate, 6–7 cm. long, 1.2–2 cm. wide, acute at the base, with a petiolule 4–6 mm. long, the lateral ones oblong, 4–6 cm. long, sessile by a very oblique base.

Sandy plain, Conde Beach, Guantanamo Bay, Oriente, Cuba (*Britton 2142*).

Tabebuia geronensis sp. nov.

Twigs stout. Leaves 1–3-foliolate; petioles slender, 1 cm. long or less; in 3-foliolate leaves, the lateral leaflets sessile, the terminal one short-stalked; leaflets oblong to ovate-elliptic or ovate-oblong, subcoriaceous, 3.5–7 cm. long, 3 cm. wide or less, obtuse and rounded or apiculate at the apex, rounded, subcordate, or lateral ones obliquely narrowed at the base, dull on both sides, lepidote above, finely and strongly reticulate-veined and densely lepidote beneath; fruiting calyx densely lepidote, 1 cm. long; capsule 8–9 cm. long, about 8 mm. thick, with a slender tip 6 mm. long.

Nueva Gerona, Isle of Pines, Cuba (*A. H. Curtiss*, May, 1904).

Tabebuia Curtissii sp. nov.

Young twigs, leaves, pedicels and calyx densely lepidote-scurfy. Leaves 3-foliolate, or the upper and lower 1-foliolate; leaflets coriaceous, those of 1-foliolate leaves elliptic, 3–6 cm. long, obtuse at both ends, those of 3-foliolate leaves obovate or oblong-obovate, 8 cm. long or less, abruptly acute at the apex, narrowed at the base, the terminal one short-stalked, the lateral ones sessile, all smooth and shining above, dull, reticulate-veined and densely lepidote beneath; flowers in terminal clusters; pedicels 2 cm. long or less; calyx narrowly campanulate, 1.5 cm. long, its teeth triangular, acute; corolla 5 cm. long, its lobes broad and rounded.

Nueva Gerona, Isle of Pines, Cuba (*A. H. Curtiss*, May, 1904).

Tabebuia crassifolia sp. nov.

A tree, 5 m. high. Leaves simple, oblong-elliptic, coriaceous, 6–12 cm. long, 4.5 cm. wide or less, obtuse or emarginate at the apex, somewhat narrowed at the base, when young densely lepidote and dark green above, pale and more densely lepidote beneath; when old strongly shining, elepidote and with impressed midvein above, remaining densely lustrous-lepidote and with very prominent midvein beneath, the secondary venation slender, neither surface reticulate-veined, the stout lepidote petioles 10–14 mm. long; flower solitary in an upper axil, its slender peduncle 3 cm. long, bearing a linear bractlet 2 mm. long below the middle; calyx densely lepidote, 1 cm. long, lobed but scarcely two-lipped; corolla light purple, about 5 cm. long.

By a spring, barren savannas southeast of Holguin, Oriente, Cuba (*Shafer 1285*).

Tabebuia angustata sp. nov.

A tree up to 12 m. high. Leaflets 3–7-foliolate; petioles slender, 5–13 cm. long; petiolules slender, 5 cm. long or less; leaflets chartaceous, oblong or oblong-lanceolate, 5–18 cm. long, 9 cm. wide or less; dull on both sides, more or less lepidote, at least when young, densely and finely reticulate-veined beneath with a prominent midvein and slender lateral veins, the apex bluntly acuminate or acute, the base obtuse or acute; flowers clustered; calyx 2-lipped, 12–16 mm. long; corolla rosy-white, 5–6 cm. long, its narrow throat somewhat longer than the limb, its lobes ciliate; capsule 10–25 cm. long.

Woodlands and along streams at lower and middle elevations in wet or moist parts of Jamaica. Type collected on the southwestern slope of Dolphin Head (*Harris 9253*). This tree has been referred to *Tecoma platyantha* Griseb.

Tabebuia jamaicensis sp. nov.

A tree up to 12 m. high. Leaves 5-foliolate; petioles stout, 15 cm. long; petiolules stout, 2–9 cm. long; leaflets chartaceous, the three upper obovate, 18–23 cm. long, 9–12 cm. wide, somewhat narrowed at the base, the two lower ovate-elliptic, about 10 cm. long and 6 cm. wide, rounded or subtruncate at the base, all abruptly acuminate at the apex, finely reticulate-veined and loosely lepidote on both sides, the midvein and lateral veins prominent beneath; corolla whitish, glabrous, 5 cm. long, its cylindric tube about 8 mm. long, its campanulate throat 2.5 cm. long, its spreading limb about 1.5 cm. long, its lobes erose.

Hillside, Negril, Jamaica (*Britton 2020*). The description is based on one leaf and one flower.

Tabebuia actinophylla (Griseb.)

Tecoma actinophylla Griseb. Cat. Pl. Cub. 194. 1866.

TYPE LOCALITY: Western Cuba.

DISTRIBUTION: Limestone cliffs, province of Pinar del Rio, Cuba.

Tabebuia Sauvallei nom. nov.

Tecoma sanguinea C. Wright; Sauvalle, Anales Acad. Habana 6: 320. 1870. Not *Tabebuia sanguinea* DC.

TYPE LOCALITY: Border of Rio Carbuni, Manacal, near Trinidad, Cuba.

DISTRIBUTION: Hillsides and river banks, near Trinidad, province of Santa Clara, Cuba.

Tabebuia Buchii (Urban)

Tecoma Buchii Urban, Symb. Ant. 3: 375. 1903.

Known only from the type locality, dry calcareous mountains, Morne La Pierre, Haiti.

Tabebuia lepidota (HBK.)

Bignonia lepidota HBK. Nov. Gen. 3: 139. 1818.

Tecoma lepidota DC. Prodr. 9: 220. 1844.

TYPE LOCALITY: Havana, Cuba.

DISTRIBUTION: Barren soil, provinces of Camaguey, Santa Clara, Matanzas and Havana, Cuba; Bahamas.

Referred by Grisebach to *Tecoma lepidophylla* and to *Tecoma Leucoxylon* and by Combs to *Tabebuia lepidophylla*.

The species consists, apparently, of many races, differing in size, number and form of leaflets and size of flowers.

Tabebuia Berterii (DC.)

Tecoma Berterii DC. Prodr. 9: 220. 1845.

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Hispaniola, ascending to 1,200 m. altitude.

Tabebuia domingensis (Urban)

Tecoma domingensis Urban, Symb. Ant. **7**: 376. 1912.
TYPE LOCALITY: Near Barahona, Santo Domingo.
DISTRIBUTION: Known only from the type locality.

Tabebuia revoluta (Urban)

Tecoma revoluta Urban, Symb. Ant. **7**: 539. 1913.
TYPE LOCALITY: Between La Vega and Jarabacoa, Santo Domingo, at 700 m. alt.
DISTRIBUTION: Known only from the type locality.

Tabebuia acrophylla (Urban)

Tecoma acrophylla Urban, Symb. Ant. 3: 374. 1903.
TYPE LOCALITY: Mountains near Bilboro, Haiti, at 600 m. alt.
DISTRIBUTION: Known only from the type locality.

Tabebuia bibracteolata (Griseb.)

Tecoma bibracteolata Griseb. Cat. Pl. Cub. 193. 1866.
TYPE LOCALITY: Eastern Cuba.
DISTRIBUTION: Known only from the type specimens.

TABEBUIA HETEROPHYLLA (DC.) Britton, Ann. Mo. Bot. Gard. **2**: 48. 1915

Rapuntia (?) *heterophylla* DC. Mém. Mus. Paris **9**: 153. 1822.
Tabebuia triphylla DC. Prodr. **9**: 214. 1845. Not *Bignonia triphylla* L.

Sandy soil and rocky hillsides, Mona, Porto Rico, Vieques, Culebra, St. Thomas, St. Croix, St. Jan, Virgin Gorda, Anagada; recorded from St. Barts and Barbadoes.

Referred by Grisebach to *Tecoma Berterii* DC., and by Urban to *Tecoma Leucoxylon* (L.) Mart.; this is not *Tabebuia leucoxyla* DC. Prodr. **9**: 212.

Tabebuia myrtifolia (Griseb.)

Tecoma myrtifolia Griseb. Mem. Am. Acad. II. **8**: 524. 1862.
Tecoma lepidota myrtifolia Maza, Anal. Hist. Nat. Madrid **19**: 265. 1890.

? *Bignonia microphylla* A. Rich. in Sagra, Hist. Cub. **11**: 104. 1850. Not Lam.

TYPE LOCALITY: Matanzas, Cuba.

DISTRIBUTION: Coastal thickets, vicinity of Matanzas, Cuba.

Tabebuia platyantha (Griseb.)

Tecoma platyantha Griseb. Fl. Br. W. I. 447. 1864.
Tecoma Brittonii Urban, Symb. Ant. **5**: 496. 1908.
Tecoma Brittonii decussata Urban, loc. cit. 497. 1908.

TYPE LOCALITY: On rocks, St. James, Jamaica.

DISTRIBUTION: Rocky woodlands, central parishes of Jamaica.

Tabebuia bahamensis (Northrop)

Bignonia pentaphylla L. Sp. Pl., ed. 2, 870. 1763 (as to the Bahama plant of Catesby). Not *Tabebuia pentaphylla* (Juss.) Hemsl.
Tecoma bahamensis Northrop, Mem. Torr. Club **12**: 65. *pl. 15*. 1902.

TYPE LOCALITY: Near Nassau, New Providence, Bahamas.

DISTRIBUTION: Bahamas; Cuba.

37. THE GENUS ANASTRAPHIA D. Don

Type species: *Anastraphia ilicifolia* D. Don.

Founded on a specimen in the Lambertian Herbarium said to have come from South America; the plant was correctly attributed to Cuba by De Candolle (Prodr. **7**: 26. 1838).

1. Involucral bracts straight, erect or nearly so.
   Involucre 2.5–3 cm. long.
      At least some of the leaves spinulose-dentate.
         Involucre campanulate.
            All the involucral bracts lanate. — 1. *A. ilicifolia*.
            Only the outer bracts lanate, the inner glabrous.
               Leaves distinctly reticulate-veined above.
                  All the involucral bracts linear-lanceolate, acuminate and erect. — 2. *A. mantuensis*.
                  Outer involucral bracts lanceolate, merely acute, all somewhat spreading. — 3. *A. montana*.
               Leaves very indistinctly reticulate-veined above, but wrinkled; outer bracts ovate. — 4. *A. Cowellii*.
         Involucre long-attenuate at base, all its many bracts lanate. — 5. *A. attenuata*.

None of the leaves spinulose-dentate.
Involucral bracts tomentose. — 6. *A. Picardae.*
Inner involucral bracts glabrous. — 7. *A. crassifolia.*
Involucre 2 cm. long or less.
Involucre 1.5–2 cm. long.
Leaves or some of them 1.5–2 cm. long.
Inner involucral bracts obtusish or short-pointed. — 8. *A. oligantha.*
Inner involucral bracts acuminate. — 9. *A. bahamensis.*
Leaves 12 mm. long or less.
Leaves strongly spinulose-dentate. — 10. *A. calcicola.*
Leaves repand-denticulate. — 11. *A. parvifolia.*
Involucre 1.5 cm. long or less.
Leaves 2–3 times as long as wide.
Leaves spinulose-denticulate.
Leaves strongly reticulated beneath. — 12. *A. Wilsoni.*
Leaves not reticulated beneath, or faintly reticulated.
Achenes short-tomentose; leaves reticulate-veined above. — 13. *A. intertexta.*
Achenes villous; leaves smooth above. — 14. *A. Shaferi.*
Leaves entire-margined. — 15. *A. obtusifolia.*
Leaves not longer than wide, or but little longer.
Leaves obtuse or truncate at base.
Involucre 6 mm. long. — 16. *A. microcephala.*
Involucre 10 mm. long. — 17. *A. Rosei.*
Leaves cuneate at base. — 18. *A. Buchii.*
2. Involucral bracts recurved, or with recurved tips.
Involucral bracts arachnoid. — 19. *A. Northropiana.*
Involucral bracts villous. — 20. *A. recurva.*
3. Involucre known only in a young condition; leaves oblong, 4 cm. long, 1.8 cm. wide, entire-margined or with a tooth near the apex. — 21. *A. lomensis.*

1. ANASTRAPHIA ILICIFOLIA D. Don, Trans. Linn. Soc. **16**: 296. 1830

Gochnatia ilicifolia Less. Linnaea **5**: 261. 1830 (attributed to Guiana doubtfully).

TYPE LOCALITY: South America [in error].

DISTRIBUTION: Limestone cliffs and river-gorges, provinces of Matanzas and Havana, Cuba. A shrub 2–3 m. high, the leaves shining above.

A specimen in Kew Herbarium from rocks on the Rio Canimar, Cuba, 1823, bears the label *Staehelina ilicifolia* Mutis., but that species is a South American *Gynoxys*.

2. ANASTRAPHIA MANTUENSIS C. Wright; Griseb. Cat. Pl. Cub. 158. 1866

TYPE LOCALITY: Pine lands near Mantua, Cuba.

DISTRIBUTION: Pine lands and rocky hillsides, near Mantua, Province of Pinar del Rio, Cuba.

3. **Anastraphia montana** sp. nov.

A depressed, spreading or prostrate shrub, the young twigs white-floccose. Leaves oblong, or oblong-oblanceolate, 2–4 cm. long, 8–16 mm. wide, coriaceous, sharply spinulose-dentate all around, dark green, shining and densely reticulate-veined above, white-floccose beneath, obtuse or acutish at the apex, the floccose petioles 1–2 mm. long; heads solitary at the ends of branches; involucre campanulate about 2.5 cm. high, its bracts rigid, somewhat spreading, in about 8 series, the outer ovate to lanceolate, slightly lanate, acute, the inner linear-lanceolate, acuminate glabrous achenes linear, narrowed at base, densely appressed-pubescent, 6 mm. long; pappus light brown, spreading, about twice as long as the achene.

Top of Sierra Caliente, south of Sumidero, Pinar del Rio, Cuba, August, 1912 (*Shafer 13781*).

4. **Anastraphia Cowellii** sp. nov.

A shrub, 2 m. high, the young twigs lanate-puberulent. Leaves oblong, 1.5–3.5 cm. long, 6–15 mm. wide, coriaceous, sharply spinulose-dentate, green, glabrous, shining and indistinctly veined, but wrinkled above, brownish-floccose beneath, mostly obtuse at the apex, obtuse or narrowed at the base, the petioles 1–4 mm. long; heads solitary or rarely 2 together; involucre narrowly campanulate, about 3 cm high, its bracts in 7 or 8 series, the outermost ovate, lanate, the middle ones lanceolate, the inner linear-lanceolate, acuminate, glabrous; corollas orange, 2 cm. long; achenes linear, 6–7 mm long, densely pubescent; pappus brownish, spreading, about 3 times as long as the achene.

Rocky hills, palm barren, city of Santa Clara, Cuba (*Britton & Cowell, 10183, type*); same locality (*Britton & Wilson 6073*); rocky places in savanna, Queen City to Minas, Camaguey, Cuba (*Shafer 2927*); savanna near Camaguey (*Britton & Cowell 13248*).

5. **Anastraphia attenuata** sp. nov.

A shrub about 2.5 cm. high, the young twigs densely lanate. Leaves oblong to oblanceolate, 1.5–5 cm. long, 8–17 mm. wide, coriaceous, entire or some of them remotely spinulose-dentate, green, glabrous and reticulate-veined above, whitish-lanate beneath, obtuse or acute at the apex, narrowed at the base, the petioles 1–2.5 mm. long; heads solitary at the ends of branches; involucre obconic, long-attenuate at the base, 3–3.5 cm. long, its bracts lanate, imbricated in about 14 series, the lower ovate, the upper lanceolate; corolla yellow, about 1 cm. long; achenes linear, densely pubescent, 6 mm. long; pappus tawny, a little longer than the achene.

Moist thickets, Sierra Nipe, Oriente, Cuba, between Piedra Gorda and Woodfred, at 400–500 meters elevation (*Shafer 3113*).

6. ANASTRAPHIA PICARDAE Urban, Symb. Ant. 3: 414. 1903

TYPE LOCALITY: Near Cadets, Haiti, at 1200 m. alt.

DISTRIBUTION: Known only from the type locality.

7. **Anastraphia crassifolia** sp. nov.

A shrub about 1.6 m. high, the young twigs densely tomentose. Leaves oblong, or oblong-oblanceolate, coriaceous, 4–7 cm. long, 1–2 cm. wide, entire-margined, green, shining, and with impressed veins above, lanate-tomentose and with prominent veins beneath; involucre campanulate, nearly 3 cm. high, its bracts in 7 or 8 series, the outer ovate, lanate, the inner linear-lanceolate, glabrous, long-attenuate.

Near mangroves, mouth of Rio Yamaniguey, Oriente, Cuba (*Shafer 4261*). Only one old involucre was collected.

8. ANASTRAPHIA OLIGANTHA Urban, Symb. Ant. 3: 417. 1903

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Santo Domingo. Known only from the type specimens collected by Wright, Parry and Brummell in 1871, and from *plate 123, f. 2*, of Plumier, with which they were identified by Professor Urban. Referred to by Hitchcock (Rep. Mo. Bot. Gard. 4: 102) as *A. pauciflosculosa* C. Wright, an unpublished species.

9. ANASTRAPHIA BAHAMENSIS Urban, Symb. Ant. 3: 415. 1903

Anastraphia paucriflosculosa Hitchc. Rep. Mo. Bot. Gard. 4: 102. *pl. 12.* 1893. Hyponym.

Anastraphia cuneifolia Greenm. Bull. N. Y. Bot. Gard. 4: 126. 1905.

TYPE LOCALITY: Andros Island, Bahamas.

DISTRIBUTION: Andros, Eleuthera, Cat Island, Fortune Island, Crooked Island, Acklin's Island, Great Exuma, Caicos Islands, Mariguana, Dellis Cay, Inagua.

I cannot distinguish, specifically, from this species, a plant of the Sierra Nipe, Oriente, Cuba (*Shafer 3185*).

10. **Anastraphia calcicola** sp. nov.

A shrub, 1–1.5 m. high, the young twigs lanate, the branches stiff. Leaves cuneate-obovate or nearly elliptic, small, 5–10 mm. long, nearly as wide as long, sharply 1–3-toothed on each margin, coriaceous, obtuse or subtruncate at the apex, glabrous and densely reticulate-veined above, white-lanate beneath, the petioles about 1 mm. long; heads solitary on short branchlets; involucre 1.5–2 cm. high, its bracts in about 4 series, loosely and sparingly lanate, the outer ovate, acute, the inner narrowly lanceolate, acuminate; achenes linear, 4 mm. long, densely pubescent; pappus yellowish-brown, about 3 times as long as the achene.

Coral rock hillsides and coastal cliffs, United States Naval Station, Guantanamo Bay, Oriente, Cuba (*Britton 2042, type; 2220*).

11. **Anastraphia parvifolia** sp. nov.

An upright shrub, 2 m. high, the young twigs lanate. Leaves oblong to oblong-obovate, small, 5–10 mm. long, 4–6 mm. wide, coriaceous, obtuse at the apex, obtuse or narrowed at the base, dark green, smooth and shining above, white-lanate beneath, the margin repand-denticulate, the slender petiole 1–3 mm. long; involucre about 2.4 cm. long, its bracts in 5 or 6 series, the outer ovate to ovate-lanceolate, loosely lanate, acute, the inner linear-lanceolate, acuminate, with lanate tips; corolla orange-yellow, 18 mm. long; achenes linear, densely pubescent, about 3 mm. long; pappus yellowish-brown, about 5 times as long as the achene.

Dense thickets in barren savannas southeast of Holguin, Oriente, Cuba (*Shafer 2938*).

12. **Anastraphia Wilsoni** sp. nov.

An intricately branched shrub 2 m. high, the young twigs somewhat lanate. Leaves oblong to oblong-obovate, subcoriaceous, 1–2.5 cm. long, 1 cm. wide or less, obtuse or acute at the apex, narrowed at the base, green, shining, and densely finely reticulate-veined above, brownish-tomentulose and prominently veined beneath, the margins strongly spinulose-dentate, the slender petioles 1.5–3 mm. long; heads solitary on short branchlets; involucre 1–1.5 cm. high, its bracts in about 8 series, the outer ovate, acute, densely lanate, the inner lanceolate to linear-lanceolate, attenuate, nearly glabrous; corolla 1.5 cm. long; achenes densely pubescent, 5 mm. long; pappus tawny, 3 times as long as the achene.

Rocky bank, Rio Toyaba, near Trinidad, province of Santa Clara, Cuba (*Britton & Wilson 5573*).

13. ANASTRAPHIA INTERTEXTA C. Wright; Griseb. Cat. Pl. Cub. 158. 1866

TYPE LOCALITY: Near San Marcos, district of Bahia Honda, Pinar del Rio, Cuba.

DISTRIBUTION: Mountain sides, Pinar del Rio, Cuba.

14. **Anastraphia Shaferi** sp. nov.

An intricately branched shrub 2–2.5 m. high, the young twigs lanate. Leaves oblong to oblong-oblanceolate, 10–18 mm. long, 8 mm. wide or less, coriaceous, sharply spinulose-dentate, obtuse at the apex, narrowed at the base, green, glabrous and smooth above, whitish-lanate and rather prominently veined beneath, the petioles about 1.5 mm. long; heads solitary or sometimes 2 together at the ends of branchlets; involucre about 1 cm. long, its villous-lanate bracts in about 5 series, the outer ovate, the inner lanceolate, acuminate; corolla "whitish," about 11 mm. long; achenes villous-pubescent, 3 mm. long; pappus tawny, 2–3 times as long as the achene.

Dry cliff, below the falls of Rio Naranja, Oriente, Cuba, 450–550 m. elevation (*Shafer 3865*).

15. **Anastraphia obtusifolia** sp. nov.

An intricately branched shrub, the young twigs lanate-tomentulose. Leaves oblong to oblanceolate, 2.5 cm. long or less, 4–10 mm. wide, coriaceous, entire-margined, dark green and finely densely reticulate-veined above, white-lanate and inconspicuously veined beneath, obtuse at the apex, narrowed at the base, the petioles 1–1.5 mm. long; head (only one old one seen attached) sessile, lateral; involucre 9–10 mm. long, its bracts in 5 or 6 series, the outer ovate, acute; the inner linear-lanceolate, acuminate.

Camp La Gloria, south of Sierra Moa, Oriente, Cuba (*Shafer 8189*).

16. ANASTRAPHIA MICROCEPHALA Griseb. Cat. Pl. Cub. 158. 1866

TYPE LOCALITY: Eastern Cuba.

DISTRIBUTION: Known only from the type specimens collected by Wright.

17. **Anastraphia Rosei** sp. nov.

A shrub with tortuous branches, the young twigs floccose. Leaves broadly elliptic, elliptic-obovate or suborbicular, 10–15 mm. long, 8–13 mm. wide, obtuse or nearly truncate at the apex, obtuse or subtruncate at the base, dark green, loosely floccose or becoming glabrate, and finely reticulate-veined above, densely white-tomentulose and with few rather prominent veins beneath, spiny-toothed, with 2 or 3 teeth on each side, the slender tomentulose petioles 3–5 mm. long; heads solitary and sessile on short spurs, about 10-flowered; involucre narrowly obconic, 10–11 mm. long, its bracts in about 5 series, all appressed-villous, acute, the outer ovate, the inner linear-lanceolate; achenes densely silky, 4 mm. long; pappus yellow-brown, 8 mm. long.

Hillside, Azua, Santo Domingo, March 18, 1913 (*Rose, Fitch & Russell 4023*). Related to *A. Buchii* Urban, of Haiti, which has leaves cuneate at base, smaller heads and less hairy involucre-bracts.

18. ANASTRAPHIA BUCHII Urban, Symb. Ant. 5: 527. 1908

TYPE LOCALITY: Dry woods, Poste Coudau, Haiti, at 100 m. elevation.

DISTRIBUTION: Known only from the type locality.

19. ANASTRAPHIA NORTHROPIANA Greenm.; Combs, Trans. Acad. Sci. St. Louis 7: 435. *pl. 36.* 1897

Anastraphia Northropiana Combsii Urban, Symb. Ant. 3: 417. 1903.

TYPE LOCALITY: Fresh Creek, Andros, Bahamas.

BAHAMA ISLANDS: Andros, New Providence, Cat Island.

CUBA: On rocky coastal hills, Punta Piedra, Nipe Bay, Oriente (*Britton & Cowell 12459*); harbor of Santiago, Oriente (*Britton 1877*); near Nuevitas, Camaguey (*Shafer 839*); Calicita, Santa Clara (*Combs 521*); Rio San Juan, Santa Clara (*Britton, Earle & Wilson 5839, 5864*); apparently the same species, collected in foliage only, on Cayo Ratones, Bay of Mariel, Pinar del Rio (*Britton & Gager 7678*). I cannot specifically distinguish the Cuban plant from the Bahamian; on the southern coast of Santa Clara Province it forms a tree up to 10 m. high with a trunk 2 dm. in diameter; its bark is very rough.

20. **Anastraphia recurva** sp. nov.

A much-branched shrub up to about 3 m. high, the young twigs tomentulose. Leaves oblong to elliptic or oblanceolate, coriaceous, 4 cm. long or less, 8–15 mm. wide, green and smooth or somewhat reticulate-veined above, lanate beneath, obtuse or acute at the apex, cuneate-narrowed, acute or obtuse at the base, spinulose-dentate or entire, the petioles 1.5–3 mm. long; heads solitary at the ends of branchlets; involucre broadly campanulate, 1.5–1.8 cm. high, its bracts densely villous, imbricated in 6 or 7 series, recurved-spreading, linear-lanceolate, acuminate; corolla yellow or yellowish, about 1 cm. long; achenes densely whitish-pubescent, about 4 mm. long; pappus tawny, 2–3 times as long as the achene.

Serpentine hills near mouth of Rio Yamaniguey, Oriente, Cuba (*Shafer 4257; type*); between Rio Yamaniguey and Camp Toa, 400 m. alt. (*Shafer 4011*); vicinity of Camp San Benito, 900 m. alt. (*Shafer 4177*); Camp La Gloria, south of Sierra Moa (*Shafer 8187, 8266*); between Camp La Barga and Camp San Benito (*Shafer 4120*).

A species which has wide variation in leaf-forms; the involucre in all specimens seen appears to be the same.

21. **Anastraphia** (?) **lomensis** sp. nov.

A shrub about 2.5 m. high, the twigs tomentulose. Leaves oblong, coriaceous, about 4 cm. long and 1.8 cm. wide, entire-margined, or rarely with a spinulose tooth near the apex, spinulose-tipped and acute, or rounded at the apex, narrowed or obtuse at the base, faintly reticulate-veined, green and glabrous above, lanate and rather prominently veined beneath, the petioles 2–3.5

mm. long; heads solitary or sometimes 2 together at the ends of twigs; young involucre 1 cm. long, its floccose bracts in about 5 series, acute, the outer ovate, the inner lanceolate.

Rocky mountain side, Loma Mensura, about 800 m. alt., Oriente, Cuba (*Shafer 3811*).

The leaves are similar to those of *A. Picardae* Urban, of Haiti.

38. UNDESCRIBED WEST INDIAN SPECIES

Cyperus calcicola sp. nov.

Perennial by short rootstocks; culms slender, tufted, smooth, 1–2.5 dm. high. Leaves shorter than the culm, 0.5–1 mm. wide; bracts of the involucre 2 or 3, the longer sometimes 4 cm. long, similar to the leaves; head globose, solitary, 5–7 mm. in diameter; spikelets about 3-flowered, 3.5–4.5 mm. long; scales dark brown, the lowest empty ones persistent on the axis after the fall of the rest of the spikelet, lanceolate, the others ovate to ovate-lanceolate, acute, faintly striate-nerved.

Limestone rocks, Cayo Muertos, Porto Rico (*Britton, Cowell & Brown 4976*).

Related to *C. fuligineus* Chapm., in which the scales of the spikelet are more numerous, strongly striate-nerved and mucronate.

Psilocarya portoricensis sp. nov.

Annual, with fibrous roots; culm rather slender, about 4 dm. high. Leaves shorter than the culm, 2–3 mm. wide; umbels several, slender-stalked; spikelets 3–5 in the umbels, ovoid, acutish, 4–6 mm. long, 2 mm. thick; scales ovate, dark brown, sharply acute; style rather deeply 2-cleft; achene oblong, 1 mm. long, transversely wrinkled; tubercle triangular, acute, one third to one half as long as the achene, and distinctly decurrent upon it.

Shore of Laguna Tortuguero, Porto Rico (*Britton, Cowell & Brown 3850*).

Nearest to *P. nitens* (Vahl) A. Wood, of eastern continental North America, the achene of which is smaller, suborbicular and the tubercle scarcely decurrent.

Rynchospora borinquensis sp. nov.

Perennial by short rootstocks; culms slender, trigonous, about 6 dm. high. Leaves flat, about 2 mm. wide, shorter than the culm;

corymbs 2 or 3, distant, filiform-stalked, compound, narrow, 2–7 cm. long; spikelets clustered, fusiform, 5 mm. long, narrowed at both ends, bearing only 1 achene; scales lanceolate or oblong-lanceolate, dark brown, acute; bristles about 6, upwardly barbed, longer than the achene and tubercle; style-branches about one-third as long as the undivided part; achene oblong-obovate, faintly transversely wrinkled, 1.5 mm. long, a little longer than the smooth, conic, acute tubercle.

Open wet places in the forest. Rio Icaco and adjacent hills, Sierra de Naguabo, Porto Rico, 465–720 m. alt. (*Shafer 3515, type*); Sierra Nipe, Oriente, Cuba (*Shafer 3453, 3638*).

Apparently nearest *R. glauca* Vahl, which has shorter, ovoid spikelets, and a shorter tubercle.

Cassia clarendonensis sp. nov.

A finely pubescent shrub about 1.3 m. high. Leaves linear in outline, 10–15 cm. long, bearing an obtusely conic gland 1 mm. high between the lowest pair of leaflets, the slender, pubescent rachis angular; leaflets 10–15 pairs, thin, pubescent on both sides, with very short pubescent petiolules, apiculate, inequilateral, the upper 2 or 3 pairs oblong, 1.5–2 cm. long, 6–7 mm. wide, the others elliptic to obovate-elliptic, shorter and slightly broader; flowers in several short pubescent panicles in the upper axils; pedicels 2–4 mm. long; sepals obliquely elliptic, obtuse, pubescent, 5–6 mm. long; petals yellow, obovate, veiny, about 9 mm. long, rather abruptly short-clawed; sepals 7; larger anthers curved, 7–8 mm. long, the smaller nearly straight, about 5 mm. long; style curved, about 11 mm. long; pods short-stalked in the calyx, linear, many-seeded, densely puberulent, 7–10 cm. long, 6 mm. wide, flat, impressed between the seeds, the margins scarcely thickened; seeds oblong, transverse, pubescent, about 4 mm. long.

Inverness, Clarendon, Jamaica (*Harris 11693*).

Purdiaea velutina Britton & Wilson, sp. nov.

A shrub 3 m. tall, or a small tree; twigs villous. Leaves obovate, 4–10 cm. long, 2–3.3 cm. broad, rounded and emarginate or mucronate at the apex, gradually tapering to a rather broad sessile base, 5–7-ribbed, reticulate-veined, glabrous; bracts oblong-obovate or obovate, 15–24 mm. long, 6–9 mm. broad, velutinous on the back, glabrous within above the middle, below clothed with rather short, appressed silky hairs; peduncles and pedicels villous; one ciliate, the three outer ones unequal, ovate, 9–12 cm. long, 4–6 mm. broad, rounded or acutish and apiculate at the apex, papery, several nerved, the two inner sepals lanceolate, 5–6 mm. long, acuminate; petals lanceolate to narrowly ovate-lanceolate, 5.5–6 mm. long, 2–2.5 mm. broad, acute, glabrous; filaments subulate, glabrous; anthers oblong; ovary subglobose, villous.

Type collected along trail, Rio Yamaniguey to Camp Toa, Oriente, Cuba (*Shafer 4474*); also collected in the vicinity of Camp San Benito, Oriente, Cuba (*Shafer 4092*).

Purdiaea Shaferi Britton & Wilson, sp. nov.

A shrub 2 or 3 m. tall; twigs glabrous or nearly so. Leaves broadly elliptic-obovate, 4.5–9.5 cm. long, 2.5–4.5 cm. broad, rounded and emarginate or mucronate at the apex, sessile, 7–9-ribbed, rather faintly and coarsely reticulate-veined, glabrous; bracts obovate, 12–14 mm. long, 7–8 mm. broad, papillose; peduncles and pedicels villous; sepals 5, ciliate, the three outer sepals very unequal, broadly ovate to ovate-oval, 8–12 mm. long, 4–8 mm. broad, rounded or acute and apiculate at the apex, papery, clothed mostly toward the base with appressed, silky hairs, several-nerved, the two inner sepals lanceolate, 5–6 mm. long, 2 mm. broad, acuminate; petals elliptic, 5 mm. long, 2.5–3.2 mm. broad, mucronate, glabrous; filaments subulate, glabrous; anthers oblong; ovary globose-ovoid, hirsute; style subulate.

Type collected in pinelands, vicinity of Baracoa, Oriente, Cuba (*Shafer 4285*).

Purdiaea microphylla Britton & Wilson, sp. nov.

A shrub 1 or 2 m. tall; young twigs and branches of the inflorescence more or less hirsute. Leaves oblanceolate to obovate, 10–15 mm. long, 5–7 mm. broad, acute at the apex, cuneate at the base, sessile, rigid, faintly 3-ribbed, glabrous; sepals unequal, rigid, the three outer ones ovate to oval, 4 mm. long, 3 mm. broad, acute, the two inner sepals ovate, 3 mm. long, 1.2–1.5 mm. broad, apiculate, ciliate; fruit 5-lobed, the angles keeled, 5-celled, glabrous; style subulate, persistent.

Type collected at Camp La Gloria, south of Sierra Moa, Oriente, Cuba (*Shafer 8265*).

Piriqueta cubensis Britton & Wilson, sp. nov.

A shrub 1–3 m. tall, the young twigs grooved, velvety-ferruginous with stellate hairs. Leaves oblanceolate or obovate, 4–8 cm.

long, 1–2.2 cm. broad, obtuse or acutish at the apex, cuneate at the base, petioled, above clothed with scattered stellate hairs, beneath velvety ferruginous with stellate hairs and reticulate-veined, the midvein and lateral nerves obscure or impressed above, prominent beneath; calyx-lobes oblong-lanceolate to ovate-lanceolate, 1.2–1.6 cm. long, 6–8 mm. broad, velvety-ferruginous; petals elliptic to somewhat oblanceolate, 1.6–1.8 cm. long, 5–6 mm. broad, glandular-ciliate; filaments filiform, glabrous; anthers oblong-lanceolate; ovary narrowly ovoid, tomentose; styles filiform, 2.5–2.7 cm. long, glabrous; capsule velvety-ferruginous, the valves ovate; seeds pyriform.

Type collected along trail, Rio Yamaniguey to Camp Toa (400 m. alt.), Oriente, Cuba (*Shafer 4190*); also collected on the Sierra Nipe, Oriente (*Shafer 3109*).

Rheedia Hessii sp. nov.

Young branches angled, slender, the older ones terete. Leaves opposite, coriaceous, clustered on short lateral twigs, narrowly lanceolate, 1.5–2.5 cm. long, 6 mm. wide or less, narrowed at the base into stout petioles 2–3 mm. long, spinulose-acuminate at the apex, the midvein prominent beneath, very indistinct above, the lateral venation wholly obscure, the margins thickened; staminate flowers solitary in upper axils on pedicels about 4 mm. long; sepals suborbicular, about 3 mm. broad; petals obovate-elliptic, rounded at the apex, 5 mm. long; stamens numerous, the stout filaments 2–2.5 mm. long; anthers less than 0.5 mm. broad.

Indiera Fria, near Maricao, Porto Rico (*F. L. Stevens & W. E. Hess 3333*). In habit and in leaf-form this somewhat resembles *R. fruticosa* C. Wright, of Cuba.

Mayepea cubensis P. Wilson, sp. nov.

A shrub 6 m. tall, the young twigs glabrous or nearly so. Leaves oblong-oblanceolate, 6–9 cm. long, 1.5–2 cm. broad, rounded and often emarginate at the apex, cuneate at the base, petioled, glabrous, impressed punctate, rigid; midrib more or less impressed above, prominent beneath, the primary veins few and rather inconspicuous; panicles terminal, shorter than the leaves, the branches glabrous; bracts oblong-lanceolate or narrowly lanceolate, hirsutulous; pedicels about 2 mm. long; calyx-lobes triangular, obtuse or acutish, sparingly hirsutulous on the outside, hirsutulous within mostly at or near the apex; petals oblong or somewhat oblong-lanceolate, 5.5–6.5 mm. long, 1.2–2 mm. broad, glabrous, obtuse, several-nerved; stamens shorter than the petals; filaments 1 mm. long; anthers elliptic-ovate to broadly elliptic; ovary ovoid, glabrous; stigma subsessile, globose-ovoid or subglobose, sometimes slightly emarginate.

Type collected at mouth of the Rio Yamaniguey, Oriente, Cuba (*Shafer 4253*).

Agalinis albida Britton & Pennell, sp. nov.

Annual; plant green, tending to blacken in drying. Stem 4–6 dm. tall, slender, with virgately ascending branches, obscurely striate-4-angled, glabrous; leaves opposite, or somewhat subopposite above, ascending or recurved-spreading, linear-subulate below to linear and longer above, entire, acute, those of the stem 1–2.5 cm. long, 0.5–1 mm. wide; bracts gradually much reduced; leaves thickened, minutely scabrous to scabro-roughened above. axillary fascicles none; racemes elongated, 2–16-flowered; pedicels ascending, slender, clavate, glabrous, in flower 0.5–1 mm. long, in fruit 2–3 mm. long, much shorter than the bracts; calyx-tube 2–2.5 mm. long, depressed-hemispheric, obscurely veined, 1/3–2/5 the length of the capsule, somewhat truncate, its lobes 0.7–1 mm. long, broadly triangular to ovate-triangular, acute to acuminate; apex of tube and lobes within sparingly puberulent; corolla 10–15 mm. long, spreading, 7–10 mm. wide, membranous, its tube 8–12 mm. long, straight to slightly upcurved, its lobes 2–3 mm. long, rounded to truncate, all somewhat spreading, without minutely pubescent, within slightly pubescent about the bases of the filaments, pubescent below sinus and over most of basal portions of posterior lobes; lobes all ciliate, white, at times shaded with violet; posterior filaments 2.5–3.5 mm. long, anterior 5–6.5 mm. long, all somewhat lanose; anther-sacs 1–1.5 mm. long, oblong-lanceolate, acute to mucronate at base, lanose-pubescent with white hairs on the valvular surface, glabrous on the sides; style 4–5 mm. long, filiform, glabrous; stigma 2.5 mm. long; capsule 4 mm. long, depressed-globose, dark-brown; seeds 0.6–0.8 mm. long, lunate-triangular to narrowly quadrangular, slightly less than one-half as broad as long, irregular; testa pale, with reticulations delicate, brown, enclosing elongated angular spaces; intrareticular lines very fine, forming a network.

Wet, grassy pineland, western Cuba, Isle of Pines, and in Jamaica.

Type, *Colpothrinax* savanna, vicinity of Herradura, province of Pinar del Rio, Cuba, collected in flower and fruit August 26–30, 1910 (*Britton, Earle & Gager 6475*).

CUBA. Pinar del Rio: Guane (*Shafer 10662*); Herradura (*Hermann 291, 565*); Laguna Jovero (*Shafer 10937*); Laguna los Indios (*Shafer 10801*); Pinar del Rio (*Wright 2991 p.p.*); San Cristobal (*Wright 2991 p.p.*), Santa Clara: Cieneguita (*Combs 443*), Isle of Pines: Managua (*Palmer & Riley 1102*).

JAMAICA. Shooter's Savanna (*Harris 11160*); Upper Clarendon (*Harris 11100*).

Differs from other species of *Agalinis* bearing short-pedicelled flowers, spreading corolla-lobes and dark brown seeds (*A. purpurea* and near allies) by its leaves strongly ascending, but 1–2.5 cm. long, its corolla much paler, nearly or quite white, and relatively small, and by its seeds which are less than one-half as broad as long.

Jacaranda Cowellii Britton & Wilson, sp. nov.

A shrub 1.5–2 m. tall, the young twigs, pedicels, calyx and corolla more or less glandular-pubescent; leaves once-pinnate, 2.5–6 cm. long, occasionally longer; petioles and rachis narrowly grooved; leaflets 8–15 pairs or more, opposite or subopposite, elliptic to oval or orbicular, 2–5 mm. long, 1.5–3 mm. broad, sessile, rigid, green and lustrous above, paler beneath, the margin strongly involute, the midvein impressed above, prominent beneath; bracts of the inflorescence oblong; calyx-lobes triangular-ovate or ovate, acutish, 2 mm. long; corolla-tube 2–2.5 cm. long, the lobes orbicular; filaments of the fertile stamens subulate, glabrous, the filament of the sterile stamen flattened, bearded below the middle, glabrous above, densely bearded at the apex; anthers oblong-elliptic; ovary ovoid, glabrous; style subulate; fruit elliptic or oblong-elliptic, the apex rounded, or abruptly short-acuminate with the tip acutish or obtuse.

Type collected in palm barrens in the vicinity of the city of Santa Clara, Cuba (*Britton & Cowell 13316*); also collected at the same locality (*Britton & Wilson 6071; Britton & Cowell 10174*); dry hill, Holguin, Oriente (*Shafer 12434*); barren savanna southeast of Holguin, Oriente (*Shafer 2940*).

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 180

MOSSES FROM THE WEST COAST OF SOUTH AMERICA

R. S. WILLIAMS

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Mosses from the west coast of South America

R. S. Williams

(with plates 21–25)

A list of mosses collected by Dr. and Mrs. J. N. Rose in Peru, Bolivia and Chile, July to October, 1914, while on a trip undertaken chiefly for the purpose of obtaining Cactaceae.

This collection of 41 mosses, coming as it does largely from the dry cactus region of the west coast of South America, contains for its size an unusually large number of interesting species.

Campylopus incrassatus (Kze.) C. M.

Peru: near Mollendo, *18996*.

Campylopus peruvianus sp. nov.

Sterile: plants in compact cushions with more or less branching stems, radiculose below, and 10–15 mm. high; leaves ovate-lanceolate, entire except at the apex, closely imbricate, erect-appressed when dry, somewhat spreading when moist, the upper rather larger, 3–4 mm. long, mostly with a short, rough, hyaline point rarely more than 0.5 mm. long; costa about one half the width of the leaf in the lower part, in cross-section showing stereid bands above and below the guide cells and bearing on the back about 24, not serrate, lamellae up to 4 cells in height; alar cells enlarged, mostly pale, extending to the costa; marginal cells of lower leaf narrow and elongate, forming a narrow, hyaline border sometimes extending half way up the leaf; the median cells mostly short-rhomboidal, those just above the alar, short rectangular, all with slightly thickened not pitted walls.

Peru: near Mollendo, August, *18997*.

Astomum chilense sp. nov.

Dioicous, the inconspicuous male flowers containing 5 or 6 antheridia with few paraphyses, enclosed by 2 or 3 very small inner perigonial leaves; the outer leaves being scarcely differentiated: plants in rather compact mats with simple stems about 1 mm. high, bearing radicles at base; stem-leaves up to 1.5 mm., rarely 2 mm. long, ovate-lanceolate, more or less folded and crispate when dry, rather widely spreading when moist, with flat, entire margins; costa excurrent into a short apiculus, in cross-section showing 2 large guide cells, a rather small stereid band between them and the row of large cells next the upper surface, and below the guide cells a much larger stereid band with outer cells somewhat enlarged; cells in lower part of leaf pale, smooth, mostly short-rectangular, about 8 μ wide by 12 μ long, in upper part densely papillose, rather distinct, nearly square, about 6 $\times$ 6 μ; perichaetial leaves scarcely differentiated; seta often somewhat bent and twisted when dry, erect when moist, about 2.5 mm. long; capsule oblong, slightly wrinkled when dry, about 1 mm. long, including the short, oblique beak; spores rough, about 16 μ in diameter; calyptra cucullate, smooth, descending about half way down the capsule.

CHILE: vicinity of La Serena, October, *19290*.

GYROWEISIA BOLIVIANA R. S. Williams, Bull. N. Y. Bot. Gard. **3**: 104. 1903.

PERU: Cuzco, September, *19057*.

LEPTODONTIUM GRACILE C. M.

PERU: vicinity of Lima, July, *18594*.

BARBULA FUSCINERVIA Mitt.

PERU: Juliaca, September, *19092*.

BARBULA FUSCO-VIRIDIS Broth.

CHILE: Palos Quemnados, October, *19184;* La Ligua, October, *19532*.

BARBULA REPLICATA Tayl.

PERU: near Oroya, July, *18717*; Arequipa, July, *19531;* Posco, July, *18813;* Cuzco, August, *19055*.

Pterogoneurum Roseae sp. nov.

Autoicous, the male flower terminal, the outer perigonial leaves not differentiated, the inner with a very small, pale-golden, roundish, scarcely costate blade bearing a rough, hyaline hair-point 3 or 4 times as long, enclosing 5 or 6 antheridia about 50 μ long and numerous, somewhat club-shaped paraphyses twice as long as the antheridia: plants appearing somewhat gregarious, only 2–3 mm. high, with very short stems and crowded, bud-like branches; stem leaves when dry, erect, appressed-imbricate, when moist, widely spreading, broadly ovate, serrulate nearly to the base, the blade about 1 mm. long with a rough, hyaline hair-point often exceeding the blade in length, the margins of the upper half of the blade broadly inflexed over the costa; costa expanded in the upper half, in cross-section showing a broad stereid band below the single row of large cells bearing about 20 rows of filaments 3–5 cells high with the terminal cell often contracted into a mamillate apex; basal cells of leaf pale, short-rectangular to square, up to 20 μ wide and about 25 μ long, with walls slightly thickened at the angles, the cells about one half up the leaf becoming more or less transversely elongate, especially toward the margin, with unequally thickened, not pitted, walls; outer perichaetial leaves not differentiated, the 1 or 2 inner leaves very small, pale, narrowly lanceolate, nearly ecostate; seta reddish, 8–9 mm. high; capsule ovate-oblong, nearly symmetric and erect, 2 mm. long with the lid; lid conic, about as high as its basal diameter; peristome papillose, very irregular, from a low basal membrane, the teeth varying from long-lanceolate to little more than lobes scarcely projecting above the annulus; annulus persistent, of a single row of large cells; calyptra cucullate, smooth, extending about half way down the capsule; spores slightly rough, up to 24 μ in diameter.

PERU: vicinity of Lima, July, *18595* (type); Posco, August, *18813a*.

Crossidium Rosei sp. nov.

Autoicous, the male flowers at the apex of the branches, the inner perigonial leaves smaller than the outer, otherwise scarcely differentiated, the 6 to 8 antheridia about 0.25 mm. long, with rather numerous, often longer, filiform paraphyses: plants in rather compact mats, the short stems, with radicles at base, bearing several short branches crowded together bud-like, and 2–3 mm. high; leaves when dry appressed-incurved, often somewhat crispate, when moist, erect-spreading, ovate-oblong to oblong-spatulate, 2–2.5 mm. long, in the upper third finely papillose on both sides, the margins entire and flat or more or less recurved; costa slightly excurrent, enlarged in the upper half, in cross-section showing a large stereid band on the under side and on the upper side some 6–8 large cells, mostly in one row, bearing numerous, short, somewhat club-shaped filaments 2 or 3 cells high with the terminal cell papillose; leaf cells distinct throughout, the basal pale green, nearly square to short-rectangular, up to 20 μ wide by about 35 μ long, the median cells scarcely elongate, about $16 \times 16\ \mu$, with walls scarcely thickened; perichaetial leaves hardly differentiated, the inner usually smaller; seta rather flexuous, about 8 mm. long; capsule erect, nearly symmetric, oblong, about 1.5 mm. long with the lid; lid conic, acute, a little higher than its basal diameter, the cells, except at the base, elongate in oblique rows; peristome a papillose basal membrane extending 3 or 4 rows of cells above the persistent annulus, its margin more or less incised and bearing here and there short lobes; calyptra cucullate, smooth, descending well below the lid; spores rough, up to 25 μ in diameter.

PERU: vicinity of Lima, July, *18774*.

PSEUDOCROSSIDIUM gen. nov.

Dioicous. Small plants with simple or slightly branched stems having a distinct central strand and leaves, when dry, erect-appressed or sometimes twisted about the stem. Stem-leaves with margins in the upper part once to twice revolute, the upper side of the revolute part with cells often much inflated or with greatly enlarged papillae. Costa broader in the upper part than below, nearly percurrent or excurrent; in cross-section about two thirds up showing 5 to 8 guide cells, mostly in one row, beneath them a large stereid band and on the upper side numerous lax, thin-walled cells in 1 to 3 layers forming a continuous, densely papillose surface or sometimes more or less broken up into filaments 2 or 3 cells high with the terminal cells papillose (occasionally, also, a thin band of stereid cells just above the guide-cells in *P. apiculatum*). Cells of the upper part of leaf not or slightly elongate, mostly obscure with crowded papillae on one or both sides, in the lower part, smooth, pale, rectangular or short, more or less transversely elongate. Perichaetial leaves greatly differentiated, the 2 or 3 inner much larger than those of the stem, convolute, pale throughout, with narrow costa mostly vanishing below the obtuse or truncate, nearly or quite entire apex. Capsule nearly cylindric and erect with a slightly oblique, subulate lid. Peristome of 32 slender, papillose teeth twisted to the left, from a low basal membrane. Annulus of 2 or 3 rows of persistent cells. Calyptra cucullate.

Type species, *P. chilense*.

Pseudocrossidium chilense sp. nov.

Evidently dioicous, the male flowers not found: plants in brownish green cushions with somewhat branching stems, 2–4 mm. high, with a very distinct central strand and walls of outer cells scarcely thickened; stem-leaves erect-appressed when dry, more or less broadly ovate, obtusely or acutely pointed, the upper about 1 mm. long, the lower shorter, rather deeply keeled above with the margins strongly revolute half way down or more; costa nearly percurrent, enlarged in the upper half, 120–140 μ wide, in cross-section above the middle showing 6 to 9 guide-cells mostly in one row, below them a large stereid band and on the upper side 2 or 3 layers of lax, thin-walled cells, those at the surface densely papillose and sometimes more or less separated; cells of upper part of leaf scarcely elongate, about 6 μ in diameter, more or less papillose on both sides, in lower part, paler, smooth, mostly nearly square to transversely elongate, often 12 $\times$ 12 μ; perichaetial leaves projecting well above those of the stem, the 2 or 3 inner convolute, about 2 mm. long, mostly broadly rounded or truncate at the entire or nearly entire apex, the leaf-cells mostly slightly elongate throughout with lax, thin walls, smooth or finely papillose on the back in the upper part; seta erect, about 1 cm. long; capsule cylindric, about 2.25 mm. long without lid, the stoutly beaked lid nearly erect, 1 mm. long, with the elongate cells in oblique rows; peristome of 32 slender papillose teeth, twisted about one half around to the left, from a rather low basal membrane; annulus of 2 or 3 rows of small cells; calyptra cucullate, smooth; spores smooth, about 10 μ in diameter.

CHILE: near Valparaiso, September *19132b*.

Pseudocrossidium apiculatum sp. nov.

Dioicous, the outer perigonal leaves like those of the upper stem, the inner much shorter, broadly ovate, with narrow costa, enclosing numerous antheridia, 0.4 mm. long, and abundant, slightly club-shaped paraphyses: plants in compact, greenish brown mats with mostly simple stems 1 cm. high, with large, very distinct central stand and outer walls of 1 or 2 rows of rather small cells with scarcely thickened cell-walls; stem-leaves ovate-lanceolate, acute, the upper about 1.5 mm. long, appressed and mostly twisted about the stem when dry, the margins in the upper half often twice revolute; costa excurrent, apiculate, in the widest part 140–160 μ across, in cross-section showing 6 to 8 guide cells, below them a large stereid band and on the upper side 3 or 4 layers of lax, thin-walled cells forming a compact densely papillose surface or broken up into distinct filaments 2 or 3 cells high with the terminal cell papillose (sometimes also a thin band of stereid cells occurs just above the guide-cells); cells of upper leaf mostly not elongate or transversely elongate, often 12 $\times$ 12 μ, papillose on both sides, those of the revolute part often much inflated or with greatly enlarged papillae on the upper face; lower cells of leaf paler, mostly rectangular, 12–16 μ wide and 20–40 μ long; perichaetial leaves pale, convolute, the inner 2.5 mm. long or more, projecting well above the stem-leaves, somewhat obovate to oblong, the apex obtusely rounded and more or less erose, the costa narrow and vanishing a little below the apex; fruit unknown.

PERU: above Arequipa, August, *18977*.

[**Pseudocrossidium excavatum** (Mitt.) comb. nov.

To this genus I would also refer *Tortula excavata* Mitt. Jour.

Linn. Soc. 12: 154. 1869. It has a cross section of leaf and perichaetial leaves very similar to the preceding but is a much smaller species with stem leaves only about 0.5 mm. long and lacking the sharp apiculate point. From *P. chilense* it may be at once distinguished by the basal cells which are rectangular, not mostly transversely elongate or square. The costa is also narrower, about 60 μ in the widest part. It seems to be known only from the Andes near Quito.]

Desmatodon subtophaceus (R. S. Williams) comb. nov.

Didymodon subtophaceus R. S. Williams, Bull. N. Y. Bot. Gard. **3**: 119. 1903.

PERU: above Arequipa, August, *19533;* Juliaca, September, *19099.*

CHILE: Las Vacas, near Chiapa, October, *19230.*

The stereid band is nearly or quite lacking in the upper part of the costa but present in the lower part.

TORTULA CONFUSA Card.

PERU: Cuzco, September, *19519.*

TORTULA KUNZEANA (C. M.) Mitt.

CHILE: La Ligua, *19383;* Paloma, October, *19354.*

Tortula limensis sp. nov.

Apparently mostly autoicous but occasionally synoicous, the inner perigonial leaves much smaller and paler than the outer and enclosing abundant antheridia, 0.3–0.4 mm. long, with numerous slightly longer, club-shaped paraphyses: plants in compact mats with more or less branching; stems about 1 cm. high having a very small central strand or none; stem-leaves mostly oblong, the larger about 3 mm. long by 1.5 mm. wide, appressed-contorted when dry, somewhat spreading, recurved when moist, with flat or slightly recurved crenulate and papillose margins; costa terete, slightly rough on the back, about 40 μ wide in the lower part, slightly tapering upward, excurrent into a reddish not quite smooth hair-point sometimes over one half the length of the blade, in cross-section showing 2 large guide-cells, below them a stereid band and on the upper side a few thin-walled cells in two layers, the upper surface finely papillose; cells of upper leaf not elongate, densely papillose on both sides, 16–20 μ in diameter, those of basal part pale, smooth, up to 25 μ wide and 60–80 μ long; inner perichaetial leaves very similar to those of the stem but a little larger; seta about 12 mm. long; capsule oblong, slightly curved and nodding, 2.5 mm. long without the lid, the lid conic, in height often but little exceeding its basal diameter; peristome of 32 pale, nearly erect, very papillose teeth more or less contracted at the joints, from a basal membrane about one-tenth the height of the teeth; annulus of 1 or 2 rows of small cells adherent to the rim of the capsule; calyptra cucullate, descending well below the base of the lid; spores slightly rough, up to 25 μ in diameter.

Peru: Lima, July, *18603c* (type), *18603a;* north of Lima, July, *19523*.

A species much like some forms of *T. montana* in general appearance.

Tortula minuscula sp. nov.

Dioicous, the terminal bud-like male flower at length appearing lateral by the growth of a subapical branch; the antheridia about 0.3 mm. long, with abundant slightly club-shaped paraphyses: plants in compact, dusky green mats with often branching stems 5–8 mm. high, having a distinct central strand; stem-leaves about 2 mm. long, appressed or somewhat erect-spreading when dry, rather broadly ovate-lanceolate, entire, the margins somewhat recurved along the middle and thickened with 1 row of additional cells in the narrow-grooved point; costa percurrent, often slightly broadened and flattened near the middle of the leaf with a cross-section showing 10 to 12 guide cells, a single row of cells nearly as large on the ventral side and on the dorsal side a row of slightly smaller cells with a few stereid cells between them and the guide-cells; the cross-section near apex shows no stereid cells and only 2 guide-cells; cells of upper part of leaf very papillose on both sides, the median often slightly transversely elongate, about $5 \times 8\ \mu$, the basal short-rectangular to nearly square; perichaetial leaves very similar to those of upper stem but with slightly larger and paler base; seta 6–7 mm. long; capsule erect, ovate-oblong, about 1 mm. long without the lid; the lid slightly oblique, conic-subulate, scarcely 0.5 mm. long; peristome from a papillose basal membrane projecting well above the annulus, of 32 erect or nearly erect, very papillose teeth of irregular length; annulus of 2 or 3 rows of persistent cells; calyptra cucullate, smooth, descending well below the lid; spores smooth, about 10 μ in diameter.

Peru: Cuzco, September, *19520*.

Tortula muralis (L.) Hedw.

Chile: Viña del Mar, near Valparaiso, September, *19105*; Las Vacas, near Chiapa, *19230a*; vicinity of La Serena, *19289*; vicinity of Illapel, *19462*, *19462d*; La Paloma, October, *19522*.

ENCALYPTA EMERSA C. M.?

BOLIVIA: Comanche, August, *18884*.

This plant is perhaps distinct from *E. emersa*, of which I have seen no specimens. The Bolivian plant is autoicous with stems rather stout, about 2 cm. high; stem-leaves oblong, about 4 mm. long by 2 mm. broad, the apex rounded, the margins somewhat crenate and papillose; costa vanishing a little below the apex, rough on the back with pale spines, simple toward the apex, branching at the middle and lower part of the costa; capsule cylindric, nearly smooth, emergent, without peristome; calyptra entire at base, somewhat scabrous at apex.

ALIGRIMMIA PERUVIANA R. S. Williams, Bull. N. Y. Bot. Gard. **3**: 124. 1903.

PERU: vicinity of Arequipa, August, *18823*, the locality from which the type specimens were described.

GRIMMIA MICRO-OVATA C. M.

BOLIVIA: Comanche, August, *18882a*; vicinity of Comanche, August, *18882*; vicinity of La Paz, August, *18870*.

GRIMMIA SAXATILIS Mitt.

PERU: Juliaca, September, *19091*.

ZYGODON CIRCINATUS Mitt.

PERU: near Mollendo, August, *19526*. Type specimens collected on the island of Chiloe, Chile, and apparently unknown elsewhere, excepting from this Peruvian collection.

Physcomitrium Roseae sp. nov.

Antheridia not found: plants in thin mats or somewhat gregarious, with stems about 2 mm. high, scarcely projecting above the earth over which they grow with the rosette-like cluster of leaves resting on the surface; stems with a few radicles at the base and 5 to 7 leaves clustered at the apex; leaves mostly ovate, acute, with flat, entire margins, about 2.5 mm. long by 1.5 mm. wide, with sometimes 1 or 2 much smaller inner leaves; costa percurrent, weak, in cross-section showing 5 or 6 cells of somewhat variable size without thickened walls; cells of upper part of leaf more or less hexagonal, 20–25 μ in diameter, toward the base square to rectangular, about 25 μ wide and 30–50 μ long; seta 2 mm. long; capsule subglobose, about 1.5 mm. high, without annulus and peristome, the cells about the rim elongate in 5 or 6 rows, forming a rather ill-defined border, those below to near the base very irregular, becoming at the base smaller, quite regular and with small stomata in several rows; lid nearly flat, with an ill-defined border of transversely elongate cells that become toward the center of lid much broader and larger; spores mostly roundish, smooth, 28–30 μ in diameter; calyptra (perhaps not normal) remaining attached to the seta half way down the capsule, terete-cylindric, smooth.

CHILE: near Valparaiso, September, *19176*.

FUNARIA CALVESCENS Schwaegr.

BOLIVIA: vicinity of La Paz, August, *18858*.

FUNARIA HYGROMETRICA (L.) Sibth.

PERU: vicinity of Chosica, June, *18549*; Arequipa and vicinity, August, *18822*, *19001*; Juliaca, September, *19098*.

CHILE: near Valapraiso, September, *19106*, *19107*, *19132a*; Santiago, September, *19181*.

FUNARIA MACROSPORA R. S. Williams, Bull. N. Y. Bot. Gard. **3**: 133. 1903.

BOLIVIA: La Paz, August, *19463*; Araranca, August, *19527*.

PERU: Arequipa, August, *19528*. The spores in all these specimens are rough and the larger measure 25–30 μ. Possibly the species is not distinct from *F. hygrometrica*. The plants are all much larger than any specimens of *F. hygrometrica arctica* I have seen.

FUNARIA SUBERECTA Mitt.

CHILE: vicinity of Illapel, October, *19462a*.

MIELICHHOFERIA CAMPYLOTHECA C. M.

BOLIVIA: Comanche, August, *18884a*.

HAPLODONTIUM JAMESONI (Tayl.) Hpe.

PERU: Juliaca, September, *19097*.

HAPLODONTIUM SERIOLUM C. M.

PERU: Juliaca, September, *19518*.

LEPTOBRYUM PYRIFORME (L.) Wils.

BOLIVIA: Araranca, August, *19464*.

LEPTOBRYUM WILSONI (Mitt.) Broth.

PERU: Arequipa and vicinity, August, *19514*, *19517*.

ANOMOBRYUM FILIFORME (Dicks.) Husn.

PERU: above Toyatoya, August *18941;* Juliaca, September, *19101*.

BRYUM CONCAVUM Mitt.

BOLIVIA: La Paz, August *18895*, *18896*, *19463a*.

PERU: Arequipa, August, *19529;* Cuzco, September, *19056*, *19058*.

BARTRAMIA FRAGILIFOLIA C. M.

BOLIVIA: vicinity of Comanche, August, *19524*.

Philonotis fragilicaulis sp. nov.

Flowers and fruit not known; plants in compact cushions with slender, branching stems, mostly denuded of leaves in the lower part and without radicles, 3–4 dm. long and 0.25 mm. in diameter, having a large well-defined central strand and often rough surface in the older parts from the large, mamillose-inflated outer cells; leaves nearly erect and loosely imbricate-incurved when dry, scarcely spreading when moist, ovate-pointed, about 1.5 mm. long and 0.75 mm. wide, the margins flat, serrulate in the upper part, sometimes crenulate nearly to the base; costa stout, rough on the back in the upper half, excurrent into a serrulate, short or somewhat elongate and subulate point; cells of leaf on the under surface, more especially the median cells, mamillose-inflated at the base, those of the upper leaf mostly somewhat elongate, more or less quadratic, the median 8–12 μ wide and 20–30 μ long, the basal rather larger and more rectangular.

PERU: Araranca, 4260 m. alt., August, *19513*.

POGONATUM POLYCARPUM (Schimp.) Broth.

PERU: Juliaca, September, *19100*.

HEDWIGIDIUM IMBERBE (Sw.) Bry. Eur.

BOLIVIA: vicinity of Comanche, *18883*.

FABRONIA ANDINA Mitt.

BOLIVIA: vicinity of La Paz, August, *18857*, *18871;* Comanche, August, *19515*.

LESKEA GRACILLIMA Tayl.

PERU: Cuzco, September, *19059*, *19530*.

One specimen (No. 18603b) is not determined. It is possibly a small *Pohlia*, but lacks fruit and may belong elsewhere.

Explanation of plates 21-25

PLATE 21

Campylopus peruvianus. 1. Plant about natural size. 2. Stem-leaf, × 18. 3. Hyaline point of leaf, × 103. 4. Basal cells on one side of costa, × 124. 5. Median cells of leaf, × 124. 6. Half a cross-section near the middle of leaf, × 124.

Astomum chilense. 7. Plant about natural size. 8. Plant, × 10. 9. Apex of leaf, × 183. 10 and 11. Upper stem leaves, × 20. 12. Lower stem leaf, × 20. 13. Median cells of leaf, × 183. 14. Cross-section of leaf about half way down, × 124. 15. Basal cells on one side of costa, × 124.

PLATE 22

Pterogoneurum Roseae. 1. Plant about natural size. 2. Upper leaf, × 10. 3. Lower leaf, × 10. 4. Inner perichaetial leaf, × 10. 5. Calyptra, × 10. 6. Cells at the shoulder of leaf about half way up blade, × 124. 7. Apex of leaf-blade, × 46. 8. Capsule, × 10. 9. Half a cross-section near the middle of leaf, × 124. 10. Part of peristome, annulus and rim of capsule, × 124. 11. Basal cells from margin extending only part of the way to costa, × 124.

Crossidium Rosei. 12. Plant about natural size. 13. Calyptra, × 11. 14 and 15. Upper and middle stem leaves, × 18. 16. Basal cells on one side of costa, × 124. 17. Capsule, × 11. 18. Median leaf cells, × 124. 19. Cross-section about one third down leaf, × 103. 20. Part of peristome, annulus and rim of capsule, × 124.

PLATE 23

Pseudocrossidium chilense. 1. Plant about natural size. 2. Plant, × 9. 3 and 4. Perichaetial leaves, × 20. 5. Basal cells on one side of costa, × 124. 6 and 7. Upper and middle stem leaves, × 20. 8. Median cells of leaf, × 183. 9. Cross-section of leaf below the middle, × 124. 10. Cross-section above the middle, × 183.

Pseudocrossidium apiculatum. 11. Plant about natural size. 12. Plant, × 6. 13. Stem-leaves, × 13. 14. Perichaetial leaf, × 13. 15. Cells in upper leaf about midway between margin and costa, × 183. 16. Cells just above the rectangular basal cells, × 183. 17. Cross-section of leaf about one third down, × 124. 18. Basal cells of leaf from margin to costa, × 124. 19. Cross-section of a second leaf, × 183.

PLATE 24

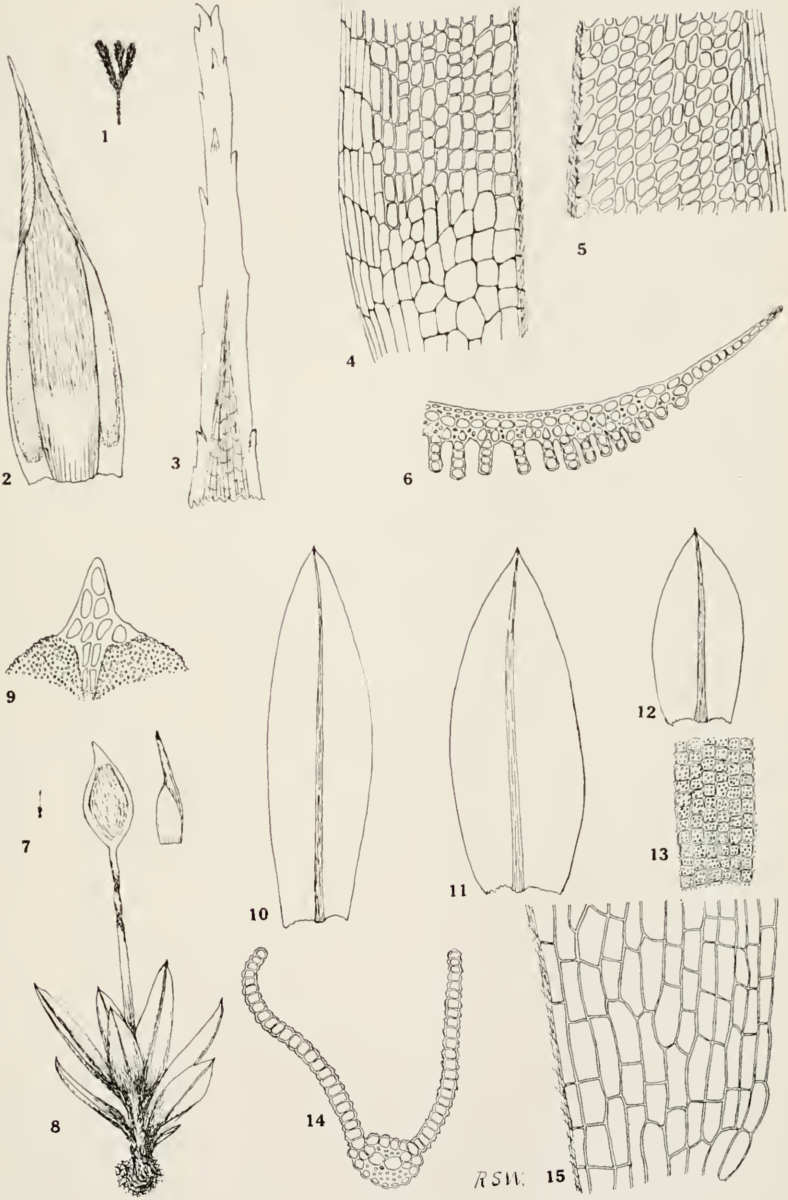
Tortula minuscula. 1. Plant about natural size. 2. Calyptra, × 14. 3. Capsule, × 14. 4. Median exothecal cells, × 124. 5. Median cells of leaf, × 183. 6. Part of peristome, annulus and rim of capsule, × 183. 7. Perichaetial leaf, × 20. 8 and 9. Stem leaves, × 20. 10. Basal cells of leaf from margin to costa, × 183. 11. Cross-sections of costa in upper part and near the middle, × 183.

Tortula limensis. 12. Plant about natural size. 13 and 14. Stem-leaves, × 6. 15. Capsule, × 6. 16. Calyptra, × 6. 17. Cross-section of leaf, × 124. 18. Apex of leaf-blade and costa on under side, × 124. 19. Median cells of leaf, × 124. 20. Basal cells of leaf from margin to costa, × 124. 21. Part of peristome, annulus and rim of capsule, × 124.

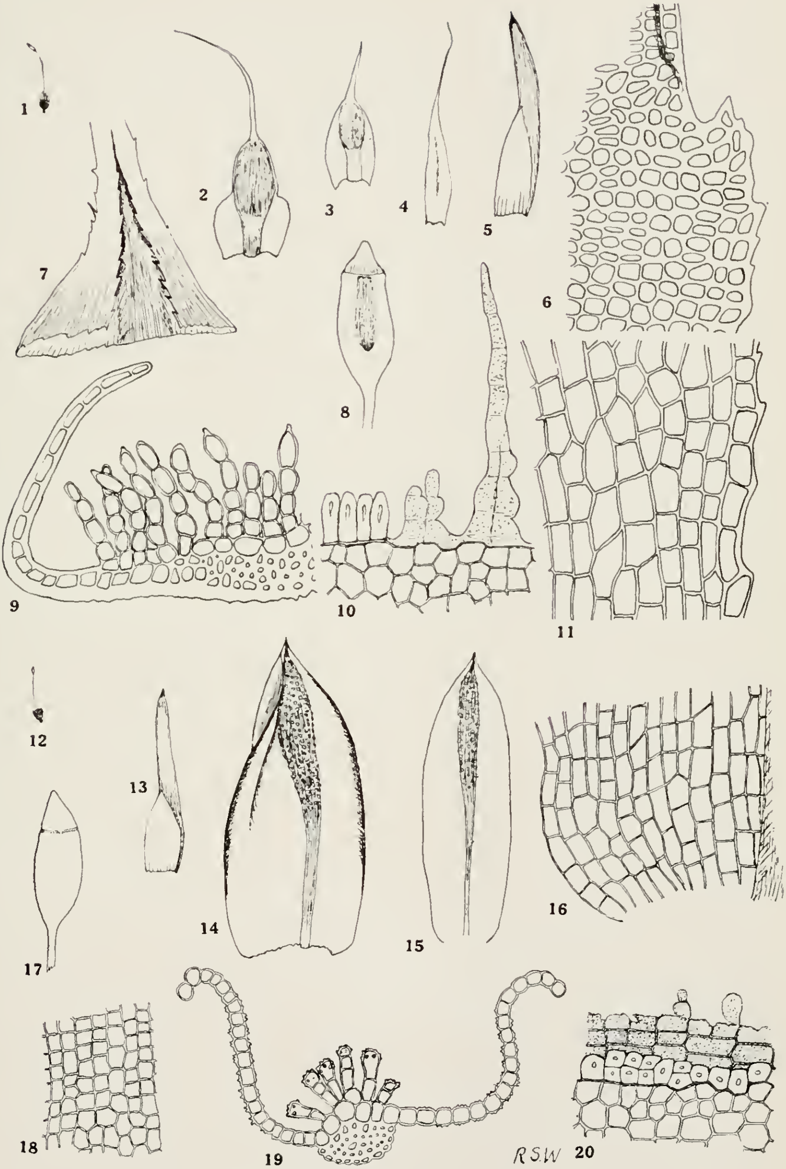
PLATE 25

Physcomitrium Roseae. 1. Plant, × 5. 2. Leaf, × 14. 3. Apex of leaf, × 100. 4. Cells about rim of capsule, × 100. 5. Cells at base of capsule surrounding a stoma, × 100. 6. Median cells of leaf, × 100. 7. Cells of lid from margin to center, × 100. 8. Basal cells of leaf from margin to near the costa, × 100. 9. Part of cross-section of leaf near the middle, × 100.

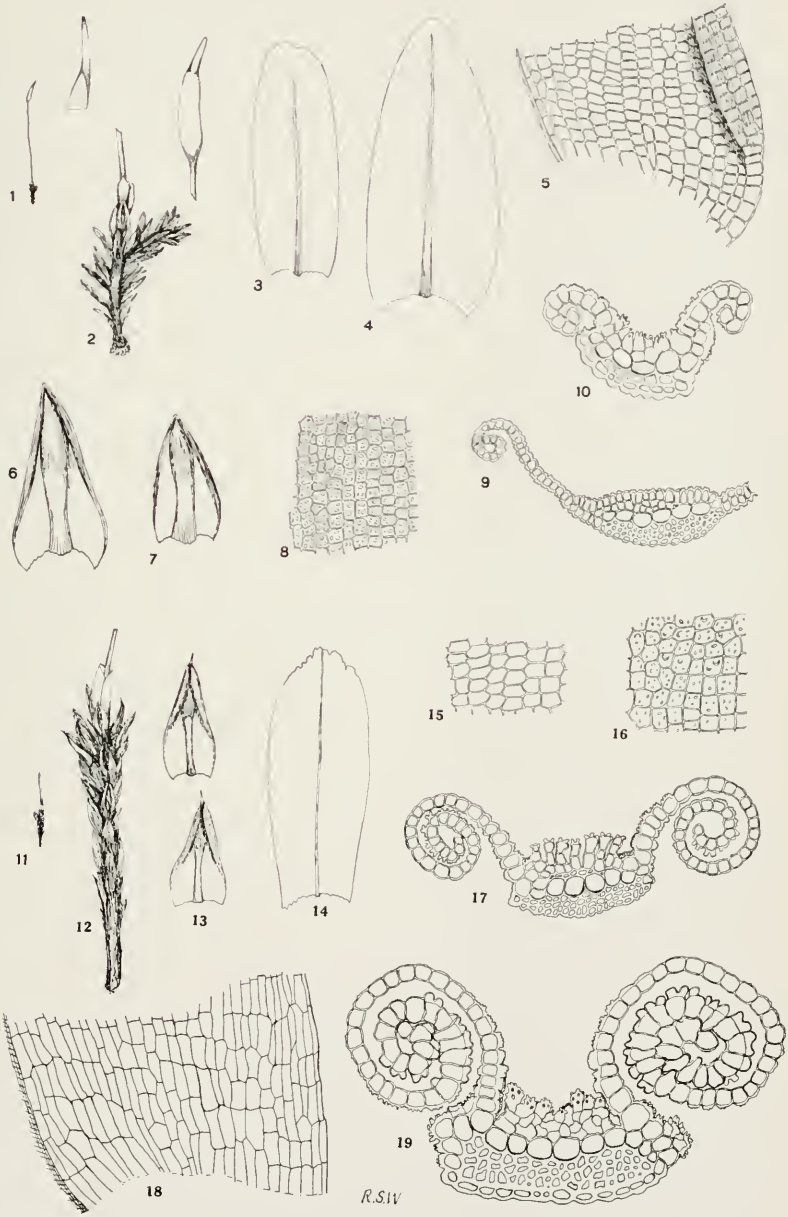
Philonotis fragilicaulis. 10. Plant, about natural size. 11 and 12. Stem leaves, × 23. 13. Median cells of leaf showing mamillae at the lower and under surface, × 183. 14. Leaf at apex, × 183. 15. Basal cells of leaf from margin to costa, × 183. 16. Part of cross-section of leaf near the middle, × 183. 17. Part of cross-section of leaf a little below the middle, × 183.



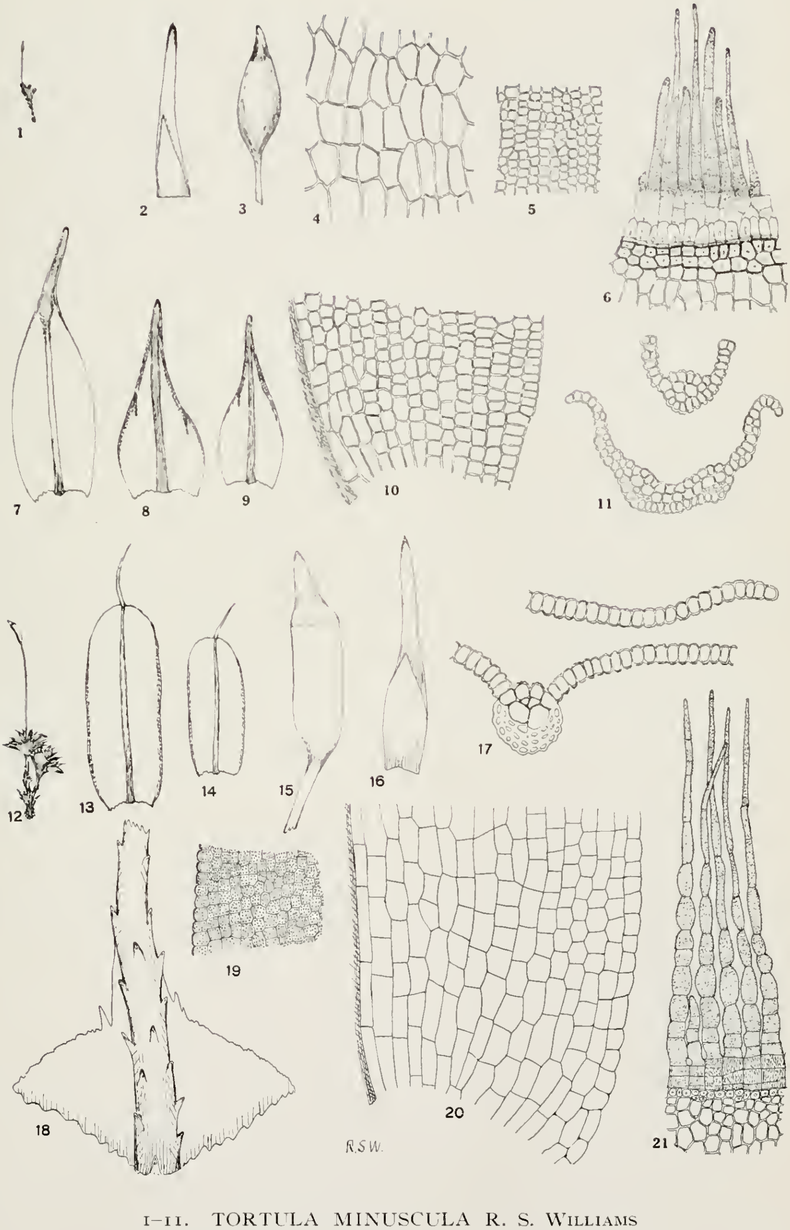
1–6. CAMPYLOPUS PERUVIANUS R. S. WILLIAMS
7–15. ASTOMUM CHILENSE R. S. WILLIAMS



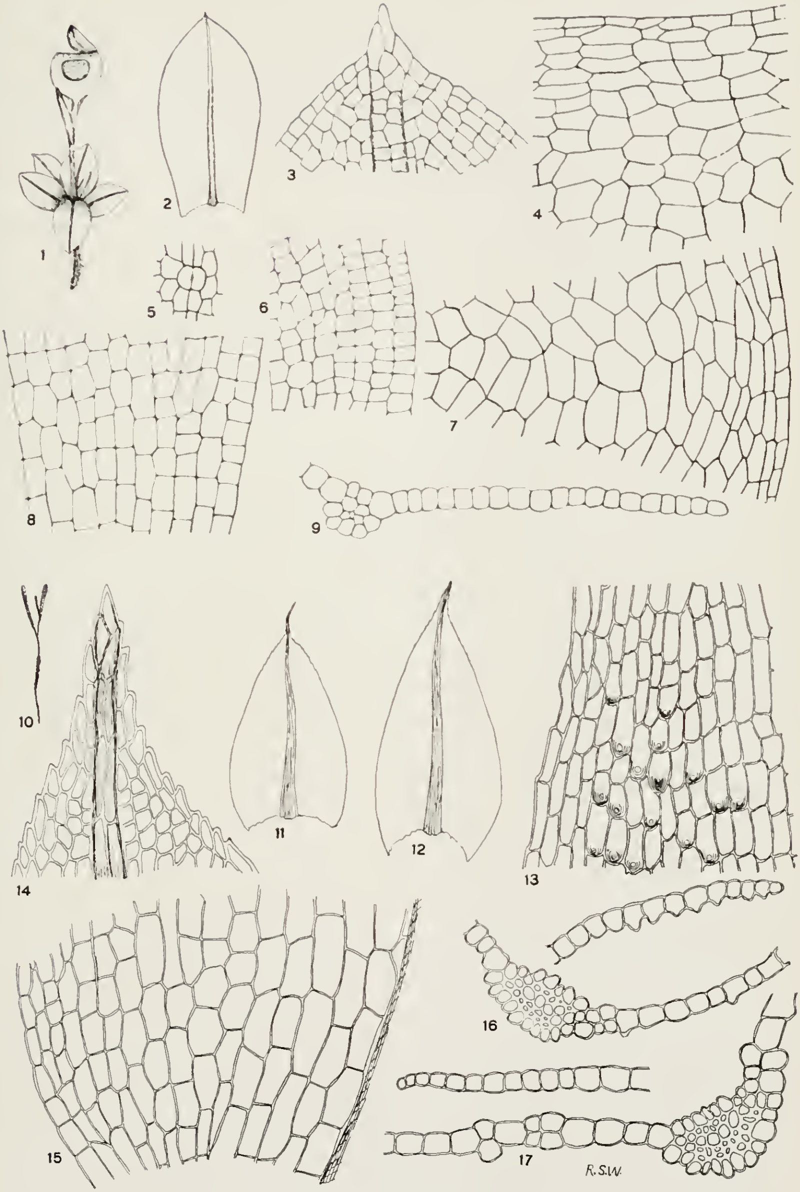
1–11. PTEROGONEURUM ROSEAE R. S. WILLIAMS
12–20. CROSSIDIUM ROSEI R. S. WILLIAMS



1–10. PSEUDOCROSSIDIUM CHILENSE R. S. WILLIAMS
11–19. PSEUDOCROSSIDIUM APICULATUM R. S. WILLIAMS



1–11. TORTULA MINUSCULA R. S. WILLIAMS
12–21. TORTULA LIMENSIS R. S. WILLIAMS



1–9. PHYSCOMITRIUM ROSEAE R. S. WILLIAMS
10–17. PHILONOTIS FRAGILICAULIS R. S. WILLIAMS

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 181

THE ORIGIN OF DWARF PLANTS AS SHOWN IN A SPORT OF HIBISCUS OCULIROSEUS

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The origin of dwarf plants as shown in a sport of Hibiscus oculiroseus

A. B. STOUT

(WITH PLATES 26 AND 27)

The publication in 1901–1903 of Die Mutationstheorie aroused a new interest in the well-known sports or spontaneous variations of earlier writers. While Darwin had recognized the occurrence of such variations he did not consider that they were the sole means or even the most frequent means by which species originated. De Vries sought to separate mutability as a type of sporadic variability from fluctuating variability, to define quite different laws for the two, and to ascribe to the former the only power to give rise to forms of specific rank.

Since 1901 much further evidence has accumulated regarding the appearance, the behavior, and the heredity of so-called mutations. It is fully established that marked variations do appear and that these are often hereditary. This phase of the general doctrine of variation is fully established. Of the various practical and theoretical considerations presented by these cases none are more fundamental than those relating to the expression and the heredity of "newly born" characteristics.

The general conception of mutation and the categories of behavior that indicate the process were combined by De Vries with the doctrine that plant characters are to be considered as so exactly represented by definite hereditary units that they can be properly called "unit characters." De Vries especially emphasizes this view in the preface of the English translation of Die Mutationstheorie (1909).

It has also been shown that numerous cases of hybridization result in an increased variability in the F_2 generation over that of the parents, in the production of intermediate forms, and in unexpected ratios. The Mendelian factorial hypothesis, which attempts to explain such phenomena, assumes that the difficulties of analysis in terms of unit characters indicate that characters are themselves the results of the combined action or interaction of hereditary units called factors to which various values can be attributed as seems necessary. There are some striking cases of reversion resulting from crosses that seem to support this view; as, for example, the production in sweet peas of the reversionary purple bicolor known as "Purple Invincible" from crosses between certain white flowering strains of "Emily Henderson" (Bateson, 1913, Chap. V). The developments of the Mendelian theory have led, however, to various and conflicting conceptions regarding the nature of the hereditary units and of the fundamental processes of mutation or discontinuous variation.

De Vries on the one hand considers that mutability is due to lability of hereditary physiological units; these change from stable to labile, from active to inactive (or latent) or even to a semilatent condition, giving irregularities of expression both in inbred and crossbred lines of progeny. Only in the rare cases of progressive mutation are new characters added and in none of the mutations is complete loss of hereditary qualities essential. The units of De Vries assume different degrees of activity; they are not uniform and consistent units in their influence.

In marked contrast to this view is the conception of Bateson that all variation is due to the presence or absence of "unit factors", that all true mutation is due to loss of factors, and that cases of discontinuous variation resulting from crosses are reversions which are due to recombination of factors. This view minimizes the occurrence of latency, ignores lability and insists on a rather rigid unity of assumed hereditary units, not in any sense comparparable with the appearance of the visible characters of plants.

These two very different interpretations indicate clearly the difficulties that arise in the attempts to analyze the facts of heredity and variation in terms of units and raise anew the questions as to the validity of the conceptions regarding mutation.

It is the purpose of this paper to present the facts as thus far determined regarding the origin and the behavior of a marked variation in *Hibiscus oculiroseus* and to point out some considerations suggested by such cases.

THE DWARF FORM OF HIBISCUS OCULIROSEUS

The two plants shown in PLATE 26 are typical for the appearance of dwarf and robust plants of *H. oculiroseus* at the end of the first year of growth as handled in my cultures. Both plants were from seed planted in January, 1914. The seedlings were grown in pots in a greenhouse until May, when they were planted in adjoining beds in the experimental garden. The photograph was taken September 13, 1914. A glance at the plate will show the marked differences that exist between the two types. The dwarf plant is shorter, but is more branched with large well-developed lateral branches arising close to the base; the internodes are shorter, making the leaves more crowded; the leaves are smaller and many of them are somewhat irregular or asymmetrical in outline and many of them are crinkled. Few of the dwarf plants have thus far come into flower, but those that have showed flowers nearly if not fully as large as the robust types.

From the data regarding the ancestry of the dwarf plants, it appears that a plant of *Hibiscus oculiroseus* was obtained by the New York Botanical Garden from the firm of Pitcher and Manda in the year 1896. This firm obtained their original stock of this plant from Mr. W. F. Bassett of Hammonton, New Jersey, who introduced the plant (Britton, 1903) into the trade some years before. Bassett obtained the first plant of this type about the year 1880 from a colony of wild plants growing near Absecen, New Jersey. The plant was propagated by seed, and introduced into the trade. It was commonly called the "Crimson Eye."

Britton (1903) points out that this type differs from *H. Moscheutos* in several characters. *H. Moscheutos* in its most abundant form, at least in the vicinity of New York City, has flowers of a rose color, lighter along the veins and becoming nearly pure white for about 1 cm. at the base of the corolla lobes. *Hibiscus oculiroseus* has a rose red or Tyrian rose eye about 2 cm. in radius, beyond which the petal is a sea-foam yellow. The flower pods are ovoid with a long tapering point, the calyx segments are triangular-lanceolate and nearly twice as long as broad. *Hibiscus Moscheutos* has a nearly globular bluntly pointed pod. On this account he gives the type specific rank under the name *H. oculiroseus*.

Cultures of H. oculiroseus at the New York Botanical Garden

Open-fed seed was collected from the plant obtained from Pitcher and Manda and planted for the purpose of increasing the stock of the species. The progeny (Nash, 1909) was composed in part of plants conforming to *H. oculiroseus* and in part of plants whose flowers suggested that the plants were hybrids between *H. oculiroseus* and the rose-flowered type of *H. Moscheutos*, an assumption which the writer has since proved to be true by controlled crosses.

At the time the writer began his investigations with *Hibiscus* (1911) there were seven plants of the *H. oculiroseus* characters growing in the Garden, all derived from the one parent plant. All of these were vigorous plants about five feet tall. Five of these plants have been used as parents and will be referred to as *O* No. 1, *O* No. 2, etc.

One of these plants (*O* No. 1) produces each year a considerable number of leaves, somewhat crinkled and irregular, and the uppermost internodes of the branches are somewhat shortened. One would be inclined to attribute this to a fluctuating variation due perhaps to local soil conditions. The other four plants show no trace of any of the dwarf characteristics.

Plants of the first pedigreed generation

In 1912, fifteen plants (Series I) were grown from open-fed seed collected from the plant *O* No. 1. Fourteen of these were robust and vigorous in growth, but three of them had some leaves irregular in shape and also exhibited a shortening of internodes at the tips of stems quite identical to that of the parent plant and were in general intermediates between the robust type and the extreme dwarf type. One plant was of the dwarf type quite identical with the one above described. Ten of the plants, including the dwarf and one of the intermediates, were grown in 1913, when all bloomed. The dwarf plant (No. 1 of Series I) continued small and much branched with many crumpled leaves. Two capsules of selfed seed were obtained from this plant and one capsule was obtained from a sister plant (No. 5 of Series I) of the robust type.

As to flower coloration and pod character, nine of the ten plants were typical *H. oculiroseus*. One plant had flowers with faint pink coloration outside the eye in the blade of the corolla, although at a short distance or upon casual survey the flowers appeared to be typical *H. oculiroseus*. There was outside of this one plant no indication but what the seed obtained was strictly selfed, and even in this one case the flowers borne were not such as have been obtained in the F_1 hybrids between the parent plant and the only other type of *Hibiscus* growing in the vicinity of the seed parent.

The winter of 1913–14 was unusually severe on the *Hibiscus* plants growing in the experimental plots, killing about 1,500 plants of various cultures, including the dwarf plant (No. 1) and the robust plant (No. 5) of Series I, from which selfed seed had been obtained.

In addition to the plants of Series I, there were also grown during the summer of 1913 forty-five plants (Series VI) derived from selfed seed obtained during the summer of 1912 from the same parent plant (*O* No. 1). All of these were dwarf plants. Four produced flowers that were typical *H. oculiroseus*. No seed ripened and all the plants died during the winter of 1913–14. All the plants of this series were dwarfs, while of the fifteen plants of another series (Series I) from a pod of the same parent only one dwarf appeared as already noted.

The dwarf character of these plants was most conspicuous in comparison with the selfed progenies of four other plants of *Hibiscus oculiroseus* (sister plants of *O* No. 1) grown during the summer of 1913 from seed of 1912. The data for these can be briefly summarized as follows: from plant *O* No. 2, nine plants were grown, of which four bloomed; from plant *O* No. 3, forty plants, of which ten bloomed; and from *O* No. 5, twenty-seven plants, of which none came into flower. All of the plants in these four series, 103 in number, were typical for the robust type with no trace of any of the dwarf characteristics. The twenty-four plants that bloomed were true to the *H. oculiroseus* type of flower. None of the plants matured seed and every one was killed during the winter of 1913-14.

Plants of the second generation

In the summer of 1914 three series of plants were grown, constituting a second generation in descent from the parent *O* No. 1. These may now be described.

Series VII. The parent of this series was a dwarf plant (No. 1 of Series I). Thirty-five plants were grown from seed of a single pod. Twenty-seven were uniformly of the dwarf type; one was a typical robust plant and seven were intermediates showing in slight degree the characteristics of the dwarf type. Six plants bloomed; one had eyed flowers with pale pink in the blade (quite similar to No. 8 of Series I), three had the eye somewhat diluted, and on two the eye of the flower was so diluted that the flowers appeared to be nearly pure white. The one plant of robust habit had flowers of a type which suggests that it is a stray plant of hybrid origin.

Series VIII. Of the same parentage as the Series VII. Forty-six plants were grown from selfed seed of a single capsule. Forty-five of these were dwarf quite like the one from this series shown on Plate 26. One plant was intermediate but was different from other intermediates in possessing a considerable development of lateral branches, the main branch was itself robust and the leaves were only slightly crinkled. The five plants that bloomed were all typical for the *H. oculiroseus* type and were only slightly if any smaller than the flowers of robust plants. The plants of this series are shown in the middle of Plate 27 with the marker standing in their midst. The plants of Series VII are shown beyond the label stake in the rear. The intermediate plant in Series VIII just mentioned is shown at point *a*. To the right in the foreground are hybrids between *O* No. 2 and a plant of *Hibiscus Moscheutos*, and to the left are hybrids between two types of *H. Moscheutos*, all of the same age as the dwarf plants.

Series IX. The thirty-four plants of this series were grown from the selfed seed of one capsule of plant No. 5 of Series I. The parent was a robust plant. Thirty-three of the plants were of the robust type quite uniformly like the one of this series shown on Plate 26. One plant was classed as an intermediate; it was smaller than the others, its leaves were somewhat crinkled, but it was not branched from the base. Twelve plants produced flowers; ten of these were typical *H. oculiroseus*, one had flowers with slight pink coloration outside the eye, and on one plant the flowers were quite pink outside the eye, quite like the flowers produced by hybrids between *H. oculiroseus* and the pink-flower type of *H. Moscheutos*.

Nearly all the plants of these three Series (VII, VIII and IX) lived through the winter of 1914–15 and were grown during the summer of 1915 in the same beds as in the previous year. In the second year of growth several main stems, usually three to five, are produced by the single cluster of roots belonging to a plant. As the plants were grown about 30 cm. apart they were much crowded in the second year, which is a condition that does not favor the development of secondary branches and hence the plants were much less bushy than in the first year of growth. Under these conditions there were fewer differences between plants previously classed as intermediate and dwarf.

In 1915 the plants of Series VII ranged from 1.25 m. to 1.6 m. in height with the exception of the plant classed as robust which was 2.08 m. tall but which from the character of its flowers appears to be an accidental hybrid. Series VIII ranged from 1.3 m. to 1.6 m. in height. The dwarf plant shown to the left in Plate 26 had four main branches and stood 1.45 m. tall and was typical for the average plant; the plant shown at point *a* in Plate 27, classed as intermediate in 1914, was of nearly the same height and appearance. Series IX, described as robust in 1914, varied from 1.75 m. to 2 m. in height with the average quite 0.3 m. taller than that of Series VII and VIII.

During 1915 there was also grown from seed a series of twenty-eight plants from selfed seed of plant *O* No. 1, the parent of the Series I and VI. On August 25, these plants varied from 0.4 m. to 0.75 m. tall and nearly all had the dwarf characteristics. The series showed greater variation in general vigor than did the plants of Series VII and VIII in their first year of growth. A series of twenty-three plants derived from selfed seed of one of the robust plants of Series I, grown at the same time were in comparison decidedly robust averaging from 0.8 m. to 1 m. in height and with no crumpled leaves or strongly developed lateral branches. Another series of eleven plants descended from a plant of Series I classed as intermediate was on the whole intermediate between the two series just mentioned.

SUMMARY OF THE CULTURES

A total of 288 plants have been grown (at least through a single season) from seed obtained from five sister plants of *Hibiscus oculiroseus*. The dwarf type of plant has appeared only among the progeny of a single plant (*O* No. 1); the 103 plants derived from the other four sister plants were without exception of the robust type.

There was much diversity among the progeny of the plant *O* No. 1, and the two series of plants grown in the first generation gave quite different proportions. In Series I, there were eleven robust, three intermediate and one dwarf; in Series VI there were forty-five plants, all of which were dwarf.

The progeny of a single dwarf plant (the only one that has thus far matured seed) was composed of one robust (later appearing to be an accidental hybrid), eight intermediate and seventy-two dwarf plants. While the dwarf type has not bred true the greater number of the progeny are of that type. There is a pronounced tendency to breed true. Robust plants in this line of descent do not always breed true, as the only one tested gave one intermediate plant and thirty-three robust plants.

A condensed schematic presentation of these facts regarding the progenies of different lines of descent, not including the series started from seed in 1915, is given in the accompanying diagram.

- Parent
  - *O* No. 1
    - 1912. Series I. 1 dwarf, 11 robust, 3 intermediate.
      - 1914. Series VII. 27 dwarf. 1 robust (?). 7 intermediate.
      - 1914. Series VIII. 45 dwarf. 1 intermediate.
      - 1914. Series IX. 33 robust. 1 intermediate.
    - 1913. Series VI. 45 dwarf.
  - *O* No. 2 — 1913. Series II. 9 plants, robust.
  - *O* No. 3 — 1913. Series III. 40 plants, robust.
  - *O* No. 4 — 1913. Series IV. 27 plants, robust.
  - *O* No. 5 — 1913. Series V. 27 plants, robust,

DISCUSSION

The dwarf type of *Hibiscus oculiroseus* constitutes a marked and distinct variation from the usual robust type of the species. It has smaller leaves, many of the leaves are crumpled, the internodes are shorter, and there is an increased development of branches. It is such group-differences as these that constitute the elementary species of De Vries, for, as he states (1901, p. 176): "Elementare Arten unterscheiden sich von ihren nächsten Verwandten mehr oder weniger in allen ihren Merkmalen." All the changes, however, are considered to be a result of a change in the condition of a single pangen.

It is difficult or impossible to describe such a mutation in terms of definite characters that have been gained or lost. The ordinary type of development of the leaves and internodes have been modified mainly in the direction of arrested growth, while the amount of branching has been increased, due chiefly to the development of basal lateral buds that usually remain dormant.

In comparison with the robust type the characteristics of the typical dwarfs are readily recognized, the general effect being quite adequately shown in the illustrations on PLATES 26 and 27. The characteristics of the two types can be listed as follows:

Robust form	*Dwarf form*
First year of growth, 0.8–1.1 m.	0.4–0.75 m.
Second year of growth, 1.75–2 m.	1.25–1.6 m.
No branching from base of shoots.	Large branches from base.
Internodes about 30 in number.	Internodes about 30 in number, but all proportionally shorter.
Leaves ovate, larger ones lobed, palmately veined, densely white stellate-pubescent beneath, glabrous above; leaves all flat.	Leaves identical except that the largest are smaller than the average of robust type; many leaves crinkled.
Flowers and fruit are typical *H. oculiroseus*.	Flowers and fruit identical with those of robust form; apparently no smaller.

While typical plants classed as robust and dwarf were very uniform in the above characteristics, there were a few plants, as noted, described as intermediates or semi-dwarfs, which possessed in some degree of development one or more of the characters of the dwarf form but which in the second year of growth were less distinguishable.

The mutant of *Oenothera Lamarckiana* that most nearly approaches in its characters the dwarf *Hibiscus* is, of course, *Oe. nanella*. The principal characteristics of this plant compared with those of the parent form as given by the description of De Vries may be given as follows:

Oe. Lamarckiana	*Oe. nanella*
Robust: 1.5–1.8 m. tall.	Dwarf: about one-fourth as tall as *O. Lamarckiana*, often blooming when 10–20 cm. tall.
Secondary branches abundant and strong.	Secondary branches lacking or nearly absent.
	Internodes much shorter making leaves and flowers more compact.
Leaves ovate-lanceolate; long petioled, much crumpled surfaces.	Leaves sessile or nearly so; broad at base, often auriculate or heart-shaped; petioles very brittle.
Flowers with petals 3–4 cm. long; buds thin, tapering to a point.	Flowers very nearly as large; buds often laterally twisted.
Fruit and seeds normal.	Fruit and seeds of almost normal size.

The dwarf *Oe. nanella* differs from *Oe. Lamarckiana* in nearly all of its vegetative organs. De Vries maintains, however, that such a mutation is brought about by a change in the activity of a single hereditary "pangen," but that the visible result depends only partly on the direct results of the changed condition in one pangen. On this point he states (1901, p. 305): "Der äussere, sichtbare Erfolg hängt also nur zum Theil von der Mutation, zum Theil aber auch von den älteren Merkmalen ab. Oder mit anderen Worten, die neue Art kennzeichnet sich in der Regel nicht durch eine enizige neue Eigenschaft, sondern dadurch, dass veile oder alle Organe in bestimmter Weise umgestaltet wurden." This means that in the case of *Oe. nanella* when the *alta* pangen (1913) becomes inactive it affects not only the height of the plant but also produces a transformation of many other characters, such as the nature of the leaves and the branching. De Vries states regarding *Oe. nanella* (1904, p. 532): "The most remarkable feature is the shape of the leaves. They are broader and shorter, and especially at the base they are broadened in such a way as to become apparently sessile. The stalk is very brittle, and any rough treatment may cause the leaves to break off." These remarkable differences in the leaves are brought about. De Vries assumes, by a change in the "*alta* pangen", a pangen concerned with the height of the plant. Such a view is, it would appear, *directly opposed to a conception of independence between heredity units.* We get in such cases the clearest possible conception of the application of De Vries's idea of a heredity unit ("pangen") as an element of the germ-plasm which affects and determines the character of a plant as a whole, constitutionally, and in all or many of its characters. Such a view is quite different from the units of Weismann, which were assumed to be individual in effect and sufficiently numerous to correspond directly to every detailed feature of expression.

The original Mendelian doctrines of unit characters assumed qualitative germ cell units, independent in action, and each responsible for the expression of a character. Color and wrinkledness of peas (qualities of the cotyledons) were considered as separable hereditary units quite independent of any preformation of the cotyledons themselves. Mendelian theories have been concerned with the phase of development and heredity which involves qualities, and though evading the difficulties of assumed spacial relationship in preformation, they assume that the qualitative values of the "factors" are predetermined. It is an important fact established especially by Mendelian studies that qualities of organs may appear and disappear independently of the organ and to certain degrees independently of each other. This suggests that the older conceptions of the preformation of organs as such do not hold and that a hereditary unit for an organ with all its characteristics does not exist. This is very clearly seen in the numerous studies of inheritance and variation of color in which organs like petals, leaves, and stems of plants, eyes of insects, etc., remain quite the same except for color. Such facts emphasize on the one hand the wide possibilities of latency as most excellently developed by De Vries, and on the other the most evident fact that qualities which appear to be localized in organs are more often general qualities of the entire organism, the development of which is a matter of intercellular and inter-tissue relationships.

The arguments of De Vries consistently seek to establish the doctrine of the fewness of the pangens. On this basis dwarfness is assumed to be the same in all the different cases in which it appears throughout the plant kingdom.

No consistent uniformity, however, exists among the dwarf types derived in different species or even in the same species. Some types of dwarf garden peas appear to differ from tall varieties chiefly in the character of the internodes. In the "brachytic" varieties of cotton (Cook, 1915) the shortened internodes and modified leaves and bracts are usuall confined to the fruiting branches. Numerous types of dwarf and semi-dwarf types exist in many species, a notable instance of which has been recently described by Bartlett (1915), who found that two dwarf types arose in a single pedigreed generation of *Oenothera Reynoldsii*. One of these, *semialta*, is about half as tall as f. *typica* and has a very dense and showy inflorescence, in which the fruits and flowers are very little smaller than in the parent form. The leaves, however, are decidedly reduced. As described by Bartlett (1915, p. 130) the sister dwarf "*debilis* is more variable in size than mut. *semialta*, but averages about half as high as the latter. Its fruits and flowers are somewhat reduced, but by no means proportionally to the plant. The leaves, on the contrary, are much more reduced than those of mut. *semialta*".

Bartlett has not discussed these in terms of characters that have been gained, lost, or modified, but does point out that the appearance of these two dwarf forms as sister mutants in the rather large number of individuals "bears a certain degree of resemblance to Mendelian segregation." The case is especially interesting in affording a record of the simultaneous origin of hereditary variations from a single parentage giving dwarf forms of markedly different characteristics.

Furthermore, the facts of variation resulting from hybridization involving dwarf forms indicate a diversity of behavior quite in line with the above-mentioned facts. Mendel considered that the dwarf garden pea differed from the tall in a single character pair and that he obtained neither intermediates nor a greater range of variation in the F_2 generation. Darbishire (1911) considers that this is the case and that the dwarf garden pea differs from the tall variety only in respect to two types of internodes, long and short. Punnett (1911, p. 35) applying the conception of presence and absence very generally to peas states "all peas are dwarf, the tall pea is a dwarf plus a unit factor." This generalization is not borne out by the data. Lock (1904) in progeny of crosses between a tall and a semi-dwarf ("Satisfaction" and native No. 2) found in the F_2 great variation in habit ranging from very robust to very feeble dwarf. Although he considers that there must be some sort of Mendelian segregation if the internodes are solely considered, he admits that "this cross seems to afford an example of remarkable intensification of both the allelomorphic characters of the same pair, namely tallness and dwarfness, the former in the F_1 and both in the F_2 and later generations" (p. 414). Keeble and Pellew (1910) in crossing two well-known staple semi-dwarfs varieties of the garden pea obtained in the F_2 a wide variation, giving both dwarf and tall as well as intermediates. They conclude that length of internode and width of stem are both involved and in their interpretation dwarfs lack both factors, semi-dwarfs lack one and talls possess both. Height in sweet peas is also of complex character, as breeding studies of dwarf, semi-dwarf and tall varieties have shown. Crosses with bush and "Cupid" give an F_1 that is tall and an F_2 with variation involving plants that include tall, bush and two types of "Cupid". Bateson attempts to explain this case as he does all cases of increased variation in terms of presence or absence of factors, giving *different interactions in different combinations.* The point is clear that greater variability does develop and that not only is height of sweet peas evidently a compound character, but that the assumed factors take on different values. For example, the factor T ("tallness") when combined with P (erect: branching) gives the bush variety. The two sets of allelomorphs assumed in this case are not independent units in expression. It may be emphasized that the original rigid unit-factor hypothesis is being given up in favor of the admission, as we see in this case, of a marked modifiability of the effect of the assumed factors. The integrity of the assumed units in these cases can only be maintained by assuming a permanence in them, which is entirely at variance with the visible results which they are assumed to produce.

The behavior of the dwarf characteristics of *Oenothera nanella* in hybridization is of special interest in this connection. The group of characters appearing in *Oe. nanella* go together in crosses with *Oe. Lamarckiana*, not as a unit giving alternative expression but in the splitting that develops in the F_1 generation giving the parent forms as twin hybrids. De Vries assumes (1913) that the *alta* pangen is inactive in *Oe. nanella* and labile in *Oe. Lamarckiana.* In this case inactive × labile gives both inactive and labile.

When *Oe. rubrinervis* is crossed with *Oe. nanella* splitting also occurs in the F_1 giving *Oe. Lamarckiana* and a new type called *Oe. subrobusta.* The *alta* pangen in *Oe. rubrinervis* is assumed to be active, so in this case active × inactive = labile and inactive + active. The *Oe. subrobusta* form splits in the next generation, giving dwarf forms which, however, are evidently not *Oe. nanella. None of the types derived are like either of the two parent forms.*

Again when *Oe. muricata* is crossed with *Oe. nanella* the F_1 is of two new types called *Oe. laeta* and *Oe. velutina. Oe. velutina* splits up in the F_2 giving a dwarf *Oe. murinella* that is not like *Oe. nanella.* None of the types are like the parent forms. The assumed condition of the *Oe. alta* pangen in this case is active × inactive = labile, active and inactive.

The appearance of twin hybrids not like the parents and of second generation dwarfs not like *Oe. nanella* is also the rule in crosses between *Oe. nanella* and *Oe. Hookeri, Oe. Cockerelli, Oe. cruciata* and also *Oe. biennis* when the latter is the seed parent.

When *Oe. nanella* is fertilized by pollen from *Oe. biennis* the F_1 is composed largely of dwarf plants. In the earlier crosses De Vries reports a few tall plants and many dwarfs (1913, p. 241) but from a cross in 1907 he obtained only dwarfs which, however, he classed in two types, *Oe. semialta* and *Oe. debilis*, each of which was different from the *Oe. nanella* parent. In this case the condition of the *alta* pangen in the hybrids is assumed to be inactive × labile, which is the same condition assumed for *Oe. nanella* × *Oe. Lamarckiana*.

De Vries finds in such behavior evidence of the production of new species in groups by hybridization. He assumes that a few pangens are involved and that those exist in few conditions. The integrity of such units can only be assumed by calling in such all-sufficient properties as lability and inactivity which admit of very sporadic behavior.

It is generally assumed that a new elementary species arises suddenly without transitional forms. This is not the case with the dwarf type of *Hibiscus* here described. The plant *O* No. 1 from which all dwarf plants thus far obtained have arisen, possessed a few of the characteristics of the dwarf. The next generation gave dwarf, intermediates and robust plants in quite irregular numbers in the two series grown. Bartlett (1915) describes two dwarf types arising in a progeny of *Oe. Reynoldsii*, one of which (*semialta*) is intermediate in general stature and has leaves less reduced than in the extreme dwarf form (*debilis*). Variations such as these are not like ordinary fluctuations in giving a frequency distribution agreeing with Quetelet's law and they do not conform to the Mendelian ratios of segregation, although as Bartlett points out, there is much in the behavior that suggests the segregation assumed by Mendelian interpretation. *They are irregular and sporadic variations* involving different degrees and intensity of change. The most marked of these involve changes affecting the character of several organs.

Further evidence regarding irregular expression of characters is seen in the well-known cases cited by De Vries of non-isolable races, eversporting varieties, and inconstant species, indicative of irregular and sporadic inheritance and expression of ever present tendencies which in these cases rigid selection fails to isolate.

That there are cases of variation that are cumulative is evident. De Vries especially has given data on two such cases. In a race of *Chrysanthemum segetum*, having an average of twenty-one ray florets in the terminal inflorescence in a crop of 1,500 plants one plant was found with four lateral flower heads with twenty-two ray florets. Seed from this plant gave a progeny of 423 plants one of which had a terminal inflorescence of thirty-four rays. Seed from this plant gave a mixed progeny with one plant having sixty-six ligulate florets, three of which were among the tubular disk flowers. Seed from this plant gave progeny with florets ranging from thirty-three to one hundred and one with a few completely double flowers.

