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MORE PLAT STUDY: FEWER PLANT NAMES

Harvard Memorial Volume for Merrill
Journ. Arn. Arb. 27. 1946

MORE PLANT STUDY : FEWER PLANT NAMES

Carleton R. Ball

Journ. Arn. Arb. 27: 371-385 (Oct. 15), 1946

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Nature produces infinite variety. Man (the taxonomist) desires, imagines, and describes uniformity. Therein lies perpetual confusion and conflict. Before obvious differences can be evaluated, we need to understand their nature, extent, and probable causes. The writer can speak definitely only of the genus Salix (willows).

FOUR MAJOR CLASSES AND CAUSES OF VARIATION

Four major classes of variation occur normally on shrubby and/or arborescent willows, and to a lesser degree on prostrate and creeping species. A: The same organ, on one part or on different parts of a single plant, normally presents striking variations. The pattern is permanent but the expression is modified by environmental conditions. B: An individual organ usually or often shows great variation during the course of a season or a year. These variations are the direct result of the advance from spring to summer, to autumn, and back to spring again, but their expression will be modified by differing conditions in differing seasons or years. C: Plants of a single species, growing under obviously different conditions of local environment, frequently present large variations from spot to spot. While presumably environmental effects, these variations may include the hereditary differences of Class D also. D: Two or more individuals, growing under apparently identical conditions of local environment, frequently display obvious differences. These should be hereditary variations, if the environments actually are identical, but are influenced somewhat by the age of the plant.

A. Variation of an Organ on a Single Plant

The Individual Leaf. As the leaf emerges from the budscale, the outer or apical portion broadens first. This broadening progresses toward the base. If the nutrient supply is reduced by competition farther out, before growth

of the leaf is completed, the lower (first-developed) leaves may never finish normal basal expansion. Leaf-bases may remain cuneate, acute, or rounded, which should have become acute, rounded, or cordate, respectively. The tip also may fail to elongate, leaving the apex obtuse or acutish when it should have been acute or acuminate.

Different Leaf Forms on a Single Twig. On any given twig, there will be three successive and intergrading sizes and shapes of leaves, occupying basal, central, and apical locations on the twig. The basal leaves in general will be smaller, narrower at base, and broader and blunter at apex, than the central leaves. The apical leaves will tend to be larger, broader at base, and more acute or acuminate at apex, than the central leaves. The central leaves, therefore, are somewhat intermediate between the basal and apical leaves in size and shape, just as they are intermediate in position and time of deveopment. In general, therefore, there is a steady progression in leaf size and shape from the base (first developed) to the apex (last-developed) of the twig. This progression tends to recapitulate the developmental history of the individual leaf. These facts hold, no matter what the normal shape of the leaf may be.

Four Types of Twig Per Plant. Normally there are three, and sometimes four, types of leafy twigs produced successively during each season. Type a is the short twigs which develop simultaneously with the fruits, from lateral leaf-buds on the fruiting twigs. Type b is the longer and somewhat vigorous twigs which develop, after fruiting is over, from apical buds on the fruiting twigs. Type c is the vigorous shoots which develop later from buds on older wood, after the food-drain of fruiting is over. Type d is the luxuriant shoots (water sprouts) which sometimes develop on trunks and/or roots in late summer. Schneider (10, p. 9-10)* discussed parts of this problem briefly in 1918, but in somewhat vague language, the writer more fully in 1943. (4)

* Numbers in parentheses refer to "Literature Cited" at end of paper

On each of these four successive types and sizes of branchlets, there will tend to be the same progressive shift in size and shape of leaves, from base to apex, as was described above. But in addition to this normal progression, all the leaves on type a tend to be shorter and relatively broader, , all of those on type b tend to be intermediate, and all of those on type c tend to be larger than on the others. These changes, like those on a single twig, probably represent the more abundant food supply and more favorable temperatures as the season advances. Fruiting limits nutrients available to early shoots and rapid elongation of a summer twig may cause food to bypass the basal leaves. Sometimes the apical leaves on late-produced type-c twigs do not attain full size because of drought or cold in autumn. The leaves of all three groups on the sprouts of type d often are enormous in size and more or less different in shape, but there will be the same general progression from base to apex of sprout. Because of the variations just discussed, the writer often takes from 3 to 6 or 7 sheets from a single plant.

B. Variation of an Individual Organ During the Year

Twig, Budscale, and Branchlet Changes. These organs, as well as petioles, may change greatly in color and clothing during the successive seasons of a year, and the twigs during successive years as they become 1-year and 2-year branchlets. These changes are caused by plant reactions to sun, temperature, rain, etc. In general, they are greatest in plants in full sun and on those organs in direct sunlight.

In general, colors darken as the season advances. Original yellows, light greens, and light browns become varying shades of dark brown to blackish. As new twigs are produced during the summer, each must pass through these changes. In a few species, as S. amygdaloides and S. lutea, the yellow is permanent. In parts of Alaska and Yukon, as noted by Dr. Setchell, the abundant Salix Barclayi yellows the spring landscape with its bright yellow twigs and the very light yellowish-green of the unfolding leaves. But in the herbarium, and the manuals, the branchlets are blackish. The occASIONAL

bits of still-yellow epidermis are neither large enough or numerous enough to be conspicuous. The same facts are tmue of S. monticola in the Rocky Mountains, according to the continuing observations of Professor Ernest C. Smith, After going through the press, the twigs, with rare exceptions, are like those of S. Barclayi. By extremely careful drying, much of the ywllow color may be retained.

Twig, Budscale, and Branchlet hairiness is one of the most variable charcters of the vegetative organs of willows, and presumably of other plants as well. It is highly external, being a product of the epidermal cells and therefore greatly influenced by temperature, sun, etc. Its primary function function probably is protection of young tissues against sun scald. In many species, the seasonal shoots (chornotini) are more or less densely puberulent, pubescent, or tomemhose. This covering may be present in lesser degree as these shoots become 1-year (annotini) and 2-year branchlets in succeeding years. In other species, the seasonal twigs may be completely glabrous and remain so in later years. All this sounds simple, but - -.

