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CHARLES SPRAGUE SARGENT

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THE JOURNAL OF THE ARNOLD ARBORETUM

DURING the ten years from 1887 to 1897 *Garden and Forest*, a weekly Journal of Horticulture and Forestry, offered the opportunity for the prompt publication of information about trees and shrubs collected at the Arnold Arboretum. Since the publication of that journal was discontinued the Arboretum has had no organ on which it could depend to publish within a reasonable time the material which is gathered in its laboratories.

To overcome this difficulty the Arboretum will now begin the publication of a quarterly journal. In its pages will appear notes on trees and shrubs with descriptions of new species and their relationships, letters from correspondents, and notes on the vegetation of countries visited by officers and agents of the Arboretum. In the Journal of the Arboretum will appear also such items of news about the Arboretum, its library, collections, and projects which will interest botanists, horticulturists and other friends of the institution.

Since 1911 information in regard to the flowering and fruiting of some of the interesting plants in the Arboretum and their cultivation has appeared in *Bulletins of Popular Information* published at irregular intervals. The Journal of the Arboretum will not take the place of these Bulletins, which will be continued.

C. S. SARGENT.

July, 1919

JOURNAL

OF THE

ARNOLD ARBORETUM

VOLUME I

JULY, 1919

NUMBER 1

NOTES ON AMERICAN WILLOWS. V THE SPECIES OF THE PLEONANDRAE GROUP¹

CAMILLO SCHNEIDER

IN my conspectus of the Mexican species of *Salix* (Bot. Gaz. LXV. 1-41. 1918) I stated that I had "already made a rather extensive investigation of the forms belonging to the *Pleiandrae*² group (sect. *Nigrae*, *Triandrae*, *Pentandrae* subsect. *Lucidae* and *Bonplandianae*)"; I then dealt with all the forms of this group which are found from Mexico to South America. To-day I propose to give a key for the determination of all the American species and varieties of these sections, to discuss their geographical distribution, and to deal with those forms of which I have not yet spoken in my paper cited above. The *Pleonandrae* group is well defined in so far as the male plants always have more than 2 (from 3 to 15) stamens, while all the other American *Salix* (except of course some hybrids) have 2 stamens or only one in *S. sitchensis*, *S. Coulteri* and *S. Uva-Ursi*.

Besides the rich material of the herbarium of the Arnold Arboretum I have been able to study the collections of the Gray Herbarium and of the herbaria of the Missouri Botanic Garden, of the Field Museum, of the Geological Survey of Canada, and of the Leland Stanford University; and I have had at my disposal part of the collections of the herbaria at Kew, New York, Reno and Washington.³ I wish to express my best thanks to

¹ The preceding parts of this series have appeared in Botanical Gazette: I. The species related to *Salix arctica* Pall. (Bot. Gaz. LXVI. 117-142. 1918.) — II. The species related to *Salix glauca*. (l. c. 318-353. 1918.) — III. A conspectus of American species and varieties of sections *Reticulatae*, *Herbaceae*, *Ovalifoliae* and *Glaucæ*. (l. c. LXVII. 27-64. 1919.) — IV. The species and varieties of section *Longifoliae*. (l. c. 309-346. 1919.) See also A conspectus of Mexican, West Indian, Central and South American species and varieties of *Salix*. (Bot. Gaz. LXV. 1-41. 1918.)

² The name *Pleiandrae* was used by ANDERSSON (1867, 1868) but he included in his group also sect. *Fragiles* of which the male plants are diandrous. I prefer to use the spelling *Pleonandrae* of VON SEEMEN (*Salic. Japon.* 15. 1903) who restricts his group to the species with more than 2 stamens.

³ In the enumeration of specimens I am using the following abbreviations: A., Herbarium of the Arnold Arboretum. — C., Herbarium of the Field Museum, Chicago. — Cal., Herbarium of California Academy of Science. — Cor., Herbarium of Cornell University. — CU., Herbarium of University of Chicago. — E., Herbarium of the University of Oregon, Eugene. — G., Gray Herbarium. — Jeps., Herbarium of Professor W. L. Jepson, Berkeley, Cal. — K., Kew Herbarium. — L., Herbarium of the University of Wyoming, Laramie, Wyo. — M., Herbarium of the Missouri Botanic Garden. — N., Herbarium of the New York Botanic Gar-

the curators of all these herbaria. For some interesting material I am indebted to Professor G. P. Clinton, New Haven, Conn., Miss A. Eastwood, San Francisco, Professor J. K. Henry, Vancouver, B.C., Mr. I. M. Johnston, Upland, Cal., and last, but not least to Mr. J. C. Nelson, Salem, Ore. From the Herbarium of the University of Oregon, at Eugene, I have received the *Salix* material of the Howell Herbarium.

CLAVIS SPECIERUM VARIETATUMQUE

Folia adulta¹ semper utrinque concoloria, viridia, linearia, lineari-lanceolata vel lanceolata, utraque facie stomatibus plus minusve aequinumerosis (tantum in quadam forma incerta *S. nigrae* paucioribus vel fere nullis) instructa; petioli (vel basis laminae) apice eglandulosi vel subeglandulosi (i.e. glandulis distinctis flavescentibus saepe irregulariter lobulatis haud praeditis, sed saepe glandulae minimae punctiformes adsunt); ramuli fragilissimi Sect. I. *NIGRAE*.
Ramuli annotini² biennesque plus minusve rufescentes vel purpurascens; ovaria pedicellique semper glabri.