In respect to these results De Vries says (1901, p. 526): "Es wird sich jedem Leser die Frage aufdrängen: ist dieser Uebergang ein allmählicher oder ein stossweiser gewesen? Mir scheint das letztere der Fall zu sein, aber es hängt dabei viel ab von der Bedeutung, welche man den Wörtern giebt. Jedenfalls geschah die Umwandlung nicht im Laufe der Jahrhunderte, wie es die Selectionstheorie anzunehmen pflegt, nicht einmal brauchte es dazu Jahrzehnte. Drei Jahre genügten, und solches in einer Cultur von nur wenigen Quadratmetern Umfang."

De Vries considers that this result is due to the reappearance of a latent character. It is not clear what the latent character is in this case. The species already possessed ray flowers in the outer circle of flowers. The development of a so-called double-flowered race consisted of a change of tubular flowers to ray flowers. Furthermore, as wholly double flowered plants are sterile, the double flowered plants are obtained continually by planting seed from plants not fully double flowered.

A similar case is seen in the development of *Linaria vulgaris peloria*. Individuals of certain races produce rarely a single peloric flower, an evidence De Vries considers of a semi-latent character which seldom becomes active. Seed from two such plants gave out of a generation of two thousand one hundred plants, twenty plants having only peloric flowers. Progeny of these peloric plants gave ninety per cent. true to the type. In both *Chrysanthemum segetum* and *Linaria vulgaris peloria* self sterility made it difficult to grow pure line progenies. De Vries points out (1901, p. 564) that while he considers these as cases of mutation they are of a type quite different from that in *Oenothera*. In regard to the origin of such variations that are hereditary the evidence is not at all conclusive that slight variations may not be inherited even in a cumulative manner.

That this is the case is further suggested by the difficulty of drawing a definite line of distinction between species, varieties and races. De Vries, who has written most fully on this point from the standpoint of genetics, states that the best examples of varieties are those showing latency of a single character which may be just as constant as species (1901, p. 119); again he treats *O. nanella* (1901, p. 256) as a variety simply because somewhat similar dwarf types recur in a great number of species. He also gives the general view that varieties usually differ in one character (1901, p. 363); he states in another connection that the chief difference between improved races and species, even the smallest of elementary species, is the instability of the former and the stability of the latter (1901, p. 84); but we may note that inconstant species do occur (1901, p. 270).

It is clear that some cases of sporadic variation reproduce more true to type than others. The so-called law of mutation that "neue elementare Arten sind meist völlig constant, vom ersten Augenblicke ihrer Entstehung an" (1900, p. 175) is itself a qualified statement. The difficulty of assigning a definite heredity in terms of unit characters or unit factors to "newly born" characteristics which appear in mutations has become apparent. This is especially recognized in part by the view of Gates that mutation is a phenomenon of variability which is quite distinct from heredity.

Thus far progeny has been grown from only one of the dwarf plants of *Hibiscus oculiroseus*. One capsule of seed gave forty-six plants, all but one of which were dwarf, and another capsule gave twenty-seven dwarf, one robust and seven intermediates as judged by the growth made the first year. The type appears to be only slightly inconstant. Further breeding tests will determine if the type becomes more constant by selection and if differences exist between the progenies of different dwarf plants.

There has been much discussion recently regarding the possibility of the association of hybridization with mutation especially in the Oenotheras. The rather well-known history of *Hibiscus oculiroseus* and its dwarf mutant is of significance in this respect. The wild form of *H. oculiroseus* was originally found in a region in which the species *H. Moscheutos* exhibits much polymorphism, involving problems which the writer now has under investigation. Its affiliations with this species are so evident that for some time it was known as a variety. The several differentiating characters possessed by *H. oculiroseus* have already been noted and while a few variations have been observed in my pedigreed cultures the species breeds remarkably true to type. In fact the only variations that have appeared have been among the progeny of the plant giving dwarf plants, and none of the variations suggest that this particular plant is a hybrid at least of the usual type. As far as now known, *H. oculiroseus* has a limited distribution in nature and since it is closely associated with *H. Moscheutos* it may well be that it has been derived from this species.

Mr. George William Bassett, owner of the William F. Bassett nurseries, writes in 1915: "We have never, to my recollection, observed any dwarf tendency in *Hibiscus* 'Crimson Eye.' Nor have we had any occasion to throw any out for any cause." It does not appear that dwarf forms have appeared in the cultivation of the species. Mr. Norman Taylor reports to the writer that he has observed in Long Island colonies of dwarf plants of the pink-flowered form of *H. Moscheutos*.

The evidence indicates that the dwarf form is of spontaneous origin. There is no series of characteristics belonging to either *H. Moscheutos* or the parent stock of *H. oculiroseus* that can be considered as combining to produce the dwarf, an interpretation given to the origin of *Oe. gigas* by Heribert-Nilsson (1912). The immediate parent (*O* No. 1) of the dwarf plants possessed in slight degree the characteristics of crinkled leaves and shortened internodes which later appeared more intensified in the dwarf plants. This, coupled with the variability of the progeny, might be considered by Mendelians to indicate that the parent plant was a half-mutant. While it is no doubt true that such cases do occur (a most notable case is that of *Oe. semigigas*), it is evident that the conception has been applied to many cases of irregular inheritance and sporadic variation and even to instances of cumulative variation.

A most important type of discontinuous variation is that of simultaneous variation in a group of characters, well illustrated by the dwarf *Hibiscus*. Not only is a number of characters modified but the habit of profuse branching from the base appears as a character quite new to the parent species. Such phenomena are not well explained on any conception of continuous unit characters.

Bateson does not admit that such simultaneous variation can occur as a sporadic variation. He does not believe in the mutation and inheritance of group-characters as described by De Vries and already mentioned with respect to characters of *Oe. nanella*. He prefers to think of the phenomena as due to a recombination of factors. His strongest evidence for this view is the apparent marked reversions that appear in certain crosses. If, however, recombinations can give new groups or develop characteristics new to the particular race and species, his analysis is of doubtful validity.

To assume that a variation such as the dwarf *Hibiscus* is due to a single change in a single hereditary unit is to assign to the units different values and to admit of interaction between units. On the other hand to assume that there are hereditary factors that are themselves stable but that can interact upon each other in various ways is to assign different values to the supplementary or coördinating units and to the various interactions between them. This makes the comprehensive description of the processes of heredity in terms of units other than characters of doubtful validity.

It is quite clear that hereditary variations giving dwarf forms of various degrees of intensity and extensity do arise. If in all cases single characters, factors or other hereditary units are concerned the evidence is clear that they possess different potencies and belong to quite different categories, or else that they undergo quite different sorts of changes not only in different species but in the same species, variety, strain or even pure line.

The accumulation of evidence from all lines of plant breeding shows that sporadic and irregular expression and inheritance of characters are frequent and are widely distributed among plants, and that ordinary stable characters and combinations become split up and modified in processes of both mutation and hybridization, giving variability not conforming to the usual laws of fluctuating variability.

SUMMARY

A dwarf form of *Hibiscus oculiroseus* has appeared in a pedigreed culture as a sporadic variation. It differs from the robust form in possessing a smaller stature, shorter internodes, smaller leaves, many crinkled leaves and in the development of lateral branches from the base of the main stem.

Plants intermediate between the dwarf and the robust forms appear. These possess one or more of the characters of the dwarf type in some degree of development.

All the dwarf plants thus far obtained are the progeny of a single plant (*O* No. 1). No dwarf plants appeared among the 103 plants grown as progeny of four sister plants of plant No. 1.

The parent plant of this dwarf (*O* No. 1) possessed already in slight degree the characteristics of crinkled leaves and shortened internodes.

The dwarf plants appeared in varying numbers along with robust and intermediate types. One series (Series No. I) was composed of one dwarf, eleven robust and three intermediate plants; another series (Series VI) was composed of forty-five dwarf plants.

There is a strong tendency for the dwarf form to breed true. In a total of eighty-one plants grown from seed of a dwarf there were seventy-two dwarf plants, eight classed as intermediates, and one that was robust (Series VII and VIII).

It is difficult to describe the dwarf type in terms of characters that have been lost or gained. The smaller and crinkled leaves and the shortened internodes are evidences of reduced or arrested growth. In the marked development of branches from the base there is increased growth or at least development of buds that usually remain dormant.

There is no series of characters of either *H. oculiroseus* or *H. Moscheutos* that can be considered as combining in hybridization to give the dwarf.

The simultaneous appearance of variations involving modifications of groups of characters and of intermediates of various kinds exhibit sporadic variations of various degrees of intensity quite in line with the general evidence of the sporadic nature and wide range of such variations.

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Explanation of plates 26-27

PLATE 26.

To the left, typical plant of the dwarf form of *Hibiscus oculiroseus* (Plant No. 14 of Series VIII). To right typical plant of the robust form (Plant No. 23 of Series IX). Photograph taken September 13, 1914. Both plants are seven months old.

PLATE 27.

View in garden. In center with marker in the midst is a series (Series VIII) of dwarf plants. Plant indicated at *a* is an intermediate. At the right is a series of hybrids between *H. oculiroseus* (Plant *O* No. 2) and the pink-flowered type of *H. Moscheutos*. To the left is part of a series of hybrids between white-flowered and pink-flowered forms of *H. Moscheutos*. The three series are of the same age and illustrate the difference between the dwarf and the robust forms.

STOUT: HIBISCUS OCULIROSEUS

STOUT: HIBISCUS OCULIROSEUS

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NOTES ON ROSACEAE—X

P. A. RYDBERG

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Notes on Rosaceae—X

P. A. Rydberg

Rubus Hybrids

Hybrids are rather common in the genus *Rubus*, especially among the blackberries. Numerous hybrids have been admitted in Europe. The only really good attempt made to segregate hybrid forms in America, was that by Mr. Bicknell.* Mr. Bicknell studied these forms in the field and in most cases found the supposed parents growing in the immediate vicinity. I also have studied blackberry hybrids two summers in the Adirondacks, the Catskills, the mountains of southwestern Virginia, western North Carolina, and eastern Tennessee, and around Ottawa, Canada. It is a pity that it never occurred to Mr. Blanchard, who did so much valuable work on the blackberries, to explain the numerous forms as, partly at least, due to hybridity. It would not have been very hard to determine whether or not many of his new species probably had arisen through hybridizing. Mr. Bicknell, without having seen many of Mr. Blanchard's species in the field, reduced nearly all of them into hybrids or into synonyms of older species.

I think that his interpretation was correct in the majority of cases, but that he went too far in his reduction in some others. It is risky to make pronunciations without seeing the species in the field, and my course in the North American Flora was perhaps not so wise. It may have been better to leave many of the supposed species as such than to pronounce them as hybrids, without any better proofs than the finding of intermediate and intergrading characters. No definite conclusion can be had, however, without experimental work in crossing. The only alternative course to pursue would have been to admit all the proposed species as such and to describe twice as many more, most of them without any definite distinctive characters. In such a case, a key would have been impossible to make.

* Bull. Torrey Club 38: 103–133. 1911.

The following ninety-three tentative hybrids have been recorded. Their essential characters have been pointed out in the North American Flora, but in that work no specimens are cited, except the types of new species and the first records of new hybrids. It is, however, valuable to students of the brambles to know what specimens the monographer regarded as such hybrids. I have, therefore, prepared the following list of specimens.

Rubus acaulis × *stellatus.*

ALASKA: 1885, *Huff;* Copper Center, *Heidman 88.*

Rubus acaulis × *pubescens.* *Rubus propinquus* Richardson is regarded as a synonym of this.

MACKENZIE: Hay River, July 1, 1903, *Preble & Cary 25;* wooded country, *Richardson.*

Rubus arcticus × *pubescens.**

QUEBEC: Mt. Albert, Gaspé County, 1906, *Fernald & Collins 623a;* Table-top Mountain, *Fernald & Collins 617.*

Rubus arcticus × *saxatilis* (*R. castoreus* Frees). No locality has been recorded on this side of the Atlantic, but it may be expected in northeastern Canada.

Rubus idaeus × *spectabilis.* This is unknown except as a garden plant, and it is natural that it should be so, as *Rubus idaeus* and *R. spectabilis* have no common territory where both grow wild. Indigenous hybrids of *R. spectabilis* and species related to *R. idaeus* have been collected in Alaska, viz., the two following:

Rubus spectabilis × *viburnifolius.*

ALASKA: Lake Clark, 1902, *Gorman.*

Rubus spectabilis × *subarcticus.*

ALASKA: Camp 53, 1899, *Shrader.*

Rubus occidentalis × *rosaefolius.* Known only as a garden hybrid.

Rubus idaeus × *ursinus.* Only known as a spontaneous garden hybrid, which is under cultivation as the Logan Berry.

Rubus idaeus × *phoenicolasius.* *R. Paxii* Focke. Only known as a garden hybrid.

* In answer to a letter to Dr. Fernald suggesting that the plant collected by him and Mr. Collins was a hybrid, I received the following reply: "I have no doubt that the plants you refer to are hybrids of *Rubus triflorus* and *arcticus.* Such specimens are found in small colonies throughout Gaspé, Newfoundland, and southern Labrador, wherever *R. arcticus* occurs."

Rubus occidentalis × *strigosus* (*R. neglectus* Peck; *Melanobatus neglectus* and *M. michiganus* Greene). This is a rather common hybrid and it would be superfluous to cite specimens. Sometimes it resembles more one parent, sometimes the other. The original *R. neglectus* is most like *R. occidentalis*, while *Melanobatus michiganus* approaches *R. strigosus*.

Rubus occidentalis × *procumbens*. The very interesting plant, which I referred to this hybrid, was collected by Commons nearly forty years ago. Commons recognized it as a hybrid of *R. occidentalis* but made no suggestion of the other parent. This is evidently a member of the *Eubatus* section, apparently to be sought among the dewberries, and most likely *R. procumbens*. Mr. Commons remarks: "I tried to perpetuate this by sowing the seeds at various times, but not one came up."

Rubus leucodermis × *melanolasius*.

BRITISH COLUMBIA: near international boundary between Kettle and Columbia River, *J. M. Macoun 64002;* Chilliwack Valley, *J. M. Macoun 34805;* also *7035* and *69970* from British Columbia.

MONTANA: Belton, 1903, *Umbach 698;* McDonald's Lake, 1909, *M. E. Jones*.

OREGON: Eastern Oregon, 1897, *Cusick 1729*.

WASHINGTON: 1897, *Horner 163*.

Rubus macropetalus × *viburnifolius*. No other specimen but the original one, *Mr. & Mrs. C. Van Brunt 121*, from Glacier, British Columbia, has been seen of this hybrid.

Rubus idaeus × *strigosus*. This is not uncommon in cultivation, but no record of it in a wild state has been made.

Rubus argutus × *cuneifolius*. This was first recognized as a hybrid by Mr. Bicknell. The same form had also been collected by Britton & Hollick, who did not venture to name it. Their specimens were determined as *R. Andrewsianus* by Mr. Blanchard, but the dense grayish pubescence of the under leaves is not found in that species. All the specimens seen are from the sandy coast strip.

NEW JERSEY: Atlantic Highlands, 1906, *Hollick & Britton;* Toms River, 1900, *Bicknell 90*.

Rubus cuneifolius × *floridus*. What I regard as this hybrid is one much resembling the last hybrid but a weaker plant with more curved prickles. Judging from the analogy, it is not improbable that this plant is such a hybrid, as it differs from *R. argutus* × *cuneifolius* in the same characters as does *R. floridus* from *R. argutus*, and both *R. floridus* and *R. cuneifolius* are found in the district where the supposed hybrid has been found. Mr. Ashe distributed it mixed with *R. cuneifolius*.

VIRGINIA: Ocean View, Norfolk, 1898, *Kearney 1212*.

NORTH CAROLINA: Chapel Hill, *Ashe*, mixed with *R. cuneifolius*.

Rubus cuneifolius × *lucidus*. Mr. Nash collected specimens near Eustis, Florida, which resemble *R. cuneifolius* in many respects, but the leaves are larger, more acute and more coarsely serrate. He determined them doubtfully as *R. cuneifolius*. Similar specimens were also collected by Chapman, in Duval County, Florida, together with *R. cuneifolius*. He also has collected *R. lucidus* in the same county.

FLORIDA: Duval County, *Chapman 2832*, mostly; Eustis, 1894, *Nash 70*.

Rubus cuneifolius × *trivialis*. Somewhat similar specimens were collected by Coker at Hartville, South Carolina, but in these the plant is prostrate, the flowers mostly solitary, and in habit it resembles more *R. trivialis*. These specimens I regard as *R. cuneifolius* × *trivialis*.

Rubus canadensis × *sativus*. The specimens which I regard as this hybrid were originally labeled *R. canadensis*, but Mr. Blanchard has afterwards written on the sheets "A var. or form of *R. can.* W. H. B." It is evidently not pure *R. canadensis* for the inflorescence is glandular and the leaflets of the new shoots are broadly cordate and abruptly acuminate as in *R. sativus*.

VERMONT: Windham, June 6, 1903, *Blanchard 265*.

Rubus nigricans × *sativus*. I have no positive evidence that *R. frondisentis* Blanchard is such a hybrid, but the plant combines characters of the two species, and is found where the ranges of the two species overlap. It is also a very local plant and has not been collected except at the original station.

Rubus argutus × *nigrobaccus*. This hybrid was first recognized by Mr. Bicknell, but he used the name *R. allegheniensis* × *argutus*, following Blanchard and Fernald in interpreting *R. allegheniensis*. The plant is not uncommon and the following specimens are referred here.

NEW YORK: Lynbrook, Long Island, 1901, *Bicknell 36;* Elizabethtown, Essex County, 1900, *Macy;* Bronx Park, 1896, *Nash;* Highland Falls, 1910, *Mearns 50.*

MASSACHUSETTS: Quaise, Nantucket Island, 1910, *Bicknell 33;* Shawaukemmo Spring, Nantucket Island, *Bicknell 35;* Canton, near Boston, 1906, *Blanchard 99, set 9.*

VIRGINIA: Rosslyn, 1897, *Kearney.*

CONNECTICUT: Southington, 1904, *Andrews 3.*

PENNSYLVANIA: Tannersville, 1901, *Britton.*

NEW JERSEY: Clifton, 1890, *Nash 900;* Paramus Swamp, Bergen County, *Nash 947;* also *Mackenzie 2086.*

Rubus frondosus × *nigrobaccus.* This was also first recognized as a hybrid by Bicknell, although he included in it specimens which I do not think belong to it but rather to *R. nigrobaccus* × *recurvans.* It was not at all unnatural that he should do so, as he did not recognize *R. recurvans* as a distinct species.

MASSACHUSETTS: Shawaukemmo Spring, Nantucket Island, 1908, *Bicknell 20.*

NEW YORK: Jamaica, Long Island, 1901, *Bicknell 25;* Port Washington, *Bicknell 21, 23;* Franklin Square, *Bicknell 19.*

PENNSYLVANIA: north of Philadelphia, 1906, *Blanchard 100, Set 6;* Lancaster County, 1894, *Ely.*

NEW JERSEY: Succasunna, 1909, *Mackenzie 4123.*

Rubus canadensis × *nigrobaccus.* This hybrid was first recognized by myself when I studied the blackberries in the Catskills, 1906, at Tannersville, where it grew together with *R. nigrobaccus* and *R. canadensis.* I also saw it in the Adirondacks and in southwestern Virginia.

NEW YORK: Tannersville, 1906, *Rydberg 7974;* Little Moose Lake, 1906, *Rydberg 7820a;* Stanford, 1909, *Taylor 712;* Tannersville, 1892, *Vail;* North Harpersfield, *Topping 132.*

MASSACHUSETTS: Tyringham, Berkshire County, 1897, *Vail.*

VERMONT: Grafton, 1902, *Blanchard 177;* Simonsville, *Blanchard 183;* Rutland, 1902, *Eggleston 2884.*

VIRGINIA: White Top Mountain, 1908, *Rydberg 8104;* between Marion and White Top Mountains, *Rydberg 8138.*

NORTH CAROLINA: Graham County, 1897, *Biltmore Herbarium 1307c.*

NEW BRUNSWICK: Grand Falls, *Macoun 21181.*

Rubus amicalis × *nigrobaccus.* Comparing the specimens referred here with *R. canadensis* × *nigrobaccus,* I came to the conclusion that this must be a hybrid of the species mentioned. They were collected by Arthur at Isle au Haut, Maine.

Rubus nigrobaccus × *Randii.* This was first recognized by myself while collecting in the Adirondacks. Both parents grew in the vicinity. Subsequently I thought it was the same as *R. frondisentis* Blanchard, but I have found it is not. None except the original specimens have been seen.

Rubus nigrobaccus × *pergratus.* The following specimens I think belong to this hybrid. They were collected near the type locality of *R. amicalis* × *nigrobaccus. Rubus pergratus* is also common in the region.

MAINE: Isle au Haut, 1909, *Arthur 55, 56.*

Rubus heterophyllus × *nigrobaccus.* I have no evidence that the specimens referred here belong to a hybrid except that the plant combines the habit and glandular pubescence of *R. nigrobaccus* with the leaf cut of *R. heterophyllus.* The original specimens are the only ones seen.

Rubus nigricans × *nigrobaccus.* This I collected at Kingsmere Lake, Quebec, where both *R. nigricans* and *R. nigrobaccus* were growing. I have no doubt but my specimens were of hybrid origin. I cannot distinguish them from specimens of *R. glandicaulis* distributed by Mr. Blanchard. *R. biformispinus* Blanchard I think is also a hybrid of the same two species, though approaching *R. nigricans* more than *R. nigrobaccus.* The following specimens belong here:

QUEBEC: Kingsmere Lake, 1906, *Rydberg 7946.*

NEW BRUNSWICK: Frederickstown, *Blanchard 606.*

MAINE: Yarmouth, 1909, *Blanchard 507;* Brownville, *Blanchard 508;* Bar Harbor, *Blanchard 509;* Calais, *Blanchard 510;* Isle au Haut, 1909, *Arthur 52;* Kennebunk, 1905, *Blanchard 74, Sets 1, 2;* Kennebunkport, 1905, *Blanchard 79.*

NOVA SCOTIA: Granville, 1909, *Blanchard 718, 727;* Yarmouth, *Blanchard 728.*

Rubus nigrobaccus × vermontanus. If *R. glandicaulis* is a hybrid between *R. nigrobaccus* and *R. nigricans, R. frondisentis* is very likely a hybrid between the former and *R. vermontanus.*

VERMONT: Townshead, 1903 and 1904, *Blanchard 243, 244;* Huntington, 1903, *Blanchard 257.*

Rubus hispidus × nigrobaccus. R. permixtus Blanchard stands in the same relation to *R. hispidus* as *R. glandicaulis* does to *R. nigricans,* I therefore do not hesitate in regarding it as a hybrid between *R. nigrobaccus* and that species.

VERMONT: Westminster 1902 and 1903, *Blanchard 225, 226, 227, 229;* Putney, 1902, *Blanchard 228;* Westminster, 1903, *Eggleston 3245.*

NEW HAMPSHIRE: Walpole, 1903, *Blanchard 233.*

NOVA SCOTIA: *Macoun 81438, 81439.*

Rubus argutus × frondosus. This was first recognized by Mr. Bicknell.

NEW YORK: Rockville Center, Long Island, 1906, *Bicknell 38;* between Yonkers and Mount Vernon, 1902, *Burnham.*

CONNECTICUT: Southington, 1905, *Blanchard 99, set 1;* 1904, *Andrews 27.*

Rubus argutus × recurvans. This was included in *R. argutus × frondosus* by Bicknell, who did not regard *R. frondosus* and *R. recurvans* distinct.

MASSACHUSETTS: Quaise, Nantucket Island, 1909, *Bicknell 34.*

NEW YORK: Cedarhurst, Long Island, 1910, *Bicknell 37.*

Rubus argutus × Baileyanus. This was also segregated out by Mr. Bicknell.

MASSACHUSETTS: below the "Cliff," Nantucket Island, 1910, *Bicknell 40.*

NEW YORK: East Rockaway Bog, Long Island, 1908, *Bicknell 41;* also at Hawlett, *Bicknell 42.*

Rubus argutus × Enslenii. This was also recognized by Mr. Bicknell, although he did not publish the same. His specimens closely match the type of *R. ostryifolius* Rydb., which I now do not hesitate in regarding as this hybrid.

NEW YORK: Hempstead Plains, Long Island, 1910, *Bicknell 65;* Lynbrook, *Bicknell 62, 64, 66.*

NEW JERSEY: Highlands, *Britton;* Ogdensburg, 1910, *Mackenzie 4625;* South Amboy, 1905, *Mackenzie 1376.*

VIRGINIA: Norfolk, 1898, *Kearney 1365.*

Rubus argutus × carpinifolius. Both Engelmann and Bailey recognized this as a hybrid, regarding one of the parents as *R. trivialis* from which *R. carpinifolius* was not separated at that time. Bailey thought that the other parent was *R. argutus.* Engelmann gave it as *R. villosus*, under which name both *R. argutus* and *R. nigrobaccus* were then known.

MISSOURI: St. Louis, 1863, *Engelmann;* Cahokia, 1863, *Engelmann.*

Rubus floridus × lucidus. In the description of *R. persistens* Rydb. two different plants were included. Unfortunately, it happened that the specimen which was assigned as the type evidently belongs to a hybrid of *R. floridus* and a species then unknown. *R. persistens*, therefore, must pass into synonymy.

Rubus carpinifolius × floridus. Dr. Engelmann regarded the original specimen of this hybrid as a variety of *R. trivialis.* It is more likely that it is a hybrid of *R. carpinifolius*, which at his time was not distinguished from *R. trivialis*, and *R. floridus*, which is also found in Texas.

TEXAS: Houston, 1842, *Lindheimer.*

Rubus floridus × frondosus. Some specimens collected at Bluff Lake, Missouri, by Eggert probably belong to a hybrid between *R. floridus* and *R. frondosus.* The only reason for believing so is that they combine characters of both and were found in a region common to both.

MISSOURI: Bluff Lake, *Eggert.*

TENNESSEE: Knoxville, 1896, *Ruth.*

Rubus Enslenii × frondosus. This was first recognized by Mr. Bicknell and well described by him.

NEW YORK: Hempstead Plains, Long Island, 1906, *Bicknell, 48, 49, 70.*

MASSACHUSETTS: Nantucket Island, 1906, *Bicknell 47.*

Rubus frondosus × procumbens. I have no definite evidence that *R. Rossbergianus* is a hybrid of *R. frondosus* and *R. procumbens*, but the habit is intermediate between the two; the leaves resemble in form those of *R. frondosus*, but are harsher; and the stem is light colored, tough and prickly as in *R. procumbens*. Both are found in the region.

CONNECTICUT: Southington, 1905, *Blanchard 89, set 1–3;* Graniteville, *Blanchard 89, set 3;* Canton, *Blanchard 89, set 5;* Southington, 1904, *Andrews 21, 22, 23, 31, 33, 35.*

NEW JERSEY: Tuckerton, *Mackenzie.*

Rubus frondosus × hispidus. Also one of Mr. Bicknell's hybrids, collected only at the original station and vicinity, *Bicknell 43, 69.*

Rubus canadensis × recurvans. The specimens from which *R. recurvans subrecurvans* was described approach *R. canadensis* L. in so many respects, such as the form of the leaves, the inflorescence, and the weakly developed armature of the stems, that I have regarded it as a hybrid with that species.

MAINE: Kennebunkport, 1905, *Blanchard 71;* York Beach, 1909, *Blanchard 516.*

Rubus Brainerdi × vermontanus. The specimens referred to this hybrid were collected at the type station of *R. Brainerdi* and together with it. *R. vermontanus* is common in the region.

VERMONT: Weybridge, *Brainerd;* also 1902, *Eggleston 2894.*

Rubus amicalis × pergratus. No specimens except the original ones have been seen.

Rubus argutus × canadensis. This was first recorded by myself from southwestern Virginia, but similar specimens have also been collected in the north.

VIRGINIA: road between Marion and White Top Mountain, 1908, *Rydberg 8099;* Chattam Hill Road, 1892, *Small.*

NORTH CAROLINA: Biltmore, 1909, *Crafton & Eggleston, 4416.*

NEW JERSEY: Greenwood Lake, 1907, *Mackenzie 2675;* Ogdensburg, 1910, *Mackenzie 4625.*

Rubus canadensis × Randii. This was first recorded by myself from the Adirondacks, where both parents grow.

NEW YORK: Little Moose Lake, 1906, *Rydberg 7818; 7820:* Twin Lakes, *Rydberg 7842;* East Lake, *Rydberg 7861.*

NOVA SCOTIA: Pictou, 1906, *C. B. Robinson 528.*

Rubus canadensis × *pergratus.* Also first recorded by myself at Tannersville, New York, *7960, 7961.*

Rubus Baileyanus × *canadensis.* The specimens originally recorded as this hybrid were collected near an artificial lake or reservoir above Sparta, New Jersey. *R. canadensis* was growing in the neighborhood but *R. Baileyanus* was not collected there. The habit of the plant and the poor fruiting indicate a hybrid of *R. canadensis* and, probably, *R. Baileyanus.* To this belong:

NEW JERSEY: Morris Lake, Sparta, 1906, *Rydberg 7992;* Montague Township, Sussex County, 1909, *Nash;* Midvale, 1908, *Rydberg 8016.*

NOVA SCOTIA: *Macoun 81433, 81431.*

Rubus elegantulus × *nigrobaccus. Rubus flavinanus* Blanchard evidently represents this hybrid. The plant is decidedly intermediate between the two. None except Blanchard's specimens have been seen.

Rubus Baileyanus × *nigrobaccus.* This was first recognized as a hybrid by Mr. Bicknell, who, however, did not publish the same. The following specimens belong here:

NEW YORK: Smithtown, Long Island, 1910, *Bicknell 17, 24.*

PENNSYLVANIA: Presque Isle, Erie, *Otto Kuntze 2671.*

NEW JERSEY: Midvale, 1908, *Rydberg 8017.*

Rubus Baileyanus × *procumbens.* This has been known for fifteen years or more and is even in cultivation, but it was first regarded as a variety of *R. procumbens*, and later as a distinct species under the name *R. roribaccus.* Mr. Bicknell was the first one to recognize it as a hybrid. Some of his specimens match very closely the original ones distributed by Professor Bailey.

MASSACHUSETTS: Nantucket Island, 1910, *Bicknell 8.*

NEW YORK: Cedarhurst, Long Island, 1910, *Bicknell 6;* Aqueduct, 1905, *Bicknell 7.*

NEW JERSEY: Ledgewood, 1909, *Mackenzie 4127;* Succasunna, *Mackenzie 4126.*

VIRGINIA: Glade Springs, 1908, *Rydberg 8148;* Fairfax, 1906, *Blanchard 101, set 3.*

PENNSYLVANIA: Willow Grove Park, 1906, *Blanchard 101, set 2;* Lancaster, *Blanchard 101, set 1.*

CONNECTICUT: Southington, 1906, *Blanchard 101, set 5½*.

MISSOURI: Little Blue Tank, 1897, *Mackenzie 210*.

IOWA: Papoose Creek, 1894, *Mackenzie 681*.

Rubus Baileyanus × frondosus. First segregated by Mr. Bicknell.

MASSACHUSETTS: Quaise, Marcy's Pond, below the "Cliff," and Squam, Nantucket Island, 1910, *Bicknell 85, 86, 88, 87, 84*.

NEW JERSEY: Budd's Lake, 1905, *Eggleston 0;* Mt. Arlington, 1905, *Mackenzie 1402;* Stanhope, *2085;* Berkeley Heights, *2047*.

Rubus Baileyanus × hispidus. This was at first included in *R. hispidus × procumbens* by Bicknell. He, however, determined his Long Island material as *R. Baileyanus × hispidus*.

NEW YORK: Aqueduct, Long Island, 1905, *Bicknell 73*.

NEW JERSEY: near Musconetcony River, 1906, *Mackenzie 2107*.

MASSACHUSETTS: Reed Pond, Nantucket Island, 1910, *Bicknell 75;* Reading, 1897, *Kingman*.

Rubus Baileyanus × carpinifolius. Another plant collected by Eggert at Bluff Lake, Missouri, in 1878 must be, on account of the combination of characters, a hybrid between *R. Baileyanus* and *R. carpinifolius*, which both grow in the region.

Rubus arenicola × hispidus. The original specimens are the only ones seen of this hybrid.

Rubus nigrobaccus × plicatifolius. The specimen referred to this hybrid (*Blanchard 516*, sheet 1), was labeled by Mr. Blanchard *R. recurvans* var. *subrecurvans*, which variety I regard as a hybrid between *R. recurvans* and *R. canadensis;* but this number evidently does not belong there. The glandular pubescence of the inflorescence and the cut of the leaves in the specimens mentioned indicating *R. nigrobaccus* blood. The pubescence and the plication of the leaves suggest *R. plicatifolius*.

Rubus nigricans × plicatifolius. I regard *R. multiformis* Blanchard as a hybrid of *R. nigricans* and *R. plicatifolius*.

NOVA SCOTIA: Yarmouth, 1909, *Blanchard 724;* Annapolis *Blanchard 726;* Kentville, *Blanchard 725*.

MAINE: Bar Harbor, 1909, *Blanchard 512;* Kennebunkport, 1905, *Blanchard 80*.

QUEBEC: *Macoun 67904.*

Rubus canadensis × *plicatifolius.* The almost unarmed stem of *Rubus multiformis delicatior* Blanchard indicates a hybrid of *R. canadensis.* The plicate leaves suggest *R. plicatifolius.*

MAINE: Kennebunkport, 1905, *Blanchard 81.*

NOVA SCOTIA: Halifax, *Macoun 81426.*

Rubus hispidus × *plicatifolius. Rubus semierectus* Blanchard I take as a hybrid. The small flowers, bristly stem and broad leaflets suggest *R. hispidus*, the pubescent strongly veined and subplicate leaflets, *R. plicatifolius.*

MAINE: Kennebunk, 1905, *Blanchard 67.*

NEW YORK: vicinity of Tannersville, 1891, *Vail.*

NOVA SCOTIA: *Macoun 5792, 19076.*

Rubus heterophyllus × *recurvans.* No other specimens than those cited in the North American Flora, viz., *Blanchard 256*, from Huntington Hills, Massachusetts, have been seen which may be referred to this hybrid.

Rubus argutus × *flagellaris.* This as well as all the other hybrids of *R. flagellaris* were discovered by Mr. Bicknell. For specimens and notes see his paper in the Bull. Torrey Club 38: 103–133, 1911. The other hybrids are *Rubus flagellaris* × *frondosus, R. flagellaris* × *procumbens, R. Baileyanus* × *flagellaris, R. flagellaris* × *hispidus* and *R. flagellaris* × *Enslenii.*

Rubus nigrobaccus × *procumbens.* This was first recognized by Mr. Bicknell, but under the name *R. allegheniensis* × *procumbens.*

NEW YORK: Merrick, Long Island, 1910, *Bicknell 30;* Hewlett, *Bicknell 28;* Lynbrook, *Bicknell 26.*

MASSACHUSETTS: Wauwinet, Nantucket Island, 1910, *Bicknell 27.*

Rubus argutus × *procumbens.* This was also first recognized as a hybrid by Bicknell. *Rubus multispinus* Blanchard matches Bicknell's specimens very closely.

NEW YORK: Rockville Center, Long Island, 1909, *Bicknell;* Hewlett, *Bicknell 68;* Lawrence, *Bicknell 67.*

MASSACHUSETTS: Nantucket Island, 1899, *Bicknell 29;* 1910, *Bicknell, 82, 83;* Reheboth, 1906, *Blanchard 96, set 2;* Plymouth, 1906, *Blanchard 96, set 3.*

RHODE ISLAND: Rocky Point, 1906, *Blanchard 96, set 1.*

Rubus procumbens × *recurvans.* Many specimens from Connecticut resemble *R. procumbens* closely, but are more pubescent and with the leaves of the floral branches more incised. These I have regarded as hybrids with *R. recurvans.* They are:

CONNECTICUT: Southington, 1904, *Andrews 29, 28, 41, 61, 37, 34, 30;* Plainville, 1903, *Blanchard 222;* Winsted *Blanchard, 259.*

MASSACHUSETTS: Southwick, 1903, *Blanchard 253.*

Rubus pergratus × *procumbens. Rubus recurvicaulis* Blanchard seems to me a hybrid of *R. pergratus* and *R. procumbens,* combining characters of both. I have seen no specimens except those distributed by Mr. Blanchard.

Rubus canadensis × *procumbens. Rubus recurvicaulis inarmatus* stands to *R. canadensis* as *R. recurvicaulis* does to *R. pergratus,* and I believe also this to be a hybrid.

MAINE: Kennebunk, 1905, *Blanchard 67, 69.*

NOVA SCOTIA: North Sidney, 1907, *C. B. Robinson 616.*

Rubus hispidus × *procumbens.* This was first recognized by Mr. Bicknell. The following specimens belong here:

NEW YORK: Cypress Hill, 1905, *Bicknell 74.*

VERMONT: Londonderry, 1903, *Blanchard, 246;* Newfane, 1902, *Blanchard 186.*

NOVA SCOTIA: Boylston, 1890, *Chas. Hamilton, 19985.*

NEW JERSEY: Mt. Arlington, 1905, *Mackenzie 1404;* also 1904, *Mackenzie 903.*

Rubus Baileyanus × *Enslenii.* Also one of Mr. Bicknell's hybrids.

MASSACHUSETTS: Nantucket Island, 1908, *Bicknell 52, 54, 55.*

CONNECTICUT: New Haven, 1895, *Helen Ingersoll.*

NEW YORK: Woodmere, 1904, *Bicknell 56.*

DISTRICT OF COLUMBIA: Riverdale, 1901, *Steele.*

VIRGINIA: Marion, *N. L. & E. G. Britton & A. M. Vail.*

Rubus Enslenii × *procumbens,*

Rubus Baileyanus × *Enslenii,*

Rubus Enslenii × *flagellaris,* and

Rubus Enslenii × *hispidus.* Of these four hybrids, I have seen none but Mr. Bicknell's specimens. See Bull. Torrey Club 38: 130–131. 1911.

Rubus argutus × *nigricans*. I cannot distinguish *R. adscendens* Blanchard from Mr. Bicknell's hybrid. The following specimens belong here:

NEW YORK: Smithtown, Long Island, 1808, *Bicknell 89*.

NEW JERSEY: Allamuchy Mountains, 1906, *Mackenzie 2108*, *2300;* Succasunna, 1909, *Mackenzie 4153*.

CONNECTICUT: Southington, 1906, *Blanchard 90;* 1903, *Blanchard 262, 224;* Londonderry, *Blanchard 246;* 1904, *Andrews 53, 57, 56*.

MASSACHUSETTS: Essex County, *Oakes*.

Rubus frondosus × *nigricans*. From this I cannot separate *Rubus abbrevians* Blanchard. The following specimens belong here:

MASSACHUSETTS: Long Pond and Trot's Swamp, Nantucket Island, 1910, *Bicknell 31, 32*.

CONNECTICUT: Southington, 1906, *Blanchard 95*.

VERMONT: Windham, 1904, *Blanchard 57*.

PENNSYLVANIA: Germantown, *Meehan 8679*.

Rubus nigricans × *recurvans*. *R. semisetosus* Blanchard I regard as a hybrid between *R. nigricans* and *R. recurvans*. The following specimens belong here:

CONNECTICUT: Southington, 1903, *Blanchard 201, 202, 225;* Londonderry, *Blanchard 247;* Plainville, 1906, *Blanchard 91, set 1;* also 1903, *261, 203*.

RHODE ISLAND: Rocky Point, 1906, *Blanchard 91, set 3*.

NOVA SCOTIA: Sable Island, *Macoun 21193, 21183* (these specimens are doubtful).

Rubus amicalis × *nigricans*. *Rubus tardatus* Blanchard is probably also a hybrid, the parents being *R. amicalis* and *R. nigricans*. Mr. Blanchard's specimens are the only ones seen.

Rubus nigricans × *pergratus*. In my opinion *R. peculiaris* Blanchard is also a hybrid, viz., of *R. nigricans* and *R. pergratus*. Besides Mr. Blanchard's specimens the following belong here:

QUEBEC: vicinity of Montmorency Falls, 1905, *Macoun 67904, 67905*.

Rubus canadensis × *nigricans*. *Rubus junceus* Blanchard is probably also a hybrid. Besides the specimens distributed by Mr. Blanchard, the following are referred to it.

ONTARIO: Cranberry Lake, Algonquin Park, 1900, *Macoun 24696a.*

MAINE: Sangerville, 1895, *Fernald 244.*

Rubus nigricans × *Randii.* Only the specimens of the original collection have been recorded.

Rubus Baileyanus × *nigricans.* This was first recognized by Mr. Bicknell. C. C. Curtis's specimens have much narrower leaflets and are doubtfully referred to it.

NEW YORK: Hempstead Plains, 1910, *Bicknell 15;* between Yonkers and Mount Vernon, 1903, *C. C. Curtis;* Van Courtlandt Park, 1896, *Bicknell.*

CONNECTICUT: Plainville, 1904, *Andrews 26;* Southington, 1903, *Blanchard 237* (determined as *R. semisetosus*).

Rubus flagellaris × *nigricans.* This was collected by Mr. Bicknell, who included it in *R. nigricans.* The following specimens so named I refer to the hybrid instead.

MASSACHUSETTS: Little Neck, Millbrook Swamp and Long Pond, Nantucket Island, 1910, *Bicknell X, XX, XXX.*

Rubus nigricans × *procumbens.* This was also recognized as a hybrid although he did not describe the same. The following specimens belong to it:

NEW YORK: East Hempstead, Long Island, 1910, *Bicknell 16;* Jamaica, 1906, *Bicknell 18.*

CONNECTICUT: Plainville, 1904, *Andrews 55;* Southington, *Andrews 54, 57, 58, 59, 62.*

VERMONT: Londonderry, 1903, *Blanchard 245* (referred doubtfully to *R. vermontanus*).

NOVA SCOTIA: *Macoun 81425;* Sable Island, *Macoun 21193.*

Rubus nigricans × *vermontanus. Rubus vermontanus viridifolius* has glandular hispid inflorescence and I therefore believe it contains some *R. nigricans* blood in it. I therefore regarded it as a hybrid. Many specimens referred to *R. setosus* by Blanchard belong here:

VERMONT: Marlboro, 1902, *Blanchard 191;* Woodstock, 1910, *Britton;* Stockbridge, 1897, *Eggleston;* West Windham, 1904, *Blanchard 59, set 1;* Stratton, *59, Blanchard, set 2;* Rutland, 1899, *Eggleston 1228.*

NEW YORK: Tannersville, 1906, *Rydberg 7954*.

NEW HAMPSHIRE: Alstead, 1903, *Blanchard 236, 234, 235*.

MAINE: Biddeford, 1905, *Blanchard 86*.

QUEBEC: East Templeton, 1903, *Macoun 59963*.

Rubus hispidus × *nigricans*. Mr. Bicknell found this very variable, sometimes approaching one parent, sometimes the other. My observations agree very well with his. Often the plant resembles a robust *R. hispidus*, but with the leaflets of the new shoots having a tendency often to be five instead of three. It is then *R. hispidus major* Blanchard. Sometimes it resembles more *R. nigricans* in habit. If the leaflets of the new shoots happen to be only three, it is *R. trifrons* Blanchard. The following represent *R. hispidus major:*

CONNECTICUT: Southington, 1904, *Andrews 60;* Botsford, 1897, *Eames*.

MAINE: Kennebunkport, 1905, *Blanchard 84;* Kennebunk, *Blanchard 85*.

NOVA SCOTIA: Cape Breton, 1901, *Howe & Lang 748;* Pictou, 1907, *C. B. Robinson 574, 494*.

MASSACHUSETTS: 1879, *Perkins*.

PENNSYLVANIA: Pocono Plateau, 1893, *Britton*.

NEW YORK: Tannersville, 1908, *Rydberg 8037*.

Specimens resembling *R. trifrons* are the following:

VERMONT: West Wadsboro, 1904, *Blanchard 55;* Stratton, 1902, *Blanchard 198*.

NEW YORK: Tannersville, 1906, *Rydberg 7957, 7954* (one sheet of this number Mr. Blanchard has determined as *R. hispidus*, the other as *R. setosus*. Both were from the same plant).

The following are intermediate or cannot be referred to either form:

VERMONT: North Windham, 1903, *Blanchard 251* (named *R. setosus*); Stratton, 1902, *Blanchard 199*.

NEW JERSEY: Musconetcong River, *Mackenzie 2108, 2300*.

NEW YORK: Tannersville, 1906, *Rydberg 7956*.

CONNECTICUT: Southington, 1904, *Andrews 60*.

Rubus hispidus × *vermontanus*. In my mind there is very little doubt but *R. jacens* Blanchard represents this hybrid. A few specimens referred to *R. trifrons* by Blanchard apparently belong here also. The following specimens have been recorded:

VERMONT: Townsend, 1903, *Blanchard 241;* Stratton, 1904, *Blanchard 55, set 2*; South Londonderry, 1903, *Blahchard 250.*

NEW HAMPSHIRE: Alstead, 1903, *Blanchard 232, 231.*

Rubus cubitans Blanchard seems to me to be a mixture. The flowering branches and the new shoots were not collected at the same time. Do they belong to the same plant? The floral branches seem to me as typical *R. hispidus*, though with more flowers than usual. The leaflets of the new shoots have the texture of those of *R. hispidus* but the form of those of *R. vermontanus.* They may very well represent a hybrid.

Rubus argutus × *hispidus.* This was first recognized by Mr. Bicknell, who, however, did not characterize the same. Only Bicknell's specimens are known.

Rubus canadensis × *hispidus.* The only specimens seen, which may be referred to this hybrid, are the original ones cited in the North American Flora.

NOVA SCOTIA: Le Have River, *Macoun 81436a.*

NEW YORK BOTANICAL GARDEN

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STUDIES OF WEST INDIAN PLANTS—VII

NATHANIEL LORD BRITTON

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Studies of West Indian plants—VII

NATHANIEL LORD BRITTON

39. THE GENUS SCLERIA BERG. IN CUBA

The last previous treatment of the Cuban species is that of Mr. C. B. Clarke in Urban, Symb. Ant. **2**: 8–169. 1900.

A. Hypogynium present.
  1. Hypogynium not covered with a white rough crust.
    a. Margin of the hypogynium neither ciliate nor fimbriate [see *S. cubensis*].
      * Roots fibrous; rootstocks none or very short.
        Achene reticulated or irregularly ridged; plants slender. — 1. *S. setacea.*
        Achene smooth; plants stout. — 2. *S. lacustris.*
      ** Perennials, with rootstocks. [Rootstock in *S. setuloso-ciliata* short, or perhaps none.]
        Achene smooth.
          Ligule large, its margin scarious or callous.
            Climbing; branched; pilose. — 3. *S. secans.*
            Erect; simple; glabrous. — 4. *S. catalinae.*
          Ligule short, small; culms erect or spreading.
            Culms slender; leaves relatively smooth.
              Panicle red-purple; achene purple to white. — 5. *S. melaleuca.*
              Panicle brown-green; achene white.
                Achene depressed-globose. — 6. *S. pterota.*
                Achene longer than thick.
                  Leaves 2–4 mm. wide. — 7. *S. Wrightiana.*
                  Leaves 8–15 mm. wide. — 8. *S. setuloso-ciliata.*
            Culms stout; leaves very rough. — 9. *S. scindens.*
        Achene verrucose, reticulated or papillose.
          Achene papillose. — 10. *S. ciliata.*

Achene verrucose or reticulated.
Achene reticulated; hypogynium supporting 3 deeply 3-lobed tubercles. 11. *S. Curtissii.*
Achene verrucose-reticulated; hypogynium 3-lobed.
Glabrous or nearly so. 12. *S. stercorrhiza.*
Leaves and sheaths densely pilose-pubescent. 13. *S. pilosissima.*
b. Margin of the hypogynium ciliate, ciliolate or fimbriate [nearly or quite eciliate in *S. cubensis*].
Margin of the hypogynium ciliate or ciliolate.
Achene 2 mm. long or less. 14. *S. microcarpa.*
Achene 2.5–3 mm. long.
Style-base black, persistent; achene ellipsoid. 15. *S. mitis.*
Style-base pale, deciduous; achene subglobose.
Leaves about 3 mm. wide. 16. *S. phylloptera.*
Leaves 8–16 mm. wide.
Margin of the hypogynium ciliolate or eciliate. 17. *S. cubensis.*
Margin of the hypogynium densely long-ciliate. 18. *S. Grisebachii.*
Margin of the hypogynium 3-lobed, the lobes laciniate or fimbriate. 19. *S. porphyrorrhiza.*
2. Hypogynium covered with a white rough crust. 20. *S. havanensis.*
B. Hypogynium none, or obsolete.
Annuals with fibrous roots; inflorescence glomerate-spicate.
Achene smooth. 21. *S. distans.*
Achene verrucose, reticulated or cancellate.
Bracts strongly ciliate; achene cancellate. 22. *S. pinetorum.*
Bracts glabrous; achene verrucose or verrucose-reticulated.
Inflorescence simply glomerate-spicate. 23. *S. verticillata.*
Inflorescence branched. 24. *S. Liebmanni.*
Perennial by rootstocks.
Inflorescence glomerate-spicate; achene smooth. 25. *S. hirtella.*
Inflorescence not glomerate-spicate.
Panicle loose. 26. *S. lithosperma.*
Inflorescence subcapitate.
Achene 2–3 mm. long, with 2 pits on each side of the 3-angled base. 27. *S. gracilis.*
Achene 4 mm. long, without pits. 28. *S. Baldwinii.*

1. SCLERIA SETACEA Poir. in Lam. Encycl. 7: 4. 1806

Scleria hemitaphra Steud. Syn. Pl. Cyp. 169. 1855.

Scleria Torreyana Walp. Ann. 3: 696. 1853.

Scleria dictyocarpa Griseb. Cat. Pl. Cub. 259. 1866.
Scleria debilis C. Wright; Sauvalle, Anales Acad. Habana 8: 154. 1872.
S. reticularis pubescens Britton, Ann. Lyc. N. Y. 3: 232. 1885.

Savannas and along streams, Pinar del Rio:—southern United States; Porto Rico; tropical continental America.

2. SCLERIA LACUSTRIS C. Wright; Sauvalle, Anales Acad. Habana 8: 152. 1872

Lagoons near Pinar del Rio. Recorded by Clarke from French Guiana and from Java.

3. SCLERIA SECANS (L.) Urban, Symb. Ant. 2: 169. 1900

Schoenus secans L. Syst. ed. 10, 865. 1759.
Scleria reflexa HBK. Nov. Gen. 1: 232. 1815.

Mountain woodlands, Oriente:—Haiti to Martinique and Trinidad; Jamaica; tropical continental America.

My examination of the type specimen of *Schoenus secans* L., in the herbarium of the British Museum of Natural History, some years ago, showed that it was the same as *Scleria reflexa* HBK., and not the same as *Scleria Flagellum-nigrorum* Berg.

4. **Scleria catalinae** sp. nov.

Perennial by thick rootstocks; culm stout, sharply 3-angled, roughish on the angles, glabrous, about 1.3 m. high. Leaves glabrous, slightly roughish-margined, 3–5 dm. long, 1–2.3 cm. wide, 3-nerved, attenuate-acuminate, the ligule triangular-ovate to triangular-lanceolate, acute or acuminate, many-striate, narrowly callous-margined, 2 cm. long or less; panicle about 5 dm. long, of few, distant, slender branches, the staminate and pistillate spikelets intermixed; staminate spikelets oblong, 3–4 mm. long; achene ovoid, purplish, smooth, shining, acute, 2 mm. long, the style-base persistent; hypogynium obconic, 1 mm. long, glabrous, its base rounded, its 3 rounded lobes appressed.

Santa Catalina, Pinar del Rio (*Van Hermann 3272*).

By its very large ligule related to *S. arundinacea* Kunth, but the achene and inflorescence are quite different, resembling those of *S. cubensis* Boeckl.

5. SCLERIA MELALEUCA Schl. & Cham. Linnaea 6: 29. 1831

Savannas and banks, Camaguey; Havana; Pinar del Rio:—Jamaica; Porto Rico; St. Vincent to Trinidad; continental tropical America. The West Indian specimens here referred are not very different from the following species.

6. SCLERIA PTEROTA Presl in Oken, Isis 21: 268. 1828

Scleria pratensis Nees in Mart. Fl. Bras. 2^1: 179. 1843.
Scleria Ottonis Boeckl. Linnaea 38: 490. 1874.

Woodlands and banks, Santa Clara; Havana; Pinar del Rio; Isle of Pines:—Haiti to St. Thomas and Barbadoes; Jamaica; continental tropical America.

7. SCLERIA WRIGHTIANA Boeckl. Flora 64: 79. 1881

Scleria elata C. Wright; Sauvalle, Anales Acad. Habana 8: 153. 1872. Not Thwaites.

Pine-lands and savannas, Pinar del Rio and Isle of Pines. Endemic.

8. SCLERIA SETULOSO-CILIATA Boeckl. Flora 65: 30. 1882

Wet situations, Matanzas; Havana; Isle of Pines:—Guatemala.

9. SCLERIA SCINDENS Nees, Linnaea 9: 303. 1834

Mountain woodlands, Oriente:—Tortola; St. Kitts to St. Vincent.

10. SCLERIA CILIATA Michx. Fl. Bor. Am. 2: 167. 1803

Scleria Elliottii Chapm. Fl. S. U. S. 531. 1860.

Barrens and pinelands, Santa Clara; Matanzas; Pinar del Rio; Isle of Pines:—southeastern United States; Santo Domingo.

11. SCLERIA CURTISSII Britton; Small, Fl. S. E. U. S. 200, 1328. 1903

? *Scleria pauciflora effusa* Clarke in Urban, Symb. Ant. 2: 143. 1900.

Savannas, Pinar del Rio and Isle of Pines:—Florida. Referred by Wright, by Clarke and formerly by me to *S. pauciflora* Muhl.

12. SCLERIA STEREORRHIZA C. Wright; Clarke in Urban, Symb. Ant. **2**: 147. 1900

Scleria bracteata Griseb. Cat. Pl. Cub. 249. 1866. Not Cav.
Scleria bracteata angustata Griseb. *loc. cit.* 1866.
Scleria stereorrhiza major Clarke in Urban, *loc. cit.* 1900.

Along streams and on hillsides, Santa Clara; Havana; Pinar del Rio. Endemic.

13. **Scleria pilosissima** sp. nov.

Perennial by short, branched rootstocks; culms rather slender, but stiff, sharply 3-angled, loosely pilose, simple, 3–4 dm. high. Leaves roughish-margined, 1–2 dm. long, 2–4 mm. wide, acuminate, stiff, densely pilose, the midvein prominent beneath; clusters of spikelets 1 or 2, pilose, 2–4 cm. long, the staminate and pistillate spikelets intermixed; scales lanceolate, acute, pubescent; achene subglobose, 2–2.5 mm. in diameter, transversely verrucose, pubescent, obtuse, abruptly apiculate; hypogynium with 3 rounded, appressed lobes.

Sunny hillsides among rocks, between Punta Gorda and Woodfred, Oriente, Cuba, 400–500 m. alt. (*Shafer 3099*).

Related to *S. stereorrhiza* C. Wright.

14. SCLERIA MICROCARPA Nees, Linnaea **9**: 302. 1834

Scleria foliosa C. Wright; Sauvalle, Anales Acad. Habana **8**: 154. 1872. Not A. Rich.
Scleria microcarpa foliosa Clarke in Urban, Symb. Ant. **2**: 149. 1900.

River banks, Pinar del Rio and Isle of Pines:—Porto Rico; Guadaloupe; Jamaica; Trinidad; continental tropical America.

15. SCLERIA MITIS Berg. Vet. Akad. Handl. Stockh. **26**: 145. 1865

Scleria Eggersiana Boeckl. Cyp. Nov. **2**: 41. 1890.

Pinal de Sta. Ana collected by Eggers, according to Clarke:—Porto Rico; Guadeloupe; Martinique; St. Vincent; Trinidad: continental tropical America.

16. SCLERIA PHYLLOPTERA C. Wright; Griseb. Cat. Pl. Cub. 248. 1866

Scleria microcarpa angustifolia Boeckl. Flora **64**: 79. 1881.

Moist savannas and borders of lagoons, Santa Clara; Pinar del Rio. Endemic.

17. SCLERIA CUBENSIS Boeckl. Cyp. Nov. **2**: 42. 1890

Scleria microcarpa subeciliata Clarke in Urban, Symb. Ant. **2**: 149. 1900

Banks and woodlands, mountains of Oriente and Santa Clara:—Hispaniola; Porto Rico; Jamaica.

18. SCLERIA GRISEBACHII Clarke in Urban, Symb. Ant. **2**: 150. 1900

Bogs, Santa Clara; Havana:—Hispaniola; Antigua; Dominica; Martinique; Jamaica.

19. SCLERIA PORPHYRORRHIZA C. Wright; Sauvalle, Anales Acad. Habana **8**: 155. 1872

Pinelands, Pinar del Rio. Recorded by Clarke from Brazil.

20. **Scleria havanensis** sp. nov.

Rootstocks stout, horizontal, 3–4 cm. long, about 6 mm. thick. Culms many, slender, trigonous, nearly smooth, about 5 dm. long; leaves nearly smooth, narrow, 1–1.5 mm. wide; inflorescence a single small cluster of intermixed staminate and pistillate spikelets; achene white, ridged-reticulated, globose-oblong, rounded, 2 mm. long; hypogynium low, obscurely 3-lobed, covered with a rough whitish crust.

Coca Hill, Campo Florida, province of Havana (*Brother Leon 4731*).

21. SCLERIA DISTANS Poir. in Lam. Encycl. **7**: 4. 1806

Scleria tenella Griseb. Cat. Pl. Cub. 249, in part. 1866. Not Kunth.

? *S. hirtella pauciliata* Britton, Ann. N. Y. Acad. Sci. **3**: 236. 1885.

Cuba, collected by Wright:—Hispaniola; Porto Rico; St. Thomas; Guadeloupe.

22. **Scleria pinetorum** sp. nov.

Annual, with many finely fibrous roots; culms slender, erect, 2–4 dm. high. Leaves grass-like, pubescent with spreading hairs, 1–2 mm. wide; inflorescence glomerate-spicate, 5–8 cm. long;

bracts linear-lanceolate, ciliate, 6 mm. long or less; achene globular, white, deeply reticulated, about 1.5 mm. in diameter, with a row of pits at its base, the short base 3-angled.

Pine-lands and savannas, Pinar del Rio. Type collected between Candelaria and Artemisa (*Wilson 1724*).

Previously referred by me (Ann. N. Y. Acad. Sci. 3: 236) to *S. interrupta* A. Rich., of Guiana, which now seems to me to be distinct.

23. SCLERIA VERTICILLATA Muhl.; Willd. Sp. Pl. 4: 317. 1805

Pinelands, Pinar del Rio; Isle of Pines:—eastern United States; New Providence, Bahamas.

24. SCLERIA LIEBMANNI Steud. Syn. Pl. Cyp. 179. 1855

Scleria tenella Griseb. Cat. Pl. Cub. 249, in part. 1866. Not Kunth.

Scleria luzulaeformis C. Wright; Sauvalle, Anales Acad. Habana 8: 156. 1872.

Savannas near San Juan de Buena Vista, jurisdiction of Bayamo, according to Sauvalle (*Wright 3418*, in part); Mexico to Brazil.

25. SCLERIA HIRTELLA Sw. Prodr. 19. 1788

Scleria nutans Kunth, Enum. 2: 352. 1837.

Moist grounds, Oriente; Santa Clara; Pinar del Rio; Isle of Pines,—southern United States; Haiti; Porto Rico; Jamaica; Trinidad; continental tropical America; tropical Africa.

26. SCLERIA LITHOSPERMA (L.) Sw. Prodr. 18. 1788

Scirpus lithospermus L. Sp. Pl. 51. 1753.

Scleria filiformis Sw. Prodr. 19. 1788.

S. lithosperma filiformis Britton, Ann. N. Y. Acad. Sci. 3: 231. 1885.

Woodlands and thickets, all provinces:—Florida; Bahamas; West Indies; tropical continental America; Old World tropics.

27. SCLERIA GRACILIS Ell. Bot. S. C. & Ga. 2: 571. 1824

Moist savannas, Pinar del Rio:—southeastern United States.

28. Scleria Baldwinii (Torr.) Steud. Syn. Pl. Cyp. 175. 1855

Hypoporum Baldwinii Torr. Ann. Lyc. N. Y. 3: 382. 1836.

Border of lagoon, Laguna Santa Maria, Pinar del Rio:—southeastern United States.

FURTHER STUDIES OF BADIERA DC.

Since the publication of my former paper on this genus (Bull. Torrey Club 37: 360–363. 1910), additional specimens which have come to hand afford the following notes and descriptions.

1. Badiera Penaea (L.) DC.

Professor Urban has informed me that my opinion that this is identical with *Badiera domingensis* (Jacq.) DC. is correct, although he has distributed Santo Domingo specimens under the name *B. domingensis*.

1*a*. **Badiera portoricensis** sp. nov.

A tree up to 6 m. high, the trunk sometimes 1.5 m. in diameter, the slender branches ascending, the young twigs appressed-pubescent. Leaves subcoriaceous, obovate, 3 cm. long or less, 7–15 mm. wide, bright green and shining above, paler and rather dull green beneath, both surfaces with short, scattered hairs when young, becoming glabrate above, the midvein slightly impressed above, rather prominent beneath, the lateral veins few, distant, obscure, the apex rounded or obtuse, the base narrowed or cuneate, the pubescent petioles 1–2.5 mm. long; inflorescence few–several-flowered, 4–6 mm. long; bracts ovate or ovate-lanceolate, acute, pubescent, 0.5 mm. long; pedicels appressed-pubescent, 1.5–2.5 mm. long; sepals broadly ovate, obtuse, ciliolate, the larger about 1 mm. long; petals white; keel appressed-pubescent, 2 mm. long, narrowed below; fruit about 6 mm. wide, about 5 mm. high, finely pubescent, narrowly margined, notched at the apex, subtruncate at the base, its stipe about 0.6 mm. long.

Rocky slopes and hillsides, western Porto Rico, especially on serpentine, from sea-level to 700 m. altitude. Type collected at Guanajibo, near Mayaguez (*Britton, Cowell & Brown 4349*). Recorded by Bello from my type locality as *B. domingensis* DC. [*Polygala domingensis* Jacq.; *B. Penaea* (L.) DC.] of Hispaniola, to which species it is nearest related, but which differs in pilose-pubescent twigs, rather densely pubescent leaves, and much more pubescent, shorter-pedicelled flowers.

2. BADIERA VIRGATA Britton

The specimen referred to by me under *B. oblongata* Britton (*Britton & Wilson 6066*) from Santa Clara, Cuba, is now, in the light of additional material, put with *B. virgata*, as a broad-leaved race.

4. BADIERA DIVERSIFOLIA (L.) DC.

This, the only Jamaican species of the genus, forms a tree up to 6 m. high, as at St. Ann's Bay (*Britton 2498*).

5. BADIERA CUBENSIS Britton

In the original description of this species (Bull. Torrey Club 37: 362), I included too many citations of specimens. C. Wright's Cuban *1913* consists, apparently, of three species; it is to the specimen with abruptly acuminate leaves cuneate-narrowed at the base, 4–6 cm. long, that the name should be restricted. As shown by specimens from Bahia Honda, Pinar del Rio (*P. Wilson 9429*) the leaves vary to obovate. The fruit is glabrous when mature, its slender stipe 2 mm. long.

5*a*. BADIERA FUERTESII Urban, Symb. Ant. 7: 244. 1912

A tree of the mountains of Santo Domingo, with glabrous leaves, strongly reticulate-veined on the upper surface.

6. BADIERA MONTANA Britton

Described from fruiting specimens collected in the Trinidad Mountains, Santa Clara, Cuba. Flowering specimens with apparently the same foliage and pubescence come from limestone hills in the vicinity of Sumidero, Pinar del Rio (*Shafer 13819*), but flowers from the Trinidad Mountain tree are needed to make the identity wholly satisfactory.

8. **Badiera propinqua** sp. nov.

Twigs slender, densely appressed-pubescent. Leaves ovate to ovate-elliptic, 2–4.5 cm. long, 8–25 mm. wide, bluntly acute or obtuse and emarginate at the apex, narrowed or obtuse at the base, sparingly short-pubescent on both sides or becoming glabrous, the midvein impressed above, prominent beneath, the slender lateral veins 6 to 8 on each side of the midvein, the appressed-pubescent petioles 1.5–3 mm. long; inflorescence few-flowered, 4–5 mm. long; bracts ovate, densely pubescent, scarcely 0.5 mm. long; pedicels slender, appressed-pubescent, 1.5–2.5 mm. long; sepals suborbicular, rounded, pubescent, the larger about 1.3 mm. long; petals white; keel pubescent on the sides, about 2.5 mm. long; fruit (from *Wright 1913, in part*) 10 mm. wide, 7 mm. long, deeply notched, scarcely margined, glabrous, decurrent on its stipe, which is about 2 mm. long.

Cuba. Type collected between Los Palacios and San Juan de Zayas, Pinar del Rio (*Shafer 11818*). The description is drawn to include the part of *Wright 1913*, and *Wright 3496*, previously referred by me to *B. cubensis*. The part of *Wright 115*, included by me in the original description of *B. cubensis*, is perhaps referable here also.

9. **Badiera punctata** sp. nov.

A shrub about 1 m. high, with slender, ascending, or nearly erect branches, the twigs densely appressed-pubescent with short hairs. Leaves ovate to ovate-elliptic, firm in texture, 1.5–2.5 cm. long, 12 mm. wide or less, obtuse or emarginate at the apex, obtuse at the base, the midvein impressed above, prominent beneath, the lateral veins 3 or 4 on each side, the upper surface strongly punctate, shining and glabrous or nearly so, the under surface dull, the petioles about 1.5 mm. long; inflorescence few-flowered; bracts scarcely 0.5 mm. long; fruiting pedicels slender, nearly glabrous, 2–2.5 mm. long; sepals ovate, obtuse, ciliate, about 1 mm. long; fruit (not quite mature) "green and red," 7 mm. wide, about as long as wide, shallowly notched at the apex, obliquely subtruncate at the base, narrowly margined, slightly pubescent, its stipe 1–1.5 mm. long.

Near a stream, Arroyo del Medio above the falls, Oriente, Cuba (*Shafer 3644*). The leaves droop at night, a phenomenon also observed in *B. virgata*.

10. **Badiera heterophylla** sp. nov.

An upright shrub 6 dm. high, the twigs short-pubescent with somewhat spreading hairs. Leaves of two quite different forms, (1) narrowly ovate, 3–4 cm. long, 12–18 mm. wide, bluntly acute at the apex, (2) elliptic, 2–2.5 cm. long, 12–14 mm. wide, rounded or obtuse at the apex; both forms emarginate at the apex, narrowed or obtuse at the base, sparingly short-pubescent and dull on both sides, the midvein impressed above, prominent beneath, the slender lateral veins only 2 or 3 on each side of the midvein, the appressed-pubescent petioles about 2 mm. long; inflorescence about 5 mm. long; bracts about 0.5 mm. long; pedicels pubescent, 2 mm. long or less; sepals rounded, pubescent, the larger about 1 mm. long; "flowers yellow"; petals slightly pubescent in the bud; fruit 7–8 mm. wide, about 5 mm. high, margined, rather deeply notched, sparingly pubescent when young, glabrous when mature, slightly decurrent on its stipe which is about 1.5 mm. long.

Deciduous woods, Sierra Nipe, near Woodfred, Oriente, at 450–550 m. altitude (*Shafer 3070*).

40. THE GENUS TRICERA Sw. IN CUBA

1. Styles coherent, at least at the base.
  - Leaves oblong to oblong-lanceolate, 2–3 cm. wide; styles coherent below. — 1. *T. Muelleriana.*
  - Leaves broadly ovate to ovate-lanceolate, 5 cm. wide or less; styles coherent nearly throughout. — 2. *T. marginalis.*

2. Styles separate and distinct.
  - * Leaves 4–10 cm. long.
    - Venation of the leaves manifest.
      - Leaves broadly ovate, subcordate. — 3. *T. cubana.*
      - Leaves lanceolate to elliptic or obovate, narrowed at the base.
        - Capsule globose-ellipsoid. — 4. *T. acuminata.*
        - Capsule ovoid, acute. — 5. *T. brevipes.*
    - Venation of the leaves obsolete or indistinct.
      - Petioles very stout, 10 mm. long or less; leaves very thick. — 6. *T. crassifolia.*
      - Petioles slender, 2–6 mm. long; leaves firm, but not very thick.
        - Twigs yellow. — 7. *T. flaviramea.*
        - Twigs green.
          - Capsule-lobes semiovate. — 8. *T. retusa.*
          - Capsule-lobes linear-spatulate. — 9. *T. gonoclada.*
  - ** Leaves 1–3.5 cm. long.
    - Leaves suborbicular to obovate or elliptic, not more than twice as long as wide.
      - Inflorescence and capsule glabrous. — 10. *T. rotundifolia.*
      - Inflorescence and capsule pubescent. — 11. *T. Shaferi.*
    - Leaves oblong to linear-oblanceolate, 2–5 times as long as wide.
      - Leaves oblong, 2–3 times as long as wide.
        - Leaves densely imbricated, less than 1 cm. long, the internodes very short. — 12. *T. vaccinoides.*
        - Leaves not densely imbricated, 1.5–3.5 cm. long.
          - Staminate flowers sessile or very nearly so. — 13. *T. glomerata.*
          - Staminate flowers manifestly pedicelled.
            - Leaves 2–3.5 cm. long, the lateral venation obsolete. — 14. *T. bahamensis.*

Leaves 1–1.5 cm. long, the lateral venation wholly obscure. 15. *T. microphylla.*
Leaves linear-oblanceolate or linear-oblong, 4–5 times as long as wide.
Capsule glabrous. 16. *T. Leoni.*
Capsule pubescent.
Leaves strongly revolute-margined, abruptly mucronate. 17. *T. revoluta.*
Leaves scarcely revolute-margined, acute or obtuse. 18. *T. foliosa.*

1. **Tricera Muelleriana** (Urban)

Buxus Muelleriana Urban, Symb. Ant. 5: 400. 1908.

TYPE LOCALITY: Cuba.

DISTRIBUTION: Known only from the type specimens (*C. Wright 1920*).

Referred by Grisebach to *Tricera laevigata* Sw., of Jamaica, and by Mueller to *Buxus subcolumnaris* Muell. Arg. = **Tricera subcolumnaris** (Muell. Arg.) Britton, of Martinique.

2. **Tricera marginalis** sp. nov.

A glabrous shrub about 3 m. high. Leaves broadly ovate to ovate-lanceolate, subcoriaceous, 4–8 cm. long, 2–5 cm. wide, reticulate-veined on both sides, with 2 distinct veins 1.5–3 mm. from the margins, the midvein impressed above, prominent beneath, the apex acute, the base obtuse or subtruncate, the rather slender petioles 1 cm. long or less; cymes several-flowered, longer than the petioles, glabrous; bracts ovate-lanceolate, acute, 1.5 mm. long; pedicels of the staminate flowers about 4 mm. long, the white calyx about 3 mm. long, its segments oblong, obtuse; stamens about as long as the calyx, the filaments about twice as long as the anthers; ovary ovoid; united styles somewhat longer than the ovary; stigmas recurved, about one-third as long as the styles.

Alluvial valley of Rio Yamaniguey, Oriente (*Shafer 4226*).

3. TRICERA CUBANA A. Rich. in Sagra, Hist. Cub. 11: 217. *pl. 71.* 1845

Buxus cubana Baill. Mon. Bux. 71. 1859.

TYPE LOCALITY: Monte Libau, Oriente.

ILLUSTRATION: A. Rich. *loc. cit.*

DISTRIBUTION: Known only from the type locality.

4. **Tricera acuminata** Griseb. Nachr. Gesell. Wiss. Goetting. **1865**: 162. 1865

Buxus acuminata Muell. Arg. in DC. Prodr. **16**[1]: 15. 1869.

TYPE LOCALITY: Cuba.

DISTRIBUTION: Known only from the type specimens (*C. Wright 1919*, in part).

5. **Tricera brevipes** (Muell. Arg.)

Buxus citrifolia brevipes Muell. Arg. in DC. Prodr. **16**[1]: 15. 1869.
Buxus brevipes Urban, Symb. Ant. **5**: 400. 1908.

TYPE LOCALITY: Cuba (*C. Wright 1919*, in part).

DISTRIBUTION: the label with *Wright 1919* in the herbarium of the New York Botanical Garden gives the locality as San Diego de Tapis; the following specimens appear to agree with it: upper valley of the Rio Navas, Oriente (*Shafer 4402*); Rio San Miguel below Mal Paso, Pinar del Rio (*P. Wilson 9309*).

Referred by Grisebach to *T. fasciculata* Griseb., of Jamaica. I am not confident that the species is distinct from *T. acuminata.*

6. **Tricera** (?) **crassifolia** sp. nov.

A glabrous shrub about 3 m. high, the twigs stout. Leaves elliptic-obovate, 6–10 cm. long, 2.5–4 cm. wide, very thick, obtuse or emarginate and mucronulate at the apex, narrowed at the base, the midvein impressed above, prominent beneath, the lateral venation faint and obscure, the stout petioles about 1 cm. long; young inflorescence axillary, about as long as the petioles, both staminate and pistillate flowers apparently sessile, the staminate about 2 mm. long.

Between Camp Toa and Camp La Barga, 400–450 m. alt., mountains of northern Oriente (*Shafer 4163*).

7. **Tricera flaviramea** sp. nov.

A glabrous shrub, 1 m. high, the young twigs and leaves yellowish green, the branches slender, somewhat ridged. Leaves elliptic or elliptic-obovate, coriaceous, revolute-margined, 3–5 cm. long, 1–2 cm. wide, rounded and minutely apiculate or emarginate at the apex, narrowed at the base, the midvein impressed above, rather prominent beneath, the lateral venation obsolete, or faintly discernible on the upper surface, the petioles 1.5–3 mm. long; inflorescence glabrous, about 1 cm. long; bracts ovate, acute, 1.5

mm. long; young staminate flowers about 2 mm. long, on pedicels about as long; capsule ovoid, obtuse, glabrous, 7–8 mm. long, 5–6 mm. thick, the persistent styles somewhat recurved, linear, 5 mm. long, separated from each other about 1 mm. at the base.

Palm-barren, Santa Clara City, Santa Clara (*Britton & Cowell 13324*, type; *Britton & Wilson 6211*).

8. TRICERA RETUSA Griseb. Nachr. Ges. Wiss. Goetting. **1865**: 163. 1865

Buxus retusa Muell. Arg. in DC. Prodr. **16**[1]: 17. 1869.

TYPE LOCALITY: Monte Verde, Oriente.

DISTRIBUTION: Mountains of northern Oriente.

9. TRICERA GONOCLADA C. Wright; Griseb. Cat. Pl. Cub. 282. 1866

Buxus gonoclada Muell. Arg. in DC. Prodr. **16**[1]: 16. 1869.

TYPE LOCALITY: Savanna near Guamacaro, western Cuba.

DISTRIBUTION: Known only from the type locality.

10. **Tricera rotundifolia** sp. nov.

A glabrous shrub, 6 dm. high, much branched, the internodes mostly shorter than the leaves. Leaves suborbicular to obovate, coriaceous, 2 cm. long or less, rounded and mucronulate or slightly emarginate at the apex, narrowed at the base, the margins thickened and somewhat revolute, the midvein rather prominent beneath, the lateral venation obsolete, the petioles 1.5–2 mm. long; inflorescence glabrous, few-flowered, in the uppermost axils; pedicels of the staminate flowers about 3 mm. long; bracts ovate, acute, 1 mm. long; staminate flowers 1.5 mm. long, their segments oblong-lanceolate, acute; capsule ovoid, about 6 mm. long, glabrous, the persistent styles contiguous, about 2 mm. long.

Between Camp La Barga and Camp San Benito, about 1,000 m. alt., northern Oriente (*Shafer 4114*).

11. **Tricera Shaferi** sp. nov.

A much-branched shrub up to 3 m. high, the twigs slender, glabrous, the internodes shorter than the leaves. Leaves obovate to elliptic, coriaceous, 1.5–3.5 cm. long, rounded or retuse at the apex and minutely mucronulate, narrowed or obtuse at the base, the midvein impressed above, prominent beneath, the lateral venation wholly obscure, the upper surface shining, dark green, the under surface dull and pale, the petioles 1–3 mm. long; inflorescence axillary, puberulent, short-stalked, much shorter than the leaves; bracts ovate, acute, about 0.5 mm. long; pedicels of the staminate flowers rather stout, 2–3 mm. long; staminate flowers about 1.5 mm. long; capsule subglobose, densely puberulent, about 4 mm. in diameter, the separated persistent styles about 2 mm. long.

Wet mountains of northern Oriente. Type collected between Camp Toa and Camp La Barga, 400–450 m. alt. (*Shafer 4167*).

12. **Tricera vaccinioides** sp. nov.

A low, glabrous, much-branched shrub, 3–6 dm. high, the branches stout, the twigs erect-ascending, densely leafy, the internodes 3–6 mm. long. Leaves oblong to oblong-obovate, 5–8 mm. long, about twice as long as wide, coriaceous, faintly 3-veined, the secondary venation almost wholly obscure, the apex acute and mucronate, the base narrowed, the stout petioles scarcely 1 mm. long; inflorescence terminal, glabrous, few–several-flowered; pedicels of the staminate flowers rather stout, rigid, about 2 mm. long; bracts lanceolate; staminate flowers about 1 mm. long; capsule globose-ovoid, glabrous, dull, about 6 mm. long, about three times as long as the persistent styles.

Stony pass, between Camp La Barga and Camp San Benito, mountains of northern Oriente, Cuba, about 1000 m. alt. (*Shafer 4122*).

13. TRICERA GLOMERATA Griseb. Mem. Am. Acad. II. 8: 157. 1860

Buxus glomerata Muell. Arg. in DC. Prodr. 16[1]: 17. 1869.

TYPE LOCALITY: Cuba.

DISTRIBUTION: Dry rocky hillsides, Oriente; Santa Clara. This is a shrub up to 3 m. high, abundant near the mouth of Cienfuegos Bay; I am indebted to Professor Fernald for a comparison of a specimen collected there, at Castillo de Jagua (*Britton, Wilson & Earle 4597*), with the specimen of C. Wright in the Gray Herbarium; he pronounced it "a perfect match."

14. TRICERA BAHAMENSIS (Baker) Britton, Bull. N. Y. Bot. Gard. 4: 139. 1906

Buxus bahamensis Baker in Hook. Ic. Pl. *pl. 1806*. 1889.

TYPE LOCALITY: Long Cay, Bahamas.

DISTRIBUTION: Cayo Romano, Camaguey:—Bahamas; Jamaica. Closely related to **Tricera Vahlii** (Baill.) Britton [*Buxus Vahlii* Baill.] of Porto Rico and St. Croix.

15. TRICERA MICROPHYLLA Griseb. Nachr. Ges. Wiss. Goetting. **1865**: 163. 1865

Buxus Wrightii Muell. Arg. in DC. Prodr. **61**[1]: 17. 1869.

TYPE LOCALITY: Western Cuba.

DISTRIBUTION: Known only from the type specimens collected by Wright.

16. **Tricera Leoni** sp. nov.

A shrub, or small tree, up to 4 m. high, glabrous throughout, the slender twigs densely leafy. Leaves linear to linear-oblong, coriaceous, shining, 2 cm. long or less, 2–4 mm. wide, spinulose-acute at the apex, narrowed at the base, the midvein faintly distinguishable above, rather prominent beneath, the lateral venation wholly obscure, the petioles 1–1.5 mm. long; inflorescence terminal, short-stalked; bracts ovate, acute, about 1 mm. long; pedicels of the staminate flowers 1.5–2 mm. long; staminate perianth-segments oblong-lanceolate, acute, 2–2.5 mm. long, filaments a little longer than the anthers; capsule globose-oblong; glabrous, 3 mm. long, the separated, persistent styles 2 mm. long.

Hill north of Monte Catalina, northeast of San Diego de los Banos, Pinar del Rio (*Brothers Leon & Charles 4874*, type); barren specimens from the southern slope of Monte Cajálbana, Pinar del Rio (*Brothers Leon & Charles 4943*), with narrower leaves than the type, are provisionally referred to the same species.

17. **Tricera revoluta** sp. nov.

A much-branched shrub, 3–10 dm. high, the twigs densely leafy, the internodes only 1–2 mm. long. Leaves linear-oblanceolate, coriaceous, 12–20 mm. long, 3–5 mm. wide, strongly revolute-margined, sharply cuspidate-mucronate at the apex, attenuate at the base, the midvein elevated beneath, the venation otherwise wholly obscure, the petioles about 2 mm. long; inflorescence few-flowered in the upper axils, pubescent; staminate flowers nearly 2 mm. long, and nearly as long as their stout pedicels; capsule subglobose, 5–6 mm. long, pubescent, shorter than the persistent, separated styles.

Dry, rocky situations, serpentine hills near mouth of Rio Yamaniguey, Oriente (*Shafer 4247*, type); between Camp La

Barga and Camp San Benito, about 1,000 m. alt., Oriente (*Shafer 4472*).

18. **Tricera foliosa** sp. nov.

A low, much-branched shrub, the slender twigs densely leafy. Leaves linear-oblanceolate, subcoriaceous, glabrous, 10–15 mm. long, 2 mm. wide or less, obtuse and often minutely mucronulate at the apex, long-attenuate to the base, the midvein impressed above, slightly elevated and channeled beneath, the lateral venation wholly obscure, the margins slightly or scarcely revolute, the petioles 1–2 mm. long; inflorescence axillary, shorter than the leaves; staminate flowers white, about 1.5 mm. long, as long or longer than their pubescent petioles; bracts lanceolate, about 1 mm. long; capsule subglobose, densely and finely pubescent, about 3 mm. in diameter, the separated persistent styles about 2 mm. long.

Among rocks near water, Camp La Gloria, south of Sierra Moa, Oriente (*Shafer 8256*, type); on rocks, vicinity of Camp San Benito, Oriente (*Shafer 4073*).

41. THE GENUS PLUMIERA L. IN CUBA

Leaves narrowly linear, 1.7 mm. wide or less. 1. *P. filifolia.*
Leaves oblong to elliptic-oblanceolate or obovate, 1–8 cm. wide.
  Leaves densely lanate or pubescent beneath.
    Corolla-lobes narrowly obovate. 2. *P. sericifolia.*
    Corolla-lobes broadly elliptic-obovate. 3. *P. lanata.*
  Leaves glabrous, or sparingly pubescent beneath.
    Petioles short, 1 cm. long or less.
      Leaves obovate or oblanceolate, the lateral venation obscure. 4. *P. clusioides.*
      Leaves narrowly oblong, the lateral venation prominent. 5. *P. nipensis.*
    Petioles slender, mostly 2–4 cm. long.
      Leaves glabrous beneath, their margins not involute.
        Corolla-lobes 2.5–3.5 cm. long, 1–1.5 cm. wide; venation widely spreading. 6. *P. emarginata.*
        Corolla-lobes 1.5–2.5 cm. long.
          Venation of the leaves ascending, not prominent beneath; corolla-lobes obovate. 7. *P. obtusa.*
          Venation of the leaves widely spreading, prominent beneath; corolla-lobes oblong-oblanceolate. 8. *P. venosa.*
      Leaves pubescent on the veins beneath, their margins involute. 9. *P. trinitensis.*

1. PLUMIERA FILIFOLIA Griseb. Mem. Am. Acad. II. **8**: 519. 1862

River cliffs, foothills of the Sierra Maestra, Nouvelle Sophie and Ensenada de Mora, Oriente. Endemic.

2. PLUMIERA SERICIFOLIA C. Wright; Griseb. Cat. Pl. Cub. 171. 1866

P. emarginata sericifolia Maza, Anales Soc. Esp. Hist. Nat. **23**: 273. 1894.

Coastal thickets, Oriente; Matanzas; Havana; Pinar del Rio: —Inagua.

Perhaps, as suggested by Professor Gomez de la Maza, a pubescent race of *P. emarginata* Griseb., which has a similar distribution in western Cuba, although I have not seen the two growing in close proximity.

3. **Plumiera lanata** sp. nov.

A shrub or small tree up to 3.3 m. high. Leaves broadly elliptic to elliptic-obovate, firm in texture, 10–18 cm. long, 5–9 cm. wide, rounded, emarginate or subtruncate at the apex, narrowed or subtruncate at the base, dark green and glabrous above, densely white-lanate beneath, the midvein channeled above, prominent beneath, the lateral veins widely spreading, averaging 6 or 7 mm. apart, united close to the margin, the stout, somewhat pubescent petioles 1–2.5 cm. long; peduncle 3–11 cm. long, glabrous; cymes many-flowered, dense; pedicels 10 mm. long or less, glabrous or pubescent; calyx subtruncate, 2–3 mm. long; corolla-tube about 1.5 cm. long; corolla-lobes broadly elliptic-obovate, white, rounded, 1.5–2.5 cm. long, 1.2–2 cm. wide; follicles 8–10 cm. long, about 1 cm. thick, short-pointed.

Coastal rocks, vicinity of Baracoa, Oriente (*Underwood & Earle 1442*).

4. PLUMIERA CLUSIOIDES Griseb. Cat. Pl. Cub. 171. 1866

? *P. obtusa parvifolia* Griseb. Mem. Am. Acad. II. **8**: 519. 1862.

? *P. clusioides parvifolia* Maza, Anales Soc. Esp. Hist. Nat. **23**: 273. 1894.

Rocky hillsides and palm-barrens, Oriente; Camaguey; Santa Clara, Havana. Endemic.

Fruiting specimens collected by Dr. Shafer in the gorge of the

Rio Yamuri, Oriente (*7800*), tentatively referred to this species, have spatulate leaves 12 cm. long.

5. **Plumiera nipensis** sp. nov.

A slender tree, up to about 6 m. in height. Leaves narrowly oblong, 9–12 cm. long, 1.5–2.3 cm. wide, obtuse at the apex, narrowed at the base, glabrous on both sides, shining above, dull beneath, the midvein channeled above, prominent beneath, the lateral venation widely spreading, impressed, but distinct, above, the rather slender petioles 1 cm. long or less; peduncle stout, 6 cm. long; follicles 13–15 cm. long, about 2 cm. thick, acutish; seeds 10 mm. long, 6–7 mm. wide, the wing about 15 mm. long, 8–9 mm. wide.

Rocky thicket, between Piedra Gorda and Woodfred, Sierra Nipe, Oriente, at 500 m. alt. (*Shafer 3089*). Perhaps the same as *P. obtusa laevis* Griseb. (Mem. Am. Acad. II. 8: 519) from Monte Verde, Oriente.

6. PLUMIERA EMARGINATA Griseb. Cat. Pl. Cub. 171. 1866

Rocky cliffs and hillsides, Matanzas; Pinar del Rio; Isle of Pines. Endemic.

7. PLUMIERA OBTUSA L. Sp. Pl. 210. 1753

Coastal hills, keys and thickets, Oriente; Camaguey; Santa Clara:—Bahamas; Hispaniola; Mona. Attributed to Jamaica, but some specimens which have been so referred represent a distinct species.*

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* **Plumiera confusa** sp. nov.

A tree, up to 6 m. high, little branched, glabrous throughout. Leaves narrowly elliptic or oblong, shining, 1–3 dm. long, 7 cm. wide or less, obtuse, emarginate or acute at the apex, narrowed at the base, the midvein channeled above, prominent beneath, the lateral venation widely spreading, the stout petioles 4–8 cm. long; peduncles stout, 7–15 cm. long; cymes large, many-flowered; pedicels rather stout, thickened upward, 9–12 mm. long; calyx nearly truncate, about 3 mm. long; corolla white with a pale yellow eye, its tube 12–15 mm. long, its lobes broadly oblong, rounded, 2.5–3 cm. long, about 1 cm. wide; follicles 8–12 cm. long, 10–12 mm. thick.

Rocky situations, southern side of Jamaica. Type collected on Great Goat Island (*Harris 9309*);

The species more resembles *P. emarginata* than *P. obtusa*. I am unable to determine, from the material available at this time, whether *P. obtusa* occurs on Jamaica or not. Other specimens referable to *P. confusa* are: Healthshire Hills near Salt Island (*Britton 3061*); base of Healthshire Hills near Salt Ponds (*Britton 3036*); Great Goat Island (*Harris 10168; Britton 1874*).

The *Plumiera* of Pedro Bluff, a locality about thirty miles west of Great Goat Island, but still within the xerophytic region, may be *P. obtusa*, but the specimen

8. **Plumiera venosa** sp. nov.

A tree up to 6 m. high, glabrous throughout. Leaves oblong-oblanceolate to narrowly obovate, 7–15 cm. long, 3 cm. wide or less, obtuse or emarginate at the apex, narrowed or cuneate at the base, the midvein impressed above, prominent beneath, the lateral veins numerous, widely spreading, united near the margin, 2–3 mm. apart, prominent beneath; petioles slender, 2–3 cm. long; cymes several–many-flowered; peduncles 6–10 cm. long; pedicels 8–15 mm. long, upwardly somewhat thickened; calyx about 3 mm. long, its teeth very broad and short; corolla-tube about 1.5 cm. long; corolla-lobes narrowly oblong-oblanceolate, 2–2.7 cm. long; follicles 10–15 cm. long, about 12 mm. thick; seed nearly 1 cm. long, its wing about 1.5 cm. long.

Coastal cliffs and hillsides near the coast, southern Oriente. Type collected in the basin of Rio Guama, Sevilla Estate near Santiago (*Taylor 93*).

Shoots from cut stumps bear nearly linear leaves up to 2 dm. long, 10–15 mm. wide, as seen by me in a coastal thicket near the mouth of Santiago Harbor (*Britton & Cowell 12632*).

9. **Plumiera trinitensis** sp. nov.

A tree 5 m. high. Leaves oblong to oblong-oblanceolate, 11 cm. long or less, 1.5–3.5 cm. wide, obtuse or emarginate at the apex, gradually narrowed to the base, glabrous above, pubescent on the veins beneath, the midvein broad, channeled above, prominent beneath, the lateral veins rather widely spreading, 2–4 mm. apart, united near the revolute margins; petioles 1.5–2.5 cm. long; follicle slightly curved, pointed, 18 cm. long, about 1.5 cm. thick.

Dry hillside, La Vigia, Trinidad, Santa Clara (*Britton & Wilson 5514*). Similar to *P. jamaicensis* Britton, which is a glabrous species up to 10 m. high, with broader leaves.

(*Harris 9996*) is not complete. In 1895, E. Campbell collected a *Plumiera* at Constant Spring (*5973*), which may be *P. obtusa*.

Growing with *P. confusa* on Great Goat Island there is a *Plumiera* which has leaves over 3 dm. long, narrowly oblong to linear-oblong, some of them not more than 3 cm. wide, and all long-acuminate at the apex (*Britton 1870*). It was not in flower at the time of my visit, March 4, 1908, but I obtained its fruit, which is much like that of *P. confusa*, and its leaf-venation resembles that of *P. confusa* also; it may be that *P. confusa* is sufficiently heterophyllous to have these narrow, elongated, long-pointed leaves.

42. THE GENUS GUETTARDA L. IN CUBA

A. Leaves minute, nearly sessile, 6 mm. long or less. 1. *G. Echinodendron.*
B. Leaves larger, 1.5 cm. long or more.
a. Leaves spinulose-tipped.
Leaves ovate to elliptic, strongly reticulate-veined beneath. 2. *G. Coxiana.*
Leaves oblong, scarcely reticulate-veined beneath. 3. *G. cueroensis.*
b. Leaves not spinulose-tipped.
* Leaves small, 3.5 cm. long or less; flowers axillary, mostly solitary.
Leaves densely silvery-silky beneath. 4. *G. rigida.*
Leaves glabrous or somewhat pubescent beneath.
Flowers sessile or nearly so; leaves ovate or oblong.
Venation inconspicuous on upper leaf-surfaces.
Corolla nearly 2 cm. long; calyx spathaceous. 5. *G. camagueyensis.*
Corolla 1–1.5 cm. long.
Calyx spathaceous; corolla-tube little longer than the limb. 6. *G. clarensis.*
Calyx truncate or oblique; corolla-tube 3–4 times as long as the limb. 7. *G. undulata.*
Venation prominent on upper leaf-surfaces. 8. *G. xanthocarpa.*
Peduncles nearly as long as the fruits; leaves obovate. 9. *G. sciaphila.*
** Leaves larger, 3.5–15 cm. long.
† Inflorescence capitate or clustered or flowers solitary at the ends of twigs, or some flowers also peduncled in the upper axils.
Inflorescence capitate-clustered.
Leaves densely pubescent or puberulent beneath.
Leaves densely puberulent beneath. 10. *G. densiflora.*
Leaves villous beneath, at least on the veins.
Fruit 2–3 cm. in diameter. 11. *G. macrocarpa.*
Fruit 6–15 mm. in diameter.
Fruit 10–15 mm. in diameter, densely puberulent; leaves densely villous beneath. 12. *G. ferruginea.*
Fruit about 6 mm. in diameter, villous; leaves villous on the veins beneath. 13. *G. lanuginosa.*
Leaves pubescent only on the veins beneath. 14. *G. crassipes.*
Flowers solitary or sometimes 2. 15. *G. zygophlebia.*
†† Inflorescence axillary, peduncled.
‡ Inflorescence 1–several-flowered.

Leaves cordate at the base; corolla 3–4 cm. long. 16. *G. calyptrata.*
Leaves not cordate; corolla much smaller.
Leaves glabrous on both sides, coriaceous.
Peduncles short, 3–15 mm. long, 1–2-flowered. 17. *G. monocarpa.*
Peduncles long, 3–8 cm. long, few–several-flowered. 18. *G. Valenzuelana.*
Leaves thin, pubescent beneath, at least on the veins.
Leaves appressed-silky beneath, long-acuminate at the apex. 19. *G. calcicola.*
Pubescence not silky; leaves obtuse to acute or short-acuminate.
Fruit oblong. 20. *G. Lindeniana.*
Fruit subglobose.
Leaves prominently reticulate-veined beneath.
Leaves setulose above. 21. *G. brevinodis.*
Leaves not setulose above. 22. *G. inaequipes.*
Leaves not prominently reticulate-veined beneath. 23. *G. elliptica.*
‡‡ Inflorescence several–many-flowered.
Leaves thick, scabrous above. 24. *G. scabra.*
Leaves thin, smooth above. 25. *G. Combsii.*
C. Species known to me only from the description. 26. *G. retusa.*

1. GUETTARDA ECHINODENDRON C. Wright; Sauvalle, Anales Acad. Habana **6**: 124. 1869

Stenostomum microphyllum Griseb. Cat. Pl. Cub. 133. 1866. Not *Guettarda microphylla* Bartl.

TYPE LOCALITY: Near San Marcos, western Cuba.

DISTRIBUTION: Known only from the type locality.

2. **Guettarda Coxiana** sp. nov.

A shrub, 2.5 m. high, with short, slender, densely pubescent twigs, the leaf-scars long-persistent. Stipules ovate, acuminate, 2–3 mm. long; leaves ovate or ovate-elliptic, 2 cm. long or less, coriaceous, rigid, the apex acute and spinulose-tipped, the base obtuse, the upper surface smooth, with indistinct venation, the under surface very prominently reticulate-veined and densely pubescent, the stout pubescent petiole 1–2 mm. long; peduncles axillary, 1-flowered or 2-flowered, pubescent, 2.5–3 mm. long; bractlets subulate, 1 mm. long; calyx obconic, truncate, densely puberulent, 2 mm. long; corolla yellowish, densely puberulent, about 3 mm. long; young fruit narrowly obovoid, puberulent, faintly ribbed, 4 mm. long, the persistent calyx-limb about 1.5 mm. long.

Rocky coastal hill, Daiquiri, Oriente (*Britton & Cowell 12685*). Named in memory of the late Jennings S. Cox, who, as manager of the Spanish American Iron Company, greatly facilitated scientific investigation in eastern Cuba.

3. **Guettarda cueroensis** sp. nov.

A tree 5 m. high, with slender branches, the young twigs appressed-pubescent. Stipules ovate, acute, pubescent, 2–3 mm. long; leaves clustered at the ends of short spurs, oblong to oblong-lanceolate, 3 cm. long or less, 6–12 mm. wide, coriaceous, acute and spinulose-tipped at the apex, obtuse or subtruncate at the base, loosely reticulate-veined on both sides, glabrous and shining above, puberulent beneath, the finely pubescent petiole 1.5–2 mm. long; flowers solitary in the axils; peduncles pubescent, stout, 2 mm. long or less; calyx subspathaceous, densely pubescent, about 3 mm. long; corolla whitish, densely pubescent, about 8 mm. long, the slender tube about 3 times as long as the limb; fruit subglobose, or globose-obovoid, densely puberulent, 8–10 mm. in diameter.

Hill, 150 m. alt., El Cuero, Oriente (*Britton & Cowell 12733*).

4. GUETTARDA RIGIDA A. Rich. in Sagra, Hist. Cub. **11**: 20. 1850

G. holocarpa Wright; Sauvalle, Anales Acad. Habana **6**: 123. 1869.

TYPE LOCALITY: Cuba.

DISTRIBUTION: Thickets and hillsides, near Regla and Guanabacoa, Havana. Endemic.

I have not seen an authentic specimen of *G. rigida*, and am referring *G. holocarpa* to it from the description. It is the only small-leaved species with silky pubescence on the under side of the leaf known to me from Cuba.

5. **Guettarda camagueyensis** sp. nov.

A shrub, 1 m. high, with terete, widely spreading branches, the young twigs brownish-pubescent with appressed hairs. Stipules pubescent, ovate, sharply acute, 3–4 mm. long; leaves ovate, rigid, coriaceous, 1.5–2.5 cm. long, 10–18 mm. wide, rounded and obtuse at the apex, cordate or subcordate at the base, ciliate, at least when young, smooth, glabrous and inconspicuously veined above, densely reticulate-veined and pubescent beneath the stout petioles about 1 mm. long; flowers solitary and nearly sessile in the axils; calyx spathaceous, appressed-pubescent, 5–6 mm. long, its lobes acute; corolla white, appressed-pubescent with long hairs, about 1.7 cm. long, the limb about one-third as long as the slender tube; fruit nearly sessile, globose, densely brownish-puberulent, about 12 mm. in diameter.

Palm-barren between Camaguey and Santayana (*Britton 2409*, type); Corojo, Camaguey (*Brother Leon 3725*).

6. **Guettarda clarensis** sp. nov.

A shrub with terete branches, the young twigs densely pubescent with long brown, somewhat spreading hairs. Stipules ovate, acute, pubescent, 5 mm. long, deciduous; leaves ovate-oblong, 2.5 cm. long or less, 8–14 mm. wide, obtuse at the apex, subcordate at the base, loosely pubescent with spreading brown hairs and inconspicuously veined above, prominently and densely reticulate-veined and pubescent beneath, the elevated midrib bearing long brown hairs; petioles stout, villous, scarcely 1 mm. long; flowers sessile and solitary in the axils; calyx spathaceous, appressed-pubescent, about 5 mm. long, its broad lobes acutish; corolla about 1 cm. long, its stout tube densely clothed with long appressed, white hairs.

Palm-barren, city of Santa Clara (*Britton & Wilson 6176*).

7. GUETTARDA UNDULATA Griseb. Cat. Pl. Cub. 131. 1866

TYPE LOCALITY: Rocky situations near Matanzas.

DISTRIBUTION: Known only from the type locality [near Punta Brava].

8. **Guettarda xanthocarpa** sp. nov.

A much-branched shrub, 1.5 m. high, the short, spur-like twigs terete, leaf-bearing at the ends. Stipules ovate, puberulent, about 1.5 mm. long; leaves oblong to oblong-lanceolate or elliptic, 2 cm. long or less, 6–12 mm. wide, coriaceous, glabrous or nearly so, acute or obtuse at the apex, subcordate at base, loosely and rather prominently reticulate-veined above, densely and finely reticulate-veined beneath, the puberulent, stout petiole 1–1.5 mm. long; fruit subglobose, yellow, densely puberulent, 6–8 mm. in diameter.

Coastal cliffs, near El Morro, Santiago Bay, Oriente (*Britton & Cowell 12538*, type); eastern Cuba (*Wright 2705*).

Grisebach referred Wright's *2705* to *G. undulata* Griseb., from which it differs in leaf-venation and pubescence; it also differs from our *12538* by shorter, broader and obtuse leaves, but is otherwise similar; when flowers are obtained it may, perhaps, be shown that they are distinct species.

9. Guettarda sciaphila Urban, Symb. Ant. 7: 409. 1912

Type locality: Near the base of Loma Mensura, Oriente.

Distribution: Known only from the type locality.

10. Guettarda densiflora Urban, Symb. Ant. 7: 407. 1912

Type locality: Pine-lands near Paso Estancia, Oriente.

Distribution: Pine-lands, hillsides and savannas, northern Oriente.

Dr. Shafer's *3794*, collected on Loma Mensura, shows its fruit to be subglobose, puberulent, and about 12 mm. in diameter.

11. Guettarda macrocarpa Griseb. Mem. Am. Acad. II. 8: 507. 1862

Type locality: Near Monte Verde, Oriente.

Distribution: Known only from the type locality.

12. Guettarda ferruginea Griseb. Cat. Pl. Cub. 131. 1866

G. calyptrata ferruginea C. Wright; Sauvalle, Anales Acad. Habana 6: 123. 1869.

Type locality: Pine-lands near Mayari, western Cuba.

Distribution: Type locality, and in the mountains of northern Oriente. Endemic.

13. Guettarda lanuginosa Urban & Britton; Urban, Symb. Ant. 7: 407. 1912

Type locality: Cayo Romano, Camaguey.

Distribution: Known only from the type locality.

14. **Guettarda crassipes** sp. nov.

A shrub 1–1.6 m. high, with stout twigs, the young ones densely appressed-pubescent. Stipules ovate, densely pubescent, about 7 mm. long, deciduous; leaves ovate to ovate-elliptic, 6–9 cm. long, 4–7 cm. wide, coriaceous, shining, glabrous and with impressed primary venation above, dull, with elevated primary venation, and very finely reticulate-veined beneath, sparingly pubescent on the stronger veins, obtuse at the apex, cordate at the base, the stout, brown petioles 1 cm. long, densely appressed-pubescent; inflorescence terminal, subcapitate, about 9-flowered; bracts lanceolate, densely pubescent; flowers nearly sessile; calyx subtruncate, densely appressed-pubescent, 4 mm. long; corolla white, densely villous-pubescent, in bud about 15 mm. long.

Between Rio Yamaniguey and Camp Toa, northern Oriente, at 400 m. alt. (*Shafer 4193*).

15. GUETTARDA ZYGOPHLEBIA C. Wright; Sauvalle, Anales Acad. Habana **6**: 124. 1869

TYPE LOCALITY: Arroyo in the Cafetal Potosi, Monte Toro, Oriente.

DISTRIBUTION: Known only from the type locality.

16. GUETTARDA CALYPTRATA A. Rich. in Sagra, Hist. Cub. **11**: 21. 1850

TYPE LOCALITY: Near Canasi, Cuba.

DISTRIBUTION: Woods and thickets, Santa Clara, Matanzas, Havana, Pinar del Rio, Isle of Pines. Endemic.

ILLUSTRATION: A. Rich. in Sagra, *loc. cit.*, *pl. 46*.

17. GUETTARDA MONOCARPA Urban, Symb. Ant. **7**: 410. 1912

TYPE LOCALITY: Pine-lands, Sierra Nipe near Woodfred, northern Oriente.

DISTRIBUTION: Woods and thickets, mountains of northern Oriente. Endemic.

18. GUETTARDA VALENZUELANA A Rich. in Sagra, Hist. Cub. **11**: 20. 1850

Guettarda bracteata Griseb. Mem. Am. Acad. II. **8**: 506. 1862.

TYPE LOCALITY: Vuelta de Abajo (Pinar del Rio), Cuba.

DISTRIBUTION: Mountains of Pinar del Rio and of northern Oriente. Endemic.

I am referring Grisebach's species to that of A. Richard with some hesitation, as did Grisebach himself (Cat. Pl. Cub. 131. 1866), but specimens from Bahia Honda, Pinar del Rio (*P. Wilson 9441*) do not appear different from several from Oriente, including a co-type (*Wright 261*) from Monte Verde.

19. **Guettarda calcicola** sp. nov.

A tree up to 5 m. high, with slender branches, the young twigs densely appressed-pubescent. Stipules ovate, appressed-pubescent with long hairs, about 4 mm. long; leaves oblong-elliptic to ovate-lanceolate, membranous, 4–8 cm. long, 3.5 cm. long or less, acuminate at the apex, acute or acuminate at the base, shining, prominently pinnately veined, with slender, ascending veins, loosely reticulate-veined and sparingly appressed-pubescent on the veins above, appressed-silky beneath, the slender petioles 3–8 mm. long; inflorescence axillary; peduncles slender, as long as the leaves or shorter, several-flowered; calyx subtruncate, appressed-pubescent, about 1.5 mm. long; young fruit oblong to oblong-obovoid, densely finely appressed-pubescent, about 5 mm. long, crowned by the calyx-limb.

Limestone rocks, near Sumidero, Pinar del Rio (*Shafer 13454, type*).

In leaf-venation and pubescence similar to the Haitian *G. multinervis* Urban, which has globose fruit.

20. GUETTARDA LINDENIANA A. Rich. in Sagra, Hist. Cub. 11: 20. 1850

TYPE LOCALITY: Near Santiago, Cuba.

DISTRIBUTION: Lower and middle elevations, Oriente. Endemic.

21. GUETTARDA BREVINODIS Urban, Symb. Ant. 7: 404. 1912

TYPE LOCALITY: Cuba.

DISTRIBUTION: Rocky limestone hills, Pinar del Rio. Endemic.

This does not appear to me to be certainly distinct from the following.

22. GUETTARDA INAEQUIPES Urban, Symb. Ant. 7: 405. 1912

TYPE LOCALITY: Cuba.

DISTRIBUTION: Known only from the type specimens (*Wright 2702*, in part), their exact station not recorded. This and the preceding species were referred by Grisebach to *G. membranacea* Sw., of Hispaniola, and by Wright to *G. Lindeniana* A. Rich.

23. GUETTARDA ELLIPTICA Sw. Prodr. 59. 1788

G. reticulata Griseb. Mem. Am. Acad. II. 8: 506. 1862.

TYPE LOCALITY: Jamaica.

Distribution: Thickets at low elevations near the coasts, Oriente; Camaguey; Santa Clara; Matanzas; Havana:—Florida; Bahamas; Jamaica; Hispaniola; Porto Rico; Mexico. Referred by A. Richard and by Grisebach to *G. odorata* Lam.

Illustration: Sargent, Sylva N. A. *pl. 229;* Man. Trees *f. 617;* Britton & Shafer, N. A. Trees *f. 768.*

24. Guettarda scabra (L.) Lam. Tabl. Encycl. 2: 218. 1793

Matthiola scabra L. Sp. Pl. 1192. 1753.

G. rugosa Sw. Prodr. 59. 1788.

G. havanensis DC. Prodr. 4: 455. 1830.

G. ambigua A. Rich. in Sagra, Hist. Cub. 11: 20. 1850. Not DC.

Type locality: "In America."

Distribution: Thickets and woodlands at lower elevations, Oriente; Camaguey; Santa Clara; Matanzas:—Florida; Bahamas; Hispaniola to Tortola, Anguilla, Grenada and Margarita; Central America; recorded from Jamaica.

25. Guettarda Combsii Urban, Symb. Ant. 6: 48. 1909

Type locality: Near Cieneguita, Santa Clara, Cuba.

Distribution: Savannas and woodlands at lower elevations, Santa Clara; Matanzas; Pinar del Rio. Endemic.

Referred by Grisebach to *G. longiflora* Griseb. of Jamaica.

26. Guettarda retusa C. Wright; Sauvalle, Anales Acad. Habana 6: 124. 1869

Type locality: La Loma Pelada, Palacios, Pinar del Rio.

Distribution: Known only from the type locality and to me only from the description, which is insufficient to enable me to group the species.

43. UNDESCRIBED WEST INDIAN SPECIES

Coccolobis rumicifolia sp. nov.

A shrub, 3 m. high, with slender branches. Leaves elliptic-lanceolate, membranous, glabrous, 15 cm. long or less, 3–7 cm. wide, acutish to acuminate at the apex, obtuse, subcordate or acute at the base, the midvein nearly flat above, prominent beneath, the primary lateral veins about 12 on each side of the midvein, faint above, rather prominent beneath, the ultimate venation coarsely reticulated, the petioles about 1 cm. long, the ochreae 4–5 mm. long; racemes slender, simple, minutely puberulent, 6–12 cm. long; ochreolae subtruncate, 0.5 mm. long, about as long as the bracts; flowering pedicels spreading, 1–3 at each ochreola, 1 mm. long; perianth about 1.5 mm. long, its lobes obtuse.

Wooded hillside, Tea Gully near Newmarket, Jamaica (*Britton 1592*).

Portulaca caulerpoides Britton & Wilson, sp. nov.

Perennial, prostrate, forming tufts 8–12 cm. in diameter; stems slender, branched, hairy in the axils. Leaves obovoid, 3–5 mm. long, 2–3 mm. broad, not at all flattened, rounded at the apex, narrowed at the base, subsessile, glabrous, shining, with labyrinthine or tortuous mottling; flowers terminal, solitary, sessile; sepals oval; petals pale yellowish-white, broadly obovate, 2.5–3 mm. long, 2–2.5 mm. broad, notched at the apex; seeds reniform, black, 0.5 mm. broad, rugulose.

Limestone rocks, Cayo Muertos, Porto Rico (*Britton, Cowell & Brown 4990*).

The aspect of this species is similar to that of the green alga *Caulerpa clavifera*, which occurs in the adjacent sea.

Chamaecrista jamaicensis sp. nov.

A shrub up to 1.3 m. high, the slender branches appressed-pubescent. Stipules lance-subulate, acuminate, striate, 2–4 mm. long; petioles 6 mm. long or less, bearing a nearly cylindric gland 1–1.5 mm. long near the lowest pair of leaflets; rachis pubescent; leaflets 4–8 pairs, dull, coriaceous, sessile, glabrous, oblong, or the two upper ones oblong-obovate, 13–22 mm. long, 8 mm. wide or less, prominently many-veined, obtuse and mucronate at the apex, rounded at the base, inequilateral; peduncles bracted, pubescent, 1-flowered, shorter than the leaves; bracts lanceolate, long-acuminate, striate, about 4 mm. long; sepals lanceolate, acuminate, about 1 cm. long, broadly scarious-margined, pubescent on the back with scattered, appressed hairs; petals obovate, short-clawed, somewhat unequal, about as long as the sepals; longer anthers 9 mm. long; pod obliquely linear, 3–4 cm. long, about 6 mm. wide, pubescent with scattered hairs.