The conspicuous pubescence of a new shoot may wear off gradually during autumn and winter, leaving glabrate to glabrous twigs in spring. Many species shed the epidermis from the branchlets in spring or early summer, and, of course, the hairs go with it. In such cases, there usually are "armpit" xxx areas on the twig, behind buds or lateral twigs, where the epidermis was not deciduous and tell-tale remnant pubescence may be found. Hairiness of budscales uaually parallels that of twigs.

Twig and Budscale Pruinosity occurs on such species as the western S. irrorata, S. Lemmoni, and S. subcoerulea, the northeastern S. pellita, and the European S. daphnoides. This waxy exudate is more external and less stable than the wax causing glaucousness of leaves, and therefore is more temporary in nature. It may be washed off by rain or snow, gradually removed by slow weathering, or completely discarded with peeling epidermis (5).

Many other species, northern and arctic, occasionally show some prūinosity of branchlets, budscales, or even capsules, with organ frequency in the order named. This has little diagnostic value, because of infrequent and irregular occurrence, confinement to a small part of the eligible organ surface, or quantity so dilute as to be distinguished only with difficulty.

Leaf Structure. Leaves and stipules may change greatly in degree of gland presence, serration, and vein-prominence during the season, as they develop from juvenile to full-sized, to mature, and to senescent condition. Glands may drop off and serratures may enlarge. Many species have normally entire leaves but scarcely one of these will fail to show some serration on vigorous apical leaves. Venation often becomes increasingly prominent with age in some species, under conditions little understood. Unusual specimens become varieties or forms under such names as venulosa, marginata, or reticulata, etc.

Leaf Hairiness. The leaves of many, probably most, species of willows are more or less hairy, on one or both surfaces, while they are unfolding. If densely hairy at first, they become less so through expansion of area, even if no hairs drop off. For those kinds not permanently hairy, the rate of hair fall varies with the kind, the environmemt, and the individual, just as in the human races. Those which have a natal coating of very long hairs on the under-surface usually lose them quickly (S. anglorum, S. laevigata) and persistence is greatest at the tip. Those with shorter hairs are likely to lose them more slowly, first from the leaf surface, then successively from the larger veins and outer midrib, and finally, if at all, from the lower midrib and petiole. Some arctic species remain ciliate on the margins. Species with permanently hairy leaves are found more commonly in cool and cold climates than in dry and hot areas, but there are exceptions. The hairs normally become thinner with age and some individuals in nearly all species lose most or all of the hairs by autumn. From this, we have varieties and forms named "glabra","glabrescens","tonsa", etc. How

[illegible] holding humans?

Leaf Glaucousness. The glaucescence or glaucosity of the lower surface of the leaves of many species of Salix are valuable and usable taxonomic characters, if botanists understand the chemistry and physiology of this expression. It is the result of a waxy secretion and the time of appearance and quantity produced seem to be governed by physiological processes. In species which normally are heavily glaucous, the whitening of the undersurface is apparent when the leaves begin to unfold, as in S. longipes, S. laevigata, S. discolor, etc. In species normally less densely glaucous, the color may not become visible until the leaves are half-grown, as in S. cordata and some relatives, S. sericea, S. lasiolepis, etc. In still others, as in the western S. lasiandra and the introduced S. fragilis, the under surface may remain pale green until the leaves are full-sized.

To add to taxonomic troubles, this white waxy substance is destroyed by too rapid or too hot drying of fresh specimens. This occurs often when electric driers are used. The glaucous condition cannot be restored. The blades remain permanently "green on both sides" and cannot be identified by the usual keys.

Floral Organs, such as aments, peduncles with their bracts or leaves, flower scales, glands, stamens, and capsules with their pedicels and styles and stigmas, likewise change greatly as they develop from the juvenile stage to maturity. Not only this, but the relative lengths of any two organs may change because some start earlier, or elongate faster, or continue growth longer than others. Some of those maturing quickest (glands, styles, and stigmas) may even shrink after maturing and so change relative dimensions. Yet some recent taxonomists still describe floralm organs in terms of relative lengths, without regard to the degree of maturity of the two organs compared, as "gland equalling the pedicel","styles ½ as long as pedicel", or "scale twice as long as the gland", etc. Such statements often are wholly misleading for taxonomic purposes.

There often is 100 percent variation in length of floral organs (except capsules) in a single ament, and it is not regular and progressive from base to apex or the reverse, although pedicels and scales tend to be longest at the base of aments. Scales are especially puzzling, as they usually are relatively short and broad in the opening ament and there is relatively little uniformity at maturity.

Scale Color and Hairiness. Scales in several Sections of Salix are pale yellow and deciduous. They may become pale brown in weathering or drying. In two Sections (Glaucae, Rostratae) with persisten scales, these are yellowish or light brown and may weather or dry to a medium brown, especially at the normally-visible apex. In other Sections, the scales usually are dark brown to black and remain so, although light-brown scales occur occasionally.

Flower scales of most willows normally are hairy, primarily for insulation and protection of the subtended organs. In most species, these hairs tend to drop off gradually, especially from the outer surface. Some scales become glabrate outside, others remain hairy. Some northern and arctic species, however, have scales glabrate or glabrous from the beginning (S. pyrifolia, S. leiolepis, S. chlorolepis).

Capsule Hairiness. Many species have permanently hairy capsules and almost never is a plant found whose capsules have become entirely glabrous in age. Only rarely do these species have varieties with normally glabrous capsules. Exceptions are S. brachycarpa var. glabellicarpa; also the species S. chlorolepis. In Sections Commutatae and Chrysanthae, having some species with permanently hairy capsules and other species with normally glabrous capsules, the latter species are likely to have varieties with more or less hairy capsules (S. Barvlayi var. hebecarpa, S. commutata var. puberula, S. Hookeriana var. tomentosa). Hairy-capsuled species in these sections do not have glabrous-capsuled variations. In some Sections (Nigrae) with normally glabrous capsules, variations with pubescent capsules may occur (S. Gooddingii, S. Humboldtiana var. Martiana) but the hairs usually are decid-

C. Plant Variations Caused by Differing Local Environments

Every farmer and farm boy knows the difference in height and color of maize plants in different parts of a single rolling clayey field. Stunted and yellow plants on the dry and stony hilltops, because of lack of water and food. Normal green and healthy plants on the lower slopes because of more water and sufficient fertility. Deep green and luxuriant plants on the flat, fertile, well-watered bottoms, through exceptionally favorable conditions. Marked differences in the size and color of plants and all of their organs. Yet all grew from the same lot of seed, in the same season. The ear-size of all three groups will be proportional to plant size but the hereditary characters, kernel-row number and kernel shape and color, will not be changed by these local influences.