Fructus perfecte maturi³ ovoidei vel ovoideo-oblongi, apice vix vel tantum breviter attenuati, pedicello brevi iis plerumque 4-5plo brevior glandulam circ. 2plo superante suffulti; folia linearia vel lineari-lanceolata; petioli laminae comparati satis longi; stipulae intus fere semper eglandulosae.

Flores feminei glandula tantum ventrali instructi.

Folia distincte linearia, tantum versus apicem attenuata.

I. *S. Humboldtiana*.

Folia plus minusve lineari-lanceolata, fere a basi ad apicem sensim attenuata 1b. *S. Humboldtiana* var. *stipulacea*.

Flores feminei glandulis 2 (ventrali et dorsali) instructi.

1c. *S. Humboldtiana* var. *Martiana*.

Fructus perfecte maturi ovoideo-subrostrati, apice satis attenuati, pedicello satis variabili longitudine glandulam 2-5plo superante; folia lineari-lanceolata ad late lanceolata; petioli saepe laminae comparati breviores vel stipulae intus plus minusve glanduliferae.

Ramuli hornotini vel petioli (saltem superne) plus minusve distincte villosuli vel folia plus minusve lanceolata basi obtusa, subrotunda vel breviter acuta et petioli breves (id est quam latitudo laminae haud longiores); stipulae intus eglandulosae 2. *S. nigra* et 2b. *S. nigra* var. *altissima*.

Ramuli petiolique citissime glabrescentes vel folia plus minusve linearia et basim versus attenuata et petioli graciles satis longi; stipulae intus glanduliferae 2c. *S. nigra* var. *Lindheimerii*.

den. — NE., Herbarium of the New England Botanical Club. — O., Herbarium of the Geol. Surv. of Canada, Ottawa. — P., Herbarium of the Academy of Science, Philadelphia. — Pu., Herbarium of the University of Washington, Pullman, Wash. — Reno, Herbarium of the Nevada Agric. Exp. Station, Reno, Nev. — St., Herbarium of the Leland Stanford University. — W., U.S. National Herbarium, Washington, D.C. — If there is no indication of a herbarium, the specimens are in A., the herbarium of the Arnold Arboretum (and mostly also in the other herbaria). Other abbreviations are: m., male specimen. — f., female specimen in flower. — fr., fruiting specimen (im. fr. means with immature fruits). — st., sterile specimen.

¹ This refers to fully developed normal leaves towards the end of sterile branchlets or shoots. The first (lowermost) leaves of these branchlets and the leaves of the flower-bearing branchlets (peduncles) are often very different and mostly much smaller.

² "Annotini" is used here for the well-ripened branchlets of the previous season, while "hornotini" is used for the shoots of this year.

³ Very often the capsules are not ripe, but have been collected unripe and have opened in drying. Hence they are frequently smaller or of a different shape. If not properly fertilized the ovaries do not develop into normal capsules, but remain much smaller and look differently.

Ramuli annotini biennesque plus minusve distincte flavescentes vel flavo-cinerei; ovaria fructusque vel pedicelli tantum saepe plus minusve villosuli; fructus ovoideo- vel anguste ellipsoideo-conici, apice plus minusve attenuati, vulgo satis longe pedicellati 3. *S. Gooddingii*.

Folia adulta subtus discoloria, plus minusve glaucescentia vel albescentia, vel viridia (concoloria) sed superne non stomatifera vel stomatibus sparsis instructa et non lineari-lanceolata et petioli apice vel ad basim laminae distincte glanduliferi.

Petioli distincte glanduliferi, satis breves vel crassi; ramuli annotini biennesque plus minusve nitiduli; amenta mascula plus minusve breviter cylindrica, satis crassa et stricta, apice vulgo attenuata, filamentis strictis; fructus satis breviter et crasse pedicellati vel folia subtus viridescencia; ramuli ut videtur semper plus minusve valde fragiles . . . Sect. III. PENTANDRAE, subsect. LUCIDAE.

Folia matura subtus distincte albescentia vel glaucescentia.

Fructus 7-12 (vulgo circ. 10) mm. longi pedicello circ. 5plo brevior excluso; folia elliptico-lanceolata, apice acuta, vix ultra 9: 2.8 cm. (surculorum excepta) magna, superne estomatifera 5. *S. serissima*.

Fructus 6-7.5 (rarius ad 9) mm. longi pedicello 3-5plo brevior excluso; folia apice plus minusve acuminata caudatave, ad 16: 4 vel 19: 2.5 cm. (eis surculorum exceptis) magna, superne estomatifera vel stomatibus paucis instructa 6. *S. lasiandra*.

Folia matura subtus plus minusve concoloria, viridescencia (interdum pallide viridia, sed non glaucescentia).

Stomata in pagina superiore foliorum iis paginae inferioris fere aequinumerosa; folia plus minusve lanceolata et plus minusve sensim caudato-acuminata, vulgo 4-5plo longiora quam lata . . . 6b. *S. lasiandra*, var. *caudata*.