Dry soil near the southern coast of Jamaica. Type from the south slope of Long Mountain (*Britton 811*).

Referred by Grisebach to *Cassia polyadena* DC., originally from

Guadaloupe; I studied the type specimen of *C. polyadena* in the Candollean herbarium at Geneva a number of years ago; it is, in my opinion, specifically distinct from the Jamaica plant.

Rhamnidium ellipticum Britton & Wilson, sp. nov.

A glabrous tree 8 m. high; leaves narrowly to broadly elliptic, occasionally somewhat obovate, 3.5–6.5 cm. long, 1.3–3 cm. broad, obtuse or rounded and usually emarginate at the apex, rounded or obtuse at the base, coriaceous, entire, above lustrous, the midvein and primary veins indistinct, pale beneath, the midvein and primary veins prominent; margin revolute; petioles 5–6 mm. long, channeled; peduncles 1.5–3 cm. long, few-flowered; pedicels 5 mm. long; calyx-lobes triangular-ovate; fruit obovoid, 1 cm. long, 6 mm. broad, glabrous.

Rocky hillside along trail, Rio Yamaniguey to Camp Toa, Oriente, Cuba (*Shafer 4005*).

Rhamnidium Shaferi Britton & Wilson, sp. nov.

A glabrous tree 3 m. high; leaves oblong-oval to oval, occasionally ovate-oval, 5–6.5 cm. long, 3–3.8 cm. broad, rounded and emarginate at the apex, cordate at the base, lustrous above and indistinctly reticulate-veined, beneath paler, the midvein and primary veins prominent; petioles 9–15 mm. long, narrowly grooved; peduncles 7–10 mm. long, few-flowered; pedicels 3 mm. long; buds ovoid.

Camp La Gloria, south of Sierra Moa, Oriente, Cuba (*Shafer 8192*).

Rhamnidium (?) **cubensis** Britton & Wilson, sp. nov.

A shrub 3 m. tall, with grayish bark and puberulent twigs. Leaves oblong-elliptic to narrowly oblong-ovate or oblong-obovate, 2–4 cm. long, 1–1.6 cm. broad, rounded and emarginate at the apex, obtuse at the base, entire, lustrous above, the primary veins prominent, reticulate-veined and paler beneath, rigid, glabrous, black-dotted, the petioles 2–3.5 mm. long, puberulent above and shallowly channeled; flower-clusters lateral, axillary; sepals triangular-ovate, acuminate, glabrous, with a conspicuous row of black glands paralleling the margin; petals hooded, broadly triangular-obovate; filaments subulate, glabrous; anthers ovate; ovary ovoid, glabrous; ovules one in each cavity.

Rocky coastal hills, vicinity of El Morro, Santiago Bay, Oriente, Cuba (*Britton & Cowell 12554*).

Nashia cayensis sp. nov.

A densely branched, aromatic shrub, the slender pendent branches finely rough-pubescent. Leaves ovate to elliptic, 15 mm. long or less, 5–9 mm. wide, obtuse or acutish at the apex, mostly rounded at the base, scabrous above, pubescent and glandular beneath, strongly few-veined with the venation impressed above, prominent beneath, the petioles about 1 mm. long; heads solitary in the axils, nearly sessile, globular and about 5 mm. in diameter when in flower, oblong-cylindric and 10–15 mm. long in fruit, densely many-flowered; bracts broadly ovate to obovate, pubescent and ciliate, about 3 mm. long; calyx of 2 narrowly spatulate sepals nearly as long as the corolla; corolla greenish, scarcely longer than the bracts, the somewhat irregular limb about as long as the campanulate tube; filaments very short; fruit orange-red, about 2 mm. in diameter.

Near Pueblo Romano, Cayo Romano, Camaguey, Cuba (*Shafer 2450*). Similar to *Lippia myrtifolia* Griseb., and clearly congeneric with the generic type, *N. inaguensis* Millsp.

Exostema stenophyllum sp. nov.

A shrub, up to 2 m. high, glabrous throughout, the slender twigs rather densely leafy. Leaves linear to linear-oblanceolate, 6 cm. long or less, 4–6 mm. wide, subcoriaceous, obtusish or acute at the apex, narrowed to the sessile base, revolute-margined, the midvein impressed above, prominent beneath, the lateral venation wholly obscure; stipules semicircular or short-ovate, obtuse, mucronulate, about 2 mm. long; flowers terminal, solitary; peduncle 1–1.5 cm. long; calyx narrowly campanulate, 8–10 mm. long, its ovate-lanceolate acute teeth about one-third as long as the tube; corolla white; corolla-tube about 14 cm. long, 1.5 mm. thick; lobes of the corolla-limb linear, 2–3 cm. long; anthers narrowly linear, about 18 mm. long and about as long as the filaments; capsule oblong, 1.5–2.2 cm. long, about 8 mm. in diameter.

Among rocks at the water's edge, Rio Guayabo above the falls, 450–550 m. alt., Oriente (*Shafer 3623*).

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 184

MOSSES OF THE PHILIPPINE AND HAWAIIAN ISLANDS COLLECTED BY THE LATE JOHN B. LEIBERG

R. S. WILLIAMS

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1915

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Mosses of the Philippine and Hawaiian Islands collected by the late John B. Leiberg

R. S. Williams

PHILIPPINE SPECIES

Trematodon capillipes C. Müll. Luzon: Mariveles Mountain, *1267*.

Dicranella (*Anisothecium*) **Leibergii** sp. nov.

Growing in rather soft, not very compact, brownish green mats; stems short, 4–5 mm. long and simple or sometimes with a single branch up to 1 cm. long; leaves laxly spreading-flexuous, narrowly lanceolate, up to 3 mm. long, widest (about 0.35 mm.) near the base and uniformly narrowed to the acute or narrowly obtuse, slightly denticulate apex, the margins below entire and flat or slightly recurved; costa one sixth or less the width of the leaf-base and nearly or quite percurrent; leaf-cells all more or less linear with slightly thickened walls, the median 6–8 μ wide and often 100 μ long, the basal wider, mostly 10–12 μ; perichaetial leaves with loosely clasping, somewhat larger base than those of the stem; seta rather weak, finally reddish, mostly 8–9 mm. long; capsule erect, oval-oblong, 1–1.5 mm. long without lid, becoming cylindric and somewhat contracted under the mouth when old and dry, the exothecal cells with somewhat thickened, nearly straight lateral walls, the median cells 16–20 μ wide by 35–60 μ long, the stomata at the base few or quite lacking; lid obliquely subulate, about 0.75 mm. long; annulus none; peristome-teeth about 250 μ high, regular, lanceolate, reddish brown below and vertically striate, divided about half way down into pale, papillose forks and borne on a basilar membrane scarcely extending above the rim; spores rough, 16 μ in diameter; calyptra cucullate, smooth, extending well down the capsule.

Polillo Island: May, 1909, *1260*.

In habit this species is much like *D. flaccidula* Mitt. of Fiji and Samoa, but the latter has an annulus, a different peristome, and spores only 3–4 μ in diameter.

Leucoloma molle (C. Müll.) Mitt. Luzon: Mariveles Mountain, July, 1909, *1273*.

DICRANOLOMA BLUMEI (Nees) Ren. Luzon: Mariveles Mountain, July, 1904, *1211*.

LEUCOBRYUM JAVENSE (Brid.) Mitt. Luzon: Mariveles Mountain, July, 1909, *1220*.

LEUCOBRYUM SANCTUM Hampe. Luzon: Tignaon, Lobayet Divide, May, 1909, *1250*.

LEUCOBRYUM SERICEUM Broth. Luzon: Tignaon Valley, Tayabas Province, 350 m. alt., May, 1909, *1249*.

OCTOBLEPHARUM ALBIDUM (L.) Hedw. Luzon: Mariveles Mountain, 760 m. alt., July, 1909, *1218*.

ARTHROCORMUS SCHIMPERI Dz. & Mb. Luzon: Mariveles Mountain, July, 1904, *1212*.

FISSIDENS INVOLUTUS Wils. Luzon: Legaspi or Lobayet, 1909, *1254a*. An Asiatic species not before credited to the Philippines.

FISSIDENS MITTENI Paris. Polillo Island: May, 1909, *1252*. This species of Ceylon, Java and Singapore is also new to the Islands.

FISSIDENS ZIPPELIANUS Dz. & Mb. Luzon: Lobayet River, Tayabas Province, on rock, 1909, *1253*.

SYRRHOPODON ALBOVAGINATUS Schwaegr. Luzon: Infanta, Tayabas Province, at sea-level, May, 1909, *1262*.

SYRRHOPODON MUELLERI Dz. & Mb. Luzon: Lobayet, Tayabas Province, 1909, *1237*.

SYRRHOPODON SUBTUBULOSUS Broth. Luzon: Mariveles Mountain, 400 m. alt., on trees, July, 1904, *1215*.

CALYMPERES DOZYANUM Mitt. Luzon: Tignaon Valley, Tayabas Province, May, 1909, *1234*.

CALYMPERES MOLUCCENSE Schwaegr. Luzon: Infanta, Tayabas Province, on mangrove shrubs, May, 1909, *1235*.

HYOPHILA COMMUTATA Broth. Polillo Island: May, 1909, *1259*. The first record of this species of Sumatra and Java for the Philippine Islands.

Didymodon orientalis (Willd.) comb. nov. (*Trichostomum orientale* Willd.; C. Müll. Syn. 1: 568. 1849.) Luzon: Legaspi, April, 1909, *1255*.

BARBULA ANGUSTIFOLIA (Hook. & Grev.) C. Müll. Luzon: Legaspi, on old walls, May, 1909, *1256*.

BARBULA CONSANGUINEA (Thw. & Mitt.) Sauerb. Luzon: Lobayet or Legaspi, 1909, *1254*.

Barbula lobayetensis sp. nov.

Dioicous, the male plant with one or two lateral appearing flowers each containing four or five antheridia, about 0.4 mm. long, and filiform paraphyses enclosed by two very broad, golden brown perigonial leaves scarcely longer than the antheridia: growing in rather thin mats with mostly simple stems 5–8 mm. long, radiculose below, leafy in the upper part and often bearing in the leaf-axils pale, branching filaments with star-shaped propagulae at their tips; stem-leaves irregularly flexuous or crispate when dry, up to 2.5 mm. long, nearly linear, sometimes slightly wider in the upper part, the somewhat recurved apex acute and denticulate, the margins below entire, papillose, flat in the upper leaf, sometimes recurved below; costa percurrent, 50–60 μ wide just above the base, in cross-section showing about four guide-cells, stereid bands above and below them and outer cells somewhat differentiated; cells of upper part of leaf distinct, papillose, mostly nearly square, about $6 \times 6\ \mu$, in the lower third, rectangular, paler, mostly 8–10 μ wide by 20–30 μ long; perichaetial much like the stem-leaves but with somewhat larger, scarcely clasping base; seta 8–10 mm. long; capsule cylindric, about 1.5 mm. long without lid, the exothecal cells with thin walls, the median about 16 μ wide by 40–50 μ long, those at the rim somewhat transversely elongate, in four or five rows, the stomata few, in one row near the base; lid subulate, about 1 mm. long; annulus none; peristome reddish brown, finely papillose, the basal membrane extending 40–50 μ above the rim and bearing filiform teeth about 0.5 mm. long and twisted once around; spores pale, smooth, about 10 μ in diameter; calyptra slightly rough at the apex.

Luzon: Lobayet, Tayabas Province, on earth, May, 1909, *1258*.

This species has propagula about like those of *B. sobolifera* Fleisch., but the leaves are very different; in habit it is quite similar to *B. pseudoehrenbergii* (Lorentz) Fleisch., a somewhat larger species with the apex of the leaf incurved and bearing in the axils of the leaves club-shaped propagula.

MACROMITRIUM ORTHOSTICHUM Nees. Luzon: Mariveles Mountain, 400 m. alt., on trees, July, 1904, *1215b*.

MACROMITRIUM ROBINSONII R. S. Williams, Bull. N. Y. Bot. Gard. 8: 344. 1914. Luzon: Mariveles Mountain, July, 1904, *1219*.

Macromitrium semipellucidum Dz. & Mb. Luzon: Mariveles Mountain, 400 m. alt., on trees, July, 1904, *1215a*.

Pohlia saxensis R. S. Williams, Bull. N. Y. Bot. Gard. **8**: 347. 1914. Polillo Island: May, 1909, *1272*.

Orthomnium stolonaceum Broth. Luzon: valley of Lobayet, Tayabas Province, May, 1909, *1241*.

Webera rupestris (Mitt.) C. Müll. Polillo Island: on wet banks, May, 1909, *1236a*. Not before credited to the Islands.

Racelopus pilifer Dz. & Mb. Polillo Island: May, 1909, *1236*.

Spiridens longifolius Lindb. Luzon: Mariveles Mountain, 760 m. alt., July, 1904, on trees, *1201*.

Aerobryopsis lanosa (Mitt.) Broth. Luzon: Mariveles Mountain, July, 1904, *1206*.

Aerobryopsis longissima (Dz. & Mb.) Broth. Luzon: Mariveles Mountain, 550 m. alt., July, 1904, *1207*.

Floribundaria floribunda (Dz. & Mb.) Fleisch. Luzon: Lobayet, Tayabas Province, 1909, *1245*.

Neckeropsis crinita (Griff.) Fleisch. Luzon: Infanta, Tayabas Province, 1909, *1240*; Lobayet, Tayabas Province, *1251*.

Neckeropsis Lepiniana (Mont.) Fleisch. Luzon: Lobayet river, Tayabas Province, May, 1909, *1248*.

Homaliodendron microdendron (Mont.) Fleisch. Luzon: Mariveles Mountain, on tree, July, 1904, *1217a*.

Distichophyllum Osterwaldii Fleisch. Luzon: Lobayet, Tayabas Province, 1909, without number.

Callicostella Beccariana (Hampe) Jaeg. Polillo Island: May, 1909, *1224*.

Callicostella papillata (Mont.) Jaeg. Luzon: Tignaon, *1230*; Infanta, Tayabas Province, on trees, May, 1909, *1263a*.

Chaetomitrium papillifolium Bryol. Jav. Polillo Island: May, 1909, without number.

Hypopterygium Vriesei Bryol. Jav. Luzon: Tignaon, Tayabas Province, *1233*.

Rhacopilum spectabile Reinw. & Hornsch. Luzon: Tignaon, Tayabas Province, May, 1909, *1232*.

PSEUDOLESKEOPSIS DECURVATA (Mitt.) Broth. Luzon: valley of Lobayet, Tayabas Province, river bank, May, 1909, *1223*.

PELEKIUM VELATUM Mitt. Polillo Island: 1909, *1239*.

THUIDIUM PLUMULOSUM (Dz. & Mb.) Dz. & Mb. Luzon: valley of Lobayet, on trees at sea-level, May, 1909, *1237*.

ECTROPOTHECIUM CYPEROIDES (Hook.) Jaeg. Luzon: Lobayet, Tayabas Province, May, 1909, *1231*.

ECTROPOTHECIUM MORITZII C. Müll. Luzon: valley of Tignaon, Tayabas Province, on the ground at sea-level, May, 1909, *1221*.

TRISMEGISTIA LANCIFOLIA (C. Müll.) Broth. Luzon: valley of Tignaon, May, 1904, *1225*.

ISOPTERYGIUM MINUTIRAMEUM (C. Müll.) Jaeg. Apparently this species. Polillo Island: May, 1909, without number.

TRICHOSTELEUM HAMATUM (Dz. & Mb.) Jaeg. Luzon: Mariveles Mountain, on ground, logs, etc., 760 m. alt., July, 1904, *1218a*.

TRICHOSTELEUM PAPILLATUM (Harv.) Jaeg. Luzon: valley of Tignaon, on the ground at sea-level, May, 1909, *1222*. Polillo Island: May, 1909, *1228*.

TAXITHELIUM ALARE Broth. Luzon: Mariveles Mountain, on decaying twigs, etc., July, 1904, *1203*.

TAXITHELIUM INSTRATUM (Brid.) Broth. Luzon: Mariveles Mountain, 550 m. alt., July, 1904, *1205*.

VESICULARIA CAMPYLOTHECA (Broth.) Broth. Luzon: Infanta, Tayabas Province, May, 1909, *1226*. Polillo Island: May, 1909, *1229*.

VESICULARIA FILICUSPIS Broth. Luzon: valley of Tignaon, on the ground at sea-level, May, 1909, *1221a*.

VESICULARIA MEYENIANA (Hampe) Broth. Luzon: Infanta, Tayabas Province, on trees, May, 1909, *1263*.

SEMATOPHYLLUM HYALINUM (Reinw.) Jaeg. Luzon: Mariveles Mountain, 600 m. alt., *1208;* 760 m. alt., July, 1904, *1204;* 870 m. alt., *1202*.

HAWAIIAN SPECIES

Dicranella hawaiica (C. Müll.) Broth. Oahu: Honolulu, March, 1909, *1261*. Determined from the description only.

Hymenostomum ovale sp. nov.

Dioicous, the male plant with a single terminal flower, the inner antheridial leaves very short and broad, deeply concave, sometimes obtuse, enclosing six to eight antheridia and rather abundant, slightly longer paraphyses: growing in rather compact, pale greenish cushions with mostly simple stems 2–3 mm. high; stem-leaves crispate when dry, 1.5–2 mm. long, nearly linear, acutely pointed, the margins entire and more or less inrolled in the upper three fifths either wet or dry; costa about 45 μ wide just above the base and one sixth the width of the leaf-base, slightly excurrent into a more or less incurved point, smooth on the back, in cross-section near the middle showing four guide-cells, stereid bands above and below them and outer cells on the ventral side large, on the dorsal side, scarcely differentiated; leaf-cells mostly four-sided, about $8 \times 8\ \mu$ in upper part, rather obscure and finely papillose on both upper and under surface, the basal cells rectangular, 8 μ wide by 25–30 μ long toward the costa, with slightly thickened, pale, not hyaline walls; perichaetial leaves much like those of the stem, but with slightly larger base; capsule oval, about 1 mm. long without the lid, the lid subulate, oblique, often nearly as long; exothecal cells thin-walled, elongate-hexagonal to rectangular, about 25 μ wide by 40–60 μ long, the stomata few, near the base, sometimes not evident; annulus and peristome none; spores rough, round, about 20 μ in diameter; calyptra cucullate, extending far below the lid, the apex smooth.

Oahu: Honolulu, March, 1909, *1247*.

Claopodium hawaiense sp. nov.

Dioicous: growing in thin, yellowish green mats with irregularly branching, smooth stems mostly less than 1 cm. long, bearing few radicles and spreading-flexuous, not decurrent, somewhat complanate leaves; leaves of stem and branches very similar, about 0.5 mm. long, ovate-lanceolate, the tapering point serrulate, the border of one row of more or less differentiated cells, serrulate all round; costa often pale, about 16 μ wide at the base, smooth, extending into the point, sometimes appearing slightly excurrent; cells of upper part of leaf mostly rhomboidal, about 6 μ wide by 16–20 μ long, below more elongate and irregular, the upper and median cells mostly unipapillate on each side, the papillae sometimes extending almost to the leaf-base and very prominent on the branch-leaves but often almost lacking on the lower part of the stem-leaves; perichaetial leaves loosely convolute, erect, smooth, broadly oblong-lanceolate, the inner nearly 1.5 mm. long with rather short, narrowly acute, not quite entire point; seta rough throughout, 10–12 mm. long; capsule oblong, nodding, about 1 mm. long without the lid, constricted under the mouth when dry, the exothecal cells mostly oblong with walls much thickened at the angles, the stomata few, near the base; annulus large; outer peristome finely cross-striate below, papillose in the upper part, the inner about as high as the outer, consisting of a high basal membrane, rather pale and minutely papillose, bearing narrow, keeled segments with short, narrow slits along the median line and terminating in filiform points with one or two slender, nodose cilia nearly as long, between them; lid conical, acute, its height slightly exceeding the basal diameter; spores not quite smooth, about 10 μ in diameter.

Oahu: Honolulu, March, 1909, *1227*.

Compared with *C. prionophyllum* (C. Müll.) Broth. of India, Java and the Celebes, this species is perhaps slightly stouter and has broader, shorter pointed, more serrulate leaves as well as a rough seta.

CONTRIBUTIONS FROM THE NEW YORK
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PHYTOGEOGRAPHICAL NOTES ON THE ROCKY MOUNTAIN REGION—V. GRASSLANDS OF THE SUBALPINE AND MONTANE ZONES

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Phytogeographical notes on the Rocky Mountain region
V. Grasslands of the Subalpine and Montane Zones

P. A. RYDBERG

In a previous paper, I have discussed the forest trees of the mountains proper. Next to the trees the most important vegetation consists of the grasses. In fact, it may be said that in most cases where the land is not covered by the forest, the grasses are the predominant plants. The principal exceptions are the following: (1) Lakes and ponds, as the aquatic grasses are few and there are no aquatic trees. (2) Rock-slides and bare cliffs, where the soil is too scant. As soon as humus and sediments have had time to increase the soil, regions of this type will gradually change into either a forest-formation or a grassland. (3) Shrub formations. These are not very common in the mountains, but more so in the foothills. They are mostly found on the borders between the forest and the grassland, and in time will change into either, usually into the former. (4) Certain brook banks, especially in the subalpine region, where the vegetation consists of species of *Mertensia*, *Senecio*, *Delphinium* and other dicotyledonous plants.

Usually the forest occupies the slopes, while the grasslands occupy either the elevated ridges or so-called "hog-backs," or else the valleys or so-called "parks." The cause of this division is pointed out, or at least suggested, in one of my preceding papers on the alpine region.* The "hog-backs" are exposed to the desiccating winds and are therefore too dry for forest growths. In the valleys too much snow lodges during the winter and melts too slowly during the summer and the trees would be suffocated. There may also be other causes. In the valleys and parks, the drainage is often too poor and the soil has become too alkaline or saline for tree growth.

The grasslands are, however, not wholly confined to the ridges and valleys. In many places, the slopes where the soil and

* Bull. Torrey Club 40: 681, 682. 1913.

drainage are both good and where there is no special exposure either to wind or snow are occupied by grasses and not by forest. In such cases it is harder to point out the causes of the conditions. In some cases the forests have been destroyed by fires, and the grasses have gained possession of the ground before a reforestation had taken place.

A. SUBALPINE ZONE

The grasslands of the Subalpine Zone resemble much those of the Alpine Zone, which has been treated in a previous article. They are, however, of comparatively less extent, only covering larger areas in the more open valleys, where too much snow lodged, and along the wind-swept "hog-backs." The former are practically a continuation of the alpine meadows, the latter of the mountain crests. The grasses are mostly the same with some additions from the Montane Zone below. The grasses confined to the Subalpine Zone only are indeed very few.

Species in the following lists marked with an asterisk (*) are restricted to the lower parts of the zone; those marked with a dagger (†) to the upper part.

1. Lakes, Ponds, Brooks and Swamps

Lakes or ponds are very rare in the Subalpine Zone; they are mostly situated in amphitheaters immediately under the snow fields and are usually filled with ice until late in the spring. They are almost void of higher vegetation, which is limited to a few species of *Sparganium* and *Potamogeton*. There are, as a rule, no grasses. The only aquatic grass in the upper part of the Zone is *Catabrosa aquatica*, which is usually confined to the mountain brooks in places where the current is less swift. In the lower part of the Zone is added to this *Panicularia pauciflora*, growing in willow bogs. Th ecommon water grasses of the lower mountain regions and the Great Plains are wanting: viz. *Phragmites*, *Spartina*, *Calamagrostis*, *Panicularia americana*, and *Phalaris*.

2. Meadows

The wet meadows are confined to the lower and moister parts of the open valleys. In the upper part of the Zone they are practically identical with the Alpine meadow-lands; in the lower part a number of species from the Montane Zone are added. Along the water courses perhaps the most common grass in the upper part is *Deschampsia caespitosa*. Where the soil is richer the predominant grasses are *Phleum alpinum*, *Agrostis variabilis*, *Trisetum subspicatum*, *T. majus* and several species of *Poa*. In the lower part these, except the poas, are more or less replaced by *Alopecurus aristulatus*, *Muhlenbergia comata*, *Agrostis asperifolia*, *Graphephorum muticum*, and *Danthonia californica*. Among bushes, especially along the streams, the most common grasses are *Calamagrostis canadensis*, *C. Langsdorfii*, *Panicularia nervata*, and *P. pauciflora*. In the Northern Rockies many wet meadows are made up wholly of *Alopecurus occidentalis*, but this species is rare in the Southern Rockies.

The following grasses are found in the Subalpine Zone throughout the whole Rocky Mountain region:

**Muhlenbergia racemosa*	*Trisetum subspicatum*
* " *comata*	" *majus*
**Phleum pratense*	**Graphephorum muticum*
" *alpinum*	**Danthonia californica*
**Alopecurus aristulatus*	* " *intermedia*
" *occidentalis*	*Poa pratensis*
**Agrostis asperifolia*	" *reflexa*
" *hyemalis*	" *leptocoma*
" *variabilis*	" *alpina*
Calamagrostis Langsdorfii	* " *Olneyi*
" *canadensis*	* " *Vaseyana*
**Deschampsia atropurpurea*	**Panicularia nervata*
† " *curtifolia*	" *pauciflora*
" *caespitosa*	**Hordeum jubatum*

The following are restricted to one of the two divisions:

Southern Rockies

Muhlenbergia Wolfii	*Poa callichroa*
**Agrostis canina*	† " *pudica*
†*Deschampsia alpicola*	" *occidentalis*
Graphephorum Wolfii	* " *tricholepis*

Northern Rockies

Agrostis variabilis	*Poa nervosa*

The following mesophytic grasses, which could be counted among the meadow-grasses, prefer, however, river banks more or less covered by shrubbery.

Calamagrostis Langsdorfii	*Trisetum montanum*
" *canadensis*	**Elymus glaucus*

3. DRY VALLEYS AND BENCH-LANDS

Sometimes the sides of the valleys slope gently and the meadow passes gradually into the dryer part of the valley and this into the mountain side, sometimes the sides rise in a series of steps or shelves, one above the other. These steps are the remains of former river-banks or lake-shores. They are known as benches. The grasses of the bench-lands and other drier portions of the valleys are decidedly xerophytic. They consist mostly of genera which are characteristic of the Great Plains or the Foot-hills. In the Subalpine Zone the bench-lands are not often found and are always of insignificant area. The following grasses are characteristic of the bench-lands of the Subalpine Zone:

Stipa Tweedyi	*Bromus Porteri*
" *minor*	" *Richardsonii*
Poa crocata	" *polyanthos*
" *longiligula*	*Agropyron violaceum*
" *lucida*	*Elymus simplex*
" *Buckleyana*	

4. MOUNTAIN SLOPES

Sometimes the meadow passes gradually into the mountain slopes, without any intervening xerophytic region. The mountain grass-slope is often mesophytic in its nature, especially in the Subalpine Zone, and is much like that of the Alpine Zone. In the Northern Rockies the most important grass of such mountain sides is *Festuca ingrata*, which, however, has its best development in the Montane Zone. This grass is also common in the northern part of the Southern Rockies, but on the southern slopes of the latter its place is taken by *Festuca arizonica* and *F. Thurberi*. The latter for instance covers all the southern slopes of the Abajo Mountains in southeastern Utah, almost to the top (3,300 m. alt.). These slopes, however, are more xerophytic than the mountain sides of the Northern Rockies. The grass flora of the mountain sides is of the following composition:

Stipa minor	*Festuca ingrata*
* " *Nelsonii*	† " *saximontana*
Agrostis hiemalis	*Bromus Richardsonii*
Trisetum subspicatum	" *Pumpellianus*
" *majus*	*Agropyron andinum*
Poa longiligula	" *Scribneri*
" *paddensis*	" *violaceum*
" *epilis*	
" *confusa*	
" *laevigata*	

The following are restricted to one region:

Southern Rockies

Muhlenbergia gracilis	*Poa Fendleriana*
" *subalpina*	" *Sheldonii*
Poa aperta	*Bromus Porteri*
" *longipedunculata*	

Northern Rockies

**Poa Cusickii*	†*Agropyron latiglume*
" *nevadensis*	

Southern slope of the Southern Rockies

On the more xerophytic southern slopes of the Rockies of Colorado and New Mexico, the following species are the characteristic ones:

Trichachne saccharatum	*Festuca arizonica*
Poa crocata	" *Thurberi*
" *Fendleriana*	† " *saximontana*

5. Hog-backs

As stated before, the grass flora of the hog-backs or exposed ridges is practically the same as that of the rock-crests of the alpine region, except that a few of the more mesophytic grasses, as for instance *Trisetum subspicatum* and *Deschampsia curtifolia*, are lacking. A few species from the Montane Zone are added.

The following species growing in both the Northern and Southern Rockies belong here:

Calamagrostis purpurascens	*Festuca curtifolia*
†*Poa rupicola*	" *saximontana*
" *crocata*	†*Agropyron Scribneri*
† " *Pattersonii*	† " *andinum*
" *epilis*	
" *paddensis*	
" *longiligula*	

The following belong here also, but are restricted to but one region:

Southern Rockies	Northern Rockies
Muhlenbergia subalpina	*Poa confusa*
" *filiculmis*	" *Cusickii*
Festuca minutiflora	*Sitanion rigidum*

B. MONTANE ZONE

The grasslands of the Montane Zone resemble more those of the Great Plains and the Foothills. In the large open valleys or so-called parks, many of the grasses are the same as those found in the valleys of the plain region, in fact many have followed the streams up from the prairies. The grass flora of the bottoms of the canyons and of the river banks is also much the same as further down in the plain region. The flora of the elevated ridges and "hog-backs" also is more or less a continuation of that of the plains, with the addition of some endemic grasses. The grass flora of the mountain slopes consists more exclusively of grasses peculiar to the mountain regions.

Species in the following lists marked with an asterisk (*) are common to the Great Plains; those marked with a dagger (†), to the Subalpine Zone. Species marked with a double dagger (‡) are northern species found at low altitudes throughout the boreal regions but not on the Great Plains or the Prairies; in the Rocky Mountains they are restricted to the Montane and Subalpine Zones. Species marked with a section (§) occur also on the Staked Plains and in the Upper Sonoran region.

1. LAKES, PONDS AND SWAMPS

The water grasses are not many. *Catabrosa aquatica* is mostly confined to slow running brooks, *Phragmites Phragmites*, *Panicularia americana* and *P. borealis* are found in lakes and ponds mostly near the shore; so also are *Phalaris arundinacea*, *Agrostis asperifolia*, *Beckmannia erucaeformis*, and *Calamagrostis Langsdorfii*, but these prefer the bogs rather than the deeper water. The following belong to this formation:

Phalaris arundinacea	**Phragmites Phragmites*
**Calamagrostis hyperborea*	**Panicularia americana*
Agrostis asperifolia	‡ " *nervata*
**Beckmannia erucaeformis*	† " *pauciflora*
‡†*Catabrosa aquatica*	‡ " *borealis*

The following is restricted to the Northern Rockies:

Panicularia elata

2. MEADOWS

As in the Subalpine Zone the wet meadows are situated in the more open valleys, but they are here of greater extent, as the grade of the water courses is not so steep as in the higher regions. Many of the grasses are the same as those of the subalpine meadows and even some of the alpine species, such as *Poa alpina* and *Phleum alpinum*, are occasionally found along the water courses, where the ground is kept cool by the ice water from the mountains. Still more species are common to this and the valleys of the Foothills and the Great Plains. The genera of Aveneae, such as *Deschampsia*, *Trisetum* and *Graphephorum*, become more sparing, and those of Agrostideae, such as *Agrostis*, *Muhlenbergia* and *Calamagrostis*, more common. The tribe Hordeae, rarely represented in the subalpine meadow, becomes also more frequent, especially the genus *Hordeum* and the stoloniferous species of *Agropyron*. It is scarcely worth while to indicate the principal species, for in one meadow there might be one species predominant, in another there might be another species. In the Northern Rockies the predominant species in many places are *Alopecurus occidentalis*, *Agrostis alba*, *Phalaris arundinacea*, or *Festuca vallicola*, but in the Southern Rockies this is rarely if ever the case. Here the species of *Poa* are usually predominant. The following grasses inhabit the montane meadows:

**Phalaris arundinacea*
Muhlenbergia racemosa
" *Richardsonis*
* " *comata*
" *filiformis*
Phleum pratense
† " *alpinum*
**Alopecurus aristulatus*
" *occidentalis*
Agrostis alba
" *asperifolia*
" *tenuiculmis*
* " *hiemalis*
†Calamagrostis Langsdorfii
" *canadensis*
" *Scribneri*
* " *neglecta*
* " *hyperborea*
" *micrantha*
†Deschampsia caespitosa
†Trisetum majus
Graphephorum muticum
Danthonia californica
" *intermedia*
**Eatonia intermedia*
Melica spectabilis
" *bulbosa*
Poa pratensis
" *reflexa*
" *leptocoma*
* " *triflora*
† " *alpina*
" *Wheeleri*
" *Olneyi*
" *pratericola*
**Panicularia nervata*
" *pauciflora*
**Agropyron pseudorepens*
**Hordeum jubatum*
* " *nodosum*
" *boreale*

The following are also found in the meadows, but are restricted to one region:

Southern Rockies

**Muhlenbergia Wrightii*
Agrostis canina
**Calamagrostis inexpansa*
Graphephorum Shearii
Graphephorum Wolfii
**Poa interior*
" *tricholepis*
Agropyron Palmeri

Northern Rockies

Panicum pacificum
Muhlenbergia squarrosa
Agrostis humilis
" *aequivalvis*
" *variabilis*
Calamagrostis blanda
Calamagrostis laxiflora
**Eatonia pennsylvanica*
Poa nervosa
" *longipila*
Festuca vallicola

Certain species are limited to, or more common in, the more alkaline meadows, which are quite wet in the spring but dry in the autumn. These are:

**Puccinellia airoides*	**Agropyron Smithii*
**Spartina gracilis*	* " *molle*
**Distichlis stricta*	* " *dasystachyum*
Elymus simplex	(Northern Rockies only)

A few species may be counted to the meadow flora, but they are found only in sandy places, on creek-banks, etc., and are limited to the Southern Rockies. These are:

Muhlenbergia simplex	*Muhlenbergia Wolfii*
" *aristata*	

The following meadow species are usually most common among shrubs:

Eatonia pennsylvanica	*Savastana odorata*
Panicularia nervata	*Oryzopsis micrantha*
" *pauciflora*	*Elymus glaucus*

So also the following, which, however, are restricted to one region:

Southern Rockies	Northern Rockies
Stipa Porteri	*Melica subulata*
Panicularia Holmii	*Panicularia elata*
Festuca fratercula	*Festuca elatior*

3. DRY VALLEYS AND BENCH-LANDS

The dry valleys and bench-lands are more common and of greater extent in the Montane Zone than in the Subalpine, and more common in the Northern Rockies than in the Southern. Except in the three parks of Colorado (Northern, Middle and Southern) they are also as a rule smaller in the Southern Rockies. The grasses are composed mainly of two elements, the species common to the Great Plains and those endemic to the mountains. In the drier parts of the valleys there are scarcely any high northern ones running south in the mountains. In the southern portion of the Southern Rockies, there are a few species belonging to the Staked Plains and the Upper Sonoran flora. The species of *Andropogon*, *Sporobolus*, and *Koeleria* and the stoloniferous species of *Agropyron* are immigrants from the Great Plains, while those of *Stipa* (except *S. comata*) and most species of *Bromus* are endemic. The species of *Poa* and the bunched species of *Agropyron* are divided between the two categories. The following belong here:

**Andropogon furcatus*
* " *Hallii*
**Stipa comata*
" *Tweedyi*
" *viridula*
" *Nelsonii*
" *minor*
**Muhlenbergia Richardsonis*
**Sporobolus airoides*
* " *asperifolius*
* " *chryptandrus*
**Bouteloua oligostachya*
Poa crocata
" *longiligula*
" *laevigata*
" *confusa*
* " *pratericola*
* " *Buckleyana*
**Koeleria gracilis*
Festuca campestris
Bromus polyanthus
‡ " *Richardsonii*
" *Pumpellianus*
‡Agropyron violaceum
* " *tenerum*
‡ " *caninum*
* " *pseudorepens*
* " *Smithii*
* " *molle*
" *spicatum*
**Hordeum jubatum*
**Sitanion elymoides*
Elymus triticoides
" *condensatus*
" *simplex*

The following also belong here but are restricted:

Southern Rockies

Andropogon chrysocomus
§Blepharineuron tricholepis
Poa lucida
Bromus Porteri
§Festuca Thurberi
§Agropyron arizonicum
§ " *Bakeri*

Northern Rockies

Stipa Richardsonii
" *Williamsii*
" *Elmeri*
Muhlenbergia squarrosa
Calamagrostis montanensis
Poa nevadensis
Bromus breviaristatus
" *Flodmanii*

Agropyron spicatum
" *Richardsonii*
* " *albicans*
Agropyron Gmelini
* " *dasystachyum*
Sitanion montanum

4. MOUNTAIN SLOPES AND HILLSIDES

The mountain slopes in the Montane Zone resemble closely those of the Subalpine Zone, but are more common and of greater extent. The number of species is much larger. As stated under the Subalpine Zone, the most important species in the Northern Rockies is *Festuca ingrata*, and its place is taken on the southern slopes of the Southern Rockies by *F. arizonica* and *F. Thurberi*. The following species are represented in both the Northern and the Southern Rockies:

**Stipa viridula*
" *Nelsonii*
" *minor*
" *Vaseyi*
Oryzopsis exigua
Agrostis hiemalis
†*Trisetum subspicatum*
† " *majus*
Poa longiligula
† " *epilis*
† " *paddensis*
" *laevigata*
†*Festuca saximontana*
" *ingrata*
" *confinis*
‡*Bromus Richardsonii*
" *Pumpellianus*
†*Agropyron andinum*
‡ " *violaceum*
* " *tenerum*
**Sitanion elymoides*
**Elymus canadensis*

The following are restricted to one region:

Southern Rockies

**Trichachne saccharatum*
Stipa Scribneri
Muhlenbergia gracilis
* " *subalpina*
Melica Porteri
Poa aperta
" *macroclada*
" *Fendleriana*
Poa longipedunculata
" *Sheldonii*
§*Festuca fratercula*
§ " *arizonica*
§ " *Thurberi*
Bromus lanatipes
" *Porteri*
§*Sitanion molle*

Northern Rockies

Stipa Richardsonii	*Elymus innovatus*
" *Lettermannii*	†*Agropyron latiglume*
Poa Cusickii	" *spicatum*
" *nevadensis*	

5. HOG-BACKS AND DRY RIDGES

The flora here consists mostly of grasses from the Great Plains intermixed with some elements from the Subalpine Zone. The grass flora is rather poor in number of species. This is especially the case if those common to the hillsides are eliminated. The flora includes the following grasses:

**Aristida longiseta*	*Poa crocata*
* " *Fendleriana*	† " *paddensis*
Stipa viridula	†*Festuca brachyphylla*
**Calamagrostis purpurascens*	† " *saximontana*
Avena americana	†*Agropyron andinum*
Danthonia intermedia	† " *Scribneri*
Bouteloua oligostachya	" *spicatum*
**Koeleria gracilis*	

The following are restricted to one region:

Southern Rockies	Northern Rockies
Stipa Vaseyi	†*Poa Cusickii*
†*Muhlenbergia subalpina*	**Festuca campestris*
" *filiculmis*	†*Sitanion rigidum*
Poa Fendleriana	" *lanceolatum*

To the preceding formations may be added the following five in which the grasses do not constitute the principal or predominant species:

6. WOODS

The truly wood species of grasses are very few, and even these do not grow in the deep forest but in more open places. They are the following:

Oryzopsis asperifolia	*Poa compressa*
Cinna latifolia	*Festuca Jonesii*
Avena striata	

To these are added in the Northern Rockies:

Calamagrostis Suksdorfii
Deschampsia elongata

7. COPPICES AND RIVER BANKS

The following prefer more or less shaded situations among bushes, or on river banks among willows, birches, or alders:

§*Savastana odorata*
Stipa Richardsonii
Oryzopsis exigua
" *micrantha*
Calamagrostis canadensis
" *Langsdorfii*
Sporobolus cryptandrus
Panicularia nervata
" *pauciflora*
Festuca elatior
Elymus glaucus

Limited to one region:

Southern Rockies	Northern Rockies
Trisetum montanum	*Deschampsia elongata*
Panicularia Holmii	*Panicularia elata*
Melica Porteri	*Melica subulata*

8. SAND-DRAWS AND SAND-HILLS

A few species characteristic of the sand-hill regions of Nebraska and Kansas enter the river valleys, growing on sandy river-banks, draws, and in bottoms of canyons. They are:

Panicum barbipulvinatum
Eriocoma cuspidata
Muhlenbergia pungens
Festuca octoflora
Sporobolus asperifolius
" *confusus*
" *cryptandrus*

To these are added in the Southern Rockies:

Bouteloua prostrata
Muhlenbergia Thurberi
" *gracillima*
Munroa squarrosa
Elymus ambiguus

9. HOT SPRING FORMATION

In the Northern Rockies, especially in the Yellowstone National Park, there are found many hot springs. The minerals held in solution in the hot water, mostly silicates, are deposited, forming often large fields of deposits in the form of crusts, which in course of time often become broken up and form sand fields. These hot spring formations have a peculiar flora of their own. The grasses are not many, however, but at least two of them have, so far as the writer knows, never been found elsewhere. These are *Panicum thermale* and *Deschampsia pungens.* The former has been collected also around hot springs in California. Besides these *Spartina gracilis* and *Panicum barbipulvinatum* are common. These are plants from the Great Plains, the former frequent in alkaline meadows and the latter in sand-draws. Another plant although not a grass, but a sedge, may be mentioned here, viz. *Eleocharis thermalis*, growing in the pools below the springs with water even too hot for a comfortable bath.

10. RUDERAL REGIONS

A few of the ruderal grasses of the Great Plains and the regions east thereof have been found near dwellings, along roads, in fields and in waste places as high up as within the limits of the Montane Zone. These are:

Synthyrisma humifusum
Panicum capillare
" *barbipulvinatum*
Poa annua
Dactylis glomerata
Chaetochloa glauca
Polypogon monspeliensis
Avena fatua
Bromus hordeaceus
" *secundus*

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CONTRIBUTIONS FROM THE NEW YORK
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NOTES ON TRICHOMANES—I.
THE IDENTITY OF TRICHOMANES PYXIDIFERUM L.

MARGARET SLOSSON

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Notes on Trichomanes—I. The identity of Trichomanes pyxidiferum L.

MARGARET SLOSSON

(WITH PLATES 30 AND 31)

The genus *Trichomanes* as included by Linnaeus in his "Species Plantarum" contains eleven species of the genus as now understood, in addition to certain species now included in *Hymenophyllum* and *Davallia*. The first species mentioned is *Trichomanes membranaceum*. But Linnaeus had previously established the genus as a monotypic one based on Plumier's *pl. 86*.* This plate represents *Trichomanes crispum*, which must thus be regarded as the type of *Trichomanes*.

Since Linnaeus's time many subdivisions of the genus have been made and some raised to generic rank. It is not proposed to enter into a discussion of the validity of these groupings in these "Notes." The genus *Trichomanes* is here referred to in its widest sense. Nor is it proposed to undertake a monograph of the genus or any of its subdivisions. To do so would be a somewhat tremendous undertaking, as those who have attempted to sort out even a few of the species will agree. The genus is in a chaotic state. The chief reason for this is the large number of descriptions of species that have been published without illustration. With plants of this nature, accurate figures of some sort accompanying specific descriptions are in many cases a necessity; it is often practically impossible to furnish a written description that will apply to one species and to one alone.

* Gen. Pl. 20. 1737; also Hort. Cliff. 476. 1737.

In this state of affairs all attempts to fix upon the oldest name for any species of the genus, excepting Linnaean species, must be temporarily given up. We have first to see if the current idea of the plant may not be erroneous, and if the plant can be definitely pinned to a given name. During the last three years I have been fortunate enough to obtain for examination, mostly through the kindness of European botanists, types of various species, and to have had for comparison with such adequate plates of published species as do exist, a large collection of tropical American plants, including the collections at the New York Botanical Garden, and many specimens from the United States National Museum at Washington which Mr. William R. Maxon has kindly allowed me the privilege of examining. In these "Notes" photographs of these types will be published, and old plates reproduced side by side with photographs of herbarium specimens when it appears that the identity of any species has been misunderstood and can be definitely fixed upon in this way. This should give part of a foundation for a future revision of the genus. Photographs, when sufficiently enlarged, do not mislead. A beginning in this direction has already been made by others. The most notable instance is Dr. Carl A. M. Lindman's excellent paper, "Remarks on Some American species of *Trichomanes* sect. *Didymoglossum* Desv.",* which may well serve as a model. Dr. Lindman's fine illustrations are drawings made by the aid of a camera lucida, not photographs, but I have preferred photography as sometimes bringing out characters the eyes may overlook.

The subject of the present paper is the identity of *Trichomanes pyxidiferum* L.

Linnaeus's description of this species reads as follows:†

"*pyxidiferum* 5. TRICHOMANES frondibus sub-bipinnatis: pinnis alternis confertis lobatis linearibus.
Filix pyxidifera. *Plum. fil.* 74. *t.* 50.
Dareae tunbrigensis facie. *Pet. fil.* 104. *t.* 13. *f.* 13.
Habitat in America."

Plumier's plant was from Santo Domingo. The locality of

* Ark. Bot. 1: 7–55. 1903.
† Sp. Pl. 1098. 1753.

Petiver's is not stated, except as America, but his figure points unmistakably to the same plant as Plumier's.

This species has been variously interpreted, no doubt often correctly, but probably the most common idea of it is that based on Hedwig's plate* and description. These represent a distinct easily recognizable and common tropical American species, but a recently received specimen of quite another plant from Santo Domingo makes it appear that the latter must bear the Linnaean name. A leaf of this plant, collected on rocks near Constanza, at an altitude of 1,250 meters, March 19, 1910, by H. von Tuerckheim, No. 3069, is figured on PLATE 30, FIG. 2, together with a reproduction of a leaf from Plumier's plate, FIG. 1. It will be seen that the most notable characteristics of the two leaves, the flexuose rachis, the stiff short wide pinnae, and especially the conspicuously short broad almost inflated indusium, appear in both.

This is the plant described by Christ as *Trichomanes junceum*.† His type is from Costa Rica, collected by Wercklé, and specimens so collected, from Christ's Herbarium and now in the Underwood Herbarium at the New York Botanical Garden, agree exactly with the Von Tuerckheim plant. Two leaves from these Costa Rican plants are figured on PLATE 30, FIG. 3.

Christ cites also *Pringle 3800* from Mexico, and a leaf from this number, collected on "faces of damp rocks, Tamasopo Canyon, State of San Luis Potosi, 17 July, 1891," is figured on PLATE 30, FIG. 4, as showing a still more marked resemblance to the Plumier plate. Christ's description of his plant is reprinted below. It will be seen that his idea of *Trichomanes pyxidiferum* is of quite a different species, exactly what does not appear, but most likely the plant of Hedwig's.

"8. Trichomanes junceum n. spec., typ. in Herb. Christ.

"E sectione *T. pyxidiferi* L.

"Differt ab illo statura rigida valde elongata contorta, laciniis angustissimis, urceolis minimis recte patentibus sive recurvis. Habitu Cystosirae angustissimae comparandum, colore nigrescente.

"Rhizomate repente duro 3 mm. lato squamulis patentibus nigris dense vestito, stipite basi incrassato iisdem squamulis ves-

---

* Filices Gen. et Sp. *pl.* 3. *f. 2 and c.* 1799.

† Bull. Boiss. II. 4: 944. 1904.

tito, 3 ad 4 cm. longo filiformi sed rigido, laminae rachi 10 cm. longa flexuosa, lamina lanceolata pinnis adscendentibus lineari-lanceolatis ad 4 cm. longis iterum pinnatis laciniis linearibus ⅔ mm. latis apice furcatis acutis nervo inconspicuo, urceolis ad basin laciniarum, brevissime pedunculatis patulis sive recurvis 1½ mm. longis anguste conicis vix 1 mm. latis, limbo statu maturo horizontaliter patente receptaculo exserto.

"Plante singulièrement étroite dans toutes ses parties, d'un tissu dur, bien différent du tissu diaphane de *T. pyxidiferum.*

"Hab. Costa-Rica inter muscos epiphyticum. I. Wercklé.

"Obs. Cette forme semble être assez répandue dans l'Amérique centrale. Je l'ai très bien caractérisée du Mexique. I. Pringle 3800 avec la désignation erronée: *T. radicans* Sw. Je l'ai du S. du Brésil. I. Schwacke."

As in many species of *Trichomanes*, the leaf-segments in this plant vary in width, sometimes becoming very contracted, giving the plant a still stiffer look. A curious line parallel with the margins, resembling a false vein broken at intervals, is to be seen in the dried leaves by transmitted light,* but disappears on soaking them in water.† It seems to be formed by some contraction of the leaf-tissue. A note evidently referring to this, on the labels of some of H. H. Smith's plants, reads "the streaks parallel with the veins are a constant character," so it may be they appear also in living plants.

Additional specimens of *Trichomanes pyxidiferum* are in the Underwood Herbarium, as follows:—

CUBA: "Cuba Orientale," *Wright 1807, 906* in part, *907* in part.

JAMAICA: "Old England," below Cinchona, 1070 m. alt., *Underwood 1666.*

MEXICO: moist virgin forest, 1524 m. alt., *W. A. Murrill & Edna L. Murrill 35;* without locality, *Fred Müller 400, Sartorius.*

PERU: near Tarapoto, *R. Spruce 4761;* without locality, *Matthews.*

COLOMBIA: rather rare on trees, damp forest, Sierra del Libano, 1524–1828 m. alt., *H. H. Smith 2255;* on trees and rocks, damp

* See PLATE 30, FIG. 5. A magnifying glass showed this also in the original photograph of FIG. 3.

† See PLATE 30, FIG. 6.

forest, Sierra de Onaca, 1070–1930 m. alt., *H. H. Smith 2443*, in part.

BOLIVIA: San Juan, 1161 m. alt., *R. S. Williams 1207*.

AFRICA: Perie-Wald, Capland, 600 m. alt., *O. Kuntze*.

The question now comes up, what is Hedwig's plant? The earliest name for this that I have been able to fix upon so far with any degree of certainty is *Trichomanes hymenophylloides*, the name given by Van den Bosch in 1863 to his *T. leptophyllum*,* which is a homonym of *T. leptophyllum* A. Cunningham. Van den Bosch's publication of his *T. leptophyllum* reads as follows: "*T. leptophyllum. T. pyxidiferum.* Hook. & Grev. tab. 206; Hook. sp. fil. 1, p. 121 (fide specim.)

"Hab. St. Vincent! Martinique! Guadeloupe! Jamaica! St. Domingo! Cuba!"†

Hooker and Greville's plate 206 and the long and careful accompanying description are based on specimens from St. Vincent, collected by the Rev. L. Guilding. These specimens I have not seen, but the plate and description agree well with a large series of specimens from St. Vincent and other parts of tropical America. These specimens in turn connect this plate with that of Hedwig's, which represents a less mature and more contracted leaf-state of the plant than Hooker and Greville's.

Both plates are reproduced in part on PLATE 31 of this paper, together with photographs of leaves of specimens from Santo Domingo and Jamaica.

It is scarcely necessary to reprint here Hooker & Greville's description. The essential points of it, the characteristics by which the plant differs from the plant I refer to true *T. pyxidiferum*, will be seen on PLATE 31. These are: the more slender almost delicate character of the leaf; the straighter more slender rachis; and, most conspicuously, the shape of the indusium. This, instead of being short and broad, has a long slender tube and a suddenly flaring mouth. The amount of leaf-tissue on either side of this indusium varies, even in the same leaf, as will be seen from FIG. 4. It is considerably greater in Hooker & Greville's figure than in Hedwig's, as might be expected from a figure representing, as has already been stated, a much more mature and luxuriant

* Ned. Kr. Arch. 5^3: 209. 1863.

† Ned. Kr. Arch. 4: 363. 1859.

form of the plant. Hooker and Greville, commenting upon the indusium in relation to Plumier's plant, with which they supposed theirs to correspond, write: "A remarkable character is described by Plumier in the fructification of this plant; for the fronds, he says, are 'garnies la pluspart, dans le fond de leur découpure, d'une petite boëte, ou calice, rempli de plusieurs vesicules, et scelé par un couvercle garni d'un petit poil dans le milieu.' Now that the involucres should be closed by a convex lid, through which the columella is continued, we consider to be a circumstance impossible in the genus: but we can very well believe that, to an eye unassisted by the microscope, the large expanded and entire (not two-lipped) mouth of the involucre may have the appearance of a lid. And this dilatation of the mouth of the involucre is more remarkable than in any other species of the genus we are acquainted with. We shall be happy if other botanists concur with us in this opinion, and thus determine with tolerable satisfaction the identity of a species, which no one seems to have understood since the time of Plumier." In this connection it may be stated that in dried specimens, at least, of the plant I refer to *T. pyxidiferum*, the indusium, while not strictly two-lipped, is at first bent inward at the apex in a falsely two-lipped fashion, the two edges pressed close together except where the "columella" pushes through, so that it resembles a saccate involucre closed by a sort of convex top, although, of course, this cannot be called a "lid" in any strict sense of the word. No "streaks" or "lines," similar to those I have described in leaves of *T. pyxidiferum*, occur in *T. hymenophylloides*.

Specimens of *T. hymenophylloides* are in the Underwood Herbarium, as follows:—

PORTO RICO: Maricao, *F. L. Stevens 1987;* El Gigante, *F. L. Stevens 1512;* on tree fern, Monte Cerrote, near Adjuntas, 900–1050 m. alt., *Britton & Brown 5426;* on tree fern, between Adjuntas and Jayuya, Arroyo de los Corchos, 800–900 m. alt., *Britton, Cowell & Brown 5267a;* creeping on tree trunks in forest, Rio Prieto and adjacent hills, Sierra de Naguabo, 910 m. alt., *J. A. Shafer 3622;* on dripping wet rocks, Rio Prieto and adjacent hills, 690–1,035 m. alt., *J. A. Shafer 3597;* on rocks in mountain forest, Alto de la Bandera, near Adjuntas, *Britton & Shafer 2070.*

HISPANIOLA: Province of Barahona, Santo Domingo, *Fuertes 1511.*

CUBA: slopes and summit of El Yunque, near Baracoa, 304–608 m. alt., *Pollard & Palmer 158a* in part.

JAMAICA: Morce's Gap, 1493 m. alt., *W. Harris Fl. Jam. 7114;* trail from Vinegar Hill to Mabess River, *Underwood 1253;* Mabess River, below Vinegar Hill, 912 m. alt., *Underwood 1260* in part, *1263;* near Cuna-Cuna Pass, 820 m. alt., *Underwood 2726;* Maybess River, *George L. Fisher 43;* Morce's Gap, *George L. Fisher 110;* vicinity of Morce's Gap, 1,500 m. alt., *W. R. Maxon 2764;* without locality, *Jenman, Wilson.*

GUADELOUPE: without locality, *Madiana;* various localities, *Duss 4436* in part, *4297, 4298.*

MARTINIQUE: Bois de la Calebasse, 360–810 m. alt., *Duss 4059;* Bois du Lorrain, 350–800 m. alt., *Duss 1627.*

DOMINICA: Mt. Diablotin, *F. E. Lloyd 864;* Laudat, *F. E. Lloyd 347, 147;* Hempstead, *F. E. Lloyd 649.*

ST. KITTS: on trees in forest, Belmont, *Britton & Cowell 401;* on trees in forest, Wingfield Estate, *Britton & Cowell 452.*

MONTSERRAT: Pond Mountain, near Roches, 610 m. alt., *Shafer 780;* Chaner's Mountain, 610 m. alt., *Shafer 776.*

GRENADA: without locality, *Jenman;* without locality, *Sherring;* Grand Etang, St. Georges, *W. E. Broadway.*

ST. VINCENT: forest, upper Richmond and Wallibon Valleys, on trees, 456–547 m. alt., *H. H. & G. W. Smith 1724;* without locality, *H. H. & G. W. Smith 61.*

TRINIDAD: without locality, *Jenman;* without locality, *Fendler 143, 145.*

MEXICO: moist virgin forest, 1524 m. alt., *W. A. & E. L. Murrill 38.*

GUATEMALA: Pensamalá, Depart. Alta Verapaz, 1161 m. alt., *H. v. Tuerckheim 949.*

COLOMBIA: damp forest, especially glens, near streams, common on trees, logs and rocks, Las Partidas, 1070 m. alt., *H. H. Smith 2256;* on rocks by stream, damp forest, Sierra del Libano, 1828 m. alt., *H. H. Smith 2442;* damp forest, common on trees, Sierra de Onaca, 760–1980 m. alt., *H. H. Smith 2443* in part.

ECUADOR: Andes, *R. Spruce 5355.*

NEW YORK BOTANICAL GARDEN

Description of plates 30 and 31

PLATE 30

TRICHOMANES PYXIDIFERUM L.

FIG. 1. Reproduction of part of *pl. 50*, Plumier's Traité des fougères de l'Amérique. Paris. 1705.

FIG. 2. Leaf from Santo Domingo, *H. v. Tuerckheim 3069*, natural size.

FIG. 3. Leaf from Costa Rica, *Wercklé*, natural size, authentic specimen of *T. junceum* Christ from Christ's herbarium.

FIG. 4. Leaf from Mexico, *Pringle 3800*, natural size, referred by Christ to *T. junceum*.

FIG. 5. Part of a dried sterile leaf from specimen shown in FIG. 2, enlarged.

FIG. 6. Part of a fertile leaf from specimen shown in FIG. 2, after soaking in water, enlarged.

PLATE 31

TRICHOMANES HYMENOPHYLLOIDES Van den Bosch

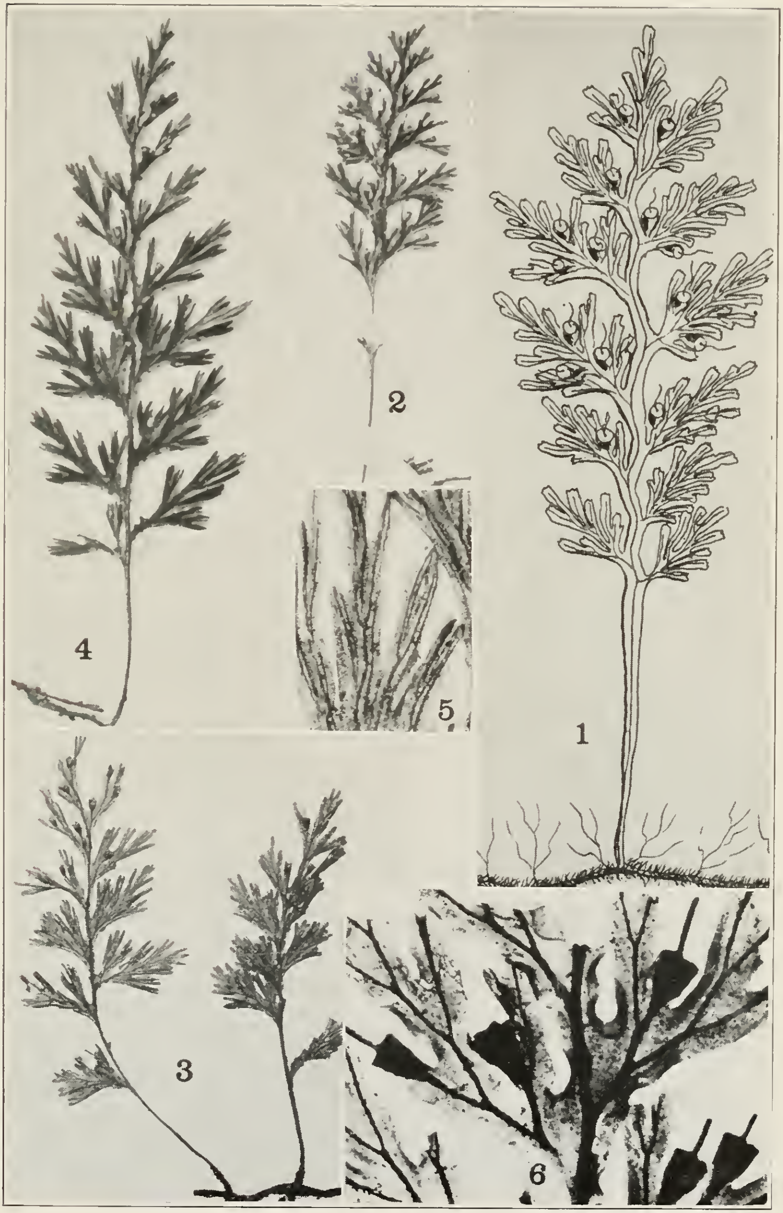
FIGS. 1, 3, 4. Reproduction of part of *pl. 206*, Hooker & Greville's Icones filicum. London. 1831. FIGS. 1, 3. Fertile leaves. FIG. 4. Portion of a fertile leaf, enlarged.

FIGS. 2 and *c*. Reproduction of part of *pl. 3*, Hedwig's Filicum genera et species. Leipzig. 1799.

FIG. 5. Leaf from Santo Domingo, *Fuertes 1511*, natural size.

FIG. 6. Leaf from Jamaica, *Underwood 1260*, natural size.

FIG. 7. Part of a fertile leaf from specimen shown in FIG. 5, enlarged.



TRICHOMANES PYXIDIFERUM L.

TRICHOMANES HYMENOPHYLLOIDES VAN DEN BOSCH

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NOTES ON PLANTS OF THE SOUTHERN UNITED STATES—I

FRANCIS W. PENNELL

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Notes on plants of the southern United States—I

FRANCIS W. PENNELL

During two seasons' field-study of the southern species of the group of scrophulariaceous plants termed by the writer the Agalinanae,* including the genera *Agalinis*, *Aureolaria*, *Afzelia* and *Macranthera*, various other plants belonging to many families were incidentally collected. Most of these have proved to be species well known in their respective areas. Others, and some of these, are believed to be of especial interest, and it is the purpose of this series of papers to consider such.

A considerable number of records extend materially the known ranges of certain species. Several species are here first described. For a number of critical groups revisions of southern species, more or less partial, are attempted. Of such groups *Commelina*, "*Nemexia*," *Chamaecrista* and *Lacinaria* are genera to which special attention was given in the field.

The two seasons spent by the writer in the south were those of 1912 and 1913. In 1912, from August 1 to October 18, he was in the southeast, August 2–6 about Atlanta (at Stone Mountain) and Rome, Georgia, after August 8 at various points in the Coastal Plain from the Mississippi River in Louisiana to Wilmington, North Carolina. From Covington, Louisiana, to north of the Savannah River in South Carolina he was in open grassy pine-land, where *Pinus palustris*, if not predominant, is at least an important tree. One week, August 20–26, was spent in West Feliciana Parish, Louisiana, in the region of loess hills just east of the Mississippi River. Here was enjoyed the hospitality of Mr. Edward Butler, and with him all specimens were collected. Near the Georgia coast, and across the portion of South Carolina traversed by the Atlantic Coast Line Railroad the writer was in a region of deeper sand and more scrub, consequently in a region having a flora materially different from that of the open pine-land.

About Wilmington, North Carolina, he was in yet another district of unusual interest, in aspect recalling the open grassy pine-lands further south.

In 1913, from August 22 to October 20, the writer was again in the field, traversing districts inland from, or west of, those visited the year before. In the Mississippi Valley collections were made in Indiana, Illinois, Missouri, especially in the eastern (Cambrian) Ozark region, Arkansas and Oklahoma. Most of September was spent in Texas, through the Black Belt, in the Edwards Plateau northwest of New Braunfels and at Boerne, in the coastal plain eastward from Cuero and Victoria to Rosenberg, and in the pine-land of the southeast. Late September and early October he was in the pine-land of western Louisiana, in Arkansas, in the mountains of northeastern Alabama and eastern Tennessee, and about Stone Mountain, Georgia. Detailed itineraries of the routes of both seasons will be published in the writer's "*Agalinis* and Allies in North America."*

All specimens collected by the writer, unless otherwise specified, are in the herbarium of the University of Pennsylvania. Some of these are represented by duplicates in the herbarium of the New York Botanical Garden, and in other herbaria. In the following lists numbers cited in parentheses are those of the writer's collecting. For groups critically studied specimens are cited from various herbaria indicated by letters as follows:

Academy of Natural Sciences, Philadelphia	(A.)
Biltmore Herbarium, Biltmore, North Carolina	(B.)
Missouri Botanical Garden, St. Louis	(M.)
University of Pennsylvania, Philadelphia	(P.)
United States National Museum, Washington	(U.)
New York Botanical Garden, New York City	(Y.)

To the custodians of all the above herbaria the writer is indebted. In an especial degree he must acknowledge the kindness of Dr. John M. Macfarlane, of the University of Pennsylvania, whose interest made possible the collecting of the specimens recorded as well as much of the opportunity for their study. This study has been conducted at the University of Pennsylvania and at the New York Botanical Garden.

* It is expected that this paper will soon appear in the Contributions of the Botanical Laboratory of the University of Pennsylvania.

MISCELLANEOUS SPECIES

ADIANTUM PEDATUM L.

Collected in deciduous woodland in the loess hills near Catalpa, West Feliciana Parish, Louisiana, August 21, 1912, *4285* (P.); station previously known to Dr. R. S. Cocks of Tulane University.

ASPLENIUM PYCNOCARPON Spreng.

A. angustifolium Michx.

In a damp ravine in deciduous woodland, Catalpa, Louisiana, August 22, 1912, *4312* (P., Y.); August 23, *4334* (P., Y.). Previously reported in the American Fern Journal **3**: 16. 22 Mr 1913.

SAGITTARIA ANGUSTIFOLIA Lindl.

Edge of small pool in open pine-land, east of Covington, St. Tammany Parish, Louisiana, August 16, 1912, *4243* (P.).

PASPALUM CURTISIANUM Steud.

Open grassy pine-land, north of Abita Springs, St. Tammany Parish, Louisiana, August 14, 1912, *4159* (P.), identified by Mrs. Agnes Chase.

STENOPHYLLUS CILIATIFOLIUS (Ell.) C. Mohr.

Open moist woodland, north of Abita Springs, Louisiana, August 18, 1912, *4264* (P., Y.).

CAREX VERRUCOSA Muhl.

Edge of pool, in pine-land, Abita Springs, Louisiana, August 12, 1912, *4130* (P., Y.).

ARISAEMA QUINATUM (Nutt.) Schott.

Deciduous woodland in loess hills, Catalpa, Louisiana, August 21, 1912, *4286* (P.).

ERIOCAULON DECANGULARE L.

In addition to the typical form, characterized by leaves linear, 3–5 mm. wide, and involucral bracts glabrous, collected at Abita Springs, Louisiana, *4144* (P., Y.), and at Theodore, Mobile County, Alabama, *4472* (P., Y.), there was collected at Theodore, Alabama, a plant differing as follows: leaves broader, 10–15 mm. wide, heads larger, lower involucral bracts broader, outer pubescent. This may possibly be a new species.

ANEILEMA NUDIFLORUM (L.) Kunth, Enum. Pl. 4: 66. 1843

Based upon *Commelina nudiflora* L., citing the second edition of the Species Plantarum, where the species is continued unchanged from the first edition. *Commelina nudiflora* L. (Sp. Pl. 41. 1753), "Habitat in India," is not to be typified by Hermann's plant described by Linnaeus in the Flora Zeylanica 13. 1748, and identified by C. B. Clarke as the species commonly known by this name. In the Species Plantarum Linnaeus's earlier description of this has been modified by the addition of the phrase "involucro nullo" and the adoption of the specific name "*nudiflora*," while from photographs kindly sent me through the courtesy of Mr. B. Daydon Jackson it appears that all specimens of this name in the Linnean herbarium in 1753, and incidentally all subsequently added, belong to *Aneilema*, apparently to this species. The combination *Aneilema nudiflorum* appears not to have been formed by Robert Brown (see Prod. 271. 1810), as it is usually quoted. Collected along streets of Thomasville, Thomas County, Georgia, September 29, 1912, *4737* (P.).

THE GENUS COMMELINA (PLUMIER) L. IN THE UNITED STATES

The following revision of this genus in the United States is provisional, based upon studies in the field and examination of all material in the herbaria of the New York Botanical Garden, the University of Pennsylvania and the Academy of Natural Sciences. It is planned to gather at the Garden a living collection, as complete as possible, of all species inhabiting North America, and for the accomplishment of this the cooperation of all interested is solicited. Mature capsules and seeds, as well as specimens, sent to the writer will be appreciated. Perhaps with living plants for study several proposed species here reduced to synonymy will prove valid. Or, more probably, several here tentatively maintained will be found of varietal rank. At some future date it is hoped to attempt a fuller revision.

Key to the species

Spathes with margins not connate at base.

Two posterior petals blue, anterior much smaller, lanceolate, white. Capsule two-celled, four-seeded (no rudiment of third cell). Annual. Stems decumbent at base, rooting at lower nodes. Leaves lanceolate, 8–12 cm. long. Anthers six. Seeds 3.5–4 mm. long, gray, rugose. 1. *C. communis.*

All three petals blue, anterior slightly smaller, ovate. Capsule three-celled, five-seeded (posterior cell one-seeded, indehiscent). Perennials.

Roots fibrous. Stems creeping, at least at base, rooting at the nodes. Spathes short-peduncled, acute to acuminate, 10–35 mm. long, glabrous or nearly so. Posterior petals long-stalked, 6–8 mm. long. Anthers five (posterior lacking).

Stems soon erect. Leaves lanceolate, 8–10 cm. long. Spathes becoming long-acuminate, 25–35 mm. long. Seeds 2.8–3 mm. long, smooth. 2. *C. caroliniana.*

Stems extensively creeping. Leaves broadly lanceolate, 3–8 cm. long. Spathes acute, 10–25 mm. long. Seeds 2–2.5 mm. long, reticulate. 3. *C. longicaulis.*

Roots tuberous, clustered. Stems erect, not rooting at the nodes. Spathe long-peduncled, caudate, 40–75 mm. long, pubescent. Posterior petals short-stalked, 10–12 mm. long. Anthers six. 4. *C. dianthifolia.*

Spathes with margins connate at base. Perennials. Seeds smooth, farinose.

All three petals blue, equal or nearly so, ovate. Plant strictly erect, relatively stout and broad-leaved. Sheaths ciliate with ferruginous hairs, without evident auricles. Spathes crowded near summit of stem, short-stalked. Two anterior cells of capsule each two-seeded, posterior relatively large but one-seeded and indehiscent. 5. *C. virginica.*

Two posterior petals blue, anterior much smaller, white. Plants often lax or slightly decumbent from base, more slender and narrower-leaved. Sheaths ciliate on rounded auricles with white hairs. Spathes more scattered, both near summit of and in axils along stem, longer-stalked. Cells of capsule all one-seeded, posterior normal, dehiscent, becoming reduced, tardily dehiscent, to even obsolete.

Leaf-blades linear-lanceolate to lanceolate, 8–14 cm. long. Posterior petals 10–25 mm. long. Seeds somewhat flattened. Roots evidently fleshy. Stems green, erect or somewhat diffuse from the base, but not decumbent and rooting at the nodes.

Leaves lanceolate. Posterior petals usually larger, 12–25 mm. long. Seeds mostly more or less oblong. 6. *C. erecta.*

Leaves linear-lanceolate. Posterior petals usually smaller, 10–15(–20) mm. long. Seeds mostly circular.

Spathes 1.5–3 cm. long, with mostly long white hairs near the base. Posterior petals 12–18(–20) mm. long. 7. *C. crispa.*

Spathes 1–2 cm. long, rarely with long white hairs near the base. Posterior petals mostly 10–15(–18) mm. long. 8. *C. angustifolia.*

Leaf-blades lanceolate-ovate to ovate, 5–9 cm. long. Posterior petals 8–11 mm. long. Seeds scarcely flattened. Roots scarcely fleshy. Stems mostly reddish, more or less decumbent at the base and rooting at the lower nodes. 9. *C. elegans.*

1. COMMELINA COMMUNIS L.

Commelina communis L. Sp. Pl. 40. 1753. "Habitat in America." Apparently an erroneous statement of nativity, as the Linnean diagnosis, as well as the fuller description and figure of Dillenius (Hortus Elthamensis 93. *pl. 78.* 1732), appear to apply to this originally East Asian species. All specimens in the Linnean herbarium, from photographs sent me, are evidently the species here described.

Flowers and fruits August to October.

Moist loam or sandy soil, eastern Massachusetts to Virginia and western North Carolina; also in Jackson County, Missouri, and probably in the intervening area. Abundant as a weed eastward. Evidently introduced from eastern Asia.

RHODE ISLAND. Newport:* roadsides near Old Harbor, Block Island, >† September 14, 1913, *M. L. Fernald, B. Long & G. S. Torrey 9137* (A.).

NEW YORK. Bronx: garden, New York Botanical Garden, ≷ September 24, 1915, *F. W. Pennell 6649* (Y.), *6714* (Y.). Richmond: yard, Port Richmond, > September 23, 1915, *F. W. Pennell 6648* (Y.).

NEW JERSEY. Atlantic: Pleasantville, ≷ September 1, 1910, *N. Taylor 2778* (Y.). Burlington: Kinkora, > August 18, 1910, *N. Taylor 2550* (Y.). Camden: Fish House, > August 17, 1910, *B. Long 4512* (A.). Gloucester: Mickleton, > September 10, 1892, *B. Heritage* (A.). Mercer: Trenton, > July, 1889, *F. E. Lloyd* (Y.). Monmouth: Bradley Beach, ≷ September 22, 1915, *F. W. Pennell 6577* (Y.). Ocean: Point Pleasant, ≷ September 22, 1915, *F. W. Pennell 6603* (Y.).

PENNSYLVANIA. Bucks: Bristol, ≷ September 18, 1898, *C. D. Fretz* (A.). Chester: West Chester, > August 24, ——, *W. Darlington* (Y.). Delaware: cultivated soil, Wawa, ≷ August 20, 1906, *F. W. Pennell 1925* (Y.). Lancaster: in sandy places, Tucquan, ≷ August 31, 1899, *A. MacElwee 1217* (A.). Lehigh: roadside, Alburtus, ≷ August 27, 1911, *H. W. Pretz 3893* (A.). Montgomery: Pennsburg, > May 30, 1907, *J. R. Mumbauer 400* (A.). Northampton: waste places, Easton, > August 27,

* In the following lists one specimen from each county is cited, counties being arranged alphabetically.

† Before dates cited the following signs are used: >, in flower; <, in fruit.

1892, *T. C. Porter* (A.). Perry: Marysville, > August 7, 1888, *J. K. Small* (Y.). Philadelphia: Wissahickon Ravine, > September 2, 1908, *S. S. Van Pelt* (A.).

DELAWARE. Newcastle: ditch banks, Wilmington, < September 10, 1873, *A. Commons* (A.).

MARYLAND. Harford: along shore south of Havre de Grace, > August 1, 1902, *G. H. Shull 143* (Y.). Montgomery: along canal bank, Cabin John, > August 21, 1904, *H. D. House 320* (Y.).

DISTRICT OF COLUMBIA. Moist soil, Chain Bridge, > August 10, 1910, *F. W. Pennell 2544* (Y.).

VIRGINIA. Alexandria: along Potomac River opposite Washington, > July 22, 1910, *F. W. Pennell 2451* (Y.).

NORTH CAROLINA. Cherokee: in damp shady woods, Andrews, > September 5, 1900, *A. M. Huger* (Y.).

MISSOURI. Jackson: along railroad, Independence, > September 24, 1912, *B. F. Bush 6861* (Y.).

2. COMMELINA CAROLINIANA Walt.

Commelina caroliniana Walt. Fl. Carol. 68. 1788. Presumably from Berkeley County, South Carolina. Description apparently of species here considered. There is no type specimen in the Walter herbarium at the British Museum.

Flowers and fruits September to October.

At a few stations through the southern states, South Carolina and Florida to Missouri. Possibly introduced, but more probably native as its collection by Baldwin and other early collectors would suggest.

SOUTH CAROLINA. Charleston: Charleston, ⋛ November, 1855, *L. R. Gibbes* (Y.).

FLORIDA. Duval: moist cultivated grounds near Jacksonville, ⋛ October 1, 1894, *A. H. Curtiss 5177* (Y.); also *4144*, *2992*. Volusia: New Smyrna, *Baldwin* (A.).

ALABAMA. "Ala.," > September, 1839, *S. B. Buckley* (Y.).

MISSISSIPPI. Point St. Martin, < October 13, 1898, *S. M. Tracy 5122* (Y.).

MISSOURI. Jackson: introduced, Sheffield, < September 14, 1905, *B. F. Bush 3332* (Y.). "Missouri," *T. Nuttall* (A.).

3. COMMELINA LONGICAULIS Jacq.

Commelina longicaulis Jacq. Coll. 3: 234. 1789. "Ad rivulos & in humidis crescit ad Caracas." Description apparently of species here considered, although leaves unusually narrow. Figured in Jacq., Icon. Pl. Rar. *pl. 294.*

Nephralles parviflora Raf. Fl. Tellur. 3: 70. 1837. "Kentucky and Tennessee." Type of the genus *Nephralles* Raf. *l. c.* 70. A specimen of Rafinesque's collecting, labeled "Kentucky," and bearing this name, has been seen in the herbarium of Columbia University at the New York Botanical Garden.

Commelina diffusa Burm. f. (Fl. Ind. 18. *pl. 7. f. 2.* 1768) is treated as unidentifiable. While conceivably this, if the plant in both hemispheres be identical, the long pedicels, conventional flowers, and description (apparently contradicted by the figure) "involucro nullo" are not in accord with our plant.

Flowers and fruits, southward throughout the season, northward, late summer and autumn.

Moist loam or sandy soil, along streams, frequently a weed in cultivated ground, from eastern Kentucky and eastern Kansas southward to Bolivia. As usually understood, a widespread species of tropical and subtropical regions. From the few specimens seen the writer is not convinced that the plant of the Old World tropics is conspecific with that of the New. Possibly locally or extensively introduced in the United States.

PENNSYLVANIA. Philadelphia: Old Navy Yard, on ballast, Philadelphia, *I. Burk* (P.).

GEORGIA. Catoosa: along Chickamauga Creek, near Ringgold, > August 6–12, 1895, *J. K. Small* (Y.). Thomas: along streets, Thomasville, > September 29, 1912, *F. W. Pennell 4736* (P.). Wilkes: *A. W. Chapman* (Y.). "Georg.," ricefields, *Leconte*, sub. nom. "*Commelina pestifera* Leconte" (A.).

FLORIDA. Franklin: low grounds, Apalachicola, > July–September, *A. W. Chapman* [Biltmore herbarium *2038a*] (Y.). Gadsden: moist ground, River Junction, > September 11, 1897, *A. H. Curtiss 5991* (Y.). Lee: river bank, Myers, > July–August, 1900, *A. S. Hitchcock 364* (Y.). Leon: Tallahassee, > August 7–9, 1895, *G. V. Nash 2345* (Y.). Manatee: Osprey, > March 3, 1904, *B. H. Smith* (A.). Pinellas: low wet soil, St. Petersburg, ≷ April 3, 1908, *Mrs. C. C. Deam 4062* (Y.). Wakulla: low pine-land, St. Marks, < September 25, 1912, *F. W. Pennell 4700* (P.).

ALABAMA. Covington: cultivated soil, Florala, ≷ September 14, 1912, *F. W. Pennell 4638* (P., Y.). Lee: Auburn, > September 9, 1897, *F. S. Earle & C. F. Baker* (Y.).

MISSISSIPPI. Harrison: Biloxi, September 29, 1899, ≷ *S. M. Tracy 6389* (Y.).

TENNESSEE. Knox: river-banks, Knoxville, > July, 1898, *A. Ruth 134* (Y.).

KENTUCKY. Bell: along Cumberland River, > September, 1893, *T. H. Kearney 590* (Y.). Fayette: damp, near Lexington, > August, 1833, *R. Peter* (A., Y.). Harlan: > July 24, 1888, *F. E. Lloyd* (Y.). Lyon: Kuttawa, > September 27–October 9, 1903, *W. W. Eggleston 5251* (Y.).

MISSOURI. Barry: common, Eagle Rock, > September 18, 1896, *B. F. Bush 356* (Y.). Dunklin: common, Campbell, > August 16, 1895, *B. F. Bush 540* (Y.). St. Louis: wet ground along the Meramec River, Valley Park, > August 27, 1913, *F. W. Pennell 5314* (P.).

KANSAS. Cherokee: rich woods, 1896, *A. S. Hitchcock 841* (Y.). Miami: ≷ July 30, 1882, *J. H. Oyster* (Y.).

ARKANSAS. Pulaski: Little Rock, ≷ August 15, 1885, *H. E. Hasse* (Y.).

OKLAHOMA. Rogers: common, Verdigris, > August 2, ——, *B. F. Bush 583* (Y.).

LOUISIANA. Plaquemines: in wet grounds, common, > June, 1882, *A. B. Langlois 348* (Y.). St. Tammany: low ground, Mandeville, > August 16, 1912, *F. W. Pennell 4241* (P.). Tangipahoa: Tangipahoa, *J. L. Riddell* (A.). West Feliciana: moist cultivated soil, Catalpa, > August 22, 1912, *F. W. Pennell 4294* (P.); also *Pennell 4322* (P.).

TEXAS. Bowie: Texarkana, > May 9, 1891, *E. N. Plank* (Y.).

Also seen from Bermuda, Bahamas, Cuba, Santo Domingo, Jamaica, Porto Rico, Lesser Antilles, Mexico, Guatemala, Nicaragua, Panama, Colombia, British Guiana, Brazil and Bolivia.

4. COMMELINA DIANTHIFOLIA Red.

Commelina dianthifolia Red. Lil. 7: 390. *pl. 390.* 1813. Illustration and description undoubtedly of species here considered, although native country not stated. Name of species probably proposed by Delile.

Flowers late—July to September.

Shady or open places, New Mexico and Arizona to Oaxaca. Northward at elevations of 6,000–9,500 feet.

NEW MEXICO. Bernalillo: sunny rocks, Sandia Mountains, > July 21, ——, *C. C. Ellis 174* (Y.). Dona Ana: Organ Mountains, 6,500 feet alt., > September 17, 1893, *E. O. Wooton* (Y.). Grant: Fort Bayard Watershed, > September 10, 1905, *J. C. Blumer 59* (Y.). Lincoln: White Mountains, 7,000 feet alt., > August 11, 1897, *E. O. Wooton 311* (Y.). San Miguel: Pecos, 7,000 feet alt., > August 21, 1908, *P. C. Standley 5169* (Y.). Sierra: moist shady places, Lookout Mines, 8,500 feet, > August 12, 1904, *O. B. Metcalfe 1212* (Y.). Socorro: rocky places, Mogollon Mountains, > August, 1881, *H. H. Rusby 415* (P., Y.).

ARIZONA. Cochise: rolling andesitic pine-land, recently lumbered, Barfoot Park, Chiricahua Mountains, 8,000–8,250 feet alt., > September 5, 1906, *J. C. Blumer 1354* (Y.). Yavapai: Prescott, > August 15, 1896, *O. Kuntze* (Y.).

Also seen from Chihuahua, Durango, Federal District (of Mexico), and Oaxaca.

5. COMMELINA VIRGINICA L.

Commelina virginica L. Sp. Pl. ed. 2, 61. 1762. "Habitat in Virginia." Description unmistakably of species here considered, although this name has been usually applied to a state of *C. erecta* L.

Commelina longifolia Michx. Fl. Bor. Am. 1: 23. 1803. "Hab. in umbrosis sylvarum Virginiae et Carolinae." Not *C. longifolia* Lam. Tabl. Encyc. 1: 129. 1791. Description unmistakably of species here considered.

Commelina hirtella Vahl, Enum. Pl. 2: 166. 1806. New name for *C. longifolia* Michx.

Ananthopus clandestinus Raf. Fl. Ludov. 21. 1817. "Grows in shady and swampy soils." Louisiana, *C. C. Robin.* Type of genus *Ananthopus* Raf. *l. c.* 20. Description of large leaves would indicate species here considered.

Ananthopus undulatus Raf. Fl. Tellur. 3: 70. 1837. "Alabama, in my herbal." Description of ample, ovate leaves, 5–8 inches long, would indicate species here considered.

Allotria scabra Raf. *l. c.* 70. 1837. "Virginia and Carolina." Type of genus *Allotria* Raf. *l. c.* 70. Description of three subequal petals and of size of plant would indicate species here considered.

Commelina ignorata Kunth, Enum. Pl. 4: 60. 1843. New name for *Ananthopus clandestinus* Raf.

Flowers and fruits mid-July to October.

Moist to wet loam soil, especially alluvial, mostly along riverbanks, southeastern Pennsylvania to northern Florida, inland to mountains of eastern Tennessee, southern Illinois, southern Missouri, and eastern Texas, locally frequent to common.

NEW JERSEY. Camden: Kaighn's Point, > August, ——, *C. E. Smith* (A., Y.).

PENNSYLVANIA. Lancaster: island, Peach Bottom, > September 7, 1863, *J. J. Carter* (A.). Philadelphia: Gray's Ferry above Bartram's Garden, < September, 1862, *A. H. Smith* (A.), probably introduced.

MARYLAND. Baltimore: Baltimore, 1866, *P. V. LeRoy* (Y.). Cecil: moist soil, Conowingo, July 1, 1914, *F. W. Pennell 1565* (A.). Montgomery: along canal below Glen Echo, August 10, 1910, *F. W. Pennell 2549* (Y.).

VIRGINIA. Alexandria: moist soil, Alexander Island, ≷ September 16, 1910, *F. W. Pennell 2670* (Y.); also *Pennell 2450* (Y.). Fairfax: moist soil along Potomac River above Great Falls, < August 7, 1910, *F. W. Pennell 2523* (Y.).

NORTH CAROLINA. Brunswick: west of river, Wilmington, > October 3, 1908, *E. B. Bartram* (A.). Cherokee: meadows, one or two miles east of Andrews, ≷ August 4, 1900, *A. M. Huger* (Y.). Forsyth: Salem, *L. D. von Schweinitz* (A.). Rowan: Faith Post Office, August 14, 1891, *J. K. Small & A. A. Heller 411* (P., Y.). Wake: Raleigh, < August, 1898, *C. W. Hyams* (Y.).

GEORGIA. Bibb: muddy swamp of Ocmulgee River about two miles below Macon, < September 5, 1903, *R. M. Harper*

1969 (Y.). Floyd: moist soil along Coosa River, West Rome, < August 4, 1912, *F. W. Pennell 4081* (P.). Sumter: muddy bank of Muckalee Creek, ≷ August 9, 1897, *R. M. Harper* (Y.).

FLORIDA. Duval: miry, partially shaded places near Jacksonville, < August 29, 1896, *A. H. Curtiss 5762* (Y.); also *Curtiss 2993* (A., Y.). Franklin: Apalachicola, *A. W. Chapman* (Y.). Leon: near Tallahassee, *N. K. Berg* (Y.).

ALABAMA. Lee: Auburn, > September 8, 1897, *F. S. Earle & C. F. Baker* (Y.). Morgan: low ground, Decatur, > July 18, 1900, *Biltmore Herbarium 2037e* (Y.).

MISSISSIPPI. Oktibbeha: Agricultural College, > August 11–17, 1896, *C. L. Pollard 1279, 1325* (Y.).

TENNESSEE. Cocke: along French Broad River between Paint Rock and Del Rio, ≷ August 26, 1897, *T. H. Kearney 924* (Y.). Knox: Knoxville, ≷ July, 1898, *A. Ruth 135* (Y.).

ILLINOIS. Union: Clear Creek, ≷ August 13, 1900, *F. S. Earle* (Y.).

MISSOURI. Butler: swamps, < October 16, 1905, *B. F. Bush 3717* (Y.). Dunklin: common, sands, Campbell, > August 15, 1895, *B. F. Bush 529* (Y.); also *Bush 6292* (Y.). Jasper: low woods, Neck City, < September 12, 1908, *E. J. Palmer 1288* (Y.). McDonald: bottoms, Noel, > August 10, 1908, *B. F. Bush 5053* (Y.). New Madrid: > September 15, 1893, *B. F. Bush 133* (Y.).

ARKANSAS. Pulaski: Little Rock, > August, 1885, *H. E. Hasse* (Y.).

LOUISIANA. Plaquemines: in low half-shady places, > November, 1880, *A. B. Langlois* (P.). Terrebonne: low moist ground near swamp near Houma, ≷ October 9, 1913, *E. C. Wurzlow* (Y.). West Feliciana: moist deciduous woodland, Catalpa, > August 21, 1912, *F. W. Pennell 4273* (P.).

TEXAS. Bowie: Texarkana, < October 20, 1894, *Letterman 19* (Y.). Wood: swamps, Mineola, > August 14, 1900, *J. Reverchon 2187* (Y.).

6. COMMELINA ERECTA L.

Commelina erecta L. Sp. Pl. 41. 1753. "Habitat in Virginia."
Description unmistakably of species here considered.

Ananthopus cordatus Raf. Fl. Ludov. 22. 1817. "In open fields." Louisiana, *C. C. Robin.* Description indicates this species, or possibly *C. angustifolia* Michx.

Larnalles dichotoma Raf. Fl. Tellur. 3: 71. 1837. "Apalachian mts." Type of genus *Larnalles* Raf. *l. c.* 70. A specimen of Rafinesque's collecting, labeled "Mts. Apalachis, *Larnalles dichotoma* Raf.," has been seen in the herbarium of Columbia University at the New York Botanical Garden.

Larnalles glauca Raf. *l. c.* 71. 1837. "Kentucky, Illinois." Description indicates this species, or possibly *C. crispa* Wooton.

Commelina Rafinesquei Kunth, Enum. Pl. 4: 60. 1843. New name for *Ananthopus cordatus* Raf.

Commelina saxicola Small, Fl. S. E. U. S. 242, 1328. 1903. "Type, Stone Mt., Ga., *Small*, no. 124, in Herb. C. U." *Small 124*, indicated on sheet as type, was collected on Dunn's Mountain, Rowan County, North Carolina, August 18–27, 1894.

Commelina angustifola Michx. and *C. crispa* Wooton, until more fully compared living, are continued as of specific rank. Both are probably better considered as geographic varieties of *C. erecta* L.

Capsules with posterior cell more or less reduced and tardily dehiscent, a state which has been separated as "*Commelina virginica*," are to be found in the same colonies and even upon the same plants with capsules normally developed, three-celled and evenly dehiscent.

Flowers and fruits July to September.

Sandy to loamy, often rocky soil, New York City, New York, to northern Florida, westward to Kansas and Bexar County, Texas; southward below the fall-line only in local heavier soils; locally frequent to common, especially southward. Southward apparently passes into *C. angustifolia* Michx., westward apparently into *C. crispa* Wooton.

NEW YORK. New York: rocks, Inwood, ≷ August 17, 1880, *A. Brown.*(Y.); Washington Heights, clefts of rock with *Cheilanthes vestita*, > August, 1867, *W. W. Denslow* (Y.).

NEW JERSEY. Burlington: banks of a ditch near Plattsburgh, > July, 1850 (Y.). Camden: dry sandy ground, Griffith Swamp, *I. Burk* (P.).

PENNSYLVANIA. Lancaster: rocky places along the railroad, Safe Harbor, ⋛ September 1, 1899, *A. MacElwee 1238* (A., Y.).

DELAWARE. Sussex: dry sandy soil, Millsboro, > August 15, 1877, *A. Commons* (A.).

MARYLAND. Washington: hillside along railroad, Sandy Hook, ⋛ July 17, 1910, *F. W. Pennell 2412, 2413* (Y.). Wicomico: dry sandy soil, Salisbury, < July 27, 1865, *J. J. Carter* (A.).

DISTRICT OF COLUMBIA. Near Georgetown, *Dr. Robbins 154* (Y.).

VIRGINIA. Botecourt: Indian Rock, > June, 1887, *H. E. Wetherill* (P.). Elizabeth City: Old Point Comfort, ⋛ September 25, 1895, *N. L. Britton* (Y.). Fairfax: island at Great Falls, < September 2, 1905, *C. S. Williamson* (Y.).

WEST VIRGINIA. Fayette: Nuttallburg, > August 11, 1891, *C. F. Millspaugh 1113* (Y.).

NORTH CAROLINA. Buncombe: in rich soil, Biltmore, ⋛ July 19, 1897, *Biltmore Herbarium 2036c* (P., Y.). Forsyth: Salem, *L. D. von Schweinitz* (A.). Polk: light soil, face of White Oak Mountains, near Columbus, > July 5, 1897, *Biltmore Herbarium 2036a* (P., Y.). Rowan: Dunn's Mountain, > August 18–27, 1894, *J. K. Small 124* (Y.), type of *C. saxicola* Small. Swain: sandy soil, 1,700 ft. alt., > July 10, 1891, *H. C. Beardslee & C. A. Kofoid* (Y.).

SOUTH CAROLINA. Oconee: Clemson College, > June 19, 1906, *H. D. House 2403* (Y.). Pickens: sandy places along rivers, > July 9, 1897, *H. D. House 1338* (Y.).

GEORGIA. Cobb: dry rocky woods on Kennesaw Mountain, > July 12, 1900, *R. M. Harper 219* (Y.). DeKalb: light soil on granitic rock, Stone Mountain, August 2, 1912, *F. W. Pennell 4036* (P.). Gwinnett: on the Yellow River near McGuire's Mill, ⋛ July 11, 1893, *J. K. Small* (Y.). Rabun: in canyon at Tallulah Falls, April 20, 1893, *J. K. Small* (Y.).

FLORIDA. Lake: hammock land, sand, Eustis, ⋛ July 1–15, 1894, *G. V. Nash 1157* (A., Y.). Leon: near Tallahassee, *N. K. Berg* (Y.).

ALABAMA. Covington: cultivated soil, Florala, > September 14, 1912, *F. W. Pennell 4637* (P.). Elmore: Double Bridges, > August 9, 1899, *F. S. Earle 141* (Y.). Etowah: sandy hills, Sand Mount, > July 9, 1898, *H. Eggert* (Y.). Lee: Auburn, > August 8–11, 1897, *F. S. Earle & C. F. Baker 736, 1041* (Y.).

MISSISSIPPI. Clarke: Enterprise, > June 10, 1897, *S. M. Tracy 3278* (Y.). Lowndes: Columbus, > May 3, 1896, *S. M. Tracy 3083* (Y.).

TENNESSEE. Cocke: along French Broad River between Paint Rock and Del Rio, > September 10, 1897, *T. H. Kearney 923* (Y.). Davidson: Nashville, > August 11, 1897, *Biltmore Herbarium 311d* (Y.). Rutherford: crevices of limestone rocks, Fosterville, > August 17, 1897, *Biltmore Herbarium 311c* (Y.).

MISSOURI. Barry: woods, Eagle Rock, > August 12, 1905, *B. F. Bush 3222* (Y.). McDonald: gravelly places, Noel, ≷ August 7, 1908, *B. F. Bush 4984* (Y.). Shannon: woods, Monteer, > August 5, 1910, *B. F. Bush 6101* (Y.).

KANSAS. Riley: shady places, > July 20, 1895, *J. B. Norton 524* (Y.).

ARKANSAS. Pulaski: Little Rock, > June, 1885, *H. E. Hasse* (Y.).

LOUISIANA. West Feliciana: cultivated soil, Baines, > August 23, 1912, *F. W. Pennell 4323* (P.).

TEXAS. Bexar: San Antonio, *G. Jermy* (Y.). Comal: New Braunfels, > September 14, 1913, *F. W. Pennell 5454* (P.). Travis: Austin, > September 13, 1913, *F. W. Pennell 5432* (P.).

7. COMMELINA CRISPA Wooton

Commelina crispa Wooton, Bull. Torrey Club **25**: 451. 13 Au 1898. "Collected at the base of the Organ Mountains, Doña Ana Co., [New Mexico], Sept. 1; altitude 4,800 feet, [Wooton] no. 545." Co-type seen in the herbarium of the New York Botanical Garden.

Flowers and fruits June to September.

Dry sandy soil, woodland or open, dunes, sand-hills, etc., northern Indiana to Colorado south to Texas and eastern Arizona, apparently extending into northern Mexico.

INDIANA. Lake: old sand-dunes, Miller, ≷ August 23, 1915, *F. W. Pennell 6422* (Y.). Porter: wooded sand-hill, Dune Park, ≷ August 16, 1897, *A. Chase* (A.).

ILLINOIS. Henderson: sandy barrens near Oquawka, *H. N. Patterson* (Y.).

NEBRASKA. Cherry: Niobrara Reserve, ≷ July, 1903, *L. Krautter* (P.). Knox: Soldier Creek, > July 18, 1893, *F. E. Clements* (Y.). Lincoln: dry sandhills north of North Platte, > August 18, 1915, *F. W. Pennell 6409* (Y.). Thomas: on Dismal River south of Thedford, > June 17, 1893, *P. A. Rydberg 1345* (Y.).

MISSOURI. Jasper: dry soil, Prosperity, > June 17, 1909, *E. J. Palmer 2242* (Y.).

KANSAS. Geary: Fort Riley, > September, 1892, *E. E. Gayle 565* (Y.). Hamilton: Syracuse, > July 11, 1893, *C. H. Thompson 91* (Y.). Kiowa: near Belvidere, ≷ September 14, 1897, *L. F. Ward* (Y.).

OKLAHOMA. Payne: sandy woods, etc., very abundant, > July, 1893, *E. W. Olive 122* (Y.). "Arkansas," *T. Nuttall* (A.).

TEXAS. Coke: Fort Chadbourne, > May 16, 1858, *S. Hayes* (Y.). Concho: Paint Rock, > July 13, ——, *J. M. Bigelow* (Y.). Culberson: dry, rocky ravine, Van Horn's Well, *J. M. Bigelow* (Y.). Duval: San Diego, 1884, *M. B. Croft* (Y.). McLennan: Waco, 1869, *Griffith* (Y.). Mitchell: *G. W. Holstein* (A.).

COLORADO. Fremont: Cañon City, > August 8, 1896, *C. L. Shear 3780* (Y.). Yuma: Wray, > July 15, 1909, *G. E. Osterhout 4030* (Y.).

NEW MEXICO. Chaves: sandy plain, twenty miles south of Roswell, ≷ August, 1900, *F. S. & E. S. Earle* (Y.). Doña Ana: Organ Mountains, ≷ September 1, 1897, *E. O. Wooton 545* (Y.). Eddy: junction of Delaware Creek and the Pecos, 1856, *Pope* (Y.). Grant: Dog Springs, ≷ September 16, 1893, *E. A. Mearns 2349* (Y.). Otero: Jarilla Junction, > September 4, 1900, *F. S. & E. S. Earle 523* (Y.).

ARIZONA. Cochise: Cochise, ≷ October 12, 1900, *D. Griffiths 1902* (Y.).

8. COMMELINA ANGUSTIFOLIA Michx.

Commelina angustifolia Michx. Fl. Bor. Am. **1**: 24. 1803. "Hab. in campestribus Carolinae." Type not seen nor verified, but description evidently of species here considered.

Commelina Swingleana Nash, Bull. Torrey Club **22**: 160. 18 Ap 1895. "Collected in the high pine-land region at Umatilla

[Florida] early in August [1894, *G. V. Nash*]." Type, labeled, "vicinity of Eustis, Lake Co., Florida, G. V. Nash 1525," seen in the herbarium of the New York Botanical Garden.

Commelina Nashii Small, Fl. S. E. U. S. 242, 1328. 1903. "Type, Nash, Pl. Fla., no. 2465, in Herb. C. U." Type, collected at "Tampa, Hillsborough County, Florida, August 24, 1895," seen in the herbarium of Columbia University at the New York Botanical Garden.

Flowers and fruits June to October, southward throughout the season.

Sandy soil, pine-land, and fields, dunes, etc., in the Coastal Plain, North Carolina to southern Florida, Cuba and southern Texas.

North Carolina. Carteret: sand banks near Beaufort, 1906, *I. F. Lewis 85* (Y.). New Hanover: dry sand, sea beach near Wrightsville, ⋛ September 1, 1900, *C. S. Williamson* (Y.).

South Carolina. Beaufort: Bluffton, *J. H. Mellichamp* (Y.). Berkeley: Summerville, > June, 1850, *L. R. Gibbes* (Y.).

Georgia. Chatham: Savannah, *Mrs. Say* (A.). Glynn: sandy pine-land, Brunswick, > October 10, 1912, *F. W. Pennell 4833* (P.). Richmond: dry sandy soil, Augusta, > July 6, 1898, *A. Cuthbert* (Y.).

Florida. Brevard: hammock, Merritt's Island, > September 15, 1895, *A. A. Baldwin 112* (A., P.). Clay: Green Cove, 1881, *M. Treat* (A.). Dade: in pine-lands between Cutler and Longview Camp, > November 9–12, 1903, *J. K. Small & J. J. Carter 992* (A., Y.). Duval: dry fields and woods near Jacksonville, ⋛ June, *A. H. Curtiss 2294* (A., P., Y.). Gadsden: old field near River Junction, > May 3, 1898, *A. H. Curtiss 6339* (Y.). Hillsboro: high pine-land, Tampa, > April 1–15, 1894, *G. V. Nash 387* (Y.). Lake: high pine-land, Eustis, > August, 1894, *G. V. Nash 1644* (A., Y.). Lee: pine forest, Samville, > June 6, 1912, *J. W. Harshberger* (P.). Manatee: Palma Sola, > May 5, 1900, *S. M. Tracy 6756* (Y.). Monroe: shell sand-dunes, Boot Key, > April 7–12, 1909, *N. L. Britton 530* (Y.). Nassau: near St. Mary's, 1817, *Dr. Bacon* (Y.). Pinellas: pine clearing near bay, > April 7, 1908, *Mrs. C. C. Deam 4066* (Y.). St. John: St. Augustine, > April 12, 1897, *J. Crawford* (Y.). St. Lucie: Fort Pierce,

> April 8–9, 1904, *A. B. Burgess 717* (Y.). Santa Rosa: moist sandy soil, Milton, > September 9, 1912, *F. W. Pennell 4577* (P.). Volusia: New Smyrna, *Baldwin* (A.).

Alabama. Escambia: Flomaton, > August 24, 1897, *S. M. Tracy 3551* (Y.). Mobile: sandy pine-land, Spring Hill, ≷ September 5, 1912, *F. W. Pennell 4533* (P.).

Mississippi. Harrison: Biloxi, < July 30, 1897, *S. M. Tracy 3561* (Y.). Jackson: Horn Island, > July 14, 1899, *S. M. Tracy 6388* (Y.).

Louisiana. Plaquemines: Breton Island, ≷ August 18, 1900, *S. M. Tracy & F. E. Lloyd 273* (P.).

Texas. Bexar: San Antonio, > June, ——, *Blake* (Y.). Brazos: gravelly banks, Bryan, > May 28, 1915, *E. J. Palmer 7793* (Y.). Colorado: dry sandy oak-land, Sheridan, > September 21, 1913, *F. W. Pennell 5524* (P.), *5537* (P., Y.). Galveston: sands, Galveston, > August 8, 1902, *J. Reverchon 3415* (Y.). Harris: sandy soil, Houston, > May 29, 1903, *Biltmore Herbarium 6685a* (Y.). Montgomery: ≷ July 18–21, 1909, *R. A. Dixon 490* (Y.). Nueces: near sea-level, Corpus Christi Bay, > April 9–12, 1894, *A. A. Heller 1555* (Y.). Travis: loose loam soil, Austin, > September 13, 1913, *F. W. Pennell 5433* (P.), *5434* (P.). Victoria: black sandy loam, Victoria, > September 19, 1913, *F. W. Pennell 5503* (P., Y.). Walker: in a pine grove, Huntsville, > July 9–12, 1909, *R. A. Dixon 406* (Y.).

Also in Cuba, where known as *C. hamipila* Wright.

9. Commelina elegans HBK.

Commelina elegans HBK. Nov. Gen. et Sp. 1: 259. 1816. "Crescit in regno Novogranatensi, locis temperatis, umbrosis, ad ripas fluvii Juanambu, alt. 760 hexap." Description apparently of species here considered.

Flowers and fruits throughout the season.

Moist soil, apparently throughout tropical America from southern Florida and southern Texas to Argentina.

Florida. "Chitto River, South Florida," ≷ September, 1878, *A. P. Garber 48* (A., Y.).

Texas. Duval: San Diego, 1884, *M. B. Croft 8* (Y.).

Also seen from Bermuda, Bahamas, Cuba, Santo Domingo, Jamaica, Porto Rico, Lesser Antilles, Mexico, Guatemala, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Brazil, Bolivia, Paraguay and Argentina.

New York Botanical Garden

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NOTES ON SPECIES OF HALYMENIA

F. S. COLLINS AND M. A. HOWE

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Notes on species of Halymenia

F. S. Collins and M. A. Howe

In connection with studies of a series of specimens of red algae of the genus *Halymenia* from Bermuda, southern Florida, and North Carolina, we have been forced to recognize as entitled to specific rank four striking and apparently well-defined forms that we are venturing to describe as new. One of these is related to *Halymenia floridana* J. Ag., two find their closest affinity in *H. Floresia* (Clem.) Ag., and the fourth is allied to *H. actinophysa* M. A. Howe. Descriptions follow:

Halymenia bermudensis sp. nov.

Thallo violaceo-rubro, plerumque stipitato; stipite inferne subtereti, superne complanato vel costato-alato, interdum ramoso, plus minusve elongato; fronde membranacea, firma, levi, nec nitente, 60–120 μ crassa, suborbiculari, cordata vel obovata, saepe, interdum repetite, lobata vel prolifera, divisionibus frondi primariae conformibus; margine plana vel plicata, subintegra, crenata, vel interdum irregulariter dentata; medulla frondis subcompacta, inter fila tenuiora filis crassioribus stellatim radiatis frequenter sparsis; strato corticali frondis series 1–3 cellularum minorum monstrante; strato subcorticali series 1–3 cellularum majorum monstrante; tetrasporangiis sparsis; cystocarpiis ignotis.

Species *H. floridanae* J. Ag. proxima, sed differt colore magis saturate violaceo-rubro, minus roseo, fronde magis dissecta, substantia firmiore, cortice crassiore, firmiore, saepe pleiostromatico.

Ad oras Insularum Bermudensium (typum legit F. S. Collins, Apr. 25, 1912, no. 7074).

Thallus usually stipitate; stipe commonly 2–10 mm. long, 0.45–0.75 mm. thick, subterete below, complanate or costate-alate above, sometimes branched, occasionally more elongate and subrhizomatous; frond membranous, rather firm or slightly gelatinous, 60–120 μ thick, variable in form, suborbicular, cordate, or obovate, attaining a width of 4–30 cm., subentire, or sparingly or copiously lobed or proliferous, the lobes or proliferations conformable or ovate, themselves sometimes once or twice lobed in similar fashion, the proliferations often stipitate, the apices rounded-obtuse, the margins plane or more or less ruffled-plicate, subentire, lightly sinuate-crenate, or now and then irregularly coarsely or obscurely dentate; surface dull or rarely subnitent, smooth; color (dried) violet-red (rosolane-purple to Indian lake*); medulla of stipe compact, sometimes pseudoparenchymatous, 0.15–0.45 mm. thick; cortex of stipe or of its costa very firm, compact, parenchymatous, 8–30 cells thick, its cells in distinct anticlinal rows, cells of subcortex larger and irregularly disposed; medulla of frond moderately compact, its filaments mostly 3–8 μ in diameter, usually interspersed (in older parts at least) with coarser filaments, 6–20 μ in diameter, having more homogeneous refringent contents, such filaments radiating from substellate ganglion-like enlargements 15–65 μ in diameter; cortex of frond parenchymatous or subparenchymatous, 1–3 cells thick, the cells usually firm-walled, subquadrate in section, the superficial cells angular, mostly 5–10 μ in diameter in surface view, their outer walls 2–4 μ thick, protoplasts close (separated 2–3 μ), sub-cortex 1–3 cells thick, its cells mostly 13–25 μ in diameter; tetrasporangia 12–16 μ × 8–10 μ; cystocarps unknown.

BERMUDA: In shallow water in clefts of rocks and caves and among roots of *Rhizophora; A. F. Kemp*, August, 1856 (as *Rhodymenia palmata*); Walsingham, *W. G. Farlow*, February, 1881; near Hamilton, *M. A. Howe 69*, June 12, 1900; Stokes Bay, Tucker's Town, *M. A. Howe 313*, July 6, 1900; Harrington Sound, *A. B. Hervey*, January 15, 1913; Dingle Bay, *A. B. Hervey*, March 30, 1915; Grasmere, *A. B. Hervey*, March 9, 1914; Old Ferry, *A. B. Hervey*, April 2, 1913; Castle Harbor, *F. S. Collins*, April 25, 1912 (Phyc. Bor.-Am. *2050*), and May 3, 1913.

TYPE: Castle Harbor, near Tucker's Town, April 25, 1912, *F. S. Collins 7074*, in herb. F. S. Collins.

* Ridgway, R. Color standards and color nomenclature *pl. 26.* 1912.

This species seems to be fairly common in Bermuda. Its favorite habitat is the walls of narrow deep clefts in the shore cliffs, such as are found between Tucker's Town and Walsingham. Here it grows from a little below low-water mark down at least to a depth of two or three meters, usually as single separate plants rather than in dense tufts. It seems to thrive best where much shaded. In an unattached condition it occurs also among mangrove roots, as in the vicinity of Hamilton. These loose fronds are darker in color, firmer in texture, and less adherent to paper when dried under pressure than are the attached forms. There is much variation in the form of the frond; the primary form seems to be orbicular and plane with a slightly developed stipe. Rapid marginal growth of the frond results in ruffles and plications, and when these are well developed the plant has somewhat the aspect of *Porphyra amplissima* in miniature. In color and habit it is often suggestive also of certain conditions of *Callymenia reniformis*, from which, however, it differs markedly in structure. Proliferous growth is common; the proliferations are sometimes sessile but are oftener stipitate, the stipe terete or flattened, in the latter case with or without an obvious costa, which may be continued into the base of the main expansion. In the older plants, under certain conditions of growth, the basal stipe, terete or flattened, may branch and form a matted subrhizomatous complex from which individual fronds arise, these usually orbicular or cuneate, or sometimes cordate from a cuneate base. An important character of this species is the presence, in the medulla, of conspicuous stellate ganglia more or less similar to those exhibited by the type specimen of *Halymenia floridana* J. Ag. and by *Sebdenia heteronema* M. A. Howe.* These may be easily observed through the cortex by transmitted reduced light under low-power lenses without the use of any staining reagents; however, their protoplasts have a peculiar affinity for haematoxylin stains and they may be differentiated with remarkable distinctness by overstaining with preparations of haematoxylin and afterwards partly decolorizing. The nodes of the ganglia are irregularly stellate or subglobose; from each of them radiate three to ten coarse rather rigid and straight tapering filaments with dense homogeneous refringent contents; in the

* Mem. Torrey Club 15: 163–165. *pl. 58.* 1914.

less developed conditions these radiating arms seem to lose themselves among the ordinary filaments of the medulla, but in older well-developed states some of these radiating arms may be traced directly to other ganglia, which thus form an interconnecting system. When a portion of the thallus is crushed on a glass slide and the other parts are reduced to a confused mass these ganglia and their rays often persist with little change. Septa in these enlarged specialized filaments are distant and irregularly placed. We have seen but few tetraspores and these were apparently not very well developed. Cystocarps have not been observed, although hundreds of specimens have been examined with the hope of finding them. In one lot of material, however, from Grasmere, we found small red spots resembling cystocarps under a hand lens, but these spots were apparently caused by the irritation of some endophyte or through injury by some small animal.