Wild plants respond in the same way to moisture and fertility differences in rich, well-watered alluvium, drier second-bench, sterile sand or gravel bars or sand dunes, and dry and barren hilltops, wherever the same species gains a foothold in several or all of these habitats. In the drier and more sterile locations, the plants will be depauperate and the vegetative and many of the floral organs will be reduced accordingly. In the average or normal habitats, the plants will be normal and their organs will tend to be of average dimensions. Where moisture and fertility are high and temperatures favorable, as on a mid-latitude alluvial flood-plain, the plants will be luxuriant and their organs will respond by tending to reach sizes well beyond the normal. But these differences, however striking the extremes, do not make the different plants into "new" species or varieties. They should be labelled for what they obviously are: "depauperate", "normal", and "luxuriant". If conditions were changed, the plants would change also.

Conditions producing extreme heat locally may result in striking changes in affected plants, such as depauperate growth of plant and parts, extreme hairiness, etc. Such conditions occur on sandy and rocky situations, s bars, blow-outs, dunes, quarries, out-crops, etc., where extreme

radiation of heat may occur. In the same way, extreme shade may cause remarkable differences in size, shape, thickness, and color of vegetative organs.

When the leaves of certain species of willows (Longifoliae) are eaten off in summer by sawfly larvas, a full new crop of much smaller leaves is likely to appear. They usually will be densely white-hairy, probably a reaction to midsummer temperatures much higher than those prevailing when leaves normally are unfolding. These plants are very deceptive in appearance, looking like something very different from what they really are. Usually, however, some attached fragments of the original and much different leaves may be found and the deception unmasked.

D. Actual Hereditary Differences

We see differences between individuals of the same species, even when growing under apparently identical conditions. If the conditions actually are identical, then these differences should be real and hereditary. The number of such differences, the regularity of their association, the uniformity of their expression, and the degree of their departure from the norm of the species will be factors in determining whether any of the plants warrant recognition as different taxonomic entities.

These basic facts can be verified only by a study of numerous plants in the field, in different geographic areas of the species range. Having in mind, however, the above-presented facts regarding variations, much may be deduced from a study of abundant and widely collected herbarium material. In the case of shrubby and arborescent plants, a herbarium specimen is but a fragment at best. Because the two sexes are on separate plants, it is a fragment of only one half. A series of specimens, unless specially collected, is only a series of fragments of the halves. And even if an extensive series came from plants which were practically identical, they would have been collected at different times in the season,

at different periods of development, and from different portions (expressions) of the plants. And no two plants are practically identical. Some will be undeveloped or juvenile, other full-sized, still others mature. Unless the whole series is quite extensive, therefore, no satisfactory large-scale comparison is possible.

Furthermore, the average herbarium labels carry few or none of the data which might enable the taxonomist to determine if local environments (habitats) actually were similar, let alone identical. For these reasons, the student cannot be completely sure whether the differences observed on specimens are actual and hereditary or the effects of local environmental influences, either permanently or temporarily prevailing. To name new species or varieties, therefore, from one or a few fragmentary specimens under such conditions is to shun personal responsibility and to leave the real labor for another to perform later.

COMBINING PRECEPT AND EXAMPLE

Precept is easy and often abundant. Example is difficult and often proportionately rare. Certain important precepts have been set forth above. Summarized, they read: "Know what to expect from plants growing under different conditions, and why".

Below are outlined two quite different methods of studying botanical material for taxonomic purposes. In either case, it is assumed that the material represents, or is supposed to represent, a given species and its varieties, together with closely related species of possibly doubtful validity, and species and/or varieties currently held to be synonyms.

Two Methods of Studying Taxonomic Material

The first method is to obtain the largest possible collection of specimens representing all of these real, supposed, and/or unadmitted entities. Better still, study large numbers of living plants in the field, in different habitats in various geographic areas of the total range. Even better yet, do both. Because adequate field study is difficult or impossibl

for many students, chief dependence must be put on herbarium material. In any case, the specimens should be sorted out by geographic areas, without regard to the names which have been applied to them previously. Whether living or dead, complete or fragmentary, they are studied critically for similarities and differences, and the differences are analyzed as to nature, causation, and value, on the basis of the previous precepts. All this is without cross reference to the previously-published descriptions of the species and varieties involved.

This is the centripetal method, working from the outside in. It gets to the heart of the matter. It assumes the possibility of the specific unity of the material. It challenges the mind to discover if there are differences, and to prove whether discovered difference are inherent or merely the effects of local environment. It says: "Find out what there is, -- then what others thought there was." It keeps the mind free from prejudice while this is being done.

The second method is to study, successively, the descriptions and the cited or supposed material of each of the named species and varieties known or suppected to belong within the broad limits set. When one such has been studied and segregated, another is taken up, and so on until all have been covered. This is the centrifugal method, working from the inside out. It flies out from the center in all directions. It assumes differences, consciously or unconsciously, because others have done so. One is following a blazed trail instead of blazing one. Others have applied different names, have emphasized different characters or appearances, and have made comparisons to prove that significant differences exist. There is an internal pressure to verify what others have found or decided. All of this influence is present in addition to the urge to father more entities, new or resurrected, especially just before a new edition of a manual.

Standards for Taxonomic Workers

At present there are no professional standards or requirements for taxonomic workers. Each is a law unto himself, although their products affect tens of thousands of students and teachers, either as a help or as a burden. This lack of standards is responsible in part for the lack of respect in which this profession is held. If embryo taxonomists were required to go out and measure and record the range of variation in organs on a single large living plant or on numerous smaller plants of several species, they would return both tired and amazed. If they were required to follow the progressive variation of all organs on a plant through all of the seasons of even a single year, they would become both enlightened and humbled. Knowledge, with amazement and humility, is an excellent foundation for future taxonomists.