Stomata in pagina superiore foliorum nulla vel sparsa (rarissime ut videtur satis numerosa); folia late ovata, elliptica vel elliptico-lanceolata et semper plus minusve subito in acumen longum caudatum attenuata vel haud ultra 3½plo longiora quam lata (in f. *angustifolia* 5-6plo longiora quam lata iis *S. lasiandrae* var. *caudatae* saepe similia sed vulgo distinctius glanduloso-serrata vel basim versus magis angustata).

Folia plus minusve late ovato- vel elliptico-lanceolata, satis subito caudato-acuminata.

Ramuli novelli foliaque novella glabra vel citissime glabrescentia.

17. *S. lucida*.

Ramuli hornotini et interdum partim annotini pubescentia sordide grisea vel rufescente praediti; folia initio sparsa pilosa, etiam adulta saltem in venis subtus (rufescenti-)pilosa . . . 7b. *S. lucida* var. *intonsa*.

Folia plus minusve anguste lanceolata, satis sensim acuminata.

7c. *S. lucida* f. *angustifolia*.

Petioli eglandulosi vel glandulis indistinctis parvis praediti, vel stomata in pagina superiore foliorum nulla et folia satis indistincte glanduloso-denticulata.

Ramuli annotini biennesque plus minusve flavescentes, non distincte rubescentes vel purpurascetes, fragiles; folia superne vulgo stomatifera vel petioli satis tenues et longi, quam lamina vix ultra 6plo breviores.

Sect. II. TRIANDRAE.

Folia plus minusve lanceolata, sensim acuminata, superne stomatibus numerosis instructa; ramuli distincte flavescentes.

4b. *S. amygdaloides* var. *Wrightii*.

Folia plus minusve ovato- vel elliptico-lanceolata, satis subito acuminata; ramuli vulgo magis olivacei vel flavo-brunnei vel cinereo-fusci.

Ramuli satis flavescentes, initio ut folia novella plus minusve pilosuli.

4a. *S. amygdaloides* f. *pilosiuscula*.

Ramuli magis brunnescentes vel cinereo-fusci, ab initio ut folia glaberrimi.

4. *S. amygdaloides*.

Ramuli annotini distincte rubescentes vel purpurascetes vel tomentelli, tenaces (tantum in *S. Harbisonii* fragiles); folia superne nunquam stomatifera (vel in *S. Harbisonii* secundum costam stomatibus plus minusve sparsis praedita) Sect. IV. BONPLANDIANAE.

Fructus satis parvi et crassi, breviter ovoideo-conici, apice vix vel paullo attenuati, 4-5 mm. longi, pedicello satis crasso 4-5plo brevioris excluso, vel pedicelli (basisque fructuum) pilosi.

Ramuli annotini dense tomentosi; folia initio subtus dense villosa-tomentosula; petioli breves, vix ad 8 mm. longi; amenta mascula parva, tenuia, vix ad 3:0.8 cm. magna; fructus conferti, circ. 4 mm. longi, basi pedicelloque pilosi 8. *S. jaliscana*.

Ramuli annotini glabri; folia subtus semper glabra vel cito glabrescentia vel petioli foliorum majorum ultra 10 mm. longi; amenta serotina, ex axillis foliorum adulatorum orientia vel coetanea, mascula vulgo 4-6 cm. longa; fructus circ. 5 mm. longi, pedicello 4-5plo brevioris excluso, glabri.

Amenta serotina, autumnis apparentia (vel in forma guatemalensis coetanea), mascula femineaque 4-6 (-8) cm. longa.

Ramuli novelli foliaque initio glabra 9. *S. Bonplandiana*.

Ramuli novelli foliaque initio subtus plus minusve villosula.

9b. *S. Bonplandiana* var. *pallida*.

Amenta coetanea vel breviora, vix ultra 3 cm. longa.

9c. *S. Bonplandiana* var. *Toumeyi*.

Fructus 5-9 mm. longi, apice subito vel longius attenuati vel pedicello gracili saepe tantum duplo brevioris suffulti.

Stipulae in facie interiore plus minusve glanduliferae, parvae vel nullae; folia matura superne vivide viridia, nitidula, margine satis indistincte et adpresse glanduloso-denticulata; fructus vix ultra 6 mm. longi, pedicello subduplo ad 3/5plo brevioris excluso.

Ramuli novelli (foliaque subtus) glabri 10. *S. laevigata*.

Ramuli novelli (foliaque subtus plus minusve) tomentelli vel villosuli.

10a. *S. laevigata* f. *araquipa*.

Stipulae in facie interiore tantum plus minusve pilosae vel glabrae haud glanduliferae (vel in *S. Harbisonii* interdum pauciglandulosae), saepe (saltem in ramulis vegetis) satis magnae; folia matura superne pallide vel intensius sed plus minusve opace viridia, margine argutius glanduloso-serrato-denticulata; fructus 6-10 mm. longi pedicello subduplo vel duplo (rarius ad 4plo) brevioris excluso.

Ramuli tenaces; folia in pagina superiore ut videtur nunquam stomatifera.

Stipulae fere semper distincte acutae vel etiam in ramulis vegetioribus minimae vel nullae; ramuli hornotini et saepe annotini plus minusve tomentelli vel villosuli vel folia majora (eis surculorum exceptis) anguste lanceolata et vix ultra 1.4 cm. lata.