Halymenia bermudensis evidently finds its nearest ally in the little-known *H. floridana* J. Ag.,* with the type of which, as also with the Peruvian *Sebdenia heteronema* M. A. Howe,† it shows more or less agreement in having usually rather conspicuous substellate medullary ganglia. It differs, however, from *H. floridana*, which is now known only from southern Florida and from near Beaufort, North Carolina (*W. D. Hoyt*), in its darker color (rosolane purple rather than pinkish vinaceous), in its commonly more lobed or dissected thallus, in its rather firmer texture, in its thicker, firmer, and less monostromatic cortex, and in its possible loss of sexual reproduction. Although, in a general way, the two species show a similarity in the medullary ganglia and the dimorphous medullary filaments, a critical comparison shows certain points of difference in these organs. The ganglia are less numerous, less conspicuous, and less obviously anastomosing in *H. bermudensis*. The arms on leaving the ganglion commonly taper away gradually, usually without a septum or obvious interruption of the protoplast; in *H. floridana*, the arms usually taper towards the ganglion and usually have a septum or a wide interruption of the protoplast near the place of emergence. As a result of these

* Anal. Alg. 59. 1892. Howe, Bull. Torrey Club 38: 511. 1911; Mem. Torrey Club 15: 164. 1914.

† Loc. cit.

peculiarities, the outline of the central node or ganglion in *H. bermudensis* is, when viewed through the cortex, more lobed, stellate, or brachiate, and less orbicular or rotate than in *H. floridana.*

J. Agardh founded *Halymenia floridana* on several specimens sent to him from Florida by Mrs. Floretta C. Curtiss, and he appears to have put certain specimens of the same thing, or of the typical thing, in the "*Kallymenia reniformis*" cover in his herbarium. Specimens of it, collected by A. H. Curtiss at Gilbert's Bar, Florida, were distributed by Curtiss with a printed "Algae Floridanae" label under the name "*Kallymenia reniformis* J. Ag.," from which plant it differs greatly in structure. *Halymenia floridana* and *H. bermudensis*, however, differ from typical *Halymenia* (*H. Floresia*) in their firmer subparenchymatous cortex, in their much firmer, non-deliquescent and scarcely gelatinous outer walls of the superficial cells, and in the striking development of the medullary ganglia. It is possible, as has already been hinted by one of us,* that more critical studies, especially of the development of the cystocarps (abundant in *H. floridana*), may furnish adequate grounds for the establishment of a new generic group which would include not only *Halymenia floridana* and *H. bermudensis* but also the Peruvian *Sebdenia heteronema*. J. Agardh placed *Halymenia floridana* in his section *Halarachnion* of the genus *Halymenia*, and De-Toni† has ranged it, with a question mark, under the generic name *Halarachnion*, but the type of *Halarachnion* (*H. ligulatum*) has no medullary ganglia comparable with those of *Halymenia floridana* and it differs also in the structure of the cortex.

Halymenia bermudensis may or may not adhere to paper when dried under pressure.

Halymenia Gelinaria sp. nov.

Thallo roseo-vinaceo vel vinaceo-purpureo, brevi-stipitato; stipite a disco basali orto, inferne subtereti, superne cuneato; fronde plana, levi, nec nitente, membranacea vel subcarnosa, plerumque maxime gelatinosa, 60–600 μ crassa, suborbiculari, oblonga, ovata vel cuneato-obovata, latitudine 5 cm. usque 6 dm.,

* Howe, Mem. Torrey Club 15: 165. 1914.

† Syll. Alg. 4: 1655. 1905.

simplice vel parce subconformiter divisa, margine plana, integra vel irregulariter dentata aut crenulata, nonnunquam fimbriata; medulla frondis laxa vel subvacua, filamentis transversalibus crebris, filis stellatis paucis et inconspicuis; strato subcorticali dense filamentoso, filamentis anastomosantibus, cellulis nodalibus majoribus; strato corticali series 1–4 cellularum monstrante, parietibus cellularum mollissimis, gelatinoso-deliquescentibus; tetrasporangiis decussatim divisis; cystocarpiis numerosis, minutis, ad una pagina frondis plerumque prominulis, massa sporarum turbinata, 120–140 μ diam.

Species colore, habitu, cystocarpiorum forma, *H. floridanae* J. Ag. proxima, sed differt thallo multo magis gelatinoso, plerumque crassiore, cortice manifeste filamentoso, nec pseudoparenchymato, filis stellatis minus evolutis. Structura *H. Floresiae* (Clem.) Ag. similis, habitu differt, fronde latiore integra vel subintegra, nec regulariter pinnata.

Ad oras Floridae et Carolinae Septentrionalis (typum legit M. A. Howe in loco "Jupiter Inlet" dicto ad oras Floridae, Oct, 13, 1902, no. 1252).

Thallus short-stipitate from a small basal disk; stipe 3–5 mm. long, 0.75–1.2 mm. thick, cuneate from a subterete base; frond plane, membranous or carnose-membranous, usually very gelatinous, 60–600* μ thick, suborbicular, oblong, ovate, or cuneate-obovate, attaining a width of 5 cm. to 6 dm., subentire or rather sparingly (usually conformably) parted, lobed, or proliferous, the margins entire or very irregularly lobulate, dentate, erose-crenulate, or occasionally laciniate-fimbriate; surface dull, smooth; color pinkish vinaceous, rocellin-purple, vinaceous purple, or deep hellebore-red;† medulla of stipe 0.45–0.75 mm. thick, moderately compact, gelatinous; cortex of stipe gelatinous, mostly 8–15 cells thick; medulla of frond moderately compact or subvacuous, its filaments mostly 8–14 μ in diameter, many of them obliquely transverse, connecting the opposite subcortical layers, the cells mostly 20–70 μ long, the medulla occasionally showing a few rather inconspicuous stellate ganglia with nodes 20–40 μ in diameter and slender, elongate, rigid, straight or flexuous, now and then tortuous or nodulose, usually long-celled, radiating filaments, these commonly 4–7 μ in diameter, the ganglionic system with

* The minimum is drawn from the thinner parts of dried specimens, as shown when sections are soaked out with water; the maximum is from the older parts as shown in formalin-preserved material.

† Ridgway, loc. cit. *pl. 27 and 38.*

more homogeneous refringent protoplasts; cortex and subcortex of frond rather distinctly filamentous; subcortex consisting of a close network of anastomosing filaments, the stellately branched nodal cells mostly 13–20 μ in diameter; cortex 1–4 cells thick, the superficial cells (protoplasts) 3–10 μ in diameter in surface view, mostly obtuse and more or less isodiametric, sometimes broader than high, or, 1.5–2 times higher than broad and subacute, often segregated in groups of 2–8, their outer walls very gelatinous and deliquescent; tetrasporangia (protoplasts) 18–26 $\mu \times$ 13 μ, the spores decussately paired; cystocarps numerous, minute, commonly slightly protuberant on one face, the spore-mass turbinate, 120–240 μ in diameter.

FLORIDA: Unattached, Jupiter Inlet, *Mrs. G. A. Hall*, September 14, 1896 (Phyc. Bor.-Am. *749b* and *749c*, as *H. floridana*); *M. A. Howe 1252–1255*, October 13, 1902; Indian River Inlet, *Mrs. G. A. Hall*, May, 1899 (Phyc. Bor.-Am. *749a*, as *H. floridana*, and *750*, as *H. floridana*, forma *dentata*); Key West, *Mrs. G. A. Hall.*

NORTH CAROLINA: Bogue Beach, Beaufort, *W. D. Hoyt*, August 12 and 16, 1907.

TYPE: Jupiter Inlet, Florida, October 13, 1902, *M. A. Howe 1252*, sheet C, in herb. N. Y. Botanical Garden.

The plant is known locally in the Jupiter Inlet region as the "beefsteak" seaweed. In form and color of the thallus, as well as in size and form of the cystocarps, *Halymenia Gelinaria* bears a remarkable resemblance to *H. floridana;* in fact, for two species that differ so much in the structure of the cortex, the similarity is astonishing. The affinities of *H. Gelinaria* are, however, clearly with *H. Floresia*, a species that it resembles much less in general habit. From *H. Floresia*, it differs chiefly in forming broad, entire or subentire membranes, which may reach a length or width of 60 cm., and in the less often acute, more isodiametric, superficial cells. *H. Floresia*, in typical forms, was found floating with it in Jupiter Inlet (*Howe 1231*) without intergrading conditions. When lobules, proliferations, or teeth occur in *H. Gelinaria*, they are very irregularly disposed, while in *H. Floresia* the branching is manifestly pinnate, or rather, bi-tri-pinnate. The main axes in *H. Floresia* may vary a good deal in width, but we have never seen them any broader than 7 cm. and they are rarely more than

2 or 3 cm. in width. From *Halymenia floridana*, *H. Gelinaria* differs in the much more gelatinous, often thicker, thallus, in the less firm, obviously filamentous rather than parenchymatous or subparenchymatous cortex, in the deliquescent outer walls of the superficial cells, in the longer cells of the medullary filaments, and in the comparatively rare and inconspicuous and differently shaped medullary ganglia. In *H. floridana* the freely anastomosing medullary ganglia are, with proper illumination or with differential staining* the most conspicuous anatomical feature of the thallus; their radiating branches are coarser than the ordinary medullary filaments and the ganglionic system looks like a sort of skeleton or framework about which the rest of the thallus has been filled in. In *H. Gelinaria*, small stellate cells, with ordinary unspecialized protoplasts are normal elements of the subcortex, but larger specialized stellate ganglia of the medulla with refringent protoplasts are rare or occasional and are not usually obvious without a special search; their radiating branches are commonly more slender than the ordinary medullary filaments among which they make their way; these branches rarely anastomose, commonly showing free ends, and they are, perhaps, rather more suggestive of medullary rhizoids than parts of a primary framework, yet they seem to differ from the medullary rhizoids of the Florideae in general in being straighter and more rigid, and in having denser more homogeneous refringent protoplasts. Medullary ganglia of a somewhat similar sort are of occasional occurrence in *H. Floresia* also. The difference between *H. Gelinaria* and *H. floridana* as to the character of the cortex comes out strongly when a section is made or even when a margin or a fold of the surface is examined microscopically; in *H. Gelinaria*, the dissolving away of the outer walls of the superficial cells leaves these cells more or less isolated and separate, so that the general surface appears minutely papillate, while in *H. floridana* under the same conditions the general surface is covered by a firm cuticle and is perfectly smooth. The cystocarps of *H. floridana* and *H. Gelinaria* appear to be very similar in form, size, and structure, but it is possible that an exhaustive study of the earlier stages of their development might reveal differences as marked

* See page 171.

as are shown by a microscopic comparison of the vegetative characters of these two superficially similar plants. The cystocarp of *H. floridana*, however, is commonly somewhat protuberant on both faces of the frond, while that of *H. Gelinaria* is commonly protuberant on only one face. In both, the spore-mass or "nucleus" is very dense, turbinate or oblate-spheroid, sometimes apparently two- or three-lobed, and is supported by a short stalk.

In 1900 (Phyc. Bor-Am. 750) the senior author of the present paper used the name "*Halymenia floridana* forma *dentata* (Crouan) Collins" for a dentate-margined condition of the present species, citing *Gelinaria dentata* Crouan in Mazé & Schramm, Algues de Guadeloupe, as a synonym. In doing this he was, in effect, adopting the opinion (expressed *in litt.*) of a distinguished phycologist who was familiar with the Guadeloupe specimens distributed by Mazé & Schramm but knew *Halymenia floridana* J. Ag. from description only. However, the Mazé, Alg. Guad. no. 1602, "Capesterre, Plage du bourg" in the herbarium of the British Museum, is certainly very different, as to species, at least, from either *H. floridana* or *H. Gelinaria*. Whatever may be the relation of other Guadeloupe specimens to these two species, the name *dentata* of Crouan, a "nomen seminudum" at best, can not, under the provisions of the "American Code" at least, be adopted for either, on account of the previously published *Halymenia dentata* Suhr.

Halymenia Gelinaria adheres very firmly to paper when dried under pressure.

Halymenia pseudofloresia sp. nov.

Thallo violaceo-rubro, brevi-stipitata; stipite inferne subtereti, superne cuneato; fronde juvenili membranacea, gelatinosa, aetate provecta firmiore et subcoriacea, 50–450 μ crassa, circumscriptione suborbiculari, ovata, cuneato-obovata, vel nonnunquam valde irregulari, longitudine 7–30 cm., profunde lobata vel prolificationibus stipitatis munita; rachidibus 1–8 cm. latis, lobis et prolificationibus plerumque lanceolatis, serratis vel seriebus loborum etc. secundariorum munitis; superficie haud nitente, plerumque plana, sed aetate provecta minute verruculosa; medulla frondis laxa, subvacua, filamentis sparsis percursa, filamentis transversalibus crebris, filamentis stellatis paucis, inconspicuis; strato subcorticali indistincte filamentoso, cellulis 20–50 μ diam.; strato corticali cellularum minorum 2–6 series monstrante, cellulis superficialibus aetate elongatis, obconicis vel clavato-truncatis, denique diametro plerumque 2–5-plo longioribus, parietibus externalibus gelatinosis, deliquescentibus; tetrasporangiis decussatim divisis; cystocarpiis ignotis.

Ab *H. Floresia* (Clem.) Ag. et *H. Gelinaria* Collins & Howe differt colore magis saturate rubro vel violaceo-rubro, fronde denique firmiore, subcoriacea, nonnunquam verruculosa, cellulis terminalibus filorum corticalium clavato-truncatis. Frons *H. pseudofloresiae* magis divisa est quam *H. Gelinariae*, minus et minus regulariter quam *H. Floresiae*.

Ad oras Insularum Bermudensium (typum legit A. B. Hervey, Jan. 15, 1915).

Thallus short-stipitate; stipe* 5–10 mm. long, 1–2 mm. thick, cuneate from a subterete base; frond membranous and gelatinous in younger parts, becoming firmer and subcoriaceous with age, 50–450 μ thick, suborbicular, ovate, cuneate-obovate, or commonly very irregular in general outline, attaining a length of 7–30 cm., deeply, irregularly, or subpalmately lobed, or often showing cuneate-based substipitate marginal proliferations, the main expansions or axes 1–8 cm. broad, the lobes or proliferations commonly lanceolate, serrate, biserrate, or subpinnately lobulate or bilobulate, the teeth mostly acuminate-deltoid; surface dull, mostly smooth, but often becoming rugose and minutely and copiously verruculose with age; color (when dried) daphne-red, becoming deep hellebore-red or neutral red† in old fronds; medulla of stipe 0.75–1.0 mm. thick, moderately compact; cortex of stipe rather firm, subparenchymatous, mostly 20–40 cells thick; medulla of frond mostly rather loose or subvacuous, its filaments 10–16 μ in diameter, many of them obliquely transverse, connecting the opposite subcortical layers, the cells 25–90 μ long, the medulla or inner subcortex occasionally showing a few inconspicuous stellate ganglia with nodes 20–40 μ in diameter and slender long-celled branches 2–5 μ in diameter; cortex and subcortex rather firm and solid, obscurely filamentous; cells of subcortex ellipsoidal, mostly 20–50 μ in diameter, obscurely anastomosing or concatenate; cortex 2–6 cells thick, the superficial cells (protoplasts) 4–13 μ in diameter in surface view, angular, obtuse, subisodiametric or often broader than high in younger parts, becoming columnar, obtuse, acute, or acuminate, and finally, for the most

* A well-developed original stipe has been seen in only one case.

† Ridgway, loc. cit., *pl. 38*.

part, obconic or clavate-truncate and 2–5 times higher than broad, their outer walls gelatinous or deliquescent; tetrasporangia (protoplasts) 14–26 $\mu \times$ 12–14 μ, the spores decussately paired; cystocarps unknown.

BERMUDA: *W. G. Farlow*, 1881; Green Bay, *W. S. Wadsworth*, February, 1890; Castle Harbor, near Tucker's Town, *F. S. Collins 7075*, April 25, 1912; Walsingham, *A. B. Hervey*, January 15, 1915 (Phyc. Bor.-Am. *2099*).

TYPE: Walsingham, *A. B. Hervey*, January 15, 1915, in herb. F. S. Collins.

Halymenia pseudofloresia differs from both *H. Floresia* and *H. Gelinaria* in its normally deeper red color, in the firmer subcoriaceous texture and verruculose surface of its older fronds, and in the mostly clavate-truncate and much elongate superficial cells of the older parts of its frond. From *H. Floresia*, which apparently occurs in southern Florida and the West Indies, as well as in the Mediterranean and adjacent regions, it differs also in the less deeply dissected frond, with the teeth or ultimate lobules mostly acuminate-deltoid from a broad base rather than mostly lanceolate, ligulate, or ciliiform from a somewhat constricted base. Lanceolate outgrowths from a narrowed base are of occasional occurrence, but such seem to have more the habit and nature of proliferations than of normal lobes and lobules. From *Halymenia Gelinaria*, *H. pseudofloresia* differs furthermore in its more lobed and dissected and more obviously pinnate frond and in its firmer, less distinctly filamentous cortex.

The older parts of *Halymenia pseudofloresia*, at least as shown in the Walsingham specimens collected by Hervey, are infested by four or five kinds of endophytic algae, and we have sometimes suspected that the small verrucae referred to in our description as occurring on the old fronds might be caused by irritation due to their presence. However, most of these verruculae appear to be free from any endophyte and we have thought best to treat them as more or less normal parts of the old frond. We have not observed any tendency of these verrucae of the general surface to develop into proliferations, even though the marginal proliferations commonly spring from somewhat similar outgrowths. These surface verruculae are dense, dark red, and about 0.2–

0.6 mm. in diameter, and to the naked eye they sometimes look a little as if they might be cystocarps. A filamentous short-celled Rhodophyceous endophyte sometimes forms dense subglobose or irregularly lobed glomeruli in the medulla and these also may have the superficial appearance of being cystocarps of the *Halymenia*.

Halymenia pseudofloresia, like *H. bermudensis*, is commonly found in an unattached condition, and possibly the absence of cystocarps is in some way associated with this fact. The senior author has noted that *Delesseria sinuosa* and certain other membranaceous Rhodophyceae are commonly sterile when found in places where they have apparently been vegetating for some time unattached.

Specimens of *Halymenia pseudofloresia*, with occasional exceptions as to parts of the old fronds, adhere firmly to paper when dried under pressure.

Halymenia echinophysa sp. nov.

Thallo pallido-vinaceo vel lilacino, membranaceo, gelatinoso, 125–200 μ crasso (madefacto), circumscriptione suborbiculari, 10–18 cm. diam., profunde, irregulariter vel subpalmatim lobato, lobis irregulariter obovatis vel suborbicularibus, marginibus sinuato- vel eroso-dentatis; medulla frondis subvacua vel laxe filamentosa, filamentis homogeneis, 10–14 μ diam.; strato corticali gelatinoso translucido, submonostromatico, cellulis superficialibus ovoideis, subglobosis vel ellipsoideis, 4–8 μ diam. max., 5–10 μ inter se distantibus, in membrana communi horizontaliter vel verticaliter positis, parietibus exterioribus (vel membrana superficiali extra-cellulari) 10–18 μ crassis; strato subcorticali 2–4-stromatico, cellulis arcte anastomosantibus, ovoideis, ellipsoideis, vel interdum complanatis, extimis 6–10 μ diam., intimis 25–65 μ diam. max., nonnullis subglobosis, 80–180 μ diam., echinato-stellatis, in medullam protrudentibus, processubus 15–40, subrigidis, subspinescentibus, munitis.

Species *H. actinophysae* M. A. Howe proxima, sed differt thallo minore, crassiore, magis lobato, non-nitente, membrana superficiali communi duplo crassiore, cellulis superficialibus inter se duplo distantioribus, filamentis medullaribus dimidio minus crassis et minus regulariter et minus manifesto capitatis in strato subcorticali abientibus, cellulis intimis strati subcorticalis saepe multum majoribus, magis echinato-stellatis, cum processubus subspinescentibus saepe permultis.

Ad oras Insularum Bermudensium, in profundis (typo in herb. Hort. Reg. Kew., a Exped. "Challenger" lecto et "*Kallymenia reniformis*" denominato).

Frond membranous, gelatinous, 125–200 μ thick (when soaked out), suborbicular in general outline, attaining width of 10–18 cm., deeply, irregularly or subpalmately lobed or divided, the lobes irregularly obovate or suborbicular, mostly 2–6 cm. broad, their margins sinuate- or erose-dentate or sparingly sublobulate; surface dull; color (dried) light grayish vinaceous to Persian lilac;* medulla of frond subvacuous or loosely filamentous, its filaments homogeneous, mostly 10–14 μ in diameter (including gelatinous walls; protoplasts commonly only 1–4 μ); cortex of frond gelatinous, translucent, submonostromatic, the superficial cells (protoplasts) ovoid, subglobose, or ellipsoid, 4–8 μ in maximum diameter, widely spaced (separated 5–10 μ), their longer axes horizontal or vertical, their outer walls ("surface jelly") 10–18 μ thick; subcortex of 2–4 layers of closely anastomosing, ovoid, ellipsoid, or often flattened, thick-walled cells, the outer (protoplasts) granular, 6–10 μ in diameter, the inner mostly 25–65 μ in maximum diameter, some of the inner cells larger, subglobose, 80–180 μ in diameter, echinate-stelliform, projecting into the medullary cavity and showing when detached 15–40 rather rigid subspinescent processes, these mostly 25–60 μ long and 10–20 μ in diameter at base; other parts unknown.

BERMUDA: Dredged in "31 fathoms, off Bermuda" by members of the Challenger Expedition in 1873, and reported as "*Kallymenia reniformis* J. G. Agardh" (Rep. Voy. Challenger, Bot. **1**: Bermudas 117. 1884). This is the only specimen known to the present writers.

TYPE: In the herbarium of the Royal Botanic Gardens, Kew, England.

Halymenia echinophysa appears to find its nearest ally in *H. actinophysa* M. A. Howe,† from La Paz, Lower California, but differs in the smaller, thicker, more lobed, non-nitent thallus, with the surface jelly twice as thick, the surface cells twice as widely spaced, the medullary filaments one half as stout, in the less regularly and less obviously capitate terminations of these

* Ridgway, loc. cit. *pl. 38, 39.*

† Bull. Torrey Club **38**: 509. *pl. 34.* 1911.

filaments in the subcortex, and in the often much larger, more numerously and more echinately branched stelliform cells of the inner subcortex.

From *H. bermudensis* Collins & Howe, to certain forms of which it bears a superficial resemblance, it differs in being much more gelatinous, in the much thicker surface jelly or outer walls of the superficial cells (10–18 μ vs. 2–4 μ thick), in the more generally monostromatic cortex, in the more widely spaced (5–10 μ vs. 2–3 μ) protoplasts of the superficial cells, in having a medulla that is filamentous and homogeneous instead of showing a system of substellate ganglia with refringent specialized protoplasts, and in the presence in the inner subcortex of cells that are 80–180 μ in diameter with 15–40 subspinescent processes, while the inner cells of the subcortex of *H. bermudensis* are 13–25 μ in diameter and have no obvious appendages.

When the enlarged echinate-stelliform cells of the inner cortex are detached, some of their numerous sharp-pointed processes show apices that look as if they had been free from all cell connections, but most of them show at the apex traces of a septum to which they have narrowed down and at which point they have been disjoined from their former cell connections. The protoplasts of these large echinate cells are similar to those of their neighbors or are more vacuous, wherein they differ greatly from the substellate medullary ganglia of *H. bermudensis* and *H. floridana*, the protoplasts of which are conspicuously different from those of the ordinary cells in being denser, more homogeneous, and more refringent. As is the case in *H. actinophysa*, the cells of the subcortex of *H. echinophysa* are so gelatinous and translucent that their form and relations can not well be ascertained without resort to staining reagents, such as solutions of haematoxylin.

Of the four species above described, specimens of three, *Halymenia Gelinaria*, *H. pseudofloresia*, and *H. bermudensis*, have already been distributed in the Phycotheca Boreali-Americana of Collins, Holden & Setchell, as indicated. This will, we trust, in a measure atone for the lack of illustrations in the present paper.

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL
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PERUVIAN MOSSES

R. S. WILLIAMS

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Peruvian mosses

R. S. Williams

(with plates 17–20)

The following list is made up of two collections. The first, obtained by Harry Ward Foote, on the Yale Peruvian Expedition of 1911, was kindly forwarded by Dr. A. W. Evans of Yale. It consisted of forty-eight packets and contained thirty-seven species among which appear to be two novelties, also two species known before only from Patagonia. The specimens are from localities varying from about 900 to 3,300 meters in altitude. They were without number, and I have accordingly rearranged and numbered them from 1 to 48.

The second collection consisted of forty-three packets, obtained by Messrs. Cook and Gilbert, with the exception of three species by Hiram Bingham, while on the Yale University-National Geographic Society Peruvian Expedition in 1915. In this second collection four species are apparently new to science. I may say that it was through the coöperation of the United States Department of Agriculture that Messrs. Cook and Gilbert were detailed to accompany this expedition and the specimens were forwarded to me by Mr. William R. Maxon of the United States National Museum. The altitude at which this second collection was obtained varies from 1,800 to 4,100 meters, and there are thirty-three species not in the first collection, making seventy species in this list. The type specimens of the new species are deposited in the herbarium of the New York Botanical Garden.

Dicranum Mittenii C. Müll.

Above Arma Valley, July, 1915, *H. Bingham 2063.*

I have not been able to find any publication of this species except that by Brotherus in Engler & Prantl's Nat. Pflanzenfam. (1: 328), under subgenus 4. It is a plant of medium size with the ovate leaf-base quickly narrowed to a long, subulate and serrulate point; the alar cells are numerous, those above in the broader part of the leaf narrow and elongate with pitted walls. The collection is scanty and sterile.

CAMPYLOPUS LEUCOGNODES (C. Müll.) Paris.

Lucumayo Valley, 3,600 m., June, 1915, *Cook & Gilbert 1264a.*

FISSIDENS ASPLENIOIDES (Sw.) Hedw.

San Miguel, on rock, 1,820 m., September, 1911, *Foote 1.*

FISSIDENS CRISPUS Mont.

Ollantaytambo, about 3,000 m., May, 1915, *Cook & Gilbert 754.*

FISSIDENS RIGIDULUS Hook. f. & Wils.

Ollantaytambo, on rock, about 3,000 m., May, 1915, *Cook & Gilbert 670.*

TRICHOSTOMUM BRACHYDONTIUM Bruch.

Cuzco, on dry rock, about 3,500 m., July, 1911, *Foote 2;* these Cuzco specimens have leaves shorter and broader than in typical specimens and possibly should not be referred here, but they seem to be only a stunted form of the species; Lucma, on dead wood, 2130 m., August, 1911, *Foote 15a.*

TRICHOSTOMUM SEMIVAGINATUM Schimp.

Ollantaytambo, about 3,000 m., May, 1915, *Cook & Gilbert 501a.*

Leptodontium integrifolium sp. nov.

Dioecious, the male plants about like the fertile, the flowers with outer leaves similar to those of the stem, the inner broadly oblong, rounded obtuse, scarcely one third the length of the outer, costate, of mostly golden-brown, elongate, smooth cells enclosing five or six antheridia and numerous, longer, filiform paraphyses: fertile plants simple or slightly branched, the stems 3–4 cm. long with scattered, loose tufts of radicles and leaves, when dry rather loosely imbricate and incurved-flexuous, when moist spreading-recurved; stem-leaves 3–3.5 mm. long, ovate-lanceolate, the entire margins strongly recurved from a little below the apex to near the base and papillose; costa stout, papillose on the back, excurrent into a serrulate point sometimes 0.5 mm. long; cells of the upper part of leaf rather obscure, scarcely elongate, 8–9 μ in diameter, densely papillose on both sides, in the lower fourth of leaf, elongate, narrowly rectangular, smooth, except near the margin and costa; perichaetial leaves about 6 mm. long, convolute, with a subulate, abruptly spreading, serrulate point; fruit unknown. (PLATE 17, FIGS. 1–7.)

Ollantaytambo, about 3,000 m., May, 1915, *Cook & Gilbert 704a.*

Growing with *Thuidium peruvianum.*

Globulina peruviana sp. nov.

Inflorescence unknown: plants in rather compact mats with simple stems 1–4 mm. high, bearing radicles at the base and imbricate-appressed leaves rather uniformly placed along the stem or somewhat clustered at the apex and forming a globose bud about 0.5 mm. in diameter; stem in cross-section about 200 μ in diameter with cells of outer walls not differentiated and with a distinct central strand; leaves rotundate or slightly oblong, about 0.5 mm. long, more or less cucullate, the flat margins crenulate half way down or more; costa vanishing abruptly a little below the apex, rather weak in the lower part, widest near the apex, slightly rough on the back and papillose on the inner face, in cross-section showing two rows of medium-sized, thick-walled cells on the dorsal side and a single row of much larger cells on the ventral side; cells mostly gradually smaller from the base to the apex of the leaf, more or less shortly rectangular below, 12–16 μ by 16–30 μ, toward the apex square to rhomboidal, with sides 6–8 μ long, finely papillose on both sides about the upper half of the costa, the marginal cells smooth; fruit unknown. (PLATE 17, FIGS. 8–15.)

Araranca, south side of Roya Pass, about 4,100 m., April, 1915, *Cook & Gilbert 177a.*

Growing apparently on dry soil with *Pogonatum polycarpum*, at the highest elevation given for any of the collections.

BARBULA COSTATA Mitt.

Ollantaytambo, about 3,000 m., May, 1915, *Cook & Gilbert 610b.*

A small amount of what is apparently this species occurred, with immature fruit, growing with *Bryum argenteum.* What appears to be this also was found sterile, mixed with *Leskea gracillima,* at the same locality by these collectors, *663a.*

BARBULA PRUINOSA (Mitt.) Jacq.

Cuzco, on dry rock, 3,500 m., July, 1911, *Foote 3.*

BARBULA REPLICATA Tayl.

Cuzco, on dry rock, 3,500 m., July, 1911, *Foote 4;* Ollantaytambo, about 3,000 m., on soil, May, 1915, *Cook & Gilbert 610a.*

Mitten was correct, I believe, in thinking *B. apiculata* Hampe not distinct from this species.

BARBULA SUBULATULA C. Müll.

Urubamba, on damp earth, 2,900 m., July, 1911, *Foote 5.*

TORTULA AFFINIS Hampe.

Sicuani, Vilcanota Valley, on stone, about 3,600 m., April, 1915, *Cook & Gilbert 157;* Ollantaytambo, on rock, about 3,000 m., May, 1915, *Cook & Gilbert 612;* Urubamba, on rock, 2,900 m., July, 1911, *Foote 6.*

Tortula bipedicellata Besch. and *T. confusa* Card., I believe, do not differ from *T. affinis*, which in turn is very close to *T. pichinchensis* (Tayl.) Mitt., differing chiefly in having a low basal membrane of the peristome, the cell structure of which also varies. In *T. pichinchensis* the cells are often as high as broad, and somewhat rhomboidal in slightly oblique rows; in *T. affinis* the cells are low, mostly two or three times broader than high.

TORTULA ANDICOLA Mont.

Ollantaytambo, about 3,000 m., May, 1915, *Cook & Gilbert 771.*

Tortula lacerifolia sp. nov.

Dioecious: plants with stems (in this small collection scattered through cushions of *Fabronia andina*) mostly simple, 6–8 mm. high, with radicles at the base and leaves more or less aggregate toward the apex; stem-leaves twisting incurved when dry, erect-spreading when moist, oblong, mostly 2–2.5 mm. long, the margins usually deeply incised in the upper half into readily separating, narrow, irregular segments, often 0.25 mm. long and twisted part way round or inflexed or reflexed, the margins of the lower leaf being entire and recurved; costa golden-brown, stout, near the base 80 μ wide, smooth on the back, more or less papillose on the upper side, excurrent into a thorn-like spine, in cross-section showing two large guide-cells, a large band of stereid cells on the dorsal side, with two medium-sized cells on the ventral side; cells throughout upper leaf rather obscure, mostly hexagonal, mamillose and covered on both sides with small often C-shaped papillae, those of lower leaf pale, with few or no papillae and mostly short-rectangular, up to about 18 μ wide by 40–50 μ long; outer perichaetial leaves like those of the stem, the inner small, pale, more or less deeply cleft into numerous segments, the archegonia numerous, with few paraphyses; fruit unknown. (PLATE 18, FIGS. 1–6.)

Ollantaytambo, about 3,000 m., July, 1911, *Foote 7.*

GRIMMIA MICRO-OVATA C. Müll.

Temple of Viracocha near Tinta, on rock, about 3,500 m., April, 1915, *Cook & Gilbert 206;* Ollantaytambo, on rock, about 3,000 m., May, 1915, *Cook & Gilbert 609.*

GRIMMIA OVATA Web. & Mohr.

Cuzco, on dry rock, about 3,500 m., 1911, *Foote 8.*

Grimmia rivulariopsis sp. nov.

Dioecious, the male plant rather more slender than the fertile with often 2–3 flowers scattered along the stem; the inner perigonial leaves small, ovate, ecostate, or faintly costate, enclosing rather numerous, fusiform antheridia about 0.5 mm. long, without paraphyses: fruiting-plants abundantly branching, 2–3 cm. high, without radicles and bearing slightly secund leaves, erect-spreading when moist, mostly somewhat incurved-appressed when dry; stem-leaves oblong-ovate, about 2 mm. long, rather abruptly narrowed to an acute, serrulate apex, the margins entire, of a double thickness of cells and recurved from a little below the apex to near the base; costa stout, percurrent, smooth on both sides and flat or convex on the ventral side in the upper part; cells of stem-leaves distinct, smooth, with slightly thickened, scarcely or not sinuous walls, the median mostly 6 μ wide by 6–8 μ long, the basal more or less rectangular, 8 μ wide by 16–22 μ long; perichaetial leaves larger than those of the stem, about 3.5 mm. long, the costa of the inner leaves rather faint below, widest toward the apex, not quite percurrent, the cells of the lower half of leaf narrowly rectangular or linear with slightly thickened, straight walls; capsule ovate, immersed, about 1.5 mm. high, without stomata, a band of five or six rows of small, transversely elongate cells about the rim, the median exothecal cells scarcely or not elongate, rather irregular with scarcely thickened or sinuous walls, up to 25 μ in diameter; seta erect, scarcely one half the capsule in height; peristome-teeth lanceolate, about 120 μ wide at the base and 400 μ high, red, papillose, entire or often split at the apex or along the median line and slightly lacunose; annulus none; lid convex, obliquely apiculate; calyptra little more than covering the apiculus, the base cleft into several lobes. (PLATE 19.)

Ollantaytambo, about 3,000 m., on rock in stream bed, May, 1915, *Cook & Gilbert 753;* and on rock, same place and collectors, *561.*

Most closely related to *G. amblyophylla* C. Müll. of the South American species, but the apex of the leaf is very different, the cells of the stem-leaves much smaller, with thinner, scarcely sinuous walls and the inner perichaetial leaves have much longer, narrower cells throughout the lower leaf.

RHACOMITRIUM CRISPIPILUM (Tayl.) Jacq.

Lucumayo Valley, 3,000 m., June, 1915, *Cook & Gilbert 1264*.

FUNARIA CALVESCENS Schwaegr.

Ollantaytambo, about 3,000 m., on wet soil, May, *Cook & Gilbert 669;* Manchu Picchu, about 2,100 m., May, *Cook & Gilbert 996*.

MIELICHHOFERIA ANDINA Sull.

Araranca, south side of La Roya Pass, about 4,100 m., on earth wall, April, 1915, *Cook & Gilbert 182a*.

MIELICHHOFERIA BOGOTENSIS Hampe.

Ollantaytambo, about 3,000 m., May, 1915, *Cook & Gilbert 705*.

LEPTOBRYUM WILSONI (Mitt.) Broth.

Arequipa, on wet rock, 2,300 m., June, 1911, *Foote 9*.

ANOMOBRYUM FILIFORME (Dicks.) Husn.

Santa Rosa, on dry hillside, 3,960 m., July, 1911, *Foote 10*.

BRYUM ANDICOLA Hook.

Above San Miguel, on rocks, 1,830 m., September, 1911, *Foote 11*.

BRYUM ARGENTEUM L.

Cuzco, on dry rock, 3,500 m., 1911, *Foote 12;* Ollantaytambo, on soil, about 3,000 m., May, 1915, *Cook & Gilbert 610*.

Bryum biforme sp. nov.

Pseudoautoicous, the male plants minute, 1–2 mm. high, attached by radicles to the tomentum of the fertile stems, each plant bearing one or two flowers containing two or three antheridia, with few, somewhat longer paraphyses; the outer antheridial leaves broadly ovate-lanceolate, scarcely serrulate, with costa vanishing well below the apex: fertile plants with more or less branching, tomentose stems 3–4 cm. high, the short branches often bearing at the apex abundant, filiform flagella, 3–4 mm. long and covered with minute scale-like leaves; stem-leaves widely spreading when moist, somewhat spreading-flexuous and twisted when dry, serrulate above, rather broadly ovate, acute, slightly decurrent, 3–3.5 mm. long, the margins flat above, recurved below with a border of elongate, narrow, pale cells most distinct half way down the leaf where it becomes four or five cells wide; costa not quite percurrent, from a broad, reddish brown base, tapering gradually to the slender apex; cells in upper leaf rhomboidal or hexagonal, in lower leaf larger and more or less rectangular, all with somewhat thickened walls distinctly pitted, at least in the lower leaf; the median cells about 16 μ wide and 40–50 μ long; outer perichaetial leaves about the length of the stem-leaves, from a broad base, oblong, acute, serrulate and with costa vanishing a little below the apex; seta about 2 cm. long; capsule pendent with sporangium rather narrowly ovate and tapering into a neck about one half the length of the sporangium, the median exothecal cells irregularly elongate with evenly thickened, mostly slightly curving walls, the stomata abundant in the neck, about 40 μ long; annulus large; peristome-teeth lanceolate, about 100 μ wide at the base and 600 μ high, with hyaline borders and the outer plates finely punctate, mostly one and one half to two times wider than high, the inner lamellae without cross-walls; inner segments about the height of the teeth, keeled and solid along the median line, very slender-pointed with mostly two long, slender cilia between them, sometimes distinctly appendiculate; spores rough, up to 20 μ in diameter; lid highly convex-apiculate. (PLATE 20.)

Torontoy, Urubamba Valley, about 3,600 m., May, 1915, *Hiram Bingham 730.*

This is, I believe, the only *Bryum* known having inflorescence as above described; the flagella also are unusual.

BRYUM DENSIFOLIUM Brid.

Urubamba, on damp earth, 2,900 m., July, 1911, *Foote 13;* Santa Anna, 912 m., August, 1911, *Foote 14.*

MNIUM LIGULATUM C. Müll.

Lucma, on dead wood, 2,130 m., Aug. 1911, *Foote 15*, growing mixed with *Cyclodictyon aeruginosum* (Mitt.) Broth. and *Trichostomum brachydontium* Bruch.; Urubamba, on wet earth, 2,900 m., July, 1911, *Foote 16.*

ANACOLIA SUBSESSILIS (Tayl.) Broth.

Urubamba, on loose earth and rocks, 2,900 m., July, 1911, *Foote 17;* Ollantaytambo, about 3,000 m., *Cook & Gilbert*, May, 1915, *504*, *749*, *771a.*

BREUTELIA BRYOCARPA Herzog.

Lucumayo Valley, 1,800–3,600 m., June, 1915, *Cook & Gilbert, 1320a.*

A few stems with one capsule were found mixed in with *Breutelia tomentosa*. This is evidently the same species as that collected by Weddell in Peru and named, apparently in manuscript only, *Bartramia nutans* by Montagne. It is also the same as my Bolivian collection, No. 2825, referred to *Breutelia nutans* (Mont.).

BREUTELIA TOMENTOSA (Sw.) Schimp.

San Miguel, Urubamba Valley, about 1,800 m., May, 1915, *Cook & Gilbert 988;* Lucumayo Valley, 1,800–3,600 m., June, 1915, *Cook & Gilbert 1320.*

POGONATUM CAMPYLOCARPUM C. Müll.

Lucumayo Valley, 1,800–3,600 m., June, 1915, *Cook & Gilbert 1322.*

POGONATUM POLYCARPUM (Schimp.) Broth.

Araranca, south side of La Roya Pass, about 4,100 m., April, 1915, *Cook & Gilbert 177 and 182.*

POLYTRICHUM ANTILLARUM Rich.

Torontoy, Urubamba Valley, about 2,400 m., June, 1915, *Cook & Gilbert 1194;* Lucumayo Valley, 1,800–3,600 m., on wet earth, June, 1915, *Cook & Gilbert 1318.*

HEDWIGIA ALBICANS (Web.) Lindb.

Temple of Viracocha, near Tinta, about 3,500 m., April, 1915, *Cook & Gilbert 204;* Ollantaytambo, about 3,000 m., May, 1915, *Cook & Gilbert 501.*

HEDWIGIDIUM IMBERBE (Sm.) B.S.G.

Urubamba, on rocks, 2,900 m., July, 1911, *Foote 18;* Ollantaytambo, 2,750 m., July, 1911, *Foote 19;* Temple of Viracocha, near Tinta, about 3,500 m., April, 1915, *Cook & Gilbert 204a.*

BRAUNIA CANESCENS Schimp.

Near Calca, on rock, April, 1915, *Cook & Gilbert 245;* Ollantaytambo, about 3,000 m., April and May, 1915, *Cook & Gilbert 473, 502, and 503.* This species has been considered scarcely distinct from *B. cirrifolia* (Wils.) Jaeg., but it seems to me to be a rather smaller species with more closely imbricate leaves. The leaves also, below the apex of the stem, are broader in the upper part, often slightly obovate, and more abruptly narrowed to the pale apex of blade and hair point. *B. cirrifolia* has leaves rather lanceolate and gradually narrowed to a yellowish apex and flexuous hair point. *Braunia argentinica* C. Müll. and *B. cirrifolia* var. *falcatula* Herzog belong, I should say, under *B. canescens*.

PRIONODON BOLIVIANUS C. Müll.

Torontoy, Urubamba Valley, about 3,600 m., May, 1915, *Hiram Bingham 729*.

SQUAMIDIUM ROTUNDIFOLIUM (Mitt.) Broth.

Above San Miguel, 1,830 m., September, 1911, *Foote 20*.

PILOTRICHELLA VIRIDIS (C. Müll.) Jacq.

San Miguel, Urubamba Valley, 1,800 m., May, 1915, *Cook & Gilbert 919*.

PAPILLARIA IMPONDEROSA (Tayl.) Broth.

Above San Miguel, on moist earth, 1,830 m., September, 1911, *Foote 21*.

METEORIOPSIS REMOTIFOLIA (Hornsch.) Broth.

San Miguel, 1,500–1,830 m., July, 1911, *Foote 22*.

NECKERA EUCARPA Schimp.

Urubamba, on bark, 2,900 m., July, 1911, *Foote 23;* Ollantaytambo, about 3,000 m., May, 1915, *Cook & Gilbert 763*.

NECKERA JAMESONI Tayl.

Ollantaytambo, about 3,000 m., on *Alnus*, May, 1915, *Cook & Gilbert 763a*.

NECKERA LINDIGII Hampe.

Lucma, on dead wood, 2,130 m., August, 1911, *Foote 24;* Urubamba, on bark, with *N. eucarpa*, 2,900 m., July, 1911, *Foote 23a*.

POROTRICHUM VALDIVIAE C. Müll.

Ollantaytambo, about 3,000 m., on trunks, May, 1915, *Cook & Gilbert 762a;* apparently the farthest northern station for this species.

ENTODON PLATYGYRIOIDES C. Müll.

Above San Miguel, on rock, 1,830 m., September, 1911, *Foote 25*.

ERYTHRODONTIUM SQUARROSUM (C. Müll.) Par.

Santa Ana, on rock, 912 m., August, 1911, *Foote 26*.

FABRONIA ANDINA Mitt.

Ollantaytambo, on rock, about 3,000 m., May, 1915, *Cook & Gilbert 662;* Urubamba, 2,900 m., July, 1911, *Foote 27;* Ollantaytambo, 2,750 m., July, 1911, *Foote 28.*

FABRONIA POLYCARPA Hook.

Santa Ana, 912 m., August, 1911, *Foote 29.*

CYCLODICTYON AERUGINOSUM (Mitt.) Broth.

Lucma, on dead wood, 2,130 m., August, 1911, *Foote 30.*

RHACOPILUM TOMENTOSUM (Hedw.) Mitt.

Santa Ana, on dead wood, 912 m., August, 1911, *Foote 31, 32;* San Miguel, 1,525 m., September, 1911, *Foote 33.*

LESKEA GRACILLIMA Tayl.

Urubamba, 2,900 m., July, 1911, *Foote 34,* on bark, *35* on rock; Ollantaytambo, on rock, about 3,000 m., May, 1915, *Cook & Gilbert 609a, 663.*

THUIDIUM PERUVIANUM Mitt.

Ollantaytambo, about 3,000 m., May, 1915, *Cook & Gilbert 704, 748.*

HYGROAMBLYSTEGIUM IRRIGUUM (Wils.) Loeske.

Urubamba, on rock, 2,900 m., July, 1911, *Foote 36.* Apparently not before reported for South America. The next nearest known location is, I believe, Guatemala.

Drepanocladus longifolius (Wils.) comb. nov.

Amblystegium longifolium Wils.; Mitten; Jour. Linn. Soc. Bot. 12: 571. 1869.

Temple of Viracocha, near Tinta, about 3,500 m., in a spring, April, 1915, *Cook & Gilbert 216.*

These sterile specimens seem to belong under this species although only known from Patagonia up to the present time.

Hygrohypnum peruviense sp. nov.

Inflorescence unknown: growing in loose mats with irregularly branching stems without radicles, 2–3 cm. long and about 200 μ in diameter, in cross-section showing a distinct central strand and outer walls of about three rows of smaller, thick-walled cells; leaves loosely erect-spreading, more or less secund, rather broadly ovate-acute, somewhat cymbiform, 1.5–2 mm. long, and nearly or quite entire; costa stout, 80 μ wide or more at the base, simple and extending about three fourths up the leaf or shorter and dividing into two to five branches; leaf-cells all elongate, prosenchymatose and mostly slightly sinuous, with rather thin walls, the median 5–6 μ wide and 40–60 μ long, the alar usually forming a distinct cluster of broad, short cells either greenish or finally reddish-brown; fruit not found. (PLATE 18, FIGS. 7–12.)

A variety evidently of the above, growing in flowing water, has elongate, hispid, wiry stems, 10–15 cm. long, without leaves below and in habit like *H. Bestii*, except much more slender.

Cuzco, on wet rock, 3,500 m., July, 1911, *Foote 37* (type); Ollantaytambo, about 3,000 m., on rock under spring, May, 1915, *Cook & Gilbert 666* (the variety).

CTENIDIUM MALACODES Mitt.

Ollantaytambo, about 3,000 m., on trunks, May, 1915, *Cook & Gilbert 762b.*

MITTENOTHAMNIUM ANDICOLA (Hook.) Card.

Ollantaytambo, about 3,000 m., on trunks, May, 1915, *Cook & Gilbert 762.*

MITTENOTHAMNIUM OXYSTEGUM (Spruce) Card.

Santa Ana, on rock, 912 m., August, 1911, *Foote 38.*

HYPNUM SCHREBERI Willd.

Ollantaytambo, about 3,000 m., May, 1915, *Cook & Gilbert 748a.*

ECTROPOTHECIUM AERUGINOSUM (C. Müll.) Mitt.

Santa Ana, 912 m., on dead wood, August, 1911, *Foote 39.*

PALAMOCLADIUM LESKEOIDES (Hook.) E. G. Britton.

San Miguel, on rock, 1,830 m., September, 1911, *Foote 40.*

BRACHYTHECIUM ASPERULUM (Hampe) Jaeg.

Ollantaytambo, about 3,000 m., May, 1915, *Cook & Gilbert 753a.*

BRACHYTHECIUM FLACCUM C. Müll.

Huadquinia, on wet earth, 1,530 m., August, 1911, *Foote 41;* Ollantaytambo, about 3,000 m., on trunks, May, 1915, *Cook & Gilbert 762c.*

BRACHYTHECIUM SERICEOVIRENS (C. Müll.) Par.

Ollantaytambo, on rock, 2,750 m., July, 1911, *Foote 42.* Known previously only from Patagonia.

BRACHYTHECIUM STEREOPOMA (Spruce) Jaeg.

San Miguel, on live wood, 1,830 m., July, 1911, *Foote 48.*

RHYNCHOSTEGIUM AQUATICUM (Hampe) Jaeg.

Urubamba, in water, 2,900 m., July, 1911, *Foote 43;* Arequipa, in water, June, 1911, *Foote 44;* Cuzco, on wet rocks, July, 1911, *Foote 45.*

RHYNCHOSTEGIUM CONOPHYLLUM (Tayl.) Jaeg.

Urubamba, on rock, 2,900 m., July, 1911, *Foote 46;* San Miguel, on live wood, 1,830 m., July, 1911, *Foote 47.*

NEW YORK BOTANICAL GARDEN

Explanation of plates 17–20

PLATE 17

Leptodontium integrifolium. 1. Plant about natural size. 2. Perichaetium, × 7. 3. Stem-leaf, × 15. 4. One side of base of leaf, × 115. 5. Median cells of leaf, × 240. 6. Apex of leaf, × 50. 7. Cross-section of leaf, × 150.

Globulina peruviana. 8. Plant about natural size. 9. Plant, × 10. 10. Stem-leaf, × 45. 11. Apex of costa and leaf, × 230. 12. Median cells of leaf, × 230. 13. Basal cells on one side of costa, × 230. 14. Cross-section of stem, × 230. 15. Cross-section of leaf, × 230.

PLATE 18

Tortula lacerifolia. 1. Plant about natural size. 2. Perichaetial leaf, × 25. 3. Upper stem-leaf, × 25. 4. A segment from the leaf-margin, × 130. 5. Base of leaf on one side of costa, × 180. 6. Cross-section of leaf, × 180.

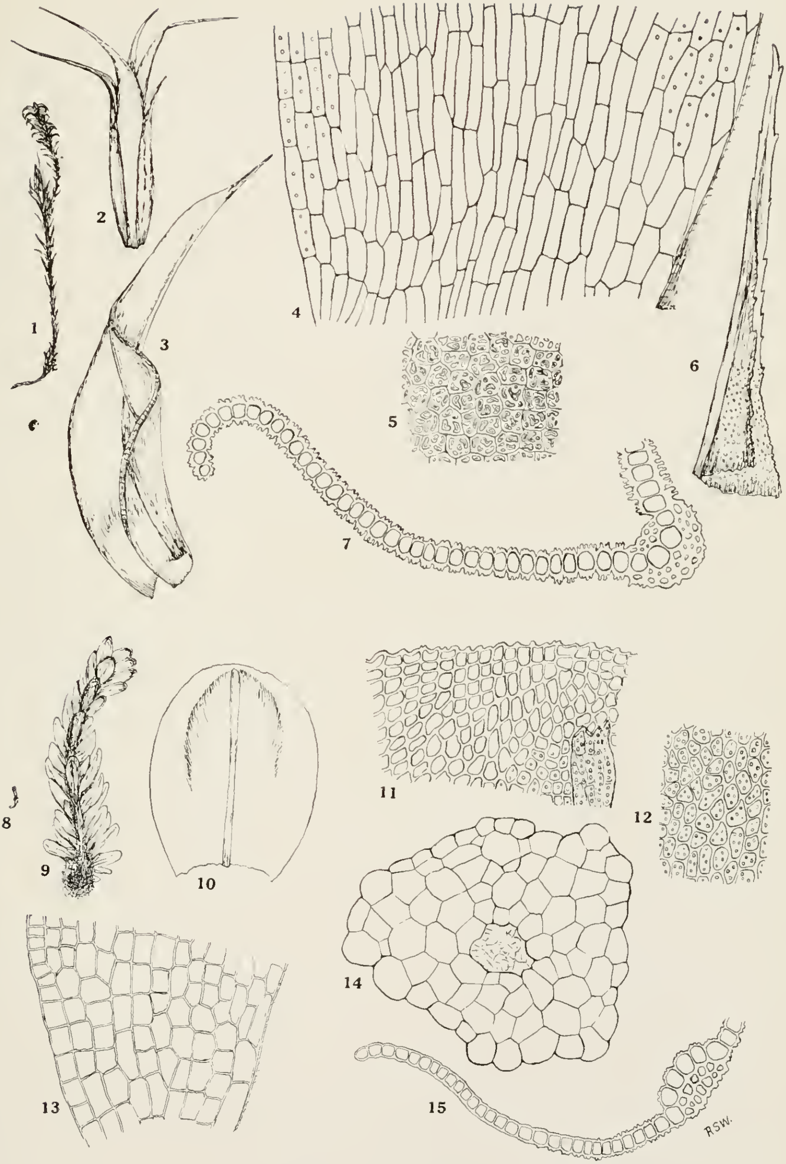
Hygrohypnum peruviense. 7. Plant about natural size. 8. Cross-section of stem, × 130. 9. Basal leaf-cells on one side of costa, × 270. 10, 11. Stem-leaves, × 25. 12. Median leaf-cells, × 270.

PLATE 19

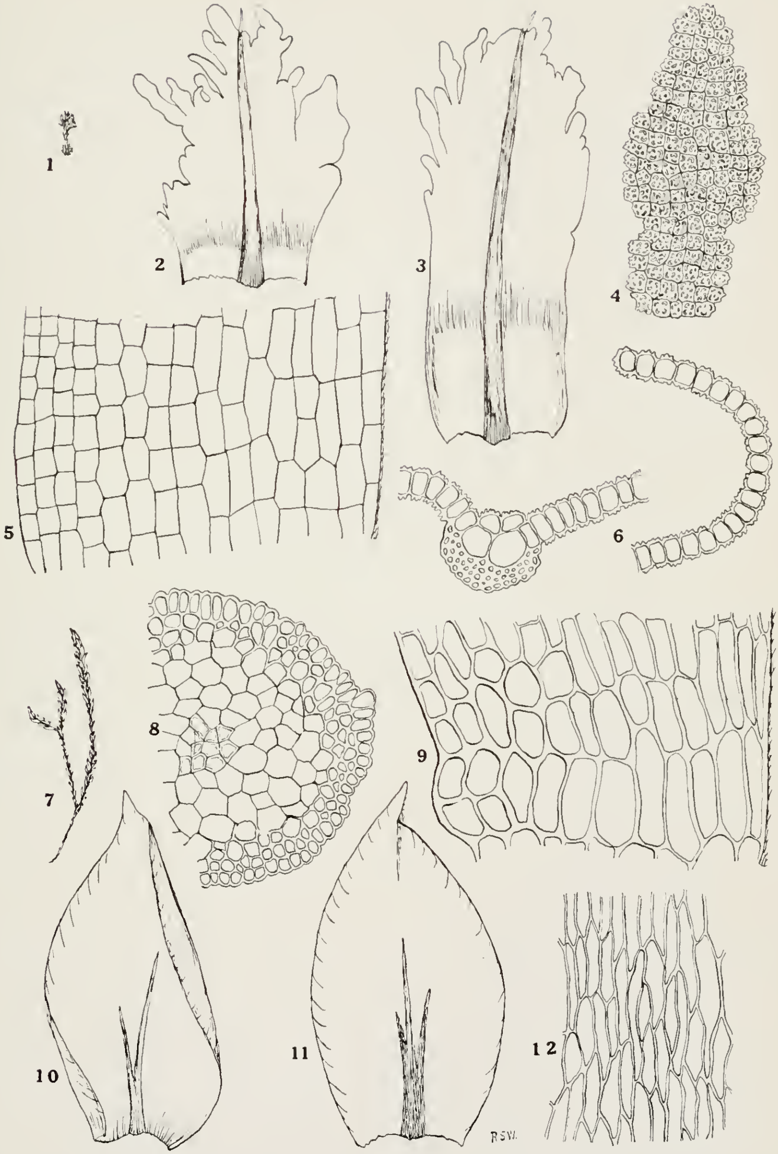
Grimmia rivulariopsis. 1. Fertile and male plant about natural size. 2. Capsule, seta and perichaetial leaf, × 20. 3. Calyptra, × 20. 4. Lid, × 20. 5. Part of peristome and rim of capsule, × 110. 6. Antheridia with leaf, × 20. 7. Upper part of stem leaf, × 180. 8. Stem-leaf, × 18. 9. Median cells of leaf, × 180. 10. Cells in lower part of perichaetial leaf, × 180. 11. Perichaetial leaf, × 18. 12. Median exothecal cells, × 180. 13. Cross-section of stem-leaf, × 180.

PLATE 20

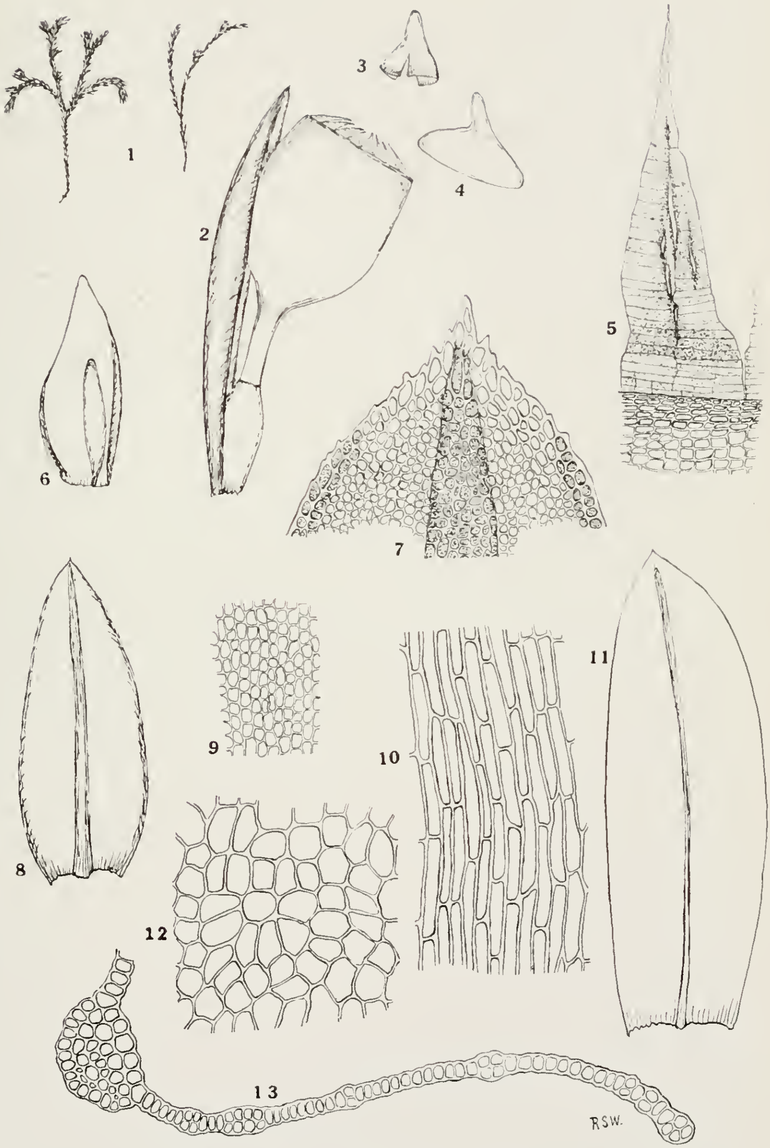
Bryum biforme. 1. Fertile and male plant about natural size. 2. Male plants, × 20. 3. Capsule, moistened, × 8. 4. Upper stem-leaf, × 16. 5. Outer perichaetial leaf, × 16. 6. Upper part of stem-leaf, × 135. 7. Border of leaf and adjoining cells about half way down, × 135. 8. Inner perichaetial leaf, × 16. 9. Stoma, × 135. 10. Median exothecal cells, × 135. 11. Part of peristome, annulus and rim of capsule, × 100.



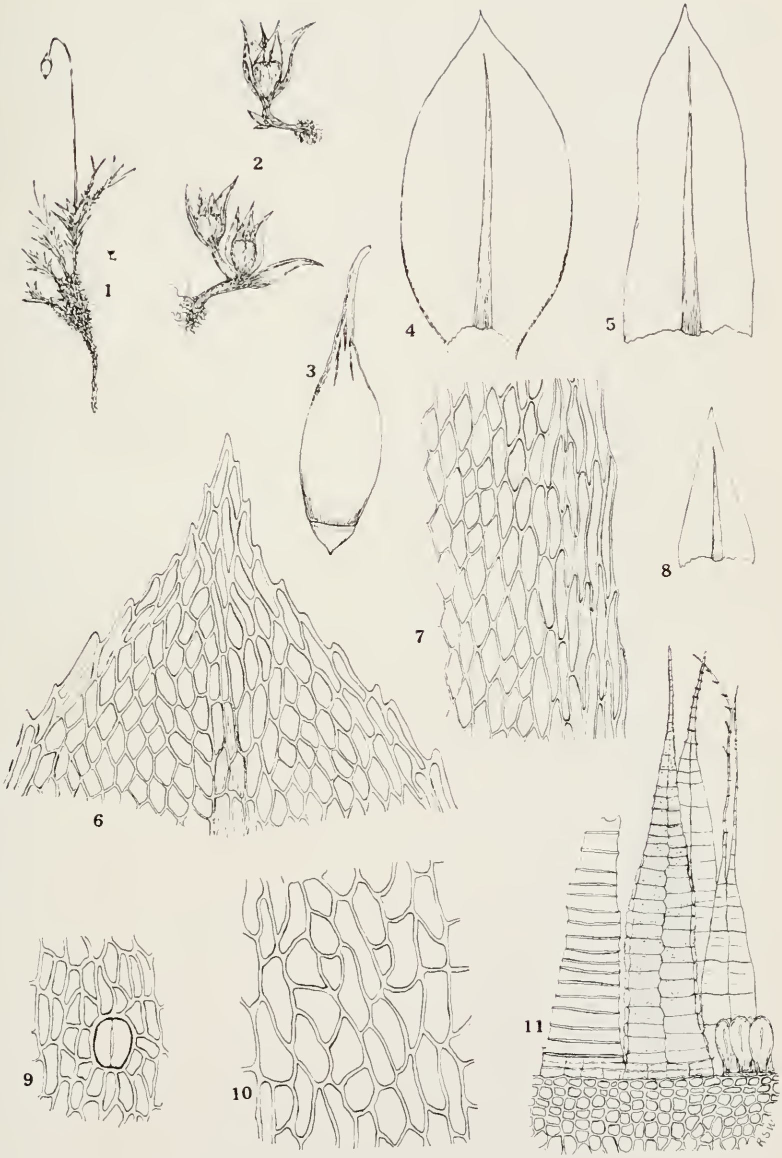
1–7. LEPTODONTIUM INTEGRIFOLIUM R. S. Williams
8–15. GLOBULINA PERUVIANA R. S. Williams



1–6. TORTULA LACERIFOLIA R. S. Williams
7–12. HYGROHYPNUM PERUVIENSE R. S. Williams



GRIMMIA RIVULARIOPSIS R. S. WILLIAMS



BRYUM BIFORME R. S. WILLIAMS

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL
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PHYTOGEOGRAPHICAL NOTES ON THE ROCKY MOUNTAIN REGION

VI. DISTRIBUTION OF THE SUBALPINE PLANTS

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Phytogeographical notes on the Rocky Mountain region
VI. Distribution of the subalpine plants

P. A. Rydberg

I have already pointed out in a paper entitled "Vegetative Life Zones of the Rocky Mountains," read at the twentieth anniversary of the New York Botanical Garden, that the Subalpine and Montane Zones of the Rockies are very different from those zones in the eastern part of North America, although the Hudsonian and Canadian Zones extend west to the foot of the Rockies from the headwaters of the Athabasca River northward. Also, I showed that the aspen was the only one among the ecologically important trees, common to the eastern and central (Rocky Mountain) provinces, that the Subalpine and Montane Zones of the central and western (Pacific) provinces merge in the north, and that many species have emigrated from either of these provinces to the other. These statements were largely based on the most conspicuous element of these zones, namely, the forest trees. Now it is to be shown whether or not these statements apply to the secondary species of the forests, to the grassands and other herbaceous formations, and to the coppice.

The subalpine flora may be divided into the following categories:—I. The transcontinental element, many members of which are also found in the Old World; II. Plants common to the Rockie and either of the other provinces; III. The endemic element. To the first belong the larger proportion of the plants common to the alpine-arctic zone.

Some of the plants of the first category may have a range limited in the Middle Province to the Canadian Rockies alone; others may extend throughout the Northern Rockies, but not be found in the Southern; while still others may extend throughout the Rocky Mountain system. Of the second category, some plants may be common to the Rockies and the Hudsonian Zone of the east, some others common to the Rockies and the Pacific mountains, or to the Sierra Madre in Mexico, or to the Alaskan mountains, or to the arctic coast. Some might have their home in the Rockies and spread to other regions, and others might be immigrants into the Rocky Mountain system. Among the plants of the third category, many are distributed throughout the Rockies, others have a distribution limited to either the Northern or the Southern Rockies, or to certain parts of either, while still others are purely local.

The strictly subalpine element of the flora of the Rockies is in fact very small, the plants consisting mostly of species that are found also in the Montane Zone, especially the upper part thereof, and of alpine-arctic species, running down in the swales, along the streams, or along the wind-swept hog-backs. In fact some plants, especially aquatics and hydrophytes, are common to three or more zones. In the following lists the plants common to the alpine-arctic zone are designated by a dagger (†). No attempt is made to designate those common to the Montane Zone, as they would probably constitute 90 per cent. of the remaining species.

I

1. Transcontinental species ranging throughout the Rockies

This element is represented among the trees by the quaking aspen, *Populus tremuloides*,* but this tree is not one of the characteristic trees of the Subalpine or Subarctic Zone either of the east or of the Rockies, nor is it limited to the subalpine regions. One should therefore not lay too much stress upon this tree and its

* It is true that some botanists, such as Tidestrom, Wooton and Standley, regard the Rocky Mountain aspen as a distinct species, *Populus aurea*, differing in smaller, thicker, less toothed leaves and different colored anthers and bark, but as the distribution of this species has not been worked out, it is better here to ignore the same and include it in *P. tremuloides*.

distribution when considering the resemblances of and distinctions between the Hudsonian flora and the subalpine flora of the Rockies. Looking over the following two lists we find that they are mostly made up of either aquatic plants and hydrophytes or plants from dense or open woods or copses, requiring a good deal of moisture.

Trees

Populus tremuloides

Shrubs

Salix chlorophylla
Betula glandulosa
Lepargyrea canadensis
Vaccinium caespitosum
Linnaea americana
Distegia involucrata

Herbs

Sparganium minimum
" *angustifolium*
Potamogeton natans
" *alpinus*
" *heterophyllus*
" *Richardsonii*
" *pectinatus*
" *filiformis*
Triglochin palustris
" *maritima*
Scheuchzeria palustris
Savastana odorata
Muhlenbergia racemosa
Phleum pratense
" *alpinum*
Alopecurus aristulatus
" *occidentalis*
Agrostis hiemalis
" *canina*
Calamagrostis Langsdorfii
" *canadensis*
" *purpurascens*
Deschampsia caespitosa
" *atropurpurea*
Avena striata
Danthonia intermedia
Trisetum subspicatum
Phragmites Phragmites
†*Catabrosa aquatica*
Bromus ciliatus
Poa pratensis
† " *alpina*
" *crocata*
†*Festuca curtifolia*
Panicularia nervata
Hordeum jubatum
Agropyron violaceum
Eriophorum angustifolium
†*Carex Hepburnii*
" *leptalea*
† " *obtusata*
† " *gynocrates*
" *siccata*
" *interior*
" *canescens*
" *brunnescens*
" *Rossii*
" *aurea*

†*Carex capillaris*
" *misandra*
" *Halleri*
† " *atrata*
" *rostrata*
Lemna minor
†*Juncus triglumis*
† " *castaneus*
Juncoides parviflorum
† " *spicatum*
" *intermedium*
†*Lloydia serotina*
Vagnera stellata
Lysiella obtusata
Peramium ophioides
†*Cytherea bulbosa*
†*Oxyria digyna*
†*Bistorta vivipara*
Alsine longifolia
" *laeta*
" *crassifolia*
" *borealis*
Moehringia macrophylla
" *lateriflora*
Sagina saginoides
†*Silene acaulis*
Anemone parviflora
Pulsatilla ludoviciana
†*Thalictrum alpinum*
Batrachium confervoides
†*Draba crassifolia*
† " *fladnizensis*
† " *aurea*
†*Chrysosplenium tetrandrum*
†*Saxifraga cernua*
Leptasea Hirculus
†*Sibbaldia procumbens*
†*Potentilla quinquefolia*
† " *nivea*
† " *uniflora*
Dasiphora fruticosa
Geum rivale
Tium alpinum
Epilobium alpinum
" *Hornemannii*
† " *anagallidifolium*
Chamaenerion angustifolium
† " *latifolium*
Hippurus vulgaris
Moneses uniflora
Pyrola uliginosa
" *chlorantha*
" *minor*
" *secunda*
Menyanthes trifoliata
Veronica americana
" *Wormskioldii*
" *serpyllifolia*
†*Elephantella groenlandica*
Utricularia vulgaris
" *minor*
Campanula petiolata
Erigeron jucundus
" *compositus*
Artemisia spithamaea

2. Transcontinental species confined to the Northern Rockies

The number of transcontinental plants found in the Northern Rockies, but not in the Southern, is much smaller, and of these a larger percentage are arctic-alpine, descending into the Subalpine Zone. Among these plants there are no trees and only a few low shrubs.

Shrubs

†*Salix pseudomyrsinites*
Ribes hudsonianum
Andromeda polifolia
Chiogenes hispidula
Vaccinium uliginosum

Herbs

†*Eriophorum Chamissonis*
†*Scirpus pauciflorus*
† " *caespitosus*
†*Carex capitata*
" *aenea*
" *Heleonastes*
† " *supina*
" *deflexa*
" *Hassei*
" *livida*
" *vaginata*
" *atratiformis*
" *miliaris*
" *scirpoidea*
†*Juncoides hyperboreum*
Cypripedium passerinum
†*Ranunculus hyperboreus*
Drosera rotundifolia
Parnassia palustris
† " *Kotzebuei*
†*Saxifraga rivularis*
Anthiphylla oppositifolia
Comarum palustre
Mertensia paniculata
Veronica scutellata
†*Pinguicula vulgaris*
Valeriana septentrionalis
Erigeron alpinus
" *unalaschkensis*
" *purpureum*
Senecio pauciflorus

3. TRANSCONTINENTAL SPECIES LIMITED TO THE CANADIAN ROCKIES

Some of the transcontinental subarctic plants have not spread at all south in the mountains and are found in the Rockies only at an altitude where the Subarctic Zone covers the lowlands. In other words, they are found only in the Canadian Rockies. These plants are also found north of the arctic timberline. They are:

Shrubs

†*Rubus acaulis*
† " *Chamaemorus*
†*Ledum groenlandicum*
†*Cassiope tetragona*
†*Vaccinum Vitis-Idaea*
†*Oxycoccus Oxycoccus*

Herbs

†*Eriophorum Scheucheri*
† " *alpinum*
†*Juncoides arcticum*
† " *arcuatum*
†*Orchis rotundifolia*
†*Arenaria norvegica*
†*Drosera longifolia*
†*Condrosea Aizoon*
†*Leptasea tricuspidata*

II

1. Species nearly equally distributed in the Rockies and the Pacific mountains

There are many species which seem equally at home both in the Rocky Mountains, the Sierra Nevada and the Cascade Mountains. The larger part of these are more or less xerophytic plants growing in the drier part of the subarctic zone, especially on southern exposures. Nearly all of the plants listed below are also equally distributed in the Montane and the Subalpine Zones. To these belong four of the conifers, *Pseudotsuga mucronata*, *Pinus Murrayana*, *P. flexilis* and *P. albicaulis*. Of these the last mentioned is the only one which is not better represented in the Montane Zone. Its distribution is also more extensive in the Pacific mountains, and it is not found in the Southern Rockies. It has therefore been placed among the immigrants, though its original home might be the Northern Rockies. *Pseudotsuga mucronata* is also found in the mountains of northern Mexico. All extend north in the Rockies to about latitude 55 degrees, except *Pinus Murrayana*, which grows much further north in the Yukon Valley, at latitude 65 degrees.

Trees

Pseudotsuga mucronata
Pinus Murrayana
Pinus flexilis

Shrubs

Salix glaucops
Ribes montigenum
Pachystima myrsinites
Phyllodoce empetriformis
Ledum glandulosum
Kalmia microphylla
Gaultheria humifusa

Herbs

Muhlenbergia comata	*Ranunculus Eschscholtzii*
Agrostis asperifolia	*Aconitum columbianum*
" *variabilis*	*Cardamine umbellata*
Danthonia californica	*Draba nitida**
Graphephorum muticum	† " *oligosperma*
Poa longiligula	†*Rhodiola integrifolia*
" *Fendleriana*	*Parnassia fimbriata*
Bromus polyanthus	*Pectianthia pentandra*
Panicularia pauciflora	*Micranthes arguta*
Elymus glaucus	*Ivesia Gordonii*
†*Carex nigricans*	*Potentilla diversifolia*
" *Douglasii*	*Fragaria bracteata*
" *illota*	*Gayophytum racemosum*
" *athrostachya*	*Amarella strictiflora*
" *phaeocephala*	" *plebeia*
" *festivella*	*Leptodactylon Nuttallii*
" *Reynoldsii*	*Phacelia heterophylla*
" *nova*	*Pentstemon procerus*
Lemna gibba	*Mimulus Langsdorfii*
Veratrum speciosum	*Pedicularis racemosa*
†*Juncus Drummondii*	" *bracteata*
† " *Parryi*	*Erigeron simplex*
" *Mertensianus*	" *Coulteri*
Eriogonum umbellatum	" *salsuginosus*
†*Bistorta bistortoides*	†*Antennaria media*
Alsine bailcalensis	" *rosea*
" *calycantha*	*Dugaldia Hoopesii*‡
†*Cerastium beeringianum*	*Achillea lanulosa*
Alsinopsis Nuttallii	*Arnica pedunculata*
Nymphaea polysepala	" *cordifolia*
Anemone globosa	

2. SPECIES COMMON TO THE ROCKIES AND THE MOUNTAINS OF THE GREAT BASIN

A few plants are distributed through a larger or smaller part of the Southern Rockies (especially the Wasatch Mountains of Utah

* Lacking in Colorado.

‡ In the Southern Rockies only.

and the Bear River Mountains of Idaho) and of the higher mountains of the Great Basin extending to the eastern slopes of the Sierra Nevada. These plants are very few in the Subalpine Zone, more in the Montane, and still more in the Submontane and Upper Sonoran. Some of these are listed under the endemic element of the Rockies, as it is very hard to tell whether their original homes are in the Rockies or in the Basin mountains. To this element belongs one tree, *Pinus aristata*, growing on dry southern slopes from Colorado west to eastern California. It is perhaps more frequently met with in Colorado, but it might have originated on the eastern slopes of the Sierra Nevada, as its only close relative, *P. Balfouriana*, is also found there. The following is a partial list of the plants of this category:

Tree

Pinus aristata

Herbs

†*Erigeron Kingii*
†*Draba pectinata*
Ivesia utahensis
Drymocallis pumila
Kentrophyta tegetaria
Macronema discoidea
Senecio seridophyllus

3. SPECIES COMMON TO THE NORTHERN ROCKIES AND THE CASCADE MOUNTAINS

As the Northern Rockies and the Cascades are connected by several mountain chains in British Columbia, it is very hard to decide where these common plants should be counted, to the Rocky Mountain flora or to the flora of the Cascades. It is probable that to the former should be counted those which are generally distributed in the main chain of the Rockies in Alberta and Montana, especially if their range extends south into the Yellowstone Park. I would even include in the Rocky Mountain flora such species as *Larix Lyallii* (although very local), which crosses the main range at a few places, while I would count *Tsuga Mertensiana*, which extends east only to the Bitter Root and Selkirk Mountains, to the Cascade element.

a. Rocky Mountain Element

Tree

Larix Lyallii

Shrubs

Ribes petiolaris
†*Phyllodoce glanduliflora*

Herbs

Carex Tolmiei
Tofieldia intermedia
Erythronium grandiflorum
Eriogonum Piperi
" *polyphyllum*
†*Draba lonchocarpa*
Ozomelis trifida
Heuchera ovalifolia
Drymocallis pseudorupestris
Atragallus spicatus
Hedysarum sulphurescens
Amarella anisopetala
Pentstemon crassifolium
Castilleja lutea
" *pallescens*
Erigeron pedatus
Antennaria corymbosa
†*Senecio Fremontii*

b. Cascade Element

Tree

Tsuga Mertensiana

Shrubs

Salix Barclayi
" *subcaerulea*
Alnus sinuata
Rubus nivalis
Azaliastrum albiflorum
Gaultheria ovatifolia

Herbs

Carex laeviculmis
" *stenochlaena*
" *Mertensii*
Juncoides glabratum
Alnus sinuata
Silene oregana
†*Ranunculus Suksdorfii*
Aquilegia columbiana
†*Smelowskia ovalis*
Arabis Lyallii
Hemieva ranunculifolia
†*Lutkea pectinata*
Viola adunca
Osmorrhiza Leibergii
Pentstemon fruticosus
Synthyris reniformis

Most of these extend to the western slopes of the Rockies in British Columbia or northern Montana, but *Tsuga Mertensiana*, *Osmorrhiza Leibergii* and *Synthyris reniformis* are restricted to the western slopes of the Bitter Root Mountains in Idaho.

4. Western immigrants from the Sierra Nevada and the Cascades, which have invaded the Northern Rockies

There are a number of species which are common to the Pacific mountains and the Rockies, but have a wider distribution in the former than in the latter. Their home may therefore be regarded as being on the west coast, and they may be regarded as immigrants into the Rocky Mountains. Those of the following list are common to the Sierra Nevada and the Cascades, and their range extends into the Northern Rockies. Some of these are found in the Bitter Root or the Selkirk Mountains only, and are without doubt immigrants. Others extend into the main Rockies of Alberta and Montana and even as far south as northern Wyoming. Whether these are immigrants or endemics to the Rockies is more doubtful. A very few reach the Wasatch Mountains in northern Utah. There are no immigrants from the Sierras to the southern Rockies. It is true that there are a few subalpine endemics common to the Sierra Nevada and the Southern Rockies, but these are plants characteristic of the mountains of the Great Basin, and limited to the eastern slope of the Sierra Nevada and the western slope of the Rockies.

Trees

Pinus albicaulis	*Salix sitchensis*

Shrubs

†*Salix cascadensis*	*Cassiope Mertensiana*
Ribes laxiflorum	*Vaccinium occidentale*
Ribes glandulosum	*Linnaea longiflora*

Herbs

Stipa oregonensis	*Carex spectabilis*
Poa Cusickii	*Xerophyllum tenax*

Juncus Regelii
" *nevadensis*
Cytherea occidentalis
†*Eriogonum pyrolaefolium*
Naiocrene parvifolia
†*Arenaria salmonensis*
Anemone Drummondii
Pulsatilla occidentalis
Ranunculus alismellus
Aquilegia formosa
Thlaspi californicum
Dentaria rupicola
Draba eurocarpa
Pectianthia Breweri
Heuchera glabra
Potentilla flabellifolia
Epilobium oregonense
" *luteum*
†*Dasystephana calycosa*
Romanzoffia sitchensis
Adenostegia ramosa
†*Pedicularis contorta*

Of these *Eriogonum pyrolaefolium*, *Draba eurocarpa*, *Potentilla flabellifolia* and *Linnaea longiflora* are limited to the Bitter Root-Selkirk region, while *Pinus albicaulis* and *Stipa oregonensis* extend south to Wyoming, and *Vaccinium occidentale* to northern Utah.

5. Immigrants from Alaska and the arctic coast

The following are mostly arctic, a few being subarctic plants from near the arctic timber line, which extend farther south in the Rockies and are there found in the subalpine as well as the alpine zone. Of these *Silene repens*, *Micranthes Lyallii*, *Dasystephana glauca* and *Euphrasia mollis* extend as far south as Montana; the others are limited to the Canadian Rockies.

Shrubs

†*Salix myrtillifolia*
† " *alaxensis*
† " *Barrattiana*
† " *Seemanii*
" *Drummondiana*
Salix arbusculoides
" *desertorum*
" *saskatchewana*
†*Arctous erythrocarpa*

Herbs

Carex venustula
" *physocarpa*
" *MacCallae*
Silene repens
†*Anemone Richardsonii*
Aconitum delphinifolium
Sophia sophioides
Pilosella Richardsoniana
Arabis ambigua
Micranthes Lyallii

Micranthes aestivalis
Spathularia Brunnoniana
" ferruginea
Argentina subarctica
†Hedysarum Mackenzii
Moneses reticulata
Androsace septentrionalis*
†Amarella propinqua
†Dasystephana glauca
†Castilleja pallida
Euphrasia mollis
Valeriana sitchensis
†Campanula heterodoxa
Erigeron grandiflorum
Erigeron lanatus
†Antennaria monocephala
†Artemisia Richardsoniana
Petasites frigida
" corymbosa
Senecio lugens

6. Immigrants from the south

Immigrants from the south are almost unknown in the Subalpine Zone; they are more frequent in the Montane and Submontane Zone and are very common in the Sonoran. The following are the only ones found in the subalpine zone:

Pseudocymopterus purpureus   *Blepharineuron tricholepis*

III

1. Endemic species, which also have emigrated into the Cascade Mountains

The endemic element of the Rocky Mountains is by far the largest. As the Rockies and the Cascades are connected through several mountain chains it is natural that many of the endemic Rocky Mountain species should have emigrated into the Cascade Mountains. Let us treat these species first.

The dominant tree in the Subalpine Zone is, as already stated in a previous article,† the Engelmann spruce, *Picea Engelmannii*. Often associated with it is found the subalpine fir, *Abies lasiocarpa*. Both extend throughout the Rockies from about latitude 55 degrees southward to the higher mountains of New Mexico and Arizona. They are also found in the northern portion of the western or Pacific province, i.e. throughout the Cascades, but not in the Sierra Nevada region. They are not found in the eastern province but are represented there by *Picea canadensis*, *P. mariana*, and *Abies balsamea*. Although the two species of *Picea* have been reported

* Also in Europe.

† See Bull. Torrey Club 42: 11. Ja 1915.

from Alberta and Montana, all specimens referred to these and seen by me have turned out to belong to *Picea albertiana*. *Picea Engelmannii* and *Abies lasiocarpa* may be regarded as endemic Rocky Mountain species, which have emigrated into the Cascades. In the Northern Rockies there could be added to these *Larix Lyallii*, which has also emigrated into the northern part of the Cascades. In the very lowest part of the Subalpine Zone there are sometimes found intermixed trees of *Pseudotsuga mucronata* belonging really to the Montane Zone. It has about the same distribution in the Rockies as the spruce and fir mentioned above, but is also equally common though in the Pacific province and extends south into the Sierra Madre of Mexico. It is hard to tell if its original home was in the Rockies or on the Pacific coast.

The two species, *Picea Engelmannii* and *Abies lasiocarpa*, are not restricted to the Subalpine Zone, however, for both run down into the Montane Zone on northern slopes and along streams. The element of the Rocky Mountain flora, which has the same distribution as these, is, as stated before, not large and it contains no other woody plants.

Trees

Picea Engelmannii	*Abies lasiocarpa*

Herbs

Trisetum majus	*Arabis rupestris*
Poa reflexa	" *Drummondii*
" *leptocoma*	*Lithophragma bulbifera*
" *Paddensis*	*Ozomelis stauropetala*
" *nevadensis*	*Leptasea austromontana*
† " *rupicola*	†*Sieversia ciliata*
†*Festuca saximontana*	*Epilobium Drummondii*
Carex Engelmannii	†*Phlox caespitosa*
" *pyrenaica**	*Macronema grindelifolium*
" *petasata*	*Aster apricus*
" *Geyeri*	*Anaphalis subalpina*
Juncus balticus montanus	*Antennaria umbrinella*
Ophrys nephrophylla	" *anaphaloides*
Trollius albiflorus	*Arnica Parryi*
Cardamine acuminata	" *Rydbergii*

* Also in Europe and Asia.

2. Endemic species, common to the Northern and Southern Rockies

The endemic element, which extends over the whole Rockies, but has not invaded the Cascades, is much larger, but it does not include any of the forest trees and only a few shrubs. It consists of the following species:

Shrubs

†*Salix petrophila*
† " *saximontana*
" *brachycarpa*
Ribes parvulum
†*Vaccinium oreophilum*
" *scoparium*

Herbs

Potamogeton interior
Stipa Tweedyi
" *minor*
" *Nelsonii*
Deschampsia curtifolia
Poa Olneyi
" *Buckleyana*
" *epilis*
" *laevigata*
Bromus Porteri
" *Pumpellianus*
Festuca ingrata
Agropyrum andinum
" *Scribneri*
Carex pseudoscirpoidea
† " *albonigra*
† " *chalciolepis*
† " *scopulorum*
† " *chimaphila*
Allium brevistylum
*Disporum trachycarpum**
Ophrys borealis
Eriogonum flavum
Bistorta linearifolia
†*Claytonia megarrhiza*
†*Oreobroma pygmaea*
Alsine strictiflora‡
Cerastium scopulorum
" *strictum*
†*Alsinopsis propinqua*
† " *obtusiloba*
Silene Douglasii
" *Menziesii*
†*Anemone zephyra*
Thalictrum venulosum
Atragene tenuiloba
†*Ranunculus affinis*
† " *eximius*
" *alpeophilus*
Aquilegia caerulea
Thlaspi glaucum
†*Smelowskia americana*
Radicula alpina
†*Draba andina*
" *crassa*
†*Clementsia rhodantha*
Heuchera parviflora
†*Saxifraga debilis*

* East to Manitoba and the Black Hills.
‡ East to Quebec.

†*Muscaria adscendens**
" *delicatula*
†*Micranthes rhomboidea*
" *arnoglossa*
†*Spathularia Vreelandii*
Potentilla filipes
" *glaucophylla*
" *divisa*
† " *saximontana*
" *arachnoidea*
Fragaria glauca
†*Acomastylis turbinata*
Lupinus parviflorus
" *caespitosus*
†*Trifolium nanum*
Atelephragma elegans
Aragallus deflexus
†*Epilobium clavatum*
" *wyomingense*
Osmorrhiza obtusa
†*Vaccinium oreophilum*
" *scoparium*
†*Primula Parryi*
†*Androsace carinata*
" *subumbellata*
" *filiformis*
Anthropogon elegans
†*Dasystephana Romanzovii*
† " *affinis*
Pleurogyne fontana
Swertia scopulina
† " *congesta*
Leptodactylon pungens
†*Phlox depressa*
Phlox Kelseyi
" *alyssoides*
†*Phacelia sericea*
† " *ciliosa*
†*Eritrichum elongatum*
*Myosotis alpestris**
Besseya gymnocarpa
Castilleja rhexifolia
" *lanata*
" *lancifolia*
† " *occidentalis*
Valeriana edulis
Solidago scopulorum
† " *ciliosa*
" *oreophila*
Chrysopsis pumila
†*Aster alpinus**
" *Fremontii*
†*Erigeron trifidus*
" *glabellus*
" *flagellaris*
Antennaria microphylla
" *sedoides*
" *aprica*
Chaenactis alpina
†*Rydbergia grandiflora*
Achillea subalpina
†*Artemisia scopulorum*
Arnica subplumosa
" *rhizomata*
" *pumila*
†*Senecio Purshianus*
" *cymbalarioides*
" *pseudaureus*

3. ENDEMIC SPECIES LIMITED TO THE NORTHERN ROCKIES

The following endemics are not merely local but are practically limited to the Northern Rockies:

* Also in Europe.

Shrubs

†*Salix Tweedyi*	*Salix Fernaldii*

Herbs

*Alopecurus caespitosus**	*Potentilla glomerata*
Agrostis idahoensis	" *perdissecta*
Poa nervosa	" *Macounii*
" *confusa*	" *ovina*
Sitanion rigidum	†*Acomastylis sericea*
Agropyron latiglume	*Lupinus pulcherrimus*
Xerophyllum Douglasii	" *monticola*
Erythronium obtusum	*Trifolium Haydeni*
Eriogonum caespitosum	† " *montanense*
" *heracleoides*	*Cystium platytropus*‡
Spraguea multiceps	*Atelophagma Forwoodii*
†*Alsine americana*	" *debilis*
Arenaria lithophila	*Homalobus Bourgovii*
†*Silene Lyallii*	†*Aragallus foliolosus*
" *multicaulis*	† " *alpicola*
Anemone tetonensis	† " *viscidus*
" *lithophila*	† " *viscidulus*
Ranunculus saxicola	*Viola flavovirens*
" *Helleri*	*Epilobium latiusculum*
†*Caltha leptosepala*	" *saximontanum*
†*Aquilegia Jonesii*	*Ligusticum filicinum*
†*Smelowskia lobata*	*Pseudoreoxys bipinnata*
†*Draba densiflora*	*Angelica Roseana*
Arabis oreophila	*Bupleurum americanum*
" *exilis*	" *purpureum*
Coniomitella Williamsii	*Vaccinium globularis*
Heuchera flabellifolia	†*Douglasia montana*
" *grossularifolia*	†*Dasystephana monticola*
†*Telesonix heucheriformis*	*Polemonium pulcherrimum*
†*Muscaria monticola*	† " *viscosum*
†*Micranthes Rydbergii*	†*Collomia debilis*
" *occidentalis*	†*Phlox costata*
† " *saximontana*	† " *diapensioides*

* Canadian Rockies only.

‡ Also in Nevada.

Phacelia alpina
† " *Lyallii*
Mertensia stenoloba
† " *Tweedyi*
Pentstemon Lyallii
† " *montanus*
" *aridus*
" *pseudohumilus*
" *Tweedyi*
Synthyris laciniata
" *dissecta*
†*Castilleja Tweedyi*
† " *pulchella*
†*Pedicularis ctenophora*
† " *cystopteridifolia*
Oreostemma Haydeni
†*Erigeron radicatus*
Hulsea carnosa
Senecio sphaerocephalus
† " *alpicola*
" *megacephalus*

Some of these endemics of the Northern Rockies extend south into the Wasatch Mountains of Utah. As I have already stated, the exchange of species between the Northern and Southern Rockies does not take place along the continental divide in Wyoming, but between the Wasatch and Teton Mountains, through the Bear River Mountains in southeastern Idaho. This exchange is more evident in the Montane Zone, but the following northern endemics have crossed the line and their range extends into Utah:

Eriogonum heracleoides
Arabis oreophila
Anemone tetonensis
Potentilla Macounii
Ligusticum filicinum
Angelica Roseana
Vaccinium globulare
Polemonium viscosum
Collomia debilis
Synthyris laciniata

A few of the northern endemics extend eastwards into the Black Hills of South Dakota such as:

Atelephragma Forwoodii
Epilobium saximontanum

4. ENDEMIC SPECIES RESTRICTED TO THE SOUTHERN ROCKIES

The endemics are more numerous in the Southern Rockies than in the Northern. The more widely distributed are the following:

Shrubs

Salix pseudolapponum
" *Wolfii*
Ribes coloradensis
Ribes Wolfii
Sambucus microbotrys

Herbs

Muhlenbergia Wolfii
“ *subalpina*
“ *filiculmis*
“ *gracilis*
†*Deschampsia alpicola*
†*Avena Mortoniana*
Trisetum montanum
Graphephorum Wolfii
†*Poa alpicola*
“ *Vaseyana*
“ *occidentalis*
“ *lucida*
“ *aperta*
“ *longipedunculata*
“ *Sheldoni*
† “ *Pattersoni*
“ *Traceyi*
† “ *Grayana*
† “ *Lettermanii*
Festuca arizonica
“ *Thurberi*
† “ *minutiflora*
Elymus simplex
Carex elynoides
“ *occidentalis*
“ *Egglestonii*
“ *eburnea*
“ *Nelsonii*
† “ *bella*
Veratrum tenuipetalum
Anticlea coloradensis
Juncus Hallii
“ *parous*
Juncoides subapetalum
Erythronium parviflorum
Sisyrinchium alpestre
Limnorchis purpurascens
Eriogonum arcuatum
“ *chloranthum*
“ *neglectum*
†*Paronychia pulvinata*
Cerastium Earlei
“ *variabile*
“ *oreophilum*
Alsinopsis macrantha
Arenaria confusa
“ *Tweedyi*
“ *Fendleri*
Silene Hallii
†*Wahlbergella montana*
*Ranunculus alismaefolius**
“ *Macauleyi*
“ *micropetalus*
† “ *adoneus*
† “ *stenolobus*
†*Caltha rotundifolia*
†*Aquilegia saximontana*
“ *elegantula*
“ *oreophila*
Aconitum Bakeri
“ *insigne*
Delphinium occidentale
“ *Barbeyi*
†*Thlaspi coloradense*
† “ *purpurascens*
†*Smelowskia lineariloba*
Lesquerella parvula
“ *montana*
Sophia purpurascens
Cheirinia oblanceolata
“ *nivalis*
† “ *radicata*
† “ *amoena*
†*Draba Parryi*

* North to Wyoming.

Draba chrysantha
" *graminea*
" *streptocarpa*
" *spectabilis*
" *luteola*
" *aureformis*
†*Rhodiola polygama*
Ozomelis stenopetala
" *Parryi*
Heuchera flavescens
†*Telesonix Jamesii*
†*Saxifraga simulata*
†*Micranthes brachypus*
†*Leptasea chrysantha*
Potentilla modesta
" *viridior*
" *decurrens*
Drymocallis fissa
†*Trifolium stenolobum*
† " *lividum*
† " *dasyphyllum*
" *Brandegei*
† " *Parryi*
Homalobus humilis
Aragallus oreophilus
" *Parryi*
Lathyrus arizonicus
Geranium Pattersonii
Viola neomexicana
" *bellidifolia*
Epilobium ovatifolium
" *stramineum*
Ligusticum Porteri
Ligusticella Eastwoodiae
†*Oreoxis humilis*
† " *Bakeri*
† " *alpina*
Pseudocymopterus montanus
Pseudocymopterus sylvaticus
† " *Tidestromii*
Pseudopteryxia anisata
" *longiloba*
Oxypolis Fendleri
†*Angelica Grayi*
Conioselinum scopulorum
" *coloradense*
†*Primula angustifolia*
Androsace pinetorum
†*Anthropogon barbellatum*
†*Amarella monantha*
†*Condrophora Fremontii*
† " *americana*
Dasystephana Parryi
Ploemonium delicatum
" *foliosissimum*
† " *confertum*
" *miletum*
† " *Brandegei*
Gilia globularis
†*Phlox condensata*
Phacelia nervosa
†*Eritrichium argenteum*
Mertensia polyphylla
† " *lateriflora*
† " *Bakeri*
† " *nivalis*
† " *viridula*
† " *Parryi*
† " *alpina*
†*Pentstemon Hallii*
† " *stenosepalus*
† " *Harbourii*
† " *caespitosus*
Chionophila Jamesii
†*Besseya alpina*
" *plantaginea*

Besseya Ritteriana
Castilleja brunnescens
" *confusa*
† " *puberula*
†*Pedicularis Parryi*
" *Grayi*
† " *scopulorum*
Valeriana acutiloba
Campanula Parryi
Coleosanthus umbellatus
Solidago decumbens
†*Tonestus pygmaeus*
Oreochrysum Parryi
Chrysopsis alpicola
" *asprella*
Pyrrocoma Clementis
Townsendia grandiflora
Aster Canbyi
†*Erigeron pinnatisectus*
† " *melanocephalus*
† " *leiomeris*
" *glandulosus*
" *elatior*
" *superbus*
" *formosissimum*
Hymenopappus cinereus
†*Rydbergia Brandegei*
†*Artemisia Pattersonii*
†*Artemisia saxicola*
Arnica macilenta
" *ovata*
Senecio chloranthus
" *pudicus*
† " *amplectens*
" *pagosanus*
† " *Holmii*
† " *taraxacoides*
" *Soldanella*
" *carthamoides*
" *invenustus*
" *admirabilis*
" *lapathifolium*
" *crassulus*
" *perplexans*
" *anacletus*
" *atratus*
" *foliosus*
† " *Harbourii*
" *Nelsonii*
" *crocatus*
" *Jonesii*
† " *petrocallis*
" *pentadontus*
† " *werneriaefolius*
" *ambrosioides*
" *multicapitatus*

5. Local endemic species

The following are rare and local species which have been collected at only one or two localities within the Canadian Rockies or the states mentioned below:

Canadian Rockies

†*Wahlbergella attenuata*
†*Cassiope saximontana*
†*Douglasia nivalis*
†*Mertensia Drummondii*
†*Antennaria chlorantha*
" *acuta*

Montana

†*Potentilla Vreelandii*
Dodecatheon uniflorum
Pedicularis Canbyi

Idaho

Allium simillisimum
Romanzoffia Leibergii
†*Tonestus laceratus*

Wyoming

†*Oreobroma minima*
Aconitum ramosum
†*Draba ventrosa*
†*Muscaria micropetala*
Potentilla wyomingensis
" *virgultata*
" *Nelsonii*
†*Pedicularis Hallii*
" *lunata*
†*Trifolium scariosum*
Mertensia viridis
Aquilegia larimiensis
†*Erigeron flabellifolius*
Arnica tenuis

Utah

†*Wahlbergella Kingii*
Aquilegia scopulorum
Delphinium attenuatum
Capnorchis brachycarpum
Lesquerella Wardii
†*Draba sobolifera*
" *brachystylis*
Gormannia debilis
Edwinia macrocalyx
Potentilla paucijuga
†*Synthyris pinnatifida*
Castilleja viscida
" *parvula*

Colorado

Poa callicroa
" *pudica*
" *tricholepis*
Allium Pikeanum
Alsine polygonoides
Radicula curvipes
Radicula Underwoodii
Arabis oblanceolata
†*Potentilla tenerrima*
† " *minutifolia*
†*Trifolium bracteolatum*
†*Trifolium attenuatum*
†*Aragallus Hallii*
†*Polemonium Grayanum*
Besseya reflexa
Chaenactis peduncularia

One of the strangest distributions is that of *Viola biflora*, a European species, which has been collected in America only at a few places in Colorado and in Alaska.

SUMMARY

The subalpine flora contains over eight hundred species. Of these about 30 per cent. are also found above the timberline and about 60 per cent. are also found in the Montane Zone or pine belt. This leaves only about 10 per cent., which are restricted to the Subalpine Zone. The percentage of characteristic subalpine species is, however, larger, probably 25 per cent. or 30 per cent. of the number, for the 30 per cent. growing above the timberline is divided into two categories, alpine plants descending below the timberline, and subalpine species ascending above the same. So are also some of the plants which are common to the Subalpine and Montane Zones, essentially subalpine, though they descend into the upper part of the Montane Zone. A small proportion is even common to the three zones, and a few, as for instance *Poa crocata*, range from the plains to the alpine regions.

Of the eight hundred species, over 20 per cent. are transcontinental plants, and of these the larger part, about 15 per cent. of the whole number, extend as far south as Colorado and scarcely 2 per cent. are confined to the Canadian Rockies. About one hundred species are common to the old world. Besides the transcontinental element nearly 20 per cent. more are common to some part of the Rocky Mountain region and some part of the Pacific mountains. Of these about 5 per cent. are equally distributed throughout both provinces and 6 per cent. limited to the northern part of both. The remainder is about equally divided between Rocky Mountain plants which have invaded the Cascades and Pacific plants found in the Northern Rockies.

The strictly endemic species constitute nearly 60 per cent., and if those which have invaded the Pacific mountains are added the endemic element comprises about 70 per cent. of the flora. Of the 60 per cent. of strictly endemic plants fully one half are restricted to the Southern Rockies, fully one fourth common to both, and less than one fourth restricted to the Northern.

Of the trees and shrubs found in the Subalpine Zone, eighteen are transcontinental, eighteen are common to the Pacific mountains or emigrants from them, nine are immigrants into the Canadian Rockies from arctic regions, and eighteen are endemics, five of which have invaded the Cascades. Of the endemics, eight are common to both the northern and the southern Rockies, and five are limited to each region; none of them are strictly local.

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187. Notes on Plants of the Southern United States—I, by Francis W. Pennell.

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NOTES ON PLANTS OF THE SOUTHERN UNITED STATES—II

FRANCIS W. PENNELL

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Notes on plants of the southern United States—II

FRANCIS W. PENNELL

In the first series of these notes, published in the February Bulletin of this year, there was given a tentative revision of the genus *Commelina*. The treatment of species there presented differed widely from current treatments and should probably have been preceded by a fuller introductory statement. A summary of the conclusions reached may therefore be in place.

Commelina communis L. is the common introduced weed of the northeastern states. Both *Commelina longicaulis* Jacq. and the little-known *C. caroliniana* Walt. have passed as *C. nudiflora* L., but, as is shown on page 96, the latter specific name must be retained for a plant of another genus, *Aneilema nudiflorum* (L.) Kunth. Strangely enough the Linnean *Commelina nudiflora* had been perpetuated in the names of two species belonging to different genera. Linnaeus's description of his *Commelina virginica* is clear and diagnostic, and leaves no doubt that the plant he was considering is that we have been calling *C. hirtella* Vahl. But the plant which has been separated in recent floras, by reason of having its capsule three-celled, as *C. virginica*, is but a state or condition of *C. erecta* L. *C. crispa* Wooton and *C. angustifolia* Michx. are continued as species but are very near, possibly not distinct from, *C. erecta*. *Commelina elegans* HBK. is a widespread species of tropical America.

In the present paper further noteworthy records, based upon my southern collections of 1912 and 1913, are given, and revisions are made of a portion of the genus *Schoenocaulon*, and of the *Nemexia* subgenus of the genus *Smilax*.

MISCELLANEOUS SPECIES

CAREX GLAUCESCENS Ell.

This species was listed in the first series of these Notes (p. 95) as *C. verrucosa* Muhl., a later name. See Mackenzie; Small, Fl. SE. U. S. ed. 2, 1324. 1915.

PLEEA TENUIFOLIA Michx.

Moist sandy soil in pine-land, Winter Park near Wilmington, New Hanover County, North Carolina, October 16, 1912, *4917*.

YUCCA GLAUCA Nutt.?

As compared with the prevalent growth of this widespread species, plants collected near Dallas, Texas (*Reverchon 4029, 4029A*, *F. W. Pennell 5407*), apparently differ as follows:

Leaves thickened, rigid, usually conspicuously fibrillose. Upper bracts ovate, acute, pale, with broad white margins. Capsule 50–60 mm. long, oblong, not or scarcely constricted. Seeds flat, 9–10 mm. long. 1. *Y. glauca* Nutt.

Leaves thinner, shorter, dull-green, weak-tipped, short-fibrillose above, more fibrillose at base. Upper bracts broadly lanceolate, acuminate, brown, with narrower white margins. Capsule 30 mm. long, oblong-ovoid, evidently constricted about the middle Seeds more turgid, 6 mm. long. 2. *Y.* sp.

Full identification of the doubtful plant is left for someone more conversant with this group.

GYROTHECA TINCTORIA (Walt.) Salisb.

Moist open pine-land, north of Abita Springs, St. Tammany Parish, Louisiana, > August 14, 1912, *4196*.

BLEPHARIGLOTTIS CONSPICUA (Nash) Small.

Moist sandy open pine-land, Pass Christian, Harrison County, Mississippi, > August 27, 1912, *4364*.

IBIDIUM BECKII (Lindl.) House.

Moist deciduous woodland, Catalpa, West Feliciana Parish, Louisiana, > August 21, 1912, *4282*.

SCHOENOCAULON A. GRAY IN SOUTHERN TEXAS

Two species of this genus, hitherto confused, may be distinguished as follows:

Base of stem scarcely or not fibrous-coated. Leaves 3–5 mm. wide, slightly or not glaucous, shorter than the scape. Scape stout. Inflorescence 15–20 mm. thick. Bracts rounded. Perianth-segments oblong-ovate, nearly membranous, with broad scarious margins, crenulate. Filaments stout, much dilated, 5–7 mm. long. Styles 1–2 mm. long. Flowering in autumn. 1. *S. Drummondii.*

Base of stem densely fibrous-coated. Leaves 1.5–4 mm. wide, glaucous, mostly equaling the scape. Scape slender. Inflorescence 9–15 mm. thick. Bracts acutish to acute. Perianth-segments linear-oblong, thickened, not scarious-margined, entire. Filaments slender, not dilated, 3–4 mm. long. Styles less than 1 mm. long. Flowering in spring. 2. *S. texanum.*

1. SCHOENOCAULON DRUMMONDII A. Gray; Torrey, Bot. Mex. Bound. Surv. 222. 1858–9. "This species was first discovered by Drummond, and is No. 284 of his third Texan collection." Co-type seen in the herbarium of Columbia University at the New York Botanical Garden.

Texas. In the lower coastal plain. Flowers late-September to early-October.

TEXAS. Colorado: sandy soil, three miles east of Alleyton, > September 22, 1913, *F. W. Pennell 5557* (P, Y). Dewitt: roadside near Yorktown, > October 6, 1857, *A. Schott* (Y).

2. SCHOENOCAULON TEXANUM Scheele, Linnaea **25**: 262. 1852. "Gesellschaftlich auf trockner Prairie, deren sehr nahe Unterlage Kalkfelsen ist, bei Neubraunfels: *Lindheimer*, April 1846." *Lindheimer 1221*, seen in the herbaria of the New York Botanical Garden, the Academy of Natural Sciences at Philadelphia and the University of Pennsylvania, is probably from the type-locality.

Texas to Chihuahua and San Luis Potosi. Edwards Plateau and southwestward. Flowers April to June.

TEXAS. Hays: San Marcos > Spring, 1898, *S. W. Stanfield* (Y). Kendall: Rocky bluffs, > June, 1885, *J. Reverchon 1607* (P, Y). Kerr: Kerrville > April to June, 1894, *A. A. Heller 1626* (A, Y). Travis: hills, Austin, > May 13, 1872, *E. Hall 644* (Y).

SMILAX, SUBGENUS NEMEXIA (RAF.), IN THE EASTERN UNITED STATES

The subgenus or section of *Smilax* containing the herbaceous-stemmed vines, frequently with beautiful foliage and bearing umbels of lurid green, mostly malodorous flowers—a group of plants commonly known as the carrion-flowers—is one which has long been of especial difficulty to taxonomists. Various writers have held nearly the entire group of species here presented, as well as certain East Asian allies, in one species, *Smilax herbacea*, while others have attempted segregations based upon the shape of the branchlets, the length of the peduncles, the number of primary veins, and other characters which field-study proves too variable for certain use. But it has gradually become apparent that a number of species may be distinguished upon features at first thought of little moment.

Linnaeus in the first edition of the Species Plantarum recognized two species, *Smilax herbacea* and *S. Pseudo China*. The types of these show that they are identical, and that the widespread glaucous- and glabrous-leaved species of the east is properly called *S. herbacea*. *Smilax tamnifolia* and *S. pulverulenta*, two surprisingly distinct species considering how poorly our books have described them, were added by Michaux. *Smilax lasioneuron* was described by Hooker in 1840 from the Saskatchewan region, and the main innovation of this present revision is the extension of this species eastward to embrace a plant widespread through the Mississippi Valley states. Hooker and his followers have laid emphasis upon the short-peduncled cymes of *S. lasioneuron*, but it requires but slight inspection of a series of any species of this group to show how undependable this character is; indeed, that peduncles should be shortened in specimens of western more arid regions seems natural. Two southern species have been added by Dr. Small, and the present writer describes one species, believed new to science, from Georgia.

The carrion-flowers are here continued as a subgenus of *Smilax*, in deference to the opinion of Mr. John B. Norton, of the United States Department of Agriculture, who is engaged in a study of the entire genus *Smilax*. To him I am indebted for valuable criticism.

My interest in this group extends from 1908, and my collections include most of the species, although several critical southern species have not been obtained.

Anthers about equaling the filaments. Leaves lanceolate to triangular-ovate, usually more or less hastate-lobed at base. Leaves slightly paler and glabrous beneath. Peduncles frequently several in an axil.

  Perianth-segments 1.5–2.5 mm. long. Peduncles and pedicels relatively short, the latter less than 10 mm. long. — 1. *S. tamnifolia.*

  Perianth-segments 4 mm. long. Peduncles and pedicels longer, the latter about 20 mm. long. — 2. *S. leptanthera.*

Anthers shorter than the filaments. Leaves ovate to cordate, not hastate-lobed at base.

  Mature leaves pale beneath, relatively short-acuminate. Berries dark-blue, glaucous. Perianth-segments broadly lanceolate, 2–5 mm. long.