Such procedure would insure fuller and more accurate descriptions of plants, in journals and in manuals. With that, more people would know more about more plants. It also would curb the present tendency to consider every observed variation as a novelty to be named. This would mean a reduction in the flood of synonyms, so expensive of time and money. It would keep systematic botany simpler and taxonomists more respected. The end result would be more time and money spent on knowledge of plants and less on knowledge of names. Many years ago, when a great university inaugurated a program of "humanizing instruction at the freshman level", a non-botanist said to the president : "I have seen a miracle on this campus". "What have you seen?" he was asked. "I have seen a class in botany out of doors looking at a plant",was the reply.

Many new species and varieties have been based on these major developmental and environmental variations. This will continue unless there is better teaching. Even a single leaf from each of the three series on a single twig, or three from each of the four twig-types on a single plant, may become the type of supposed new entities. A paleo-botanist may do just that because, to him, a leaf is a determinable and usable unit. If two or more leaves are markedly different, they must represent, of course, different entities. Let us use a little common sense in this matter of basing novelties on such variations. Let us not make another 1000 so-called species of Crataegus, or of any other genus, with the types specimens of three species taken from one tree.

All are familiar with the often striking differences between the children of the same human parents. All had exactly the same ancestors, but some are short and some tall, some slender and some stout, some fair and some dark, and some quick and some slow. But we do not insist on naming new varieties and forms based on these differences. Nor do we base new species on the differences between the juvenile and the adul human organism.

Example: Exit Salix Missouriensis Bebb ⟶

Turning now from precept to example, there is set forth an example of the results obtained when variable taxonomic material is studied by the centripetal method. Some may not agree with the conclusions reached. Conclusions in taxonomy always must rest on personal judgements. But it is hoped that there may be agreement as to the values of the method used.

In 1867, Andersson (2, p.159), the Swedish salicologist, in a monographic discussion of S. cordata Muhl., arranged S. rigida Muhl. as a subspecies and thereunder created a new variety, vestita. This was based on a single juvenile specimen collected by Neuwied at Ft. Osage on the Missouri River (not far from present Kansas City). Of it, Andersson says: ramis crassiusculis, annotinis tomentosis; foliis novellis plus minus dense sericeo-tomentosis, lucidis, integris; amentis ♀ precocibus omnino nudis, rachi dense villosa, squamis sat dense pilosis, capsulis e basi sat crassa conicis, stylo haud elongato apiculatis."

In 1868, Andersson (3, p. 252) presented var. vestita again, this time as a 7th variety of subspecies rigida. The description is shortened and the reference to thick branchlets omitted. The plant would pass for S. cordata, except perhaps for the stout aments and the long-haired scales.

In 1895, Bebb (6, p.372) decided to raise Andersson's variety to specific rank but, because of the earlier S. vestita Pursh, he named it S. missouriensis and designated it as "n. sp." Needed parts of his long description will be given in the dission of plant and organs which follows. He was somewhat doubtful of the validity of his species, however, and said:

"For one of the Cordatae, the extraordinary height and size of trunk attained by this willow, the repeated (reputed? CRB.) durability of the wood for fence-posts, the early period of flowering, together with the technical characters above given, would seem to amply warrant its elevation to the rank of a valid species. At all events, as such, it is more likely to receive that further study and criticism which will determine its true status, than if left as a doubtful variety within the limits of such a polymorphous species as S. cordata."

Several items in Bebb's description and discussion require comment. If the comments appear derogatory of his judgement, let us remember that he always had been careful and conservative, that here he apparently was grossly misled by others on two important points, and that he was aged and failing (he died in 1896).

In the past six years, the writer has studied more than 1000 sheets of S. cordata and S. missouriensis in his own herbarium, the U.S. National Herbarium, and that of the University of Nebraska. Increasing Nebraska collections by Dr. Walter Kiener soon convinced him that S. missouriensis was not a distinct species but at most only a variety (var. vestita Anderss.). Since the preparation of the above discussion of the nature and causes of variation, and the appearance of Dr. Fernald's recent discussion in Rhodora (7, p.27-28), most of this material has been reviewed for data on the points at issue, with the further conclusion that vestita is not even a valid variety, for the reasons given below.

Polymorphism. Bebb refers to S. cordata Muhl. as polymorphous. It is. All willows (and other plants) are, although perhaps not in just the sense Bebb meant. That polymorphism is the thesis of the present paper. S. cordata is an excellent illustration of the principles set forth herein. It has a range (with var. vestita) of almost 2000 miles east-west and some 1100 miles north-south, with a corresponding diversity of climate, soils, and local habitats. It is a large enough shrub to permit expression of the maximum variation on a single plant.

Height and Diameter. Bebb describes his species as a tree "30 or 40 or even 50 feet in height, trunk 10 or 12, rarely 18, inches in diameter." Sargent, in 1896 (9, p.137), repeated these dimensions and later manuals have repeated the height. Where did Bebb get this record of ~~must~~ tree-like height for a shrubby or arborescent plant? He had never seen it growing, but refers to collections by Sargent and Bush from Courtney, Jackson Co., Mo. There are three true tree willows which occur along

the Missouri in that area, namely, S. longipes (var. Wardii), S. amygdaloides, and S. nigra. All three may attain the height, and rarely the trunk diameter, recorded by Bebb. It seems almost certain that, if Sargent or Bush furnished the height data, they included plants of one or more of these tree species when estimating maximum height and diameter. S. longipes, especially, bears a deceptive resemblance to luxuriant S. cordata (var. vestita).