Folia plus minusve late lanceolata, petioli majorum ad 1.8 cm. longi 11. *S. longipes*.

Folia anguste lanceolata (eis surculorum exceptis) et petioli majorum vix ultra 10 mm. longi . . . 11b. *S. longipes* var. *venulosa*.

Stipulae fere semper distincte obtusae rotundatae, in ramulis sterilibus (surculis exceptis) vulgo distincte evolutae; ramuli etiam novelli glabri vel cito glabrescentes (surculi tantum saepe magis pilosi); folia plus minusve lanceolata vel anguste elliptico-lanceolata.

11c. *S. longipes* var. *Wardii*.

Ramuli fragiles; folia in pagina superiore vulgo secundum costam sparse stomatifera 12. *S. Harbisonii*.

SECT. I. *NIGRAE* Loudon. — Sect. *Australes* Andersson in Öfv. Svensk. Vetensk. Akad. Förh. xv. 114 (1858), ex parte. — Sect. *Austro-americanae* sive sect. *Humboldtianae* Andersson in Svensk. Vetensk. Akad. Handl. vi. 15 (Mon. Salic.) (1867), ex parte. — For further information see Schneider in Bot. Gaz. LXV. 5 (1918). It may be mentioned that in a certain form of *S. nigra* which will be discussed later the upper epidermis of the leaves contains relatively few or no stomata at all.

1. *S. Humboldtiana* Willdenow. — See Schneider, l. c. 6. — As I have stated, this species in its typical form is confined to South America.

1b. *S. Humboldtiana* var. *stipulacea* (Martens & Galeotti) Schneider. — See Schneider, l. c. 7 (1918). — This variety represents the type in Central America and Mexico but does not reach the southern border of the United States.

1c. *S. Humboldtiana* var. *Martiana* (Leybold) Andersson. — See Schneider, l. c. 8 (1918). — A badly understood form which seems to be confined to certain parts of Brazil and Colombia.

2. *S. nigra* Marshall, Arbust. Am. 139 (1785). — Muhlenberg in Neue Schrift. Ges. Nat. Fr. Berlin, iv. 237, t. 6, fig. 5 (1803). — Michaux f., Hist. Arb. Am. III. 324, t. 5, fig. 1 (1813); N. Am. Sylva, III. 78, t. 125, fig. 1 (1819). — Pursh, Fl. Am. Sept. III. 614 (1814). — Hooker, Fl. Bor.-Am. II. 148 (1839). — Barratt, Salic. Am. no. 20 (1840). — Carey in Gray, Man. 429 (1848). — Andersson in Svensk. Vetensk. Akad. Handl. VI. 19, t. 2, fig. 15 (Monog. Salic.) (1867), ex parte; in De Candolle, Prodr. XVI. 2 200 (1868), ex parte. — Newhall, Trees N.E. Am. 72, fig. 36 (1890). — Bebb apud Watson & Coulter, Gray Man. ed. 6, 480 (1890), excl. var. *Wardii*. — Sargent, Silva N. Am. IX. 103, t. 462 (1896), excl. syn. ex parte; Man. Trees N. Am. 168, fig. 140 (1905), pro parte max. — Glatfelter in Trans. Acad. Sci. St. Louis, VI. 427, t. 1, figs. 5-7, 10 (1894). — Britton & Brown, Ill. Fl. I. 494, fig. 1173 (1896). — Sudworth in Bull. U.S. Dept. Agric. Div. For. XIV. 118 (Nomencl. Arb. Fl.) (1897), ex parte. — Ball in Proc. Iowa Acad. Sci. VII. 143 (1900); in Elys. Mar. III. 19 (1910). — Mohr in Contrib. U.S. Nat. Herb. VI. 465 (Pl. Life Ala.) (1901). — Small, Fl. S.E. States, 341 (1903), ex parte. — Schneider, Ill. Handb. Laubh. I. 32, figs. 11a-b, 12a (1904). — Hough, Handb. Trees, 78, figs. 91-92 (1907), pro parte max. — Robinson & Fernald, Gray's Man. 320, fig. 640 (1908). — Britton & Shafer, N. Am. Trees, 183, fig. 184 (1908), ex parte et excl. syn. — Small, Shrubs Florida, 9 (1913). — Rydberg, Fl. Rocky Mts. 191 (1917). — *S. pentandra* Walter, Fl. Car. 243 (1788). — *S. flavo-virens* Hornemann, Cat. Hort. Hafn. Suppl. II. 11, ex Willdenow, Berl. Baumz. ed. 2, 426 (1811), pro syn. *S. nigrae*. — *S. ligustrina* Michaux f., Hist. Arb. Am. III. 326, t. 5, fig. 2 (1813); N. Am. Sylva, III. 80, t. 125, fig. 2 (1819). — *S. falcata* Pursh, Fl. Am. Sept. II. 614 (1814). — Hooker, Fl. Bor.-Am. II. 149 (1839). — Forbes, Salict. Woburn. 279, t. 148 (1829). — *S. Houstoniana* Pursh, Fl. Am. Sept. II. 614 (1814), ex parte. — Forbes, Salict. Woburn.