Leaves glabrous beneath. Bracts on stem below leaves appressed.
Stem 3–5 dm. tall, erect, without tendrils. Leaves all clustered near summit of stem, oblong-ovate, acute. Perianth-segments 2–3 mm. long. Seeds 4.5–5 mm. long, maturing two to a berry. 3. *S. biltmoreana.*
Stem elongated, climbing, with tendrils. Leaves on adult stems all alternate, cordate to ovate, acuminate. Perianth-segments 3–4 mm. long. Seeds 3.5–4 mm. long, maturing three to five to a berry. 4. *S. herbacea.*
Leaves puberulent to pubescent beneath. Bracts on stem below leaves more or less spreading.
Stem elongated, climbing, with numerous tendrils. Peduncles all in the axils of normal leaves. Leaves puberulent to pubescent beneath, acuminate. Seeds maturing three to five to a berry.
Perianth-segments 3.5–4.5 mm. long. Leaves ovate to cordate. 5. *S. lasioneuron.*
Perianth-segments 2–2.5 mm. long. Leaves triangular-ovate. 6. *S. tenuis.*
Stem not or slightly elongated, not climbing, with few to no tendrils. Peduncles, at least in part, in the axils of bracts below the leaves. Leaves pubescent beneath.
Perianth-segments 4–5 mm. long. Seeds maturing three to five to a berry. Leaves acuminate, paler beneath. Stems frequently somewhat elongated and with tendrils. 7. *S. ecirrhata.*
Perianth-segments 2.5–3 mm. long. Seeds maturing two to three to a berry. Leaves acute to mucronate, whitened beneath. Stems not elongated, very rarely with tendrils. 8. *S. Hugeri.*
Mature leaves shining-green beneath, strongly acuminate. Berries black, not or scarcely glaucous. Seeds maturing three to five to a berry. Perianth-segments lanceolate, 4–6 mm. long. 9. *S. pulverulenta.*

1. SMILAX TAMNIFOLIA Michx.

Smilax tamnifolia Michx. Fl. Bor. Am. 2: 238. 1803. "Hab. in Carolina." Description of leaves as "rotundato-obtusis" apparently applies to this. Type not verified.
Coprosmanthus tamnifolius Kunth, Enum. Pl. 5: 267. 1850.
Nemexia tamnifolia Small, Fl. SE. U. S. 281. 1903.

Moist sandy soil near streams, in the Coastal Plain; Long Island to South Carolina.

Flowers after the other species, in northern New Jersey and on Long Island in late-June and early-July.

NEW YORK. Nassau: Rockville Center, *E. P. Bicknell* > June 27 (Y).

NEW JERSEY. Atlantic: Egg Harbor, *J. B. Brinton* > June 21 (P). Burlington: Atsion, *B. Long 6217* > July 19 (A). Camden: Parkdale, *G. W. Bassett 66* > June 14 (A). Cape May: Court House, *F. W. Pennell 3984* > July 15 (A). Cumberland: Beaver Dam, *B. Long 4943* (A). Gloucester: Repaupo, *E. B. Bartram* > June 23 (A). Middlesex: near Milltown, *N. Williamson* > August (Y). Monmouth: Farmingdale, *N. Taylor 2148* > July 4 (Y). Ocean: Barnegat, *B. Long 5296* < September 29 (A). Salem: Yorktown, *B. Long 4137* (A).

PENNSYLVANIA. Delaware: Tinicum, *T. C. Porter* (Y).

DELAWARE. Sussex: Laurel, *A. Commons* > June 18 (A).

MARYLAND. Dorchester: near Sharptown, *J. P. Otis* (A). Kent: Chestertown, *E. G. Vanatta* < August 3 (A). Prince Georges: Hyattsville, *F. H. Knowlton* > June 27 (U).

DISTRICT OF COLUMBIA. Terra Cotta, *C. S. Pollard 606* (U).

VIRGINIA. Nansemond: Suffolk, *A. A. Heller 925* > June 8–13 (P, U, Y), a large-leaved form.

SOUTH CAROLINA. Aiken: Graniteville, *H. Eggert* > May 21 (M). Clarendon: Manning, *W. Stone 245* > May 21 (A).

2. **Smilax leptanthera** Pennell, sp nov.

Stem striate, glabrous. Leaves alternate; petioles slender, rounded, narrowly channeled above, 6–7 cm. long; blades triangular-ovate, cordate at base, acuminate at apex, dull-green above, slightly glaucous beneath, glabrous above and beneath. Tendrils about 7 cm. long, stouter than in *S. tamnifolia*, two to an axil. Staminate inflorescence: peduncles 12–15 cm. long; umbels thirty-five- to forty-flowered; pedicels filiform, 18–22 mm. long; sepals six, lanceolate, yellowish green, one-nerved, 4 mm. long, spreading to reflexed-spreading; filaments six, 1.2 mm. long, glabrous; anthers linear, recurved-coiled, 1–1.2 mm. long. Pistillate inflorescence not seen.

TYPE: Warm Springs, Meriwether County, Georgia, collected in flower May 22, 1905, *S. M. Tracy 9257*, in the herbarium of the New York Botanical Garden.

Piedmont Region of central Georgia, known only from the original collection.

Species closely allied to *S. tamnifolia*.

3. **Smilax biltmoreana** (Small) J. B. Norton, comb. nov.

Nemexia biltmoreana Small, Fl. SE. U. S. 281, 1328. 1903.

"Type, Biltmore Herbarium, no. 906b, in Herb. N. Y. B. G." Type seen.

Woodlands; highlands of North Carolina and upper South Carolina.

Flowers in May, fruits in August.

NORTH CAROLINA. Buncombe: Biltmore, *Biltmore Herbarium 906, 906b* > May 4 (B, Y). Cleveland: Kings Mountain, *Biltmore Herbarium 14954 p. p.* (B). Henderson: Flat Rock, *Dr. Shoolbred* (Y). Rutherford: Hickory Nut Gap, *J. K. Small & A. M. Huger* < October 3 (Y).

SOUTH CAROLINA. Greenville: Caesars Head, *L. M. Bragg 3637* < August 26 (S).*

4. SMILAX HERBACEA L.

Smilax herbacea L. Sp. Pl. 1030. 1753. "Habitat in Virginia, Marilandia." Type, a specimen in the Linnaean herbarium, obtained evidently from Gronovius and labeled by him "Smilax annua inermis caule fusco purpureo glabro claviculis plurimis teneris vestito. Ex alis foliorum oritur pedunculus teres glaber semipedalis gerens flores in capitulos globos, collectos." This is evidently a duplicate of Clayton's No. 541 from Virginia, identified both in the Linnaean and Gronovian herbaria as the plant here considered.

Smilax Pseudo China L. *l. c.* 1031. 1753. "Habitat in Virginia, Jamaica." Species clearly aggregate, represented in the Linnean herbarium by specimens written up by Linnaeus as follows, according to a letter of B. D. Jackson: "three sheets pinned together; the first is '11 K Pseudo China,' it is a barren branch, the leaves leathery: the second sheet is written up '11' and seems quite the same plant as the former, but has one berry, the third sheet is of a West Indian species, coll. by Patrick Browne in Jamaica, probably *S. celastroides*." From the wording of the Linnaean description none of these can be considered the type of *S. Pseudo China*, but this would be

* Specimens from the Charleston Museum, Charleston, South Carolina, are indicated by "S."

rather a specimen of Gronovius, also studied by Linnaeus, now in the Gronovian herbarium in the British Museum. The description of Linnaeus is word for word from Gronovius, except for the addition of the phrase "racemis ovato-oblongis," inappropriate for any *Smilax* whatever. "Smilax caule tereti inermi: foliis inermibus, caulinis cordatis, ramorum lanceolatis; pedunculis longissimis," Gronovius, Fl. Virg. 156. 1742, citing Clayton's Nos. 541, 561 and 630, is represented in the herbarium by Nos. 561 and 630 (for No. 541 see above note under *S. herbacea*). These two numbers are identified by Dr. A. B. Rendle as both the same as No. 541, that is, as genuine *Smilax herbacea* L. For the verification of these two Linnaean types I am indebted to Dr. B. Dayden Jackson, of the Linnaean Society of London, and to Dr. A. B. Rendle, of the British Museum.

Smilax inermis Walt. Fl. Carol. 244. 1788. Type, presumably from Berkeley County, South Carolina, not verified.

Smilax peduncularis Muhl.; Willdenow, in Linnaeus, Sp. Pl., ed. 4, 4: 786. 1806. "Habitat in Canada, Pensylvania." Type not verified.

Nemexia nigra Raf. Neogenyt. 3. 1825. New name for *S. herbacea* L., but apparently intended for the black-fruited *S. pulverulenta* Michx.

Nemexia cerulea Raf. *l. c.* 3. 1825. New name for *S. peduncularis* Muhl.

Coprosmanthus peduncularis Kunth, Enum. Pl. 5: 264. 1850.

Coprosmanthus herbaceus Kunth, *l. c.* 265. 1850.

Smilax herbacea α Simsii A. DC. Monogr. Phan. 1: 51. 1878. "*S. herbacea* Sims, Bot. Mag. *pl. 1920*." From figure and description evidently a narrow-leaved form of *S. herbacea*.

Smilax herbacea β peduncularis A. DC. *l. c.* 51. 1878.

Nemexia herbacea Small, Fl. SE. U. S. 280. 1903.

Smilax herbacea crispifolia Pennell, Proc. Acad. Nat. Sci. Phila. 62: 559. 1910. "Type.—Serpentine, Mineral Hill, Delaware County, Penna., F. W. Pennell 594, coll. Sept. 6, 1908, in Herb. Acad. Nat. Sci. Phila." A narrow, rigid-leaved form of dry soils, probably identical with *S. herbacea Simsii*.

Most woodlands, spring-heads, and near streams; more rarely, in dry soils, thickets, or open barrens; under the latter circumstances, usually as forma *crispifolia*: New Brunswick to Alabama, west to Indiana and Nebraska.

Flowers in eastern Pennsylvania, New Jersey and southeastern New York late-May to early-June, fruits September to November.

NEW BRUNSWICK. York: Fredericton, *J. Fowler* (U).

ONTARIO. York: Toronto, *Biltmore Herbarium 902b* > June (B).

MAINE. Penobscot: Oldtown, *L. H. Harvey 1014* (U).

NEW HAMPSHIRE. Grafton: Lisbon, *F. Blanchard* (M).

VERMONT. Caledonia: Barnet, *F. Blanchard* (M).

MASSACHUSETTS. Berkshire: Great Barrington, *C. L. Pollard* (U). Bristol: Nonquitt, *E. L. Sturtevant* (M). Essex: Ipswich, *T. Morong* > June 23 (M, Y). Plymouth: Marion, *A. M. Vail* > July (Y).

RHODE ISLAND. Newport: Crescent Beach, Block Island, *Fernald, Long & Torrey 9249* (A).

CONNECTICUT. Fairfield: Greens Farms, *C. L. Pollard 36* > June 7 (U). New Haven: Mt. Carmel, *W. E. Safford 137* > June 5 (U).

NEW YORK. Bronx: east of Van Cortlandt Park, *F. W. Pennell 7039* > June 14 (Y). Delaware: Arkville, *E. N. Harvey* > August (P). Essex: Westport, *N. L. Britton* (Y). Greene: New Baltimore, *N. Taylor 1375* < August 19 (Y). Oneida: Sylvan Beach, *W. R. Maxon 554* (U). Onondaga: Syracuse, *L. M. Underwood* > June (Y). Orange: Guymarch, *F. W. Pennell 6919* (Y). Queens: College Point, *J. Schrenk* > June 3 (Y). Richmond: near Garretson, *A. M. Vail* < October 24 (Y). Rockland: Spring Valley, *P. Wilson* (Y). Sullivan: Mongaup, *F. W. Pennell 6820* (Y). Tioga: Apalachin, *F. E. Fenno 402* > July 27 (Y). Tompkins: Fall Creek, *W. Trelease* > June 13 (M). Ulster: Cragsmoor, *E. M. Farr* (P). Washington: *S. H. Burnham* > July 18 (B). Westchester: Tarrytown Heights, *F. W. Pennell 7001* > June 13 (Y).

NEW JERSEY. Bergen: Alpine, *F. W. Pennell 5729* < September 12 (Y). Burlington: Bordentown, *B. Long 3086* (A). Cape May: Court House, *F. W. Pennell 2601* < August 30 (Y). Essex: Montclair, *J. F. Poggenburg* < September 5 (Y). Gloucester: Woodbury, *C. S. Williamson* > May 25 (A). Middlesex: Milltown, *A. M. Vail* (Y). Monmouth: Farmingdale, *B. Long &*

S. Brown 3545 > May 28–30 (A). Ocean: New Egypt, _J. H. Grove 285_* > May 31 (A). Sussex: Andover, _N. L. Britton_ < September 28 (Y).

PENNSYLVANIA. Bucks: Penn Valley, _J. Crawford_ (U). Chester: Sugartown, _F. W. Pennell 821_* < September 23 (A). Delaware: Wawa, _F. W. Pennell 3648_*, _3649_* > June 9 (A). Fayette: Ohio Pyle, _Brown, Crawford & Van Pelt 29_ (A). Lancaster: Pleasant Grove, _J. J. Carter_ < August 22 (Y). Lehigh: Slatington, _C. C. Bachman 2413_ > June 8 (A). Montgomery: Ashbourne, _B. Long 5835, 5836_ > May 28 (A). Northampton: Bangor, _C. S. Williamson_ > May 30 (A). Philadelphia: Germantown, _T. Meehan_* < September 24 (A). Westmoreland: _P. E. Pierron_ > June 10 (U). York: McCalls Ferry, _N. L. Britton_ (Y).

DELAWARE. Newcastle: Townsend, _J. B. Brinton_ > May 30 (A).

MARYLAND. Allegany: Cumberland, _H. Shriver_ (Y). Garrett: Oakland, _F. W. Pennell 6729_ (Y). Kent: Chestertown, _E. G. Vanatta_ (A).

VIRGINIA. Fairfax: Great Falls, _F. W. Pennell_ (Y). Page: Stony Man Mountain, _E. S. & Mrs. Steele 176_ < September 1 (B, M, U, Y). Pulaski: Peak Mountain, _J. K. Small_ (B, M, U). Rockingham: Mt. Crawford, _A. A. Heller_ > May 5–13 (A). Tazewell: Tazewell Peak, _A. H. Howell 437_ (U).

NORTH CAROLINA. Guilford: High Point, _Biltmore Herbarium 902c_ (B). Haywood: Eagle's Nest, _P. C. Standley 5489_ < September 4 (U). Iredell: Statesville, _Biltmore Herbarium 902d_ > May 19 (B). Watauga: Blowing Rock, _A. M. Huger_ (Y).

SOUTH CAROLINA. Anderson: Pendleton, _L. M. Bragg 3897_ (S). Greenville: Paris Mount, _J. K. Small_ (Y). Oconee: Clemson College, _H. D. House 2119_ (U).

GEORGIA. DeKalb: _H. Eggert_ > May 23 (M).

ALABAMA. Lee: Auburn, _F. S. Earle_ (Y).

OHIO. Licking: _W. W. Stockberger 902_ > June 1 (B).

INDIANA. Steuben: Clear Lake, _C. C. Deam_ (U). Wells: Twin Bridges, _C. C. Deam_ > June 12 (B).

ILLINOIS. Clinton: Carlyle, _N. M. Glatfelter_ (M). Stark: Wady Petra, _V. H. Chase_ > May 28 (U).

* Forma _crispifolia_.

NEBRASKA. Lancaster: Lincoln, *H. J. Webber* (Y).

MISSOURI. Greene: Springfield, *P. C. Standley 9745* < September 2 (U).

5. SMILAX LASIONEURON Hook.

Smilax lasioneuron Hook. Fl. Bor. Amer. **2**: 173. *pl. 187, A.* 1840. "Hab. Carlton House Fort on the Saskatchawan, *Dr. Richardson.*" Type not verified, but evidently plant here considered.

Coprosmanthus lasioneuron Kunth, Enum. Pl. **5**: 265. 1850.

Smilax herbacea γ *lasioneuron* A. DC. Monogr. Phan. **1**: 52. 1878.

(?) *Smilax diversifolia* Small, Bull. Torrey Club **25**: 607. 1898. "The original specimens were collected by the writer along the Flint River near Albany, Georgia, May 24–28, 1895." Type, in immature fruit, seen in the herbarium of Columbia University at the New York Botanical Garden. Needs to be studied in flower and mature fruit.

(?) *Nemexia diversifolia* Small, Fl. SE. U. S. 281. 1903.

Nemexia herbacea melica A. Nels. Proc. Biol. Soc. Wash. **17**: 175. 1904. "I take as type Mr. Andrews' specimens from Boulder Cañon [Colorado],—fruit in 1903, flowers (staminate and pistillate) in 1904." Type not seen, but evidently plant here considered.

Nemexia lasioneuron Rydb. Bull. Torrey Club **32**: 610. 1905.

Moist soil, thickets, and along streams; southwestern Ontario and Ohio to Georgia, Alabama, Colorado and Wyoming. Intergrades with *S. herbacea* and with *S. ecirrhata.* Through the Mississippi Valley this species grows much larger and frequently bears peduncles much longer than does the typical form of drier western regions.

ONTARIO. Huron: Wingham, *J. A. Morton 5971* > June 25 (A, Y).

GEORGIA. Dougherty: Albany, *J. K. Small* (Y), type of *S. diversifolia* Small.

ALABAMA. Bullock: Union Springs, *Biltmore Herbarium 14675a* (B).

KENTUCKY. Warren: near Green River, *S. F. Price* (M).

OHIO. Hamilton: Cincinnati, *C. G. Lloyd* > May 23 (M).

INDIANA. Allen: Fort Wayne, *F. W. Pennell 5301* (P). Wells: Bluffton, *C. C. Deam 14* (M, U).

ILLINOIS. Cook: Chicago, *W. C. Ohlendorf* > May 15 (B). Dupage: Naperville, *L. M. Umbach* (U). Kane: Elgin, *E. E. Sherff* < September 14 (M). Lasalle: Starved Rock, *Greenman, Lansing & Dixon 118* (Y). St. Clair: *H. Eggert* > June 14 (M). Stark: Wady Petra, *V. H. Chase* > May 28 (A).

WISCONSIN. Milwaukee: Milwaukee, *H. E. Hasse* (Y).

MINNESOTA. Winona: Stockton, *J. M. Holzinger* < September (U).

NORTH DAKOTA. Benson: Lake Ibsen, *J. Lunell* (Y). McHenry: Towner, *J. Lunell* < September 10 (Y).

SOUTH DAKOTA. Fall River: Hot Springs, *P. A. Rydberg 1052* > June 19 (U, Y). Lawrence: Deadwood, *W. P. Carr 154* (Y). Mellette: White River, *E. J. Wallace* (Y). Washabaugh: *S. S. Visher 2280* < August 22.

IOWA. Decatur: *J. P. Anderson* (M). Johnson: Iowa City, *A. S. Hitchcock* (U).

NEBRASKA. Cedar: St. James, *F. Clements 2609* (U). Lancaster: Lincoln, *G. G. Hedgcock* > May 22 (M). Lincoln: Hershey, *C. D. Mell 41* > May 15 (U). Thomas: Halsey, *L. Krautter* > May 29 (P).

MISSOURI. Barry: Monett, *F. W. Pennell 5359* (P). Cass: *G. C. Broadhead* > June 17 (M). Greene: Springfield, *P. C. Standley 8397* < August 29 (U). Jackson: Independence, *B. F. Bush 529* > June 7 (M). Jasper: Webb City, *E. J. Palmer 473* > June 20 (M). Jefferson: Sulphur Springs, *W. Trelease* < October 23 (M). St. Louis: Valley Park, *F. W. Pennell 5315* (P). Shannon: *B. F. Bush 68* > June 8 (U).

ARKANSAS. Benton: Sulphur Springs, *F. W. Pennell 5364, 5366* < September 3 (P).

OKLAHOMA. Creek: Sapulpa, *F. W. Pennell 5379* < September 7 (P). Kay: *M. White* (Y).

WYOMING. Crook: Sundance Mountain, *A. Nelson 2139* > July 3 (B, M, Y). Fremont: Wind River, *T. A. Williams* (Y). Sheridan: Dayton, *F. Tweedy 2277* < September (Y).

COLORADO. Boulder: Boulder, *F. Daniels 224* (M). El Paso: Colorado Springs, *M. E. Jones 997* > June 18 (U, Y). Larimer: Horsetooth Mountain, *F. W. Pennell 5850* (Y).

6. SMILAX TENUIS Small

Smilax tenuis Small, Bull. Torrey Club 25: 607. 16 D 1898. "The original specimens were collected by Dr. Hale, many years ago in Louisiana." Type seen in the herbarium of Columbia University at the New York Botanical Garden.

Nemexia tenuis Small, Fl. SE. U. S. 281, 1329. 1903. Woods, Louisiana and eastern Texas.

LOUISIANA. *Dr. Hale* > April (Y).

TEXAS. San Augustine: San Augustine, *G. L. Corbett* (U).

7. SMILAX ECIRRHATA (Engelm.) S. Wats.

Smilax herbacea ε ecirrhata Engelm.; A. DeCandolle, Monogr. Phan. 1: 52. 1878. "Prope Saint-Louis Americae bor. (Engelm.) . . . in h. ber. fol. 89 . . . et in h. Boiss." Type not seen nor verified.

Smilax ecirrhata S. Wats.; A. Gray, Man. ed. 6, 520. 1890.

Coprosmanthus ecirrhatus Chapm. Fl. S. U. S. ed. 3, 504. 1897.

Nemexia ecirrhata Small, Fl. SE. U. S. 280. 1903.

Woodlands; southwestern Ontario to Tennessee, Minnesota and Missouri.

ONTARIO. Huron: Wingham, *J. A. Morton 2283* > June 14 (M, U).

TENNESSEE. Franklin: Cowan, *H. Eggert* > May 7 (M). Knox: Knoxville, *Biltmore Herbarium 906d* > May 1 (B).

KENTUCKY. Bell: Pineville, *Biltmore Herbarium 906c* > May 7 (B). Estill: Irvine, *Biltmore Herbarium 14826* (B).

OHIO. Erie: Groton, *E. L. Moseley* < October 23 (U). Lorain: Amherst, *A. E. Ricksecker* > May 12 (U).

INDIANA. Huntingdon: *C. C. Deam 1953* (Deam). Tippecanoe: Lafayette, *F. W. Pennell 5310* (P). Wells: Bluffton, *C. C. Deam* > May 12 (M, U).

ILLINOIS. Cook: West Pullman, *L. M. Umbach* > May 21 (U). Hancock: —— > May 21 (M). McLean: Bloomington, *G. Vasey* (U). St. Clair: French Village, *H. Eggert* > May 8 (M, Y).

MICHIGAN. Gratiot: Alma, *C. A. Davis* > May 15 (U).

WISCONSIN. Grant: Boscobel, *C. H. Sylvester* > June (Y).

Minnesota. Chippewa: Montevideo, *L. R. Moyer* > May 30 (B). Winona: Winona, *J. M. Holzinger* > June (U).

Iowa. Fayette: *B. Fink 614* > June (U). Harrison: *R. Burgess* (Y). Johnson: *T. J. & M. F. L. Fitzpatrick* > May 13 (U).

Missouri. Clark: Dumas, *B. F. Bush* (M). Jackson: Courtney, *B. F. Bush* (M). Jefferson: Victoria, *H. Eggert* < August 24 (M, Y).

8. **Smilax Hugeri** (Small) J. B. Norton, comb. nov.

Nemexia Hugeri Small, Fl. SE. U. S. 280, 1328. 1903. "Type, Stone Mt., Ga., *Small*, May 1–18, 1895 (fl.); Hickory Nut Gap, N. C., *Small & Huger*, Oct. 3, 1901, in Herb. N. Y. B. G." Type, "Stone Mt., De Kalb Co., Georgia, J. K. Small, May 1–18, 1895," seen in the herbarium of the New York Botanical Garden. Fruiting specimen cited is *S. biltmoreana*.

Woodlands, Piedmont and upper coastal plain of South Carolina to Alabama.

South Carolina. Aiken: Graniteville, *H. Eggert* (M). Berkeley: Santee Canal, *H. W. Ravenel* > April (S). Eutaw: Nelson's Ferry Road, *L. M. Bragg* (S).

Georgia. Clarke: Athens, *Biltmore Herbarium 14826* < July 22 (B). Dekalb: Stone Mountain, *J. K. Small* > May 1–18 (Y), type. Marion: Buena Vista, *R. M. Harper 1409* (M, U, Y).

Florida. Gadsden: *A. W. Chapman* (Y).

Alabama. Lee: Auburn, *F. S. Earle & C. F. Baker* < September 8 (Y). Tallapoosa: Dadeville, *C. L. Pollard & W. R. Maxon 138* (U, Y). Tuscaloosa: Tuscaloosa, *E. A. Smith* > April (M).

9. Smilax pulverulenta Michx.

Smilax pulverulenta Michx. Fl. Bor. Amer. 2: 238. 1803. "Hab. in Canada et Pensylvania." Type not verified, but a specimen of this plant of Michaux's collecting, "No. 29," seen in the herbarium of the Academy of Natural Sciences of Philadelphia, is probably a co-type.

Smilax herbacea var. *pulverulenta* A. Gray.

Nemexia pulverulenta Small, Fl. SE. U. S. 281. 1903.

Rich woods; southeastern New York to North Carolina and

Tennessee; also in southern Missouri. Frequent in the Piedmont region of southeastern Pennsylvania.

Flowers in New Jersey and southeastern Pennsylvania early- to late-May, two weeks to ten days before *S. herbacea;* fruits September to November.

New York. Bronx: east of Van Cortlandt Park, *F. W. Pennell 7070* (Y).

New Jersey. Bergen: Fort Lee, *F. W. Pennell 7061* (Y). Cape May: Cold Spring, *O. H. Brown* (A). Gloucester: Swedesboro, *C. D. Lippincott* > May 22 (A). Mercer: near Trenton, *A. R. Slack* (P).

Pennsylvania. Bucks: Nockamixon, *A. MacElwee* > May 28 (A). Chester: New Garden Station, *F. W. Pennell 4995* (A). Delaware: Cheyney, *F. W. Pennell 1986* < September 17 (Y). Franklin: Mercersburg, *Detwileer* > June 12 (A). Lancaster: Haines Station, *J. J. Carter* > May 16 (Y). Montgomery: Ashbourne, *B. Long 5824, 5828* > May 21 (A) Northampton: Easton, *T. Seal* > June 2 (A). Philadelphia: Cobbs Creek, *T. S. Githens* > May 14 (A). York: *J. Crawford* (A).

Delaware. Newcastle: Stanton, *W. M. Canby* > June 13 (B).

Maryland. Cecil: Conowingo, *S. S. Van Pelt & B. Long* > May 21 (A). Montgomery: High Island, *C. L. Pollard 254* > May 19 (U).

District of Columbia. Rock Creek Park, *H. D. House 716* > May 13 (U).

Virginia. Alexandria: Rosslyn, *C. L. Pollard* > May 6 (U). Smyth: Marion, *N. L. Britton & others* > May 22 (Y).

West Virginia. Fayette: Thurmond, *Biltmore Herbarium 902e* (B).

North Carolina. Buncombe: Biltmore, —— > May 8 (B). Forsyth: Salem, *L. D. von Schweinitz* (A). Halifax: Weldon, *E. B. Bartram* > April 19 (A).

Tennessee. Knox: Knoxville, *A. Ruth 154* > May (Y).

Missouri. Greene: Gates, *P. C. Standley 9377* < August 26 (U). Howell: Willow Springs, *F. W. Pennell 5339* (P). Jasper: Webb City, *E. J. Palmer 487* (M). Shannon: Monteer, *B. F. Bush 2787* > May 11 (M).

New York Botanical Garden.

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 192

STUDIES OF WEST INDIAN PLANTS—VIII

NATHANIEL LORD BRITTON

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Studies of West Indian plants—VIII

Nathaniel Lord Britton

44. FURTHER RECORDS OF JAMAICA SEDGES*

Cyperus fugax Liebm. Vid. Selks. Skr. V. 2: 196. 1851

Savanna, Belle Vue, near Spanish Town (*Harris 12183*).
Distribution: Mexico and Guatemala.

Cyperus cyperoides (L.) Kuntze, Rev. Gen. Pl. 3^2: 333. 1898

Scirpus cyperoides L. Mant. 181. 1771.
Mariscus Sieberianus Nees, Linnaea 9: 286. 1834.
Mariscus cyperoides Urban, Symb. Ant. 2: 164. 1900. Not *M. cyperoides* A. Dietr.

Belle Vue, near Spanish Town, in wet hollows in pastures (*Harris 12045*); previously collected in Jamaica by Hart and by Wullschlaegel.

Distribution: Trinidad. Native of the Old World tropics.

Cyperus nanus Willd.

In Bull. Dept. Agric. Jamaica 5: Suppl. 1, 9, I noted Mr. C. B. Clarke's record of this species from Jamaica, as based on the same specimen (*March 13*) as his record of *Mariscus gracilis* Vahl (*Cyperus granularis* [Desf.] Britton), and I subsequently ascertained that this specimen preserved in the Kew herbarium is

* Bull. Dept. Agric. Jamaica 5: Suppl. 1. 1907. Bull. Torrey Club 35: 568, 569. 1909. *Ibid.* 41: 1, 2. 1914.

C. granularis. It would therefore appear that *C. nanus* was entered as Jamaican by Mr. Clarke in error. *C. granularis* on the other hand is now known to me to inhabit dry soil at Long Acre Point near Black River (*Britton 1383*).

Cyperus ignotus sp. nov.

Perennial, glabrous; culm rather stout, smooth, bluntly 3-angled, about 5 dm. high. Basal leaves as long as the culm or longer, smooth, 2.5–4 mm. wide, those of the involucre similar, much longer than the inflorescence, sometimes 3 dm. long; umbel compound, its primary rays 8 cm. long or less; spikelets compressed, capitate, 6–8-flowered, the heads numerous, 8–10 mm. in diameter; rachis wingless; scales ovate-lanceolate, mucronulate, very faintly nerved, closely appressed and overlapping, 2 mm. long; style 3-cleft; achene oblong, trigonous, 1.3 mm. long, about twice as long as thick, narrowed at both ends.

In damp, shaded places, near Vinegar Hill, St. George, at about 1,100 m. alt. (*Harris 12350*). Plant with the habit of *C. elegans* L., but with flat leaves and quite different spikelets.

ELEOCHARIS NODULOSA (Roth) Schultes; R. & S. Mant. 2: 87. 1824

Scirpus nodulosus Roth, Nov. Pl. Sp. 29. 1821.

Swamp, Belle Vue near Spanish Town (*Harris 12179*).

DISTRIBUTION: Southern United States; Cuba; Hispaniola; Porto Rico; Antigua; Guadeloupe; continental tropical America.

ELEOCHARIS MICROCARPA Torr. (*E. minima* Kunth), was recorded by Mr. Clarke as collected in Jamaica by Purdie, but his determination of the specimen from the interior of Manchester preserved in the Kew herbarium was subsequently doubted by Mr. Clarke, and we have no other knowledge of the existence of this species in Jamaica.

Stenophyllus junciformis (HBK.)

Isolepis junciformis HBK. Nov. Gen. 1: 222. 1815.

Scirpus juncoides Willd.; Griseb. Fl. Br. W. I. 572. 1864.

Summit of Bull Head Mountain (*Underwood 3364*); Liguanea Ridge, St. Andrew (*Harris 12219, 12345*).

DISTRIBUTION: Cuba; South America.

Owing to two different species having been distributed as *Scirpus juncoides* under C. Wright's Cuban No. 1533, I formerly misidentified Professor Underwood's No. 3364 and recorded it* as *Stenophyllus subaphyllus* (Clarke) Britton, a species apparently restricted to eastern Cuba.

Fimbristylis miliacea (L.) Vahl, Enum. **2**: 287. 1806

Savannas and swamps, Belle Vue, near Spanish Town (*Harris 12182, 12188*).

Distribution: Southern United States; Cuba; Porto Rico; continental tropical America and Old World tropics.

Rynchospora oligantha A. Gray, Ann. Lyc. N. Y. **3**: 212. 1835

Hollis savanna, Upper Clarendon (*Harris 12249*).

Distribution: Southeastern United States. Not yet detected in Cuban savannas.

Rynchospora pusilla Chapm.; Curtis, Am. Jour. Sci. II. **7**: 409. 1849

Rynchospora intermixta C. Wright; Sauvalle, Anales Acad. Habana 8: 88. 1872

Bull Head Mountain, along roadside in wet places (*Harris 12261*).

Distribution: Southeastern United States; Santa Clara, Pinar del Rio and Isle of Pines, Cuba.

Scleria gracilis Ell. Bot. S. C. & Ga. **2**: 571. 1824

Bull Head Mountain, 800–900 m. alt., forming small patches on exposed hillside (*Harris 12262*).

Distribution: Southeastern United States; Pinar del Rio and Isle of Pines, Cuba.

45. STENOPHYLLUS Raf. IN THE WEST INDIES

Type species: *Scirpus Stenophyllus* Ell. The generic name dates from 1825 (Neog. 4). The name *Bulbostylis*, taken up by Mr. C. B. Clarke for the genus in 1893 (Hook. f. Fl. Brit. India) and subsequently, was first published by Kunth, under *Isolepis*, in 1837 (Enum. **2**: 205).

* Bull. Dept. Agric. Jamaica **5**: Suppl. 1, 12. 1907.

A. Spikelet solitary.
  Spikelet terminal, not subtended by a bract.
    Caudex stout, 2–15 cm. high, densely clothed with persistent leaf-bases. — 1. *S. paradoxus.*
    Caudex none.
      Leaves elongated; spikelet straw-color. — 2. *S. leucostachys.*
      Leaves short; spikelet dark brown. — 3. *S. conifera.*
  Spikelet apparently lateral, subtended by a bract.
    Achene smooth. — 4. *S. floccosus.*
    Achene papillose-reticulated.
      Achene twice as long as thick. — 5. *S. portoricensis.*
      Achene scarcely longer than thick. — 6. *S. curassavicus.*
B. Spikelets (except in depauperate plants) several or numerous.
  a. Spikelets in a single capitate cluster.
    Plants leafless or nearly so, or leaves 1–3 cm. long.
      Spikelets few, 6 mm. long or less.
        Leaf-blade 6 mm. long or less. — 7. *S. subaphyllus.*
        Leaf-blade 1–3 cm. long. — 8. *S. alpestris.*
      Spikelets several, 6–20 mm. long.
        Scales loosely pubescent. — 9. *S. Wilsoni.*
        Scales glabrous or ciliolate. — 10. *S. Tuerckheimii.*
    Leaves about one half as long as the culm. — 11. *S. fimbriatus.*
  b. Spikelets in a simple or compound umbel, or sometimes compact or capitate.
    Spikelets clustered in umbelled heads or spikes, or head sometimes solitary.
      Culm pilose above. — 12. *S. vestitus.*
      Culm glabrous.
        Scales mucronate by the excurrent midvein. — 13. *S. junciformis.*
        Scales acute, the midvein not excurrent; achene papillose. — 14. *S. antillanus.*
    Spikelets not clustered in the umbels, or somewhat clustered.
      Achene 0.5 mm. long, gray, densely pitted; scales suborbicular. — 15. *S. coarctatus.*
      Achene 0.7–1 mm. long, white, transversely undulate; scales ovate. — 16. *S. capillaris.*

1. STENOPHYLLUS PARADOXUS (Spreng.) Standley, Contr. U. S. Nat. Herb. **18**: 88. 1916

Schoenus paradoxus Spreng. Syst. 1: 190. 1825.

Bulbostylis paradoxa Linden; Regnell, Cyp. 17. 1900.

TYPE LOCALITY: Mt. Silla de Cacares, near El Pexual, Venezuela.

DISTRIBUTION: Isle of Pines, Cuba: continental tropical America.

One of the noteworthy elements in the vegetation of sandy pine-lands on the Isle of Pines, sometimes occupying areas many acres in extent.

2. **Stenophyllus leucostachyus** (HBK.)

Isolepis leucostachya HBK. Nov. Gen. **1**: 220. 1815.
Bulbostylis leucostachya Kunth; Clarke in Urban, Symb. Ant. **2**: 85. 1900.

Type locality: Wet woods of the Orinoco at Maypuri.

Distribution: West Indies (*Swartz*, according to Clarke): northern South America. Unknown to me from the West Indies.

3. **Stenophyllus coniferus** (Kunth)

Isolepis conifera Kunth, Enum. **2**: 206. 1837.

Type locality: Surinam.

Distribution: Recorded by Clarke as doubtfully collected by Mayerhoff in Hispaniola: northern South America.

4. Stenophyllus floccosus (Griseb.) Britton, Torreya **13**: 216. 1913

Scirpus floccosus Griseb. Cat. Pl. Cub. 241. 1866.
Bulbostylis floccosa Clarke; Urban, Symb. Ant. **2**: 86. 1900.

Type locality: Eastern Cuba.

Distribution: Known only from the type locality.

5. Stenophyllus portoricensis Britton, Torreya **13**: 216. 1913

Type locality: Rocky coastal thicket near Guanica, Porto Rico.

Distribution: Coastal thickets, southwestern Porto Rico.

6. **Stenophyllus curassavicus** Britton, nom. nov.

Bulbostylis floccosa var.(?) *pumilio* Clarke; Urban, Symb. Ant. **5**: 290. 1907.

Type locality: Curaçao.

Distribution: Banks and limestone rocks, Bonaire and Curaçao.

The spikelets of this species are much compressed. The varietal name published by Mr. Clarke is not taken up because the plant attains a greater size than his description indicates. The plant is abundant about Willamsted, Curaçao (*Britton & Shafer 2946*).

7. STENOPHYLLUS SUBAPHYLLUS (Clarke) Britton, Bull. Dept. Agric. Jamaica 5: Suppl. 1, 12. 1907

Bulbostylis subaphylla Clarke; Urban, Symb. Ant. 2: 86. 1900.

TYPE LOCALITY: Eastern Cuba.

DISTRIBUTION: Eastern Cuba; formerly erroneously attributed by me (*loc. cit.*) to Jamaica (see page 443).

8. **Stenophyllus alpestris** (Urban)

Bulbostylis alpestris Urban, Symb. Ant. 7: 168. 1912.

TYPE LOCALITY: Near Constanza, Santo Domingo, in pine-lands, 2,500 m. alt.

DISTRIBUTION: Known only from the type locality.

9. STENOPHYLLUS WILSONI Britton, Torreya 13: 215. 1913

TYPE LOCALITY: Castle Island, Bahamas.

DISTRIBUTION: Castle Island and Little Inagua, Bahamas.

10. **Stenophyllus Tuerckheimii** (Urban)

Bulbostylis Tuerckheimii Urban, Symb. Ant. 7: 169. 1912.

TYPE LOCALITY: Near Constanza, Santo Domingo, in pine-lands, 1,250 m. alt.

DISTRIBUTION: Known only from the type locality.

11. **Stenophyllus fimbriatus** (Nees)

Oncostylis fimbriata Nees; Martius, Fl. Bras. 2: 88, 1843.
Scirpus Dussii Boeckl. Cyp. Nov. 2: 38. 1890.
Bulbostylis fimbriata Clarke; Urban, Symb. Ant. 2: 87. 1900.

TYPE LOCALITY: River-banks at Villa Rica, Brazil.

DISTRIBUTION: Martinique; Peru; Brazil.

12. **Stenophyllus vestitus** (Kunth)

Isolepis vestita Kunth, Enum. 2: 210. 1837.
Oncostylis vestita Nees; Martius, Fl. Bras. 2: 88. 1843.
Scirpus hirtus Griseb. Cat. Pl. Cub. 241. 1866.

TYPE LOCALITY: Surinam.

DISTRIBUTION: Province of Pinar del Rio, Cuba; western Porto Rico: continental tropical America. The Porto Rico plant was referred by Clarke to *Bulbostylis Langsdorffiana*.

13. STENOPHYLLUS JUNCIFORMIS (HBK.) Britton, Bull. Torrey Club **43**: 442. 1916.

Isolepis junciformis HBK. Nov. Gen. **1**: 222. 1815.
Scirpus juncoides Willd.; Griseb. Fl. Br. W. I. 572. 1864.

TYPE LOCALITY: Near the Guachari cavern, 500 feet alt.

DISTRIBUTION: Savannas and pine-lands, province of Pinar del Rio, Cuba; Hispaniola; Jamaica; Trinidad: continental tropical America.

14. **Stenophyllus antillanus** sp. nov.

Culms tufted, nearly filiform, 2–4.5 dm. long, minutely rough-ciliolate or smooth. Leaves filiform, similar to the culm and one half to two thirds its length, rough-ciliolate or smooth, their sheaths pilose. Umbel compact or subcapitate; spikelets few or several, linear, 6–12 mm. long, 1.5 mm. wide, 8–12-flowered; scales ovate, known with a strong, whitish keel, acute, 1.5 mm. long; achene obovoid, nearly white, sharply trigonous, 0.7 mm. long, papillose, tipped by a minute, conic tubercle.

Dominica and Martinique. Type from Grand Savanna, Dominica (*F. E. Lloyd 822*).

Referred by Clarke (in Urban, Symb. Ant. **2**: 89. 1900) to *S. capillaris*.

15. STENOPHYLLUS COARCTATUS (Ell.) Britton; Small, Fl. SE. U. S. 189. 1903

Scirpus coarctatus Ell. Bot. S. C. & Ga. **1**: 83. 1816.

TYPE LOCALITY: Beaufort, South Carolina.

DISTRIBUTION: On a sand pile in Santiago Harbor, Oriente, Cuba, March, 1909; southeastern United States.

16. STENOPHYLLUS CAPILLARIS (L.) Britton, Bull. Torrey Club **21**: 30. 1894

Scirpus capillaris L. Sp. Pl. 49. 1753.
Bulbostylis capillaris Clarke; Hook. f. Fl. Brit. India **6**: 652. 1893.

TYPE LOCALITY: Virginia.

Distribution: Sandy and rocky soil, provinces of Oriente and Pinar del Rio and on the Isle of Pines, Cuba; pinelands at high elevations in Santo Domingo; Jamaica (not recently collected): continental North America; temperate South America.

Stenophyllus tenuifolius (Rudge).

Scirpus tenuifolius Rudge, Pl. Guian. 18, *pl. 22.* 1805.

Scirpus bufonius Poir. Encycl. Suppl. 5: 105. 1817.

Bulbostylis capillaris tenuifolia Clarke; Urban, Symb. Ant. 2: 89. 1900.

Recorded by Clarke as collected by C. Wright in Cuba (*Wright 3382*), but our specimens of that number are not essentially different from *S. capillaris*. The species inhabits tropical South America.

46. GALACTIA P.Br. IN CUBA

Type species: *Glycine Galactia* L.

A. Corolla 2–2.5 cm. long, the standard parallel with the wings and keel. 1. *G. rudolphioides.*

B. Corolla not more than 1.7 cm. long, the standard erect, not parallel with the wings and keel.

- *a*. Twining or trailing vines.
  - Corolla about 1.7 cm. long; leaflets 8 mm. long or less; peduncle 1-flowered. 2. *G. minutifolia.*
  - Corolla less than 1.5 mm. long; leaflets 1–6 cm. long; peduncles mostly few- to several-flowered.
    - Terminal leaflet (when 3) long-stalked.
      - Calyx-lobes longer than the tube.
        - Inflorescence short, 1- to few-flowered.
          - Branches prostrate; calyx loosely pubescent.
            - Leaflets 3 or 1, oblong to narrowly linear, 2–10 mm. wide. 3. *G. parvifolia.*
            - Leaflet only 1, ovate or elliptic, 10–18 mm. wide. 4. *G. monophylla.*
          - Branches suberect; calyx densely villous. 5. *G. suberecta.*
        - Inflorescence elongated, several- to many-flowered.
          - Leaflets membranous or chartaceous, flat, dull; standard 9–11 mm. long.
            - Leaflets oblong to obovate-oblong. 6. *G. Combsii.*
            - Leaflets ovate to elliptic or ovate-lanceolate.
              - Leaflets membranous; raceme usually long-peduncled. 7. *G. striata.*
              - Leaflets chartaceous; raceme short-peduncled or sessile. 8. *G. spiciformis.*
          - Leaflets subcoriaceous, revolute-margined, shining; standard 7 mm. long. 9. *G. Earlei.*

Calyx-lobes shorter than the tube.	10. *G. brachyodon.*
Leaflets nearly equally short-stalked.	
Leaflets densely or loosely pubescent beneath.	
Leaflets obovate, strongly reticulate-veined, loosely pubescent on both sides.	11. *G. Jenningsii.*
Leaflets linear-oblong, narrowed at both ends, densely silky beneath.	12. *G. revoluta.*
Leaflets glabrous, or with only some scattered hairs beneath.	
Flowering pedicels 1–2 mm. long; pod short-pilose, its pedicel 3 mm. long.	13. *G. galactioides.*
Flowering pedicels 0.5 mm. long; pod long-pilose, its pedicel 1.5 mm. long or less.	14. *G. savannarum.*
b. Erect shrub; leaflets 3.	15. *G. Jussiaeana.*

1. Galactia rudolphioides (Griseb.) Benth. & Hook.; Sauvalle, Anales Acad. Habana 5: 337. 1869

Dioclea rudolphioides Griseb. Mem. Am. Acad. II. 8: 178. 1860.
Galactia Odonia Griseb. Cat. Pl. Cub. 75. 1866.

Pinelands, thickets and hillsides, Oriente, Matanzas: Bahamas.

2. Galactia minutifolia Urban, Symb. Ant. 2: 325. 1900

Dry soil, Oriente. Endemic. Referred by Grisebach to *G. parvifolia* A. Rich.

3. Galactia parvifolia A. Rich. Ess. Fl. Cub. 414. 1845

Galactia stenophylla Urban, Symb. Ant. 2: 313. 1900. Not H. & A.
Galactia parvifolia triphylla Urban, *loc. cit.* 314. 1900.
Galactia parvifolia heterophylla Urban, *loc. cit.* 315. 1900.
Galactia parvifolia monophylla Urban, *loc. cit.* 315. 1900.
Galactia Grisebachii Urban, Symb. Ant. 5: 372. 1908.

Grassy fields and banks at lower elevations, all provinces and Isle of Pines: South Florida; Hispaniola. Consists of races differing in number, form and size of leaflets.

4. Galactia monophylla Griseb. Cat. Pl. Cub. 75. 1866

Grassy places, Oriente, Havana; Bahamas.

5. **Galactia suberecta** sp. nov.

A somewhat woody trailing vine, with slender, villous, erect or ascending branches 1–2.5 dm. high. Stipules lanceolate, acute, 2–3 mm. long; petioles slender, villous, 1–2 cm. long; leaflets 3, oblong to oblong-oblanceolate or oval, 1–3 cm. long, mostly obtuse or rounded at the apex, appressed-pubescent on both sides, strongly reticulate-veined beneath, the lateral ones nearly sessile, obtuse or rounded at the base, the terminal one narrowed at the base, on a petiolule 3–4 mm. long; peduncles 1-flowered, shorter than the petioles; calyx villous, 6 mm. long, its lanceolate lobes longer than the tube; corolla purple, 1 cm. long.

Savanna near San Juan, Isle of Pines, Cuba (*Britton & Wilson 14973*).

6. GALACTIA COMBSII Urban, Symb. Ant. **2**: 219. 1900

Grassy places, Santa Clara, Pinar del Rio. Endemic. Referred by Combs to *G. angustifolia* HBK.

7. GALACTIA STRIATA (Jacq.) Urban, Symb. Ant. **2**: 320. 1900

Glycine striata Jacq. Hort. Vind. **1**: 32. *pl. 76.* 1770.
Galactia cubensis HBK. Nov. Gen. **6**: 429. 1823.
Galactia Berteriana DC. Prodr. **2**: 238. 1825.
Galactia striata cubensis Urban, Symb. Ant. **2**: 322. 1900.
Galactia striata Berteriana Urban, *loc. cit.* 1900.

Thickets and hillsides at lower elevations, all provinces and Isle of Pines: Jamaica; Hispaniola; Porto Rico; continental tropical America. Recorded by Grisebach and by Wright as *G. filiformis* Benth. Some Cuban specimens with short-peduncled inflorescence are only with difficulty separable from the following species. Races differ in pubescence.

8. GALACTIA SPICIFORMIS T. & G. Fl. N. A. **1**: 288. 1838

Thickets, Cays of Camaguey: southern Florida; Bahamas.

9. **Galactia Earlei** sp. nov.

Stem slender, somewhat woody, twining, finely appressed-pubescent 5 dm. long or longer. Stipules lanceolate-subulate, about 2 mm. long; petioles slender, sparingly pubescent, 3 cm. long or less; leaflets 3, oblong or elliptic, 1.5–3 cm. long, 8–15 mm. wide, glabrous and shining with the midvein impressed above, sparingly appressed-pubescent beneath, revolute-margined, obtuse or slightly emarginate at the apex, rounded at the base, the terminal one with a petiolule 4–8 mm. long, the lateral ones nearly sessile; inflorescence stalked, slender, many-flowered, 6–12 cm. long, densely brownish-pubescent; flowers clustered, almost sessile; calyx 6–7 mm. long, densely brownish appressed-pubescent, its teeth longer than the tube, the upper one ovate, the others lanceolate; standard clawed, nearly orbicular, 7 mm. long.

Pine woods, Baracoa, Oriente (*Underwood & Earle 1342*).

11. **Galactia Jenningsii** sp. nov.

A very slender, slightly woody vine, the branches 1.5–3.5 dm. long, loosely pilose or glabrate. Stipules subulate, striate, about 1 mm. long; petioles slender, pilose, 3–10 mm. long; leaflets 3, nearly equally short-petioluled, obovate, oblong or oblong-obovate, subchartaceous, 6–20 mm. long, rounded or emarginate at the apex, rounded or narrowed at the base, pubescent on both sides, strongly reticulate-veined above; peduncles axillary, 1- to few-flowered, as long as the petioles or shorter; calyx pilose, about 6 mm. long, its lanceolate acuminate lobes about as long as the tube or a little longer; flowers purple; standard suborbicular, clawed, 7–8 mm. long; wings narrowly oblong, about as long as the standard; pod linear, short-beaked, appressed-pubescent, sessile in the calyx, 2.5 cm. long, 5 mm. wide.

White-sand pine-barrens, Isle of Pines, scarce and local (*Britton & Wilson 14,186*, type; *O. E. Jennings 350*).

10. GALACTIA BRACHYODON Griseb. Mem. Am. Acad. II. 8: 178. 1860

Near Monte Verde, Oriente. Endemic.

12. GALACTIA REVOLUTA Urban, Symb. Ant. 2: 333. 1900

Dry hillsides, northern Oriente. Endemic.

13. GALACTIA GALACTIOIDES (Griseb.) Hitchc. Rep. Mo. Bot. Gard. 4: 77. 1893

Dioclea galactioides Griseb. Cat. Pl. Cub. 76. 1866.

Galactia impressa C. Wright; Sauvalle, Anales Acad. Habana 5: 337. 1869.

Near Bahia Honda, Pinar del Rio, collected only by Wright. Endemic. Erroneously recorded from the Bahamas.

14. **Galactia savannarum** sp. nov.

A slender, somewhat woody vine, 6 dm. long or longer, rather densely pubescent with brownish reflexed hairs, or the older parts glabrate. Stipules lanceolate, acuminate, 1–2 mm. long; petioles slender, 5–10 mm. long; leaflets 1 or 3, oblong, oblong-lanceolate, or the terminal one oblong-oblanceolate, subcoriaceous, revolute-margined, 1–3 cm. long, 6–12 mm. wide, glabrous on both sides or with some scattered hairs beneath, obtuse or emarginate at the apex, rounded at the base, the pubescent petiolules equal, about 1.5 mm. long; inflorescence interruptedly spicate, slender, 5–12 cm. long, densely appressed-pubescent; flowering pedicels 0.5 mm. long or less; calyx 4–5 mm. long, appressed-pubescent, its lobes about equalling the tube; flowers blue-purple, about 8 mm. long; standard suborbicular, clawed, about 6.5 mm. broad; wings and keel nearly equal in length; pod borne on a pedicel about 1.5 mm. long, linear, acute, densely villous, 2.5–3 cm. long, 7 mm. wide.

Barren savannas, Oriente, Camaguey, Santa Clara. Type from savanna southeast of Holguin, Oriente (*Shafer 1237*).

15. GALACTIA JUSSIAEANA Kunth, Mimos. 196. 1824

Clitoria glomerata Griseb. Cat. Pl. Cub. 74. 1866.

Pine-lands and plains, Pinar del Rio and Isle of Pines: Jamaica; Hispaniola; tropical South America. Common in pine-lands on the Isle of Pines, attaining a height of 6 dm.

47. THE GENUS MACHAONIA H. & B. IN CUBA

Type species: *Machaonia acuminata* H. & B.

Fruit essentially glabrous.
- Fruit constricted below the middle. — 1. *M. pauciflora.*
- Fruit gradually narrowed to the base. — 2. *M. littoralis.*

Fruit pubescent.
- Fruit sparingly pubescent, the persistent calyx-lobes long. — 3. *M. trifurcata.*
- Fruit densely pubescent, the persistent calyx-lobes short.
  - Fruit broadly obpyramidal, 2.5 mm. long. — 4. *M. microphylla.*
  - Fruit narrowly obpyramidal, 3–4 mm. long. — 5. *M. calcicola.*

1. MACHAONIA PAUCIFLORA Urban, Symb. Ant. 5: 512. 1908

The species is based on part of *C. Wright's 433*, collected, presumably, in Oriente, and has not been found by us.

2. **Machaonia littoralis** sp. nov.

A shrub, about 2 m. high, with slender branches, the young twigs short-pilose, leafy to their tips. Leaves rhombic-ovate to elliptic, 6–10 mm. long, subcoriaceous, entire, 7 mm. wide or less, abruptly acute, obtuse, or some of them rounded at the apex, narrowed at the base, glabrous, pinnately few-veined, the glabrous or somewhat pubescent petioles 0.5–1 mm. long; inflorescence corymbose-cymose, several-flowered; pedicels very slender, sparingly pubescent, 1–2 mm. long; fruit narrowly obpyramidal, sparingly papillose or glabrous, 2 mm. long, 1 mm. thick at the top, evenly gradually narrowed to the rounded base, the persistent calyx-lobes ovate or ovate-lanceolate, about 0.5 mm. long.

Coastal thickets, vicinity of Siguanea, Isle of Pines, Cuba (*Britton & Wilson 14942.*)

3. MACHAONIA TRIFURCATA Urban, Symb. Ant. 5: 512. 1908

Cuba (*C. Wright 2760*). Referred by Grisebach to the Jamaican *M. cymosa* Griseb., but clearly different from that species. Not found by us. A part of *C. Wright 433* in the herbarium of the New York Botanical Garden has the characters of this species.

4. MACHAONIA MICROPHYLLA Griseb. Mem. Am. Acad. II. 8: 510. 1862

Rocky hills at lower elevations in dry districts, province of Oriente.

A barren specimen, collected in the palm barren near the city of Santa Clara, Santa Clara province (*Britton & Wilson 6130*) is doubtfully referred to this species.

5. **Machaonia calcicola** sp. nov.

?*Spermacoce spinosa* Jacq. Stirp. Am. 21. 1763. Not L. 1762. Not *Machaeonia spinosa* C. & S.

?*Spermacoce havanensis* Jacq.; Gmel. Syst. 234. 1796.

A much-branched shrub or small tree up to 3 m. high, the slender twigs densely puberulent, bristle-tipped. Leaves ovate or rhombic-ovate to elliptic or oblong-lanceolate, 6–15 mm. long, acute, short-acuminate, or some of them obtuse at the apex, narrowed or obtuse at the base, glabrous, pinnately few-veined, the short petioles puberulent; inflorescence corymbose-cymose, several- to many-flowered; pedicels slender, pubescent, 1–2 mm. long, calyx densely pubescent, its ovate or ovate-lanceolate lobes as long as the tube or somewhat shorter; corolla white or yellowish, about 1 mm. long, its ovate-oblong obtuse lobes about as long as the tube; stamens shorter than the corolla; fruit obpyramidal, 3–4 mm, long, 1.5 mm. thick at the top, tapering gradually to the base, densely pubescent, the persistent calyx-lobes about 0.5 mm. long.

Limestone rocks, northern parts of Havanna and Pinar de. Rio. Type from coastal hillside, Bay of Mariel, Pinar del Rio (*Britton & Earle 7619*).

A barren specimen from limestone rocks at Cape Corrientes (*Britton & Cowell 9894*) is doubtfully referred to this species.

48. THE GENUS HEPTANTHUS Griseb.

A Cuban genus, of which three species were described at the place of original publication (Cat. Pl. Cub. 148. 1866); all were from western Cuba, *H. cochlearifolius* Griseb. being typical, and none have since been added to the genus. I now propose three others, all from eastern Cuba.

Leaf-blades glabrous above or merely puberulent.
  Peduncles longer than the leaves. — 1. *H. cochlearifolius.*
  Peduncles shorter than the leaves.
    Leaf-blades orbicular-ovate, 1–2 cm. long; petioles densely villous. — 2. *H. cordifolius.*
    Leaf-blades triangular- ovate, 4–6 mm. long; petioles sparingly villous. — 3. *H. Shaferi.*
Leaf-blades pubescent on both surfaces.
  Leaf-blades repand-dentate; peduncles much shorter than the petioles. — 4. *H. brevipes.*
  Leaf blades incised-serrate or lobed; peduncles as long as the leaves or longer.
    Leaf-blades 12 mm. long or less, incised-serrate. — 5. *H. ranunculoides.*
    Leaf-blades 1–2.5 cm. long, deeply 3-lobed, the lobes coarsely few-toothed. — 6. *H. lobatus.*

1. HEPTANTHUS COCHLEARIFOLIUS Griseb. Cat. Pl. Cub. 148. 1866

TYPE LOCALITY: Western Cuba.

DISTRIBUTION: Pine-lands and savannas, Pinar del Rio.

The upper leaf-surfaces are glabrous or nearly so.

A plant related in leaf-form, but with the upper leaf-surfaces densely puberulent is common in pine-lands and white sand in the central districts of the Isle of Pines, but could not be found in flower during our visit to this region in February and March, 1916 (*Britton & Wilson 14163*); it is therefore referred to this species with doubt.

2. **Heptanthus cordifolius** sp. nov.

In habit and aspect similar to *H. cochlearifolius*, forming cushion-like tufts 1–1.5 dm. broad. Petioles densely villous, 8 cm. long or less; leaf-blades orbicular-ovate, 1–2 cm. long, nearly or quite as wide as long, repand-dentate, rounded or obtuse at the apex, cordate at the base, distinctly punctate, glabrous above, villous on the few veins beneath; peduncles filiform, sparingly villous, shorter than the petioles; involucre campanulate, about 5-flowered; flowers white.

In damp soil among stones at edge of low thicket in deciduous woods near the base of Loma Mensura, Oriente, about 680 m. alt. (*Shafer 3786*).

3. **Heptanthus Shaferi** sp. nov.

Forming small tufts 4–6 cm. broad. Petioles filiform, loosely villous, 4 cm. long or less; leaf-blades triangular ovate, 4–6 mm. long, rather sharply few-dentate, bluntly acute at the apex, cordate at the base, distinctly punctate, glabrous on both sides or with a few hairs on the veins beneath; peduncle filiform, loosely villous, about 2.5 cm. long; involucre narrowly companulate, 4-flowered, about 1.5 mm. long.

On bank of a stream, Camp La Gloria, south of Sierra Moa, Oriente (*Shafer 8217*).

4. Heptanthus brevipes Griseb. Cat. Pl. Cub. 148. 1866

Type locality: Low riparian woods near Toscano [Pinar del Rio].

Distribution: Known only from the type locality and from the original collection (*Wright 2821*).

5. Heptanthus ranunculoides Griseb. Cat. Pl. Cub. 148. 1866

Type locality: Western Cuba.

Distribution: Known only from the original specimens (*Wright 2820*).

6. **Heptanthus lobatus** sp. nov.

Densely tufted, the tufts 1–1.5 dm. broad. Petioles densely villous, 7.5 cm. long or less; leaf-blades broadly ovate or orbicular-ovate in outline, pubescent with long hairs on both surfaces, 1–2.5 cm. long, deeply 3-lobed, the lobes coarsely few-toothed, the middle one obovate-cuneate, obtuse; peduncles filiform, loosely villous, as long as the petioles or longer; involucre narrowly campanulate, about 3 mm. long, several-flowered; flowers white.

Sandy bank, alluvial valley of Rio Yamaniguey, Oriente (*Shafer 4201*).

49. UNDESCRIBED SPECIES FROM PORTO RICO

Malpighia Shaferi Britton & Wilson, sp. nov.

A shrub 2–2.5 m. tall, with grayish-brown twigs. Leaves oblong-elliptic to elliptic or somewhat oblong-lanceolate, 13–17 cm. long, 4.5–8.5 cm. broad, acute, or rounded and mucronate, or occasionally retuse at the apex, more or less inequilateral and acute or rounded at the base, reticulate-veined above, armed beneath with closely-appressed stinging hairs, the margin somewhat revolute; petioles stout, 8–12 mm. long; cymes nearly sessile; pedicels 8–18 mm. long; sepals elliptic to broadly ovate, 2–3 mm. long, 1.2–1.5 mm. broad; glands fully one half the length of the sepals; larger petals 10–11 mm. long, the blades 6 mm. broad, pink, prominently keeled on the back; stamens unequal; anthers cordate; styles unequal, the anterior one slightly shorter than the posterior ones; fruit red.

Type collected in the vicinity of Isabel Segunda, Vieques Island (*Shafer 2448*).

Byrsonima ophiticola Small, sp. nov.

Tree up to 8 m. tall, the twigs with dark gray bark, the young tips with dark red pubescence. Leaves clustered at the ends of the twigs, 3–6.5 cm. long, the blades spatulate to narrowly obovate, rounded or obtuse at the apex, closely and finely pubescent when young, sparingly pubescent when full-grown, dull, paler green beneath than above, acute or acuminate at the base, rather long-petioled; panicles 5–9 cm. long, the bracts less than 3 mm. long; pedicels closely pubescent, at least in anthesis; sepals ovate or oblong-ovate, 2.5–3 mm. long, obtuse or acutish, the glands mostly less than one half as long as the sepal-body; petals yellow, turning to scarlet, 8–10 mm. long, the blade broadly reniform or orbicular-reniform, 7–8 mm. wide, the claw shorter than the blades; drupes not seen.

Serpentine slopes, Guanajibo near Mayaguez (*Britton, Cowell, & Brown 4350*). Related to *Byrsonima lucida* DC., from which it differs in the longer petioles, larger panicles, and larger flowers. The petals besides unfolding yellow and turning scarlet, have relatively shorter claws and more broadly reniform blades than in *B. lucida*, and are of very firm texture and more persistent.

Chamaesyce Cowellii Millspaugh, sp. nov.

A small, prostrate, glabrous annual, many-stemmed from the rootstalk; stems short; branches filiform, 2–3 cm. long; nodes swollen and prominent. Inflorescence solitary in the upper axils. Leaves thick, sarcous, ovate, entire, blunt, 2–3.5 × 1.5–2 mm., strongly inequilateral at the oblique and but slightly cordate base, petiolate; stipules various, those of the upper surface mostly quadrilateral and often bilobed, others triangular, all lacerate; those of the under surface of the branches formless in laceration. Involucres turbinate, short-pedunculate, glabrous without, densely woolly within; lobes triangular, aristate, densely ciliate; sulcus shallow, inconspicuous, flanked by two minute lobes similar in form to the others; glands green, flattened parallel to the walls of the involucre; appendages narrow, greenish, crenate, about half the width of the glands. Capsule glabrous, deeply sulcate; seeds pink, ovate-quadrangular, the dorsal angle most prominent, 1 × 0.6 mm., the facets finely and anastomosely transverse-ridged in a central longitudinal line. Allied to *Chamaesyce serpens* (HBK.) Small.

Collected from the crevices of limestone rocks at Cayo Muertos (*Britton, Cowell & Brown 5007*). Type, sheet No. 427101, in the herbarium of the Field Columbian Museum.

Sebesten brachycalyx (Urban)

Cordia Sebestena brachycalyx Urban, Symb. Ant. 1: 389. 1899.

This tree, first made known from the southern and eastern coasts of Porto Rico, appears to differ specifically from the related *Sebesten Sebestena* (L.) Britton (*Cordia Sebestena* L.) of wide distribution in the West Indies, Florida and tropical continental America, and there much planted for ornament. *S. brachycalyx* has much rougher upper leaf-surfaces and a much smoother calyx than *S. Sebestena* (often glabrous), and its yellow or orange fruit is shorter-beaked than the white fruit of that species; the corolla of *S. brachycalyx* has a narrower limb than that of *S. Sebestena.* The species inhabits Porto Rico, Vieques, Culebra, and Buck Island, St. Thomas.

Crescentia portoricensis sp. nov.

A vine-like, glabrous shrub, with long, slender branches, the bark light gray. Leaves elliptic-obovate, fascicled at the nodes, 15 cm. long or less, 2–8 cm. wide, coriaceous, shining above, dull beneath, strongly reticulate-veined on both sides, abruptly short-acuminate at the apex, cuneate at the base, the slender petioles 6–12 mm. long; peduncle 1–2 cm. long, slender in flower, much thickened in fruit; calyx 2 cm. long, deeply 2-lobed; corolla subcampanulate, 4 cm. long, yellowish white, reticulate-veined, its broadly ovate, entire, acute or blunt lobes about one fourth as long as the tube; fruit narrowly oblong, 10 cm. long, 3.5 cm. in diameter, terete, pointed at the apex, truncate at the base.

River-valley forests, mountains of western Porto Rico. Type from Rio de Maricao, 500–600 m. alt. (*Britton, Stevens & Hess 2455*).

Mikania Stevensiana sp. nov.

Climbing to a height of 5 m., the branches glabrous, striate, nearly terete, the twigs angular, sparingly pubescent. Leaves triangular-ovate in outline, firm in texture, brittle when dry, 5 cm. long or less, very scabrous and sparingly short-hispid above, pubescent on the elevated veins beneath, 5-nerved, sharply 3-lobed, the middle lobe triangular-lanceolate, long-acuminate, dentate, 3 or 4 times as long as the acute, entire or sparingly toothed, lateral ones; petioles sparingly pubescent, 1–2 cm. long; inflorescence corymbose-paniculate; heads peduncled; bracts of the involucre linear, acute, 7 mm. long; achenes angled, glabrous, 5 mm. long; pappus-bristles about 40; corolla 7 mm. long, as long as the pappus, its lobes acute.

Wooded valley, Maricao River, above Maricao (*Britton & Cowell 4225*, type; *Britton, Stevens & Hess 2439*).

50. UNDESCRIBED SPECIES FROM CUBA

Schoepfia cubensis Britton & Wilson, sp. nov.

A slender, glabrous shrub, 2.5–4 m. tall, the young twigs compressed, longitudinally ridged, often flexuose, glabrous. Leaves elliptic to oval, 2–3.4 cm. long, 1.5–2.8 cm. broad, short-petioled, entire, glabrous, rounded at the apex, equilateral and rounded or occasionally subcordate at the base, lustrous and rather indistinctly veined on both surfaces; principal veins 5 or 6 on each side of the midvein, strongly divergent; peduncles 0.8–1.2 cm. long; fruit sessile, ellipsoid, 8 mm. long, 7 mm. wide.

Camp La Gloria, Oriente (*Shafer 8278*).

Cassia scleroxyla sp. nov.

A slender tree, about 8 m. high, with smooth bark and exceedingly hard wood, the young twigs loosely appressed-pubescent.

Leaves glandular, 8–10 cm. long; petiole and rachis grooved above, sparingly appressed-pubescent; petiole 1–2 cm. long; leaflets 6–8 pairs, linear-lanceolate, chartaceous, 2–4 cm. long, acute and mucronate at the apex, rounded or narrowed at the base, rather dark green and glabrous above, pale green and sparingly pubescent beneath, the pubescent petiolules about 2 mm. long; flowers loosely corymbose; pedicels slender, puberulent, about 1 cm. long; sepals very unequal, sparingly pubescent, ciliate, the larger ones 4–5 mm. long; petals bright yellow, the larger 6–7 mm. long; perfect anthers 7, about 3 mm. long; pod linear, glabrous, 3–4.5 cm. long, 6–7 mm. wide, reticulate-veined, abruptly acute, septate between the seeds.

Hillside, Berraco, near Daiquiri, Oriente (*Britton & Cowell 12664*).

Among West Indian species, perhaps most nearly related to *C. domingensis* Spreng.

Cassia Shaferi Britton & Wilson, sp. nov.

Shrub 1 m. tall; twigs, petioles, rachis, and branches of the inflorescence hirsutulous. Leaves 6.5–10 cm. long, glandular, the gland slender, 1.5–2 mm. high, acutish or obtuse, situated either between the leaflets of the lowest pair or below on the petiole; petioles and rachis grooved; stipules narrowly oblong-lanceolate, 6–7 mm. long, acuminate; leaflets 4–6 pairs, oblong to elliptic, 1.5–3 cm. long, 7–12 mm. broad, rounded and mucronulate at the apex, rounded and very inequilateral at the base, sparingly hirsutulous on the midrib above, hirsutulous beneath, the hairs scattered and mostly appressed, short-petioluled; margin thickened, ciliate; pedicels hirsutulous; buds subglobose; sepals densely hirsutulous; pod flat, 11 cm. long, 9 mm. broad; seeds 3.5–4.5 mm. long.

Pine-lands near the base of Loma Mensura, Oriente (*Shafer 3770*); also collected in open places at base of Loma Mensura (*Shafer 3803*).

Apparently closely related to *Cassia bahamensis* Mill.

Pachyanthus reticulatus Britton & Wilson, sp. nov.

A shrub 1–1.5 m. tall; young twigs compressed, more or less grooved, ferruginous, stellately scabrous-puberulent. Leaves ovate, 9–12 cm. long, 5–7 cm. broad, obtuse at the apex, cordate at the base, above densely ferruginously stellate-puberulent when young, glabrescent, lustrous and dark green in age, the venation strongly impressed, below pale brown, reticulate-veined and densely stellate-canescent, prominently 5-nerved; petioles 1.5–2.5 cm. long; flowers sessile, calyx campanulate, densely stellate-tomentulose, the lobes 5, deltoid at the base, linear above, 5–6 mm. long.

Low dry thickets, pine-lands, Sierra Nipe, near Woodfred, Oriente (*Shafer 2967*).

Labatia aristata Britton & Wilson, sp. nov.

A much-branched shrub, 2–3 m. high, the branches rigid, gray, the young twigs appressed-pubescent. Leaves broadly ovate to suborbicular, 2–3.5 cm. long, coriaceous, glabrous, strongly pinnately and reticulate-veined, dark green and shining above, dull green beneath, aristate at the apex, rounded or subcordate at the base, the yellowish green, rather stout petioles 5–10 mm. long; pedicels solitary or several together, slender, glabrous, 5–8 mm. long; calyx sparingly pubescent, 2.5–3 mm. long, deeply 4- to 5-lobed, the lobes lanceolate or oblong-lanceolate, acutish, scarcely imbricated; corolla green, about 2.5 mm. long, 4–5-lobed to about the middle, the lobes rounded, slightly imbricated; anthers oblong, a little longer than the filaments; staminodia obovate, somewhat longer than the filaments; drupe oval, dark purple, 2.5 cm. long, its flesh very thin; seeds 2, oblong.

Coastal hills and thickets, provinces of Oriente, Santa Clara and Havana, Cuba; type collected between the Rio Chorrera and Marianao, Havana (*Brother Leon 6230*).

Tournefortia Earlei sp. nov.

A shrub, 1–2 m. high, with long, slender branches, or vine-like and 3 m. long, the branches densely pubescent with short, soft, appressed hairs. Leaves narrowly linear, or linear-lanceolate, 3–7 cm. long, 2–6 mm. wide, acute or bluntish at the apex, densely appressed-pubescent above, densely white-tomentulose beneath, the petioles 1.5–3 mm. long; cymes short-peduncled, their few, very slender branches 2–4 cm. long; calyx 1 mm. long, appressed-pubescent, its lanceolate or ovate-lanceolate lobes acute; corolla-tube about 2 mm. long, the narrowly lanceolate lobes about as long; fruit depressed, 4 mm. broad, about one half as high as broad, glabrous.

Hillsides, Guantanamo Bay and Santiago Bay, Oriente. Type from Guantanamo Bay (*F. S. Earle 82*). Related to *T. incana* Lam. and *T. stenophylla* Urban.

Cestrum pinetorum sp. nov.

A glabrous shrub, about 1 m. high, with slender branches. Leaves narrowly oblong to oblong-lanceolate, 7 cm. long or less, 6–16 mm. wide, rather thin in texture, faintly shining, bluntly acute at the apex, narrowed at the base, the midvein slender above, prominent beneath, the lateral veins few, obscure, the slender petioles 3–5 mm. long; clusters axillary, few- to several-flowered; fruiting pedicels very short; fruiting calyx obconic-campanulate, about 5 mm. long, its triangular-ovate teeth acutish, about one third as long as the tube; berry globose-ovoid, purplish, about 7 mm. long.

Open pine-woods Sierra Nipe near Woodfred, Oriente, 500–650 m. alt. (*Shafer 3031*, type; *3591*).

Casasia parvifolia sp. nov.

A much-branched shrub, about 2 m. high, the twigs slender, puberulent when young. Stipules lanceolate, acute, about 3 mm. long. Leaves glabrous, oblong-spatulate, 3 cm. long or less, 5–8 mm. wide, obtuse or acutish at the apex, narrowed or cuneate at the base, coriaceous, clustered at the ends of the twigs, pinnately few-veined, shining and with impressed midvein above, the midvein very prominent beneath, the petioles about 1 mm. long; fruit terminal, solitary, sessile, globose, warty, about 10 mm. in diameter.

Rocky river-banks, mountains of northern Oriente; type collected between Camp La Barga and Camp San Benito, 450–900 m. alt. (*Shafer 4100*).

Baccharis Shaferi sp. nov.

A glabrous shrub, 6 dm. high or less, with slender ascending branches, the twigs angled. Leaves triangular-cuneate, 6–12 mm. long, 7 mm. wide or less at the truncate or subtruncate apex, bright green and shining above, dull and whitish-papillose beneath, the slender midvein slightly elevated on both sides, the lateral veins 1–3; heads sessile, solitary or 2 or 3 together at the ends of short twigs, or in the axils; young involucres about 4 mm. long, the ovate, acute bracts imbricated in about 4 series.

Dry pine woods, Arroyo del Medio above the falls, 450–550 m. alt., Oriente (*Shafer 3257*, type); specimens from Camp La Gloria, south of Sierra Moa, Oriente (*Shafer 8213*), have longer leaves than the type specimens.

51. UNDESCRIBED SPECIES FROM THE ISLE OF PINES, CUBA

Zamia silicea sp. nov.

Caudex slender, completely buried in sand, 2 dm. long or longer. Basal scales lanceolate, villous, 1–2 cm. long; leaves glabrous or the base of the petiole villous, spreading or ascending, 1–4 dm. long; leaflets 30 or fewer, coriaceous, shining, many-veined, obovate-oblanceolate, 3–6 cm. long, 2 cm. wide or less, rounded or obliquely subtruncate and callously denticulate at the apex, narrowed at the base; peduncles densely short-pubescent, 2–4 cm. long; male cone cylindric, about 3 cm. long and 1.3 cm. thick, its scales densely pubescent, hexagonal, the upper and lower ones about as wide as high, the middle ones nearly twice as wide as high; ripe pistillate cones ellipsoid, short-tipped, 5–6 cm. long, about 2.5 cm. thick, the hexagonal scales puberulent, seeds red, about 12 mm. long, broadly grooved on the inner side, rounded on the back, obliquely and obtusely umbonate at the apex.

Frequent in pine-lands and in white silicious sand. Type from near Los Indios (*Britton & Wilson 14166*).

Cyperus pinetorum sp. nov.

Perennial by short rootstocks; culms tufted, stiff and wiry, compressed, 1.5–2.5 cm. high. Basal sheaths striate-veined, acute, 2–4 cm. long; involucral leaves 1 or 2, nearly subulate, 0.5–3 cm. long; spikelets linear, 10–22 mm. long, 1.5 mm. wide, digitate, one cluster subtended by the involucral leaves with usually a similar one on a slender ray 4 cm. long or less; scales elliptic, obtuse, mucronulate, yellowish-brown, 1.5 mm. long; achene sharply trigonous, about 0.6 mm. long, nearly as thick as long, often persistent on the rachis after the scales have fallen away.

White sand pine barrens. Type from the vicinity of Los Indios (*Britton and Wilson 14170*).

Related to *C. Haspan* L., differing in broader spikelets, broader scales and proliferous inflorescence.

Xyris longibracteata Britton & Wilson, sp. nov.

Annual(?); leaves erect, linear, 8–10 cm. long, 1–1.5 mm. broad, occasionally somewhat spirally twisted, the margin rough; scapes several, erect, glabrous, 15–18 cm. tall, terete or nearly so; involucre subtending the spike composed of several bracts of unequal length, each tapering abruptly into a long, linear tip, the longest bract often exceeding the spike; spikes ellipsoid to ovoid, 7–9 mm.

long, 4–6 mm. broad; bracts ovate to orbicular-ovate, 4–5 mm. long, 3.5–4 mm. broad, acute at the apex; lateral sepals included; keel toothed from the apex to below the middle; petals broadly obovate, 5 mm. long, 3.5–4 mm. broad.

White sand, vicinity of Los Indios, Isle of Pines (*Britton, Britton & Wilson 14215*).

Chamaecrista micrantha sp. nov.

Stems several from a woody root, ascending or suberect, few-branched or simple, slender, villous, 2–3 dm. long. Stipules lanceolate acuminate, 2.5–4 mm. long; leaves 8–18 mm. long; petiolar gland short-stalked; rachis villous; leaflets 10–24, oblong, villous, 3–3.5 mm. long, mucronulate, the midvein very excentric; peduncles very slender, villous, 6–15 mm. long; sepals lanceolate, acute, villous, about 4 mm. long; petals rounded, 5 mm. long; pod linear, finely pubescent, 2–3 cm. long, 3–4 mm. wide.

Pine-lands and savannas, Pinar del Rio and Isle of Pines, Cuba. Type collected near San Pedro, Isle of Pines (*Britton & Wilson 14294*). Referred by Grisebach to *Cassia pygmaea* DC., and taken up by Bentham under *Cassia procumbens* L., but the type of *C. procumbens* is the same as *C. nictitans* L.

Chamaecrista savannarum sp. nov.

Stems several from a deep woody root, slender, ascending or erect, short-pubescent, 2–4 dm. high, simple or little-branched. Stipules lanceolate or ovate-lanceolate, 2–4 mm. long, acuminate, strongly veined; leaves 2.5 cm. long or less, the rachis pubescent; petioles 2–4 mm. long, bearing a scutellate, sessile or very short-stalked gland; leaflets 3–13 pairs, appressed-pubescent or glabrate, oblong or linear-oblong, 3–7 mm. long, somewhat oblique, aristulate, the midvein very excentric; peduncles slender or nearly filiform, 8–20 mm. long; sepals lanceolate, acuminate, slightly pubescent, 4–5 mm. long; petals 7–8 mm. long; pod linear, sparingly pubescent, 3–4 cm. long, 4 mm. wide.

Savannas and pine-lands, Pinar del Rio and Isle of Pines, Cuba. Type collected near Siguanea, Isle of Pines (*Britton & Wilson 14379*).

Bauhinia Jenningsii P. Wilson, sp. nov.

A slender shrub or tree, sometimes 5 m. high; young twigs, branches of the inflorescence, under surface of the leaves and pods finely puberulent with minute, mostly appressed hairs; petioles

1.5–2 cm. long; leaves lanceolate-ovate to oblong-ovate or ovate, 7–14 cm. long, 2.5–5 cm. broad, acute at the apex, subtruncate or rounded at the base, 5-nerved, finely reticulate-veined and glabrous above, reticulate-veined and minutely papillose beneath; inflorescence corymbose; flowers long-pedicelled; calyx scarlet, puberulent with appressed hairs; petals lanceolate or occasionally somewhat oblanceolate, 1.2–1.6 cm. long, 2–2.7 mm. broad; sterile stamens 9, half as long as the fertile stamen; ovary stipitate; pods oblong, 5–9 cm. long, 0.8–1.5 cm. broad, brown; seeds oblong-elliptic to elliptic, 7–8 mm. long, 5–5.5 mm. broad, brownish black.

Wooded limestone plain, Coe's Camp, Ensenada de Siguanea (*Britton & Wilson 14851*, type); coastal plain, San Juan (*Britton & Wilson 15544*); coral soil, north of Caleta Grande (*O. E. Jennings 480*).

Savia perlucens sp. nov.

A shrub, about 2 m. high, the slender branches terete, grey. Stipules ovate, acute; leaves obovate or elliptic-obovate, coriaceous entire, 9 cm. long or less, acute or acuminate at the apex, obtuse or acute at the base, bright green and strongly shining above, dull green beneath, the midvein prominent above and beneath, both surfaces reticulate-veined; flower-clusters supra-axillary, depressed, about 3 mm. broad, puberulent.

Limestone plain, Caleta Grande (*Britton, Wilson & Leon 15330*).

Phyllanthus nanus Millspaugh, sp. nov.

A low, spreading, glabrous perennial, about 5 cm. in extent, with thick, strongly imbricated leaves. Root thick, branching, giving off a mass of thread-like rootlets. Stems many, springing from the rootstalk, very short (1–1.5 cm.); branches diffuse, rather thick and striate, 1–2 cm. long. Inflorescence dioecious, biflorate, in the axils of the apical leaves of the short branchlets. Leaves thick, glabrous, ovate, cordate, acute, entire, 1.3×1–2.3×1.75 mm.; petioles very short; stipules entire, aristate from a deltoid base, the upper half withered to a dark brown color. Flowers sessile or nearly so; sepals 5, equal, ovate, acute, strongly striate-keeled; glands 5, verrucoid, minute; staminal column twice the length of the anthers; anthers 2, transversely connate in an apical ring; female calyx as in the male but nearly twice the size; ovary 3-carpelled, 6-celled, nearly sessile; styles 3, short, bifid to half their length, the stigmatic apices cleaveate; capsule depressed-globose, glabrous; seeds dark brown, sharply angled, 0.9×0.75 mm. dorsal facet minutely and closely transverse anastomose-wrinkled.

In white sand in the vicinity of Los Indios (*Britton & Wilson*

14192). Type sheet in the herbarium of the Field Columbian Museum.

Chamaesyce Jenningsii Millspaugh, sp. nov.

Prostrate, spreading from a low rootstock; stems many, divaricately branching, internodes about 1.5–3 cm.; branches 2 to many at each swollen node, wiry, divergently forking; leaves oval to ovate, 5×3–8×4 mm., glabrous above, finely long silvery-pubescent beneath, obliquely cordate, blunt, shallowly but sharply serrate throughout the margins. Inflorescence solitary in the terminal forks and axils; involucres long-turbinate, glabrous without, hairy within; pedicels about twice the length of the tube; lobes triangular; sulcus large, deep, triangular, the fundus unoccupied; glands nearly circular, flattened to the walls of the involucre; appendages none, or rarely merely a marginal line of the same color and texture as the glands; bracteoles as many as the stamens, ligulate, transparent. Capsule glabrous, ovoid; carpels strongly keeled; seeds ovate-quadrangular, 1.2×1 mm., angles sharp, facets sharply and anastomosely transverse ridged including deep, quadrangular pits.

Vivijagua (*O. E. Jennings 621*); type in the herbarium of the Carnegie Museum, Pittsburgh, Pennsylvania. Also in coastal sands at the same place (*Britton & Wilson 14690*).

Tapura obovata Britton & Wilson, sp. nov.

A tree 10 m. tall; young twigs and petioles minutely strigillose; leaves obovate, 3.5–7 cm. long, 1.5–4.4 cm. broad, rounded at the apex, cuneate to rounded-cuneate at the base, dull above, lustrous beneath and reticulate-veined, glabrous, short-petioled; flowers short-pedicelled; calyx-lobes 5, ciliate, sparingly appressed-pilose on the outside, the two outer lobes smaller than the three inner ones, broadly oblong-elliptic to oval, 2.5–3.2 mm. long, 2–2.2 mm. broad, the three inner lobes oval to suborbicular, 3.4–3.8 mm. long, 3–3.3 mm. broad; corolla-lobes 5, unequal, the three smaller lobes spatulate-obovate, 4–4.6 mm. long, 1.2 mm. broad, the two larger lobes spatulate, 4.6–5 mm. long, 2.2–2.5 mm. broad; filaments lanceolate-oblong to oblong; ovary pilose; style filiform, pilose, 3-lobed.

Savanna, Vivijagua (*Britton & Wilson 15607*, type); coastal plain, San Juan (*Britton & Wilson 15524*).

Calyptranthes pinetorum Britton & Wilson, sp. nov.

A depressed, glabrous, much-branched shrub 6 dm. high or less, 3–10 dm. broad, the twigs stout, gray, terete or nearly so. Leaves opposite, thick-coriaceous, ovate to orbicular, flat, 1–3.5 cm. long, rounded or obtuse at the apex, cordate or subcordate at the base, bright green and shining above, pale green and dull beneath, densely punctate, the midvein prominent, the lateral veins faint, the stout petioles 1–2 mm. long; peduncles rather stout, somewhat longer than the leaves; inflorescence cymose, few- to several-flowered; young fruit sessile, subglobose, 2 mm. in diameter, the calyx-limb 2 mm. broad.

Pine-lands, central districts. Type from north of Los Indios (*O. E. Jennings 390*).

Related to *C. nummularia* Berg. of Hispaniola, *C. Maxoni* Britton & Urban of Jamaica, and *C. Boldinghi* Urban of St. Martin.

Evolvulus arenicola Britton & Wilson, sp. nov.

A diminutive perennial, with a slender, woody root, the few or solitary, simple or few-branched stems slender, appressed-pubescent, 2–5 cm. long, ascending or nearly prostrate. Leaves ovate to elliptic, 9–15 mm. long, puberulent or glabrate above, appressed-pubescent beneath, mostly obtuse or rounded at both ends, the midvein faint, the lateral veins wholly obscure, the pubescent petioles 1–2 mm. long; flowers 1 or 2 at the ends of the stems or branches; pedicels 5–8 mm. long, pubescent; sepals linear-lanceolate, acuminate, villous, 5 mm. long; corolla white, rotate, 9–12 mm. broad; obscurely lobed; stamens about one-half as long as the corolla; styles deeply 2-cleft; capsule subglobose, shorter than the sepals.

White sand, vicinity of Los Indios (*Britton & Wilson 14190*).

Gerardia pinetorum Britton & Wilson, sp. nov.

Acaulescent; leaves elliptic-ovate to elliptic, 1.5–2 cm. long, 5–8 mm. broad, rounded at the apex, cuneate or somewhat rounded at the base, hispidulous above and below with jointed hairs; petioles 1–1.5 cm. long, densely hispidulous; scape erect, 4–8 cm. high, more or less hispidulous with jointed hairs, the spikes few-flowered, 1–2 cm. high, the bracts lanceolate, 4–5 mm. long, ciliolate, long-acuminate; calyx-lobes subequal, narrowly lanceolate, 4–4.5 mm. long, 0.5–0.8 mm. broad, ciliolate; corolla rose-pink, glabrous, the tube cylindric, 5–5.5 mm. long, the limb subequally 5-lobed, the lobes broadly obovate to somewhat oval-obovate, 4.5–8 mm. long, 2.5–5 mm. broad.

Along the Los Indios River above Los Indios (*O. E. Jennings 456*).

Rondeletia calcicola sp. nov.

A glabrous shrub about 2 m. high, the twigs slender. Leaves coriaceous, narrowly oblong to oblong-oblanceolate, 5–13 cm. long, 8–18 mm. wide, shining above, dull beneath, acute at the apex, attenuate at the base into petioles about 1 cm. long or less, loosely reticulate-veined with the midvein prominent on the under surface; inflorescence terminal, few-flowered; fruiting pedicels rather stout, 3–7 mm. long; capsule oblong or oblong-obovoid, glabrous, 1 cm. long, about twice as long as thick; fruiting calyx-lobes ovate-lanceolate, acute, 1–1.5 mm. long.

Wooded limestone plain, Coe's Camp, Ensenada de Siguanea (*Britton & Wilson 14842*).

Diodia ciliata Britton & Wilson, sp. nov.

Stems perennial, prostrate, 4–6 dm. or more in length, rooting and partly buried in sand, densely pilose with whitish hairs on the younger growth; leaves elliptic to somewhat elliptic-obovate, 1.5–3 cm. long, 7–14 mm. broad, acute at the apex, cuneate to broadly cuneate at the base, the margin conspicuously and densely ciliate with rather stiff white hairs, yellowish green and glabrous above, the midvein and lateral veins inconspicuous, whitish-pilose beneath, especially on the midvein, sessile; stipules ciliate; ovary 2-celled; fruit elliptic-obovoid, 3 mm. high, glabrous, or with few scattered appressed hairs on the back.

In white sand, vicinity of Los Indios (*Britton & Wilson 15347*).

Diodia arenicola Britton & Wilson, sp. nov.

Perennial; stems ascending, 1–1.5 dm. high, glabrous; leaves lanceolate, 6–14 mm. long, 2–3 mm. broad, acute at the apex, rounded or somewhat acutish at the base, glabrous or with few, stout, scattered, mostly appressed hairs above, glabrous beneath, sessile; stipules linear-lanceolate, 2 mm. long; calyxlobes triangular-ovate, ciliate; corolla 5 mm. high, the lobes ovate, obtuse; anthers ovate-lanceolate; style 3-lobed; fruit ellipsoid, 2.5 mm. high, 1.2 mm. broad, glabrous.

Along arroyo, Los Indios, Isle of Pines (*O. E. Jennings 355* in part, type); vicinity of Los Indios (*Britton & Wilson 15812*).

Mitracarpum depauperatum Britton & Wilson, sp. nov.

A diminutive, woody perennial, 2–5 cm. high, forming small tufts, the stems few-branched or simple, the internodes very short. Leaves narrowly linear, 6–15 mm. long, less than 1 mm. wide, densely clustered, acute, sessile, glabrous; stipules deeply laciniate, about one-third as long as the leaves; calyx very small; corolla salverform, white, its tube cylindric, 2.5 cm. long, its limb spreading, 4-lobed, the lobes ovate, acute, nearly 1 mm. long.

Dry white sand, central districts; type from near Los Indios (*Britton & Wilson 14197*).

Palicourea elongata Britton & Wilson, sp. nov.

A shrub 2 m. or more high; twigs, branches of the inflorescence, and pedicels minutely hispidulous with brownish hairs; leaves in whorls of threes, lanceolate or occasionally broadly oblanceolate, 12–19 cm. long, 4–6 cm. broad, acuminate at the apex, cuneate to somewhat rounded cuneate at the base, puberulent above on the midvein when young, puberulent beneath, especially on the midvein and lateral veins; stipules linear-lanceolate, 8–12 mm. long, ciliate; panicle elongate, 7–19 cm. high; calyx-lobes deltoid-ovate, ciliate; corolla puberulent, 7–10 mm. long, the lobes triangular-ovate; fruit broadly ovoid, 4–5 mm. long, 4–4.5 mm. broad, flattened.

Arroyo, Las Tunas (*Britton & Wilson 14749*, type); Arroyo, vicinity of San Pedro (*Britton & Wilson 15785*); Los Indios (*O. E. Jennings 332*).

Elephantopus arenarius Britton & Wilson, sp. nov.

Plant 6–8 cm. high, the stem branching from the base; leaves cauline, linear, 2–4 cm. long, 1 mm. broad, involute, conspicuously ciliate at the broadened, clasping base with long hairs, entire; peduncles loosely hirsutulous, 2–3.5 cm. long; glomerules 5–6 mm. high; bracts broadly ovate to ovate-orbicular, cordate at the base with a linear, ligulate tip, 0.5–1 cm. long, reticulate-veined on the back, glabrous; scales acuminate, glabrous; achenes (immature) 2 mm. long; pappus-scales triangular to lanceolate, ciliate.

White sand, vicinity of Los Indios (*Britton & Wilson 14206*).

Closely related to *Elephantopus pratensis* C. Wright, but differing in the narrow involute leaves and linear ligulate tipped bracts.

Erigeron purpuripes Britton & Wilson, sp. nov.

A low, scapose perennial. Leaves tufted, erect, the blades elliptic to oblong-obovate, 1–2 cm. long, pinnately few-veined, obtuse at the apex, narrowed at the base, ciliolate, puberulent or glabrate; petioles very slender, purple, 2 to 4 times as long as the blades; scapes nearly filiform, erect, appressed-pubescent, about twice as long as the leaves; involucre 4 mm. high, subcylindric, its bracts in 2 or 3 series, linear, puberulent, the outer shorter than the inner; ligules white; disk-flowers tubular, 5-lobed, the lobes obtuse; achenes flattened, oblong or somewhat oblong-elliptic, minutely hispidulous; pappus-bristles in 1 series, barbellate.

In white sand, vicinity of Los Indios (*Britton & Wilson 14207*).

Helenium scaposum sp. nov.

A low, pubescent, scapose perennial. Leaves several or many, densely tufted, short-petioled, oblong to spatulate, punctate, 1.5–3 cm. long, 6–10 mm. wide, rather strongly 5- to 7-nerved, entire or repand-dentate, obtuse or acute at the apex, narrowed or cuneate at the base; scapes rather stout, 5–11 cm. high; involucre about 5 mm. high; its bracts ovate-lanceolate, acute, appressed or little spreading; rays 10 to 12, bright yellow, obovate, 3-toothed, 5–8 mm. long; disk yellowish, depressed-globose, 8–12 mm. in diameter, its corollas 5-lobed, the lobes triangular-ovate; pappus scales of ray-flowers and disk-flowers alike, elliptic to obovate, lacerate, not aristate.

White sand pine-lands, west-central districts. Type from near Siguanea (*Britton & Wilson 14346*).

A plant with quite the floral structure of *Helenium*, but its scapose habit is aberrant, resembling that of some *Tetraneuris* species.

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 193

A NOTE ON THE STRUCTURAL DIMORPHISM OF SEXUAL AND TETRASPORIC PLANTS OF GALAXAURA OBTUSATA

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A note on the structural dimorphism of sexual and tetrasporic plants of Galaxaura obtusata

MARSHALL A. HOWE

In a monograph of *Galaxaura*, a genus of calcified red algae of the family Chaetangiaceae, published by the late Professor Kjellman of Upsala in 1900,* two groups of species, denominated the "Cameratae" and the "Spissae," are recognized in the section *Dichotomaria*, the section that includes the West Indian *Galaxaura obtusata* (Ell. & Sol.) Lamour. and its allies. The plants of these two groups differ markedly and constantly in the structure of the cortex, as may be determined by a microscopic examination, particularly after decalcification. In both groups, the cortex consists essentially of three layers of cells. In the "Cameratae," the cells of the outermost or superficial layer are funnel-shaped or broadly obconic and are supported by the cylindric, clavate, or narrowly funnel-shaped, widely spaced cells of the middle layer, which, in turn, spring from the very large firmly united cells of the inmost layer; the funnel-shaped superficial cells are in contact by their edges only and they arch over large intercellular chambers, which are continuous or confluent, being bounded below by the large cells of the inmost layer and merely traversed rather than bounded by the widely spaced stalk-cells; in other words, the single superficial layer constitutes a sort of a roof or outer sheath, supported by short pillars. In the "Spissae," the cells of the outermost or superficial layer are hemispheric or saucer-shaped and are supported by the ovoid or subglobose, connivent or rather close-set cells of the middle layer, which, in turn, rest upon the large firmly united cells of the inmost layer; the intercellular spaces are comparatively small and instead of obviously extending from the superficial layer to the inmost layer they are commonly divided into two series or strata by the rounded connivent cells of the middle layer. In other words, the middle layer of the

* Kjellman, F. R. Om Floridé-slägtet *Galaxaura*, dess organografi och systematik. Kongl. Sv. Vet.-Akad. Handl. 33[1]: 1–109. *pl. 1–20.* 1900.

cortex in the "Cameratae" consists chiefly of large obviously confluent intercellular *chambers* filled with lime, while in the "Spissae" this middle layer is made up chiefly of rounded calcified *cells*. Expressed in another way, it may be said that the two outer layers of the cortex in the "Cameratae" are filamentous, if two cells in a row (or, often, two or three cells supported capitately by a single stalk-cell) may be said to constitute a filament, while in the "Spissae," the cortex is parenchymatous or subparenchymatous throughout. In the process of decay or on teasing to pieces with needles after decalcification, it often happens that the outer cortex peels off, leaving the inner cortex still surrounding the central strand of filaments. In the "Cameratae", such a separation commonly takes place near the base of the stalk-cells constituting the middle layer, so that the two outer layers are exfoliated together, leaving the stumps of the stalk-cells protruding from the large firmly coherent cells of the inmost layer. In the "Spissae," the separation under such circumstances takes place between the two outer layers, only the single superficial layer being exfoliated, the middle layer of rounded subparenchymatous cells remaining firmly attached to the larger cells of the inmost layer.

In the course of a microscopic examination of certain specimens of *Galaxaura* from Bermuda, Florida, and the West Indies, representing forms currently referred to *G. obtusata*, it was noted that some of these specimens showed the cortex structure of the "Cameratae" group while others showed that of the "Spissae" group. It was at first supposed that two or more species were represented in this material, but it was afterwards observed that the two forms were often collected together almost throughout their range, that they showed the same or parallel variations in external characters, and that they could not be separated without a microscopic examination. A little later it was noted that whenever reproductive organs could be found (and by search they could be found in most of the specimens), the plants of the "Cameratae" structure were always tetrasporic, while those of the "Spissae" structure were always antheridial or cystocarpic. This discovery led to a careful reexamination of all the available material, with results that were confirmatory of this correlation.

One of the largest single collections at hand was that made by the writer on Condé Beach, Guantanamo Bay, Cuba, in March, 1909 (*no. 6460*), where nineteen plants or fragments of plants were picked up on the shore (the species is apparently an inhabitant of rather deep water and is found washed ashore or by dredging in 7–18 meters). Of these nineteen, three were antheridial and of the "Spissae" structure, three were cystocarpic and of the "Spissae" structure, twelve were tetrasporic and of the "Cameratae" structure, and the remaining one was apparently sterile and of the "Cameratae" structure. Of five plants dredged in 18 meters off Ratones Island near Ponce, Porto Rico (*no. 7575*), four belonged to the "Cameratae" and were tetrasporic, and one belonged to the "Spissae" and was cystocarpic. Of numerous plants or fragments dredged in 7–10 meters at the mouth of Guanica Harbor, Porto Rico (*no. 7005*), all of the thirteen examined showed the "Spissae" structure, three or four of them being evidently antheridial, one cystocarpic, and the rest apparently sterile. Of five plants found washed ashore in the harbor of Port Morant, Jamaica (*no. 6276*), two had the "Spissae" structure and were cystocarpic, while three showed the "Cameratae" structure, though tetraspores could actually be found on only one of the three. In six plants from Barbados, similar to each other in general habit, though not all collected at the same time and place, five were "Cameratae," four of them with obvious tetraspores, while the sixth showed the structure of the "Spissae" group and was cystocarpic. On the coast of Florida also, in the region of Jupiter Inlet, Indian River, and Lake Worth, in plants that are somewhat larger, coarser, and longer-segmented than the typical *Galaxaura obtusata*, the same correlations may be observed.

Finally, it is to be noted by consulting Kjellman's monograph, that all of the species that he placed in the group "Cameratae," in so far as their mode of reproduction was known to him, are tetrasporic, while of the "Spissae" the one species of which the reproductive organs are described is cystocarpic.

For complete proof that the "Cameratae" structure is a constant characteristic of the tetrasporic plants of *Galaxaura obtusata* and its allies and that the "Spissae" structure is likewise a constant character of the sexual plants, it would of course be desirable that actual cultures should be made under control conditions as has been done by Hoyt* and by Lewis† to demonstrate the alternation of generations in certain other tetraspore-producing algae. This could be done only in tropical or subtropical waters, would probably require months for its accomplishment, and is not likely to be achieved in the immediate future. Meanwhile, however, it seems to the writer that the proof is conclusive that the suggested correlation exists, 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 gametophytic and sporophytic phases in the life-cycle of a single species.

It is well known that differences of habit occur between sexual and tetrasporic plants of certain red algae, as, for example, in species of *Griffithsia*, but such differences seem to be due largely to the presence of the reproductive organs themselves or to differences in the form of the cells that are rather directly concerned with their production. So far as is known to the writer of these notes, there has been no previous record of a case in which there has been alleged to exist any such constant and pronounced dimorphism in the purely vegetative microscopic structure of the sexual and tetrasporic plants in the Rhodophyceae as is here attributed to *Galaxaura obtusata*—differences that do not express themselves in general habit, but afford an easy means of distinguishing a tetrasporic from a sexual plant, even though apparently sterile.

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* Hoyt, W. D. Alternation of generations and sexuality in *Dictyota dichotoma*. Bot. Gaz. **49**: 55–57. 1910.

† Lewis, I. F. Alternation of generations in certain Florideae. Bot. Gaz. **53**: 236–242. 1912.

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EL GENERO

RYNCHOSPORA VAHL, EN CUBA

POR EL

Dr. Nathaniel Lord Britton

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EL GENERO RYNCHOSPORA VAHL, EN CUBA (1)

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Ciperáceas hojosas, la mayor parte perennes por rizomas, con tallos erguidos triangulares o cilíndricos, hojas estrechamente planas o involutas y espiguillas ovado-oblongas o fusiformes variamente agrupadas. Escamas delgadas, uninervias, imbricadas todas alrededor, comúnmente mucronadas por el nervio medio excurrente, las inferiores vacías. Flores superiores unisexuales, las inferiores hermafroditas. Periantio de 1 a 20 (comúnmente 6) cerdas erizadas hacia arriba o hacia abajo o escabrosas, ausentes en algunas especies. 3 estambres comúnmente. Estilo bipartido, bidentado o raramente entero. Aquenio lenticular o hinchado, no triangular, liso o arrugado transversalmente, recubierto por la base persistente del estilo (tubérculo), o en algunas especies por el estilo completo. (La etimología griega alude al tubérculo en forma de pico).

Este género encierra, poco más o menos, 200 especies de extensa distribución geográfica muy abundantes en las regiones cálidas.

ESPECIE TIPO: RYNCHOSPORA AUREA Vahl.

A. Estilo largo, sus ramas cortas, mucho más cortas que la parte no dividida.
  a. Espiguillas densamente acabezueladas.
    x. Tallos monocéfalos.

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(1) Traducido del manuscrito inglés por el Hermano León, Colegio de la Salle, Habana, y a quien lo envió el Dr. Britton para ser presentado a la "Sociedad Poey" (*Memorias*, Vol. II, pág. 151, 1916).

Aquenio escarioso-alado en la base. 1. *R. subimberbis.*
Aquenio no alado.
Vainas y brácteas peloso-ciliadas. 2. *R. hispidula.*
Hojas y brácteas lampiñas, o brácteas rara vez cilioladas. 3. *R. globosa.*
xx. Cabezuelas varias o numerosas.
Cabezuelas paniculadas o corimbosas, numerosas.
Cabezuelas corimboso-paniculadas. 4. *R. cyperoides.*
Cabezuelas en una panoja estrecha y alargada. 5. *R. exaltata.*
Cabezuelas solo 2-4.
Hojas y tallos lisos. 6. *R. Tracyi.*
Hojas y tallos escabrosos. 7. *R. siguaneana.*
b. Espiguillas paniculadas, fasciculadas o corimbosas, no densamente acabezueladas.
Tubérculo cerca de dos veces tan largo como el aquenio o más largo, aquenio rugoso.
Aquenio oblongo. 8. *R. triflora.*
Aquenio linear. 9. *R. trispicata.*
Tubérculo más corto que el aquenio o poco más largo; aquenio liso o casi liso.
Cerdas casi tan largas como el aquenio o más. Aquenio no escuteliforme.
Pocas espiguillas en los fascículos; aquenio no asurcado. 10. *R. corymbosa.*
Espiguillas 12-20 en los fascículos; aquenio con 1-2 surcos. 11. *R. gigantea.*
Aquenio escuteliforme. 12. *R. scutellata.*
Cerdas rudimentarias o ausentes.
Espiguillas en fascículos distantes. 13. *R. elongata.*
Espiguillas subracemosas en panojas estrechas. 14. *R. racemosa.*
B. Estilo corto, sus ramas en su mayoría, tan largas, poco más o menos, como la parte no dividida.
a. Cerdas: ninguna o rudimentarias.
x. Aquenio arrugado transversalmente.
Espiguillas pardas.
Planta robusta; tallos 5-8 dm. de largo. 15. *R. rufa.*
Planta muy delgada; tallos de 1-3 dm. de largo. 16. *R. pusilla.*
Espiguillas pálidas o blancas.
Espiguillas de 1-2 mm. de largo. 17. *R. micrantha.*
Espiguillas de 3-6 mm. de largo.
Aquenio 3-dentado en el ápice. 18. *R. setacea.*
Aquenio no 3-dentado.
Espiguillas numerosas, corimbosas; tallos de 1-3 dm. de largo.

Tallo lampiño. 19. *R. tenuis.*
Tallo áspero pulverulento. 20. *R. pseudolunata.*
Espiguillas en grupos de 2-5; tallos de solo 2-8 cm. de largo. 21. *R. Berterii.*
xx. Aquenio liso o reticulado. No arrugado.
Aquenio liso.
Espiguillas estrechamente lanceoladas de 8-12 mm. de largo. 22. *R. podosperma.*
Espiguillas de 3-5 mm. de largo.
Espiguillas: pocas, en grupos pedunculados y axilares. 23. *R. brevirostris.*
Espiguillas: muchas, en un grupo terminal denso. 24. *R. Chapmani.*
Aquenio reticulado.
Lampiño; hojas de 1 mm. de ancho o menos. 25. *R. divergens.*
Pubescente; hojas de 1 a 3 mm. de ancho. 26. *R. hirsuta.*
b. Cerdas presentes, comúnmente bien desarrolladas.
x. Cerdas plumosas; aquenio arrugado transversalmente. (Véase 36 *R. Gageri.*)
Tuberculo 2-lobado en la base. 27. *R. diodon.*
Tubérculo cónico, no 2-lobado. 28. *R. plumosa.*
xx. Cerdas no plumosas.
* Cerdas erizadas hacia abajo. 29. *R. axillaris.*
** Cerdas erizadas hacia arriba.
.|. Aquenio liso, o reticulado, no arrugado transversalmente.
Aquenio liso.
Tallo muy robusto, de 3 a 8 dm. de alto; planta pelosa, al menos arriba. 30. *R. cephalotoides.*
Tallo delgado de 3 dm. de alto o menos, lampiño.
Tubérculo cerdoso.
Hojas planas. 31. *R. fuscoides.*
Hojas acanaladas o involutas, casi filiformes.
Aquenio de 1 mm. de largo o menos. 32. *R. filifolia.*
Aquenio de 1.5 a 2 mm. de largo.
Espiguillas de 5 mm. de largo en fascículos distantes. 33. *R. leptorhyncha.*

Espiguillas de 3 mm. de largo en fascículos aproximados formando grupos terminales espiciformes. 34. *R. joveroensis.*

Tubérculo liso, o simplemente granular (a veces escasamente cerdoso en *R. gracilenta*).

Cerdas tan largas como el aquenio o más.

Espiguillas de 3.5-5 mm. de largo.

Cerdas no plumosas en la base; espiguillas en varios fascículos distantes. 35. *R. gracilenta.*

Cerdas ligeramente plumosas en la base; espiguillas en fascículos aproximados formando un grupo terminal. 36. *R. Gageri.*

Espiguillas de solo 2mm. de largo; hojas filiformes. 37. *R. Lindeniana.*

Cerdas más cortas que el aquenio, a veces muy cortas.

Hojas lineares; espiguillas de 4-5 mm. de largo. 38. *R. fascicularis.*

Hojas en forma de cerdas, filiformes; espiguillas de 2-3 mm. de largo. 39. *R. Wrightiana.*

Aquenio reticular. 40. *R. Grayi.*

.|. .|. Aquenio arrugado transversalmente.

Cerdas más cortas que el aquenio.

Hojas y tallos filiformes.

Espiguillas sentadas.

Espiguillas sub-acabezueladas; hojas encorvadas. 41. *R. cernua.*

Espiguillas espigado-paniculadas; hojas no encorvadas. 42. *R. Shaferi.*

Espiguillas con pedúnculo filiforme. 43. *R. rariflora.*

Hojas planas, acanaladas o involutas, no filiformes.

Hojas involutas; espiguillas agrupadas en una cabezuela terminal densa. 44. *R. nipensis.*

Hojas planas; espiguillas en grupos corimbosos. 45. *R. cymosa.*

Cerdas tan largas como el aquenio o más (a veces más cortas en *R. microcarpa*).
Espiguillas entre ovoideas y globulares.
Aquenio no estipitado; espiguillas de 2-3 mm. de largo.
Tubérculo agudo, de un cuarto a dos tercios de la longitud del aquenio.
Espiguillas sentadas o casi sentadas.
Hojas filiformes. 46. *R. bahamensis.*
Hojas planas.
Espiguillas densamente apretadas en 1-3 grupos espiciformes terminales. 47. *R. pruinosa.*
Espiguillas no densamente apretadas en los grupos.
Tubérculo la mitad tan largo como el aquenio o más.
Hojas cortas, las de la base de 6 cm. de largo o menos; aquenio oblongo. 48. *R. Randii.*
Hojas alargadas; aquenio anchamente obovado 49. *R. glauca.*
Tubérculo corto, no más de un tercio del largo del aquenio. 50. *R. microcarpa.*
Espiguillas sobre pedúnculos filiformes y encorvados hacia abajo. 51. *R. cubensis.*
Tubérculo deprimido, redondeado, menos de un cuarto del largo del aquenio. 52. *R. miliacea.*
Aquenio estipitado, tubérculo cerdoso; espiguillas de 5-7 mm. de largo. 53. *R. marisculus.*
Espiguillas entre fusiformes y lanceoladas, de 4-6 mm. de largo.
Hojas y tallos filiformes. 54. *R. stenophylla.*
Hojas planas, 2-3 mm. de ancho; tallos más bien robustos. 55. *R. borinquensis.*

1. RYNCHOSPORA SUBIMBERBIS Griseb, Cat. Pl. Cub. 245. 1866
Pinares y sabanas húmedas, Pinar del Río. Endémica.

2. RYNCHOSPORA HISPIDULA Griseb. Cat. Pl. Cub. 245. 1866.
R. Grisebachii Boeckl. Urban, Symb. Ant. *2*: 166. 1900.
Pinares, Pinar del Río. Endémica.

3. RYNCHOSPORA GLOBOSA (H. B. K.) R. & S. Syst. *2*: 89. 1817.
Chaetospora globosa (H. B. K.) Nov. Gen. *1*: 230. 1815.
R. cephalantha A. Rich. in Sagra. Hist. Cub. *11*: 293. 1850 (ex descr.)
Pinares y sabanas, Pinar del Río e Isla de Pinos: Trinidad; México hasta Paraguay.

4. RYNCHOSPORA CYPEROIDES (Sw) Mart. Denkschr. Acad. Wiss. Muench. *6*: 149. 1816-17.
Schoenus cyperoides Sw. Prodr. 19. 1788.
Terrenos húmedos, en todas las provincias y la Isla de Pinos: Bahamas; Jamaica; Hispaniola; St. Kitts; Guadalupe, Martinica; América tropical continental y Africa tropical.