Most collectors do not record heights of plants collected. In the Bebb Herbarium at Field Museum are 3 specimens collected by Bush in 1892 along the Missouri River in Jackson Co., Mo. It may be that Bebb's species was based on these, but no heights are given on the labels. One is said to be a tree 12 inces in diameter and two are called small trees, with 10- and 6-inch diameters, respectively. In 1895 and 1896, Dr. Glatfelter collected at least 31 specimens of var. vestita (distributed as S. cordata x S. sericea) in and around St. Louis, Mo., the labels giving heights and often diameters. Of these 31, only 10 reached 20 ft. or more. Three of these 10 reached 25 ft., with diameters of 5.5-7 inches. Only 1 was 30 ft. high, with 7-inch diameter. These taller plants mostly had single stems, dividing low. Other collectors record heights from 15 to a maximum (la.) of 27 feet. It may be that Sargent was responsible for the exaggerated height record. In any case, the Jackson Co. plants were from conditions of moisture, fertility, and climate which make all vegetation remarkably luxuriant. The eastern plant has a general height of 10 to 20 feet, with the maximum somewhat more.

Branchlet Size and Hairiness. In 1867, Andersson (2) described very stout twigs but in 1868 he dropped the phrase. Bebb said: "one-year-old twigs stout." Actually, twigs show just about the same stoutness from the Great Plains to the Atlantic.

Hairiness varies in exactly the same ways throughout the entire area. It is fixed in many minds that the vegetative parts of S. cordata are glabrate or glabrous and those of var. vestita are hairy. The study of some 1000 specimens shows hairiness (puberulence, pubescence, and/or tomentum) to be practically universal. The white-pubescent seasonal twigs occur in Lower Canada, New England, the Potomac-Shenandoah Valleys, the Appalachians, and the Lake States, as well as in the Mississippi-Missouri Valleys.

The denser the twig pubescence, the more frequently it is associated with pubescence of budscales, petioles, midribs, and sometimes stipules and young blades. Glabrate to glabrous yellowish seasonal or 1-year twigs were more common westward in the drier areas, but many 1-year and 2-year twigs glabrous in spring showed tell-tale remnant pubescence behind buds and lateral twigs. The long season and high summer temperatures of the lower Missouri are favorable to denser pubescence of twigs.

Leaves. Andersson's type had only very young leaves. Bebb describes the leaves as;

> "lanceolate or oblanceolate, 5-6 inches long, 1-1.5 inches wide, cuspidate-acuminate, narrowed from above the middle toward the acute or rounded (but not truncate or cordate) base, at first more or less clothed with silky hairs, soon smooth and dark green above, except for the downy midrib, paler but not glaucous beneath, margin glandular-serrate, petioles downy, 0.5 in. long."

These statements regarding leaf length, leaf base, and glaucousness are not true for either the western or eastern plants. The leaves of "S. missouriensis" by no means average 5-6 inches long. On fruiting twigs and many early seasonal twigs, the leaves are 3-4 inches long and 0.7-1 inch wide. On more vigorous seasonal shoots, they reach 5-6 inches long by 1-1.5 or 1.8 inches wide.

In the eastern area, the leaves average about the same in size, on comparable twigs, as in the western. Relatively large leaves, up to 5.5 inches long and 1.4-1.7 inches wide, are found frequently from Lower Canada and New England southward. Westward, the leaves tend to average narrower. One specimen from Maine has blades 6.5 by 1.4 inches, while specimens from Quebec, Vermont, and New York run to 6 by 1.5-1.7 inches. Petioles on leaves in the Northeast range from 0.5-1 inch long. In Virginia, leaves range up to 6 by 1.75 inches; in West Virginia to 5 by 1.5 inches. None larger have been found in the Missouri River area, on either supposed species. Specimens with shorter but relatively broad leaves occur sparingly throughout and are likely to be associated with densely pubescent shoots, budscales, petioles, midribs, and sometimes blades.

In the material assigned to S. missouriensis, the bases of the larger leaves commonly are truncate and some are strongly cordate (Glatfelter 13), Bebb's note to the contrary notwithstanding. The range for leaf-base shape is exactly that for accepted S. cordata. In both eastern and western plants, mature leaves are glaucescent to glaucous beneath, altho the color may not develop until the leaves are nearly full-sized. The leaves on autumnal collections of both plants usually are strongly glaucous.

Early Flowering. One of the distinctive characters asserted for S. missouriensis was its early flowering. Bebb quotes Bush as follows: "The aments usually open about the first of February and have passed out of bloom by March 1st, whereas those of S. cordata do not appear till the first week in April." This is a difference of about two months, if true, but it does not happen to be true. Let Bush's own collections speak. In 1896, he collected S. missouriensis Nos. 448, 464, 470, 475, and 480 at Courtney, Jackson Co., Mo., between April 11 and 19, the first spring after Bebb's publication. These five specimens, in U.S. Natl. Herb., bear just-opening aments, not-yet-flowering aments, flowering aments, and young fruiting aments, all 10 weeks after flowering should have started and 6 weeks after it should have ended, according to Bush. This was not confined to 1896. No. 6552 has 3-inch pistillate aments in flower on April 15, 1912, as delayed as those of 1896. No. 7719 has sessile 2-inch aments in flower on March 24, 1916, seven weeks after it should have begun and 3 weeks after it should have ended. The Glatfelter specimens from St. Louis were in bud from Mar. 25 to April 7; in flower from March 27 to April 12, and in young fruit from April 17 to 24.

Ament Length and Laxity. Bebb described the amebts as precocious, sessile, dense-flowered, the staminate oblong, 1.5-2 in. long by 0.5 in. wide, the pistillate lengthening to 3 in. and becoming more or less lax in fruit. Sargent (9, p.137), in 1896, adds another inch gratituously ("3-4 inches long"). The maximum (not average) is 3 inches. Abundant material shows that the pistillate, at flowering, are 1-2 in. long, lax, borne on short (0.5 cm.) bracted peduncles. In fruit, the aments become 1.5-2.5 or rarely 3 inches long (Bush 6552) and very lax, and the peduncles become up to 1 cm. long, with small leaves. Laxity is a function of rachis and/or pedicel elongation. The pedicels become 1.5-2.5 or rarely 3 (Bush 475) mm. long, the capsules 6-7 mm. and the styles 0.5-0.6 mm. long. Eastern material shows aments up to 2.5 inches long from Lower Canada, Massachusetts, and New York, and one Massachusetts specimen (Forbes 563) with aments up to 3 in. (7 cm.) long. Pedicels up to 2-2.5 mm. are frequent in the east and 3-mm. pedicels occur in New Hampshire (Rand-Robinson 625) and Massachusetts (the Forbes plant with 7-cm. aments)

Scale Length and Hairiness. Both Andersson and Bebb stress the length of the flower scales and of their densely-investing hairs. Both were studying specimens from luxuriant plants whereon most organs were larger than average. Also, the resulting ament laxity enabled the usually partly hidden scales to be easily seen. These facts are true also of luxuriant plants in the eastern area.