21, t. 11 (1829). — ? *S. ambigua* Pursh, Fl. Am. Sept. 617 (1814). — ? *S. Purshiana* Sprengel, Syst. v. 608, in indice (1828). — *S. nigra* var. *falcata* Torrey, Fl. N.Y. II. 209 (1843). — Carey in Gray, Man. 429 (1848). — Andersson in Ofv. Svensk. Vetensk. Akad. Förh. xv. 114 (1858). — Newhall, Trees N.E. Am. 74, fig. 37 (1890). — Sargent, Silva N. Am. ix. 104, t. 463 (1896). — *S. nigra* a. *angustifolia* a. *falcata* et β . *longifolia* Andersson in Svensk. Vetensk. Akad. Handl. vi. 20 (1868). — *S. nigra* b. *latifolia* a. *brevijulis* et β . *longijulis gracilescens* Andersson, l. c. 21 (1868). — *S. nigra* [subspec.] *S. furcipila* Gandoger, Fl. Europ. XXI. 167 (1890). — *S. nigra* [subspec.] *S. leptodes* Gandoger, l. c. — *S. nigra* [subspec.] *S. ventricosa* Gandoger, l. c.

A very well-known eastern species the range of which seems to extend along the Atlantic coast from southern New Brunswick to northern North Carolina, and westward through northwestern South Carolina and northern Georgia (from where I have not yet seen typical material) to central and eastern Alabama (probably also to northern Missouri), southern Arkansas (where var. *altissima* is the prevailing form) and from northern Louisiana to northeastern Texas (where it seems to spread in the central parts as far south as Val Verde County on the Rio Grande, although most of the material from Texas belongs to var. *Lindheimerii*). The southern borderline of the range of *S. nigra* reaches its most western point at about 100° W. L., and from there runs northward through central Oklahoma and the eastern parts of Kansas, Nebraska, and South Dakota.¹ For the northern limit of its range may be taken a line running from about the 95th degree W. L. along the north shores of Lake Superior through southern Ontario and Quebec to southern New Brunswick. *S. nigra* does not occur in the southwest or west where it is represented by *S. Gooddingii*. In the south the typical form apparently passes by many intermediates into var. *Lindheimerii* and var. *altissima*. Of peculiar interest are the forms of the southeast from Virginia to northern Florida because they show a smaller number of stomata on the upper surface of the leaves. While in the typical form as well as in var. *altissima* and var. *Lindheimerii* the number of the stomata is scarcely less on the upper than on the lower leaf-surface, these southeastern forms sometimes only have a few stomata along the midrib and even these seem to be occasionally wanting. I have not yet been able to detect other characters to separate these forms from typical *nigra* but for two reasons I think it best to enumerate them below. Firstly, they certainly need a further study, and secondly I wish to draw the special attention of all collectors to them, because the distribution of *S. nigra* in the southeast is very insufficiently known, and material of it from that

¹ According to the map given by Hough *S. nigra* inhabits almost the whole state of Kansas, the eastern half of Nebraska and South Dakota, the southeastern corner of North Dakota and nearly the whole of Minnesota except the northwestern corner. I have not yet seen material from the Dakotas and Minnesota but according to Lunell's enumeration (Am. Midl. Nat. iv. 197 [1916]) *S. nigra* is wanting in North Dakota, and according to Petersen (Fl. Nebr. ed. 2, 69 [1912]) it occurs in Nebraska only in the eastern part of the state. It is absent from northern central and western Kansas (see Hitchcock in The Industrialist, xxiv. 323 [Fl. Kansas] [1899].)

region in herbaria is very scanty. From the range given in Britton and Brown's Flora or in Small's Flora it would appear that *S. nigra* was distributed along the whole eastern coast including Florida. In his Florida Shrubs 9 (1913), Small distinguishes two species from northern Florida with "leaf-blades green beneath." One he calls *S. nigra*, and the other *S. marginata* "Weimer" [Wimmer]. The first apparently represents the form I refer to above, while *S. marginata* seems to me identical with the plant I describe as *S. Harbisonii*. As to the name *marginata* see later under *S. longipes renulosa*. Harper, in his Geogr. and Veget. of northern Florida (in Sixth Ann. Rep. Florida Geol. Surv. 401 [1914]) says under *S. nigra* "Banks of streams, etc., mostly westward." He probably too includes forms of *S. Harbisonii* which, as I shall explain later, often looks intermediate between *S. nigra* and forms of *S. longipes*. I have been able to examine the following specimens of what I believe is a form closely related to typical *S. nigra* from Virginia to northern Florida.

VIRGINIA. Alexandria County: Arlington, May 10, 1891, *F. Blanchard* (fr.; M.; stomata in pagina foliorum superiore pauciora). Dinwiddie County: Petersburg, banks of the Appomattox River, August 22, 1908, *A. Rehder* (st.; A.). Gloucester County, without exact locality, common, September 14, 1912, *C. S. Sargent* (st.; A.; very similar to the preceding). Smyth County: about falls of Holston River, June 8, 1892, *J. K. Small* (fr.; A., M.; stomata in pag. superiore foliorum partim non visa).