5. RYNCHOSPORA EXALTATA Kunth, Enum. *2*: 291. 1837.
Echinoschoenus triceps Nees, Linnacea *9*, 297. 1834.
R. triceps Urban, Symb. Ant. *2*: 167. 1900. No Boeckl.
Terrenos húmedos o anegadizos. Oriente:
Sur América tropical.

6. RYNCHOSPORA TRACYI Britton, Trans. N. Y. Acad. Sci. *11*: 84. 1892.
Orilla de laguna, Laguna de Santa María, Pinar del Río: Estados Unidos del Sudeste; Bahamas.

7. **Rynchospora siguaneana** sp. nov.
Rizomas cortos, robustos, tallo delgado, erguido, escabroso, de 1 m. próximamente de alto. Hojas inferiores de 1-3 dm. de largo, 2-5 mm. de ancho, de margen áspero, el nervio medio saliente en el envés; las superiores mucho más cortas; los grupos de espiguillas generalmente 2, densos, uno de ellos sentado ó casi sentado

en la punta del tallo, el otro más pequeño, nacido sobre un pedúnculo filiforme de 12 cm. de largo ó menos; espiguillas sentadas de unos 7 mm. de largo, lanceolado-fusiformes; brácteas cerdosas, escabrosas, tan largas como las espiguillas o más; escamas pálidas con el nervio medio más oscuro, las inferiores ovadas, las superiores lanceoladas, todas aristuladas; estilo largo, ligeramente bipartido en el ápice; anteras estrechamente lineares, más largas que los filamentos; aquenio elíptico, comprimido, de 2-2.5 mm. de largo, 1.5-2 mm. de ancho, arrugado transversalmente; tubérculo subulado, algo más largo que el aquenio; cerdas 2 o 3, lisas, próximamente tan largas como el aquenio y tubérculo juntos.

Manigua del litoral cerca de Siguanea, Isla de Pinos. (*Britton y Wilson* 14356).

8. RYNCHOSPORA TRIFLORA Vahl, Enum. *2*: 232. 1806.
R. stenorrhyncha Griseb. Fl. Br. W. I. 575. 1866.
Cuba, recogida por Wright; Trinidad, Brasil.

9. RYNCHOSPORA TRISPICATA (Nees) Schrad.; Syn. Pl. Cyp. 145. 1855.
Ephippiorhynchum trispicatum Nees in Mart. Fl. Bras. *2'*: 136. 1842
Ciénagas, Pinar del Río: Sur de México hasta Bolivia.

10. RYNCHOSPORA CORYMBOSA (L.) Britton, Trans. N. Y. Acad. Sci. *11*: 85. 1892.
Scirpus corymbosus L. Sp. Pl. 76. 1753.
R. aurea Vahl, Enum. *2*: 229. 1806.
Ciénagas y maniguas húmedas, Santa Clara, Habana, Pinar del Río, Isla de Pinos: Jamaica; Haití hasta Trinidad; América tropical continental; Antiguo Continente tropical.

11. RYNCHOSPORA GIGANTEA Link, Jahrb. *3*: 76. 1820.
R. surinamensis C. Wright; Sauvalle, Anales Acad. Habana *8*: 86. 1872.
Lagunas, Pinar del Río: América del Sur.

12. RYNCHOSPORA SCUTELLATA Griseb. Cat. Pl. Cub. 246. 1866.
A lo largo de los arroyos en las sabanas, Pinar del Río: Endémica.

13. RYNCHOSPORA ELONGATA Boeckl. Cyp. Nov. *1*: 261. 1888.
Montes de Montañas pedregosas, Oriente: Jamaica.

14. RYNCHOSPORA RACEMOSA C. Wright: Sauvalle, Anales Acad. Habana *8*: 86. 1872.
R. polyphylla Griseb. Cat. Pl. Cub. 246. en parte. 1866. No Vahl.
R. polyphylla umbrosa Boeckl. Linnaea *37*: 636. 1873.
Montes altos de Oriente: Guadalupe.

15. RYNCHOSPORA RUFA (Nees) Boeckl. Flora *64*: 78. 1881.
Psilocarya mexicana Liebm. Mex. Halvgr. 60. 1856.
R. mexicana C. Wright; Sauvalle, Anales Acad. Habana *8*: 87. 1872.
R. rufa Liebmanniana Clarke in Urban, Symb. Ant. *2*: 117. 1900.
Arroyos de los pinares, Pinar del Río: Puerto Rico; México; Guayana inglesa.

16. RYNCHOSPORA PUSILLA Chapm.; Curtis, Am. Journ. Sci II *7*: 409. 1849.
R. intermixta C. Wright; Sauvalle, Anales Acad. Habana *88*: 88. 1872.
R. lunata C. Wright; Sauvalle, loc. cit. 86, en parte. No Griseb.
Sabanas húmedas y orillas de lagunas, Santa Clara, Pinar del Río; Isla de Pinos: Estados Unidos del Sudeste; Jamaica.

17. RYNCHOSPORA MICRANTHA Vahl, Enum. 2. 231. 1806.
Suelo húmedo, Matanzas; Habana; Pinar del Río: Puerto Rico hasta Granada; Jamaica; América tropical continental; Tenerife y Guinea.

18. Rynchospora setacea (Berg) Boeckl. Vidensk. Medd. Kjob. 1867-70. 159.
Schoenus setaceus Berg. Act. Helv. *7*: 130. 1772.
R. tenerrima Spreng. Syst. Cur. Post. 26. 1827.
R. spermodon Griseb. Fl. Br. W. I. 576. 1864.
Terrenos húmedos, Oriente; Santa Clara; Pinar del Río; Isla de Pinos: Puerto Rico hasta Granada; Jamaica; América tropical continental.

19. Rynchospora tenuis Link. Jahrb. *3*: 76. 1820.
R. cubensis Griseb. Fl. Br. W I. 576. 1864. No Griseb. Cat. Pl. Cub. 246. 1866.
Terrenos húmedos, Oriente, Camagüey, Santa Clara, Pinar del Río, Isla de Pinos: Bahamas; Dominica hasta Granada; América tropical continental.

20. Rynchospora pseudolunata Boeckl. Cyp. Nov. *1*: 25. 1888.
R. cubensis Griseb. Cat. Pl. Cub. 246. 1866. No Griseb. Fl. Br. W. I. 576, 1864.
Cerca de Monte Verde, Oriente. Endémica.

21. Rynchospora Berteri (Spreng.) Clarke in Urban, Symb. Ant. *2*: 119. 1900.
Schoenus pusillus Sw. Prodr. 20. 1788.
Hypolytrum Berterii Spreng. Neue Entd. *1*: 241. 1820.
R. pusilla Griseb. Kar. 123. 1857. No Chapm.
Riberas húmedas, Oriente, Camagüey, Pinar del Río, Habana: Haití; Jamaica; Puerto Rico; Guadalupe.

22. Rynchospora podosperma C. Wright; Sauvalle, Anales Acad. Habana *8*: 87. 1872.
Dichromena filiformis Kunth, Enum. *2*: 281. en parte 1837.
R. filiformis Griseb. Fl. Br. W. I. 576. 1864. No Vahl.
R. longispicata Boeckl. Linnaea *37*: 600. 1873.
Sabanas y pinares, Pinar del Río: Trinidad y Sur América tropical.

23. Rynchospora brevirostris Griseb. Cat. Pl. Cub. 246. 1866.
Sabanas, Santa Clara, Pinar del Río. También en la Isla de Trinidad según C. B. Clarke.

24. Rynchospora Chapmani Curtis, Am. Journ. Sci. II. *7*: 409. 1849.
R. brachychaeta C. Wright; Sauvalle, Anales Acad. Habana *8*: 85. 1872.
Sabanas y pinares, Pinar del Río; Isla de Pinos: sudeste de los Estados Unidos. Erróneamente referida por Mr. C. B. Clarke a *R. pallida* Curtis.

25. Rynchospora divergens Curtis, Am. Journ. Sci. II *7*: 409. 1849.
R. lamprosperma C. Wright; Sauvalle, Anales Acad. Habana *8*: 87. 1872.
Sabanas y pinares, Pinar del Río: Sudeste de los Estados Unidos; Bahamas.

26. Rynchospora hirsuta Vahl, Enum. *2*: 231. 1806.
Schoenus hirsutus Vahl, Eclog. *1*: 6. 1796.
Pinares húmedos y sabanas, Pinar del Río; Isla de Pinos: Trinidad y Sur América tropical.

27. Rynchospora diodon (Nees) Boeckl. Linnaea *37*: 558. 1873.
Ptilochaeta diodon Nees, in Mart. Fl. Bras. *21*: 148. 1843.
R. lunata Griseb. Cat. Pl. Cub. 244. 1866.
Lugares peñascosos, Oriente: Brasil.

28. Rynchospora plumosa Ell. Bot. S. C. & Ga. *1*: 58. 1816.
R. penniseta Griseb. Cat. Pl. Cub. 244. 1866.
Sabanas, Pinar del Río e Isla de Pinos: sudeste de los Estados Unidos.

29. Rynchospora axillaris (Lam.) Britton, Bull. Torr. Club *15*: 104. 1888.
Schoenus axillaris Lam. Tabl. Encyl. *1*: 137. 1791.
R. cephalantha A. Gray, Ann. Lyc. N. Y. *3*: 218. 1835.
Orillas de lagunas, Pinar del Río: sudeste de los Estados Unidos.

30. Rynchospora cephalotoides Griseb. Cat. Pl. Cub. 242. 1866.
Montes húmedos, Pinar del Río e Isla de Pinos. Endémica. Erróneamente referida por Mr. C. B. Clarke, a mi parecer a *R. comata* (Link) Schultes.

31. Rynchospora fuscoides Clarke in Urban, Symb. Ant. *2*: 124. 1900.
Pinares húmedos y orillas de lagunas, Pinar del Río: sudeste de los Estados Unidos.

32. Rynchospora filifolia Torr. Ann. Lyc. N. Y. 3. 366. 1836.
Sabanas y orillas de lagunas, Pinar del Río; Isla de Pinos: sudeste de los Estados Unidos.

33. Rynchospora leptorrhyncha C. Wright; Sauvalle, Anales Acad. Habana *8*: 84. 1872.
Lagunas de pinares, Pinar del Río: Florida.

34. **Rynchospora joveroensis** spec. nov.
Rizomas cortos; tallos muy delgados, lisos, lampiños, erguidos, de 3-5 dm. de alto. Hojas acanaladas, involutas, tan largas o más cortas que los tallos, como de 1 mm. de ancho; inflorescencia de 2-4 fascículos de espiguillas, aproximados, oblongos o subglobosos formando un grupo terminal espiciforme, o a veces el fascículo inferior a una distancia de 1-2 cm. de los demás; espiguillas pardas, de como 3 mm. de largo, casi sentadas; aquenio elíptico-obovado, de como 1.5 mm. de largo, liso, brillante, como dos veces tan largo como el tubérculo cónico y setoso; cerdas erizadas hacia arriba, tan largas como el aquenio y el tubérculo, o más cortas.
Terreno arenoso y húmedo en la región de las lagunas de Pinar del Río. Tipo recogido entre la laguna Jovero y la laguna del Bufeo (*Shafer 10992*).

35. Rynchospora gracilenta A. Gray Ann. Lyc. N. Y. *3*: 216. 1836.
Citada por C. B. Clarke como hallada en Cuba por

Wright y clasificada bajo el nombre manuscrito *R. tetrandra* Wright, pero nuestros ejemplares bajo esta etiqueta son *R. leptorrhyncha*: Este y sudeste de los Estados Unidos.

36. **Rynchospora Gageri** spec. nov.

Rizomas cortos; tallos filiformes, lisos, cespitosos, lampiños, erguidos, de 1-2 dm. de alto. Hojas filiformes, tan largas como los tallos o algo más cortas, las brácteas similares; inflorescencia en 2 o 3 fascículos de espiguillas, pequeños y aproximados, formando un grupo terminal de 8-15 mm. de largo; espiguillas pardas, oblongas, como de 4 mm. de largo, con solo un aquenio; aquenio cortamente estipulado, obovado, pardo, liso, brillante, de 1 mm. de largo; tubérculo cónico-aleznado, próximamente dos tercios tan largo como el aquenio; cerdas erizadas hacia arriba, aproximadamente tan largas como el aquenio y el tubérculo, ligeramente plumosas en su misma base.

Sabanas, Pinar del Río. Tipo recogido cerca de Herradura (*Britton, Earle y Gager 6618*).

Parecida en aspecto a *R. plumosa*, que tiene un aquenio arrugado transversalmente y cerdas largamente plumosas.

37. Rynchospora Lindeniana Griseb. Cat. Pl. Cub. 244. 1866.
Monte Líbano, recogida por Linden (1845). Endémica.

38. Rynchospora fascicularis Vahl, Enum. *2*: 234. 1806.
Schoenus fascicularis Michx. Fl. Bor. Am. *1*: 37. 1803.
Pinares húmedos, Pinar del Río: Jamaica; sudeste de los Estados Unidos; Guatemala hasta Venezuela.

39. Rynchospora Wrightiana Boeckl. Flora 64: 78. 1881.
R. gracillima C. Wright; Sauvalle, Anales Acad. Habana 8: 85. 1872. No Thwaites.
Cuba, recogida por Wright: Sudeste de los Estados Unidos; Puerto Rico.

40 RYNCHOSPORA GRAYI Kunth, Enum. *2*: 539. 1837.
Laguna Los Indios, Pinar del Río; Sudeste de los Estados Unidos.

41. RYNCHOSPORA CERNUA Griseb. Cat. Pl. Cub. 248. 1866.
Pinares, Montañas de Oriente. Citada también en Cuba occidental por Grisebach. Endémica.

42. **Rynchospora Shaferi** spec. nov.

Rizomas cortos; tallos filiformes, densamente cespitosos, de 2.5-4 dm. de largo. Hojas finamente filiformes aproximadamente tan largas como los tallos o más cortas; espiguillas pocas, 2 mm. de largo próximamente, en 2-4 fascículos aproximados, formando un grupo terminal espiciforme de 1-2 cm. de largo; aquenio oblongo, 1 mm. de largo próximamente y como dos veces tan largo como ancho, arrugado transversalmente, próximamente 3 veces tan largo como el tubérculo cónico; cerdas erizadas hacia arriba, más cortas que el aquenio. Suelo pedregoso y ligero, montañas del norte de Oriente. Tipo recogido cerca de la base de la Loma Mensura, de 680 m. de altitud próximamente. (*Shafer 3797*).

43. RYNCHOSPORA RARIFLORA (Michx). Ell. Bot. S. C. & Ga, *1*: 58. 1816.
Schoenus rariflorus Michx. Fl. Bor. Am. *1*: 35. 1803.
R. setacea Kunth, Enum. 2: 299. 1837.
Sabanas, Pinar del Río; Isla de Pinos: Sudeste de los Estados Unidos; Jamaica.

44. **Rynchospora nipensis** spec. nov.

Raíces toscamente fibrosas; rizomas cortos; tallos muy delgados o casi filiformes, 3-4 dm. de largo. Hojas involutas, acanaladas, 1 mm. de ancho próximamente, tan largas como el tallo o más cortas; inflorescencia en un grupo terminal, denso, acabezuelado, subgloboso u ovoideo de espiguillas de 6-10 mm. de largo; espiguillas de 2 mm. de largo próximamente; aquenio oblongo, 1-5 mm. de largo, arrugado transversalmente, 2-3 veces tan largo como el tubérculo cónico; cerdas erizadas hacia arriba, más cortas que el aquenio. Barranca pedregosa, entre Piedra Gorda y Woodfred, Sierra de Nipe, Oriente, 400-500 m. de altitud. (*Shafer 3103*).

45. RYNCHOSPORA CYMOSA (Willd.) Ell. Bot. S. C. & Ga. *1*: 58. 1816.
Schoenus cymosus Wild. Sp. Pl. *1*: 265. 1797.
R. gracilis Griseb. Cat. Pl. Cub. 243. 1866. No Vahl.
R. Torreyana Griseb. loc. cit. 1866. No A. Gray.
Suelo húmedo, Santa Clara; Pinar del Río; Isla de Pinos: Estados Unidos del Este; Jamaica; Haití; Puerto Rico; Martinica; América del Sur.

46. RYNCHOSPORA BAHAMENSIS Britton, Torreya *13*: 217. 1913.
Riberas, laderas y pinares, norte de Oriente: Bahamas; Puerto Rico.

47. RYNCHOSPORA PRUINOSA Griseb. Mem. Am. Acad. II *8*: 535. 1862.
R. scabrata Griseb. Cat. Pl. Cub. 243. 1866.
Montes húmedos, maniguas y orillas de los ríos, Oriente. Endémica.

48. **Rynchospora Randii** spec. nov.

Raíces finamente fibrosas; rizomas cortos; tallos casi filiformes, 3-4 dm. de largo. Hojas planas, 1-1.5 mm. de ancho, 6-10 cm. de largo, mucho más cortas que el tallo; espiguillas pocas, 1.5 mm. de largo próximamente, en 2 o 3 fascículos terminales aproximados; aquenio oblongo, 1.3 mm. de largo, dos veces más largo que ancho próximamente, arrugado transversalmente, un poco más largo que el tubérculo cónico-aleznado; cerdas erizadas hacia arriba, tan largas como el aquenio o más.

Terreno húmedo, Sierra de Nipe, Oriente. Tipo recogido a lo largo de las orillas sombreadas de un arroyo 450-550 m. de altitud, cerca de Woodfred (*Shafer 3077*). La especie es nombrada en honor de Mr. Charles F. Rand, Presidente de la Spanish American Iron

Company, como agradecimiento a la importante ayuda prestada al Dr. Shafer. por los empleados de esta Compañía mientras estuvo en Woodfred en 1909.

49. Rynchospora glauca Vahl, Enum. *2*: 233. 1806.
R. gracilis R. & S. Syst. *2*: 86. 1817. No Vahl.
Cuba, recogida por Wright, según Clarke: Puerto Rico; Hispaniola; Jamaica; América tropical continental.

50. Rynchospora microcarpa A. Gray. Ann. Lyc. N. Y. *3*: 202. 1836.
R. Torreyana microrhyncha Griseb. Cat. Pl. Cub. 243. 1866.
Sabanas, Habana: Pinar del Río; Isla de Pinos: Estados Unidos del sudeste; Bahamas.

51. Rynchospora cubensis A. Rich. in Sagra, Hist. Cuba *11*: 294. 1850.
R. deflexa Griseb. Cat. Pl. Cub. 243. 1866.
Terrenos húmedos y laderas herbosas, en todas las provincias: Santo Domingo.

52. Rynchospora miliacea (Lam.) A. Gray, Ann. Lyc. N. Y. *3*: 198. 1836.
Schoenus miliaceus Lam. Tabl. Encycl. *1*: 137. 1797.
R. sparsa Vahl, Enum. *2*: 230 1806.
Cuba, recogida por Wright, según Clarke, citada también por Grisebach: Estados Unidos del Sudeste.

53. Rynchospora marisculus Nees in Mart. Fl. Bras. *21*: 142. 1842.
R. jubata Liebm. Mex. Halvgr. 66. 1850.
R. odorata Griseb. Cat. Pl. Cub. 242. 1866.
R. tenuiseta C. Wright; Sauvalle, Anales Acad. Habana *8*: 83. 1872.
Cuba occidental, recogida por Wright; citada por Clarke como recogida también por Eggers en La Clarita, Sabanas, Isla de Pinos: Bahamas; Haití; Jamaica; América tropical continental.

54. Rynchospora stenophylla Chapm. Fl. S. U. S. 525. 1860.
R. Preneloupiana Boeckl. Cyp. Nov. *1*: 26. 1888. (según Clarke).
R. tenuifolia Griseb. Cat. Pl. Cub. 244. 1866.
Terreno pedregoso y húmedo, Habana; Pinar del Río. Citada como de Cuba oriental: Estados Unidos del Sudeste; (?) Hispaniola.

55. Rynchospora borinquensis Britton, Bull, Torr, Club. *42*: 387. 1915. Montañas del norte de Oriente: Puerto Rico.

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STUDIES OF WEST INDIAN PLANTS—IX

NATHANIEL LORD BRITTON

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Studies of West Indian plants—IX

NATHANIEL LORD BRITTON

52. CLEOME PROCUMBENS JACQ. AND ITS RELATIVES

The small, simple-leaved Cleomes of the West Indies, form an interesting and peculiar group of the genus, very different in habit and aspect from the large, typical, compound-leaved ones. Seven species appear to be represented.

Annuals or biennials.	
Pedicels filiform.	
Leaves linear-oblong; pod subterete.	1. *C. Sloanei.*
Leaves filiform; pod compressed.	2. *C. guianensis.*
Pedicels very short; leaves very narrowly linear.	3. *C. stenophylla.*
Perennials with woody roots.	
Pod acute or acuminate; leaves linear to oblong, acute or acuminate.	
Leaves acuminate; pedicels half as long as the pods.	4. *C. procumbens.*
Leaves acute; pedicels as long as the pods or longer.	
Petals about 4 mm. long; leaves oblong to oblong-lanceolate.	5. *C. Wrightii.*
Petals 8–10 mm. long; leaves narrowly linear.	6. *C. macrorhiza.*
Pod obtuse; leaves ovate or elliptic, obtuse or rounded.	7. *C. obtusa.*

1. CLEOME SLOANEI Urban, Symb. Ant. 5: 347. 1907

Grassy and sandy places, at low elevations, southern side of Jamaica.

This species is referred by Fawcett and Rendle, as previously by other authors, to *C. procumbens* Jacq., which is, apparently, confined to Hispaniola.

2. CLEOME GUIANENSIS Aubl. Pl. Guian. 2: 675. 1775

Sandy pine lands, Pinar del Rio, Cuba; northern South America.

3. CLEOME STENOPHYLLA Klotzsch; Urban, Symb. Ant. 4: 251. 1905

Plains at low elevations, southern and southwestern Porto Rico; St. Bart's; Bonaire; hillsides, Curaçao; Guiana.

4. CLEOME PROCUMBENS Jacq. Stirp. Am. 189. *pl. 120.* 1763

Hispaniola. Erroneously recorded from Cuba, and, apparently also erroneously referred to Jamaica, as Jacquin's figure of the type would seem to represent a well-marked species, not collected since its original discovery.

5. CLEOME WRIGHTII Urban, Symb. Ant. 5: 346. 1907

Sandy soil, Pinar del Rio and Isle of Pines, Cuba.

6. CLEOME MACRORHIZA Wright; Sauvalle, Anales Acad. Habana 5: 199. 1868

Pine-lands, Pinar del Rio, Cuba.

7. **Cleome obtusa** sp. nov.

Perennial by a slender woody root, glabrous; stems numerous, prostrate, simple or few-branched, slender, 5–15 cm. long. Leaves ovate or elliptic, 4–6 mm. long, rounded or obtuse at the apex, rounded at the base, the midvein prominent, the lateral venation obscure, the petioles 1–2 mm. long; peduncles slender or filiform, 4–8 mm. long; sepals obtuse, 2–2.5 mm. long; petals yellow, oblong or oblong-obovate, obtuse or acutish, 3–4 mm. long; stamens about two-thirds as long as the petals; filaments filiform; style about 1 mm. long; capsule elliptic, elliptic-obovate or oblong, compressed, 3–6 mm. long, 2–2.5 mm. wide, obtuse at the apex, somewhat narrowed at the base, few–several-seeded.

Dry and rocky soil in palm-barrens and savannas, Camaguey and Santa Clara, and in sand on Cayo Guayaba, Cuba. Type from savannas near Camaguey (*Britton & Cowell 13165*). Hitherto included in *C. Wrightii* Urban.

53. CHAMAECRISTA Moench IN THE WEST INDIES

Type species: *Chamaecrista nictitans* (L.) Moench.

A. Sepals rigid, scarious, many-nerved (*Diphyllae*). 1. *C. diphylla*.
B. Sepals membranous, scarcely nerved.
  a. Prostrate herbs, the flowers on filiform peduncles.
    Leaflets only 1 pair, obovate; stipules cordate (*Rotundifoliae*). 2. *C. rotundifolia*.
    Leaflets 3–7 pairs, oblong to obovate; stipules lanceolate (*Pilosae*).
      Stems pilose. 3. *C. pilosa*.
      Stems appressed-pubescent. 4. *C. serpens*.
  b. Erect, ascending or rarely prostrate herbs or shrubs.
    1. Midvein of the leaflet central or excentric, not marginal.
      * Shrubs, with coriaceous or subcoriaceous leaves.
        † Leaflets many, 20–50 pairs, linear; stipules large; stem flexuous (*Flexuosae*). 5. *C. flexuosa*.
        †† Leaflets fewer, 2–12 pairs, oblong or obovate; stipules small; stem not flexuous (*Lineatae*).
          ‡ Foliage densely pubescent. 6. *C. grammica*.
          ‡‡ Foliage glabrous or puberulent.
            § Leaflets dull.
              Leaflets obovate or oblanceolate.
                Leaflets 2 or 3 pairs, 5 mm. long or less. 7. *C. obcordata*.
                Leaflets 3–11 pairs, 7–15 mm. long.
                  Gland sessile. 8. *C. lineata*.
                  Gland stalked. 9. *C. granulata*.
              Leaflets oblong.
                Leaflets acute, cuspidate. 10. *C. pinetorum*.
                Leaflets rounded and mucronulate at apex. 11. *C. jamaicensis*.
            §§ Leaflets shining.
              Leaflets oblong, or the upper obovate, 1.5 cm. long or less, strongly callous-margined.
                Leaflets glabrous; gland large, nearly sessile. 12. *C. portoricensis*.
                Leaflets ciliate; gland small, stalked. 13. *C. Tuerckheimii*.
              Leaflets elliptic to ovate to obovate, 1.5–3 cm. long, not callous-margined.
                Leaflets elliptic, acute. 14. *C. caribaea*.
                Leaflets ovate to obovate, obtuse, retuse, or mucronate.
                  Leaflets 1–3 pairs, obovate, mostly retuse. 15. *C. inaguensis*.

Leaflets 4–9 pairs, ovate to ovate-oblong, mostly obtuse. 16. *C. lucayana.*

** Herbs or shrubs, with membranous leaves (*Glandulosae*).

† Flowers large, 2–4 cm. broad.

Leaflets villous or pubescent beneath.

Glands elongated, petiolar and also often between the leaflets; midvein of leaflets nearly central, the lateral veins many. 17. *C. glandulosa.*

Glands short, sessile, petiolar only; midvein of leaflets excentric, the lateral veins few. 18. *C. Dussii.*

Leaflets glabrous beneath.

Leaflets oblong to linear; gland stipitate. 19. *C. Swartzii.*

Leaflets obovate or oblong; gland sessile or stout-stipitate. 20. *C. polyadena.*

†† Flowers small, seldom over 1 cm. broad.

‡ Petiolar glands sessile, or very short-stalked.

Prostrate; leaflets 4–6 pairs. 21. *C. pygmaea.*

Erect or ascending; leaflets 8 pairs or more.

Plant densely hirsute all over. 22. *C. patellaria.*

Plants glabrate or more or less villous.

Pod black-banded and black-margined. 23. *C. fasciata.*

Pod not black-banded.

Leaflets 10–15 mm. long, the midvein little excentric. 24. *C. aeschinomene.*

Leaflets 5–8 mm. long, the midvein very excentric.

Petals 6 mm. long; plant sparingly short-pubescent. 25. *C. savannarum.*

Petals 3 mm. long; plant villous. 26. *C. micrantha.*

‡‡ Petiolar glands distinctly stalked.

Pod 3.5–4 mm. broad; pubescence widely spreading. 27. *C. riparia.*

Pod 3 mm. broad or less.

Petiolar glands often 2; leaflets oblong; plant glabrous, or pubescent only above. 28. *C. mirabilis.*

Petiolar gland 1; leaflets linear or linear-oblong; plant pubescent or villous. 29. *C. Chamaecrista.*

2. Midvein of the leaflet approximate to its upper margin (*Strigillosae*).

Petiolar gland small, subsessile.

Leaves sparingly pubescent. 30. *C. strigillosa.*

Leaves densely pilose. 31. *C. adenosperma.*

Petiolar gland stalked.
  Pod glabrous or nearly so. 32. *C. pedicellaris.*
  Pod short-pilose. 33. *C. Buchii.*

1. CHAMAECRISTA DIPHYLLA (L.) Greene, Pittonia 4: 28. 1899

Cassia diphylla L. Sp. Pl. 376. 1753.

TYPE LOCALITY: "In India."

DISTRIBUTION: Provinces of Santa Clara, Pinar del Rio and on Isle of Pines, Cuba; Hispaniola; Porto Rico; recorded by Grisebach from St. Kitts and St. Vincent; continental tropical America.

2. CHAMAECRISTA ROTUNDIFOLIA (Pers.) Greene, Pittonia 4: 31. 1899

Cassia rotundifolia Pers. Syn. 1: 456. 1805.
Cassia bifoliata DC.; Collad. Cass. 120. 1816.

TYPE LOCALITY: South America.

DISTRIBUTION: Provinces of Santa Clara and Pinar del Rio and on Isle of Pines, Cuba; Jamaica; continental tropical America.

ILLUSTRATION: Collad. Cass. *pl. 9.*

3. CHAMAECRISTA PILOSA (L.) Greene, Pittonia 4: 28. 1899

Cassia pilosa L. Syst. Ed. 10, 1017. 1759.
Cassia Milleri Collad. Cass. 132. 1816.

TYPE LOCALITY: Jamaica (Sp. Pl. Ed. 2, 540).

DISTRIBUTION: Province of Pinar del Rio and Isle of Pines, Cuba; Jamaica; northern South America.

4. CHAMAECRISTA SERPENS (L.) Greene, Pittonia 4: 29. 1899.

Cassia serpens L. Syst. Ed. 10, 1018. 1759.

TYPE LOCALITY: Jamaica (Sp. Pl. Ed. 2, 541).

DISTRIBUTION: Provinces of Havana and Pinar del Rio, Cuba; Jamaica; northern South America.

5. CHAMAECRISTA FLEXUOSA (L.) Greene, Pittonia 4: 27. 1899

Cassia flexuosa L. Sp. Pl. 379. 1753.
Chamaecrista amplistipulata Rose, Contr. Nat. Herb. 12: 267. 1909.

TYPE LOCALITY: Brazil.

DISTRIBUTION: Pinar del Rio and Isle of Pines, Cuba; continental tropical America.

ILLUSTRATION: Breyn, *pl. 23*.

6. CHAMAECRISTA GRAMMICA (Spreng.) Pollard, Field Col. Mus. Bot. 2: 47. 1900

Cassia grammica Spreng. Neue Entd. 3: 55. 1822.

Cassia lineata brachyloba Griseb. Mem. Am. Acad. II. 8: 179. 1860.

TYPE LOCALITY: Maritime regions, Cuba and Hispaniola.

DISTRIBUTION: Cuba (according to Sprengel) and collected by Wright in Oriente; Hispaniola; Porto Rico; Little St. James Island, St. Jan.

The plant of southern Florida, referred to this species by Chapman and by Small, is distinct, according to the studies of Dr. Pennell.

7. **Chamaecrista obcordata** (Sw.).

Cassia obcordata Sw.; Wikstr. Vetensk. Acad. Handl. **1825**: 429. 1826.

TYPE LOCALITY: St. Bart's.

DISTRIBUTION: St. Bart's; I refer, with doubt, Dr. Boldinghs' No. 5288B from St. Martin to this species, which he recorded as *Cassia polyadena* DC. (Fl. Nederl. West Ind. 211); the St. Martin plant is more nearly related to *C. lineata* than to *C. polyadena*. Bentham indicates the same affinity for the plant of St. Bart's (Trans. Linn. Soc. 27: 572). No modern collections have been made on St. Bart's; it lies close to St. Martin.

8. CHAMAECRISTA LINEATA (Sw.) Greene, Pittonia 4: 31. 1899

Cassia lineata Sw. Prodr. 66. 1788.

Cassia cuneata Griseb. Cat. Pl. Cub. 80. 1866. Not *C. cuneata* DC.

TYPE LOCALITY: Jamaica.

DISTRIBUTION: Jamaica; Cuban provinces of Oriente, Camaguey and Santa Clara, and Isle of Pines; Hispaniola; Bahamas. Specimens from the south coast of Santa Clara, Cuba, have puberulent foliage.

9. CHAMAECRISTA GRANULATA (Urban) Britton, Ann. Missouri Bot. Gard. 2: 41. 1915

Cassia portoricensis granulata Urban, Symb. Ant. 1: 318. 1899.
Chamaecrista portoricensis granulata Cook & Collins, Contr. Nat. Herb. 8: 113. 1903.

TYPE LOCALITY: Near Salinas de Cabo Rojo, Porto Rico.

DISTRIBUTION: Southwestern Porto Rico; Mona.

10. **Chamaecrista pinetorum** sp. nov.

Shrubby, 4 dm. high, or higher, the branches slender, densely appressed-pubescent with brownish hairs. Stipules linear-lanceolate, striate, long-acuminate, 4–6 mm. long; leaves 3–5 cm. long, the rachis appressed-pubescent; leaflets 9 pairs or fewer, subcoriaceous, linear to linear-oblong, 10–15 mm. long, 2–4 mm. wide, glabrous on both sides, dull, acute and cuspidate at the apex, obliquely rounded at the base, closely pinnately veined, the prominent midvein nearly central, the petiolar gland slender-stalked; peduncles filiform, appressed-pubescent, 2-bracted, about 3 cm. long; sepals lanceolate, acuminate, 10–12 mm. long; petals obovate, somewhat shorter than the sepals or as long; ovary appressed-pubescent.

Pine woods, near Constanza, Santo Domingo, at 1,200 m. alt. (*Tuerckheim 2887*).

11. CHAMAECRISTA JAMAICENSIS Britton, Bull. Torrey Club 42: 515. 1915

TYPE LOCALITY: South slope of Long Mountain, Jamaica.

DISTRIBUTION: Southern side of Jamaica.

12. CHAMAECRISTA PORTORICENSIS (Urban) Cook & Collins, Contr. Nat. Herb. 8: 113. 1903

Cassia portoricensis Urban, Symb. Ant. 1: 317. 1899.
Cassia portoricensis callosa Urban, Symb. Ant. 1: 317. 1899.
Chamaecrista portoricensis callosa Cook & Collins, Contr. Nat. Herb. 8: 113. 1903.

TYPE LOCALITY: Near Guayanilla, Porto Rico.

DISTRIBUTION: Southern and western Porto Rico.

13. **Chamaecrista Tuerckheimii** sp. nov.

Shrubby, with a deep woody root; stems slender, villous-pubescent, 8–10 cm. long. Stipules obliquely ovate-lanceolate, acuminate, striate, 2–3 mm. long; leaves 2–2.5 cm. long, the rachis villous-pubescent; leaflets 6 or 7 pairs, linear-oblong, to oblong-oblanceolate, 6–8 mm. long, about 2 mm. wide, ciliate, shining, rounded or subtruncate and mucronulate at the apex, obliquely rounded at the base, pinnately veined with the prominent midvein somewhat excentric, the petiolar gland short-stalked; peduncles slender, villous, about 2 cm. long; sepals lanceolate, acuminate, villous, 7–8 mm. long; petals obovate, about twice as long as the sepals; legume linear, narrowed at both ends, nearly glabrous, 1.8 cm. long.

Near Maniel de Ocoa, Santo Domingo, in fields, 300 m. alt. (*Tuerckheim 3680*).

14. **Chamaecrista caribaea** (Northrop)

Cassia caribaea Northrop, Mem. Torrey Club **12**: 39. 1902.

Type locality: Fresh Creek, Andros, Bahamas.

Distribution: Andros, New Providence and Cat Island, Bahamas.

Illustration: Northrop, *loc. cit. pl. 6.*

15. **Chamaecrista inaguensis** comb. nov.

Cassia inaguensis Britton, Bull. N. Y. Bot. Gard. **3**: 443. 1905.

Type locality: Inagua, Bahamas.

Distribution: Inagua, South Caicos, Grand Turk, and Ambergris Cay, Bahamas.

16. **Chamaecrista lucayana** comb. nov.

Cassia lucayana Britton, Bull. N. Y. Bot. Gard. **4**: 138. 1906.

Type locality: Cay north of Wide Opening, Exuma Chain, Bahamas.

Distribution: Great Bahama, Cat Island, Conception, Rum Cay, and Exuma Chain, Bahamas.

17. Chamaecrista glandulosa (L.) Greene, Pittonia **4**: 28. 1899

Cassia glandulosa L. Syst. Ed. 10, 1017. 1759.

Cassia virgata Sw. Prodr. 66. 1788.

?*Cassia stricta* Schrank, Hort. Monac. **1**: *pl. 34*. 1819.
Chamaecrista virgata Greene, Pittonia **4**: 31. 1899.

TYPE LOCALITY: Jamaica.

DISTRIBUTION: Jamaica.

ILLUSTRATIONS: Bot. Mag. *pl. 3435;* Schrank, *loc. cit.*

Linnaeus included, in his citations of synonyms of this species, several others, but his description of it, together with his having received a Jamaica specimen from the collection of Patrick Browne, prior to his publication, as I am informed by Dr. B. Daydon Jackson, Secretary of the Linnaean Society of London, show that the name is to be restricted to the Jamaica plant. Subsequent authors have confused it with species from other islands and from continental tropical America. The identity of *Cassia virgata* Sw. was established for me by Mr. William Fawcett at the British Museum of Natural History. *Cassia stricta* Schrank, from the illustration and the Jamaica habitat, appears referable here, but Schrank's description of the plant is not altogether conclusive; he says the root is annual.

18. **Chamaecrista Dussii** sp. nov.

Perennial, villous-pubescent, erect, simple, 5–9 dm. high, somewhat woody. Stipules narrowly lanceolate, strongly striate, 10–12 mm. long; leaves 5–7 cm. long; petiolar gland close to the lowest leaflets, scutelliform, sessile, slightly concave, nearly 1 mm. in diameter; leaflets about 17 pairs, linear, pubescent on both sides, 10–18 mm. long, 2–3 mm. wide, obtuse, mucronate, inequilateral, the midvein excentric, the lateral veins few and distant; peduncles 4–6 mm. long; sepals lanceolate, acuminate, pubescent, about 7 mm. long; petals obovate, 8–10 mm. long; pod linear, slightly curved, villous-pubescent, obliquely short-tipped, 3 cm. long, 5 mm. wide.

Guadeloupe and Martinique. Type from Trou-Vaillant, Parnasse, Martinique (*Père Duss 1121*).

19. **Chamaecrista Swartzii** (Wickstr.)

Cassia Swartzii Wikstr. Vetensk. Acad. Handl. **1825**: 430. 1826.
Chamaecrista complexa Pollard, Field Col. Mus. Bot. **2**: 47. 1900.

TYPE LOCALITY: St. Bart's.

DISTRIBUTION: Porto Rico; Vieques; Culebra; St. Thomas; St. Jan; Tortola; St. Croix; Saba; St. Bart's; St. Kitt's; Dominica; Guadeloupe; Grenada.

The species has been much confused with the Jamaican *C. glandulosa.*

20. **Chamaecrista polyadena** (DC.)

Cassia polyadena DC. Mém. Soc. Hist. Nat. Gen. 2: 132. 1824.

Type locality: Guadeloupe.

Distribution: Guadaloupe; Dominica; Martinique; Barbadoes.

My identification of this species is based on my examination of the type, some years ago, in the Candollean herbarium at Geneva, Switzerland. Notwithstanding the usually sessile petiolar gland and the relatively broader leaflets, I am not confident that this species is distinct from the preceding one.

21. **Chamaecrista pygmaea** (DC.)

Cassia pygmaea DC. Mém. Soc. Hist. Nat. Gen. 2: 131. 1824.

Type locality: Santo Domingo.

Distribution: Hispaniola.

Referred by Bentham to *Cassia procumbens* L., which is a synonym of *C. nictitans* L. of continental North America, as previously indicated by me (Bull. Torrey Club 43: 463).

22. Chamaecrista patellaria (DC.) Greene, Pittonia 4: 32. 1899

Cassia patellaria DC.; Collad. Cass. 125. 1816.

Type locality: Cayenne.

Distribution: Jamaica; all provinces of Cuba and on the Isle of Pines; continental tropical America.

Illustration: Collad. Cass. *pl. 16.*

23. Chamaecrista fasciata Britton, Bull. Torrey Club 37: 352. 1910

Type locality: Between Bath and Cuna-Cuna Gap, Jamaica.

Distribution: Jamaica; Cuban provinces of Oriente, Camaguey, Santa Clara and Havana.

24. Chamaecrista aeschinomene (DC.) Greene, Pittonia 4: 32. 1899

Cassia aeschinomene DC.; Collad. Cass. 127. 1816.

Chamaecrista Millspaughii Pollard, Field Col. Mus. Bot. 2: 47. 1900.

Cassia mimosoides aeschynomene Benth. Trans. Linn. Soc. **27**: 579. 1871.

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Jamaica; all provinces of Cuba; Hispaniola; Porto Rico.

ILLUSTRATION: Collad. Cass. *pl. 17.*

25. CHAMAECRISTA SAVANNARUM Britton, Bull. Torrey Club 43: 463. 1916

TYPE LOCALITY: Near Siguanea, Isle of Pines, Cuba.

DISTRIBUTION: Savannas and pine-lands, Pinar del Rio and Isle of Pines, Cuba.

26. CHAMAECRISTA MICRANTHA Britton, Bull. Torrey Club 43: 463. 1916

TYPE LOCALITY: Near San Pedro, Isle of Pines, Cuba.

DISTRIBUTION: Pine-lands and savannas, Pinar del Rio and Isle of Pines, Cuba. Referred by Grisebach to *Cassia pygmaea* DC.

27. **Chamaecrista riparia** (HBK.)

Cassia riparia HBK. Nov. Gen. **6**: 369. 1824.

TYPE LOCALITY: Banks of the Magdelena River near Mompox.

DISTRIBUTION: Jamaica; province of Havana, Cuba; Grand Cayman; Andros, New Providence and Eleuthera, Bahamas; northern South America and recorded from Central America.

The plant of the Bahamas was referred by me with some doubt (Bull. N. Y. Bot. Gard. 3: 443) to *Cassia aspera* Muhl., which it closely resembles, except in the petiolar gland. Cuban and Jamaican specimens differ from the Bahaman in having the gland somewhat longer-stalked.

I have not been able to study an authentic specimen of *C. riparia.* Bentham's record of it as West Indian was based upon a plant collected in Cuba by Liebmann, preserved in the Kew herbarium.

28. CHAMAECRISTA MIRABILIS Pollard, Proc. Biol. Soc. Wash. **15**: 19. 1902

Cassia mirabilis Urban, Symb. Ant. **4**: 276. 1905.

TYPE LOCALITY: Rio Piedras, Porto Rico.

DISTRIBUTION: Northern coastal plain of Porto Rico.

29. **Chamaecrista Chamaecrista** (L.)

Cassia Chamaecrista L. Sp. Pl. 379. 1753.
Cassia diffusa DC. Mém. Soc. Hist. Nat. Gen. **2**: 130. 1824.
Cassia smaragdina Macf. Fl. Jam. **1**: 347. 1837.
Chamaecrista diffusa Britton, Ann. Missouri Bot. Gard. **2**: 41. 1915.

TYPE LOCALITY: Curaçao.

DISTRIBUTION: Bahamas; Jamaica; Cuba; ? Hispaniola; Porto Rico; St. Jan; St. Croix; St. Kitts; Guadeloupe; Grenada; Curaçao; Margarita.

ILLUSTRATIONS: Breyn, *pl. 24;* Schrank, Hort. Monac. *pl. 33*.

The species has been much confused with the annual *C. nictitans* of eastern continental North America.

The recognition of the plant of Curaçao as typical *Cassia Chamaecrista* brings *C. diffusa* into its synonymy.

30. **Chamaecrista strigillosa** (Benth.)

Cassia strigillosa Benth. Trans. Linn. Soc. **27**: 581. 1871.

TYPE LOCALITY: Cuba.

DISTRIBUTION: Province of Oriente, Cuba; Santo Domingo (according to Bentham). Referred by Grisebach to *Cassia serpens* L.

31. **Chamaecrista adenosperma** (Urban)

Cassia adenosperma Urban, Symb. Ant. **5**: 362. 1908.

TYPE LOCALITY: Sierra del Palo Quemado, Santo Domingo.

DISTRIBUTION: Known only from the type locality, and, to me, only from the description.

32. **Chamaecrista pedicellaris** (DC.)

Cassia pedicellaris DC. Prodr. **2**: 504. 1825.

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Hispaniola.

33. **Chamaecrista Buchii** (Urban)

Cassia Buchii Urban, Symb. Ant. **5**: 361. 1908.

TYPE LOCALITY: Near Gonaives, Haiti.

DISTRIBUTION: Known only from the type locality and, to me, only from the description.

54. THE GENUS LEUCOCROTON GRISEB.

A Cuban genus, of which four species have been described. *L. Wrightii* Griseb. is the type species.

A. Leaves pinnately veined.
  Leaves chartaceous.
    Pistillate inflorescence 1-flowered at the summit; staminate flowers racemose. 1. *L. Wrightii.*
    Pistillate flowers racemose, the staminate glomerate-spicate. 2. *L. flavicans.*
  Leaves coriaceous, linear-oblong or linear.
    Leaves densely whitish-scurfy beneath.
      Leaves strongly revolute-margined, not reticulate-veined beneath, coarsely reticulate-veined above. 3. *L. revolutus.*
      Leaves slightly revolute-margined, strongly reticulate-veined beneath, finely reticulate-veined above. 4. *L. saxicola.*
    Leaves glabrous on both sides.
      Leaves mostly rounded and mucronulate at the apex, dull, 6–10 mm. wide. 5. *L. angustifolius.*
      Leaves emarginate, shining, 3–5 mm. wide. 6. *L. linearifolius.*
B. Leaves palmately 5-veined. 7. *L. virens.*

1. LEUCOCROTON WRIGHTII Griseb. Abh. Kön. Gesell. Wiss. Götting. 9: 21. 1860

Woodlands and banks of streams, Oriente; Pinar del Rio.

2. LEUCOCROTON FLAVICANS Muell. Arg. in DC. Prodr. 15^2: 757. 1866

L. flavicans latifolius Muell. Arg. *loc. cit.* 1866.
L. flavicans angustifolius Muell. Arg. *loc. cit.* 1866.

Serpentine hillsides, Matanzas, Havana. The locality of C. Wright's no. 1994 is not recorded.

3. LEUCOCROTON REVOLUTUS Wright; Sauvalle, Anales Acad. Habana 7: 154. 1870

Known only from the type locality between La Mulata and La Palme, Pinar del Rio.

4. **Leucocroton saxicola** sp. nov.

A shrub, 1–3.3 m. high, much branched, the twigs short and stout. Leaves coriaceous or subcoriaceous, narrowly oblong or oblanceolate, 3–11 cm. long, 2 cm. wide or less, rounded or emarginate and apiculate at the apex, narrowed at the base, finely reticulate-veined, glabrous, and with impressed midvein above, strongly reticulate-veined, minutely scurfy and with prominent midvein beneath, the petioles 3–6 mm. long; staminate flowers racemose-spicate in the upper axils, the inflorescence 2–3 cm. long; bracts lanceolate, acute, about 1.5 mm. long; pedicels 1–2 mm. long; buds subglobose, lepidote, 1 mm. in diameter.

Rocky banks and hillsides, mountains of northern Oriente. Type collected at Arroyo del Medio, above the falls, 450–550 m. alt. (*Shafer 3466*).

Similar to *L. revolutus*, but the venation of the leaves is quite different. In *L. revolutus* only the pistillate inflorescence is known; in *L. saxicola* only the staminate.

5. **Leucocroton angustifolius** sp. nov.

A much-branched, spreading shrub, about 6 dm. high, the twigs bearing distant leaf-scars. Leaves scattered, coriaceous, glabrous, linear or linear-oblong, 5–10 cm. long, 13 mm. wide or less, revolute-margined, rounded and mucronulate or emarginate at the apex, narrowed at the base, the midvein impressed above, prominent beneath, the primary lateral veins numerous, diverging at nearly right angles from the midvein, both surfaces reticulate-veined, the petioles 4–6 mm. long; pistillate flowers solitary at the ends of clustered, terminal, slender, scaly, bracted peduncles 2–3 cm. long; bracts lanceolate, numerous, acute, ascending, 1.5 mm. long; calyx-segments lanceolate, similar to the bracts; ovary depressed-globose, obtusely 3-lobed, lepidote; styles stout, recurved.

Rio Guayabo, above the falls, Oriente, 450–550 m. alt. (*Shafer 3626*).

6. **Leucocroton** (?) **linearifolius** sp. nov.

A much-branched shrub about 6 dm. high, the twigs short, stiff, covered by leaf-scars. Leaves densely clustered at the ends of the twigs, coriaceous, glabrous, linear, 3–6 cm. long, 3–5 mm. wide, shining on both sides, emarginate at the apex, gradually narrowed to the base, short-petioled, the midvein impressed above, prominent beneath, the lateral veins very numerous and close together, prominent on both surfaces, diverging nearly at right angles to the midvein, simple, or forked; staminate flowers few, in short, solitary slender-peduncled racemes shorter than the leaves, the pedicels filiform, 2 mm. long, the bractlets linear-lanceolate; bud of the staminate flower globose, 1 mm. in diameter.

Rocky bank of river at Camp La Barga, Oriente, 450 m. alt. (*Shafer 4144*).

7. LEUCOCROTON VIRENS Griseb. Nachr. Gesell. Wiss. Götting. 1865: 175

Mountain woodlands, Oriente. The foliage of this species is very different from that of the others.

55. PASSIFLORA IN CUBA

Type species: *Passiflora incarnata* L.

A. Flowers subtended by 3 large foliaceous bracts [GRANADILLA].
  Bracts united below the middle; leaves ovate, entire, membranous. — 1. *P. maliformis.*
  Bracts distinct to the base.
    Branches sharply 4-angled; leaves ovate, entire, membranous. — 2. *P. quadrangularis.*
    Branches not 4-angled.
      Leaves entire, subcoriaceous, glabrous. — 3. *P. laurifolia.*
      Leaves lobed or parted.
        Leaves pedately parted, membranous, pubescent, the segments serrate. — 4. *P. pedata.*
        Leaves obtusely 3-lobed, glabrous, the lobes entire. — 5. *P. pallens.*
B. Flowers subtended by small or pectinate-pinnatifid bracts, or bractless.
  1. Flower-tube cylindric or cylindric-campanulate; corona not plicate [MURUCUJA].
    Leaves entire, ovate to elliptic. — 6. *P. cuprea.*
    Leaves lobed or subtruncate.
      Leaves 2-lobed or subtruncate.
        Leaves membranous, not reticulate-veined, deeply 2-lobed, the lobes acute. — 7. *P. nipensis.*
        Leaves coriaceous, reticulate-veined, the lobes obtuse or rounded, or apex subtruncate. — 8. *P. cubensis.*
      Leaves 3-lobed at the apex. — 9. *P. Shaferi.*
  2. Flower-tube short or none; corona longitudinally plicate [PLECTROSTEMMA].
A. Petals none.
  Leaves 3-divided, the segments stalked, 3-cleft. — 10. *P. Berteriana.*
  Leaves lobed or entire. — 11. *P. pallida.*
B. Petals present.
  a. Flowers subtended by pinnntisect bracts.
    Leaves membranous, flaccid. — 12. *P. foetida.*
    Leaves chartaceous.
      Plant densely velvety-pubescent. — 13. *P. gossypifolia.*
      Plants glabrous, usually with some stalked glands. — 14. *P. pseudociliata.*
  b. Bracts small, not pectinate-pinnatifid.
      * Peduncles elongated, 1-flowered, longer than the leaves. — 15. *P. penduliflora.*

** Peduncles much shorter than the leaves.
Leaves 2-lobed, mostly broader than long.
Flowers solitary, slender-peduncled, 3–4 cm. broad; fruit 3–5 cm. in diameter. 16. *P. rubra*.
Flowers clustered in the axils, 1.5–2 cm. broad, very short-peduncled, the pedicels slender; fruit about 8 mm. in diameter. 17. *P. sexflora*.
Leaves entire or bluntly 3-lobed, longer than broad.
Leaves oblong or oblong-lanceolate, entire, rounded at the base. 18. *P. multiflora*.
Leaves broadly ovate, obtusely 3-lobed, mostly cordate at the base. 19. *P. holosericea*.
C. Published species not grouped.
Leaves ovate to elliptic, dentate. 20. *P. dasyadenia*.
D. Known only from foliage. Leaves deeply 3-lobed, the lobes dentate. 21. A plant of the Isle of Pines.

1. PASSIFLORA MALIFORMIS L. Sp. Pl. 956. 1753

TYPE LOCALITY: Near Port de Paix, Santo Domingo.

DISTRIBUTION: Oriente, collected by Wright:—Hispaniola to Barbadoes; Jamaica; South America. Perhaps not indigenous in Cuba.

2. PASSIFLORA QUADRANGULARIS L. Syst. Ed. 10, 1248. 1759

TYPE LOCALITY: Jamaica.

DISTRIBUTION: Uncommon at Santiago de las Vegas (*Van Hermann 616*):—Native of Nicaragua; widely cultivated in tropical America, and locally spontaneous.

3. PASSIFLORA LAURIFOLIA L. Sp. Pl. 956. 1753

TYPE LOCALITY: Surinam.

DISTRIBUTION: Thicket, upper valley of the Rio Navas, Oriente (*Shafer 4411*):—native from St. Thomas and St. Jan to Trinidad and South America. Spontaneous after cultivation in Hispaniola and Jamaica.

4. PASSIFLORA PEDATA L. Sp. Pl. 960. 1753

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Woods and thickets, Santa Clara, Pinar del Rio:—Hispaniola; northern South America.

5. PASSIFLORA PALLENS Poepp.; Masters in Mart. Fl. Bras. 13[1]: 567. *pl. 128, f. 4.* 1872

TYPE LOCALITY: Cuba.

DISTRIBUTION: Thickets, Havana, Pinar del Rio:—Florida; Venezuela.

Recorded by Grisebach and by Sauvalle as *P. stipulata* Aubl.

6. PASSIFLORA CUPREA L. Sp. Pl. 955. 1753

TYPE LOCALITY: New Providence, Bahamas.

DISTRIBUTION: Near Baracoa, Oriente; cays of northern Camaguey:—Bahamas.

7. **Passiflora nipensis** sp. nov.

Glabrous, glandless, slender, 8 dm. long or longer. Leaves cuneate, 2-lobed to the middle or beyond, 1.5–3 cm. long, rather strongly 3-nerved, the nerves impressed above, prominent beneath, excurrent, the secondary venation sparse and slender, the lobes lanceolate, acute, the slender petioles 2.5–5 mm. long; tendrils filiform, 2–4 cm. long; peduncles solitary or geminate in the axils, 10–14 mm. long; fruit globose, dark blue, about 1.5 cm. in diameter; seeds oblong, transversely ridged, about 3 mm. long.

Open dry situations in pine lands, Sierra Nipe near Woodfred, Oriente, 500–650 m. alt. (*Shafer 3554*).

8. PASSIFLORA CUBENSIS Urban, Symb. Ant. 3: 326. 1902

Passiflora coriacea A. Rich. in Sagra, Hist. Cub. 10: 288. 1845. Not Juss.

TYPE LOCALITY: Cuba.

DISTRIBUTION: Serpentine barrens, savannas and coastal thickets, Oriente, Camaguey, Santa Clara, Havana. Endemic.

Referred by Grisebach to *P. murucuja* L. and to *P. oblongata* Sw. The species is variable in leaf-form.

9. **Passiflora Shaferi** sp. nov.

A glabrous vine, about 2 m. long. Leaves thin, elliptic-obovate, 4–5 cm. long, bluntly and shallowly 3-lobed at the apex, rounded or obtuse at the base, strongly 3-nerved, each nerve extending to a lobe and scarcely, if at all, excurrent, with 2 weaker short basal nerves, both surfaces reticulate-veined, the upper surface somewhat shining, the lower dull, the glandless petioles 4–7 mm. long; peduncles mostly 2 together in the axils, 1–2 cm. long; bractlets subulate, 1.5–2 mm. long; flowers about 3 cm. long, red, the tube cylindric, 1–1.5 cm. long; fruit subglobose, about 1 cm. in diameter.

Between Navas and Camp Buena Vista, Oriente, at 650 m. alt. (*Shafer 4466*).

10. PASSIFLORA BERTERIANA Balb.; DC. Prodr. 3: 325. 1828

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Recorded by Grisebach as collected in Cuba by Wright:—Santo Domingo.

11. PASSIFLORA PALLIDA L. Sp. Pl. 955. 1753

Passiflora minima L. Sp. Pl. 959. 1753.
Passiflora suberosa L. Sp. Pl. 958. 1753.
Passiflora hirsuta L. Sp. Pl. 958. 1753.
Passiflora angustifolia Sw. Prodr. 97. 1788.
Passiflora hederacea Cav. Diss. 10: 448. 1790.

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Banks, thickets and hillsides, all provinces and Isle of Pines:—Florida; Bermuda; West Indies and tropical continental America. The many races differ in leaf-form and pubescence.

12. PASSIFLORA FOETIDA L. Sp. Pl. 959. 1753

TYPE LOCALITY: Dominica.

DISTRIBUTION: Thickets and roadsides, Oriente, Havana, Pinar del Rio, Isle of Pines:—West Indies; continental tropical America; Old World tropics.

13. PASSIFLORA GOSSYPIFOLIA Desv. in Hamilt. Prodr. Pl. Ind. Occ. 48: 1825

P. foetida gossypifolia Masters in Mart. Fl. Bras. 13^1: 582. 1872.

TYPE LOCALITY: Not cited, presumably West Indian.

DISTRIBUTION: Dry hillsides, southern Oriente:—continental tropical America.

14. **Passiflora pseudociliata** sp. nov.

? *Passiflora ciliata polyadena* Griseb. Cat. Pl. Cub. 285. 1866.

Herbaceous, glabrous, 2 m. long or less. Leaves membranous, but not flaccid, variously 3-lobed, or sometimes 5-lobed, 2–8 cm. broad, bearing few or many slender-stalked glands, or glandless, the lobes oblong, acute or obtuse, few-toothed or entire, the slender petioles 1–5 cm. long; peduncles solitary in the axils, longer than the petioles, sometimes nearly as long as the leaves; bracts pectinate-pinnatifid; flowers blue, 4–6 cm. broad; petals narrowly oblong, blunt; crown-processes filiform, much shorter than the petals; fruit inflated, bladdery, ellipsoid or subglobose, red, 3–6 cm. long, short-stipitate, longer than the bracts.

Barren hillsides and coastal thickets, Camaguey, Santa Clara, Matanzas, Havana, Pinar del Rio.

Type from rocky soil in savanna near Camaguey (*Britton & Cowell 13155*).

Referred by Grisebach to *P. ciliata* Ait., and by Combs to *P. foetida* L.

Specimens from the Sierra Nipe, Oriente, with large leaves and fruit (*Shafer 3081, 3618*) are doubtfully referred to *P. ciliata* Ait., but they do not show the bracts, which, in *P. ciliata* of Jamaica, are as long as the fruit or longer.

15. PASSIFLORA PENDULIFLORA Bert.; DC. Prodr. 3: 326. 1828

TYPE LOCALITY: Jamaica.

DISTRIBUTION: Coastal woods and thickets, Oriente, Camaguey:—Jamaica.

16. PASSIFLORA RUBRA L. Sp. Pl. 956. 1753

TYPE LOCALITY: Martinique.

DISTRIBUTION: Banks and thickets at lower and middle elevations, Oriente, Camaguey, Santa Clara, Matanzas, Havana:—West Indies; continental tropical America.

The *Passiflora pubescens* HBK., recorded as Cuban by A. Richard, is, presumably, this species.

17. PASSIFLORA SEXFLORA Juss. Ann. Mus. Paris 6: 110. *pl. 37, f. 1.* 1805

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Thickets and hillsides, Oriente, Santa Clara:—

Florida; Jamaica; Hispaniola; Porto Rico; recorded from St. Kitts; Mexico and Central America.

18. PASSIFLORA MULTIFLORA L. Sp. Pl. 956. 1753

TYPE LOCALITY: Near Port de Paix, Santo Domingo.

DISTRIBUTION: Rocky banks and coastal thickets, Oriente, Camaguey, Santa Clara, Pinar del Rio, Isle of Pines:—Florida, Bahamas; Hispaniola to Tortola; recorded from Costa Rica.

19. PASSIFLORA HOLOSERICEA L. Sp. Pl. 958. 1753

Passiflora reticulata C. Wright; Sauvalle, Anales Acad. Habana **6**: 96. 1869.

TYPE LOCALITY: Vera Cruz [Mexico].

DISTRIBUTION: Rocky hillsides and coastal thickets, Matanzas, Pinar del Rio:—Mexico.

20. PASSIFLORA DASYADENIA Urban, Symb. Ant. **3**: 328. 1902

TYPE LOCALITY: Near El Aji [Oriente].

DISTRIBUTION: Type locality and collected also on the Sierra de Anafe, Pinar del Rio (*Wilson & Leon 11534*); flowers of both the Oriente and the Pinar del Rio plant are unknown.

21. PASSIFLORA

A high climbing, sparingly pubescent vine. Petioles slender, 2–4 cm. long, bearing 2 small glands below the middle; leaves subchartaceous, deeply 3-lobed, subtruncate at base, 10 cm. long or less, the oblong lobes 1–3 cm. wide, acute, dentate, loosely reticulate-veined.

Coastal plain, San Juan, Isle of Pines (*Britton & Wilson 15476*).

Passiflora incarnata L. of eastern continental North America is recorded by A. Richard (Sagra, Hist. Cub. **10**: 289) as having been found in Cuba, but I have no other evidence of its occurrence there.

56. RONDELETIA IN CUBA

Type species: *Rondeletia americana* L.

A. Capsule globose to globose-pyriform.
  1. Inflorescence terminal or terminal and axillary.
    a. Twigs strigose.
      Cymes several–many-flowered; leaves elliptic to ovate-elliptic, 3–8 cm. long. 1. *R. odorata*.

Peduncles 1–3-flowered; leaves oblong, 5–20 mm. long. 2. *R. microphylla.*
b. Twigs glabrous or puberulent.
* Pedicels very slender or filiform.
† Leaves small, 1–2.5 cm. long; peduncles 1- to few-flowered.
Calyx-lobes dilated above.
Leaves ovate, rounded or subcordate at the base; calyx-lobes little dilated. 3. *R. Shaferi.*
Leaves oblong, oval or obovate, narrowed or obtuse at the base; calyx-lobes much dilated.
Wholly glabrous; petioles 1–2 mm. long. 4. *R. peduncularis.*
Petioles ciliate, 4–7 mm. long. 5. *R. pachyphylla.*
Calyx-lobes linear or subulate, not dilated.
Foliage puberulent. 6. *R. pedicellaris.*
Foliage glabrous. 7. *R. alaternoides.*
†† Leaves up to 7 cm. long; inflorescence several- to many-flowered. 8. *R. subglabra.*
** Pedicels stout, short.
† Leaves petioled.
Capsule subglobose or short-pyriform.
Corolla densely silky-pubescent. 9. *R. brachycarpa.*
Corolla glabrous or with a few scattered hairs.
Calyx-teeth deltoid, minute. 10. *R. stellata.*
Calyx-teeth ovate or oblong.
Petioles slender; capsule subglobose. 11. *R. angustata.*
Petioles stout; capsule subpyriform. 12. *R. canellaefolia.*
Capsule oblong, about twice as long as thick; leaves elongated, petioled. 13. *R. calcicola.*
†† Leaves sessile, oblong-oblanceolate; capsule short-pyriform. 14. *R. yamuriensis.*
2. Inflorescence axillary or lateral.
a. Peduncles elongated, often as long as the leaves or longer.
Leaves sessile, cordate, 5–8 cm. long. 15. *R. correifolia.*
Leaves petioled, 3–5 cm. long.
Petioles about 2 mm. long. 16. *R. Lindeniana.*
Petioles 8–12 mm. long.
Stipules triangular, obtuse; leaves obtuse or rounded at the base. 17. *R. nimanimae.*
Stipules linear-subulate, broadened below; leaves rounded at the base. 18. *R. Leoni.*
b. Peduncles short, much shorter than the leaves.
* Leaves membranous to chartaceous; inflorescence mostly few- to several-flowered, rarely 1-flowered.

† Leaves faintly reticulate-veined beneath or not reticulate-veined.
Leaves glabrous, or merely puberulent, the venation obscure. — 19. *R. chamaebuxifolia.*
Leaves densely strigose-pubescent beneath, pinnately veined. — 20. *R. intermixta.*
†† Leaves strongly reticulate-veined beneath.
‡ Leaves ovate to elliptic.
Leaves rounded at the apex.
Calyx-lobes triangular; leaves 4 cm. long or less, the petioles stout. — 21. *R. lomensis.*
Calyx-lobes ovate-oblong; leaves 2 cm. long or less, the petioles slender. — 22. *R. baracoensis.*
Leaves acute or acutish at the apex; inflorescence subcapitate.
Inflorescence subsessile. — 23. *R. rigida.*
Inflorescence manifestly peduncled. — 24. *R. nipensis.*
‡‡ Leaves oblong.
Calyx-lobes linear, linear-lanceolate or ovate, acute or acutish.
Leaves 1 cm. long or less. — 25. *R. Rugelii.*
Leaves 1.5–6 cm. long. — 26. *R. Combsii.*
Calyx-lobes broadly ovate, rounded or obtuse.
Leaves tomentulose beneath. — 27. *R. camarioca.*
Leaves strigose on the veins beneath. — 28. *R. insularis.*
** Leaves coriaceous, mostly small; peduncles mostly 1-flowered.
Leaves elliptic to orbicular, obtuse or rounded.
Leaves silvery-puberulent beneath. — 29. *R. savannarum.*
Leaves tomentose beneath.
Leaves elliptic, 1.5–2 cm. long; calyx-lobes linear-lanceolate, acuminate. — 30. *R. venosa.*
Leaves oval or orbicular, 5–15 mm. long; calyx-lobes oblong, obtuse. — 31. *R. hypoleuca.*
Leaves oblong, acute or acutish.
Leaves glabrous, green both sides. — 32. *R. vacciniifolia.*
Leaves white-tomentulose beneath, dark-green and glabrous above. — 33. *R. bicolor.*
B. Capsule linear-oblong, 2 cm. long; inflorescence terminal. — 34. *R. tinifolia.*
C. Species not grouped. — 35. *R. camagueyensis.*

1. RONDELETIA ODORATA Jacq. Enum. Pl. Carib. 16. 1760

R. speciosa Lodd. Bot. Cab. 19: *pl. 1893.* 1832.

TYPE LOCALITY: Coastal thickets, Havana [Jacquin, Sel. Stirp. 59].

DISTRIBUTION: Hillsides and thickets at lower and middle elevations, Santa Clara, Matanzas, Havana, Pinar del Rio. Recorded by Richard from Oriente. Recorded from Mexico. Cultivated for ornament.

2. RONDELETIA MICROPHYLLA Griseb. Cat. Pl. Cub. 127. 1866

TYPE LOCALITY: Western Cuba.

DISTRIBUTION: River-banks, Pinar del Rio. Endemic.

The leaves are sometimes larger than those of the type specimens, attaining a length of 3 cm.

3. RONDELETIA SHAFERI Urban & Britton; Urban, Symb. Ant. **7**: 398. 1912

TYPE LOCALITY: Barren savannas near Holguin, Oriente.

DISTRIBUTION: Known only from the type locality.

Dr. Shafer's notes indicate that the plant grows along water-courses.

4. RONDELETIA PEDUNCULARIS A. Rich. in Sagra, Hist. Cub. **11**: 14. 1850

TYPE LOCALITY: Vuelta de Abajo.

DISTRIBUTION: Rocky banks and beds of streams, Oriente, Pinar del Rio. Endemic.

5. RONDELETIA PACHYPHYLLA Krug & Urban; Urban, Symb. Ant. **1**: 419. 1899

TYPE LOCALITY: Cuba.

DISTRIBUTION: Rocky stream-beds, mountains of northern Oriente. Endemic.

Recorded by Grisebach as *R. alaternoides* A. Rich. The inflorescence is both terminal and axillary.

6. RONDELETIA PEDICELLARIS C. Wright; Sauvalle, Anales Acad. Habana **6**: 102, 121. 1869

TYPE LOCALITY: Vicinity of Trinidad.

DISTRIBUTION: Cliffs and rocky hillsides, southern Santa Clara. Endemic.

7. RONDELETIA ALATERNOIDES A. Rich. in Sagra, Hist. Cub. **11**: 13. 1850

TYPE LOCALITY: Mountains near Santiago [Oriente].

DISTRIBUTION: Known only from the type locality.

Urban states (Symb. Ant. **1**: 419) that the inflorescence of this species is terminal, not axillary as first described.

8. RONDELETIA SUBGLABRA Krug & Urban; Urban, Symb. Ant. **1**: 418. 1899

TYPE LOCALITY: Near Santiago, at 1,400 m. elevation [Oriente].

DISTRIBUTION: Mountains of Oriente. Endemic.

9. RONDELETIA BRACHYCARPA (Griseb.) C. Wright; Sauvalle, Anales Acad. Habana **6**: 122. 1869

Ferdinandea brachycarpa Griseb. Mem. Am. Acad. II. **8**: 505. 1862.

TYPE LOCALITY: Thickets near Santa Catalina [Oriente].

DISTRIBUTION: Thickets and hillsides, Oriente, Camaguey, Santa Clara, Havana, Pinar del Rio:—Hispaniola.

Referred by Combs to *R. trifolia* Jacq.

10. RONDELETIA STELLATA (Griseb.) C. Wright; Sauvalle, Anales Acad. Habana. **6**: 122. 1869

Ferdinandea stellata Griseb. Mem. Am. Acad. II. **8**: 505. 1862.

TYPE LOCALITY: Pine-lands near Monte Verde [Oriente].

DISTRIBUTION: Mountains of northern Oriente. Endemic.

11. RONDELETIA ANGUSTATA C. Wright; Sauvalle, Anales Acad. Habana **6**: 122. 1869

Ferdinandea angustata C. Wright; Griseb. Cat. Pl. Cub. 127. 1866.

TYPE LOCALITY: In bogs near Toscano.

DISTRIBUTION: Arroyos and barrens, Santa Clara, Matanzas, Pinar del Rio. Endemic.

12. **Rondeletia canellaefolia** sp. nov.

A glabrous shrub about 2.5 m. high, the twigs rather stout. Leaves coriaceous, elliptic-obovate or elliptic-oblanceolate, opposite or verticellate, 10 cm. long or less, 1.5–3 cm. wide, dark green, shining above, dull beneath, obtuse or acute at the apex, cuneate at the base, the midvein prominent, the lateral veins few, distant, slender, the petioles 5–15 mm. long; inflorescence terminal and in the upper axils, few–several-flowered; peduncles 1.5–5 cm. long; pedicels short and stout; bracts triangular, minute; calyx 3–4 mm. long, its lobes foliaceous, ovate, obtuse, 1–1.5 mm. long; corolla glabrous, about 4 mm. long (immature); capsule pyriform, 1–1.5 cm. long.

Woods and on cliffs, Sierra Nipe, near Woodfred, Oriente, 450–550 m. alt. Type, *Shafer 3297*. In foliage and capsules similar to *R. stellata*, but that has minute calyx-lobes.

13. RONDELETIA CALCICOLA Britton, Bull. Torrey Club 43: 467. 1916

TYPE LOCALITY: Coe's Camp, Ensenada de Siguanea, Isle of Pines.

DISTRIBUTION: Known only from the type locality.

14. **Rondeletia yamuriensis** sp. nov.

A small tree, about 4 m. high, glabrous throughout. Leaves coriaceous, narrowly oblong-oblanceolate, 6–9 cm. long, 1–2 cm. wide, sessile, acute or obtuse at the apex, narrowed at the base, opposite or verticillate in 3's, the midvein rather prominent, the lateral veins few and slender; inflorescence terminal and also in the uppermost axils; peduncles rather slender, 6 cm. long or less; fruiting pedicels 5–10 mm. long; capsule globose-pyriform, about 1 cm. long.

Between Yamuri Arriba and Bermejal, Oriente (*Shafer 8439*).

15. RONDELETIA CORREIFOLIA Griseb. Cat. Pl. Cub. 129. 1866

TYPE LOCALITY: Western Cuba.

DISTRIBUTION: Pine-lands and savannas, Pinar del Rio and Isle of Pines. Endemic. A virgate shrub, up to 2 m. high, the large white flowers fragrant.

16. RONDELETIA LINDENIANA A. Rich. in Sagra, Hist. Cub. 11: 13. 1850

TYPE LOCALITY: Mountains near Santiago [Oriente].

DISTRIBUTION: Mountains of Oriente. Endemic. Recorded by Grisebach as *R. buxifolia* Vahl, and, doubtfully, by Sauvalle, as *R. umbellulata* Sw.

17. RONDELETIA NIMANIMAE Krug & Urban; Urban, Symb. Ant. 1: 418. 1899

TYPE LOCALITY: Near Nimanima, at 800 m. alt. [Oriente].

DISTRIBUTION: Known only from the type locality.

18. **Rondeletia Leoni** sp. nov.

A shrub or small tree up to 3 m. high, the slender young twigs, the petioles and the inflorescence appressed-pubescent with short, whitish hairs. Leaves elliptic to obovate, 3–8 cm. long, subcoriaceous, acute, short-acuminate, or some of them obtuse at the apex, narrowed or cuneate at the base, flat, or the margins somewhat revolute when old, densely pubescent with appressed hairs when young, glabrous, or sparingly pubescent on the veins beneath when old, inconspicuously reticulate-veined, the slender petioles 12 mm. long or less; stipules linear-subulate with a broadened base, pubescent, 3–4 mm. long; inflorescence axillary or lateral, 4–6 cm. long, 1–few-flowered, sometimes with a pair of small, leaf-like bracts; pedicels nearly filiform, 1–2 cm. long; bractlets linear-subulate; calyx ovoid-campanulate, densely canescent, its lobes linear or linear-spatulate, 3–4 mm. long; corolla densely white-pubescent without, its tube slender, 10–12 mm. long, cylindric, slightly expanded above, its lobes oblong-orbicular, rounded, deep purple above, 2.5–3 mm. long; capsule subglobose, 4–5 mm. in diameter.

Sancti Spiritus Mountains, Santa Clara; type from Sierra del Caballete (*Leon & Clement 6560*).

19. RONDELETIA CHAMAEBUXIFOLIA Griseb. Cat. Pl. Cub. 128. 1866

Rondeletia avenia C. Wright; Sauvalle, Anales Acad. Habana **6**: 121. 1869.

TYPE LOCALITY: Western Cuba.

DISTRIBUTION: Known only from the type locality, this not definitely recorded.

20. **Rondeletia intermixta** sp. nov.

A shrub, 1.6 m. high, the young twigs densely strigose-pubescent. Stipules triangular-ovate, pubescent, acute, persistent, spreading, about 2 mm. long; leaves oblong, chartaceous, 3–6 cm. long, acute at both ends, dark green and glabrous above, pale green and densely pubescent beneath, the midvein rather prominent, the lateral veins few, the slender petioles 8–15 mm. long; inflorescence axillary, short-peduncled, few–several-flowered, densely pubescent; bractlets ovate, acute, about 1 mm. long; calyx-teeth ovate, short; capsule globose, about 3 mm. in diameter, pubescent.

Gran Piedra, Oriente, at about 1,500 m. alt. (*Shafer 9039*). Apparently the same as a part of *C. Wright 1266*, recorded by Griesbach as *Rondeletia Poitaei* Griseb., but that name (Griseb. Fl. Br. W. I. 328) is a synonym of *Stevensia buxifolia* Poit., a plant known only from Hispaniola.

21. RONDELETIA LOMENSIS Urban, Symb. Ant. 7: 394. 1912

TYPE LOCALITY: Dry serpentine hill, Loma Santa Teresa, near El Yunque, Oriente.

DISTRIBUTION: Known only from the type locality.

Dr. Shafer's notes describe this as a shrub about 2.6 m. high with white flowers; the corollas are not shown in the specimens.

22. **Rondeletia baracoensis** sp. nov.

Twigs slender, densely whitish-pubescent when young. Stipules triangular-ovate, acute, pubescent, about 2 mm. long; leaves chartaceous, elliptic, 2 cm. long or less, rounded or obtuse at the apex, narrowed or obtuse at the base, glabrous and obscurely veined above, whitish-tomentulose and reticulate-veined beneath with the primary venation prominent, the petioles 3–5 mm. long; peduncles opposite, rather stout, 1–3-flowered, 3–13 mm. long; bractlets lanceolate, pubescent, somewhat shorter than the calyx; calyx 3 mm. long, its lobes ovate or ovate-oblong, obtuse, one half as long as the tube; corolla-bud densely white-pubescent.

Vicinity of Baracoa (*Pollard, Palmer & Palmer 245*).

23. RONDELETIA RIGIDA Griseb. Mem. Am Acad. II. 8: 505. 1862

TYPE LOCALITY: La Madelina [Oriente].

DISTRIBUTION: Known only from the type locality.

24. RONDELETIA NIPENSIS Urban, Symb. Ant. 7: 393. 1912.

TYPE LOCALITY: Sierra Nipe, near Woodfred, Oriente, in pinelands, 500–650 m. alt.

DISTRIBUTION: Pine-lands and deciduous woods of the Sierra Nipe, Oriente.

Dr. Shafer's notes show this to be a shrub about 1.3 m. high, with white flowers.

25. RONDELETIA RUGELII Urban, Symb. Ant. 7: 397. 1912

Rondeletia Poitaei microphylla Griseb. Cat. Pl. Cub. 128. 1866.

TYPE LOCALITY: near Matanzas.

DISTRIBUTION: Known definitely only from the type locality.

Rugel's label indicates that this is a shrub growing in rocks. The species is related to the following one. Grisebach considered the plant to be the same as *R. Berteriana* A. Rich. (not DC.), which was collected at La Cabana, Havana. *R. Berteriana* DC., of Hispaniola, is clearly different.

26. RONDELETIA COMBSII Greenm. Trans. Acad. St. Louis 7: 427, *pl. 34*. 1897

TYPE LOCALITY: Calicita [Santa Clara].

DISTRIBUTION: Hillsides, cliffs and rocky shores, Santa Clara; Havana. Endemic.

Plants with identical foliage have calyx-lobes ovate or lanceolate; Dr. Greenman's original description indicates that they may even be linear. A fruiting specimen from Bahia Honda, Pinar del Rio (*Wilson 9409*), is doubtfully referred to this species.

27. RONDELETIA CAMARIOCA C. Wright; Sauvalle, Anales. Acad. Habana 6: 102. 1869

TYPE LOCALITY: Savannas of Camarioca [Matanzas].

DISTRIBUTION: Serpentine barrens and savannas, in dry soil, Camaguey; Santa Clara; Matanzas. Endemic.

28. **Rondeletia insularis** sp. nov.

A much-branched shrub, about 2 m. high, the twigs densely appressed-pubescent. Stipules triangular-ovate, connate, pubescent, persistent, 2–3 mm. long; leaves gray-green, oblong or oblong-obovate, chartaceous, 3 cm. long or less, 7–10 mm. wide, glabrous and very obscurely veined above, delicately reticulate-veined and strigillose beneath, the stout petioles about 1.5 mm. long; peduncles solitary in the axils, stout, about as long as the petioles, 1-flowered, pubescent; bractlets ovate, acute, 1 mm. long; capsule globose, densely puberulent, 4–5 mm. in diameter; calyx-lobes ovate-oblong, obtuse, 1 mm. long.

Vicinity of Pueblo Romano, Cayo Romano, Camaguey (*Shafer 2444*).

29. **Rondeletia savannarum** sp. nov.

A shrub, about 2 m. high, the twigs densely appressed-pubescent. Stipules triangular, acute, finely pubescent, 1–1.5 mm. long; leaves oblong to oblong-elliptic, 2 cm. long or less, 6–10 mm. wide, coriaceous, obtuse at the apex, narrowed at the base, glabrous, dark green and obscurely veined above, silvery-puberulent beneath with the few veins rather prominent, the petioles about 1.5 mm. long; flowers solitary in the axils; peduncles stout, 2–3 mm. long; calyx-teeth linear with the base broadened, 3 mm. long, about as long as the calyx-tube; corolla-bud densely pubescent; capsule globose, densely puberulent, 4 mm. in diameter.

Barren savannas, southeast of Holguin, Oriente (*Shafer 1230*, type; *2933*).

30. RONDELETIA VENOSA Griseb. Cat. Pl. Cub. 128. 1866

TYPE LOCALITY: Near San Marcos, Bahia Honda [Pinar del Rio].

DISTRIBUTION: Known only from the type locality.

31. RONDELETIA HYPOLEUCA Griseb. Cat. Pl. Cub. 128. 1866

TYPE LOCALITY: Eastern Cuba, near Baracoa.

DISTRIBUTION: Rocky situations, Oriente. Endemic.

A plant with orbicular leaves 5–7 mm. long, collected in a rocky thicket between Camp La Barga and Camp San Benito at about 1,000 m. alt. (*Shafer 4121*), is referred to this species with hesitation.

32. **Rondeletia vacciniifolia** sp. nov.

A much-branched shrub 0.3–1.3 m. high, the young twigs densely appressed-pubescent. Stipules triangular, acute, connate, pubescent, 1.5–2 mm. long; leaves oblong, coriaceous, 6–12 mm. long, acute at both ends, or the apex obtuse and mucronate, glabrous on both sides or sparingly pubescent on the midvein beneath, the lateral venation obscure, the stout, pubescent petioles 1.5–3 mm. long; flowers solitary in the upper axils, the stout, pubescent peduncles about as long as the petioles; bractlets triangular-ovate, acute; calyx-teeth linear, 2–3 mm. long; capsule globose, pubescent, 5 mm. in diameter, reddish.

Rocky situations, mountains of northern Oriente. Type from rocky bank of river, vicinity of Camp San Benito at 900 m. alt. (*Shafer 4090*).

33. **Rondeletia bicolor** sp. nov.

A shrub about 1.7 m. high, the twigs ascending, slender, densely short-pubescent when young. Stipules triangular-lanceolate, rather abruptly attenuate from a broad base, short-pubescent, about 3 mm. long; leaves oblong or oblong-oblanceolate, coriaceous, 2–3 cm. long, acute or some of them obtuse at the apex, narrowed at the base, dark green, glabrous and very obscurely veined above, white tomentulose and prominently veined beneath, the pubescent petioles 2–4 mm. long; peduncles axillary, pubescent, in fruit about 3 mm. long; fruits solitary, globose, pubescent, about 3 mm. in diameter.

Loma de Ponciano, Sancti Spiritus Mountains, Santa Clara (*Leon and Clement 6717*).

34. **Rondeletia** (?) **tinifolia** Griseb. Cat. Pl. Cub. 129. 1866

TYPE LOCALITY: Western Cuba.

DISTRIBUTION: Sancti Spiritus Mountains, Santa Clara; pinelands and arroyos, Pinar del Rio. Endemic.

35. **Rondeletia** (?) **camagueyensis** sp. nov.

A shrub about 3 m. high, the young shoots densely appressed-pubescent. Stipules triangular, acute, about 3 mm. long; leaves ovate or elliptic-ovate, 3–4 cm. long, 3 cm. wide or less, membranous, acute at the apex, narrowed or obtuse at the base, sparingly short-pubescent and indistinctly veined above, loosely strigose-pubescent, especially on the prominent veins beneath, the stout, pubescent petioles 2–3 mm. long; capsule subglobose, 4–6 mm. in diameter.

Arroyo, savanna near Camaguey (*Britton & Cowell 13206*).

Imperfect material only was collected at the time of our visit to the locality in April, 1912.

OTHER SPECIES ATTRIBUTED TO CUBA

Rondeletia microdon DC. Prodr. 4: 408. 1830

Havana, collected by Ossa, according to De Candolle. Described as a glabrous species, with oval-oblong, short-petioled leaves acute at both ends, bipartite, persistent, obtuse stipules; corymbose peduncled flowers, the calyx truncate, with five short teeth. The genus of this plant was questioned by A. Richard (in Sagra, Hist. Cub. 11: 13), and I do not know any species which answers to the description.

Rondeletia americana L. Sp. Pl. 172. 1753

This, the type of the genus, is also recorded by De Candolle as found at Havana by Ossa, and Grisebach (Fl. Br. W. I. 327) mentions it as Cuban. I know the plant only from St. Vincent and Jamaica.

Rondeletia laevigata Ait. Hort. Kew. ed. 2, 1: 366. 1810

De Candolle mentions this also as found at Havana, but no species answering to the description is known to me from Cuba; Grisebach (Fl. Br. W. I. 328) indicates that it is from the island of Trinidad.

Rondeletia leptacantha DC. Prodr. 4: 410. 1830

Collected by Ossa, near Havana, according to De Candolle. Described as a plant with opposite spines, broadly oval, subacute leaves, the twigs and leaves subpilose when young, the slender peduncle as long as the leaves or longer, three- to five-flowered at the apex. No species of *Rondeletia* known to me answers the description. Grisebach (Cat. Pl. Cub. 133) refers the plant to *Chomelia fasciculata* Sw. [*Anisomeris fasciculata* (Sw.) Schum.], but this disposal of it is not satisfactory.

57. THREE ERIOCAULONS FROM THE ISLE OF PINES

Eriocaulon arenicola Britton & Small, sp. nov.

Plants 4–26 cm. tall, the scapes solitary or usually several together; leaves ascending or spreading, 1–8 cm. long, linear-attenuate, convex beneath, slightly concave above, glabrous; scapes slender, mostly 6-angled, slightly spirally twisted, each subtended by an obliquely opened sheath which is shorter than the leaves; heads dense, at first depressed-globose, later subglobose or ovoid-globose, becoming about 5 mm. in diameter, pubescent, whitish-gray; bracts of the involucre cuneate to obovate, the outer ones about 1.5 mm. long; flowers numerous, crowded; bracts very broadly cuneate, fully 1.5 mm. long, short-hairy at and near the apex; sepals of the staminate flowers concave, cuneate to obovate, about 1.5 mm. long, exceeding the corolla, pubescent at the apex; corolla-lobes minute, ovate to oblong-ovate, obtuse; anthers about 0.25 mm. long; sepals of the pistillate flowers about 1.5 mm. long, boat-like, keeled, pubescent near the top; petals oblong to oblong-spatulate, fully 1 mm. long; capsule reniform-didymous, fully 0.5 mm. wide: seeds oval, barely 0.5 mm. long.

White sand, vicinity of Los Indios (*Britton & Wilson 14179*).

This plant is related to *Eriocaulon sigmoideum* C. Wright. It differs from it in the larger size, the more compact heads, the more copiously pale-pubescent and longer bracts, the smaller staminate flowers, and the sepals of the pistillate flowers which are wider below the middle, instead of at the top.

Eriocaulon fusiforme Britton & Small, sp. nov.

Plants 3–6.5 cm. tall, the scapes tufted, usually densely so; leaves ascending or recurved, subulate-lanceolate, 1–2.5 cm. long, thinnish, concave, glabrous; scapes relatively slender, spirally twisted, prominently 5-angled, each subtended by an obliquely opened sheath which is shorter than the longer leaves; heads dense, fusiform, becoming 7–8.5 mm. long, acute, glabrous, brownish; bracts of the involucre ovate to oblong, obtuse, chartaceous, 2–3 mm. long; flowers numerous; bracts rhombic-ovate or rhombic-cuneate, mostly 2 mm. long, acute or short-acuminate, scarious, glabrous, or obscurely fine-pubescent; sepals of the staminate flowers spatulate to oblong-spatulate, about 1 mm. long, sometimes laciniate at the apex, about equalling the corolla or exceeding it; corolla-lobes ovate; anthers about 0.15 mm. long; sepals of the pistillate flowers about 1.5 mm. long, boat-shaped, strongly keeled and crested above the middle, acuminate; petals linear-elliptic to linear-spatulate, 1.5–2 mm. long; capsule suborbicular or orbicular-ovoid, about 0.5 mm. wide: seeds narrowly oval, about 0.5 mm. long.

Pinelands, Siguanea (*Britton & Wilson 14951*).

This differs from all described Cuban species of *Eriocaulon*. Its short stiff scapes and fusiform glabrous or nearly glabrous heads are particularly diagnostic.

Eriocaulon ovoideum Britton & Small, sp. nov.

Plants 6–11 cm. tall, the scapes tufted, usually densely so; leaves erect or ascending, narrowly linear-lanceolate to linear-attenuate, 1–3 cm. long, concave, thinnish, glabrous; scapes stoutish, spirally-twisted, sharply 5-angled, each subtended by an obliquely opened sheath which is as long as the leaves or shorter; heads very dense, ovoid or globose-ovoid, becoming 6–8 mm. long, obtuse, tan-colored; bracts of the involucre ovate to oblong, 1.5–3 mm. long, obtuse, glabrous, chartaceous; flowers numerous; bracts subreniform, mostly wider than long, broadly rounded at the apex, scarious, minutely pubescent; sepals of the staminate flowers obovate to cuneate, concave, fully 1 mm. long, erose at the apex, mostly exceeding the corolla; anthers ovoid, about 0.1 mm. long; sepals of the pistillate flowers boat-shaped, fully 1 mm. long, keel-winged and crested on the back, abruptly pointed: petals spatulate, about 1.5 mm. long, often erose at the apex; capsule reniform, about 1 mm. wide; seeds broadly oval, fully 0.5 mm. long.

White sand, vicinity of Los Indios (*Britton & Wilson 14220*).

Related to *Eriocaulon fusiforme*, differing in stouter habit, the short and broad heads, and in the broad and rounded bracts.

58. UNDESCRIBED CUBAN SPECIES

Dupatya montana sp. nov.

Stem simple, elongate, stout, densely leafy. Leaves broadly linear, 8–14 cm. long, 6–15 mm. broad at the base, narrowed to the acute apex, rigid, glabrous, striate-nerved; peduncles erect, 15–30 cm. high, often numerous, axillary, loosely pubescent with long, soft, white hairs, or glabrous; sheaths shorter than the leaves, acuminate; heads solitary on the peduncles, hemispheric, 7–8 mm. broad; outer involucral bracts ovate, the inner ones broadly oval to orbicular, rigid, acute, glabrous; receptacle pilose, the bracts membranaceous, obovate-cuneate, 1.8–2 mm. long, 0.6–0.8 mm. broad, with a tuft of short hairs on the back at the apex; staminate flowers dimerous; sepals spatulate-obovate, about 1.9 mm. long, concave, ciliate at the apex; pistillate flowers dimerous; sepals elliptic, concave; stigmas 2; ovary globose-ovate.

Collected on compact red iron ore along trail from Rio Yamaniguey to Camp Toa, Oriente, at 400 m. alt. (*J. A. Shafer 4473*, type); also collected along trail from Camp La Barga to Camp San Benito (*Shafer 4104*) and at Camp La Gloria, south of Sierra Moa (*Shafer 8045*, *8251*).

Apparently closely related to **Dupatya pungens** (Griseb.) Britton (*Paepalanthus pungens* Griseb.), another Cuban species.

Pilea Cowellii sp. nov.

Glabrous, perennial, monoecious, about 4 dm. tall; stem becoming more or less grooved and compressed in drying, clothed with numerous, small, elliptic raphides; leaves elliptic to ovate, or the uppermost oblong-obovate, 1–3 cm. long, 0.7–1.1 cm. broad, acute or obtuse at the apex, rounded and more or less cordate at the base, 3-nerved, green and lustrous above, paler beneath, with prominent, scattered, elevated callosites when fresh which become depressed in drying, entire; raphides of the upper surface linear, those of the lower surface punctiform; petioles 1–2 mm. long; inflorescence axillary, 1–2 cm. long, equalling or shorter than the leaves; staminate and pistillate flowers intermixed; staminate flowers: pedicels 0.5 mm. long, perianth glabrous, 1 mm. long, the lobes triangular-ovate; stamens 4; pistillate flowers short-pedicelled or subsessile.

Type collected on cliffs, Ensenada de Mora, Oriente (*Britton, Cowell & Shafer 12977*).

Ichthyomethia havanensis Britton & Wilson, sp. nov.

A shrub 2 m. tall, with finely pubescent twigs; leaves odd-pinnate, 1–1.4 dm. long, the petioles, rachis and petiolules velvety-ferruginous when young; leaflets 9–13, elliptic to somewhat elliptic-obovate, 2.3–4.5 cm. long, 1.3–1.7 cm. broad, acute to rounded and often apiculate at the apex, rounded at base, short-petioluled, densely clothed with short, appressed, silky hairs when young, in age glabrous or nearly so above, finely pubescent and reticulate-veined beneath; calyx campanulate, pubescent with short, appressed brownish hairs; pods broadly 4-winged, puberulent with appressed hairs, 2–3.5 cm. long, 2–2.8 cm. broad, stipitate, the margin more or less undulate; seeds oblong, 5 mm. long, 2.5–3 mm. broad.

Related to *I. piscipula* (L.) A. S. Hitchc., but differing in the much smaller and more coarsely reticulate leaflets, and smaller fruit.

Thickets not far from Cojimar, Province of Havana (*Brother Leon & Father M. Roca 6194*, type); also collected on a hill west of Chorrera, Province of Havana (*Brother Leon 5192*).

Castelaria calcicola Britton & Small, sp. nov.

A much-branched shrub up to 2.5 m. tall, with stout thorns which are branched when well developed, the twigs closely fine-pubescent; leaf-blades obovate, varying to oval or ovate, mostly 1.5–4 cm. long, rounded or retuse and mucronulate at the apex, entire, slightly revolute and reticulate in age, bright green above, paler beneath, somewhat shining, minutely pubescent, especially on the midrib and veins beneath, short-petioled; flowers several in each cluster, short-pedicelled, the pedicels densely pubescent; sepals triangular-ovate, about 1 mm. long, green, acutish, copiously pubescent; petals ovate or oval, concave, cymbiform, 3.5–4 mm. long, red, sparingly pubescent on the back; filaments subulate, nearly 2 mm. long, villous-tomentose; anthers slightly longer than the filaments, oblong, or nearly so; drupes flat, fully 1.5 cm. long, nearly as wide, about 6 mm. thick, bright-red, the flesh thin, with a fibrous-reticulate network which is impressed into the putamen.

Limestone hills, vicinity of Sumidero, Pinar del Rio (*Shafer 13434*).

This shrub is related to *Castelaria jacquinifolia*. It differs from that species in the pubescent leaves, the triangular-ovate sepals, the pubescent petals, and the narrower and longer anthers.

Stenostomum obovatum sp. nov.

A straggling tree, the slender twigs glabrous. Leaves coriaceous, obovate, 6 cm. long or less, rounded at the apex, narrowed at the base, revolute-margined, faintly shining, the midvein impressed above, prominent beneath, the lateral venation slender and obscure, the stout petioles 3–5 mm. long; inflorescence terminal; fruits in pairs, sessile, oblong, black, fleshy, 10–12 mm. long, 5–7 mm. thick.

Camp La Gloria, south of Sierra Moa, Oriente (*Shafer 8169*).

Stenostomum aristatum sp. nov.

A rough-barked tree about 6 m. high, with widely spreading branches, the slender young twigs resinous. Stipules broadly ovate, obtuse, 3 mm. long, caducous; leaves elliptic or ovate-elliptic, coriaceous, 2.5 cm. long or less, acute and aristate at the apex, mostly obtuse at the base, shining and strongly reticulate-veined on both surfaces, especially above, the margins slightly revolute, the petioles 1–2 mm. long; peduncles solitary in the uppermost axils, about one-half as long as the leaves, 1- to 3-flowered at the apex; flowers fragrant; calyx narrowly campanulate, 5 mm. long, 5-lobed, the lobes oblong or oblong-obovate, 1.5–2 mm. long, rounded; corolla white, its tube narrowly cylindric, about 2 cm. long, 1 mm. thick, its limb spreading, 5-lobed, about 1 cm.

broad, the lobes rounded; stamens 5; anthers linear, 2 mm. long; ovary 6-celled.

Rocky hill, savanna near Camaguey (*Britton & Cowell 13241*).

59. NOTES ON VARIOUS SPECIES

Evolvulus siliceus Britton & Wilson, nom. nov.

Evolvulus arenicola Britton & Wilson, Bull. Torrey Club **43**: 466. 1916. Not *E. arenicola* Johnston, 1905.

PERSICARIA HIRSUTA (Walt.) Small

Marsh near Ferry River, Jamaica (*Britton 394*). Hitherto unrecorded from Jamaica.

PHENAX SONNERATII (Poir.) Wedd.

Gravelly soil, Jamaica (*Alex. E. Wright 193*). Hitherto unrecorded from Jamaica.

PHYLLANTHUS NUMMULARIAEFOLIUS Poir.

Shady places, Hope Grounds, Jamaica (*Harris 12123, 12157, 12208*). Hitherto unrecorded from Jamaica.

VERONICA TOURNEFORTII Gmelin

Waste and shaded grounds, near Mandeville (*Crawford 683*) and near Cinchona, Jamaica (*Harris 12417*).

JACQUINIA KEYENSIS Mez.

Northern coast of Camaguey and Matanzas provinces, Cuba (*Shafer 689, 2593, 2712; Britton & Wilson 14043*); Little Goat Island, Jamaica (*Britton 1852*); Albion Mountain, Jamaica (*Harris 11678, 12199*). Heretofore recorded from the Bahamas and Florida.

CYRILLA BREVIFOLIA N. E. Brown

Mountains of northern Oriente, Cuba (*Shafer 4060, 4054, 4109, 4140, 4181, 8032*). Apparently identical with the plant of Mt. Roraima, British Guiana (Trans. Linn. Soc. II. **6**: 22. *pl. 1, f. 7–16*).

STEMODIA PARVIFLORA Ait.

Rio Piedras, Porto Rico (*Stevenson 2178*). Hitherto unrecorded from Porto Rico.

DITTA MYRICOIDES Griseb.

Sierra de Naguabo, Porto Rico (*Shafer 3603*). Hitherto unrecorded from Porto Rico.

SIDA EGGERSII E. G. Baker

Island of Culebra, Porto Rico, 1906 (*Britton & Wheeler 178*). Hitherto known only from Tortola, where Dr. Shafer made a second collection of it in 1913. A tree, 6–8 m. high, very different from typical species of *Sida*.

OSSAEA DOMINGENSIS Cogn.

Alto de la Bandera, Porto Rico (*F. L. Stevens 8717*). Hitherto known only from Santo Domingo.

LESCAILLEA EQUISETIFORMIS Griseb.

This monotypic genus of Compositae was rediscovered on the southern slope of Cajalbana in the province of Pinar del Rio, Cuba, by Brothers Leon and Charles on April 6, 1915. The genus has hitherto been imperfectly known, as it was represented in this country only by a fragment at the Gray Herbarium, collected by Charles Wright in western Cuba. *Lascaillea* is a woody vine related to *Porophyllum*. The leaves are reduced to small scales, the plant resembling certain species of *Ephedra* much more closely than it does any *Equisetum*.

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NOTES ON ROSACEAE—XI

P. A. RYDBERG

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Notes on Rosaceae—XI

Per Axel Rydberg

Roses of California and Nevada

Two years ago I had practically completed the manuscript for the monograph of the genus *Rosa* to be printed in the North American Flora. As this would only make half a part as usually published, and as the rest of the manuscript for the same part, which is to be contributed by other persons, is not yet ready and may not be for some time, I thought it would be advisable to publish some of the notes and some of the descriptions of new species in advance. Besides, Professor Le Roy Abrams, of the Leland Stanford University, has sent me for determination the collection of North American roses, found in the herbarium of the said institution. I therefore think it is a proper time to put on record my present knowledge of the genus *Rosa*, with particular reference to California and Nevada, the two states best represented in that collection.

Key to the groups and species

Pistils numerous; styles as well as the upper part of the hypanthium persistent.
 Flowers corymbose or, when solitary, supported by bracts; achenes borne both on the inner walls and in the bottom of the receptacle; leaflets large.
  Stem with scattered prickles, rarely also with intermixed bristles; sepals distinctly lobed; foliage glandular-punctate, sweet-scented. — I. Caninae.
  Stem, at least the young shoots, bristly; prickles infrastipular or lacking; sepals entire or only the outer

ones occasionally with one or two lobes; foliage not sweet-scented. II. CINNAMOMIAE.
Flowers solitary, bractless; achenes inserted only in the bottom of the hypanthium; leaflets very small. III. MINUTIFOLIAE.
Pistils few; styles deciduous with the upper part of the hypanthium which falls off like a ring. IV. GYMNOCARPAE.

I. CANINAE

A climbing rose. 1. *R. rubiginosa.*

II. CINNAMOMIAE

Flowers mostly solitary; petals usually 2.5 cm. long or more; hypanthium in fruit 12–20 mm. thick; prickles straight.
Prickles stout, more or less flattened below, ascending; petioles, rachis, and lower surface of the leaflets not pilose, except sometimes on the veins.
Leaflets very thin, pale and slightly glandular-puberulent, but not muriculate beneath. 2. *R. nutkana.*
Leaflets thicker, dark-green on both sides, conspicuously glandular-muricate beneath. 3. *R. muriculata.*
Prickles weak, almost terete; petioles, rachis, and lower surface of the leaflets distinctly pilose. 4. *R. Brownii.*
Flowers mostly corymbose; if solitary, the petals 2 cm. long or less; fruit rarely more than 1 cm. thick.
Prickles more or less curved; leaves more or less softly villous or pilose.
Leaflets not at all glandular beneath, mostly simple-toothed; hypanthium with a distinct neck, often ovoid. 5. *R. californica.*
Leaflets conspicuously glandular beneath, more or less double-toothed.
Hypanthium with a distinct neck.
Leaflets broadly oval or obovate; fruit subglobose or broadly obovoid. 6. *R. Aldersonii.*
Leaflets elliptic; fruit elongate-ellipsoid. 7. *R. Greenei.*
Hypanthium depressed-globose, without a neck; leaflets elliptic or narrowly oval. 8. *R. brachycarpa.*
Prickles straight or nearly so.
Hypanthium normally not bristly.
Hypanthium globose or nearly so; neck obsolete or inconspicuous.
Sepals lanceolate, with long caudate-attenuate or foliaceous tips, more than 1 cm. long.
Stipules, petioles, and rachis copiously glandular; leaflets orbicular or rounded-ovate, often double-toothed with gland-tipped teeth, more or less glandular-granuliferous beneath.
Leaflets very thin; prickles slender.

Leaflets green on both sides; petals about 2 cm. long. 9. *R. pinetorum.*

Leaflets pale beneath; petals about 1 cm. long. 10. *R. calavera.*

Leaflets not very thin, dark-green; prickles stout.

Leaves scarcely pubescent beneath. 3. *R. muriculata.*

Leaves decidedly pubescent beneath.

Leaflets rather simply serrate; hypanthium pilose when young. 11. *R. santae-crucis.*

Leaflets conspicuously double-serrate; hypanthium glabrous. 12. *R. Dudleyi.*

Stipules, petioles, and rachis not conspicuously glandular (stipules glandular-denticulate in no. 18).

Leaflets glabrous or nearly so.

Leaflets broadly oval, 3–5 cm. long. 13. *R. rivalis.*

Leaflets obovate to elliptic, rarely 3 cm. long.

Leaflets usually obovate, not shining; plant not conspicuously prickly. 14. *R. chrysocarpa.*

Leaflets elliptic, shining; plant usually very prickly. 15. *R. mohavensis.*

Leaflets more or less pubescent beneath.

Leaflets villous or pilose beneath, rounded or broadly oval; prickles stout.

Leaflets sparingly pubescent on both sides, thin; prickles rather few. 16. *R. myriantha.*

Leaflets pubescent on both sides, densely so beneath, thick; prickles very numerous. 17. *R. Davyi.*

Leaflets finely puberulent beneath; prickles rather weak.

Leaflets rounded-oval or suborbicular, thick; stipules conspicuously glandular-denticulate; petals less than 1 cm. long. 18. *R. rotundata.*

Leaflets elliptic to oval; stipules slightly if at all glandular-dentate; petals larger.

Sepals decidedly glandular on the back; prickles few, small and ascending. 19. *R. pisocarpa.*

Sepals not glandular on the back.

Leaflets broadly oval, thin, 2–5 cm. long; plant nearly unarmed. — 20. *R. salictorum.*
Leaflets narrowly oval or elliptic, less than 3 cm. long.
Leaflets firm; prickles few. — 21. *R. ultramontana.*
Leaflets thin; prickles numerous. — 22. *R. gratissima.*
Sepals ovate, less than 1 cm. long, not conspicuously caudate; leaflets glandular-double-toothed, glabrous or slightly glandular-granuliferous beneath. — 23. *R. Bolanderi.*
Hypanthium elongate, with a distinct neck.
Hypanthium glabrous.
Leaves finely puberulent beneath; fruit elliptic; plant unarmed or nearly so. — 24. *R. Pringlei.*
Leaves glabrous; fruit urn-shaped; prickles rather stout, flattened below. — 25. *R. Copelandii.*
Hypanthium pilose when young, ellipsoid; leaves pilose, densely so and glandular-granuliferous beneath. — 26. *R. pilifera.*
Hypanthium densely bristly or prickly.
Leaflets thin, usually more than 1.5 cm. long, not glaucous; sepals more than 1 cm. long.
Leaflets densely glandular-granuliferous beneath; teeth usually lanceolate in outline. — 27. *R. granulata.*
Leaflets sparingly glandular-granuliferous beneath; teeth ovate in outline. — 28. *R. spithamaea.*
Leaflets firm, glaucous, less than 1.5 cm. long; sepals less than 1 cm. long. — 29. *R. sonomensis.*

III. MINUTIFOLIAE

One species. — 30. *R. minutiflora.*

IV. GYMNOCARPEAE

Leaves glabrous beneath; prickles very slender.
Flowers usually solitary, not leafy-bracted; stipules narrow; leaflets with lanceolate teeth; fruit 6 mm. in diameter or less.
Leaflets 5–7, usually more than 1.5 cm. long, the terminal one rounded at the base. — 31. *R. gymnocarpa.*
Leaflets 7–9, usually less than 1.5 cm. long, the terminal one usually acute or cuneate at the base. — 32. *R. prionota.*
Flowers mostly 2–4 together, leafy-bracted; upper stipules broadly dilated; leaflets with broadly ovate teeth; fruit 6–8 mm. broad. — 33. *R. dasypoda.*
Leaves pubescent beneath; prickles usually stouter. — 34. *R. Bridgesii.*

I. CANINAE. The members of this group are natives of the

Old World and are represented in this country by a few introduced species.

1. ROSA RUBIGINOSA L. Mant. 2: 564. 1771

The sweet brier is often cultivated and has escaped in many places in this country. In some parts of the eastern United States it is thoroughly naturalized. On the western coast it has established itself in several places in Oregon and Washington, but the writer has seen herbarium specimens only from one place in California. On account of its stout prickles it has been confused with *R. nutkana*, to which it has no close relationship.

CALIFORNIA: Yreka, 1910, *Geo. D. Butler 1427, 1802.*

II. CINNAMOMIAE. This group is represented in California and Nevada only by species of the true Cinnamomiae, i. e., species with infrastipular spines usually present.

2. ROSA NUTKANA Presl, Epim. Bot. 203. 1849

Although an easily distinguished species, except from the next two species, it has been mistaken for *R. fraxinifolia* Borkh. (i. e., *R. blanda* Ait.) and *R. Woodsii* Lindl. It has also been named *R. caryocarpa* Dougl. and *R. Lyalliana* Crépin, but these names have not been published except in synonymy. *R. aleutensis* Crepin is probably an unarmed form of this species. *R. nutkana* is distributed from Alaska to northern Wyoming and Oregon. It has also been reported from northern California, but the writer has no definite locality cited. Perhaps the record is based on specimens belonging to either of the next two species.

3. ROSA MURICULATA Greene, Leaflets 2: 263. 1912

This species is closely related to *R. nutkana* and perhaps not specifically distinct. It differs in the thicker and smaller leaves densely glandular-muricate beneath and in the often corymbose inflorescence. It ranges from British Columbia to northern California.

CALIFORNIA: Mad River, Humboldt County, 1878, *Violet Rattan;* Arcàta, Humboldt County, 1899, *Dudley.*

4. **Rosa Brownii** Rydberg, sp. nov.

Stem slender, terete, glabrous, green or brownish, armed with slender straight prickles which are 5–8 mm. long, terete except the expanded depressed base; leaves five- to seven-foliolate; stipules ovate, acute; petiole and rachis finely pilose and more or less glandular; leaflets thin, 1–3 cm. long, serrate with some of the teeth double, broadly oval, acute at the apex, glabrate above, paler, pilose and slightly glandular-muricate beneath; flowers mostly solitary; pedicels 1–2 cm. long, glabrous; hypanthium globose, glabrous, in fruit about 12 mm. in diameter; sepals lanceolate, caudate-acuminate, usually with foliaceous tips, about 2 cm. long, glabrate on the back, tomentose and slightly glandular-hispid around the margins, and tomentose within; petals broadly obovate, rose-colored, 1.5–2 cm. long; styles distinct, persistent, not exserted; achenes inserted both on the inside and in the bottom of the hypanthium.

This species resembles somewhat *R. nutkana*, but the prickles are weak, not at all flattened, and the petioles, rachis and lower surface of the leaflets decidedly pilose. Much of the Californian material determined as *R. nutkana* belongs here.

CALIFORNIA: North side of Mt. Shasta, 1897, *H. E. Brown 349* (type, in the herbarium of the New York Botanical Garden); Humboldt Bay, 1901, *Chandler 1198;* Mendecino, 1903, *McMurphy 270.*

5. ROSA CALIFORNICA Cham. & Schlecht. Linnaea 2: 35. 1827

The original *R. californica* is characterized by its stout, flat, usually curved prickles, corymbose flowers, and its leaflets which are villous on both sides, usually simple-toothed and rarely slightly, if at all, glandular. The hypanthium is usually ovoid with a distinct neck. It is not uncommon throughout California, and two specimens have been seen from Lower California.