Capsule length. Neither Andersson in describing var. vestita, nor Bebb in creating S. missouriensis, mentions capsule length, so apparently they saw no difference from those of S. cordata. S. eriocephala Michx., which Fernald says is the same as S. missouriensis Bebb, is staminate. Andersson completely misinterpreted S. eriocephala from beginning to end (1,2,3), so that his statements about capsules obviously apply to those of other species. Fernald (7, p.27), however, says: " . . ., the very large precocious aments and long (up to 1 cm.) capsules having deceived those who did not consider the other characters, . . .". Fernald gives no authority for this assertion of unprecedented capsule length, an increase of some 43% over the maximum recorded.

Measuring the capsules on numerous luxuriant specimens from the Missouri flood-plains, the normal length is found to be 5-6.5 mm., with a few reaching a maximum of 7 mm. long. Outside the most favorable habitats, the capsules also average 5-6.5 mm. but never reach 7 mm., so far as seen. The capsules of accepted S. cordata normally run to 6 mm. long and occasionally to 6.3 mm.

Summary of "S. missouriensis". The great height and diameter ascribed are not proved and remain extremely doubtful. The tomentum of twigs is shared by many more eastern specimens, although Missouri-Mississippi-Valley conditions are conducive to extreme hairiness. Long leaves and truncate to cordate bases occur throughout the entire area. The reported extremely early flowering is disproved by the records. Expanded pistillate aments are not sessile and naked. The long aments, scales, scale hairs, and pedicels are matched by those on equally luxuriant eastern specimens. The long capsules asserted by Fernald just cannot be found on any plants. "S. missouriensis" is merely the luxuriant expression of S. cordata Muhl. under favorable conditions of temperature, moisture, and fertility.

"Accurate and Cautious Salicologists". Fernald (7,p.27) designates the Swedish salicologist, N.J. Andersson, as "the most accurate student ever to work on Salix,". He further said (7, -.31) ". . . it is . . . the highest of honors to get near the limited group of most cautious salicologists with Nils Johan Andersson!" Let us consider just what Andersson did with S. eriocephala Michx. and S. cordata var. vestita Andersson, which Fernald states to be one and the same (Section Cordatae).

In 1858, Andersson (1,p.117) placed S. eriocephala in a group with S. lasiolepis and its relatives (S. Bigelovii, S. irrorata) all of Section Lasiolepes (related to Cordatae) and threw in his wholly unrelated S. Coulteri (closest to S. sitchensis, Section Sitchenses) for good measure. S. cordata is not mentioned. In 1867 (2, p. 85) and 1868 (3, p. 225), he arranged S. eriocephala as a variety of S. discolor (Section Discolores), even more distantly related than S. Coulteri. In all three papers, his extended discussion contains repeated expressions of uncertainty and repeated comparisons with many and diverse species, but always with S. discolor and its relatives, to which it is least related.

In 1867, Andersson (2, p. 159) created his hairy-twigged var. vestita, specifically identical with S. eriocephala (fide Fernald), and assigned it to S. cordata, even noting its glabrous capsules. But he compared it with S. discolor, which has glabrous twigs and pubescent capsules with quite different styles and stigmas. This treatment was repeated in 1868 (3, p. 252), without the reference to S. discolor.

Andersson, in short, dealt with two specimens of an identical entity, collected in the fertile flood-plain within 400 miles of each other. The pistillate he made a variety of S. cordata, where it belonged, but compared it with the unrelated S. discolor in spite of its hairy twigs and glabrous capsules, the opposite of S. discolor. The staminate plant he first assigned to the Lasiolepes, close to Cordatae, but then shifted it to S. discolor, a completely unrelated species, and invented a pistillate plant to justify that disposition.

Many similar acts by Andersson have been cited by Bebb and others and many more remain uncited. When Fernald gave the capsules of S. eriocephala a length of 1 cm., he undoubtedly achieved the coveted nearness to Andersson in accuracy and caution.

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THE ARNOLD ARBORETUM
HARVARD UNIVERSITY
JAMAICA PLAIN, MASS., U.S.A.

January 2, 1946

Dr. Carleton R. Ball
Extension Service
U. S. Department of Agriculture
Washington, D. C.

Dear Dr. Ball:

As you may know, Dr. Merrill will reach his seventieth birthday next October. The editorial staff of the Journal of the Arnold Arboretum has thought that it might be a fitting gesture to recognize this occasion by dedicating a number of the Journal to Dr. Merrill. What we propose to do is to publish a portrait and possibly a brief biographical sketch in the October, 1946, number, which otherwise will be occupied with papers by a few of Dr. Merrill's past and present colleagues.

We should feel highly honored if you will permit us to include in this number a paper by you, and I know that Dr. Merrill will also appreciate your collaboration on this occasion. The papers need have no definite bearing upon Dr. Merrill's career, and we suggest that you submit something along the lines of your own current research, preferably a more or less independent paper rather than one of a series. Contributions should be about ten or fifteen pages of our Journal; by thus limiting them we feel that more of Dr. Merrill's associates can be included and the number thus made more representative. Manuscript should be in my hands by July 1, but in the meantime I should appreciate knowing whether or not we may count upon a contribution from you, and in having an approximation of its length. By following our current Journal style in preparing your paper, you will greatly facilitate the assembling of material for the number.

In anticipation of your kind cooperation on this occasion, and hoping for an early reply,

Very sincerely yours,

A. C. Smith

A. C. Smith
Curator of the Herbarium

ACS:F

(over)

March 12, 1946

Dr. A.C.Smith, Crator
Herbarium of Arnold Arboretum
Jamaica Plain, Massachusetts.