SOUTH CAROLINA. Oconee County: Clemson College, April 23, 1906, *H. D. House* (No. 1910, m., f.; N.; forma satis typica stomatibus paucioribus). Abbeville County: Calhoun Falls, along Savannah River, May 20, 1918, *T. G. Harbison* (No. 6, fr.; A.; stomata in foliis superne non visa). Darlington County: Darlington, in low swampy ground, April 24, 1918, *T. G. Harbison* (Nos. 19, fr., st., 21, fr., 23, fr.; A.; "large shrub"; stomata non visa vel tantum pauca secundum costam).

GEORGIA. Rabun County: Pine Mountain, along rocky stream in mountain, April 16, 1918, *T. G. Harbison* (Nos. 1, 2, m.; A.; "small tree"; flowers very young, twigs rather brownish); Clayton, on bank of small stream, April 11, 1918, *T. G. Harbison* (Nos. 1, 2, m., f.; A.; "small tree with brittle-jointed twigs"; same as preceding). Gwinnett County: Yellow River, May 22, 1897, *H. Eggert* (fr.; M.; stomata superne sparsa). De Kalb County: on and about Stone Mountain, May 1-18, 1895, *J. K. Small* (m., f.; A., N.; stomata superne nulla vel sparsa). Richmond County: near Augusta, October 7, 1914, *C. S. Sargent* (st.; A.; stomata superne non visa); on bank of river, April 6, 1918, *T. G. Harbison* (No. 6, m.; A.; "large tree; bark rough and scaly; twigs brittle-jointed"). Randolph County: Cuthbert, in low ground along a small stream, March 29, 1918, *T. G. Harbison* (Nos. 4, f., 5, m.; A.; "a tree 60 ft. tall and a foot in diameter; bark furrowed and scaly in thick plates; twigs brittle-jointed"; stomata superne tantum ad costam sparsa).

FLORIDA. Gadsden County: River Junction, in low ground, March 24, 1918, *T. G. Harbison* (No. 18, fr. im.; A.; "shrub 8 ft. tall; twigs brittle-jointed"; this form may be referable to *S. Harbisonii*); March 24, 1918, *T. G. Harbison* (No. 2, m.; A.; "a tree nearly a ft. in diameter and about 50 ft. tall; bark deeply furrowed and scaly"; stomata superne numerosa!). Duval County: Jacksonville, in low inundated swamp, March 19, 1918, *T. G. Harbison* (No. 2, fr.; A.; "large shrub or low straggling tree"; according to the rather long pedicels of the fruits this form may belong to *S. Harbisonii*).

The var. *falcata* cannot in my opinion even be distinguished as a good form (see Blake's statements in *Rhodora*, xv. 163 [1903]), and so far as I can

see it is hardly possible to separate any other forms but the two following. As to *S. ambigua* Pursh I can only say that it deserves its name until we find a type specimen.

2b. *S. nigra* var. *altissima* Sargent in *Trees & Shrubs*, II. 216 (1913). — ? *Salix* spec. Robin, Voy. Louisiana, III. 521 (1807). — ? *S. denudata* Rafinesque, *Florul. Ludovic.* 116 (1817). — As the varietal name indicates this willow becomes the tallest American *Salix* growing up to the height of 40 m. The type was collected near Fulton on the Red River, Hempstead County, Arkansas, May 20, 1909, by the well-known collector B. F. Bush (No. 5654, fr.; A.). Except in its size it differs from the type only in the more pubescent young shoots, leaves and especially the petioles which are almost barbate-tomentose above and on the average are comparatively longer, and in the shape of its leaves which as a whole are more acute at the base thus resembling var. *Lindheimerii*. Besides this var. *altissima* flowers a little later than the type where both grow together. I have seen specimens from Arkansas (Hempstead County), Louisiana (Caddo, Winn, Richland, Rapides, West Feliciana, New Orleans, St. Landry, Jefferson, Lafayette and Calcasieu Parishes), and from eastern Texas (Harrison, San Augustine, Polk, Walker, Harris, Houston, and Jefferson Counties) but some of the Texan forms need further study and may partly be referable to var. *Lindheimerii*. Sargent suggested that *S. marginata* Wimmer might be identical with var. *altissima*, but Wimmer's form belongs to *S. longipes venulosa*. *S. denudata* Rafinesque mentioned in the synonymy is an obscure species very badly described, but it seems to be referable to var. *altissima*.

2c. *S. nigra* var. *Lindheimerii* Schneider in *Bot. Gaz.* LXV. 9 (1918). — I have (l. c.) already dealt with this interesting variety which in some respects seems to form a connecting link between *S. nigra* and its southern representative, *S. Humboldtiana* (var. *stipulacea*), and I have enumerated the specimens examined from Mexico. In the United States it is found in the eastern part of central Texas and in southeastern Texas where I have seen it from the following counties: Grayson, Dallas, Tarrant, McLennan, Bell, Gillespie, Kendall, Comal, Bexar, Wilson, Calvado, Harris, Polk, Brazoria, Wharton, Matagorda, Victoria, Atascosa, Refugio; a specimen from Caddo County, Louisiana, is rather intermediate between var. *altissima* and var. *Lindheimerii*, and a sterile one from western Texas, Jeff Davis County (near Fort Davis, D. M. Andrews, No. 77; A.) belongs probably to those forms from Texas which I am unable to distinguish from typical *S. nigra*.¹ The var. *Lindheimerii* may also occur somewhere in southern Oklahoma along the Red River, and it seems to me to be connected by intermediates in the north with typical *S. nigra*, and more to the east with var. *altissima*, while in Mexico it comes very near *S. Humboldtiana* as I have previously stated.