LOWER CALIFORNIA: San Ysidro Ranch, *Mearns 3865* (peculiar form); between Tio Juana River and Laguna, *Mearns 3504.*

6. ROSA ALDERSONII Greene, Pittonia 5: 110. 1903

This species differs from *R. californica* in the doubly serrate leaflets which are conspicuously glandular-granuliferous and only slightly, if at all, pubescent beneath. The first one to recognize it as different from the typical *R. californica* was C. A. Meyer, who called it *R. californica Petersiana.** Crépin changed the varietal name to *glandulosa.*† He also gave *R. Aschersoniana* Crépin as a synonym. *Rosa Aldersonii* was described from a specimen, not quite of the usual form, having small, more rounded leaflets, short prickles and congested inflorescence. *Rosa Breweri* Greene‡ is, in my opinion, only a stunted and somewhat abnormal form of this species, with densely glandular pedicels and more hairy leaves. *R. Aldersonii* is, besides, very variable, usually with a subglobose hypanthium, with a distinct neck, but sometimes with a somewhat ellipsoid hypanthium. It also varies in having larger or smaller leaflets and with numerous or few flowers. Sometimes the styles are more or less exserted. It is fully as common as the preceding throughout California.

7. **Rosa Greenei** Rydberg, sp. nov.

Stem rather slender, 1 m. or so high, purplish, glabrous, armed with curved infrastipular prickles, which are more or less flattened, 3–6 mm. long; leaves five- to seven-foliolate; stipules narrow, 1–1.5 cm. long, densely glandular-puberulent; petiole and rachis glandular-puberulent and somewhat prickly; leaflets elliptic, acute at both ends, 2–4 cm. long, glandular-double-toothed, puberulent above, glandular-puberulent and slightly pilose beneath; inflorescence corymbiform or paniculate; pedicels 1–2 cm. long, glandular-puberulent; hypanthium elongate-ellipsoid, with a distinct neck, in fruit 2 cm. long and 1 cm. in diameter; sepals lanceolate, caudate-acuminate, about 2 cm. long, glandular-hispid on the back, tomentose within, in fruit persistent and erect; petals about 15 mm. long, rose-colored; styles distinct, persistent, not exserted.

This is related to *R. Aldersonii*, but differs in the narrower leaflets and the decidedly ellipsoid hypanthium, with a long neck.

CALIFORNIA: Santa Cruz Island, July and August, 1886, *E. L. Greene* (type, in the United States National Herbarium); apparently also San Mateo, *Heller 8582*.

8. **Rosa brachycarpa** Rydberg, sp. nov.

Stem apparently tall, stout, purple, armed with curved flattened infrastipular prickles, which are about 5 mm. long; leaves mostly seven-foliolate; stipules not strongly dilated, 1–1.5 cm. long,

* Zintr. 19. 1848.

† Bull. Soc. Bot. Belg. 15: 52. 1876.

‡ Leaflets 2: 262. 1912.

glandular-ciliate on the margins and glandular-puberulent on the back; petioles and rachis glandular-puberulent and slightly prickly; leaflets elliptic or narrowly oval, mostly acute at both ends, rather evenly serrate, with broad, occasionally double, and gland-tipped teeth, conspicuously glandular-puberulent and slightly pilose beneath, 2–4 cm. long; inflorescence rather many-flowered, corymbiform; pedicels about 1 cm. long, glabrous or nearly so; hypanthium depressed-globose, without a neck; sepals ovate, caudate-acuminate, about 1.5 cm. long, glabrous on the back, villous on the margins and tomentose within; in fruit erect and persistent; petals about 15 mm. long; styles distinct, persistent, decidedly exserted.

This species is also related to *R. Aldersonii*, but differs from all the other relatives of *R. californica* in the hypanthium lacking the neck, and in the decidedly exserted styles.

CALIFORNIA: Temescal Cañon, near Elsinore, May 23, 1892, *McClatchie* (type, in the herbarium of the New York Botanical Garden).

9. ROSA PINETORUM Heller, Muhlenbergia 1: 53. 1904

This species has been collected only in the neighborhood of the type station, that is around Monterey Bay. The following specimens have been seen.

CALIFORNIA: Pacific Grove, *Heller 6817;* 1907, *Patterson & Wiltz;* 1908, *L. E. Cox;* Point Pinos, *Heller 8413;* Monterey, *Parry.*

10. ROSA CALAVERA Greene, Leaflets 2: 257. 1912

This was included in the *R. gymnocarpa* group by Dr. Greene, perhaps on account of the shape of the leaflets and the small flowers, but the sepals and style are persistent and it is more nearly related to *R. pinetorum*, differing in the small flowers and the leaflets which are pale beneath. While *R. pinetorum* is confined to the coast, this species belongs to the Sierra Nevada.

CALIFORNIA: Calveras Big Tree Grove, *E. L. Greene;* Tulare County, *Dudley*, at the following localities: Second Dry Meadow Creek, Kern River, 1895; Board Camp, 1902; Keweath River Valley, 1896, *1385*, *1367*, *1313a;* Redwood Meadow, Alta Peak, 1896, *1642;* Coffee Pot Camp, 1897, *1765;* Hollow Log Camp, 1900; east of Sequoia Grove.

11. **Rosa santae-crucis** Rydberg, sp. nov.

Stem 1–2 m. high, dark reddish-brown, glabrous, armed with straight stout infrastipular prickles about 1 cm. long and more or less flattened; leaves mostly five-foliolate; stipules 1.5–2 cm. long, pubescent as well as densely glandular-muricate, more or less lobed; free portion ovate, obtuse; petiole and rachis villous and glandular-puberulent; leaflets rounded-oval, 1–3 cm. long, rounded at each end, rather simply serrate, with broad ovate teeth, pilose and glandular-puberulent above, villous and conspicuously glandular-muriculate beneath; inflorescence corymbose, many-flowered, leafy-bracted; pedicels short; hypanthium globose, pilose when young, in fruit 12–15 mm. in diameter; sepals lanceolate, caudate-attenuate, 15–20 mm. long, villous and glandular-hispid, erect and persistent in fruit; styles included, distinct, persistent; achenes inserted both in the bottom and on the inside of the hypanthium.

This species suggests closely *R. Aldersonii* and its relatives, but the prickles are straight.

CALIFORNIA: island of Santa Cruz, 1886, *E. L. Greene* (in the Greene herbarium).

12. **Rosa Dudleyi** Rydberg, sp. nov.

A low shrub 3–5 dm. high; branches reddish or greenish, armed with infrastipular straight prickles 5–10 mm. long, somewhat flattened below, and with smaller scattered prickles on the new shoots; leaves usually five- to seven-foliolate; stipules narrow, glandular-puberulent and conspicuously glandular-dentate; free portion lanceolate; leaflets rounded-oval, or the terminal one rounded-obovate, 1–2 cm. long, conspicuously double-serrate with gland-tipped teeth, pubescent on both sides and glandular-puberulent and somewhat paler beneath; flower corymbose; hypanthium glabrous, subglobose, in fruit about 1 cm. broad; sepals densely puberulent on both sides, grayish within, glandular-ciliolate, in age 12–15 mm. long, caudate-acuminate; petals about 1 cm. long.

In general appearance it resembles somewhat *R. sonomensis* and *R. Bridgesii*, but differs from the former in the glabrous, not bristly, hypanthium and from the latter in the persistent styles and sepals, the stouter spines, and larger subglobose fruit. It is most closely related to *R. calavera*, but differs in the thicker, more hairy leaves and stouter prickles.

CALIFORNIA: near Booles Home, Converse Basin, Fresno

County, October 16, 1900, *Dudley 3388* (in the Dudley herbarium, Leland Stanford University).

13. ROSA RIVALIS Eastw. Bull. Torrey Club 32: 198. 1905

This species is related to *R. Woodsii* and *R. pisocarpa*, but its leaflets are much larger, broader and thinner, broadly oval, sometimes almost orbicular and perfectly glabrous beneath. They resemble somewhat those of *R. myriantha*, which, however, has pubescent leaves. I have not seen the type of this species but showed Kellogg & Harford's No. 226 to Miss Eastwood, and she said that she regarded the same as typical *R. rivalis*. In the Missouri Botanical Garden herbarium, the locality of this number is given as San Francisco. This is probably wrong. In the herbarium of the New York Botanical Garden, Kellogg's field label is present, which reads: "Rosa. Long Valley, June 11, 1869, red, 7 or 8 feet high—along shady rivulet—Kellogg." According to Miss Eastwood, Long Valley is not very far from the type locality of *R. rivalis*. A form with leaves somewhat pubescent beneath and somewhat glandular petioles was collected by Mrs. Austin (No. 400) at Mill Creek, California. The following belong to *R. rivalis:*

CALIFORNIA: Long Valley, *Kellogg & Harford 226;* Placer County, 1893, *Mrs. Hardy* (on this sheet Crépin has written: "N'est pas le *R. spithamaea* Wats., ou le *californica*, etc.").

OREGON: Cold Spring, Crook County, 1898, *Coville & Applegate 131*.

14. **Rosa chrysocarpa** Rydberg, sp. nov.

Stem tall, 1–3 m. high, terete, at first light yellowish green, later grayish brown, armed with straight prickles, somewhat retrorse, terete, 3–7 mm. long, usually more or less flattened at the very base, some of them infrastipular, others scattered, of various lengths; young shoots copiously armed with bristle-like prickles; floral branches 1–2 dm. long, armed with mostly infrastipular prickles; stipules adnate, glabrous, 1–2 cm. long, the lower narrow, the upper dilated, glandular-dentate or ciliate on the margins; petiole and rachis glabrous, sometimes with a few prickles; leaflets five to seven, elliptic or oval, thin, glabrous on both sides, yellowish green, coarsely serrate throughout, petioluled, 1–4 cm. long; flowers corymbose, leafy-bracted; pedicels 1–2 cm. long, glabrous; hypanthium globose, glabrous, at first light-green, in fruit about 1 cm.

thick and orange; sepals lanceolate, caudate-attenuate, about 1.5 cm. long, glabrous or nearly so on the back, tomentose on the margins and within, in fruit erect and persistent; styles distinct, persistent, not exserted; achenes inserted both in the bottom and on the inside of the hypanthium.

This species is related to *R. Woodsii*, but differs in the yellowish green leaflets, sharply serrate with teeth directed forward, the orange fruit and usually many-flowered corymbs. The following belong here:

UTAH: Allen Cañon, 1911, *Rydberg & Garrett 9302* (type, in the herbarium of the New York Botanical Garden); Logan, *Miss Mulford 189*.

IDAHO: Castford, 1912, *Nelson & Macbride 1749;* Rock Creek, 1911, *Macbride 1375;* King Hill, 1912, *Nelson & Macbride 1109*.

NEVADA: Franktown, *Kennedy 1935;* Kings Cañon, *Baker 1221*.

CALIFORNIA: Dutch Flat, Placer County, 1909, *Dudley*.

15. ROSA MOHAVENSIS Parish, Bull. So. Calif. Acad. 1: 87. 1902

This was originally described as *R. californica glabrata* Parish. Parish overlooked the fact that there was an older *R. californica glabrata* Crépin. The present species is not related to *R. californica* but to *R. Woodsii*, from which it differs in the shining, elliptic instead of obovate, leaflets.

CALIFORNIA: Cushenberry Spring, *Parish 4941;* Aqueduct, Amador County, *Hansen 1813*, in part; Southern California, *Elmer 3732; Abrams 2821*.

16. ROSA MYRIANTHA Carr. Rev. Hort. 1865: 448. 1865

This species, not uncommon in California, has generally been overlooked. Crépin, apparently not knowing it very well, admitted it as a variety *glabra* of *R. californica*, notwithstanding the fact that it has straight prickles. Regel described it under the name *R. californica*. From his treatment it is not evident that he even knew of the existence of *R. californica* Cham. & Schlecht., but it is evident that he was not familiar with it. The following specimens belong to *R. myriantha:*

CALIFORNIA: Eel River, *Heller 6044;* Red Reef Cañon, *Abrams & MacGregor 135;* Goose Lake, *Mrs. Austin 455;* "California," *Kuntze 3205;* Berry Cañon, *Heller & Brown 5546;* Butte County, *Mrs. Austin 1800; Colby 752;* Sonoma County, *Heller 5678;* Little Chico, *Mrs. Austin 1807;* Round Valley, *Chestnut 212;* San Diego County, *Abrams 3763;* Laguna, *Mearns 36050; Schoenfeldt 3598;* Dulzura & El Mido, *Mearns 3879;* Witch Creek, San Diego County, *Abrams 4914.*

OREGON: Barlow Gate, *Lloyd;* Lower Albina, Portland, *Sheldon 10659;* Wimmer, *Hammond 119*, in part.

17. **Rosa Davyi** Rydberg, sp. nov.

Stem stout, 5–10 m. long, glabrous, armed with numerous stout prickles flattened below; leaves five- to seven-foliolate; stipules broad, 1–1.5 cm. long, glandular-dentate on the margin, densely villous, free portion lanceolate to ovate; rachis and petiole villous and sometimes glandular-hispid, usually with a few prickles; leaflets broadly oval, 1–2.5 cm. long, rather firm, rounded at both ends, coarsely and simply serrate, short-pilose above, villous beneath; flowers two or three together or solitary; pedicels 1–2 cm. long; hypanthium globose, glabrous, in fruit 15 mm. in diameter, purple; sepals lanceolate, caudate-acuminate, 15 mm. long or more, villous on the back, tomentose within, erect and persistent in fruit; petals about 2 cm. long, obcordate; styles persistent, distinct, not exserted.

Rosa Davyi resembles *R. californica* in the leaf-form, but the prickles are long, straight and very numerous. It is a rare species. Greene collected a specimen without flower or fruit, which was nearly 7 m. high, at San Joaquin. The prickles are straight, flat, and nearly 1 cm. long. It evidently belongs here.

CALIFORNIA: Saratoga, *Davy 263* (type, in the herbarium of Columbia University); Mendocino, *McMurphy 270.*

18. **Rosa rotundata** Rydberg, sp. nov.

A stout shrub, more than 5 dm. high; new canes copiously armed with slender, straight, almost terete prickles, 5–10 mm. long; branches red or purplish, with smaller infrastipular and scattered prickles; leaves mostly five- to seven-foliolate; stipules large, lance-ovate, puberulent on both sides, conspicuously glandular-denticulate, 1–1.5 cm. long; leaflets rounded, oval or suborbicular, 1–1.5 cm. long and nearly as broad, finely puberulent on both sides, coarsely crenate-serrate with broad teeth; flowers corymbose; hypanthium round-ellipsoid or globose, with a short neck; sepals ovate, caudate-acuminate, about 8 mm. long, villous within and on the margins; petals 8–10 mm. long.

This species is related to *R. pisocarpa* and *R. ultramontana*, but differs in the shorter and broader thicker leaflets, the more prominent armature, and the small flowers.

NEVADA: mountains west of Franktown, 1912, *Heller 10520* (type, in the herbarium of the New York Botanical Garden).

19. ROSA PISOCARPA A. Gray, Proc. Am. Acad. 8: 382. 1872

Professor Crépin badly misunderstood this species. Nearly anything with a small hypanthium he referred to it. Specimens of *R. Woodsii*, *R. Fendleri*, *R. ultramontana*, together with two undescribed species, and even *R. Engelmanni* we find determined as *R. pisocarpa* by him. It belongs purely to the Columbia Valley region and is not found in the Rocky Mountain states. It is characterized by the elliptic or oval leaflets, finely puberulent beneath, the comparatively short and glandular sepals, the numerous flowers and short ascending straight prickles.

The only specimen from California seen by the writer is one collected by Mrs. Austin without definite locality.

20. **Rosa salictorum** Rydberg, sp. nov.

Stem slender, 3–5 m. high or in open places lower, unarmed or nearly so, except the new shoots, which are bristly at the base; infrastipular spines seldom present; leaves five- to seven-foliolate; stipules adnate to the petioles, 1.5–2 cm. long, the upper dilated, more or less toothed, finely puberulent; petioles and rachis unarmed, puberulent; leaflets broadly oval, coarsely and evenly serrate, thin, equally green on both sides, glabrous above, finely puberulent beneath, rounded or acute at both ends, 2–4 cm. long; flowers corymbose, conspicuously leaf-bracted; pedicels glabrous; hypanthium glabrous, globose, contracted above, in fruit about 1 cm. broad; sepals lanceolate, caudate-acuminate, about 15 mm. long, glabrous on the back, tomentose within and on the margins, erect and persistent in fruit; petals pink, about 15 mm. long; styles distinct, persistent, not exserted.

This species is related to *R. pisocarpa* and *R. ultramontana*, but differs from both in the large, thin, broadly oval leaflets and the few slender prickles. It is almost unarmed except on the new shoots. From *R. pisocarpa* it also differs in the non-glandular sepals.

NEVADA: Gold Creek, July 25, 1912, *Nelson & Macbride 2113* (type, in the herbarium of the New York Botanical Garden), also *2113;* McDonalds Creek, *2156;* Owyhee River, *2196;* Big Creek, Lander County, *Kennedy 4106, 4544;* Martin Creek, 1913, *4491;* Star Canyon, southeast of Death, *Heller 10570.*

21. ROSA ULTRAMONTANA (S. Wats.) Heller, Muhlenbergia 1: 107. 1904

This was first described as *R. californica ultramontana* S. Wats.,* but is not at all related to that species. It is closely related to *R. pisocarpa* and distinguished from that mainly by the sepals which are not at all glandular. It belongs to the Great Basin, is rather common in Nevada as well as Idaho and eastern Oregon, but not so common in California. The following specimens have been seen.

CALIFORNIA: Little Grizzly Creek below Genessee, Plumas County, 1907, *Heller & Kennedy;* Hornbrook, 1909, *Rusby;* Lake Tahoe, 1909, *Dudley;* Hot Springs, Sierra Valley, 1909, *Dudley;* El Dorado County, 1900, *Dudley.*

22. ROSA GRATISSIMA Greene, Fl. Franc. 73. 1891

To this belong the following specimens:

CALIFORNIA: Griffins, *Elmer 3732;* South Fork of Kings River, 1899, *Eastwood;* Bear Valley, *Abrams 2821;* Water Cañon, *Abrams & MacGregor 482;* Sky Valley, *Culbertson 4873;* Long Pine, 1897, *M. E. Jones;* Bear Valley, *Hall 1324* (?); Colby, *Mrs. Austin* (?); South Fork of Santa Anna, *Grinnell 232;* San Bernardino Mountains, *Parish 3274;* North Fork of Kern River, *V. Bailey 1720;* Big Arroya, Soda Springs Trail, Tulare County, *Dudley 2307;* Glenbrook, near Lake Tahoe, 1906, *Dudley;* Lookwood Creek, Mount Pinos Region, *Dudley & Lamb 4634.*

* Bot. Calif. 1: 187. 1876.

23. Rosa Bolanderi Greene, Leaflets 2: 261. 1912

This species is related to the *R. Covillei* of Oregon, but the leaflets are thinner, glandular, double-toothed and decidedly glandular-pruinose beneath. Crepin determined the type as *R. gymnocarpa* with the remark that the sepals were persistent. Dr. Greene also classified it in the *Gymnocarpae*, but it evidently does not belong there.

California: Oakland, *Bolander*.

24. **Rosa Pringlei** Rydberg, sp. nov.

Stem dark gray, 1 m. high or more, terete, slender, sparingly armed with small straight infrastipular prickles, 3–5 mm. long, or wholly unarmed; branches 1–3 dm. long, usually unarmed; stipules adnate, rather narrow, 1 cm. long or less, densely and finely puberulent on the back; the free portions lanceolate, ascending, spreading, slightly glandular-ciliate; petiole and rachis densely puberulent, not at all glandular; leaflets five or seven, elliptic, 2–3 cm. long, acutish at both ends, rather firm, finely puberulent on both sides, densely so, almost velvety, and paler beneath; flowers corymbose, two to five together; pedicels 1–2 cm. long, glabrous; hypanthium ellipsoid, acute at the base, above produced into a distinct neck, glabrous, in fruit 9–10 mm. thick, 12–14 mm. long, dark-purple; sepals lanceolate, caudate-attenuate, 12–15 mm. long, finely puberulent, in fruit erect and persistent; achenes inserted both in the bottom and on the insides of the hypanthium.

This is related to *R. pisocarpa*, *R. ultramontana* and *R. Macounii*. The leaves are dark green above, finely toothed with rather blunt teeth and the hypanthium is decidedly ellipsoid, with a neck. The plant is almost unarmed. The type in the Columbia University herbarium has no prickles, but the same number in the United States National Herbarium has a single straight prickle about 5 mm. long. This was determined as *R. pisocarpa* by Crépin. Suksdorf's specimen is unarmed and Sheldon's has only a few prickles.

California: Siskiyou County, 1882, *Pringle* (type, in the herbarium, Columbia University); 1910, *G. D. Butler 1352;* Vicinity of Rawhide, 1905, *Roxana Stinchfield 25*, in part; near Stirling, 1913, *Heller 10801*.

Washington: Klickitat County, 1885, *Suksdorf*.

Oregon: Wallowa River, 1897, *Sheldon 8687*(?).

25. **Rosa Copelandii** Greene, sp. nov.

Stem dark purple, terete, shining, sparingly armed with straight infrastipular prickles, which are about 5 mm. long, rather stout and somewhat flattened below; floral branches 1–2 dm. long, purple, more or less armed; stipules 1–2 cm. long, adnate, glabrous, more or less dilated, thin, often tinged with purple; free portion semi-lunate, acuminate; petiole and rachis glabrous, often slightly prickly, purplish; leaflets five or seven, oval or elliptic, thin, perfectly glabrous on both sides, finely serrate, 1–3 cm. long; flowers corymbose; pedicels glabrous, short, 1–1.5 cm. long; hypanthium glabrous, urn-shaped, rounded at the base, prolonged above into a distinct neck, in fruit 9–10 mm. thick, 10–12 mm. long; sepals lanceolate, about 15 mm. long, caudate-attenuate, glabrous on the back, tomentose on the margins, in fruit erect and persistent; achenes inserted in and near the bottom of the hypanthium.

Dr. Greene recognized this species, but for some reason did not publish it. It is characterized by its ovoid urn-shaped hypanthium, with a conspicuous neck, and glabrous leaves.

CALIFORNIA: Mt. Eddy, Siskiyou County, September 8, 1903, *Copeland* [Baker's distribution number] *3875*.

26. **Rosa pilifera** Rydberg, sp. nov.

Stem 1 m. high or more, at first yellowish, in age dark gray, terete, armed with straight infrastipular and scattered prickles 3–5 mm. long, somewhat flattened below; floral branches 1–3 dm. long, usually sparingly armed; stipules adnate, the lower narrow, the upper dilated, 1–1.5 cm. long, pilose and glandular on the back, glandular-ciliolate on the margins; free portion linear-lanceolate to ovate, ascending; petiole and rachis pilose, glandular and sometimes with a few weak prickles; leaflets five to seven, thin, oval, 2–3.5 cm. long, sparingly pilose above, more densely so and somewhat glandular-pruinose beneath, usually more or less double-toothed and the teeth often gland-tipped; flowers corymbose; pedicels 1–3 cm. long, more or less pilose; hypanthium ellipsoid, with a neck, pilose at least when young, in fruit 8–10 mm. thick, 12–15 mm. long; sepals lanceolate, caudate-attenuate, 1.5 cm. long, more or less pilose, in fruit erect; petals about 1.5 cm. long; styles distinct, persistent, not exserted.

This species has the leaflets of *R. Aldersonii*, i. e., double-toothed and glandular beneath, but they are thinner, the prickles are slender, straight, or rarely slightly curved, and the young hypanthium at least is covered with fine soft hairs. The following belong here:

CALIFORNIA: San Francisco, *Dr. Bolander* (type, in the herbarium of Columbia University); Berkeley, *Burt Davy 854;* Pine Grove, Amado County, *George Hanson 7310;* no locality, *Kellogg & Harford 225* in part; Sierra National Forest, 1912, *Abrams 4969.*

27. ROSA GRANULATA Greene, Leaflets 2: 262. 1912

This is closely related to *R. spithamaea*, but differs in the more glandular leaves and narrow teeth. Perhaps not specifically distinct. It is known only from the type collection at San Luis Obispo.

28. ROSA SPITHAMAEA S. Wats. Bot. Calif. 2: 444. 1880

This is a rather local species characterized by its almost herbaceous stems, slender prickles and bristly receptacle.

CALIFORNIA: Trinity River, between Hyampore and Hooper, 1878–1883, *Rattan;* Trinity Mountains, *Marshall;* Lake County, 1902, *Heller;* "California," *Torrey.*

OREGON: Wimmer, *Hammond 120.*

29. ROSA SONOMENSIS Greene, Fl. Franc. 72. 1897

This is related to *R. spithamaea*, but differs from the other Californian species with prickly fruit in the firm glaucous leaves the densely prickly stem, and the short sepals.

CALIFORNIA: Petrified Forest, Sonoma County, 1883, *Greene;* Mount Tamalpais, *V. Bailey 531;* 1885, *Rattan;* Converse Basin, Fresno County, 1904, *Dudley.*

III. MINUTIFOLIAE. This group is represented by the following species and by two species in New Mexico.

30. ROSA MINUTIFOLIA Engelm. in Parry, Bull. Torrey Club 9: 97. 1882

This species is a native of Lower California and may be expected in San Diego County, California.

LOWER CALIFORNIA: Todo Santos Bay, *Parry*, *Pringle*, *Orcutt;* Ensenada, *M. E. Jones 3697*, *Anthony 189;* San Quentin Bay, *Palmer 619*.

IV. GYMNOCARPAE. This is a little group of species all confined to the North American Pacific coast.

31. ROSA GYMNOCARPA Nutt.; Torrey & Gray, Fl. N. Am. 1: 461. 1840

Until recently only one species, *Rosa gymnocarpa* Nutt., and one variety, var. *pubescens* S. Wats., have been admitted to this group. *R. gymnocarpa* ranges from British Columbia to Montana, Idaho and California. Dr. Greene in one paper* described not less than twelve species which he regarded as belonging to this group and seven more related to it but "not at all gymnocarpous." It is impossible for me to follow him in his segregation of *Rosa gymnocarpa*, and several of his "gymnocarpous" species do not belong to the group at all.

The Greenian species really belonging to the *Gymnocarpae* are the following: *R. glaucidermis*, *R. crenulata*, *R. prionata*, *R. piscatoria*, *R. abietorum*, *R. amplifolia*, *R. leucopsis*, *R. Helleri*, *R. apiculata*, and *R. dasypoda*. Of these the only clearly distinct species is *R. crenulata*, which, however, has an older name, *R. Bridgesii* Crépin. Of the others I have retained as tentative species *R. prionata*, *R. leucopsis* and *R. dasypoda*, but none of these are too good as species. They are fairly good varieties, but the rest are hardly worth naming even as forms. As most of them belong to the Columbia Valley region, I shall discuss them further in a subsequent paper and only mention those found in California.

32. ROSA PRIONOTA Greene, Leaflets 2: 256. 1912

The species is distinguished from *R. gymnocarpa* by the small and often more numerous (seven to nine instead of five to seven) leaflets with narrower and sharper teeth. The terminal leaflet is usually cuneate at the base instead of rounded. The fruit is described as globose. Both in this species and in *R. gymnocarpa* the immature hypanthium is ellipsoid. If only one

* Leaflets 2: 254–261. 1912.

to three achenes are developed, it remains so even at maturity, but if more achenes develop the fruit becomes pear-shaped or globose. The form of the fruit is, therefore, no specific character. *R. apiculata* Greene and *R. piscatoria* are forms of this species. The former will be discussed in a subsequent paper. The latter represents a strong more bristly form of *R. prionota*.

Rosa prionota is more common in California than the typical *R. gymnocarpa*.

33. ROSA DASYPODA Greene, Leaflets 2: 260. 1912

This is perhaps a good species. I had segregated out the same as such, although I had assigned as the type a Californian specimen which shows the characters better than Dr. Greene's type. The flowers are nearly always corymbose, i. e., two to four together and leafy-bracted, the leaflets thicker and not with semi-pellucid veins, the teeth broader and more rounded, and the fruit is larger, 6–8 mm. instead of 4–6 mm. in diameter.

It ranges from British Columbia to northern California, where it is represented by the following specimens:

CALIFORNIA: Siskiyou County, *Copeland* [Baker's distribution number] *3874*.

34. ROSA BRIDGESII Crépin, Bull. Soc. Bot. Belg. 15: 54. 1876

This is a good species and is the same as *R. gymnocarpa pubescens* S. Wats.* and *R. crenulata* Greene.† Crépin gave this species a short description, but later, after seeing Watson's treatment of the same, retracted and reduced it to a variety. I was a little doubtful whether the name *R. Bridgesii* belonged to this species or to *R. sonomensis* or to some related species, but Miss Eastwood, who has seen the type of *R. Bridgesii*, has told me that it is the same as *R. gymnocarpa pubescens* S. Wats. The following specimens have been seen from California:

CALIFORNIA: *Bridges 95;* Pine Ridge, Fresno County, *Chandler 171; Baker 5500;* Silver Mountain Pass, *Brewer 1915;* Havelock, Kern County, *Grinnell 217;* Tuolumne Big Trees, 1911, *Abrams 4701;* Shut Eye Pass, 1912, *4928;* Yosemite Park, 1915, *5407*.

* Bot. Calif. 1: 187. 1876.

† Leaflets 2: 255. 1912.

There are, in the collections examined, a few specimens from Nevada and the Klamath region of California which can not be referred to any of the species treated above. Some of these may be referred to *R. Macounii*, but the localities are out of the known range of that species. The rest may belong to two or three apparently undescribed species from the Columbia Valley and the Great Basin, but the limitations of these species are still unsettled.

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CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 197

NOTES ON NORTH AMERICAN SPECIES OF RICCIA

By MARSHALL A. HOWE

NEW YORK
1917

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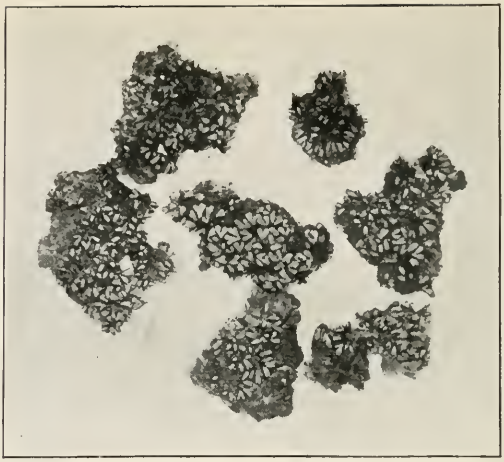

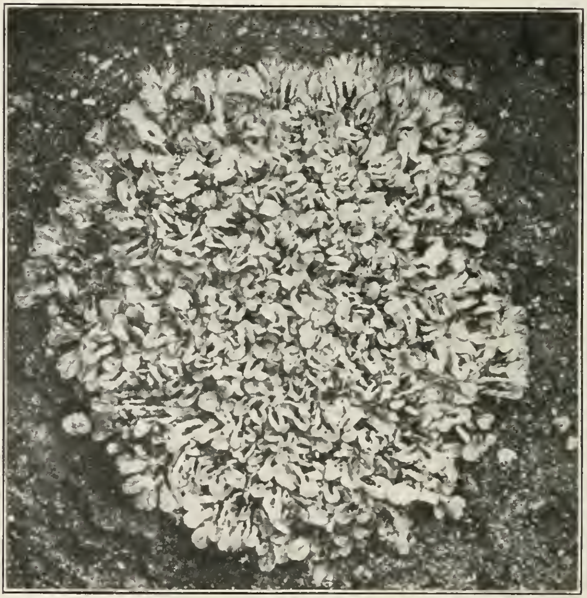

EXPLANATION OF PLATE III

1. *Riccia violacea* M. A. Howe. Photograph, natural size, of specimens collected on Cayo Muertos, Porto Rico, March 9–12, 1915, by Britton, Cowell and Brown (*no. 5089*). The specimens, still living, though dried for about ten weeks, were soaked out and photographed on May 20, 1915.

2. *Riccia McAllisteri* M. A. Howe. Photograph, natural size, taken in October, 1914, of type specimens grown at The New York Botanical Garden; original from Granite Mt. (about 70 miles northwest of Austin), Texas, collected by F. McAllister (*no. 3*) in May, 1914.

NOTES ON NORTH AMERICAN SPECIES OF RICCIA*

MARSHALL A. HOWE

(with plate iii)

RICCIA BEYRICHIANA Hampe and RICCIA LESCURIANA Austin

Riccia Beyrichiana I have discussed briefly on two former occasions,[1] but will here review some of the main points in its history, even at the risk of repeating some of the things that have elsewhere been said about it. The species was originally described in Lehmann's "Pugillus Septimus", published in Hamburg in 1838. The name was attributed to "Hampe Ms". It is probable, however, that the description was written by Lindenberg, whose classical monograph of the Ricciaceae had been published two years earlier, though Lindenberg's name appears only in the preface to Lehmann's work. The plant is said to have been collected in North America, between Jefferson and Gainesville, by a German botanical traveler, Beyrich. From what is known of Beyrich's travels it is evident that the Jefferson and Gainesville in question are in northern Georgia, where towns bearing these names are county seats about twenty miles apart. Until recent years *Riccia Beyrichiana* remained apparently unknown except from the original description. In some critical notes on the American species of *Riccia*, published by Professor Underwood in *The Botanical Gazette* in 1894, *Riccia Beyrichiana* was omitted on the ground that there was no recent evidence that it was a member of our flora. In 1898, however, Stephani, in his Species Hepaticarum[2] stated that he had seen Beyrich's plant, that it was collected in Jefferson, North America, and that it is doubtless a good species. And he gives a new description of it. Three years later, in 1901, I wrote to the Naturhistorisches Hofmuseum in Vienna, where the Lindenberg herbarium is preserved, and secured for study the pocket containing the apparent type of the species. I then published some notes on it, expressing the opinion that the species was a valid one and adding to the previous descriptions a more detailed account of the spores. Three years ago, after the meeting of the American Association for the Advancement of Science and the Botanical Society of America at Atlanta, Georgia, I took advantage of the opportunity to visit Jefferson and Gainesville and some of the intervening territory, with the hope and purpose of rediscover-

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[1] Bull. Torrey Club **28**: 161–165. 1901.
Jour. N. Y. Bot. Gard. **15**: 60–63. 1914.

[2] Bull. Herb. Boiss. **6**: 318.

* Abstracted and revised from an illustrated paper presented under a slightly different title before the Sullivant Moss Society at its New York meeting, December 29, 1916.

ing this long-lost species. I did not find it at just those points, but at Athens, Georgia, in the same general region, I did find what I took to be it and so announced the rediscovery of the species. Since that time, however, I have felt that there were difficulties in the way of distinguishing the Georgian *Riccia Beyrichiana* from *R. Lescuriana*, which was described from New Jersey in 1869 and has since been reported from as far south as Florida, as far west as California, and has been alleged to occur in Europe also.

At the time of examining the original material of *Riccia Beyrichiana*, the thallus seemed to me so much smaller than that of *R. Lescuriana* as I then knew it, while the spores were so much larger and so much more opaque, that it hardly occurred to me that the two were closely related. Stephani, in his somewhat artificial arrangement of the species in his Species Hepaticarum, had placed them fifteen numbers apart. He had, by the way, described the thallus-margins of *R. Lescuriana* (name modified to "*Lesquereuxii*") as naked, although Austin's original diagnosis had stated that they were ciliate, and, on the other hand, he had attributed cilia to the thallus-margins of *R. Beyrichiana*, even though the original description of this species had implied that they were naked. The facts are that the original specimen of *Riccia Beyrichiana* shows a few inconspicuous cilia and authentic specimens of *R. Lescuriana* show more obvious ones. A study of a considerable series of living American specimens referred to *R. Lescuriana* indicates that the thallus-margins normally and usually show a few cilia, but that, as in most ciliate-margined species, the cilia are occasionally wanting or deciduous or are so few and small as to be easily overlooked. In the matter of the size of the thallus it is to be noted that, although the type of *Riccia Beyrichiana* seemed to me a much smaller plant than *R. Lescuriana*, Stephani, who also saw authentic material of *R. Beyrichiana*, makes it out to have at least a longer thallus (max. 10 mm. vs. max. 7 mm.) than does *R. Lescuriana*. In the matter of the size of the spores, one sometimes finds in *Riccia* a good deal of variation in the spores from a single capsule and in spores from different capsules on a single plant. And in this matter of size of spores, specimens of undoubted *Riccia Lescuriana* from Florida and California make a close approach to the type of *R. Beyrichiana* from Georgia. And the same may be said in regard to the opacity of the older spores. More constant and reliable than the size of the spores as a specific character are their surface markings, and in this respect the spores of the type of *R. Beyrichiana* are essentially like those of authentic specimens of *R. Lescuriana*, that is to say, the outer face of the spore is strongly areolate with large meshes, while the inner faces are nearly smooth or are at most only faintly and imperfectly areolate. When all of the supposedly distinctive characters of *Riccia Beyrichiana* and *R. Lescuriana* are compared, in a good series of specimens from various localities, one, I think, is forced to the conclusion that they do not offer a safe and satisfactory basis for specific distinctions. The name of the species then becomes *Riccia Beyrichiana* Hampe, a name that was published thirty one years earlier than *Riccia Lescuriana* Aust. The species evidently has a wide range in North America. Its most northeastern station, so far as now known, is at Northampton, Massachusetts, where it has been found by Miss Annie Lorenz, who, by the way, states that at West Hartford, Connecticut, plants of this species persisted alive through the unusually severe winter of 1914 and that the species is apparently a perennial. Besides Massachusetts, Connecticut, New Jersey, and Georgia, the species has been found also in Illinois, Florida, Texas, Colorado, California, and Alberta (Brinkman). Under the name *Riccia Lescuriana* several European hepaticologists have attributed the species to Europe also, and as is the case with several other species in this genus, it seems impossible to separate some of the European material from the American. However, some of the non-ciliated European specimens that have been referred to *R. Lescuriana* seem to be more closely related to *Riccia glauca* or *R. bifurca* than to this species.

Riccia McAllisteri sp. nov.

Thallus 2 or 3 times rather divergently forking, often forming densely gregarious more or less radiating masses, bright green when living, often whitish- or yellowish-green with age or on drying, violet-purple or sometimes decolorate at margins and on sides, regularly reticulate above, 5–8 mm. long, the main segments oblong or oblong-obovate, 1.5–2.5 mm. wide, the terminal segments ovate, subquadrate, or somewhat obcordate, rounded-obtuse or subacute; median sulcus acute and sharply defined in anterior parts, becoming obscure in the posterior; ventral scales entire, reddish violet, claret-colored, or sometimes decolorate, imbricate, slightly exceeding the acute ascending margins, the extreme margin hyaline or violet and unistratose for a width of one or two cells; transverse sections of the thallus mostly 2–3 times broader than high, the ventral outlines rounded-convex or occasionally somewhat flattened; dorsal epidermis of two (or three) layers of cells, the cells of the primary stratum mostly mammiform-apiculate, soon collapsing and leaving rather inconspicuous, or sometimes cup-like vestiges, the cells of the secondary superficial stratum mostly 26–78μ broad, these and underlying cells in very distinct and regular rows when viewed from above; monoicous; antheridial ostioles elevated 50–160μ, often violet; capsules usually numerous, soon exposed, the spores lying conglobate in long masses at the bottom of a deep widely open pit or trough; spores at first violet or violet-brown, soon violet-black and opaque, 96–132μ in maximum diameter, ellipsoid, ovoid, subspheric, or obscurely tetrahedral, wholly destitute of wing-margins, at first almost uniformly areolate over the whole surface, the areolae mostly 7–15μ in diameter, soon obscure, and the spores finally appearing densely echinulate, the spinulae 5–11μ long, truncate or obtuse, or occasionally subacute, sometimes cristate-furcate.

On moist ground near standing water in quarry-holes, Granite Mountain (about 70 miles northwest of Austin), Texas, *Dr. F. McAllister*, May, 1914. The technical type spec mens were grown in the Propagating House of the New York Botanical Garden, whence they were collected and placed in the herbarium of that institution on December 8, 1914.

Plants that are doubtless to be referred to this species have been collected also at Glencoe, Missouri, by Dr. N. L. T. Nelson (in herb. A. W. Evans), though its spores are rather more obviously reticulate and less strikingly echinulate than those of the Texan type.

Riccia McAllisteri is related to *R. dictyospora* M. A. Howe, originally described from Athens, Georgia, yet appears to be specifically distinct, differing in the less elongate, less linear, less conspicuously marginate, more freely forking thallus, with less acute apices and rather more pronounced anterior sulcus, in the red-violet instead of black-purple scales, in the apparent absence of special "oil-body" cells, in the more elevated antheridial ostioles (50–160μ vs. 0–50μ), in the more apiculate and more persistent cells of the primary epidermis, in the usually larger (mostly 1½ diameters) cells of the secondary epidermis, in the more regularly seriate arrangement of these and the subjacent cells when viewed from above, in the violet-black and soon opaque instead of brown and rather translucent spores; and the spores of *R. McAllisteri*, except in the younger stages, impress one as echinulate rather than areolate; short spines or papillae are finally developed in *R. dictyospora*, but they rarely reach a length of 5μ.

Riccia violacea M. A. Howe, Ann. Missouri Bot. Gard. **2**: 51. 1915.

Since the type of *Riccia violacea* was collected on Mona Island, between Porto Rico and Santo Domingo, in 1914, by Britton, Cowell and Hess, the species has been found by Dr. Britton and associates in two more Porto Rican localities, namely, Salinas de Guanica (*Britton, Cowell, & Brown, 4919*) and Cayo Muertos (*Britton, Cowell, & Brown, 5089*). And what appears to be the same thing from the Bay of Mariel, Province of Pinar del Rio, Cuba, where it was collected by N. L. Britton and F. S. Earle, Sept. 21, 1910 (*no. 7594*), has been discovered among the undetermined West Indian Hepaticae in the collections of the New York Botanical Garden. The species is, accordingly, now known from four stations, representing four West Indian Islands, if two small "Keys" are counted as islands. As the plants are very small (1.5–4.0 mm. long and 0.6–1.15 mm. wide) and easily overlooked, it now seems reasonable to suppose that critical field work might show the species to be widely distributed in the West Indian region. The new material permits the addition of certain characters that were unknown at the time of publishing the original description. Few well-developed archegonia and few spores have been seen, but it seems nearly certain that the species is dioicous; at least, numerous plants have been seen that appear to bear antheridia only, while most of the Cuban material appears to bear abortive or unfertilized archegonia only. The antheridial ostioles are elevated 20–150μ and are often violet. The spores, seen sparingly in the Salinas de Guanica specimen after cultivation at the New York Botanical Garden, are soon fuscous and very opaque, 80–105μ in maximum diameter, obscurely angled or flattened-sphaeroid, destitute of wing-margins, finely, irregularly, and almost uniformly areolate over the whole surface, the areolae 7–11μ wide, soon very obscure and the spores appearing minutely and densely verruculose, the verruculae obtuse or truncate, 2–4μ high.

In studies of the terrestrial *Ricciae*, it is of great advantage to have access to living material, and it is especially illuminating to have closely related species and forms growing side by side as has been done for two years or more in the Propagating House of the New York Botanical Garden. I am greatly indebted to readers of The Bryologist for kindly supplying living material of various species and I would earnestly solicit a continuance of these favors during the coming season.

The New York Botanical Garden,
Bronx Park, New York City

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FERTILITY IN CICHORIUM INTYBUS:

THE SPORADIC OCCURRENCE OF SELF-FERTILE PLANTS AMONG THE PROGENY OF SELF-STERILE PLANTS

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FERTILITY IN CICHORIUM INTYBUS: THE SPORADIC OCCURRENCE OF SELF-FERTILE PLANTS AMONG THE PROGENY OF SELF-STERILE PLANTS

A. B. STOUT

The writer (1916) has already presented the evidence that the very prevalent self-sterility (and cross-sterility as well) in chicory can be ascribed to a *physiological incompatibility* operating between sex organs or sex cells that are fully formed, anatomically perfect, potentially functional and of simultaneous development. It was noted that this type of sexual sterility is sharply to be distinguished from sterility due to *anatomical incompatibility* (more or less purely structural differences and adaptations such as hercogamy), *impotence* (failure to produce gametes) or *embryo abortion* (death of egg after fertilization or death of young embryo). I also at that time discussed and summarized the literature bearing on such phenomena.

From my studies made in 1912 and 1913, it appears (Stout 1916, p. 365–366) that self-sterility is the rule in chicory. Three plants (designated *A*, *B*, and *C*) of wild stock were found to be self-sterile, as were 52 plants grown from the open fertilized seed of these plants, and all plants tested of ten cultivated varieties were self-sterile. In one variety (Barbe de Capucin), 29 plants of one planting and 5 of another were tested, and of other varieties about five plants of each were tested. The total of about 135 plants from these various sources were self-sterile.

However, in the pedigreed cultures grown in 1913, a few plants exhibiting varying degrees of self-fertility appeared quite sporadically among the F_1 progeny of various crosses between self-sterile plants. Of the 75 plants derived by crossing plant *A* with plant *E22* (of the variety Barbe de Capucin), only eight were self-fertile. Of 21 plants, the offspring of *A* and *E3*, four were self-fertile. Seventeen plants, the offspring of *C* and *E3*, were self-sterile, as were 30 plants from seed of a cross between a white-flowered plant, $(A \times C)$ *no. 1*, of wild stock and a plant of the variety "improved striped-leaf." The number of self-fertile plants, therefore, varied greatly in the different series, but in no series was the proportion very large.

The self-fertile plants mentioned above appeared after only one generation of ancestry known to be self-sterile. Furthermore, the parents in each cross were not closely related and were somewhat different in vegetative habit and flower color. As previously recognized (1916, p. 415), these results raised some question regarding the influence of wide-crossing as compared with that of inbreeding on the development of self-compatibilities, especially as continued inbreeding in the variety "red-leaved Treviso" had in two generations given only one feebly self-fertile plant out of a total of 49 plants (complete data given in 1916, Table 7).

In order to obtain further data on this question, it was planned to continue inbreeding within this variety, increasing the number of plants grown in 1916, and at the same time to grow for comparison an F_1 generation from crosses between plants of this variety and a self-sterile plant of a wild stock. The present paper will deal especially with the data obtained from these cultures.

Description of the Cultures

The variety "red-leaved Treviso" is a cultivated salad chicory that has been developed in continental Europe. As grown for commercial seed production the variety is biennial, seed being sown one summer for a crop that matures in the following summer. As grown in my culture the plants are more nearly annual. Seed is sown in January in flats, and the seedlings are potted and kept in continuous growth in the greenhouse until spring, when they are planted in the field. Under such treatment the plants, as a rule, reach full development in the following August. The general habit of growth of the mature plants is well shown in text-figure 1. The height has ranged from 4½ to 6½ feet with the greater number of plants about 5 feet tall. The plants are rather sparsely branched near the base but rather abundantly branched above. In the early stages of growth the rosette leaves are numerous, of large size, and erect. One of the marked characteristics of the family I have grown is the development of a type of fasciation

FIG. 1. Typical plants of the variety red-leaved Treviso. The marker stands by self-fertile plant (R. Ser. 10, No. 8); all other plants in the view were self-sterile. From photograph taken in the afternoon when all flower heads are closed.

involving duplication and cohesion of the main axis. Two main stems develop with a single root system. Occasionally these are separated from the root upward, but most usually the two are more or less fused for a distance, the fusion finally becoming complete near the top of the plant. None of the plants of this variety have shown any tendency to live over winter. The maturity and death of the stems and branches is accompanied by death of the roots. Several attempts to obtain new plants from root cuttings taken at the time of the maturity of plants have failed.

The wild white-flowered plant used in crosses with plants of the red-leaved Treviso is perennial as are wild plants of chicory in general. In the five years it has been under observation its mature height has ranged from 2¼ to 2½ feet. Its rosette leaves are few, much smaller in size than those of the red-leaved Treviso, and are flat in habit of growth. The branches are few and strongly horizontal, giving the plant a sparsely branched and scraggly appearance.

The F_1 generation plants of the crosses between plants of the red-leaved Treviso variety and the wild plant just mentioned were more like the red-leaved Treviso in habit of growth. They were all blue-flowered. Their height ranged from 4 to 6 feet, and they were abundantly and profusely branched from the base. The degree of the duplication of the main stem was much less than in the family of the red-leaved Treviso. As shown in text figure 2, the plants of this hybrid generation were large and well developed and of marked vegetative vigor. They were far more robust and vigorous in growth than the wild parent, and in respect to the degree of branching they were more developed than plants of the red-leaved Treviso strain.

The sex vigor of these plants and of plants of the Treviso variety in respect to *production* of flowers was commensurate with the vegetative vigor. From statistical data obtained in studies of flower number, it was found that the total number of flower heads produced by individual plants ranged roughly from 2,000 to 3,500 with the average number of flowers per head at about 17. At the climax of development as many as 100 to 150 flower heads opened in a single day. These statements together with the descriptions given and the illustrations in the accompanying text-figures give some conception of the full and complete sex vigor seen in the profuse production of flowers that set seed when pollinated with pollen that was compatible.

It will also readily be observed that the inbreeding within the family of red-leaved Treviso involved crosses between plants of close blood relationship and of decided similarity, and that the fertilization in

FIG. 2. Typical plants of the F_1 generation of the crosses between plants of the Treviso variety and the wild plant A.

these plants with pollen from the wild plant *A* constitutes a comparatively wide cross both in respect to blood relationship and to the vegetative characteristics of the respective parents.

Results of the Self-Pollinations of the 1916 Crop of "Improved Red-Leaved Treviso"

A total of 103 plants were grown in this crop. All were descended from two plants of the 1913 crop, and all but two had three generations of parentage known to be self-sterile. The data for the self-pollinations made on these plants are given in Table 1. Here the plants are grouped, as they were grown, in series according to the immediate parentage. The table gives the total number of heads upon which controlled self-pollinations were made, the number of heads producing no seed, the number of heads with seed, the number of seeds per head, and the percentage of fertility. Frequently birds ate seeds, indicated in the tables by "B," and thus interferred somewhat with the determination of the percentage of fertility.

The 10 sister plants of Ser. 7 were all self-sterile; of the 19 sister plants of Ser. 8, one was feebly self-fertile; of the 25 plants of Ser. 9, three were self-fertile; of Ser. 10, one of 10 plants was self-fertile; of Ser. 11, five out of 19 were self-fertile; and one of the 18 plants of Ser. 12 was self-fertile. Of the total 101 plants descended from self-sterile parentage, 11 were self-fertile in some degree. With the exception of Ser. 7, one or more self-fertile plants appeared in each series. It may be noted that three self-fertile plants, two of which were rather highly self-fertile, appeared in Ser. 9, which was derived by crossing two sister plants of the previous generation. This series was from a more closely inbred parentage than were the other series.

The total number of flower heads pollinated in these series is 1205. As a rule, not less than 10 heads were pollinated on a plant, and in nearly all cases this total includes pollinations made on several different days. When it became evident that some plants were self-fertile, special efforts were made to continue self-pollination on them in order to secure an abundance of seed for future progeny. However, as shown in the table, the number of heads pollinated on plants completely self-sterile is also often high.

The degree of self-fertility, judged by the percentage of flowers setting seed, varied considerably. Most of the self-fertile plants were feebly self-fertile, producing as a rule only a few seed per head in only a few of the heads manipulated. Others, as no. 34 of Ser. 9 and no. 8 of Ser. 10, set seed in every head pollinated, and in numerous heads the numbers were nearly equal or even equal to all that were

Table I

Record in 1916 for Self-pollinations of the Cultures of "Improved Red-leaved Treviso"

	Record for Heads Pollinated				Fertility (%)
	Total No. Heads.	With No Seed	With Seed	Seeds per Head. Remarks	
Series 6 . . .				Parentage, Series 4, no. 21. A self-fertile plant	
No. 3 . . .	10	10	0		
" 4 . . .	15	15	0		
Series 7. . . .				Parentage, Ser. 1, no. 8×Ser. 5, no. 5.	
No. 1. . . .	14	14	0		
" 2. . . .	15	15	0		
" 3. . . .	20	20	0		
" 8. . . .	10	10	0		
" 10. . . .	13	13	0		
" 12. . . .	11	11	0		
" 17. . . .	7	7	0		
" 19. . . .	10	10	0		
" 20. . . .	10	10	0		
" 21. . . .	10	10	0		
Series 8. . . .				Parentage, Ser. 4, no. 12×Ser. 5, no. 8.	
No. 1. . . .	15	15	0		
" 2. . . .	10	10	0		
" 3. . . .	13	13	0		
" 4. . . .	14	14	0		
" 5. . . .	14	14	0		
" 7. . . .	13	10	3	1, 2, 10.	0.06
" 8. . . .	12	12	0		
" 10. . . .	12	12	0		
" 11. . . .	11	11	0		
" 12. . . .	14	14	0		
" 13. . . .	10	10	0		
" 14. . . .	10	10	0		
" 15. . . .	11	11	0		
" 16. . . .	12	12	0		
" 17. . . .	12	12	0		
" 18. . . .	12	12	0		
" 19. . . .	21	21	0		
" 20. . . .	10	10	0		
" 22. . . .	10	10	0		
Series 9. . . .				Parentage, Ser. 5, no. 1×Ser. 5, no. 6.	
No. 1. . . .	10	10	0		
" 2. . . .	12	12	0		
" 3. . . .	15	15	0		
" 6. . . .	27	1	26	1, 4, 6, 6, 6, 7, 7, 7, 8, 8, 9, 9, 9, 9, 10, 10, 10, 11, 11, 11, 11, 12, 13, 13, 13, B	0.50
" 7. . . .	10	10	0		
" 10. . . .	14	14	0		
" 12. . . .	14	14	0		
" 13. . . .	10	10	0		
" 19. . . .	12	12	0		
" 20. . . .	10	10	0		
" 21. . . .	5	5	0		
" 25. . . .	24	24	0		
" 26. . . .	12	12	0		

TABLE I—*Continued*

	Record for Heads Pollinated				Fertility (%)
	Total No. Heads	With No Seed	With Seed	Seeds per Head. Remarks	
No. 28....	9	9	0		
" 29....	10	10	0		
" 30....	15	15	0		
" 31....	10	1	9	B, B, B, 1, 2, 2, 2, 3, 4	0.13
" 32....	12	12	0		
" 34....	23	0	23	3, 6, 7, 9, 9, 10, 10, 10, 10, 10, 11, 12, 12, 12, 13, 13, 14, 14, 14, 14, 14, 15, 18	0.71
" 37....	9	9	0		
" 38....	5	5	0		
" 40....	10	10	0		
" 42....	15	15	0		
" 43....	10	10	0		
" 47....	13	13	0		
Series 10....				Parentage, Ser. 4, no. 12×Ser. 5, no. 9	
No. 1....	12	12	0		
" 2....	17	17	0		
" 3....	10	10	0		
" 4....	10	10	0		
" 5....	9	9	0		
" 6....	9	9	0		
" 7....	20	20	0		
" 8....	24	0	24	4, 6, 8, 8, 8, 9, 9, 9, 10, 10, 11, 11, 11, 12, 12, 12, 12, 13, 13, 14, 14, 15, 16, 17	0.63
" 10....	11	11	0		
" 11....	8	8	0		
Series 11....				Parentage, Ser. 5, no. 1×Ser. 1, no. 8	
No. 1....	13	13	0		
" 4....	14	14	0		
" 8....	11	11	0		
" 11....	10	10	0		
" 12....	12	10	2	1, 5	0.03
" 16....	9	9	0		
" 24....	8	3	5	1, 1, 3, 4, 5	0.11
" 25....	14	14	0		
" 27....	11	11	0		
" 28....	10	10	0		
" 29....	10	8	2	2, 4	0.04
" 31....	10	10	0		
" 32....	12	9	3	1, 1, 3	0.03
" 35....	8	8	0		
" 37....	18	17	1	12	0.04
" 40....	10	10	0		
" 43....	11	11	0		
" 44....	11	11	0		
" 49....	8	8	0		
Series 12....				Parentage, Ser. 5, no. 9×Ser. 4, no. 18	
No. 1....	10	10	0		
" 2....	10	10	0		
" 3....	12	12	0		
" 4....	12	12	0		
" 5....	11	11	0		

TABLE I—*Continued*

	Record for Heads Pollinated				Fertility (%)
	Total No. Heads	With No Seed	With Seed	Seeds per Head. Remarks	
No 6....	9	9	0		
" 7....	10	10	0		
" 8....	13	13	0		
" 9....	12	12	0		
" 10....	10	10	0		
" 11....	13	0	13	B, B, 3+B, 3+B, 3+B, 5+B, 7, 8, 10, 10, 11, 18, 22	0.73?
" 12....	10	10	0		
" 13....	12	12	0		
" 16....	10	10	0		
" 17....	11	11	0		
" 18....	10	10	0		
" 19....	13	13	0		
" 20....	5	5	0		

possible. It is not to be considered that the degree of fertility is absolutely determined, and especially in those cases when birds (Ser. 12, no. 11) ate all or a part of the seed produced in certain heads. The detailed data, however, make it quite clear that various degrees of self-compatibility may exist. The evidence in this particular is quite identical with that already reported in 1916. In Ser. 11 a comparatively large proportion of plants, 5 out of 19, were self-sterile, but the fertility was low in each case.

The two plants of Ser. 6 were derived from self-fertilized seed of a plant that was feebly self-fertile and which was the only self-fertile plant that appeared in my crops of this variety previous to 1916. The two plants were self-sterile.

SELF-COMPATIBILITIES AND INCOMPATIBILITIES AMONG PLANTS OF THE 1916 CROP OF F_1 GENERATION OBTAINED BY CROSSING A PLANT (*A*) OF WILD STOCK WITH PLANTS OF THE VARIETY "RED-LEAVED TREVISO"

The data for the self-pollinations of this generation are presented in Table 2. The wild white-flowered plant *A* was the pollen parent for Series 1–4 and the seed parent of Series 5. Five different plants of the 1915 generation of "red-leaved Treviso" were concerned in the parentage, as indicated in the table. The uncertainties of securing compatible cross-pollinations among self-sterile plants (Stout, 1916,

TABLE 2

Data for Self-pollinations of F_1 generation Derived by Crossing a Wild White-flowered Self-sterile Plant (A) With Self-sterile plants of the Variety "Red-leaved Treviso"

Plant.	Data for the Heads Pollinated: Total No. Heads	Heads With No Seed	Heads With Seed	Seeds per Head. Remarks	Fertility (%)
RA. Ser. 1.				Parentage, R. Ser. 1, no. 7×A	
No. 1.	10	10	0		
" 2.	10	6	4	1, 1, 1, 5	0.05
" 3.	11	11	0		
" 4.	10	10	0		
" 5.	11	11	0		
" 6.	12	12	0		
" 7.	14	14	0		
" 8.	10	10	0		
" 9.	10	10	0		
" 10.	12	12	0		
" 11.	10	10	0		
" 12.	11	11	0		
" 13.	12	12	0		
RA. Ser. 2.				Parentage, R. Ser. 1, no. 2×A	
No. 1.	12	12	0		
" 2.	15	15	0		
" 3.	15	15	0		
" 6.	13	13	0		
" 7.	14	14	0		
RA. Ser. 3.				Parentage, R. Ser. 1, no. 6×A	
No. 1.	10	10	0		
" 2.	11	11	0		
" 3.	11	11	0		
" 4.	11	11	0		
" 5.	12	12	0		
" 7.	12	12	0		
" 8.	15	15	0		
" 9.	11	11	0		
" 10.	17	17	0		
" 13.	10	10	0		
" 14.	10	10	0		
" 15.	12	12	0		
" 16.	12	12	0		
" 17.	11	11	0		
" 18.	16	16	0		
" 19.	11	11	0		
" 20.	11	11	0		
" 21.	16	16	0		
" 22.	10	10	0		
" 23.	11	4	7	1, 3, 4, 5, 6, 7, 11	0.19
" 24.	12	12	0		
RA. Ser. 4.				Parentage, R. Ser. 5, no. 16×A	
No. 1.	10	10	0		
" 2.	10	10	0		
" 3.	10	10	0		
" 4.	10	10	0		

TABLE 2—*Continued*

Plant	Data for the Heads Pollinated: Total No. Heads	Heads With No Seed	Heads With Seed	Seeds per Head. Remarks	Fertility (%)
No. 5.	12	12	0		
" 6.	15	15	0		
" 8.	10	10	0		
" 9.	14	14	0		
" 10.	10	10	0		
" 11.	13	13	0		
" 12.	10	10	0		
" 13.	10	10	0		
" 14.	12	12	0		
" 15.	11	11	0		
" 16.	10	10	0		
AR. Ser. 5.				Parentage, A×R. Ser. 1, no. 1	
No. 1.	10	10	0		
" 2.	11	11	0		
" 3.	10	10	0		
" 4.	10	10	0		
" 5.	10	10	0		
" 6.	10	10	0		
" 7.	10	10	0		
" 8.	12	12	0		
" 9.	12	12	0		
" 10.	10	10	0		
" 11.	10	10	0		
" 12.	13	13	0		
" 13.	12	12	0		
" 14.	12	12	0		
" 15.	13	13	0		
" 16.	9	9	0		
" 17.	12	12	0		
" 18.	8	8	0		
" 19.	12	12	0		

Table 14) made it somewhat difficult to limit the parentage of the various series to the same parents, which would, of course, be highly desirable. Thus it happens that the immediate parents of these series are not the same as those of the series reported in Table 1; the plants involved are, however, closely related sister plants.

In making the cross-pollinations between the self-sterile parents here involved, no attempts were made to emasculate or to depollinate the seed parent. In brushing a flower head of a prospective seed parent with a flower head from a plant selected for a pollen parent, there was necessarily a full and rather thorough mixture of the two lots of pollen with apparently an equal chance that both should be distributed on stigmatic surfaces. A total of 54 plants were derived from four different seed parents of the red-leaved Treviso (Ser. 1–4, Table 2) and 19 were derived from the wild white-flowered plant as a seed parent. All these plants were unmistakably hybrids. In no case did a plant's own pollen function in fertilization.

It may be noted here that East (1915) has made the suggestion that the physiological conditions operating in self-incompatibility involve a failure on the part of the plant's own pollen to stimulate the proper secretions in its pistil necessary for growth of the pollen tubes. If this were the case, it would seem that self-sterility might be removed, in part at least, by mixing pollen as I have done in the crosses referred to above. Such, however, was not the result. It is possible that such results might more readily be obtained in species in which the fertilization processes are much less rapid than in chicory.

Of the 73 plants of this F_1 generation, only two plants were self-fertile with percentages of 5 and 19. In only two cases were the number of heads pollinated less than 10. The results are therefore very decided. All of these plants were blue-flowered and were quite similar in general vegetative habit and appearance. All flowered profusely throughout the season, and, as is the case with plants having only this type of sterility (physiological incompatibility), all set abundant seed in many heads open-pollinated.

Cross-Incompatibilities among the Plants Grown in 1916

A brief summary may here be given regarding the results of cross-pollinations made during 1916. Of the cultures of red-leaved Treviso (R), 37 different plants were tested in a total of 34 different combinations; of these 16 were sterile and 18 fertile in some degree. Among the plants of the F_1 generation (RA), 24 combinations of cross-pollinations were made involving 37 different plants. Of these 9 were sterile and 15 were fertile in some degree. As indicated by the figures, the combinations among the R plants involved fewer plants proportionally and more reciprocals than did those among the RA plants. No particular emphasis can be given to the number here obtained in its bearing on the influence of inbreeding or cross-breeding. The data obtained from these plants selected at random, however, indicate that cross-incompatibilities exist in marked degree. The results in this respect are quite in agreement with those already reported (1916, Tables 9–14), not only for the red-leaved Treviso but for other cultures of chicory.

Discussion and Conclusion

The sporadic development of self-compatibility giving self-fertility among the progeny of self-sterile lines of descent is in decided evidence in the cultures reported above. No doubt if a larger number of the "red-leaved Treviso" variety had been grown and tested, more than one self-fertile plant would have been found previous to the crop of 1916. However, they were not found and the variety was kept in pedigreed cultures by crossing self-sterile plants.

Self-compatibility is therefore a characteristic that was new in expression, at least to the particular and immediate line of descent involved. A total of 101 plants of the 1916 crop had three generations of ancestry known to be self-sterile; of these 11 plants were self-fertile.

There is, therefore, much in the occurrence of these plants that suggests discontinuous variation or mutation. However, the fertilities of these self-fertile plants vary. They grade over to complete self-sterility. The variation in the self-fertility of plants grown from self-fertile parents (Stout, 1916, Table 6) is much more continuous and is indicative that the irregular and somewhat discontinuous variation seen in the intensity of fertilities is only an apparent one due to the few cases observed.

It is to be noted that there have been scarcely any attempts made to study the progeny of self-sterile plants in species and varieties known to be strongly self-sterile by continued inbreeding in pedigreed lines of descent. Compton (1912, 1913) has reported that in *Reseda odorata* "self-sterile plants when bred *inter se* throw self-sterile offspring only," but he has not published data regarding the number of such families, the number of plants, or the number of generations tested. East (1915) has reported that the inter-specific hybrids between *Nicotiana forgetiana* and *N. alata grandiflora* have been completely self-sterile for four generations, and that a total of over 500 plants were tested. Data on the behavior of the parent plants, or even of the two parent species, were evidently not obtained. Correns (1912, 1913) was especially interested in the study of cross-incompatibilities and evidently tested the self-fertility of only 13 of the total of 60 sister plants obtained by crossing two self-sterile plants of *Cardamine pratense*. Of these, however, three plants appear to have been self-fertile.

In view of the prevalence of self-incompatibilities in many plants of economic importance, such as cabbage, rye, apple, plum, prune, cherry, blueberry, etc., it is somewhat surprising that more searching studies have not been made on the sporadic occurrence of self-fertile plants. It is somewhat in doubt, therefore, whether there exists a species, a variety, or even a strain of plants in which self-sterility due to physiological incompatibility is absolute. However, such may exist especially among certain hybrid strains as is suggested by East's data. Many further data are needed to allow of any adequate statement of the various degrees and intensities of such self-sterility in species or in different strains as a whole. The general evidence, however, suggests that in many such cases the sporadic occurrence of self-fertile plants may be quite as it is in chicory.

The almost complete self-incompatibility of the F_1 progeny of the crosses between plants of the "red-leaved Treviso" variety and the wild white-flowered plant *A* is noticeable. The occurrence of only two self-fertile plants of feeble fertility out of 73 such plants emphasizes the sporadic nature of the development of self-compatibility. This may also be considered as evidence that wide crossing inside the species does not especially favor the development of self-compatibility. In fact, a comparison of the behavior of these plants with that of the 1916 crop of the inbred plants of the "red-leaved Treviso" variety leads to the conclusion that inbreeding is more favorable to the development of self-compatibility than is wide crossing. In East's results (1915) all plants tested, some 500 in number, of the F_1, F_2, F_3, and F_4 generations were found to be self-sterile. As these were the offspring of an interspecific cross, it does not seem that wide crossing has here favored the development of self-compatibility. It should be noted that East suggests that there may be some increase in the development of cross-incompatibilities among the later generations, which he considers may be due to an increased homozygosity, but the evidence is not conclusive on this point.

I have not sufficient data to judge adequately of the frequency of cross-incompatibilities among the various series and generations of chicory grown. Cross-incompatibility has occurred in each generation of the red-leaved Treviso variety (for data obtained in 1914 and 1915 see Stout, 1916, Table 14) as it has in all other families thus far tested (Stout, 1916, Tables 9–13). Everywhere that I have tested for cross-incompatibility in chicory it has been found to be very general and to exist in various grades of intensity.

The numbers of self-fertile plants which appeared among the F_1

generation of crosses between the wild plant *A* and plants of the cultivated common chicory (*E* Series) are somewhat higher than those of the F_1 generation (RA plants) derived by crossing this same wild plant with plants of the red-leaved Treviso here reported. The strain (E) has not, however, been inbred in pedigreed cultures as has the red-leaved Treviso strain, so there are less adequate data on the comparative value of inbreeding and crossing with this variety.

The character of physiological self-compatibility giving fertility appears in a very irregular and sporadic manner, and it exists in different degrees of intensity in different plants. It has appeared in chicory in a family of the variety known as red-leaved Treviso after three generations of self-sterile ancestry and no doubt would occur with equal irregularity and intensity after many generations of such ancestry. It seems very conclusive therefore that the causes of self-incompatibilities are not to be ascribed to a similarity of nuclear constitution involving definite hereditary units of germ plasm which either directly determine incompatibilities (especially Correns's view of line-stuffs) or which indirectly determine them (East's view). Furthermore, the variability of the offspring grown from self-fertile plants in chicory shows a very irregular inheritance of the characteristic of self-compatibility and makes it quite clear that the expression of self-compatibility is quite of the nature of a fluctuating variability, and that self-compatibility and self-incompatibility, in chicory at least, are not to be described in terms of dominant and recessive characters which behave in any sort of Mendelian manner.

The evidence seems conclusive that the actual conditions giving the various grades of self-compatibility, and of self-incompatibility (undoubtedly there are various grades of incompatibility giving complete sterility) as well, are decidedly individual. Various aspects of this question in relation to conceptions of fertilization and to the phenomena of serum incompatibilities have already been discussed (Stout, 1916). It must be remembered that a plant whose two sets of sex-organs are completely incompatible is itself derived from the fusion of two cells that were compatible. The interactions between pistil and pollen-tubes were compatible. The germ plasms of the two sex cells were compatible in fusion, in the somatic life of the diploid cell structure of the resulting individual, and in the more intricate interactions involved in sporogenesis occurring in that individual. Yet in cases of complete self-incompatibility none of the pollen grains are functional on the pistil of the plant.

Such conditions emphasize the marked individuality of the development of conditions giving incompatibility. The conditions are fundamentally physiological and arise apparently in connection with the differentiation of the two sets of so-called sex organs. Important to an understanding of the facts of differentiation here involved are the phenomena of cross-incompatibilities. Three sister sporophytes which are quite identical in all vegetative characters may possess sex organs that are incompatible to the extent that complete self-sterility is in evidence; no. 1 may be incompatible with the male sex organs (microgametophytes and gametes) of no. 2, but compatible with those of no. 3. This difference in relation is certainly indicative of differences in the physiological qualities of the two lots of male gametophytes. Conversely the microgametophytes and gametes produced by a single sporophyte may act quite differently on the female sex organs borne on two other sporophytes, being compatible in one case and incompatible in the other. This indicates, likewise, a difference in the condition of the two sets of female organs (including pistils). Furthermore, the data as to the occurrence of cross-incompatibilities in chicory even indicate that reciprocal crosses between two plants may give quite the opposite results, showing that the relations of the two sets of sex organs may not be interchangeable.

In such phenomena we may recognize a loss of sex-vigor which is concerned with the function of gametophytes and gametes. The decrease in fertility is entirely independent of a decrease in the production of spores. Furthermore, there appears to be full and complete development of the macrogametophyte and its egg; its development is certainly not inhibited by the condition of the pistil in which it develops. There is no evidence that the microgametophyte is not fully developed with reference to its differentiation. Although often involving a decreased vegetative growth of the pollen-tube, the inhibition appears fundamentally to involve function.

The reactions involved in self- and cross-incompatibilities do seem to involve, to some extent at least, as Jost (1907) and East (1915) have especially emphasized, an interaction between the haploid pollen-tube and the diploid tissues of the pistil. There may be some question as to what extent these relations are involved.

Incompatibilities are evidently indicated not only by an inability to produce embryos, but also sometimes by a feeble viability of those that are produced. This death of embryos among seed produced by the self-pollination of different sister plants is quite as fluctuating in degree as is the production of seed itself. In its effect it is often quite like the conditions observed in the "zygotic sterility" which Davis (1915*a*, 1915*b*, 1916) has observed in the Oenotheras, especially those of hybrid origin. In chicory, however, the noticeable failure in seed production suggests that much of the embryo abortion observed may also involve a sort of sexual incompatibility. Embryo abortion, however, may be due purely to conditions of nutrition, especially in those species which exhibit no physiological incompatibility.

The incompatibilities in chicory are obviously not purely a question of haploid against diploid, but of a particular kind of haploid and diploid relationship. In discussing these various points, the writer (1916, p. 436–440) has pointed out that our knowledge of the physiology of pollen-tubes is scarcely sufficient to decide whether the critical point in the growth of the pollen-tube is determined by purely nutritive reactions with the pistil as such or whether it is really determined by the diffusion of secretions (hormones) from the macrogametophyte. The writer hopes to be able to state later somewhat definitely from cytological investigation what the relative developments and nuclear phenomena in chicory are.

In discussing the various aspects of the relation of cell organization to the development of compatibilities and incompatibilities, the writer (1916, p. 416) has pointed out that the role of any particular combination of germ plasm elements, as far as can be judged by their expression as characters in parents, in sister plants and in offspring, must be quite secondary as far as incompatibilities are concerned to a more general quality of the tissue and cell organization that develops in connection with ontogenetic growth and development. The conceptions of Jost (1907), Morgan (1904, 1910), and East (1915) are fundamentally based on this same generalization as I there pointed out.

Much the same idea, if I understand their position aright, has since been expressed by Goodspeed and Clausen in stating that such cases of physiological incompatibility seem to involve "non-specific" disturbances in the "reaction systems" (germ plasm) (1917*a*, p. 46). These authors have embodied in the conception of "reaction systems" (1916, 1917*a*) a view which in some measure is a revolt against the extreme formalism of the Mendelian factorial hypothesis, and in this sense the conception is useful in the interpretation of the phenomena of sterility especially of the type I have called impotence. In their application of this conception to the almost complete impotence of the F_1 hybrids of *Nicotiana Tabacum* × *N. sylvestris*, they are dealing with the well-known cases of degeneration so often observed during sporogenesis in interspecific hybrids. They believe that the very few perfect spores formed represent the *Tabacum* and *sylvestris* extremes of a combination series. In other words, these few spores represent the cases where the parental germ plasms segregated without mutual influence. The greater number of recombinations, however, were incompatible combinations of various elements derived from the two germ plasms. There are very few of the two original combinations that survive reduction and sporogenesis. In somatogeneses the incompatibility is seen, they believe, in a complete dominance of the *Tabacum* characters (1717*a*, 1917*b*). Whether involving chemical or mechanical reactions or involving differences in developmental tendencies in the sense used by Tischler (1907), (Stout, 1916, p. 423–427) such intra-cellular incompatibilities arise especially in the reorganization of cells during or immediately following reduction as has long been known.

In the case of physiological incompatibility, as in chicory, there appears to be no impotence except of a purely accidental sort. Any recombination system may survive, and in chicory sporogenesis in the offspring of crosses between the red-leaved Treviso variety and a wild white-flowered plant must, it would seem, give many new recombinations. The range of these recombinations must be quite the same in the various sister plants both of the F_1 generation hybrids and of the various series of red-leaved Treviso. Yet for the self-sterile plants, and these are here in greater number, all the pollen grains fail to function irrespective of the character of the particular germ plasm organization from which they came and of which they may be variously composed. On the other hand in the self-fertile plants that are sister plants of such self-sterile plants, germ cells of much the same hereditary constitutions (as judged by the characters of the plants that bear them) are compatible.

Furthermore, in the cases of self-fertility of any degree (or cross-fertility as well), the evidence thus far obtained from hybrid generations does not indicate that the fertilizations involved selective or preferential mating which favored fusion between particular recombinations of germ plasm with respect to hereditary characters.

The determination of whether physiological self- and cross-incompatibilities giving sterility involve similarity or dissimilarity of constitutional organization is, of course, very fundamental to the understanding of the nature of fertilization. Although rather widely differing in particular applications, the conceptions advanced as to the causes of physiological sexual self-incompatibility in such hermaphrodite plants as *Eschscholtzia* (Darwin, 1877), *Cardamine* (Correns, 1912, 1913), *Reseda* (Compton, 1912, 1913), *Nicotiana* (East, 1915), and in such hermaphrodite animals as *Ciona* (Morgan, 1904, 1910) have in general agreed in considering that a similarity or lack of differentiation is responsible for the sterility. The writer has already (1916) discussed these conceptions and has presented for consideration the view that the evidence is more readily to be interpreted on the basis of the principle that in general a marked degree of similarity in constitution is necessary for sexual fertility. In this relation it is to be noted that inbreeding in the variety "red-leaved Treviso" has led to a somewhat greater similarity in general characteristics than existed in the original stock grown from commercial seed. In this sense the continued inbreeding of sister plants has led to a greater homozygosity. It is in the 1916 cultures of the offspring of inbred plants that self-fertile plants appeared as noted above. As far as the results in chicory extend, and it may be said that there are no more comprehensive data to be had for any other species, the general results are not in disagreement with the view expressed above.

The sporadic variability of the sex relations and their fluctuating inheritance is very obvious in chicory. Self-fertile plants appear irregularly among the offspring of wide crosses and among plants of inbred strains which are prevailingly self-sterile. In both types of offspring the number of self-fertile plants that appear varies considerably. The manner of their appearance is not to be correlated closely with similarities or dissimilarities as these are ordinarily judged by the expression of characters. The condition of complete functional sex vigor is in many hermaphrodites so complete that it appears to be very definitely fixed in heredity. In chicory, however, we see that highly individual and epigenetic developments may arise, evidently in differentiation and in the transition to the gametophytic stage, which lead to wide and sporadic variations in the functional sex vigor.

The various phenomena of self- and cross-compatibility and incompatibility raise many questions that are fundamental to an understanding of morphogenetic differentiation involved in sexuality, but of which we have at the present time only a superficial knowledge.

When does physiological incompatibility begin to develop? Is it a steady and progressive development through the whole diploid association of the two parental cell elements involved, or is it achieved suddenly at some particular point in ontogeny? Also, when does the sexual condition as distinct from the asexual condition actually arise?

Does incompatibility arise because of sex? Are the two the same? It would seem most definitely that they are not and that incompatibilities are not merely due to sexuality. But even if independent, where incompatibilities do arise, where, how, and to what extent are they correlated with sex and is the development of the two ever parallel? To what extent are the physiological interrelations of sexuality and incompatibility dependent on such mechanical or chemical interactions as are involved in reduction and sporogenesis?

Are the differences of intra-varietal physiological compatibility and incompatibility (both self and cross) indicative of differences in sexuality as such? Are some of the organs of either sex (microgametophytes and macrogametophytes with their respective gametes) sometimes more sexual or of greater sex vigor than are others?

To what degree are the incompatibilities, and compatibilities as well, determined by nutritive relations that are to be considered as vegetative functions? Is sexuality in its origin and in its phenomena of cell fusions, as some have held, to be considered in reality as a phase of vegetative function? To what extent are the sexual incompatibilities related to phenomena of serum incompatibilities and to immunity and what are the fundamental reactions involved in the development and operation of these?

These are among the fundamental questions that naturally arise in connection with such sporadic behavior of functional sex vigor as is seen in chicory in which self-fertile plants of varying degrees of fertility arise among a progeny even after three generations of parentage known to be self-sterile.

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NOTES ON PLANTS OF THE SOUTHERN UNITED STATES—III

FRANCIS W. PENNELL

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Notes on plants of the southern United States—III

FRANCIS W. PENNELL

As with preceding issues this paper divides itself into two portions. One consists of short notes based upon the writer's field work of 1912 and 1913, recording mostly plants believed new to their respective states. The other and larger portion consists of a revision of the genus *Chamaecrista* in the United States, and for this have been reviewed, besides his own collections, all the material in several of our leading herbaria. In both parts symbols are used; > to indicate in flower; <, in fruit.

MISCELLANEOUS SPECIES

ARISTOLOCHIA LONGIFLORA Engelm. & Gray

Not "*A. longifolia*," as it appears in Coulter, Botany of Western Texas (Contr. U. S. Nat. Herb. 2), and in Small, Flora of the Southeastern United States. Collected near its original station, on dry black loam, Edwards Plateau, northwest of New Braunfels, Comal County, Texas, September 14, 1913, *5435*.

ACTAEA ALBA (L.) Mill.

Deciduous woodland, Catalpa, West Feliciana Parish, Louisiana, August 22, 1912, *4309*. With a large number of northern species, such as *Asplenium pycnocarpon* Spreng., this reaches its southern limit in the loess hills east of the Mississippi River in Louisiana.

CRACCA AMBIGUA (M. A. Curtis) Kuntze

Open long-leaf pine-land, one to two miles north of Abita Springs, St. Tammany Parish, Louisiana, > August 12, 1912, *4136*.

Cracca angustifolia (Featherman) Pennell, comb. nov.

Tephrosia angustifolia Featherman, Bot. Rep. Louisiana 73. 1871.

"Habitat.—Pine barrens near Pontchatoula [Louisiana]." From inquiry at Baton Rouge it seems probable that Featherman's type is not in existence.

Cracca onobrychoides (Nutt.) Kuntze as it occurs in central and western Arkansas and eastern Oklahoma is relatively a stout plant, its stem and leaf-rhachises hirsute with more or less spreading rusty hairs, its leaflets mostly nine to twelve pairs, elliptic-oblong, densely and softly pubescent beneath. The plant here considered, for which is taken up Featherman's name, is more slender, its stem and leaf-rhachises shortly pubescent with appressed or but slightly spreading hairs, giving by their more scattered position the effect of being less rusty, its leaflets six to nine pairs, linear-oblanceolate. This is probably a characteristic plant of the long-leaf pine-land in Louisiana and Mississippi; we have it from Gulfport, Harrison County, Mississippi, < September 8, 1900, *F. E. Lloyd & S. M. Tracy 161*, and from open pine-land, one to two miles north of Abita Springs, St. Tammany Parish, Louisiana, < August 14, 1912, *4189*. Its specific status is here proposed tentatively. Specimens of *C. onobrychoides* collected on prairies in Bowie County, Texas, in 1898, *H. Eggert*, and at Hempstead, Waller County, Texas, *E. Hall 119*, in pubescence and leaf-form show possible first stages of transition toward *C. angustifolia*. The plant needs further field-study.

EYSENHARDTIA TEXANA Scheele

The single species of *Eysenhardtia* occurring through most of central southern Texas is this, based upon Lindheimer's collection at New Braunfels, Texas. It has been confused with the central Mexican *E. polystachya* (Ortega) Sargent (*E. amorphioides* H.B.K.), but is a smaller plant, a shrub rather than a small tree, its leaflets fewer in number, finely puberulent rather than pubescent, its calyx-tube split on posterior side relatively more deeply and its legumes smaller, evidently upcurved, at maturity ascending, not reflexed. Mr. W. E. Safford and the writer are planning a revision of this small but neglected genus. On black calcareous soil, Edwards Plateau, northwest of New Braunfels, Comal County, Texas, > September 14, 1913, *5468*.

ZORNIA DIPHYLLA (L.) Pers.

Sandy soil, one mile east of Aloe, Victoria County, Texas, > September 18, 1913, *5491*. A tropical species, West Indian and

Mexican, extending into southern Arizona, but, so far as I am aware, not before reported from the Gulf States.

LESPEDEZA HIRTA (L.) Ell.

Dry sandy oak-woods west of Sheridan, Colorado County, Texas, collected ≧ September 21, 1913, *5523*.

GALACTIA MARGINALIS Benth. Ann. Wien. Mus. **2**: 126. 1838

Perhaps *G. heterophylla* (Gill.) Vail (Bull. Torrey Club **22**: 502. 1895), but not *G. heterophylla* A. Gray (Boston Jour. Nat. Hist. **6**: 171. 1850).

Sandy soil, one mile east of Aloe, Victoria County, Texas, > September 18, 1913, *5497*.

THE GENUS CHAMAECRISTA MOENCH IN THE UNITED STATES

During my two southern trips especial attention was given to the genus *Chamaecrista* Moench. This genus or, if you will, subgenus of *Cassia* L. has long been known as of particular taxonomic difficulty. As long ago as 1871 Bentham in his revision of *Cassia* emphasized this. Hence it has seemed desirable to see living plants and to study the behavior of the several species.

From the following lists the extent and deficiencies of this field-work will be apparent. I have collected nearly all the species in my course, but, as I did not travel west of central Texas or south into the Florida peninsula, I have seen but six of the thirteen species here recognized.

However, these six include all of the wide-ranging, widely variable sorts, and, as in this genus the characters of diagnostic value preserve well, the main importance of field-study has been to form some appraisement of variation within and between species. Of the geographic subspecies here treated, six in all, the writer has collected three.

Corolla large, exceeding 1 cm. in diameter; one petal only moderately longer than remaining four. Stamens 10. Pedicels 1–8, 7–40 mm. long.
- Perennials.
  - Petiolar gland slender-stalked.
    - Leaflets 7–9 mm. long, rounded-mucronulate,

glabrous, reddish beneath. Pedicels 30–40 mm. long. Sepals ovate. Legumes 30–40 mm. long, finely appressed-puberulent. 1. *C. Wrightii.*

Leaflets 8–11 mm. long, acute-mucronate, ciliate, green beneath. Pedicels 7–9 mm. long. Sepals lanceolate-attenuate. Legumes 35–40 mm. long, strigose. 2. *C. aristellata.*

Petiolar gland sessile.

Pedicel 1, 25–35 mm. long, exceeding the leaves. Sepals ovate. Stipules ovate. Leaflets strongly ridge-veined. 3. *C. texana.*

Pedicels 1–4, 15–25 mm. long, shorter than the leaves. Sepals lanceolate. Stipules lanceolate-linear. Leaflets not strongly ridge-veined.

Leaflets 4–7 pairs, not ridge-veined, pubescent. Petiolar gland small. Pedicels spreading-pubescent. Legumes 3.5–4 cm. long, pubescent. 4. *C. keyensis.*

Leaflets 12–20 pairs, finely ridge-veined, glabrous. Petiolar glands large, 1–2 mm. long. Pedicels glabrous to finely appressed-puberulent. Legumes 6.5–8.5 cm. long, sparsely finely appressed-puberulent. 5. *C. Deeringiana.*

Annuals.

Petiolar gland depressed, 1–2.5 mm. wide. Pedicels glabrous to more rarely puberulent in lines. Leaflets 10–25 pairs. 6. *C. brachiata.*

Petiolar gland not depressed, 0.07–1.5 mm. wide. Pedicels puberulent to hirsute. Leaflets 6–12(–18) pairs. Species closely related and more or less intergrading.

Leaflets glabrous (occasionally slightly puberulent in *C. fasciculata*). Legumes 3–7 cm. long, 5–7 mm. wide.

Anther-sacs purple. Petiolar gland minute, 0.07–0.2 mm. wide. Leaflets 5–9 pairs. Buds ovate, acute to short-acuminate. Legume relatively long-beaked. Pedicels appressed-pubescent. Plant low. 7. *C. rostrata.*

Anther-sacs yellow (rarely purplish in *C. fasciculata*). Petiolar gland 0.5–1.5 mm. wide. Leaflets 6–12(–18) pairs. Buds lanceolate to ovate-lanceolate, strongly acuminate. Legumes relatively short-beaked.

Pedicels and stems pubescent with incurved hairs. Legumes pubescent with relatively short and appressed hairs. Leaflets 6–12(–15) pairs. Corolla 25–30 mm. wide. 8. *C. fasciculata.*

Pedicels and stems hirsute with spreading hairs. Legumes pubescent with spreading hairs.

Leaflets 9–18 pairs, 15–20 mm. long. Corolla mostly 30–40 mm. wide. Stems stout, erect. 8*a*. *C. fasciculata β.*

Leaflets 6–10 pairs, 8–12 mm. long. Corolla about 25 mm. wide. Stems slender, spreading. 8*b*. *C. fasciculata γ.*

Leaflets pubescent with incurved hairs.

Anther-sacs yellow. Legumes 3–5 cm. long, 5 mm. wide. Plants relatively small-leaved, slender and spreading.

Pedicels and legumes pubescent with incurved hairs. 9. *C. mississippiensis.*

Pedicels and legumes pubescent with spreading hairs. 9*a*. *C. mississippiensis β.*

Anther-sacs purple. Legumes 5–6 cm. long, 4–5 mm. wide. Plant relatively large-leaved, stouter and erect. 10. *C. puberula.*

Corolla small, less than 1 cm. in diameter; one petal much larger than the remaining four. Stamens 5–9. Pedicels 1–2(–3), 2–5 mm. long. Annuals.

Legumes 3–4 mm. wide, 10- to 18-seeded. Leaflets long-ciliate. Odd petal not twice length of others. 11. *C. leptadenia.*

Legumes 4–6 mm. wide, 6- to 9-seeded. Leaflets not ciliate.

Petiolar gland with discoid head much wider than stalk-like base. Corolla with odd petal twice exceeding others. Legumes 7- to 9-seeded, pubescent with incurved (rarely spreading) hairs. Stem pubescent with ascending-incurved, rarely with spreading hairs.

Leaflets glabrous, obtuse, mucronate. Sepals puberulent on midrib. Stipules 5–8 mm. long.

Leaflets 9–18 pairs, 2–4 mm. wide. 12. *C. nictitans.*

Leaflets 15–26 pairs, 1–2 mm. wide. 12*a*. *C. nictitans β.*

Leaflets pubescent with incurved hairs, acutish to acute, more conspicuously mucronate-tipped. Sepals pubescent on midrib. Stipules 8–10 mm. long. 12*b*. *C. nictitans γ.*

Petiolar gland with head but slightly wider than stalk-like base. Corolla with odd petal less than twice exceeding others. Legumes 6- to 7-seeded, hirsute with spreading hairs. Stem, at least above, hirsute with spreading hairs.

Leaflets 15–27 pairs. Stout, erect, mostly hirsute throughout. 13. *C. aspera.*

Leaflets 9–18 pairs. Slender, diffuse, mostly hirsute only above. 13*a*. *C. aspera β.*

1. **Chamaecrista Wrightii** (A. Gray) Pennell, comb. nov.

Cassia (*Chamaecrista*) *Wrightii* A. Gray, Pl. Wright. **2**: 50. Mr 1850.

"Hill-sides, on the Sonoita,near Deserted Rancho, Sonora; Sept. [C. Wright] (1034)." Co-types seen in the herbarium of Columbia University at the New York Botanical Garden and in the herbarium of the Academy of Natural Sciences of Philadelphia.

Perennial. Stem ascending, 3–4 dm. tall, finely puberulent in lines with incurved to appressed hairs. Stipules lanceolate-acuminate, very shortly or not ciliate, 3–4 mm. long. Petioles 3–4 mm. long, slightly puberulent. Petiolar gland single, below proximal leaflets, conspicuously stalked, discoid, 0.15–0.2 mm. wide, dark-brown. Leaflets six to eight pairs, 8–10 mm. long, 2 mm. wide, obliquely ellipsoid-lanceolate, rounded, very shortly mucronulate, glabrous, not ciliate, obscurely nerved. Pedicel one, 30–40 mm. long, sparingly puberulent in lines with incurved hairs. Sepals 7 mm. long, ovate, acute. Petals 10–12 mm. long, the anterior slightly exceeding the laterals. Stamens ten, unequal, two longer; anthers 6–8 mm. long, gradually narrowed above, yellow (?). Legumes 4 cm. long, 5 mm. wide, sparingly finely appressed-puberulent. Seeds eight.

"Hill-sides," northeastern Sonora and southern Arizona.

ARIZONA. Without definite locality, *J. T. Rothrock*, 1874, 4750 ft. alt. (U).

2. **Chamaecrista aristellata** Pennell, sp. nov.

Cassia aristellata A. Gray, manuscript name on sheet here taken as type.

Perennial. Stem ascending, 4 dm. tall, puberulent with incurved hairs and hirsute with interspersed longer spreading hairs. Stipules lanceolate-acuminate, long-ciliate, 5 mm. long. Petioles 3–5 mm. long, hirsute. Petiolar gland single, slightly below proximal leaflets, conspicuously slender-stalked, discoid, 1–1.5 mm. wide. Leaflets six to eight pairs, 10–15 mm. long, 2 mm.

wide, oblique-lanceolate, falcate, acuminate-mucronate on distal side, nearly glabrous, evidently ciliate, evidently nerved. Pedicel one, 7–13 mm. long, appressed-puberulent with incurved hairs. Sepals 10–11 mm. long, lanceolate, acuminate, puberulent. Petals 10 mm. long, the anterior slightly exceeding the lateral. Stamens unequal. Legumes 4 cm. long, 4–4.5 mm. wide, strigose-hirsute, brown. Seeds twelve, 2–2.2 mm. long, oval.

Type, "Texano-Mexicanum," collected in fruit, *Berlandier 2036*, in the herbarium of Columbia University at the New York Botanical Garden.

Apparently differs from *Chamaecrista calycioides* (DC.) Greene of South America, with which it has been confused, by its fewer leaflets and solitary flowers; doubtless, when *C. calycoides* is re-collected and fully described, by other characters.

Besides the type collection, the precise locality of which is unrecorded, seen also from Cameron County, Texas, > May 8, 1900, *Vernon Bailey 231*, in the United States National Herbarium.

3. **Chamaecrista texana** (Buckl.) Pennell, comb. nov.

Cassia texana Buckl. Proc. Acad. Nat. Sci. of Phila. **1861**: 452. 1862. "Sandy soil, Bastrop Co., Texas." Type seen in the herbarium of the Academy of Natural Sciences of Philadelphia.

Perennial, from a rhizome. Stems ascending, 2–4 dm. long, puberulent in lines with ascending-incurved hairs. Stipules cordate-triangular, acuminate, slightly ridge-veined, puberulent, ciliate, 3–4 mm. long. Petioles 2–3 mm. long, puberulent with ascending-incurved hairs. Petiolar gland single, below proximal leaflets, sessile, rudimentary or mostly wanting. Leaflets ten to sixteen pairs, crowded, 6–8 mm. long, 1 mm. wide, elliptic-lanceolate, acutish, pubescent, finely ciliate, strongly ridge-veined. Pedicel one, exceeding the subtending leaf, in fruit 30–50 mm. long, puberulent with incurved hairs. Sepals 7–8 mm. long, ovate, acute, finely appressed-puberulent. Petals 10–13 mm. long, the anterior slightly exceeding the laterals. Stamens ten, unequal, one or two longer; anthers 6 mm. long, yellow. Legumes 3–4 cm. long, 5 mm. wide, sparingly finely appressed-pubescent. Seeds eight.

This has been identified as *C. chamaecristoides* and as *C. procumbens*.

C. chamaecristoides (Collad.) Greene, of South America, differs by its longer stouter stems, lanceolate stipules, slightly longer petioles, evident stalked petiolar gland, rounded not winged leaf-rachis (in *C. texana* this is flattened, slightly winged), larger scarcely veined evidently cuspidate leaflets, stouter densely puberulent pedicels shorter than the subtending leaves, and flowers larger, 30–35 mm. in diameter.

C. micrantha Britton ("*C. procumbens*," not L.), of Cuba and the Isle of Pines, differs by its ovate-lanceolate stipules, evident petiolar gland, terete not winged leaf-rachis, shorter scarcely veined usually more puberulent to pubescent leaflets, peduncles becoming but 10–20 mm. long, smaller flowers 15 mm. in diameter, and more puberulent eight- to twelve-seeded legumes.

Dry sandy soil, southern Texas.

TEXAS. Bastrop:* *S. B. Buckley* (A). Cameron: Rudolph, *F. L. Lewton 178* > April 13 (U). Duval: Pena, *G. C. Nealley 117* (P, U). Victoria: Aloe, *F. W. Pennell 5496* > September 18 (P). Webb: Laredo, *Schott 105* > June (Y). Also "De Matamoros a las Nueces," *Berlandier 2427* (A, U, Y).

4. **Chamaecrista keyensis** Pennell, sp. nov.

Perennial. Stems spreading, 1–8 dm. long, densely pubescent with spreading hairs. Stipules lanceolate-acuminate, 4.5–5 mm. long. Petioles 3–6 mm. long, densely spreading-pubescent. Petiolar gland single, toward distal end of petiole, sessile, more or less raised, saucer-shaped. Leaflets four to seven pairs, 7–10 mm. long, 2–4 mm. wide, oblanceolate, mucronate, densely pubescent with somewhat incurved hairs. Pedicels one or two, 15–20 mm. long, pubescent with spreading upcurved hairs. Sepals 8–9 mm. long, lanceolate-acuminate, hirsute. Petals 9–10 mm. long, the anterior but slightly exceeding the laterals. Stamens ten, unequal; anthers 7–8 mm. long, gradually narrowed above, reddish-purple. Legumes 4–4.5 cm. long, 4–5 mm. wide, puberulent with incurved hairs. Seeds twelve, 3 mm. long.

Type, rocky pine woods, Big Pine Key, Monroe County, Florida, collected in flower May 2, 1917, *F. W. Pennell 9553* in the herbarium of the New York Botanical Garden.

The Antillean *C. grammica* (Spreng.) Pollard, with which this has been identified, differs by its appressed pubescence and conspicuously stalked glands.

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* As in preceding lists, one specimen (rarely several) from a county is cited, county-names being arranged alphabetically. For herbaria cited see Bull. Torrey Club 43: 94. 1916.

Rocky or sandy pine-lands, Florida Keys.

Florida. Monroe: Big Pine Key, *J. K. Small 3785, 3790* <November 17 (Y); No-name Key (U, Y); Ramrod Key (Y).

5. **Chamaecrista Deeringiana** Small & Pennell, sp. nov.

Perennial, from a horizontal rhizome. Stems erect, slender, purple or purplish, 3–6 dm. tall, glabrous or sparingly puberulent above with incurved hairs. Stipules strongly ridge-veined, glabrous, 7–10 mm. long. Petioles 5–8 mm. long, sparingly appressed-puberulent to glabrous. Petiolar gland single, depressed-discoid, 1–1.5 mm. wide, brown. Leaflets 10–20 pairs, 10–20 mm. long, 2–3 mm. wide, lanceolate-linear, acute-mucronate, glabrous, not ciliate, shining, finely ascending ridge-nerved; midrib excentric. Pedicels one to four in a fascicle, 10–20 mm. long, very slender, glabrous to more rarely sparingly puberulent in lines with incurved hairs. Sepals 10–12 mm. long, lanceolate, acuminate, not dilated nor white-margined below, glabrous to finely pulverulent. Petals 14–18 mm. long, anterior slightly exceeding laterals. Stamens ten, unequal, 2 longer; anthers 8–9 mm. long, yellow or reddish. Legumes 6.5–8.5 cm. long, 5 mm. wide, 1 mm. thick, brown, thick-walled (seed-cavities scarcely visible externally), sparingly finely appressed-puberulent to glabrous. Seeds twelve to fifteen, 3.8–4 mm. long, dark purplish-brown.

Type, pine-lands near Silver Palm, Dade County, Florida, collected in flower and fruit June 22, 1915, *J. K. Small, C. A. Mosier & G. K. Small 6454*, in the herbarium of the New York Botanical Garden.

Has been confused with *C. brachiata*.

Pine-lands on Miami limestone, mainland, and on Big Pine Key, southern Florida.

Florida. Dade: Brogdon Hammock; Cocoanut Grove; Cutler; Homestead; Long Prairie; Miami, *N. L. Britton 197* > March 24 (Y); Murden Hammock; Silver Palm; near Timms Hammock, *F. W. Pennell 9540* > April 28 (Y). Monroe: Big Pine Key, *J. K. Small 3781* ≷ November 17, (Y).

6. Chamaecrista brachiata Pollard

Chamaecrista brachiata Pollard, Proc. Biol. Soc. Wash. **15**: 20. Feb. 18, 1902. "Type, No. 330,115, in the United States National Herbarium, collected by Charles L. Pollard and G. N.

Collins at Miami, Dade County, Florida, April 4–7, 1898 (No. 245)." Type seen in the United States National Herbarium.

Annual. Stems erect, 8–12 dm. tall, glabrous or sparingly puberulent above with incurved hairs. Stipules lanceolate-acuminate, glabrous or nearly so, not ciliate, 5–8 mm. long. Petioles 4–8 mm. long, sparingly appressed-puberulent to glabrous. Petiolar gland single, or occasionally two or three and serially placed, closely sessile, effused-discoid to saucer-shaped, 1–2.5 mm. wide, brown. Leaflets ten to twenty-five pairs, 10–20 mm. long, 2–3 mm. wide, linear-lanceolate, acute-mucronate, glabrous, not ciliate, obscurely nerved. Pedicels 1–4 in a fascicle, 10–20 mm. long, glabrous to more rarely sparingly puberulent in lines with incurved hairs. Sepals 10–12 mm. long, lanceolate, acuminate, glabrous or nearly so. Petals 10–18 mm. long, anterior slightly exceeding laterals. Stamens ten, unequal, 2 longer; anthers 7–9 mm. long, reddish to purplish (?). Legumes 6–8 cm. long, 5–5.5 mm. wide, sparingly finely appressed-puberulent. Seeds fifteen to eighteen, 3–3.2 mm. long, dark brown.

Dry pine-land, peninsular Florida (perhaps also in southern Alabama).

FLORIDA. Brevard: Merritt's Island, *A. A. Baldwin 23* < September 1 (A). Dade: Miami, *C. L. Pollard & G. N. Collins 245* < April 4–7 (U, Y). Duval: Jacksonville, *A. H. Curtiss 5156* > August 27 (U, Y). Hillsboro: Tampa, *N. L. Britton & P. Wilson 7* ≷ August 25 (Y). Lake: Eustis, *G. V. Nash 701* > May 1–15 (U, Y). Lee: Pine Island, *S. M. Tracy 7242* > May 14 (P, U, Y). Manatee: Bradentown, *S. M. Tracy 7089* > June 15 (P, U, Y). Marion: Fort King, *Lieut. Alden* (Y). Orange: Clarcona, *M. Meislahn 127* ≷ November 30 (U). Pinellas: Clearwater Key, *S. M. Tracy 6536* > April 21 (U). Polk: Lakeland, *Mrs. T. Meehan* ≷ March (A). Ste. Lucie: Fort Pierce, *A. B. Burgess 724* > April 8–9 (Y). Suwanee: Live Oak, *F. W. Pennell 9799* > May 23 (Y).

(?) ALABAMA. Baldwin: Bay Minette, *J. M. Macfarlane & O. Goertz* > June 15 (P), apparently this, but petiolar gland is quite small.

7. CHAMAECRISTA ROSTRATA Wooton & Standley

Chamaecrista rostrata Wooton & Standley, Contrib. U. S. Nat. Herb. **16**: 135. F 12 1913. "Type in the U. S. National

Herbarium, no. 660032, collected in sandy soil at Logan [New Mexico], October 5, 1910, by Mr. Geo. L. Fisher (no. 93)." Type seen in United States National Herbarium.

Annual. Stem erect, 1–3 dm. tall, branched, finely puberulent over entire surface with ascending-incurved hairs. Stipules lanceolate-attenuate, glabrous or nearly so, slightly ciliate, nerved, 4–6 mm. long. Petioles 2–4 mm. long, finely puberulent with incurved hairs. Petiolar gland single, toward distal end of petiole, sessile, slightly saucer-shaped, 0.07–0.2 mm. wide, brown. Leaflets five to nine pairs, 7–12 mm. long, 2–3 mm. wide, oblong, obtuse, shortly mucronulate, glabrous, scarcely finely ciliolate, paler beneath, faintly nerved. Bracteoles 2–3 mm. long, lanceolate-attenuate. Pedicels one or two in a fascicle, 7–10 mm. long, finely puberulent with incurved hairs. Sepals 7–10 mm. long, ovate-acuminate, puberulent on the midrib. Petals 10–15 mm. long, ovate-acuminate, puberulent on the midrib. Petals 10–15 mm. long, anterior exceeding laterals. Stamens ten, unequal, two longer; anthers 6–8 mm. long, purple. Legumes 3–4.5 cm. long, 4–5 mm. wide, appressed-puberulent with an evident beak, 1–2 mm. long. Seeds six to nine, 3 mm. long.

Sandy soil, Staked Plains of northwestern Texas, southwestern Kansas and eastern New Mexico.

Kansas. Morton: Richfield, *J. N. Rose 17169* ≳ September 20 (U).

Texas. Hemphill: Canadian, *A. H. Howell 87* > July (U). "Staked Plains," *G. W. Holstein* (A).

New Mexico. Quay: Logan, *G. L. Fisher 93* > October 5 (U).

8. Chamaecrista fasciculata (Michx.) Greene

Cassia fasciculata Michx. Fl. Bor. Amer. 1: 262. 1803. "*Hab.* in Pensylvania et Virginia." Type not seen nor verified, but description sufficiently indicates this plant.

Chamaecrista fasciculata ["*fascicularis*"] Greene, Pittonia 3: 242. 1897.

Chamaecrista bellula Pollard, Proc. Biol. Soc. Wash. 15: 19. 1902. "Type in the United States National Herbarium, collected by Prof. S. M. Tracy at St. Vincent, Florida, September 9, 1899 (No. 6,326)." Type, collected September 4, 1899, seen in the United States National Herbarium. Perhaps a small-leaved form of the southern Coastal Plain.

Chamaecrista camporum Greene, Pittonia 5: 108. 1903. "Type specimens collected by myself at Monticello, Illinois, 7 August, 1899." Type not seen nor verified, but description evidently of this species.

Cassia Chamaecrista L. (Sp. Pl. 379. 1753. "*Habitat in* Jamaica, Barbados, Virginia") is composite, and should be typified by "Chamae Crista pavonis americana, siliqua multiplici," Breyn. Cent. 66: *pl. 24*, from Curaçao. This is the species usually known as *Cassia diffusa* DC., an ally of *C. nictitans* L. The Linnaean diagnoses, here, in Hort. Ups. 101, 1748, and in Hort. Cliff. 158, 1737, will apply to this, the phrase "glandula petioli pedicellata" directly excluding our plant.

Annual. Stem erect, 3–9 dm. tall, much branched, puberulent in lines with ascending incurved hairs. Stipules linear-attenuate, glabrous or nearly so, ciliate, many-nerved, 5–10 mm. long. Petioles 5–8 mm. long, puberulent with incurved hairs. Petiolar gland single, near middle or toward distal end of petiole, sessile or nearly so, depressed saucer-shaped, round or slightly oval, 0.5–1.5 mm. wide, dark brown to brown. Leaflets six to twelve (or fifteen) pairs, 10–20 mm. long, 2–5 mm. wide, oblong-linear, obtuse to acute, shortly mucronulate to mucronate, glabrous (rarely very finely puberulent), finely ciliolate, paler beneath, evidently nerved. Bracteoles 3–5 mm. long, linear-attenuate. Pedicels one to six in a fascicle, 10–20 mm. long, finely or sparsely puberulent with incurved (rarely somewhat spreading, then short) hairs. Sepals 9–12 mm. long, lanceolate-acuminate, more or less pubescent on the midrib. Petals 10–17 mm. long, anterior slightly exceeding laterals. Stamens ten, unequal, two longer; anthers 8–10 mm. long, yellow or reddish (especially southwestward). Legumes 4–5 cm. long, 5–5.5 mm. wide, appressed-puberulent or glabrate on the sides, with a beak usually short but reaching 1.5 mm. long. Seeds six to fifteen, 3–3.2 mm. long.

Moist to dry, usually sandy, open places, southeastern Massachusetts to Florida and central Texas, inland to northern Ohio, southern Minnesota and central Kansas. Abundant in many parts of the southeast, especially in the Atlantic Coastal Plain. Northeast of Virginia, rare above the Fall Line, on the Serpentine and occasionally elsewhere in southeastern Pennsylvania.

Variable, and doubtless hybridizes with allied species. Southeastward probably passes into the little-known variety γ southward through the lower Alleghenies and the lower Mississippi valley passes into the very pronounced variety β.

MASSACHUSETTS. Barnstable: Woods Hole, *T. Morong* > August 10 (Y); also Plymouth County.

RHODE ISLAND. Providence: East Providence, *J. F. Collins* > August 26 (U); also Washington County.

CONNECTICUT. Fairfield: Greens Farms, *C. L. Pollard 232* ≧ August 16 (U).

NEW YORK. Nassau: Long Beach, *F. W. Pennell 2312* ≧ October 12 (Y); also Bronx, Richmond, Suffolk and Westchester Counties.

NEW JERSEY. Cape May: Cape May, *F. W. Pennell 2223* > August 4 (U); also Atlantic, Bergen, Camden, Cumberland, Gloucester, Middlesex, Monmouth, Ocean, Passaic and Somerset Counties.

PENNSYLVANIA. Delaware: Williamson School (serpentine). *F. W. Pennell 1640* (Y); also Allegheny, Beaver, Berks, Chester, Dauphin, Huntingdon, Lancaster and Montgomery Counties.

DELAWARE. Sussex: Milton, *A. Commons* > August 17 (A).

MARYLAND. Cecil: Bacon Hill, *F. W. Pennell 1616* > August 4 (Y); also Dorchester and Queen Anne Counties.

VIRGINIA. Princess Anne: Virginia Beach, *T. H. Kearney 2136* < October 6 (U); also Accomac, Fairfax, Hanover, Norfolk and Warren Counties.

WEST VIRGINIA. Jefferson: Harpers Ferry, *Detwiller*, August 6 (A).

NORTH CAROLINA. Buncombe: Biltmore, *Biltmore herbarium 180b* > July 30 (P, U, Y); also Carteret, Cherokee, Craven, Forsyth, Orange, Polk and Rowan Counties.

SOUTH CAROLINA. Orangeburg: Eutawville, *W. W. Eggleston 4980* > September 6–11 (Y); also Aiken and Berkeley Counties.

GEORGIA. Chattooga: Summerville, *C. L. Pollard & W. R. Maxon 446* > August 7–8 (U). Gilmer: Ellijay, *J. K. Small* > August 13–16 (Y). Sumter: *R. M. Harper 1003* > July 5 (U, Y). Whitfield: Dalton, *R. M. Harper 396* > August 10 (U, Y).

FLORIDA. Franklin: St. Vincent (Id.), *S. M. Tracy 6326* < September 4 (U, Y).

ALABAMA. Clay: Talladega Creek, *C. Mohr* > August 1 (U). Dekalb: Mentone, *C. Mohr* ≧ September 2 (U). Jefferson: Birmingham, *C. Schuchert* > October 9 (U, Y). Lee: Auburn,* *F. S. Earle & C. F. Baker* > August 17 (Y).

Mississippi. Carroll: *E. Smith* (U).

Tennessee. Chester: Henderson, *S. M. Bain 54 p.p* > August (Y). Knox: Knoxville, *A. Ruth 2202* > June (Y). Marion: South Pittsburg, *C. L. Pollard & W. R. Maxon 409* > August 3–4 (U, Y). Monroe: Madisonville, *F. L. Scribner* > August (U). Roane: Post Oak Springs, *C. L. Pollard & W. R. Maxon 413* > August 6 (U).

Kentucky. On Red River, *R. Peter* > July (Y).

Ohio. Erie: Oxford prairie, *E. L. Moseley* > August 6 (U).

Indiana. Newton: Roselawn, *H. Hahn* (U).

Illinois. Cook: Calvary,* *F. C. Gates* > August 21 (U); also Vermilion* County.

Wisconsin: Trempeleau: Trempeleau, *T. J. Hale* (A).

Minnesota. Brown: Sleepy Eye, *E. P. Sheldon* > July (U, Y); also Houston and Nicollet Counties.

South Dakota. Minnehaha: Sioux Falls, *Thornber* > August (U).

Iowa. Story: Ames, *L. H. Pammel & C. R. Ball 20* > July 18 (U, Y); also Buchanan, Decatur, Fayette, Hardin and Johnson Counties.