Dear Dr. Smith:

I was greatly distreessed to discover, today, your very courteous letter of Jany. 2, asking me to contribute a paper to the volume in honor of Dr. Merrill. You asked for/ and arrly reply, to which you certainly were entitled.

I don't know just what happened but apparently in the stress of completing projects on which I had worked during the war, plus the usual New Year appraisals of progress, the letter got mislaid. I am very sorry.

If there still is a place for me, I will be both honored and delighted to contribute as specified. If it now is too late for an acceptance, please do not hesitate to say so frankly, as the delinquincy is wholly mine.

As a matter of fact, some material I am ~~preparing~~ accumulating in connection with manuscripts for State Flores and my Salix monograph, would seem to be suitable for the purposes named.

Regretfully yours,

Carleton R. Ball
Collaborator

March 19, 1946

A. C. Smith, Curator,
Herbarium of Arnold Arboretum,
Jamaica Plain, Massachusetts.

Dear Dr. Smith:

Your letter of March 14 is here and noted with care. I have two manuscripts coming along, either of which I believe would be suitable for the memorial issue. It may be that I will send both of them for consideration. At any rate you can count on one.

Cordially yours

Carleton R. Ball
Collaborator

ARNOLD ARBORETUM, HARVARD UNIVERSITY
JAMAICA PLAIN (30)
MASS.

March 14, 1946

Dr. Carleton R. Ball
3814 Jocelyn Street N. W.
Washington, D. C.

Dear Dr. Ball:

Thank you for your letter of March 12 in which you express a willingness to contribute an article to our October 1946 Journal in honor of Dr. Merrill's seventieth birthday. Replies to my requests for contributions have been very gratifying thus far, but there is still ample room in the number for your contribution. I hope therefore that you will complete the work mentioned and forward me a manuscript. I know that Dr. Merrill will be very much pleased to have your paper included.

Because rather more material is accumulating than originally planned, I should appreciate having your paper kept down to about ten pages of our Journal if this is possible. I should like the manuscript at your earliest convenience, but no later than July 1.

With many thanks for your kind coöperation,

Very sincerely yours,

A. C. Smith

A. C. Smith
Curator of the Herbarium

ACS:U

April 4, 1946

Dr. A. C. Smith, Curator,
Herbarium of Arnold Arboretum,
Jamaica Plain, Massachusetts.

Dear Dr. Smith:

In further reference to your letters of Jany. 2 and March 14, regarding a contribution by me to the Merrill Memorial Volume, I am happy to say that I have just completed the second draft of my paper.

I now will let it cool off while I wait the arrival of some speciemns from the Bebb Herbarium at Field Museum, which I wish to consult before final draft. Thereafter, It will be sent promptly.

It seemed to me undesirable to submit just an ordinary paper in the taxonomic field , with Salix as the subject matter. Such an occasion seemed to plead for a new idea or approach, rather than merely a new species of variety.

Accordingly, I have pictured the normal range of variation of organs on a plant, and throught the year, and in different local habitats, as well as presumable hereditary differences. From this precept, I have gone on to an example of treatment when allowance is made for all this. Probably I will be shot. Any way, you'll get the mss. soon.

Cordially yours,

Carleton R. Ball
Collaborator

THE ARNOLD ARBORETUM
HARVARD UNIVERSITY
JAMAICA PLAIN, MASS., U.S.A.

April 8, 1946

Dr. Carleton R. Ball
3814 Jocelyn Street N. W.
Washington, D. C

Dear Dr. Ball:

I am pleased to learn from your letter of April 4 that your work on the paper which you propose to submit for our October Journal is progressing so well. The subject selected sounds very interesting, and I am sure that your discussion will be very suitable. I am anxious to read the manuscript, but there is no immediate urgency for your sending it. Probably I shall send to the printer the first manuscripts for this number during the latter part of May in order to clear the decks for the inevitable late papers.

With many thanks for your cooperation,

Very sincerely yours,

A. C. Smith

A. C. Smith
Curator of the Herbarium

ACS:U

(over)

April 15, 1946

Dr. A. C. Smith,
Arnold Arboretum of Harvard Univ.,
Jamaica Plain, Massachusetts.

My dear Dr. Smith:

Your letter of April 8 received. Herewith the manuscript. It may not be due yet but I had a chance to do it early and when I get buried in some monographing the chances are good that any extra paper would turn up among "the inevitably late papers" you mention.

According to my calculations this will run between 12 and 13 pages of the Journal. Part is written on large-type machine while my own was being repaired, but estimating the wordage gives that result. If you cannot possibly take that much, let me know. If the kind of study proposed and outlined, were given to plants, it would save many thousands of pages now wasted.

Cordially yours,

Carleton R. Ball
Collaborator

ARNOLD ARBORETUM, HARVARD UNIVERSITY
JAMAICA PLAIN (30)
MASS.

April 18, 1946

Dr. Carleton R. Ball
U. S. Department of Agriculture
Extension Service
Washington, D. C.

Dear Dr. Ball:

Thank you very much for your letter of April 15 and the enclosed manuscript. Although I have merely glanced through this paper, I can see that it is very suitable for our October Journal, and I am sure that it will be read with great interest. It impresses me that very little editing will be necessary, and in the near future I shall ask one or two of my associate editors to go through your manuscript, after which we will set it up in type along with the other papers in hand.

Your co-operation in submitting this manuscript so early is greatly appreciated. I shall try to let you have galley proof during the early summer.

With best regards,

Very sincerely yours,

A. C. Smith

A. C. Smith
Curator of the Herbarium

ACS:F

ARNOLD ARBORETUM, HARVARD UNIVERSITY
JAMAICA PLAIN (30)
MASS.

July 25, 1946

Dr. Carleton R. Ball
U. S. Department of Agriculture
Extension Service
Washington, D. C.

Dear Dr. Ball:

The manuscript which you kindly submitted for inclusion in our October Journal, honoring Dr. Merrill's seventieth birthday, has now been set up, and under separate cover I am sending you a set of the galley proofs. Kindly read this at your earliest convenience and return the proof to me, retaining the manuscript. If possible, I should like to have the proof back by August 10, so that we may start paging the number.