¹ *S. nigra* Coulter in *Contrib. U. S. Nat. Herb.* II. 419 (1892) probably belongs partly to var. *Lindheimerii*, and his var. *Brightii* seems also to represent a form of *S. nigra* and not the true *S. Wrightii*. A sterile specimen collected by C. R. Ball on the Bear Creek, 1½ mi. northwest of Junction, Kimble County, August 25, 1909 (No. 1537; O.) has very short petioles, and looks much like typical *S. nigra*.

3. *S. Gooddingii* Ball in Bot. Gaz. XL. 376, t. 12, figs. 1-2 (1905). — *S. nigra* var. *venulosa* Bebb apud Coville in Contrib. U.S. Nat. Herb. IV. 199 (Bot. Death Valley Exped.) (1893). — *S. nigra* Greene, Man. Bot. San Francisco Bay, 299 (1894), non Marshall. — Eastwood, Handb. Trees Cal. 35 (1905), pro parte max. — Sudworth, For. Trees Pacif. Slope, 213, figs. 85-86 (1908), pro parte. — Jepson in Mem. Univ. Cal. II. 175, t. 56, figs. 1-3 (Silva Cal.) (1910), incl. var. *vallicola*. — Wooton in Bull. N. Mex. Agr. Coll. LXXXVII. 43, fig. (1913). — For further synonymy and literature see Schneider in Bot. Gaz. LXV. 12 (1918). — This species is widely spread in California from Tehama and Butte Counties in the north to the very south and to northern Lower California. Toward the east it is found in southeastern Nevada, Lincoln and Clarke Counties (where the type was collected), Arizona (except probably in the northern and northeastern part of the state), southwestern New Mexico (probably not north of Socorro County and not east of the Rio Grande), and northwestern Texas (El Paso and Jeff Davis Counties). There is a specimen in Herb. N., collected by Frémont, "on road day we left Canyon Arkansas River Aug. 28," 1845 (No. 402^a, st.) which would mean Colorado if the locality is correctly given. I have seen no other specimen of our species from that state. The eastern and north-eastern limits of its range need further observation. It is clearly distinct from the eastern *S. nigra* for which it has been taken by most authors. There seem to be two forms which may be distinguished by the glabrousness or by the more or less copious pubescence of the young and the one-year-old branchlets; the more pubescent one would have to be taken for the type.

SECT. II. TRIANDRAE Dumortier. — Sect. *Australes* Andersson in Öfv. Svensk. Vetensk. Akad. Förh. xv. 114 (1858), ex parte. — Sect. *Fragiles* Andersson, l. c. 115, ex parte, non Koch, nec Fries. — For further information see Schneider in Bot. Gaz. LXV. 13 (1918).

4. *S. amygdaloides* Andersson in Öfv. Svensk. Vetensk. Akad. Förh. xv. 114 (1858); in Proc. Am. Acad. Sci. IV. 53 (Salic. Bor.-Am. 8) (1858); in Walpers, Ann. Bot. v. 744 (1858). — Bebb in Rothrock, Wheeler's Rep. VI. Bot. 240 (1878); in Coulter, Man. Rocky Mts. Bot. 334 (1885); apud Watson & Coulter, Gray Man. ed. 6, 481 (1890). — Macoun, Cat. Can. Pl. II. 444 (1883). — Sargent, Rep. For. N. Am. 10 Cens. U.S. IX. 166 (1884), pro parte max.; Silva N. Am. IX. 111, t. 467 (1896), pro parte max.; Man. Trees N. Am. 170, fig. 142 (1905), pro parte max. — Glatfelter in Trans. Acad. Sci. St. Louis, VI. 428, t. 1, figs. 1, 3, 4, 8, 9 (1894). — Bush in State Hort. Rep. Mo. 1895, p. 360 (List Trees Mo.). — Williams in Bull. S. Dak. Agric. Coll. Exp. Sta. XLIII. 105 (1895). — Britton & Brown, Ill. Fl. I. 495, fig. 1175 (1896), pro parte max.; ed. 2, I. 593, fig. 1452 (1913), pro parte max. — Sudworth in Bull. U.S. Dept. Agric. Div. For. XIV. 120 (Nomencl. Arb. Fl.) (1897), pro parte max.; For. Trees Pacif. Slope, 216, fig. 87 (1908). — Ball in Proc. Iowa Acad. Sci. VII. 144 (1900); in Coulter & Nel-