Nebraska. Lancaster: Lincoln, *J. G. Smith* > September (C); also Cass County.

Missouri. Greene: Springfield, *P. C. Standley 8322* > August 28 (U). Jackson: Courtney, *B. F. Bush 6489* ≷ August 19 (U, Y). Marion: Oakwood, *J. Davis 302* > July 17 (U). Mississippi: Charleston, *O. Kuntze 2862* < September 9 (Y). St. Louis: St. Louis, *N. Riehl 87* > August (Y). Washington: Potosi, *F. Peck* (U).

Kansas. Geary: Fort Riley, *E. E. Gayle 538* > July 20 (Y); also Douglas, Lyon, Riley and Shawnee Counties.

Arkansas. Miller: Texarkana, *A. A. & E. G. Heller 4133* > August 23 (A, U, Y) (leaflets minutely puberulent). Nevada: 4 m. se. of Prescott, *M. P. Hollister 25* > June 17 (U). Pulaski: Little Rock, *H. E. Hasse* (Y).

Oklahoma. Creek: Sapulpa, *F. W. Pennell 5392* > September 8 (P). Payne: Stillwater, *F. A. Waugh 358* (U).

* Approaching *C. fasciculata* β.

LOUISIANA. Caddo: Shreveport, *Gregg* > September 4 (A).

TEXAS. Hays: San Marcos and vicinity, *S. W. Stanfield* (Y). Parker: Weatherford, *S. M. Tracy 8026* > June 3 (P, Y). Travis: Austin, *F. W. Pennell 5430* > September 13 (P) (anthers purple). Walker: Huntsville, *R. A. Dixon 400* > July 9–12 (Y).

8a. CHAMAECRISTA FASCICULATA β

Cassia Chamaecrista robusta Pollard, Bull. Torrey Club **21**: 218. 1894. "Type a single specimen in the Columbia College Herbarium collected by Dr. C. W. Short in the mountains of Kentucky." Type seen in the herbarium of Columbia University at the New York Botanical Garden.

Cassia robusta Pollard, *l.c.* **24**: 150. 1897.

Chamaecrista robusta Pollard; Heller, Cat. N. A. Pl. 2d ed. 5. 1900.

Stem stouter, 6–15 dm. tall, more or less densely hirsute above with spreading hairs. Stipules lanceolate-attenuate, 10–14 mm. long. Petioles hirsute-pubescent. Leaflets nine to eighteen pairs, 15–20 mm. long, 3–6 mm. wide. Bracteoles 4–6 mm. long. Pedicels 15–25 mm. long, hirsute with spreading hairs. Sepals hirsute on the midrib. Petals 15–20 mm. long. Legumes 5–7 cm. long, 6–7 mm. wide, hirsute-pubescent. Otherwise as in the species.

Moist to dry soil, more frequently in low ground, and most abundant on alluvial soil, southern Ohio to northern Florida, eastern Missouri and Louisiana. Throughout the lower Mississippi valley, mostly in alluvial soil; also pushing up into the valleys of the southern Alleghenies. In southern Louisiana, where I have collected it, seemingly quite distinct from *C. fasciculata*, but study of specimens shows a surprising number of intermediates.

GEORGIA. Clarke: *R. M. Harper* > (Y). Floyd: Rome, *G. McCarthy 311* > July (U).

FLORIDA. Leon: Tallahassee, *N. K. Berg* (Y).

ALABAMA. Baldwin: Tensaw, *S. M. Tracy 8009, 8038* > August 22 (P, U, Y). Barbour: Eufaula, *G. McCarthy* > August (U). Clay: Delta, *C. Mohr* (U). Lee: Auburn, *F. S. & E. S. Earle 30* > September 14 (U, Y).*

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* Approaching the typical form of the species.

MISSISSIPPI. Franklin: Florence, *E. G. Holt 17* > July 25 (U). Jasper: *S. Deavoms 2942* (U). Noxubee: Prairie Point, *Mrs. P. A. L. Carpenter* ≷ *October* (U). Oktibbeha: Agricultural College, *C. L. Pollard 1276* > August 11–17 (U, Y).

TENNESSEE. Chester: Henderson, *S. M. Bain 54 p.p.* > August (U, Y). Franklin: Cowan, *A. Ruth* > July (U).*

KENTUCKY. Lincoln: Crab Orchard, *C. W. Short* (A). "Mountains of Kentucky," *C. W. Short* (A, Y).

OHIO. "In ditione Miami," *Dr. Frank* (U).

ILLINOIS: Cass: Little Indian, *F. C. Gates* > July 7 (U). Peoria: Peoria, *F. E. McDonald* > September (Y). Richland: *R. Ridgway* (U).

MISSOURI. Polk: Graydon Springs, *P. C. Standley 9895* ≷ September 7 (U). St. Louis: St. Louis, *O. Kuntze 2773* > September 6 (Y).

ARKANSAS. Ouachita: Camden, *A. H. Howell 618* > July 7 (U).

LOUISIANA. Avoyelles: Marksville, *W. L. McAtee 2185* > September 12 (U). West Feliciana: Baines, *F. W. Pennell 4275* > August 21 (P, Y).

8*b*. CHAMAECRISTA FASCICULATA γ

Cassia depressa Pollard, Bull. Torrey Club **22**: 515. *pl. 25*. 1895.

"Low pine woods, River Junction, Gadsden Co., Florida. G. V. Nash, September 5, 1895 (no. 2571)." Type seen in the herbarium of Columbia University at the New York Botanical Garden.

Chamaecrista depressa Greene, Pittonia **3**: 242. 1897.

Stems spreading-ascending, slender, 1–3 dm. tall, diffusely branched below. Petioles 2–5 mm. long. Petiolar gland .3–1 mm. wide. Leaflets six to ten pairs, 8–12 mm. long, 2–3 mm. wide. Bracteoles 3–4 mm. long. Pedicels 1–3 in a fascicle, hirsute with spreading, and also in part with fine incurved hairs. Sepals 8–10 mm. long, hirsute on the midrib. Legumes spreading-pubescent. Otherwise as in the species. Not satisfactorily known, but certainly not a distinct species.

Open pine-woods, Apalachicola River hills, northwestern Florida.

FLORIDA. Gadsden: Chattahoochee, *S. M. Tracy 3956* >

August 23 (U, Y); River Junction, *A. H. Curtiss 5980* > September 8 (U, Y).

9. CHAMAECRISTA MISSISSIPPIENSIS (Pollard) Pollard

Cassia mississippiensis Pollard, Bull. Torrey Club **21**: 219. 1894. "Type in herbarium of Columbia College, collected by Miss K. Skeehan, 1889, at Ocean Springs, Mississippi." Type collected November 7, 1889, seen in the herbarium of Columbia University at the New York Botanical Garden. Several specimens on sheet; these, originally described as "suffruticose," are apparently lateral shoots of a dwarfed diffusely branched plant.

Chamaecrista mississippiensis Pollard; Heller, Cat. N. A. Pl. 2d ed. 5. 1900.

Chamaecrista Tracyi Pollard, Proc. Biol. Soc. Wash. **15**: 21. 1902. "Type in the United States National Herbarium, collected by Prof. S. M. Tracy at Koshtaw, Miss., September 15, 1898." Type, *Tracy 4914*, collected October 15, 1898, seen in the United States National Herbarium.

Annual. Stem erect or ascending, 2–6 dm. tall, slender, often diffusely branched at base, finely puberulent with ascending incurved hairs. Stipules lanceolate-attenuate, glabrous or nearly so, ciliate, 4–7 mm. long. Petioles 2–5 mm. long, puberulent with incurved hairs. Petiolar gland single, sessile, depressed saucer-shaped, .3–.6 mm. wide, dark-brown. Leaflets six to fifteen pairs, 5–12 mm. long, 2–3 mm. wide, ellipsoid linear-lanceolate, acutish to acute-mucronate, appressed-puberulent, not ciliate, obscurely nerved. Bracteoles 2–3 mm. long, linear-attenuate. Pedicels one to three in a fascicle, 6–15 mm. long, finely puberulent with incurved hairs. Sepals 5–10 mm. long (in the bud longer than the petals), linear-lanceolate, long-attenuate, appressed-puberulent. Petals 8–15 mm. long, anterior slightly exceeding laterals. Stamens ten, unequal, two longer; anthers 7–9 mm. long, yellow. Legumes 3–5 cm. long, 5 mm. wide, appressed-puberulent. Seeds six to fifteen.

Moist sandy pine-land, southern Mississippi and Louisiana, extending apparently into southern Alabama and southeastern Texas.

ALABAMA. Lee: Auburn, *F. S. Earle & C. F. Baker* > August (U).

MISSISSIPPI. Copiah: *L. R. Gibbes* > August (Y). Harrison: Biloxi, *F. W. Pennell 4378* > August 28 (P). Jackson: Scranton, *S. M. Tracy 4436* > August 29 (U).

LOUISIANA. Caddo: Shreveport, *F. S. Earle* > June (Y). Plaquemines: Breton Island, *S. M. Tracy & F. E. Lloyd 198 p.p.* > August 17 (P). Rapides: Alexandria, *C. R. Ball 540 p.p.* > June 3 (U, Y). St. Landry: Opelousas, *C. Mohr* > March 15 (U). St. Tammany: Abita Springs, *F. W. Pennell 4228* > August 16 (P, Y).

TEXAS. Harris: La Porte, *G. L. Fisher 643* > August 15 (U).

9*a*. CHAMAECRISTA MISSISSIPPIENSIS β

Chamaecrista littoralis Pollard, Proc. Biol. Soc. Wash. **15**: 20. 1902. "Type, No. 371,572 in the United States National Herbarium, collected by Prof. S. M. Tracy and Prof. F. E. Lloyd on Breton Island, La., August 17, 1900 (No. 198)." Type seen in the herbarium of the United States National Museum.

Stems mostly stouter, 4–8 dm. tall, erect. Leaflets 7–15 mm. long. Pedicels hirsute with spreading, sometimes also with shorter incurved hairs. Legumes hirsute-pubescent. Otherwise as in the species.

Sandy soil, in the Coastal Plain, mostly near the Gulf coast, on dunes and in pine-land, western Florida to eastern Texas.

FLORIDA. Wakulla: St. Marks, *F. Rugel* > June (Y).

ALABAMA. Mobile: Hollanders Island, *F. W. Pennell 4506* > September 2 (P, Y); Theodore, *F. W. Pennell 4444* > August 30 (P, Y).

MISSISSIPPI. Clarke: Shubuta, *C. Schuchert* > October 11 (U). Harrison: Cat Id., *F. E. Lloyd & S. M. Tracy 183* ≧ August 26 (U, Y). Jackson: Horn Id., *S. M. Tracy 6927* > July 14 (U). Wayne: Waynesboro, *C. L. Pollard 1217* > October 8–9 (U, Y).

LOUISIANA. Calcasieu: Lake Charles, *S. M. Tracy 3957* > August 7 (U). Plaquemines: Breton Island, *F. E. Lloyd & S. M. Tracy 198 p.p.* < August 17 (U, Y.).

TEXAS. San Augustine: San Augustine, *G. L. Crocket* (U).

10. Chamaecrista puberula Greene

Chamaecrista puberula Greene, Pittonia 5: 134. 1903. "On Galveston Island [Texas], 23 Sept. 1901 [S. M. Tracy]." Co-type of Tracy, *7797*, seen in the herbarium of the New York Botanical Garden.

Annual. Stem erect, 4–8 dm. tall, puberulent with ascending-incurved hairs. Stipules lanceolate-acuminate, nerved, puberulent, finely ciliate, 4–5 mm. long. Petioles 3–6 mm. long, puberulent with incurved hairs. Petiolar gland single, short-pediceled to sessile, discoid to slightly saucer-shaped, 0.5–1 mm. wide, dark-brown. Leaflets ten to fifteen pairs, 10–18 mm. long, 2–4 mm. wide, linear-lanceolate, acutish to acute-mucronate, densely puberulent, not ciliate, midrib evident, elsewhere obscurely nerved. Bracteoles 1–2 mm. long, lanceolate-ovate. Pedicels one to three in a fascicle, 5–20 mm. long, puberulent with incurved hairs. Sepals 6–8 mm. long (in the bud shorter than the petals), ovate-lanceolate, acute to short-acuminate, pubescent. Petals 10–15 mm. long, anterior slightly exceeding laterals. Stamens 10, unequal, 2 longer; anthers 4–5 mm. long, deep purple. Legumes 5–6 cm. long, 4–5 mm. wide, appressed-puberulent. Seeds eight to fourteen, 3.7–4 mm. long.

Moist to dry sandy soil, southern Texas.

Texas. Colorado: Sheridan, *F. W. Pennell 5538* > September 21 (P, Y). Dewitt: Cuero, *A. H. Howell 252* > July 7 (U). Galveston: Galveston, *F. W. Pennell 5574* > September 23 (P, Y). Lavaca: Hallettsville, *G. L. Fisher 126* ≷ August (U). Nueces: Kings Ranch, *V. Bailey 251* > May 10 (U). Robertson: Hearne, *F. W. Pennell 5418* > September 11 (P, Y). Webb: Laredo, *A. Schott 110* > June (Y). Wharton: Pierce, *S. M. Tracy 7796* > September 16 (U, Y), anther-sacs yellowish or reddish.

11. Chamaecrista leptadenia (Greenman) Cockerell

Cassia leptadenia Greenman, Proc. Amer. Acad. 41: 238. 1905. "48 km. east of El Paso, May to October, 1849, *Chas. Wright*, no. 154 (hb. Gray)." Co-type seen in the United States National Herbarium.

Chamaecrista leptadenia Cockerell, Muhlenbergia 4: 68. 1908.

Annual. Stem erect, slender, 1–5 dm. tall, sparingly branched, puberulent in lines with incurved to spreading hairs. Stipules linear-attenuate, glabrous or nearly so, conspicuously ciliate, nerved, 5–7 mm. long. Petioles 2–5 mm. long, puberulent with incurved hairs. Petiolar gland single, stalked, discoid, 0.2–0.3 mm. wide, nearly black, stalk brown. Leaflets twelve to sixteen pairs, 8–12 mm. long, 1–2 mm. wide, oblong-linear, acutish, mucronate-tipped, glabrous, strongly ciliate, obscurely nerved. Bracteoles 1–1.7 mm. long, lanceolate. Pedicels one or two in a fascicle, 3–5 mm. long, appressed-puberulent. Sepals 4–5 mm. long, lanceolate, acuminate, hirsute. Petals 3–6 mm. long, anterior twice exceeding laterals. Stamens unequal; anthers 2 mm. long, yellow (?). Legumes 3–4.2 cm. long, 3–4 mm. wide, appressed-puberulent. Seeds ten to eighteen, 3 mm. long, very thin, light-brown.

Dry soil, western Texas to southeastern Arizona.

TEXAS. El Paso: *C. Wright 154* (U). Presidio: Chenates region, *G. C. Nealley 541* (U).

NEW MEXICO. Dona Ana: Organ Mountains, *E. O. Wooton 435* < September 1 (Y). Luna: Floridas, *A. I. Mulford 1038a* > August 2 (Y).

ARIZONA. Cochise: Bowie; Chiricahua Mts., *J. C. Blumer 2086* > August 30 (U); Fort Huachuca; Tucson. Pima: Santa Rita Mountains, *D. Griffiths & J. J. Thornber 212* (U, Y).

12. CHAMAECRISTA NICTITANS (L.) Moench

Cassia nictitans L. Sp. Pl. 380. 1753. "*Habitat in* Virginia." Typified by L. Hort. Cliff. 497. *pl. 36*, 1737, where an excellent description and figure are given.

Cassia procumbens L. *l.c.* 380. 1853. "*Habitat in* Indiis." Based wholly upon "Cassia americana procumbens, herbacea, mimosae foliis, floribus parvis, siliquis angustis, planis," A. J. A[mmann], Comm. Petrop. **12**: 238–242 (cited erroneously by Linnaeus as "Comm. petrop. t. 11"). This is fully described and is unquestionably *Chamaecrista nictitans* (L.) Moench. The type-locality is stated "circa Philadelphiam urbem in Pensylvania, Americae septentrionalis provincia, sitam." There appears to have been no specimen in the Linnean herbarium in 1753, and the species is not checked by Linnaeus until his third list in 1767. The West Indian plant known until recently by this name has been described by Dr.

Britton as *Chamaecrista micrantha* Britton, Bull. Torrey Club 43: 463. O 20 1916.

Chamaecrista nictitans Moench, Meth. 272. 1794.

Nictitella amena Raf. Sylv. Tellur. 128. 1838. New name for *Cassia nictitans* L., type of the genus *Nictitella* Raf.

Cassia Chamaecrista nictitans Kuntze, Rev. Gen. Pl. 1: 169. 1891.

Chamaecrista nictitans commixta Pollard & Maxon, Proc. Biol. Soc. Wash. 14: 163. 1901. "Type in U. S. National Herbarium, No. 357,069, collected by Charles L. Pollard and William R. Maxon in alluvial soil along the New River at Quinnimont, W. Va., August 21, 1899 (No. 31)." Type seen in the United States National Herbarium.

Cassia nictitans commixta Millsp. W. Va. Geol. Surv. 5: 283. 1913.

Annual. Stem erect, 1–4 dm. tall, much branched, puberulent with incurved hairs. Stipules lanceolate-attenuate, glabrous or nearly so, ciliate, nerved, 5–8 mm. long. Petioles 4–9 mm. long, puberulent with incurved hairs. Petiolar gland single, shortly below proximal leaflets, stalked, discoid or nearly so, 0.3–0.8 mm. wide, dark-brown. Leaflets nine to eighteen pairs, 7–15 mm. long, 2–4 mm. wide, oblong-linear, obtuse, mucronate, glabrous, not ciliate, paler beneath, obscurely nerved. Bracteoles 1.5–2 mm. long, lanceolate. Pedicels one to two or three in a fascicle, 2–4 mm. long, appressed-puberulent. Sepals 3–4 mm. long, lanceolate, acuminate, puberulent on the midrib. Petals 3–8 mm. long, anterior twice exceeding laterals. Stamens unequal, five; anthers 2 mm. long, pinkish. Legumes 2.5–4 cm. long, 4–6 mm. wide, appressed-pubescent. Seeds six to nine, 3 mm. long, thick, dark-brown.

Sandy soil, or sterile soil, frequently along roadsides, probably near the borders of its range introduced, southern Vermont and Rhode Island, to eastern Kansas, Georgia and Texas.

VERMONT. Windham: Vernon, *A. J. Grout* > August 6 (U).

RHODE ISLAND. Providence: Elmwood, J. F. Collins > August 25 (U).

CONNECTICUT. Fairfield: Bridgeport, *E. H. Eames* < September 14 (U).

NEW YORK. Westchester: Mount Kisco, *F. W. Pennell 6713* < September 26 (Y); also Albany, Bronx, Orange, Putnam, Queens, Rensselaer, Richmond and Suffolk Counties.

New Jersey. Bergen: Alpine, *F. W. Pennell 6532* < September 12 (Y); also Atlantic, Burlington, Camden, Cape May, Gloucester, Middlesex, Morris, Ocean and Sussex Counties.

Pennsylvania. Chester: Unionville, *F. W. Pennell 992* < October 3 (A); also Beaver, Berks, Bucks, Delaware, Lancaster, Lehigh, Montgomery, Northampton and Philadelphia Counties.

Delaware. Sussex: Milton, *A. Commons* > August 17 (A); also Kent and Newcastle Counties.

Maryland. Queen Anne: *E. G. Vanatta* > August 29 (A).

Virginia. Augusta: Staunton, *W. A. Murrill* < September 5 (Y); also Botetourt, Hanover, and Princess Anne Counties.

West Virginia. Fayette: Quinnimont, *C. L. Pollard & W. R. Maxon 31, 39* $\geqq$ August 21 (U, Y); also Ritchie County.

North Carolina. Buncombe: Biltmore, *Biltmore Herbarium 181b* > August 14, < September 28 (P, U, Y); also Cherokee, Craven, Haywood, Iredell, Orange, Polk and Swain Counties. Pasquotank: Elizabeth City, *F. L. J. Boettcher 291* > August 26 (U, Y) (leaflets but 6–7 mm. long and pubescence of upper part of stem spreading; perhaps a coastal form).

South Carolina. Pickens: Six Mile Creek, *H. D. House 3078* < October 22 (U).

Georgia. Chattooga: Summerville, *C. L. Pollard & W. R. Maxon 435* > August 7–8 (U). DeKalb: Stone Mountain, *C. L. Pollard & W. R. Maxon 463* > August 10–12 (U). Whitfield: Dalton, *R. M. Harper 395* > August 10 (U, Y).

Alabama. Clay: Elders, *C. Mohr* > July 30 (U). Dekalb: Mentone, *C. Mohr* > September 1 (U). Lee: Auburn, *F. S. Earle* > September 12 (Y).

Mississippi. Claiborne: Martin, *J. W. White 2944* > September 12 (U). Oktibbeha: Starkville, *S. M. Tracy 1422* < September 1 (U, Y).

Tennessee. Knox: Knoxville, *A. Ruth 291* $\geqq$ August (Y).

Kentucky. Bell: Pine Mt., *T. H. Kearney 496* < September (U); also Lyon County.

Ohio. Fairfield: Lancaster, *W. A. Kellermann* > August 18 (U).

Indiana. Lake: Tolleston, *V. H. Chase 298* < September 23 (A).

Illinois. Henderson: Oquawka, *H. N. Patterson* (U).

Missouri. Barry: Eagle Rock, *B. F. Bush 44* < September 28 (U, Y); also Greene, St. Louis and Scott Counties.

Kansas. Cherokee: *A. S. Hitchcock 668* (U, Y).

Arkansas. Benton: *E. N. Plank* (Y). Pulaski: Little Rock, *H. E. Hasse* > August 26 (Y).

Oklahoma. Le Flore: "9 m. west of Fort Smith," *J. M. Bigelow* (U).

Louisiana. Rapides: Alexandria, *J. Hale* (Y). West Feliciana: Catalpa, *F. W. Pennell 4278* > August 21 (P, Y).

Texas. Burnet: Marble Falls, *E. N. Plank* > August 10 (Y).

12*a*. Chamaecrista nictitans β

Cassia multipinnata Pollard, Bull. Torrey Bot. Club **22**: 515. *pl. 250.* 1895. No type indicated, and first specimen listed, Curtiss 712 (cited as "512"), is composite, consisting of plant described and in part of *Chamaecrista aspera*. Second specimen cited, "Near Jacksonville, A. H. Curtiss, North American Plants . . . second distribution, No. 5157, September 15, and October 27, 1894," is taken as the type. Type seen in the herbarium of the United States National Museum.

Cassia multipinnata Nashii Pollard, *l.c.* 515. 1895. "Collected in low pine woods, River Junction, Gadsden Co., Florida, by Mr. Nash, Sept. 5, 1895 (2577)." Type seen in the herbarium of the New York Botanical Garden.

Chamaecrista multipinnata Greene, Pittonia **3**: 243. 1897.

Stem 1–5 dm. tall. Stipules linear-attenuate. Leaflets fifteen to twenty-six pairs, 1–2 mm. wide. Legumes 4–5 mm. wide. Seeds six to twelve. Otherwise as in the species.

Sandy soil, in the Coastal Plain, especially in the pine-land, South Carolina to southern Mississippi. In the long-leaf pineland replacing the species, of which it may be no more than an ecological form.

South Carolina. Aiken: Aiken, *H. W. Ravenel* (U).

Georgia. Bibb: Macon, *J. M. Green* (A). Brooks: Quitman, *R. M. Harper 1632* > September 13 (U, Y). Burke: *M. H. Hopkins 19* > September 9 (Y). Sumter: Americus, *S. M. Tracy 3958* > August 20 (U).

FLORIDA. Alachua: Gainesville, *H. S. Fawcett* < November (P). Duval: Jacksonville, *A. H. Curtiss 5157* > September 15 (U). Gadsden: River Junction, *G. V. Nash 2577* > September 5 (A, Y). Leon: Tallahassee, *G. V. Nash 2403* > August 12 (U, Y). Wakulla: St. Marks, *F. Rugel 199* > September (U).

ALABAMA. Baldwin: Daphne, *C. Mohr* > August 18 (U), Cullman: Ryans Creek, *C. Mohr* < August 6 (U). Lee: Auburn. *C. F. Baker 31* < October 10 (Y). Mobile: Theodore, *F. W. Pennell 4445* > August 30 (P, Y).

MISSISSIPPI. Clarke: Shubita, *C. Schuchert* < October 11 (U). Harrison: Pass Christian, *F. W. Pennell 4362* > August 27 (P, Y). Jackson: Ocean Springs, *S. M. Tracy 4434* > August 20 (U). Simpson: Saratoga, *S. M. Tracy 8505* > August 6 (P, U, Y).

12*b*. CHAMAECRISTA NICTITANS γ

Cassia aspera Mohrii Pollard, Bull. Torrey Club **24**: 151. Mar. 30, 1897. "Type in the herbarium of the U. S. Geol. Surv. of Alabama, collected in Mobile in 1878 by Dr. Mohr." Probable co-type, lacking statement of date, seen in the United States National Herbarium.

Chamaecrista aspera Mohrii Pollard; Heller, Cat. N. Am. Pl. 2d ed. 5. Nov. 10, 1900.

Stem 3–5 dm. tall, densely puberulent to spreading-pubescent. Stipules more ciliate, 8–10 mm. long. Leaflets 18–23 pairs, 9–12 mm. long, 2 mm. wide, narrowly oblong-linear, acute, strongly mucronate-tipped, pubescent with incurved hairs. Sepals hirsute-pubescent, especially on midrib. Legumes more hirsute. Otherwise as in the species.

Sandy soil in the Coastal Plain, southern Georgia to Louisiana and southern Arkansas. Insufficiently known, but probably not specifically distinct.

GEORGIA. Decatur: *E. A. Smith* (U).

ALABAMA. Mobile: Mobile, *C. Mohr* (U).

ARKANSAS. Miller: Texarkana, *A. A. & E. G. Heller 4134* > August 23 (A, U, Y).

LOUISIANA. Caddo: Shreveport, *Gregg* > September 6 (U). Rapides: Alexandria, *J. Hale* (Y).

13. CHAMAECRISTA ASPERA (Muhl.) Greene

Cassia aspera Muhl.; Ell. Bot. S. C. & Ga. 1: 474. 1821. "On Eding's island near Beaufort [South Carolina], common." Type not seen nor verified, but description sufficiently indicates this plant.

Nictitella aspera Raf. Sylv. Tell. 128. 1838.

Chamaecrista aspera Greene, Pittonia 3: 243. 1897.

Annual. Stem erect, 3–7 dm. tall, branched, strigose-hirsute with spreading hairs, below mostly also puberulent with some shorter incurved hairs. Stipules lanceolate-attenuate, conspicuously ciliate, nerved, 8–11 mm. long. Petioles 2–5 mm. long, hirsute, as well as the rachis, with spreading hairs. Petiolar gland single, shortly below proximal leaflets, stalked, truncate, scarcely wider than the stalk, 0.15–0.25 mm. wide, brown or dark-brown. Leaflets fifteen to twenty-seven pairs, 8–15 mm. long, 1.5–2 mm. wide, narrowly oblong-linear, acute, strongly mucronate, glabrous, not ciliate, slightly glaucous beneath, obscurely nerved. Bracteoles 1.5–2 mm. long, lanceolate. Pedicels one to two or three in a fascicle, 3–4 mm. long, appressed-puberulent. Sepals 3–5 mm. long, lanceolate, acuminate, strigose-hirsute on the midrib. Petals 3–7 mm. long, anterior nearly or twice exceeding laterals. Stamens unequal, seven to nine; anthers 2 mm. long, "yellow." Legumes 1.5–2.5 cm. long, 4–5 mm. wide, strigose-hirsute. Seeds three to eight, 2.5 mm. long, 2 mm. wide, thick.

Sandy soil, hammocks, fields or in pine-land, peninsular Florida, extending northward along the Atlantic coast to southern South Carolina.

FLORIDA. Dade: Miami, *N. L. Britton 456* > April 4 (Y). Duval: Jacksonville, *A. H. Curtiss 5158* > September 19 (U, Y). Hillsboro: Tampa, *N. L. Britton & P. Wilson 82* > August 25 (Y). Lake: Eustis, *G. V. Nash 1717* > August 16–25 (A, U, Y). Lee: Alva, *A. S. Hitchcock 56* (U, Y). Manatee: Perico Id., *S. M. Tracy 7244* > May 14 (U, Y). Monroe: Key West, *Blodgett* (U, Y). Orange: Clarcona, *M. Meislahn 35* > September 19 (U). Pinellas: St. Petersburg, *Mrs. C. C. Deam 2751* > September 18 (U, Y).

13*a*. CHAMAECRISTA ASPERA β

Cassia Simpsoni Pollard, Bull. Torrey Club 21: 221. 1894. "Florida—Big Pine Key, Simpson (May, 1891), No. 174.

Type, three specimens in the National Herbarium, collected by Mr. J. H. Simpson." Type seen in the United States National Herbarium.

Chamaecrista Simpsoni Pollard; Heller, Cat. N. A. Pl. 2d ed. 5. 1900.

Stem spreading, 1–3 dm. tall, diffusely branched, puberulent with incurved hairs below or throughout, hirsute with longer hairs only above or rarely throughout. Leaflets 9–19 pairs, 5–11 mm. long. Pedicels 2–3 mm. long.—Otherwise as in the species, with which it seems to completely intergrade. Pine-lands, extreme southern Florida.

FLORIDA. Dade: Cocoanut Grove, *N. L. Britton 285* ≷ March 26 (Y); Fort Dallas; Homestead; Miami. Monroe: Big Pine Key, *F. W. Pennell 9554* ≷ May 2 (Y); Boca Chica, *F. W. Pennell 9613* > May 15 (Y); Cudjoe, *F. W. Pennell 9556* ≷ May 5 (Y); Key West; Little Pine Key; No Name Key.

8 6

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL GARDEN—No. 200

FERTILITY IN *CICHORIUM INTYBUS*: SELF-COMPATIBILITY AND SELF-INCOMPATIBILITY AMONG THE OFFSPRING OF SELF-FERTILE LINES OF DESCENT

A. B. STOUT

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FERTILITY IN *CICHORIUM INTYBUS*: SELF-COMPATIBILITY AND SELF-INCOMPATIBILITY AMONG THE OFFSPRING OF SELF-FERTILE LINES OF DESCENT.

By A. B. STOUT.

(With Plates IV—VI.)

CONTENTS.

Introduction.

The results presented in this paper pertain to the variation, the heredity and the results of selection in respect to seed production in progenies of self-fertile plants of chicory, such self-fertile plants having first appeared sporadically among the descendants of self-sterile parents.

It has already been noted (Stout, 1916, 1917) that the type of sterility involved in my studies with chicory can best be ascribed to a *physiological incompatibility* operating between sex organs that are fully formed, anatomically perfect, potentially functional, and of simultaneous development. It is quite evident that the incompatibilities are not due to *anatomical incompatibility* (structural differences such as hercogamy) or to impotence (degeneration of sex organs or sex cells). *Embryo abortion* which results from a real gametic incompatibility that develops after fertilization may also be concerned in the decreased seed production and in the poor germinations observed. Such a type of abortion is to be considered as quite distinct from that which more purely involves nutrition.

As I have already shown (Stout, 1916, 1917) this sort of sexual incompatibility is very general in chicory. It is in evidence in the many instances of cross-sterility and in a very pronounced self-sterility both in wild and in cultivated varieties.

Self-fertile plants arise, however, among the progeny of self-sterile parents, and in some of my cultures of the variety "Red-leaved Treviso," such self-fertile plants first appeared after three generations of self-sterile parentage. Thus far, in my cultures, the self-fertile plants arising spontaneously have been relatively few in number, and they have exhibited various grades of self-compatibility as judged by seed production. In the lines of descent grown as offspring of the self-fertile plants, as already reported, the inheritance of self-compatibility was very irregular; self-incompatibility appeared in all progenies, even when these were offspring of two generations of highly self-fertile plants. I have now to report the results of another generation obtained in 1916.

As is pointed out in my previous papers, the behaviour of known progenies with reference to the development of compatibilities and incompatibilities is of special interest in its bearing on fundamental problems of sexuality and fertilization, especially as they are seen in the bisexual higher plants.

Material, Methods, and Terminology.

All of the plants for which data are here presented descended from three self-sterile parents. Two of these parents were of the common unimproved cultivated chicory (Barbe de Capucin) designated in the records as *E3* and *E22*; these were crossed with a wild white-flowered plant designated as *A*. There are, therefore, two main families which may be referred to according to parentage as the $A \times E3$ family and the $A \times E22$ family (including reciprocals).

The group of sister plants grown from the same plant or from the same cross in any one season is called a *series*, and in these reports such a group bears the number of the plant that was the immediate parent, together with the numbers in serial order designating the previous parentage. Thus, for example, series ($A \times E22$) is a generation of plants derived by using pollen of plant $E22$ on pistils of plant A; series $(A \times E22)$*-4-* is a group of sister plants grown from self-fertilized seed of the F_1 plant $(A \times E22)$ *no. 4*. Thus the series $(A \times E22)$*-4-3-11-*, for which data are given in Table II, has had three generations of self-fertile ancestry; of the different series and numbers as designated, which indicate the line of descent from the original cross between A and $E22$. Although somewhat cumbersome, this treatment presents a complete record of pedigree, from which the performance of individuals, of lines of descent as a whole, and of families may be ascertained. All the plants of a sub-family will be given the designation of the common ancestor, thus all the descendants of plant $(A \times E22)$ *no. 4* may be considered as family $(A \times E22)$*-4-*, and all the descendants of plant $(A \times E22)$ *no. 10* will be designated as family $(A \times E22)$*-10-*, both, however, being sub-families in the main family $(A \times E22)$ but descending from two different sister plants.

The data in detail for any parents, or for any series referred to, but which were grown previously to 1916, are given in a report already published (Stout, 1916).

Results of the Experimental Studies.

1. *Performance of a family of Barbe de Capucin × wild white-flowered: the family $(E3 \times A)$-4-.*

In 1916 two series from two generations of self-fertile ancestry were grown in the family $(E3 \times A)$*-4-*. The results obtained from the self-pollinations of these 49 plants are compiled in Table I. Of the 23 plants of the series first presented in this table, all but five were self-fertile with percentages of fertility ranging from 4 to 48, and with an average fertility for the self-fertile plants of 20 %. The percentage of fertility, frequently referred to in this paper, is determined on the basis of the proportion of seeds produced by the flowers involved in the controlled pollinations. Of the other series, 16 plants were self-fertile, and 10 were self-sterile; the fertilities of the self-fertile plants ranged from 2 to 60 % with an average of 15 %.

TABLE I.

Self-compatibility and incompatibility in two series of a family of Barbe de Capucin (E3) × wild white-flowered (A); from two generations of self-fertile ancestry.

Plant with pedigree	Flower colour	Record for heads pollinated: Total heads	With no seed	With seed	Seed per head	Fertility per cent.
(E3 × A)–4–4–	*B*	—	—	—	—	*0·43*
No. 4	*W*	8	5	5	3, 5, 5	0·09
,, 8	*B*	10	10	0	—	—
,, 12	*B*	11	5	6	4, 4, 5, 5, 7, 11	0·18
,, 14	*W*	11	4	7	4, 4, 4, 11, 12, 14, 18	0·23
,, 16	*B*	9	9	0	—	—
,, 17	*B*	10	2	9	1, 3 + *B*, 4, 7, 7, 7, 12, 15	0·30
,, 18	*W*	10	1	9	1, 2, 2, 5, 6, 7, 8, 9, 13	0·29
,, 19	*W*	6	0	6	2, 2, 5, 5, 5, 6	0·22
,, 20	*B*	11	11	0	—	—
,, 21	*B*	11	3	8	4, 4, 5, 5, 8, 8, 9, 12	0·27
,, 22	*W*	7	2	5	3, 5, 6, 10, 11	0·28
,, 23	*W*	13	8	5	1, 1, 8, 9, 12	0·31
,, 26	*B*	11	11	0	—	—
,, 27	*W*	7	4	3	1, 2, 4	0·04
,, 28	*B*	10	10	0	—	—
,, 29	*W*	9	0	9	1, 2, 5, 5, 9, 12, 12, 12, 16	0·48
,, 30	*B*	10	0	10	2, 3, 3, 4, 5, 6, 6, 7, 13, 15	0·32
,, 31	*B*	12	10	2	3, 4	0·03
,, 32	*B*	9	4	5	2, 3, 4, 5, 5	0·12
,, 34	*W*	10	8	2	2, 5	0·07
,, 35	*B*	10	4	6	1, 1, 2, 3, 4, 7	0·10
,, 37	*W*	10	2	8	2, 2, 2, 4, 5, 5, 6, 9	0·19
,, 38	*W*	8	5	3	1, 3, 8	0·09
(E3 × A)–4– Ser. II. 20	*B*	—	—	—	—	*0·50*
No. 1	*B*	9	9	0	—	—
,, 2	*B*	12	12	0	—	—
,, 5	*B*	7	3	4	3, 3, 5, 5	0·12
,, 6	*B*	10	2	8	1, 1, 2, 3, 3, 3, 3, 5	0·12
,, 7	*B*	10	10	0	—	—
,, 8	*B*	10	5	5	1, 2, 4, 7, 17	0·17
,, 10	*B*	12	4	8	3, 3, 3, 3, 4, 5, 6, 7	0·15
,, 11	*B*	6	0	6	5, 11, 11, 12, 15, 15	0·60
,, 14	*B*	9	9	0	—	—
,, 16	*B*	10	5	5	1, 3, 5, 6, 6	0·21
,, 17	*B*	12	10	2	2, 3	0·02
,, 18	*B*	9	5	4	1, 1, 3, 4	0·05
,, 19	*B*	7	3	4	2, 2, 5, 6	0·11
,, 21	*B*	9	6	3	1, 1, 2	0·03
,, 22	*B*	11	11	0	—	—
,, 23	*B*	9	0	9	4, 4, 5, 5, 7, 8, 10, 10, 14	0·42
,, 24	*B*	9	3	6	2, 2, 3, 3, 5, 17	0·19
,, 25	*B*	8	8	0	—	—
,, 26	*B*	10	7	3	1, 2, 4	0·03
,, 27	*B*	11	10	1	12	0·06
,, 29	*B*	10	10	0	—	—
,, 32	*B*	10	10	0	—	—
,, 33	*B*	11	9	2	1, 7	0·04
,, 34	*B*	15	15	0	—	—
,, 35	*B*	9	9	0	—	—
,, 36	*B*	9	4	5	1, 1, 2, 2, 10	0·10

A glance over this table shows that a rather large proportion of plants are self-fertile. Especially is this true of series ($E3 \times A$)-*4*-*4*-, which in this respect is perhaps the most highly self-fertile of the various series thus far grown.

The more complete summary of the record for the family ($E3 \times A$) is presented in Table VII. As there indicated, the family is not a large one. From the cross between the two self-sterile plants $E3$ and A, 21 plants were grown in the F_1, of which four were self-fertile with fertilities of 2, 4, 13, and 48. Progeny were grown only from one plant having the highest fertility. Of the 18 grown, 10 were self-fertile, and the fertilities determined for 9 of these ranged from 3 to 50 °/₀, with an average at 26. Selection for parents for the next generation was confined to the two plants most highly self-fertile. Thus the immediate parents of the two series were 43 and 50 °/₀ self-fertile respectively, and the common P_1 parent was 48 °/₀ self-fertile. The selection has here been continually of plants with highest fertility. The regression to a condition of complete self-sterility and to feeble self-sterility is most noticeable. The number of plants is perhaps not sufficient to determine the mathematical expression for such regression with accuracy, but the records indicate an irregular and incomplete inheritance of self-compatibility.

However, the proportion of self-fertile plants is higher in the series grown from self-fertile parents than that of the self-fertile plants appearing sporadically among the progeny of the original self-sterile parents. The average fertility for each of the two series from two generations of self-fertile ancestry is lower than that of the preceding generation ($E3 \times A$)-*4*-. (A series was grown in each of two different years from seed of the plant ($E3 \times A$) *no. 4*; data for both are here compiled as for a single series.) The range of self-fertility has, however, been extended in the case of one plant to 60 °/₀. This plant, however, is of the series which, as a whole, is of lowest average fertility. The summary for the progeny of the plant ($E3 \times A$)-*4*-, as a whole, shows that 65 °/₀ of all the plants were self-fertile in some degree, with a distribution on the basis of self-fertility that is decidedly irregular and skew, and with an average fertility of 0·197. It has already been suggested by the writer that there is evidence that complete self-sterility may involve different intensities of incompatibilities. If there were some means of determining comparative values for these, the distribution for a family and for the different series might be found to be more in agreement with a normally fluctuating variability. As it is, the comparison may be based on the proportion of self-fertile plants and their fertilities, as has been done above.

2. *Performance of families descended from crosses between the wild white-flowered plant A and plant E22 of Barbe de Capucin.*

By far the greater number of plants of the cultures were derived from crosses between the two plants *A* and *E22*. Among the 75 F_1 progeny of the reciprocal crosses between these two self-sterile plants, there were 8 plants self-fertile to some degree. Progenies of three of these plants constituting three families, (*A* × *E22*)–*4*–, (*A* × *E22*)–*9*–, and (*E22* × *A*)–*10*–, have now been grown for three further generations. With the one exception of series (*E22* × *A*)–*10*– *Ser. II. 10*– all the different series of these families grown in 1916 had three generations of self-fertile parentage. The data for these various series will now be presented together with a discussion of the results obtained for these (sub) families.

(*a*) *The family* (*A* × *E22*)–*4*–.

Data for the three series of this family grown in 1916 are presented in Table II, and a summary of all the series of the family is given in Table VII.

Of the series (*A* × *E22*)–*4*–*3*–*6*– only two plants were grown. These were both self-sterile. The fertilities of the parental line of descent were respectively 4, 13, and 5.

The series (*A* × *E22*)–*4*–*3*–*11*– comprised 29 plants, of which 20 were self-sterile and 9 self-fertile. Not only was the proportion of self-fertile plants low, but the fertilities of such plants were low, ranging from 1 to 26 °/₀ with the average at 8 °/₀. For this series the immediate parent was of rather high fertility (32 °/₀), but the ancestry previous to this was of 4 and 13 °/₀. The feeble self-fertility of the series as a whole and of the various individuals comprising it is most noticeable, especially in comparison with the behaviour of such a series as (*E3* × *A*)–*4*–*4*– reported in Table I.

Of the 16 plants of series (*A* × *E22*)–*4*–*6*–*3*–, eight were self-fertile with range from 2 to 62 °/₀, and with an average of 25 °/₀. The relative number of self-fertile plants, the range of fertilities, and the average fertility are all higher for this series than for (*A* × *E22*)–*4*–*3*–*11*–.

A consideration of the family history shows that there has been no parent in this family with a fertility higher than 32 °/₀. The fertility

TABLE II.

Record for three series descended from plant (A × E3), No. 4. All have three generations of self-fertile parentage.

Plant with pedigree	Flower colour	Record for heads pollinated: Total heads	With no seed	With seed	Seed per head	Fertility per cent
(A × E22)-4-3-6-	*W*	—	—	—	—	*0·05*
No. 1	*W*	4	4	0	—	—
,, 2	*W*	11	11	0	—	—
(A × E22)-4-3-11-	*W*	—	—	—	—	*0·32*
No. 1	*W*	2	2	1	6	0·16
,, 3	*W*	14	12	2	2, 3	0·02
,, 5	*W*	7	7	0	—	—
,, 6	*W*	6	6	0	—	—
,, 7	*W*	10	7	3	1, 3, 4	0·04
,, 8	*W*	8	8	0	—	—
,, 9	*W*	5	1	4	3, 5, 8, 10	0·26
,, 10	*W*	7	2	5	1, 1, 3, 3, 10	0·14
,, 13	*W*	6	6	0	—	—
,, 14	*W*	6	6	0	—	—
,, 15	*W*	8	8	0	—	—
,, 16	*W*	6	6	0	—	—
,, 17	*W*	8	8	0	—	—
,, 18	*W*	12	10	2	1, 1	0·01
,, 19	*W*	3	3	0	—	—
,, 20	*W*	10	10	0	—	—
,, 21	*W*	5	3	2	4, 6	0·10
,, 22	*W*	4	4	0	—	—
,, 24	*W*	6	6	0	—	—
,, 25	*W*	10	9	1	2	0·01
,, 27	*W*	8	8	0	—	—
,, 28	*W*	6	6	0	—	—
,, 29	*W*	8	8	0	—	—
,, 31	*W*	7	7	0	—	—
,, 33	*W*	12	12	0	—	—
,, 34	*W*	7	7	0	—	—
,, 37	*W*	3	3	0	—	—
,, 38	*W*	6	6	0	—	—
,, 41	*W*	9	8	1	1	0·01
(A × E22)-4-6-3-	*W*	—	—	—	—	*0·31*
No. 1	*W*	3	0	3	5, 6, 12	0·41
,, 2	*W*	10	10	0	—	—
,, 3	*W*	4	4	0	—	—
,, 9	*W*	2	2	0	—	—
,, 11	*W*	8	5	3	1, 1, 1	0·02
,, 12	*W*	3	0	3	3, 8, 9	0·41
,, 13	*W*	5	3	2	5, 8	0·16
,, 14	*W*	2	2	0	—	—
,, 15	*W*	7	7	0	—	—
,, 16	*W*	6	0	6	1, 1, 2, 5, 8, 8	0·21
,, 17	*W*	9	6	3	2, 4, 5	0·07
,, 18	*W*	2	0	2	8, 14	0·62
,, 20	*W*	2	2	0	—	—
,, 21	*W*	6	4	2	2, 11	0·11
,, 22	*W*	3	3	0	—	—
,, 23	*W*	10	10	0	—	—

of the first self-fertile parent (*A* × *E*22) *no. 4* was very low, being only 4 °/₀. Although 7 of the 10 plants grown from its seed were self-fertile, the highest individual fertility was 23 °/₀, and the average was 14 °/₀. The four plants selected from this series as parents had fertilities of 12, 13, 16, and 22. The numbers of plants grown from these were too small for an adequate judgment of the various series, but from the two most highly self-fertile plants were derived the series (*A* × *E22*)–*4–3–11–* and (*A* × *E22*)–*4–6–3–* reported above. The first self-fertile parent was very feebly self-fertile, but with one exception parents for subsequent series were selected for highest individual fertility.

The behaviour of the various series indicates an irregular inheritance of the characteristics of self-compatibility and the frequent and decided regression to self-sterility. The range of the degree of self-fertility was rather decidedly extended in the series (*A* × *E22*)–*4–6–3–*, and the average fertility was also high. This series was decidedly more fertile in every comparison than the series (*A* × *E22*)–*4–3–11–*: the ancestral fertilities were only slightly higher, being 4, 22, and 31 as compared with 4, 13, and 32.

Considered as a whole, the family (*A* × *E22*)–*4–* had 40 °/₀ of the total plants self-fertile. The distribution on the basis of fertilities of the self-fertile plants is irregular and skew, the percentage of self-fertility observed in an individual is extended to 62, and the average percentage for all self-fertile plants is 16·5.

(*b*) *The family* (*A* × *E22*)–*9–*.

As indicated in Table VII, the third filial generation in this family consisted of six series, which were derived from as many different plants of the second generation which had in turn descended from two plants of the first generation. Thus the series are of the two main sub-families (*A* × *E22*)–*9–4–* and (*A* × *E22*)–*9–5–*.

The data for the series which descended from plant (*A* × *E22*)–*9– no. 4* are given in Table III. Of the 10 plants in series (*A* × *E22*)–*9–4–4–*, four were self-fertile; of 13 in series (*A* × *E22*)–*9–4–10–*, seven were self-fertile; and of the 4 plants in series (*A* × *E22*)–*9–4–11–*, two were self-fertile. The fertilities of the immediate parentage were quite alike, the complete record of ancestry being 23, 43, and 20 for the first mentioned, 23, 43, and 17 for the second, and 23, 43 and 20 for the last named. As shown in the tables, the proportional number of self-fertile plants varies, as do the individual fertilities. The number of plants is perhaps insufficient for adequate comparisons of differences. It is to be noted, however, that self-sterile plants appear in large proportions, and that there are various degrees of self-fertility in each series.

TABLE III.

Record for three series descended from plant (A × E22)–9–, No. 4. All from three generations of self-fertile parentage.

Plant with pedigree	Flower colour	Record for heads pollinated: Total heads	With no seed	With seed	Seed per head	Fertility per cent.
(A × E22)–9–4–4–	*B*	—	—	—	—	*0·20*
No. 1	*B*	11	5	6	1, 2, 3, 4, 5, 7	0·12
,, 2	*W*	11	11	0	—	—
,, 3	*W*	10	10	0	—	—
,, 6	*W*	10	10	0	—	—
,, 7	*W*	5	0	5	1, 2, 3, 7, 8	0·28
,, 8	*B*	7	0	7	1, 1, 2, 4, 4, 5, 5	0·18
,, 11	*W*	10	10	0	—	—
,, 12	*B*	7	6	1	6	0·06
,, 13	*B*	12	12	0	—	—
,, 15	*B*	12	12	0	—	—
(A × E22)–9–4–10–	*B**	—	—	—	—	*0·17*
No. 1	*B*	10	10	0	—	—
,, 2	*B*	2	0	2	1, 5	0·20
,, 3	*B*	11	11	0	—	—
,, 4	*B*	14	14	0	—	—
,, 5	*B*	12	11	1	3	0·02
,, 6	*B*	9	5	4	1, 2, 4, 4	0·08
,, 8	*B*	10	9	1	2	0·01
,, 10	*B*	8	0	8	2, 4, 6, 6, 9, 10, 12, 12	0·51
,, 12	*B*	3	3	0	—	—
,, 13	*B*	10	10	0	—	—
,, 14	*B*	10	6	4	1, 3, 4, 8	0·10
,, 15	*B*	10	3	7	1, 3, 4, 4, 5, 6, 14	0·25
,, 19	*B*	11	11	0	—	—
(A × E22)–9–4–11–	*B*	—	—	—	—	*0·20*
No. 1	*B*	9	7	2	1, 1	0·01
,, 2	*W*	8	6	2	1, 3	0·03
,, 3	*W*	10	10	0	—	—
,, 4	*W*	11	11	0	—	—

Considering the three series together, 13 plants were self-fertile, and 14 were self-sterile. In only one plant was the fertility higher than 28 °/₀, and in this case the percentage was 51. The average for

* In a former publication (Stout, 1916, Table 5) this plant was by error reported as white-flowered.

TABLE IV.

Record for three series descended from plant (A × E22)–9–, No. 5. All from three generations of self-fertile parentage.

Plant with pedigree	Flower colour	Record for heads pollinated: Total heads	With no seed	With seed	Seed per head	Fertility per cent.
(A × E22)–9–5–1–	*W*	—	—	—	—	*0·07*
No. 1	*W*	12	10	2	1, 2	0·02
,, 2	*W*	12	12	0	—	—
,, 3	*W*	10	10	0	—	—
,, 4	*W*	12	12	0	—	—
(A × E22)–9–5–6–	*W*	—	—	—	—	*0·46*
No. 2	*W*	12	12	0	—	—
,, 3	*W*	7	7	0	—	—
,, 4	*W*	11	11	0	—	—
,, 5	*W*	10	10	0	—	—
,, 6	*W*	11	10	1	2	0·01
,, 7	*W*	8	3	5	2, 4, 7, 11, 14	0·29
,, 8	*W*	9	9	0	—	—
,, 9	*W*	10	10	0	—	—
,, 10	*W*	12	12	0	—	—
,, 11	*W*	11	11	0	—	—
,, 12	*W*	11	9	2	3, 5	0·05
,, 13	*W*	11	4	7	1, 2, 3, 4, 7, 10, 10	0·21
,, 14	*W*	6	6	0	—	—
,, 15	*W*	11	11	0	—	—
,, 16	*W*	10	10	0	—	—
,, 17	*W*	11	5	6	2 + *B*, 3, 6, 8, 8, 11	0·23
,, 19	*W*	9	6	3	1, 6, 14	0·15
,, 20	*W*	10	8	2	3, 7	0·06
,, 21	*W*	9	0	9	*B*, *B*, 1, 3, 4, 5, 9, 12, 13	0·42
,, 22	*W*	15	9	6	1, 2, 4, 4, 4, 7	0·09
,, 23	*W*	10	7	3	2, 10, 18	0·20
,, 24	*W*	11	11	0	—	—
,, 25	*W*	11	11	0	—	—
,, 26	*W*	11	11	0	—	—
,, 27	*W*	10	10	0	—	—
,, 28	*W*	13	13	0	—	—
,, 29	*W*	11	9	2	3, 5	0·05
,, 30	*W*	13	13	0	—	—
,, 31	*W*	6	0	6	4, 10, 13, 14, 14, 15	0·77

TABLE IV—(*continued*).

Plant with pedigree	Flower colour	Record for heads pollinated: Total heads	With no seed	With seed	Seed per head	Fertility per cent.
(A × E22)–9–5–12–	*W*	—	—	—	—	*0·70*
No. 1	*W*	6	0	6	5 + *B*, 5, 7, 12, 13, 18	0·65
,, 2	*W*	11	7	4	1, 5, 5, 6	0·09
,, 3	*W*	12	0	12	7, 9, 9, 10, 10, 10, 11, 12, 13, 13, 14, 15	0·66
,, 4	*W*	13	11	2	1, 5	0·03
,, 5	*W*	13	13	0	—	—
,, 6	*W*	12	12	0	—	—
,, 7	*W*	10	10	0	—	—
,, 8	*W*	10	10	0	—	—
,, 9	*W*	11	5	6	5, 8, 10, 12, 14, 15	0·36
,, 10	*W*	9	7	2	2, 4	0·04
,, 11	*W*	13	1	12	1, 4, 5, 5, 6, 6, 7, 8, 8, 9, 11, 12	0·38
,, 12	*W*	12	6	6	1, 1, 1, 2, 2, 3	0·10
,, 13	*W*	9	4	5	2, 2, 4, 5, 8	0·13
,, 14	*W*	10	0	10	2, 5, 7, 10, 10, 11, 11, 11, 14, 15	0·56
,, 15	*W*	10	0	10	2, 2, 2, 7, 8, 9, 10, 12, 13, 14	0·50
,, 16	*W*	11	11	0	—	—
,, 17	*W*	9	3	6	6, 6, 6, 8, 10, 15	0·34
,, 18	*W*	10	10	0	—	—
,, 19	*W*	14	0	14	1, 2, 2, 2, 3, 3, 3, 4, 5, 5, 6, 6, 6, 7	0·25
,, 20	*W*	9	8	1	2	0·01
,, 21	*W*	10	10	0	—	—
,, 22	*W*	13	8	5	1, 1, 2, 3, 5	0·06
,, 23	*W*	10	10	0	—	—
,, 24	*W*	10	10	0	—	—
,, 26	*W*	10	4	6	2, 2, 2, 3, 5, 6	0·12
,, 27	*W*	12	12	0	—	—
,, 29	*W*	13	13	0	—	—
,, 31	*W*	14	14	0	—	—
,, 32	*W*	12	12	0	—	—
,, 33	*W*	11	0	11	2, 3, 8, 9, 10, 10, 10, 12, 12, 13, 15	0·54
,, 34	*W*	12	12	0	—	—
,, 35	*W*	15	15	0	—	—
,, 37	*W*	11	11	0	—	—
,, 38	*W*	12	12	0	—	—

all self-fertile plants was 14 %. This sub-family therefore is one of rather low self-fertility. The parents have all been somewhat above the average of self-fertility, and that of the second ancestral generation was much higher than the average.

Data for the three series of the third filial generation derived from the plant (*A* × *E22*)–*9– no. 5* are given in Table IV. The immediate parent of one series was selected for low self-fertility; the parents of the other two were selected for high self-fertility, one in fact having the highest percentage of any plant thus far utilized in the cultures as a seed parent.

Of series (*A* × *E22*)–*9–5–1–*, only four plants were grown, of which one was very feebly self-fertile.

Twenty-nine plants were grown and tested in series (*A* × *E22*)–*9–5–6–*. Seventeen were self-sterile; twelve were self-fertile. As further shown in Table IV, the individual fertilities were below 30 %, except for two plants. One of these was 42 % self-fertile, and the other gave the percentage of 77, which is the highest thus far realized in any of the cultures. The line of parentage has been one of rather high fertility, being 23, 33, and 46, and the series to which the parents belonged have given high values for average fertility (38 and 29). Except for the one highly self-fertile plant regression has been very decided in this series.

The series (*A* × *E22*)–*9–5–12–* is of special interest, for the immediate parent was one of 70 % self-fertility, the ancestral record being 23, 33, and 70. The series is also the largest of any thus far grown in these families. Of the 34 plants, exactly half were self-fertile. The fertilities range to 66 %, and are somewhat more evenly distributed than is usual. The average of the self-fertilities is 28 %. A comparison of the data for all the various series (Table VII) shows that, on the whole, this series is one of high fertility. However, half of the plants were self-sterile, a large number of the self-fertile plants were feebly self-fertile, none of the self-fertile plants were more self-fertile than the immediate parent, and the average is below that for any one of the line of self-fertile parentage. Still the fertilities of the two series as a whole are decidedly greater than that of the three series (Tables III and VII) derived from (*A* × *E22*)–*9– no. 4*.

Considered as a whole, this family has been grown from parents selected for high self-fertility. With the exception of one series of four plants, no series had any parent of less than 17 % self-fertility. The value for the first parent in line of descent was 23; the values of the two parents of the next generation were 43 and 33: and the values for the parents of the next generation ranged from 7 to 70. Self-sterile plants appeared in every series, and after three generations of ancestry of highest self-fertilities the proportional number of such plants was high. Of the total of 125 plants, 61 were self-fertile. The distribution of individual self-fertilities is decidedly skew. The average fertilities of self-fertile plants is 0·223.

(c) *The family (E22 × A)-10–.*

In 1916, seven series were grown in this family. One of these was of the second generation in descent. This series consisted of 15 plants, all but one of which were self-sterile. The fertility of the one self-fertile plant was one of feeble self-fertility. Self-sterility was almost complete, although the plants had two generations of self-fertile parents with fertilities of 51 and 13.

TABLE V.

Record of a series having two generations of self-fertile ancestry.

Plant with pedigree	Flower colour	Record for heads pollinated: Total heads	With no seed	With seed	Seed per head	Fertility per cent.
(E22 × A)-10– Ser. II. 10–	*W*	—	—	—	—	*0·13*
No. 1	*W*	11	11	0	—	—
,, 3	*W*	14	14	0	—	—
,, 4	*W*	10	10	0	—	—
,, 5	*W*	7	0	7	1, 1, 3, 3, 3, 8, 8	0·26
,, 6	*W*	10	10	0	—	—
,, 7	*W*	11	11	0	—	—
,, 8	*W*	10	10	0	—	—
,, 9	*W*	11	11	0	—	—
,, 10	*W*	12	12	0	—	—
,, 11	*W*	10	10	0	—	—
,, 12	*W*	12	12	0	—	—
,, 13	*W*	7	7	0	—	—
,, 14	*W*	12	12	0	—	—
,, 16	*W*	10	10	0	—	—
,, 17	*W*	9	9	0	—	—

The data for the six series of this family, having three generations of self-fertile ancestry, are given in Table VI. As shown in the pedigrees, the first two series given have the same parentage for the first two generations. The immediate parents of these series were therefore two sister plants, which, it may be noted, were very nearly identical in all vegetative characters, but differed considerably in the degree of self-fertility. From the parent of 15 °/₀ fertility, 16 plants were grown and tested for self-fertility. All but two were self-sterile, and those were

TABLE VI.

Self-compatibility and self-incompatibility in six series descended from plant (E22 × A), No. 10. All series from three generations of self-fertile parentage.

Plant with pedigree	Flower colour	Record for heads pollinated				Fertility per cent.
		Total heads	With no seed	With seed	Seed per head	
(E22 × A)–10–8–14–	*W*	—	—	—	—	*0·15*
No. 1	*W*	9	9	0	—	—
,, 2	*W*	11	11	0	—	—
,, 3	*W*	9	9	0	—	—
,, 4	*W*	10	10	0	—	—
,, 5	*W*	11	11	0	—	—
,, 6	*W*	11	11	0	—	—
,, 7	*W*	12	12	0	—	—
,, 8	*W*	10	10	0	—	—
,, 9	*W*	9	9	0	—	—
,, 10	*W*	12	12	0	—	—
,, 11	*W*	11	11	0	—	—
,, 12	*W*	10	10	0	—	—
,, 13	*W*	11	11	0	—	—
,, 15	*W*	9	2	7	1, 1, 1, 1, 2, 3, 7	0·10
,, 16	*W*	8	4	4	1, 3, 3, 6	0·10
,, 18	*W*	12	12	0	—	—
(E22 × A)–10–8–15–	*W*	—	—	—	—	*0·40*
No. 1	*W*	14	14	0	—	—
,, 2	*W*	10	2	8	3, 6, 7, 8, 10, 12, 15, 17	0·43
,, 3	*W*	10	5	5	1, 2, 2, 2, 7	0·08
,, 4	*W*	10	0	10	1, 2, 3, 4, 5, 7, 7, 13, 15	0·36
,, 5	*W*	9	3	6	2, 2, 3, 3, 4, 5	0·12
,, 6	*W*	13	10	3	1, 3, 9	0·06
,, 7	*W*	12	12	0	—	—
,, 8	*W*	8	1	7	1 + *B*, 3, 3, 3, 4, 7, 9	0·24
,, 9	*W*	10	9		12	0·07
,, 10	*W*	11	11	0	—	—
,, 11	*W*	3	1	2	6, 5	0·23
,, 12	*W*	7	1	6	1, 2, 3, 4, 5, 12	0·23
,, 13	*W*	5	1	4	3, 5, 9, 12	0·31
,, 14	*W*	11	8	3	5, 7, 9	0·11
,, 15	*W*	6	0	6	1, 3, 3, 4, 4, 7	0·22
,, 16	*W*	6	3	3	2, 2, 11	0·13
,, 17	*W*	9	1	8	1, 2, 2, 2, 2, 2, 3, 9	0·15
(E22 × A)–10–13–5–	*B*	—	—	—	—	*0·29*
No. 1	*B*	7	4	3	4, 5, 8	0·14
,, 3	*B*	5	5	0	—	—
,, 4	*B*	10	10	0	—	—

TABLE VI—(*continued*).

Plant with pedigree	Flower colour	Record for heads pollinated				
		Total heads	With no seed	With seed	Seed per head	Fertility per cent.
No. 5	*W*	10	10	0	—	—
,, 6	*B*	10	7	3	4, 5, 6	0·09
,, 8	*W*	7	2	5	1, 7, 8, 8, 9	0·28
,, 11	*B*	8	8	0	—	—
,, 12	*W*	6	6	0	—	—
,, 13	*B*	10	10	0	—	—
,, 15	*W*	9	9	0	—	—
,, 16	*W*	10	10	0	—	—
,, 17	*B*	8	5	3	2, 5, 9	0·12
,, 19	*B*	8	8	0	—	—
,, 20	*B*	8	8	0	—	—
,, 21	*B*	6	6	0	—	—
,, 22	*W*	10	10	0	—	—
,, 23	*B*	10	10	0	—	—
,, 24	*B*	5	5	0	—	—
,, 25	*W*	7	5	2	1, 1	0·02
,, 26	*B*	10	10	0	—	—
,, 27	*B*	11	11	0	—	—
,, 30	*W*	9	8	2	1, 2	0·02
,, 31	*B*	8	3	5	1, 2, 2, 3, 4	0·09
,, 33	*B*	11	11	0	—	—
,, 35	*B*	5	5	0	—	—
,, 37	*B*	10	10	0	—	—
,, 38	*B*	10	10	0	—	—
,, 39	*W*	11	4	7	1, 2, 3, 3, 4, 5, 6	0·13
,, 40	*B*	9	9	0	—	—
,, 41	*B*	9	7	2	1, 5	0·04
,, 44	*B*	5	3	2	2, 2	0·05
(E22 × A)–10–13–12–	*W*	—	—	—	—	*0·25*
No. 1	*W*	10	10	0	—	—
,, 2	*W*	14	14	0	—	—
,, 3	*W*	12	12	0	—	—
,, 4	*W*	8	8	0	—	—
,, 5	*W*	10	10	0	—	—
,, 6	*W*	10	10	0	—	—
,, 7	*W*	10	8	2	1, 5	0·04
,, 8	*W*	4	2	2	4, 5	0·13
,, 10	*W*	11	11	0	—	—
,, 11	*W*	9	4	5	1, 2, 2, 3, 4	0·08
,, 12	*W*	10	10	0	—	—
,, 13	*W*	12	12	0	—	—
,, 14	*W*	11	6	5	2, 2, 5, 7, 8	0·13
,, 15	*W*	10	0	10	1, 1, 2, 3, 3, 6, 7, 9, 9, 13	0·33
,, 16	*W*	11	5	6	3, 3, 5, 5, 6, 7	0·15
,, 17	*W*	11	11	0	—	—

TABLE VI—(*continued*).

Plant with pedigree	Flower colour	Record for heads pollinated: Total heads	With no seed	With seed	Seed per head	Fertility per cent.
No. 18	*W*	11	0	11	3, 4, 5, 5, 5, 6, 6, 8, 9, 12, 13	0·42
,, 19	*W*	10	10	0	—	—
,, 20	*W*	12	12	0	—	—
,, 21	*W*	10	8	2	1, 5	0·03
,, 22	*W*	10	10	0	—	—
,, 23	*W*	12	12	0	—	—
,, 25	*W*	10	10	0	—	—
(E22 × A)–10–13–13–	*B*	—	—	—	—	*0·56*
No. 1	*B*	10	10	0	—	—
,, 2	*B*	7	3	4	5, 7, 9, 15	0·33
,, 4	*B*	9	5	4	7, 9, 10, 14	0·28
,, 5	*W*	10	10	0	—	—
,, 6	*B*	10	9	1	5	0·03
,, 7	*B*	7	0	7	3, 5, 8, 10, 12, 13, 14	0·58
,, 8	*B*	11	8	3	6, 7, 9	0·13
,, 9	*W*	10	10	0	—	—
,, 12	*B*	9	9	0	—	—
,, 15	*W*	12	12	0	—	—
,, 16	*W*	11	11	0	—	—
,, 17	*B*	11	11	0	—	—
,, 18	*W*	11	11	0	—	—
,, 19	*B*	12	12	0	—	—
,, 20	*B*	13	13	0	—	—
,, 21	*W*	10	6	4	7, 8, 10, 12	0·25
,, 22	*B*	15	3	12	1, 1, 2, 2, 2, 3, 4, 5, 6, 7, 8, 11	0·22
,, 24	*B*	7	3	4	1, 2, 3, 5	0·10
,, 26	*B*	9	4	5	4, 6, 7, 7, 9	0·24
,, 27	*W*	9	6	3	2, 2, 11	0·12
,, 28	*W*	11	11	0	—	—
,, 30	*W*	9	2	7	2, 2, 2, 4, 8, 9, 13	0·30
,, 31	*B*	11	3	8	1, 2, 2, 3, 5, 5, 11, 13	0·25
,, 32	*B*	9	4	5	1, 2, 7, 7, 9	0·18
,, 33	*W*	8	8	0	—	—
,, 34	*B*	9	9	0	—	—
,, 35	*W*	12	12	0	—	—
,, 36	*B*	10	9	1	2	0·01
(E22 × A)–10–14–6–	*W*	—	—	—	—	*0·13*
No. 1	*W*	12	12	0	—	—
,, 2	*W*	13	13	0	—	—
,, 4	*W*	15	15	0	—	—
,, 5	*W*	12	12	0	—	—
,, 6	*W*	10	10	0	—	—
,, 7	*W*	12	12	0	—	—
,, 8	*W*	6	2	4	1, 1, 3, 5	0·10

rather feebly self-fertile. Of the 17 plants derived from *(E22 × A)–10–8– no. 15*, all but 3 were self-fertile. The difference in self-fertility seen in these series is most marked, especially in respect to the number of plants self-fertile. Results in such individual cases as these seem to indicate that selection may be effective in increasing or decreasing the development of self-compatibilities.

The next three series recorded in Table VI were all descended from the plant *(E22 × A)–10– no. 13*, which had a fertility of 38 °/₀. The immediate parents of the three series had fertilities of 29, 25, and 56. Of series *(E22 × A)–10–13–5–*, in a total of 31 plants, 21 were self-sterile. The fertilities of the 10 self-fertile plants were low, giving an average of 10 °/₀ and a range extending only to 28 °/₀. Considering the record of the line of parentage, with percents of 51, 38, and 29, and the series in the line of descent, the fertility of this series is decidedly low.

The ancestral record for series *(E22 × A)–10–13–12–* is quite identical to that for the series just noted. Of the 23 plants in the series, 15 were self-sterile. The fertilities of the self-fertile plants ranged to 42 °/₀, but the average was 16 °/₀. This is also a low performance considering the parentage.

Of the 28 plants of series *(E22 × A)–10–13–13–*, exactly half were self-fertile with percentages that extended to 58 and an average of 19. There has been, perhaps, no series grown with a more highly self-fertile ancestry. Here the selections have been from parents with percentages of 51, 38, and 56. Yet half of the series was self-sterile, and only one plant exhibited a percentage of self-fertility higher than 33.

The 7 plants of series *(E22 × A)–10–14–6–* were derived from an ancestry with fertilities of 51, 14, and 13. Only one plant was self-fertile with a percentage of 10.

A summary of the ancestral records of the various lines of descent shows that although the various parents exhibited a considerable range in fertilities, the larger series and the greater number of plants in the family have an ancestry of rather high fertilities. The results in summary emphasize the irregular heredity and the continual sporadic or ever-sporting nature of self-fertility and self-sterility in chicory. Of the 196 plants descended from the highly self-fertile plant *(E22 × A) no. 10*, a total of 118 were self-sterile. The percentage of plants self-fertile is therefore 40. The distribution of the self-fertile plants on the basis of percentages is decidedly skew. Much the greater number of plants are feebly self-fertile, and the average fertility of all plants self-fertile is 0·185.

3. *Fertilities in various Vegetative Types or Races.*

The continued growth of line progenies by self-fertilization of parents, as practised in my chicory cultures, has led to the isolation or segregation of various vegetative types or races that are very distinct, not only from each other but from the general character of the original parents crossed, or even from the first self-fertile parents of the F_1.

Marked uniformity among the sister plants of a single series first appeared in the F_3 generation, which was the second generation after self-fertile plants appeared. For example, the plants of series *(A × E22)-10-13-* were very uniform in habit of growth, as is very well shown in Plate IV. (The field number of this series was 41.) The plants were abundantly branched, making rather bushy compact individuals constituting a semi-dwarf bushy race. In respect to flower colour, this series was variable. In the foreground of Plate IV, immediately in front of field label 41, is a typical plant of series *(E22 × A)-10-8-*. The habit of growth here shown is very different from that of the semi-dwarf bush race. It is characterized by a tall well developed main stem with large conspicuous leaves. The branching is somewhat sparse and is erect; at the time the photograph was taken the branching of the plant in question had not developed. More mature plants of this type are shown in Plate V (see field label no. 49).

As has been noted above, and as shown in Table VII, two plants of *(E22 × A)-10-8-* and three plants of *(E22 × A)-10-13-* were selected as parents for a further generation. A part of each series of the latter is shown in Plate V. To the right of field label 49 is a row of *(E22 × A)-10-13-5-* which, it may be said, had not fully developed when the photograph was taken; in front of this label are plants of *(E22 × A)-10-13-13-*, and to the left are shown plants of *(E22 × A)-10-13-12-*. All the plants of these three series were quite alike in having a general habit of growth that was quite identical to that of the parents.

The very different vegetative habit of the series *(E22 × A)-10-8-* and of the next generation, series *(E22 × A)-10-8-14-* and *-15-*, is shown in Plate V in the plants of field number 49.

Other equally well marked vegetative types appeared in the F_3, and bred as true in the F_4. Series *(A × E22)-9-5-6-* is one of rather medium but scraggly growth, and with brittle branches and stems. (See Plate V, field number 53.)

Other races are shown in Plate VI. In the right foreground, extending to field label 63, are plants of *(A × E22)-4-6-3-*, which were of a very decided dwarf habit with few brittle branches, and a very marked susceptibility to a stem-rot due to fungous or bacterial infection in the tips of the branches. The field no. 63 designates the 15 plants of *(E22 × A)-10 Ser. II. 10-*, all but one of which were self-sterile; these, it will be noted, are of a rather tall and much-branched habit. Field no. 57 is for series *(A × E22)-9-4-10-*, which exhibited the rather incongruous combination of large vigorous erect rosette leaves with a weakly developed and sparsely branched main stem. To the left of field no. 57 is a row of series *(A × E22)-4-3-11-*. This series was somewhat like the dwarf series already noted, but was of more vigorous growth. The branches were brittle and very susceptible to the same disease. The dying tips of the branches are quite well shown in the reproduction of plants in the foreground.

The above rather brief description will give some idea of the various vegetative forms that have appeared in the various lines of descent. It is to be noted that the plants of each series of this F_4 generation and of most of the series of the F_3 are very uniform among themselves in general vigour and habit of growth, but that various vegetative types are very different from each other. The general data for flower colour are given in the various tables, which show that for some of the series the flower colour was quite uniform, while for others white-flowered and blue-flowered plants were both in evidence.

The data in detail given in Tables I—VI, and the summary of Table VII, show that self-incompatibility develops in these various races in quite the same degree. The most dwarf and the most robust races or lines are quite alike in performance. Plants that are widely dissimilar may be self-fertile or self-sterile. Also the performance within the various series indicates that plants that are quite identical in all vegetative characters may be either self-fertile or self-sterile.

4. *General Summary of Results.*

In Table VII, the results obtained in 1916 are compiled together with those obtained in previous years, thus presenting a summary for the various series and generations of each family. Here the summary for the F_1 generation derived by crossing the self-sterile plants *A* and *E3* or *A* and *E22* is presented in italics for comparison, but is not included in the summaries of families of self-fertile lines of descent, for

Record of Ancestry: Parentage	Fertility per cent. and generation: P_1	P_2	P_2	No. plants: Totals	Self-sterile	Self-fertile	Percentage self-fertile	Distribution, Percentage fertility: 1–5	–10	–15	–20	–25	–30	–35	–40	–45	–50	–55	–60	–65	–70	–75	–80	Average fertility of self-fertile plants
E3 × *A* (with reciprocal)	—	—	—	*21*	*17*	*4*	*19*	*2*	—	*1*	—	—	—	—	—	—	*1*	—	—	—	—	—	—	*0·17*
(*E3* × *A*)-*4-*	48	—	—	18	8	10*	55	1	—	1	—	3	2	—	—	1	1	—	—	—	—	—	—	0·26
,, *-4-4-*	,,	43	—	23	5	18	78	2	4	1	2	2	4	2	—	—	1	—	—	—	—	—	—	0·20
,, *-4- Ser. II. 20-*	,,	50	—	26	10	16	54	5	2	4	2	1	—	—	—	1	—	—	1	—	—	—	—	0·15
Summary ...	—	—	—	**67**	**23**	**44***	**65**	**8**	**6**	**6**	**4**	**6**	**6**	**2**	—	**2**	**2**	—	**1**	—	—	—	—	**0·197 ± 0·133**
A × *E22* (with reciprocal)	—	—	—	*75*	*67*	*8*	*11*	*4*	*2*	—	—	*1*	—	—	—	—	—	*1*	—	—	—	—	—	*0·114*
(*A* × *E22*)-*4-*	04	—	—	10	3	7	70	1	—	3	1	2	—	—	—	—	—	—	—	—	—	—	—	0·14
,, *-4- 1-...* ...	,,	16	—	10	10	0	00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0·00
,, *-4- 3-...* ...	,,	13	—	8	2	6	—	1	—	1	—	1	2	1	—	—	—	—	—	—	—	—	—	0·21
,, *-4- 6-...* ...	,,	22	—	7	3	4	—	—	2	1	—	—	—	1	—	—	—	—	—	—	—	—	—	0·15
,, *-4 10-...* ...	,,	12	—	3	3	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0·00
,, *-4- 3- 6-* ...	,,	13	05	2	2	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0·00
,, *-4- 3-11-* ...	,,	,,	32	29	20	9	31	5	1	1	1	—	1	—	—	—	—	—	—	—	—	—	—	0·08
,, *-4- 6- 3-* ...	,,	22	31	16	8	8	50	1	1	1	1	1	—	—	—	2	—	—	—	1	—	—	—	0·25
Summary ...	—	—	—	**85**	**51**	**34**	**40**	**8**	**4**	**7**	**3**	**4**	**3**	**2**	—	**2**	—	—	—	**1**	—	—	—	**0·165 ± 0·136**
(*A* × *E22*)-*9-*	23	—	—	6	4	2	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	0·38
,, *-9-4-*	,,	43	—	12	6	6	50	2	—	1	3	—	—	—	—	—	—	—	—	—	—	—	—	0·12
,, *-9-5-*	,,	33	—	13	3	10	77	2	1	—	—	1	1	1	2	—	1	—	—	—	1	—	—	0·29
,, *-9-4- 4-* ...	,,	43	20	10	6	4	40	—	1	1	1	—	1	—	—	—	—	—	—	—	—	—	—	0·16
,, *-9-4-10-* ...	,,	,,	17	13	6	7	54	2	2	—	1	1	—	—	—	—	—	1	—	—	—	—	—	0·17
,, *-9-4-11-* ...	,,	,,	20	4	2	2	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0·02
,, *-9-5- 1-* ...	,,	33	07	4	3	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0·02
,, *-9-5- 6-* ...	,,	,,	46	29	17	12	41	3	2	1	1	2	1	—	—	1	—	—	—	—	—	—	1	0·21
,, *-9-5-12-* ...	,,	,,	70	34	17	17	50	3	3	2	—	1	—	1	2	—	1	2	—	1	1	—	—	0·28
Summary ...	—	—		**125**	**64**	**61**	**49**	**15**	**9**	**5**	**6**	**5**	**3**	**3**	**4**	**2**	**2**	**3**	—	**1**	**2**	—	**1**	**0·223 ± 0·19**
(*E22* × *A*)-*10-*	51	—	—	23	12	11	49	2	1	2	2	1	—	—	2	1	—	—	—	—	—	—	—	0·20
,, *-10- 6-* ...	,,	23	—	2	0	2	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	0·07
,, *-10- 7-* ..	,,	02	—	3	2	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0·04
,, *-10- 8-* ...	,,	16	—	10	4	6*	60	1	—	1	—	1	1	—	1	—	—	—	—	—	—	—	—	5·22
,, *-10-13-* ...	,,	38	—	16	10	6	38	1	—	—	—	2	1	—	1	—	—	—	1	—	—	—	—	0·29
,, *-10-14-* ...	,,	14	—	5	3	2	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	0·12
,, *-10- Ser. II. 10-*	,,	13	—	15	14	1	06	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	0·26
,, *-10- 8-14* ...	,,	16	15	16	14	2	12	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0·10
,, *-10- 8-15* ...	,,	,,	40	17	3	14	83	—	2	5	—	4	—	1	1	1	—	—	—	—	—	—	—	0·20
,, *-10-13- 5* ...	,,	38	29	31	21	10	32	4	2	3	—	—	1	—	—	—	—	—	—	—	—	—	—	0·10
,, *-10-13-12* ...	,,	,,	25	23	15	8	35	2	1	3	—	—	—	1	—	1	—	—	—	—	—	—	—	0·16
,, *-10-13-13* ...	,,	,,	56	28	14	14	50	2	1	2	1	4	2	1	—	—	—	—	1	—	—	—	—	0·19
,, *-10-14- 6* ...	,,	14	13	7	6	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0·10

the self-fertile plants in the F_1 series appeared sporadically. In the columns giving fertility of ancestry, the individual percentages are given for the parents in line of descent and the performance of the series to which these belonged is, of course, to be found from the pedigree. A general summary is given in bold face type for each family as a whole.

It is a most noticeable fact that at least some self-sterile plants appeared in every series but one, and this was a small series of only two plants. The proportion of self-fertile plants varies considerably. Considering the families as a whole, it is highest in the family $(E3 \times A)$–*4*–. In the three sub-families of *A and E22* parentage, the percentages of the proportions are quite the same (40, 49, and 40). The distribution of the self-fertilities is quite similar in all families with the larger number of plants of low fertility. The range extends into somewhat higher values in the family $(A \times E22)$–*9*–. On the basis of the average fertility of the self-fertile plants, there is a range from 0·165 to 0·223.

Considering all these data, there appear to be no very decided family differences in regard to the heredity and variability of self-compatibilities and incompatibilities.

It is to be recognized that the data are not sufficient to give an adequate judgment of the performance of a family or a line of descent constituting a considerable progeny and having an ancestral record of feeble fertility. As I have conducted the experiments, to select continually for very feeble fertility is to greatly limit the number of the progeny. When the pollinations are made, there is no way of knowing with any certainty what the degree of fertility is. When this becomes known, it is usually too late to make in that year the large number of pollinations necessary for the production of considerable seed by feebly self-fertile plants. It would be quite possible, however, to keep feebly fertile plants, and by making large numbers of pollinations in succeeding years to obtain considerable seed.

Of the families grown thus far $(A \times E22)$–*4*– has an ancestry of the lowest fertility. The data for the first self-fertile ancestor (Stout, 1916, Table III) are quite adequate to establish its low fertility. Of 26 different heads pollinated on eight different days, 20 set no seed; in the six heads the number of seed were 1, 3, 3, 4, 4, 4, giving a percentage of 4. Of the ten plants grown to maturity from such seed, 7 were self-fertile, but the highest individual fertility was 23. In the next generation from four parents, 28 plants were grown. Ten plants of one series were all self-sterile, and in another series of 8 plants, 6 were self-fertile, the widely different results in this case being obtained from almost identical ancestral records. After three generations of self-fertile parents with a record of 4, 13, and 32, one rather large series of 29 plants gave 31 °/ₒ of plants self-fertile, but with ranges only to 26 °/ₒ, and the very low average of 8 °/ₒ. A sister series with ancestral record of 4, 22, and 31 °/ₒ gave 50 °/ₒ of plants self-fertile, of a range extending to 62 °/ₒ and an average of 25 °/ₒ. Such irregular and sporadic results seem characteristic so far as my data go.

However, on the whole, this family was one of relatively low ancestral fertility. Only three of the members have shown a fertility above 26 °/ₒ, and the average of 0·165 is for all offspring lower than that of any other family.

The record of ancestry for the family (*E22* × *A*)–*10*– is one of high fertility. The fertility of the first self-fertile parent was 51 °/ₒ. The 23 plants of the first generation, 16 of the second, and 82 of the third all had self-fertile parents with no fertility lower than 25 °/ₒ, yet of these the percentage of self-fertile plants was 41, which was almost identical with the record for the whole family. The most highly self-fertile series yet obtained in regard to the percentage of self-fertile plants was in this family (see (*E22* × *A*)–*10–8–15*–), but there were also two series that were almost completely self-sterile.

In the family (*A* × *E22*)–*9*–, the plants selected for parents have been, as a rule, of medium fertility, although, of course, these have been above the average. The range of fertility is considerably higher in the family, and the average fertility of self-fertile plants is also higher than in any other family.

Certain aspects of the results are perhaps clear. In every family, as a rule, the total fertility (proportion of plants self-fertile, range of fertilities, average percentage of fertility) is increased over that which evidently occurs in the progeny of self-sterile parents; at least the proportion of self-fertile plants is much greater. This increase is, as a rule, marked in the first generation of offspring grown from self-fertile parentage. Continued selection for parentage high in individual self-fertility does not steadily and continuously increase the fertilities of the progeny either as to individual or to average fertility. The marked tendency to the development of self-incompatibility has not been eliminated.

An inspection of the data presented will show that in several series the numbers of plants that are self-fertile are relatively high. For example, in series having 83, 78, and 77 °/ₒ of the plants self-fertile it might seem that the fertilities have been very much increased and that further selection might yield a race all of which would be self-fertile, at least to some degree. In every case, however, a large number of the offspring grown from highly self-fertile plants selected from such series have been self-sterile, and on the whole the record for such progeny has not been above that of the preceding generation.

In certain cases also, high records of fertility seem to be correlated with an ancestral record that is high. While the results in this respect are not uniformly in agreement, a number of the most highly fertile series do have an immediate parent of high self-fertility. Some evidence on this point may be gained by grouping the results according to the fertilities of the immediate parentage and without regard to the family or generation. This has been done in the following table.

TABLE VIII.

Summary according to degree of self-fertility of immediate parentage.

	Record for progeny																				
					Frequency distribution, Percentage fertility																
ertility f parent	Total no. plants	Number self-sterile	Number self-fertile	Percentage self-fertile	1–5	–10	–15	–20	–25	–30	–35	–40	–45	–50	–55	–60	–65	–70	–75	–80	Ave fer of fe
1–0·10	19	10	9	0·49	3	—	3	1	2	—	—	—	—	—	—	—	—	—	—	—	0
1–0·20	101	70	31	0·31	6	6	5	2	3	5	1	1	—	—	1	—	—	—	—	—	0
1–0·30	97	55	42	0·43	12	10	8	3	—	1	4	1	2	1	—	—	—	—	—	—	0
1–0·40	91	44	47	0·52	9	5	7	2	8	3	2	4	3	1	—	1	1	1	—	—	0
3–0·50	108	46	62	0·57	13	8	8	8	7	8	2	—	3	2	—	1	—	—	—	1	0
1–0·56	51	26	25	0·49	4	2	4	3	5	2	1	2	1	—	—	1	—	—	—	—	0
0	34	17	17	•0·50	3	3	2	—	1	—	1	2	—	1	2	2	—	—	—	—	0

The results show that in respect to the proportion of self-fertile plants there were only slight differences in the progeny of parents of high or of low fertility: the lowest percentage (31) was obtained in the progeny of parents whose self-fertility ranged from ·11–·20. In regard to the range of the self-fertilities, the offspring of parents of the lowest fertilities (·01–·10) extended only to 23 °/₀. The highest range is seen in offspring of the class 0·43–0·50. The number of offspring, especially of the lowest class of parentage, is not as large as one would wish. The evidence is quite conclusive, however, that there is strong regression, especially in the offspring of plants of high fertility, and that the various progenies do not differ in the degree that is decidedly correlated with the performance of the respective parents. Still the data are suggestive that the higher ranges and averages are to be obtained in the offspring of parents whose self-fertility is higher than 30 °/₀.

Discussion.

Physiological sexual compatibility in chicory is decidedly sporadic in its heredity. That its expression in the individuals of self-fertilized lines of descent is continually fluctuating is clearly in evidence from the behaviour of the various self-fertilized lines of descent reported above. The number of generations and the number of plants in the main sub-families have been, it would seem, sufficiently large to establish these points.

Starting with self-compatible plants that arose sporadically among the F_1 progeny of self-sterile parents, lines of descent have now been grown through three further generations (F_2, F_3, and F_4) and in every generation, and in every series (excepting a single one of only two plants) of each family, self-sterile plants have appeared, and usually these have been in considerable numbers. A general summary of the different generations and families shows that about half of the plants have been self-sterile: that is, there has been considerable regression in each generation, in each family, and in each series to the condition of self-incompatibility which appeared to be the rule in the original stocks from which these plants descended. Furthermore, the average performance has been quite the same for the successive generations.

The first self-fertile parents of these families and lines of descent were offspring of parents whose self-sterility had been thoroughly tested and found to be complete. As individuals they appeared to be completely self-sterile; the races or strains to which they belonged, however, are not to be considered as absolutely self-sterile. The self-fertile plants used as the first parents for the cultures here reported had thus one generation of parentage known to be self-sterile, but I have elsewhere shown (1917) that self-fertile plants may arise after three generations of ancestry self-sterile on both male and female sides. In the development of self-compatibility, these plants then differed sharply from their immediate parents, and from the greater number of their sister plants. The extremes, self-fertility and self-sterility, it would seem, are two quite decidedly contrasted characters. In the apparent suddenness of the occurrence of self-fertile plants among the offspring of self-sterile parents there is much that is suggestive of what is quite generally called mutation.

When the first self-fertile plants appeared in my cultures, I was of the opinion that the characteristic of self-fertility would be decidedly discontinuous, and that it would be transmitted as a fixed quality. In other words, it was thought that the occurrence of such self-fertile plants could be interpreted as "mutation," or possibly as a recombination of fixed heredity units which had been separated as a result of previous crossing. However, the various self-fertile plants which first appeared exhibited various grades of compatibility which are suggestive rather that compatibility is a highly variable quality. Furthermore, the self-fertilities of the offspring of self-fertile plants in all lines of descent are also of various grades. There is obviously a series of quantitative variations in the behaviour of the plants as wholes that grade from complete self-incompatibility to a very decided self-compatibility. Such a variability of expression of fertilities and such incomplete transmission of the characteristic of self-fertility, as is revealed in all my self-fertilized lines of descent, indicate that occurrence of self-fertility is not due to mutations which are at once fixed, or to recombinations of hereditary units. At least, such recombinations are decidedly not stable.

Darwin (1868, 1877) held that all the facts regarding the occurrence of self-incompatibility then known in such plants as *Eschscholtzia californica* and *Reseda odorata* show that the phenomenon is widely distributed and is of decidedly sporadic occurrence. In his opinion, self-sterility is due to "some change in the condition of life acting on the plants themselves or on their parents." The causes were held to be environmental, and the self-incompatibility was assumed to rest in too great a uniformity or similarity of the two kinds of sexual organs produced by a plant. The characteristic of functional fertility, according to Darwin, exhibits fluctuations and chance variation as do other characters.

Jost's (1907) theory of individual stuffs assumes that the causes of self-sterility (physiological incompatibility) are individual, internal, and epigenetic in that the sex organs fail to function because they are produced on the same plant: the sex organs have the same chemical individual stuff, and thereby lack the differentiation assumed to be necessary for successful fertilization. The causes were fluctuating, but were held to be solely internal.

Morgan's (1904, 1910) studies of self-incompatibility in the animal *Ciona intestinalis*, led to much the same conclusion as was reached by Jost. The failures to function are assumed to be due to too great similarity that involves cytoplasmic relations established in the individual. The similarity is thus considered as independent of the degrees of dissimilarity in the germ plasm brought about by the crossing necessary to give fertility.

Beginning about 1910, the attention of various investigators was especially directed to a study of the breeding performance of plants with respect to self-sterility in the attempts to determine its heredity and obtain clues as to the nature of the processes involved.

In 1911, Baur claimed that the self-sterility of *Antirrhinum molle* was recessive to self-fertility in *A. majus*, giving complete self-fertility in all plants of the F_1. The F_2, it was reported, was composed of a large proportion of self-fertile plants. Compton (1912, 1913) likewise supports the view that self-fertility is a simple dominant over self-sterility, and further interprets breeding results in *Reseda* on the basis of a simple presence and absence hypothesis, the absence of some substance, either nutritive or stimulating to the growth of pollen-tubes giving self-sterility, while the presence of such a substance gives self-fertility. Neither Baur nor Compton presents adequate data for his conclusions, and evidently both assumed a Mendelian behaviour of self-sterility and self-fertility on *a priori* grounds. In regard to the later generations of these *Antirrhinum* hybrids, Lotsy (1913) reports that the F_2 generations are composed of self-fertile and self-sterile plants, and that there are various degrees of self-fertility in evidence. The statement is made by both Baur and Lotsy, however, that all plants of the species *A. molle* are self-sterile.

Such interpretations have an advantage of appearing definite, simple, and conclusive. However, the performance in chicory of pedigreed cultures of offspring of self-sterile plants does not show any such simple and regular behaviour. Similar methods of study may reveal quite identical conditions and results in the above named species.

Correns, in 1912, announced the very important discovery of physiological cross-incompatibility among sister plants grown in the F_1 seed progeny of a cross between two self-sterile plants of *Cardamine pratensis*, a species which had previously been known as self-sterile. Correns thus proved, for the first time, that cross-sterility may exist within a variety among plants of seed origin which exhibit no dimorphism or trimorphism. By a grouping of the results, Correns arrived at a Mendelian analysis of the hereditary performance. Line stuffs were assumed to be represented and transmitted in the germ cells by anlagen, and it was assumed that there could be no fertilization between gametes carrying the same line stuff. An examination of Correns' actual results

(Stout, 1916) shows that the inter-fertilities and sterilities do not fall into four nearly equal classes such as Correns has grouped them. Compton (1913) has also pointed out that if Correns' assumption holds, one-fourth of the F_1 generation which he studied should have been self-fertile. On this particular point Correns' data are incomplete: he seems to consider all plants self-sterile, but his report includes data for self-pollinations of only 13 out of 60 of the F_1 generation. Of these, however, three were partly self-fertile. The interpretation that self-sterility and cross-sterility are due to a few line stuffs that are transmitted as single hereditary units is obviously inadequate. The conclusion, however, has been given considerable credence, especially in Mendelian circles.

East (1915*a* and *b*) very soon pointed out the inadequacy of Correns' interpretation, and formulated a "near Mendelian" interpretation for the almost complete self-sterility and the almost complete cross-fertility which he observed in hybrids between two species of *Nicotiana*. While discarding the conception of factors directly concerned with fertility and sterility as such, East considers that these conditions arise as indirect properties of Mendelian units; plants are self-sterile because the male gametophyte produced by a plant can possess no hereditary unit not possessed by the somatic cells of the pistil. He assumes that this degree or element of similarity between pollen-tube and pistil in self-pollination prohibits the formation of secretions in the pistil which are necessary for the nourishment and growth of the pollen-tubes.

As to the facts of breeding performance, we may note that neither East nor Correns gives adequate data as to the fluctuations in the degree of fertility, or in the behaviour of pedigreed lines of descent from self-sterile parents of a variety or a species, and there have been no data published regarding the behaviour of pedigreed lines of descent from self-fertile individuals which originated sporadically from self-sterile parentage. A few such plants were in evidence in the F_1 crop studied by Correns quite as I found them in chicory.

It is especially to be noted that there are no published data regarding the performance with reference to sterility and fertility of cultures of the so-called self-sterile species *Antirrhinum molle* and *Nicotiana Forgetiana*. Detailed studies of the performance of these, as well as of other species reported self-sterile, are greatly to be desired.

Moore (1917) recently reports that: "The species of *Tradescantia*, alsike clover, alfalfa, and Shirley poppy showed different degrees of self-sterility. *Tradescantia* was completely self-sterile; in alsike clover about

2 % of the flowers set seed when self-pollinated; in alfalfa 27 % of the flowers were fertilized with self-pollen, and when Shirley poppies were self-pollinated 39 % of the flowers set seed." The performance of individual plants is not indicated in these results, so it is impossible to judge of the variability in fertility that occurs in the various individuals involved. Evidently some individuals are self-sterile (except in *Tradescantia* ?) and some are self-fertile.

At this point one may venture to recognize that most of our misunderstanding (and assumed understanding as well) of the transmission of characters and of the nature of variation of all sorts is, no doubt, due to attempts to analyze all sorts of characters in terms of hereditary units. There has been a tendency to ascribe all sorts of characters, superficial, fundamental, all sorts of pattern effects in pigment distribution, minutely qualitative or quantitative differences of highly specialized organs, and general qualities of an organism as a whole to factors which, it would seem, are mostly thought of as corpuscular units serially arranged in the germ plasm. The inadequacies of the attempts to analyze self-sterility on this basis are quite apparent both as to methods and results.

To speak of the occasional appearance of self-compatible individuals in an ordinarily self-sterile race as sporadic, and to refer the processes determining the possibility of fertilization to variable interactions between tissues and cells as such, may to many seem less definite than an interpretation on the basis of assumed hereditary units. But the irregular behaviour of compatibility and incompatibility both in ontogeny and heredity in chicory is clear. Neither compatibility nor incompatibility are fixed and unchanging characters in transmission and in expression, and are not to be considered as directly represented in the germ plasm by hereditary elements.

In general it has been held that functional sex-vigor is congenital, and that fertility in the sense of ability to produce large numbers of offspring is hereditary. In many hermaphrodite plants, perhaps the majority, self-fertility appears complete; within many species cross-compatibility is perhaps complete; the functional compatibility between the sexes is so general in the plant and animal kingdoms that it has been held to be congenital.

The presence of sexual incompatibility, therefore, between individuals of a single race or variety, or even single line of descent, as it is found in chicory, strikes one at first as a decided anomaly, and it seems still more an anomaly that the sex organs produced on the same plant, and even in the same flower, may be as incompatible in function as though they were produced by plants of unrelated genera.

There has been much speculation as to the nature and operation of the physiological processes operating in such incompatibilities as are seen in physiological self- and cross-sterility. In many cases of self-incompatibility it has been reported that there is a limited or restricted growth of pollen-tubes. These facts have led to views that the determining factors in compatibility and incompatibility are limited to the relations between pollen-tubes and pistils alone. Jost (1907) considers that the poor growth of pollen-tubes in such cases is due to the action of individual stuff which inhibits growth of pollen-tubes having the same stuff. Compton (1912, 1913) believes that self-sterility is due to the absence of a stimulating stuff, the presence of which gives fertility. East (1915 *a*) attributes self-sterility to absence of food stuffs which are not secreted because the pollen-tubes involved do not possess any hereditary element not possessed by the diploid cells of the pistil. Moore (1917) considers that the limited growth in length of pollen-tubes observed in self-sterility in *Tradescantia* is really due to the presence of too much food.

Some of these views appear to regard the determining factors as conditions of the pistil alone; others consider that the conditions arise through a reciprocal reaction between tubes and pistil. All of them fail to recognize that a critical period in the growth of the pollen-tube may result from secretions of the egg, and that the different qualities of the pistil may be due to the diffusion of hormones from the gametophytes. As I have earlier pointed out, there is some evidence that some cases of embryo abortion may be due to incompatibility, expressing itself after fertilization and during the development of the embryo. This may be true in some cases in chicory. Further studies are in progress on this point.

Cross-sterility (within a species) without self-sterility might be explained as are isoprecipitation phenomena on the basis of an intra-specific specificity of individuals, or groups of individuals, as such. Self-compatibility, however, shows that an equally-marked differential specificity may develop in sex organs and gametes produced by a single individual: such specificity is not characteristic of the sporophytic individual as a whole, but of the pollen-tubes, pistils, embryo sacs and eggs as such.

Conclusions.

1. *Self- and cross-incompatibilities in chicory develop independently* of either (*a*) *anatomical incompatibility* with its marked structural differences and adaptations for cross-pollination; or (*b*) *embryo abortion,* at least of the sort that is due to the malnutrition of embryos by the parent plant, and which in many fruit-bearing plants involves various conditions of seed and flesh formation.

2. There is some evidence that both impotence and embryo abortion are also present in some degree in chicory.

3. The experiments with chicory already reported (1916, 1917) indicate (*a*) that self- and cross-incompatibilities are strongly in evidence; (*b*) that a few self-compatible plants may arise sporadically from parents that are self-sterile, even after three generations of self-sterile parentage; (*c*) that the progeny of such self-fertile plants do not breed true as to this character; (*d*) that the degree of self-compatibility varies; (*e*) and that selection for increased self-fertility after two generations was not effective in isolating a completely self-fertile strain.

4. The new data reported in this paper are fully in accord with the results obtained in previous years. A new generation, the third having self-fertile ancestry, exhibited quite the same irregular heredity and sporadic development of self-sterility (or regression to the condition of self-sterility) as was seen in the former generation. In this respect every family, every line, and every series were in close agreement.

5. *Self-compatibility is entirely independent of differences in vegetative vigor.* The various series of the crops grown in 1915 and 1916 showed widely different types in respect to vegetative vigor. Self-sterility appeared in all these races with practically equal frequency. Sister plants of the least vigorous dwarf race or sister plants of the most vigorous vegetative race were either self-fertile or self-sterile indiscriminately.

6. *Self-compatibility and self-incompatibility operate independently of potential sex-vigor.* The total production of flowers varied greatly among the various series. Plants with large numbers of sex organs were either self-sterile or self-fertile, as were plants with the fewest number.

7. *Self-compatibility and self-incompatibility operate independently of the purely nutritive relations of the embryos to their parent plants.*

Ten flower heads self-pollinated on a completely self-sterile plant will set no seed, while ten heads on the same plant pollinated on the same day with pollen from a highly cross-compatible plant will set abundant seed. The fruits are rather small achenes having no endosperm, and are practically composed only of the embryo: provided the pollination is compatible, they develop equally well throughout the season (Data, see 1916, Tables XV and XVI).

8. *Self-compatibility and self-incompatibility appear independently of any combination of germ plasm elements* in so far as these can be judged by the expression of characters. Each operates alike between gametes that are similar or those that are dissimilar in respect to hereditary units of genetic analysis. Plants widely different in such qualities as colour of flowers, type of branching, shape of leaves, etc. are either self-fertile or self-sterile, and plants of a sister series quite similar in all respects are either self-fertile or self-sterile. When an F_1 plant of hybrid origin is self-fertile in any degree the evidence indicates that any of the sex cells may function in any recombination; on the other hand in self-sterile sister plants whose sex cells must, it would seem, be of much the same diversity none are compatible. Also all the sex cells of an F_4 plant which must have much the same germ-plasm constitution may fail to function together, while those of a sister plant may be highly functional. Two self-sterile plants, sisters of an F_1 cross or sisters of any generation, may be cross-fertile or cross-sterile quite indiscriminately.

9. *The development of either self-compatibility or self-incompatibility occurs in both cross-bred and inbred races, the latter often being highly constant races for vegetative characters.* Both self-fertile and self-sterile plants occurred among sister plants that were F_1 hybrids of rather wide crosses (Stout, 1916, 1917); they also appeared among inbred strains derived by crossing self-sterile parents for as many as three generations (1917), and they occurred, as here reported, among the progeny of self-fertile plants, even after three generations of self-fertile parentage. The positive evidence at hand, however, makes it clear that self-compatibilities do not decrease in self-fertilized lines of descent which are so uniform that they constitute decidedly pure races.

10. *The results obtained in the cultures of chicory make it clear that self-incompatibility and self-compatibility are here not to be described as dominant and recessive characters*, or paired allelomorphs, and that there is no simple Mendelian formula that fits the results. The evidence

at hand for the behaviour of similar phenomena in other species is also quite in agreement with this conclusion.

11. *The conditions controlling sex-fusions,* judged by the behaviour of compatibilities and incompatibilities in such species as *Cichorium Intybus, arise in connection with the development of the sex organs and sex cells as such.* In this sense the controlling factors are of epigenetic and individual development.

12. *The factors which determine or prohibit successful fertilization in chicory, whatever their essential nature may be, are highly variable as to degree, specificity, and transmission in heredity.*

New York Botanical Garden,
May 10, 1917.

EXPLANATION OF PLATES.

PLATE IV.

View of series $(A \times E22)$*–10–13–* of the semi-dwarf bushy race showing very decided uniformity in general vegetative habit. Ten of this series were self-sterile and six were self-fertile. In the foreground is a plant of series $(A \times E22)$*–10–8–* showing a tall sparsely branched habit of growth. These plants are from two generations of self-fertile ancestry.

PLATE V.

View of chicory in experimental plot. Crop of 1916. Several races are shown.

PLATE VI.

Another view in experimental plot. Crop of 1916. Dwarf and semi-dwarf races are especially prominent. Plants shown in Plates V and VI are from three generations of self-fertile ancestry. Plants here shown were self-compatible or self-incompatible quite indiscriminately.

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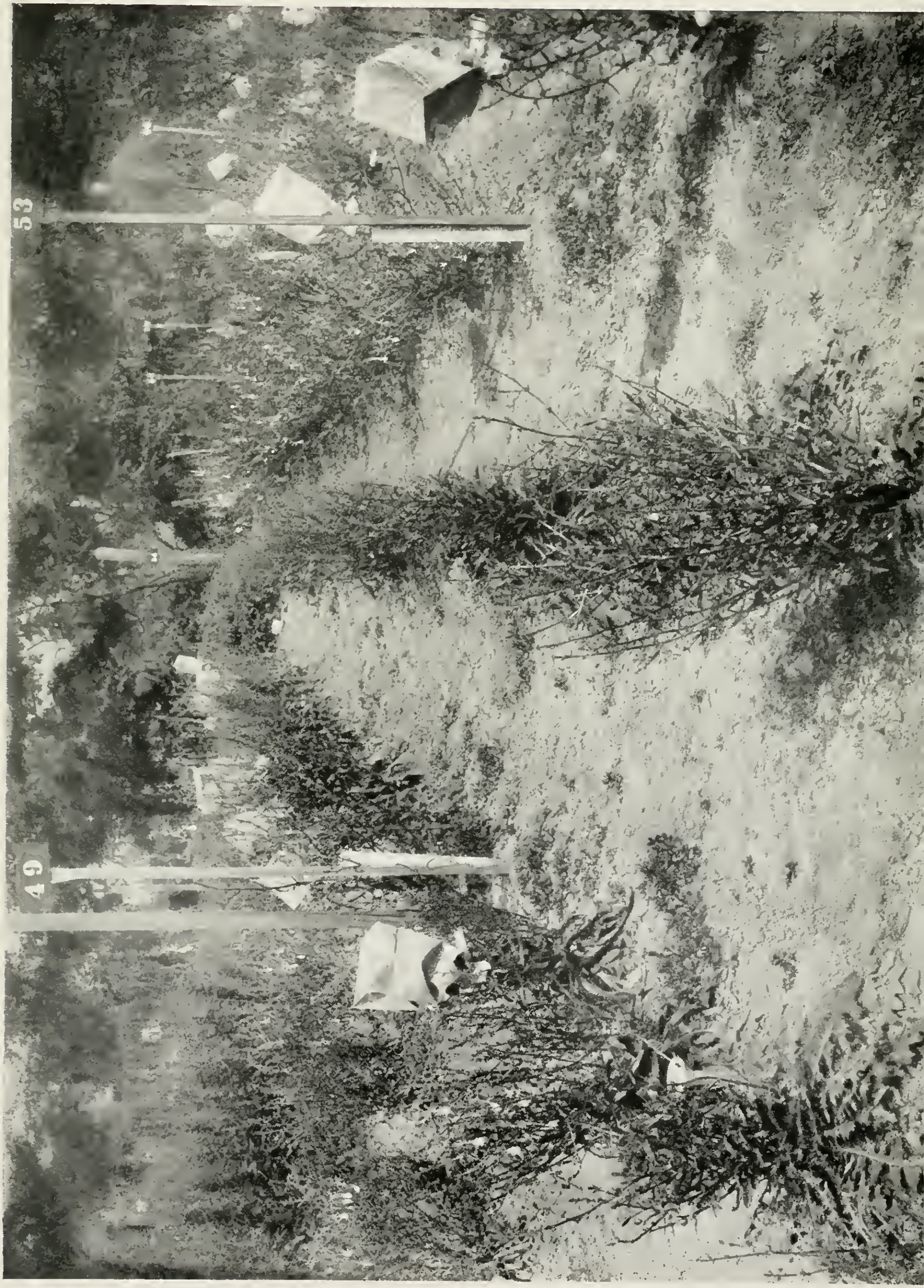
41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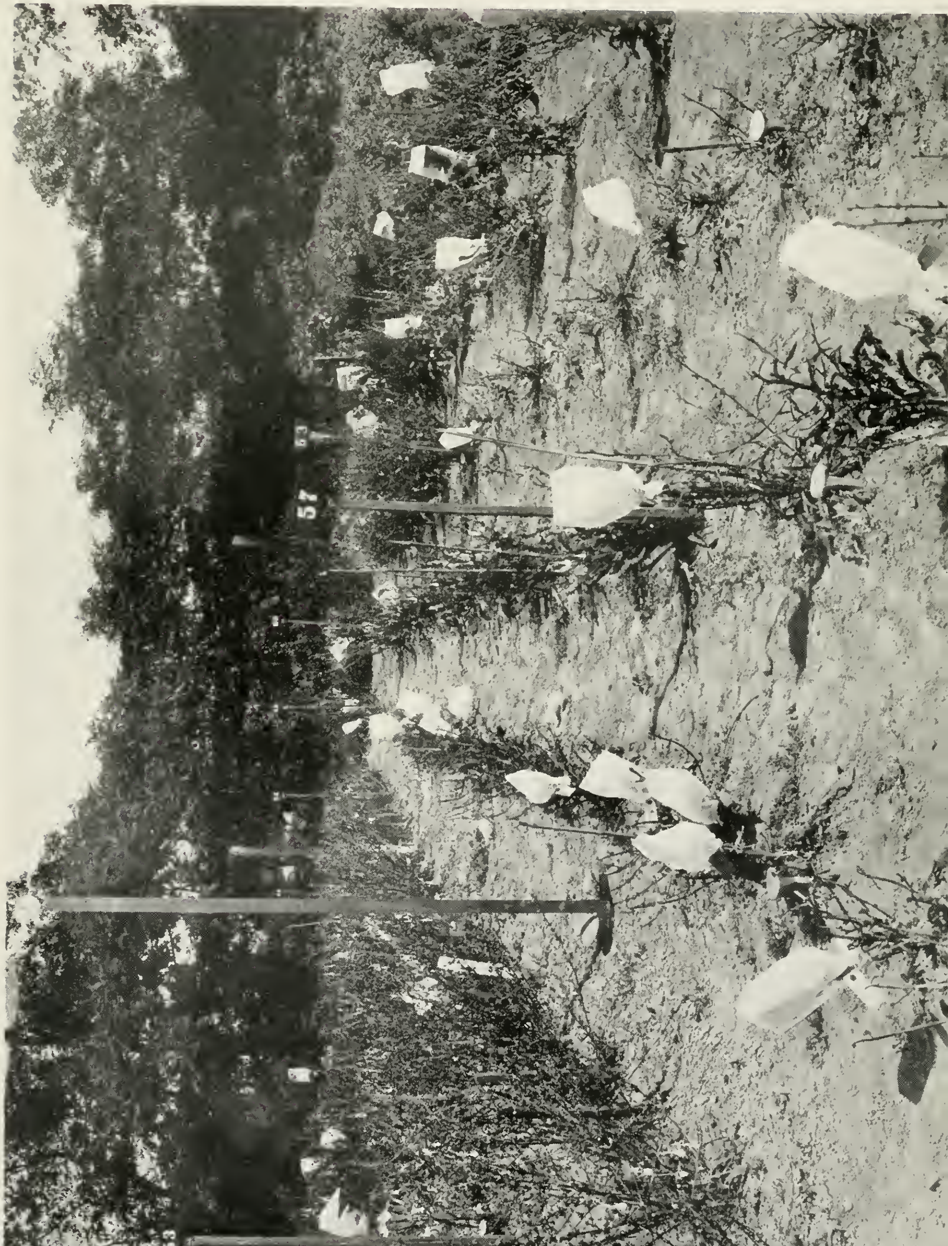
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