At this time will you kindly inform me as to the number of reprints you desire. We furnish fifty reprints to each author free of charge, but if you wish additional ones these should be ordered when you return the proof. We cannot estimate the cost of extra reprints but will merely pass on to you the printer's charges.

With many thanks for your continued coöperation,

Very sincerely yours,

A. C. Smith

A. C. Smith
Curator of the Herbarium

ACS:U

(See over)

Dr. A. C. Smith,
Curator of the Herbarium,
Arnold Arboretum of Harvard Univ.,
Jamaica Plain 30, Massachusetts.

August 1, 1946

Dear Dr. Smith:

Going to the Dept. today, I find your letter of July 25, which evidently was somewhat delayed.

I returned the proof with a letter some day or so ago but did not order any reprints because there was no letter with the proof.

I note that you furnish 50 reprints, which is very generous. I usually order 100 copies in all. Therefore, please place an order for 50 copies to be paid for by me personally.

Thank you.

Cordially yours,

Carleton R. Ball
Collaborator

July 30, 1946

Dr. A. C. Smith,
Arnold Arboretum, Harvard Univ.,
Jamaica Plain 30, Mass.

Dear Dr. Smith:

Proof and manuscript of More Plant Study: Fewer Plant Names are received and returned herewith.

A splendid job was done on editing, type-setting, and proof-reading.. I thank you for revising the wording in my final paragraph. It is improved. I can see other places where a change of a word of a few words would improve it more, but I do not make such changes in galley proof.

A few of the proof changes were caused by my errors. The hyphen in the words "last developed" in paragraph 4 of galley 22 in my ~~mass~~ manuscript but I had deleted it by a vertical stroke. The ; instead of : in paragraph 3 of galley 26 was mine also, as was the absence of "p." in line 3 on galley 27.

In Literature Cited, the spelling "Lemmonii", which you question, was erroneously used in that paper by Ball & Whited. I suppose, therefore, that it must be used in the citation of the paper.

In paragraph 9 on galley 25, I have asked the transposition of two words. As written, the citation follows the word "Rhodora", which might start someone to looking up vol. 7 of Rhodora.

Appreciating your helpfulness, and the speed with which this has been done into print, I am

Cordially yours,

Carleton R. Ball

P.S. Have heard some recent rumors of a severance of Harvard relations by Dr. Merrill, but have no facts on it, so far. Hope it in no way affects the proposed memorial volume.

ARNOLD ARBORETUM, HARVARD UNIVERSITY
JAMAICA PLAIN (30)
MASS.

August 9, 1946

Dr. Carleton R. Ball
Extension Service
United States Department of Agriculture
Washington, D. C.

Dear Dr. Ball:

Your letters of July 30 and August 1 and the corrected galley proof of your article for our October Journal are at hand. The changes suggested by you have been incorporated, and the proof will soon go back to the printer for paging. I am glad that you found so few errors.

Your request for a total of one hundred reprints is noted, and these will be ordered for you.

With many thanks for your coöperation,

Very sincerely yours,

A. C. Smith

A. C. Smith
Curator of the Herbarium

ACS:U

Dr. A. C. Smith,
Arnold Arboretum of Harvard Univ.,
Jamaica Plain 30, Massachusetts.

October 21, 1946

Dear Dr. Smith:

Congratulation on the prompt appearance of the Merrill memorial issue and the general scope and make-up of contents and authorship. I feel awed at such distinguished company. I note in Science that a special issue of Chronica Botanica contains Dr. Merrill's biography and bibliography. This paper of mine was the 157th publication for me.

On August 1 I ordered, and on Aug. 9 you acknowledged my order, for 50 reprints in addition to the 50 you so generously give. I hope nothing happens to that order, for I want to distribute where the ensuing controvery will insure my being shot before I collapse from old age (I'm only 73 past now). I forgot to say that I received a copy of the Oct. issue with the "appreciation" of Dr. Merrill. Have just written to him also.

Thanking you for the courtesies shown, I am

Cordially yours,

Carleton R. Ball
Collaborator

ARNOLD ARBORETUM, HARVARD UNIVERSITY
JAMAICA PLAIN (30)
MASS.

October 24, 1946

Dr. Carleton R. Ball
Extension Service
United States Department of Agriculture
Washington, D. C.

Dear Dr. Ball:

Thank you for your kind letter of October 21. I believe that Dr. Merrill was pleased with this issue of the Journal, and I know that he was glad to see so many of his old friends represented by contributions.

The reprints are now being printed, and I hope that you will receive yours within a couple of weeks. As to the possibility of the article resulting in gunplay, please remember that the editors are not responsible for anything that happens to you.

With best regards,

Very sincerely yours,

A. C. Smith
Curator of the Herbarium

ACS:U

Wrote him a card on Nov. 25, appreciating the 50 complimentary copies but expressing woorry because the other 50 copies, at my expense, and order when proof was returned, had not been received, alth, being wbthout covers, they should have been ready first.

(See over)

Dr. A. C. Smith,
Arnold Arboretum of Harvard Univ.,
Jamaica Plain 30, Massachusetts.

October 29, 1946

Dear Dr. Smith:

I am writing up the willows for Dr. Lundell's current Flora of Texas. I had supposed that both Salix humilis and S. tristis occured in northeastern Texas, but so far have located only one speimen of tristis and none of humilis. I want to get them in if they really occur there, in the interests of accurate ranges.

Will some one be able to scan the Texas covers for specimens of Salix humilis, its var. rigidiuscula, and S. tristis? If any are found, I would like the full data from the labels. If there is any doubt about the identification, I would like to see the specimens. Can this be done also for the Gray Herbarium material? Sorry to bother, but I like to be accurate, and our Floras sadly need it.

Sorry to note from yours of Oct. 24 that you assume no obligation for hospital or funeral expenses of shot-up contributors. It reassures me to remember that I was raised on a cattle ranch out with the Sisseton Sioux and that the gentle art of shooting from the hip on a running draw was not unknown. Perhaps the other fellow will have the expenses.

Appreciating your past courtesies, and with hopes, I am

Cordially yours,

Carleton R. Ball
Collaborator