son, *New Man. Rocky Mts. Bot.* 129 (1909); in *Bot. Gaz.* LX. 397 (1915). — Rydberg in Britton, *Man.* 313 (1901); ed. 2, 313 (1905); in *Mem. N.Y. Bot. Gard.* I. 109 (*Cat. Fl. Mont.*) (1901); *Fl. Colo.* 93 (1906); *Fl. Rocky Mts.* 191 (1917). — Howell, *Fl. N.W. Am.* I. 617 (1902). — Small, *Fl. S.E. States*, 341 (1903). — Eastwood, *Handb. Trees Cal.* 37 (1905). — Piper in *Contrib. U.S. Nat. Herb.* XI. 212 (*Fl. Wash.*) (1906). — Hough, *Handb. Trees*, 75, fig. 86 (1907), pro parte max. — Jones, *Willow Fam.* 26 (1908). — Robinson & Fernald, *Gray's Man.* 321, fig. 642 (1908). — Britton & Shafer, *N. Am. Trees*, 188, fig. 146 (1908). — Daniels in *Univ. Mo. Stud. Sci. Ser.* II. 247 (*Fl. Boulder Colo.* 99) (1911). — Schaffner in *Ohio Biol. Surv.* I. 199 (*Cat. Ohio Pl.*) (1914). — J. L. Henry, *Fl. S. Brit. Col.* 73 (1915). — *Salix* [second species] Torrey in Nicollet, *Rep. Upper Miss. Riv. App. B.* 237 (*Cat. Pl. Geyer*, 160) (1843). — *S. nigra* ***S. amygdaloides* Andersson in *Svensk. Vetensk. Akad. Handl.* VI. 21 (*Monog. Salic.*) (1867). — *S. nigra* β . *amygdaloides* Andersson in *De Candolle Prodr.* XVI.² 201 (1868). — Porter & Coulter in *U.S. Geol. Surv. Misc. Publ. No. 4.* 128 (*Syn. Fl. Colo.*) (1874). — *S. Wrightii* Rydberg, *Fl. Rocky Mts.* 191 (1917), ex parte, non Andersson. The type of this well-known species came from South Dakota where it was collected on the banks of the Missouri at Fort Pierre during the voyage of Prince Maximilian Wied-Neuwied. I have not yet been able to examine the type, but so far as I can judge by the material from South Dakota at my disposal the form of this state is identical with that of Missouri described by Glatfelter. Its range extends from Quebec (about 73° W. L.) to central New York (Onondaga and Tompkins Counties) apparently along the southern shores of Lake Erie (absent from Pennsylvania) through northern Ohio (where it has been observed according to Schaffner as far south as Franklin County) and northern Indiana (where I have seen it from Jasper and Wells Counties) to Illinois Missouri (where it is apparently absent from the southern part of the state), Kansas to northwestern Oklahoma and the northwestern corner of Texas, but the forms of Oklahoma and Texas approach the western ones which may not represent typical *S. amygdaloides*. Further to the west it is found in Colorado (except probably in the southwestern corner), Utah (here wanting apparently in the south) and Nevada (where, judging by the material before me, it does not seem to occur in the southern and central parts of the state). From Nevada the western borderline runs northward through central Oregon (Lake and Wasco Counties), southeastern Washington (West Klickitat to Whitman County) to southeastern British Columbia (eastern Kootenay according to J. L. Henry). From here the northern limit of its range seems to follow about the 50th parallel to the Winnipeg region, from where it turns a little to the south through southern Ontario and northern Quebec to Montreal. On the map given by Hough it is shown farther north in Alberta and to central Saskatchewan and central Manitoba, but I have seen no material from as far north. In the southeast Hough includes the whole course of the Ohio in the range of *S. amygdaloides* but it is not mentioned by Porter from Pennsylvania, and I have seen no specimens from the lower Ohio where it is

said to be "abundant" by Sargent (Man. 171). This is probably a mistake, as indicated above.

I am not sure whether the western forms really represent typical *S. amygdaloides*,¹ but there is certainly a form with puberulous or subtomentose young parts that deserves a special mention. Ball (1909) says that "a form with very narrow leaves, scarcely 1 cm. wide, is found on the high plains east of the Rocky Mountains." I am not yet sure to which form he refers, and I wish to state that the western forms need a much closer study than I have been able to devote to them. It may be that the following form ought to be regarded only as a form of a western variety, and that even within the range of typical *amygdaloides* another corresponding form may occur. I only wish to call attention to this western form in proposing the name *S. amygdaloides* f. *pilosiuscula*, forma nov.: a typo ut videtur tantum recedit ramulis foliisque novellis pilosiusculis (? rarius ramulis petiolis folisque ad costam breviter subtomentosis; confer no. 902 Gooddingii); ramulis annotinis biennesque satis (ut fere in omnibus aliis speciminibus occidentalibus) flavescentibus, foliis superne stomatibus vulgo numerosioribus instructis, stipulis plus minusve acutis, amentis saepissime densioribus, fructibus magis approximatis. — I refer to f. *pilosiuscula* the following specimens:

NEVADA. Washoe County: Wadsworth, alt. 1265 m., May 7, 1909, *A. A. Heller* (No. 10403, m., paratype; A., M.); sloughs between Pyramid and Winnemucca Lakes, alt. 1200 m., June 2, 1913, *P. B. Kennedy* (No. 1997, m., fr., im., G., Reno; foliis normalibus valde juvenilibus; forma in herbariis sub nomine inedito *S. washoensis* W. W. R. distributa). Churchill County: Carson Sink Region, alt. 1265 m., July 15, 1908, *P. B. Kennedy* (No. 1776, fr. type; A., M., Reno).

UTAH. Davis County: Farmington, June 11, 1908, *J. Clemens* (fr. juv.; G.). Salt Lake County: Salt Lake City, alt. 1300 m., May 12, 1880, *M. E. Jones* (No. 1711, m.; A.); May 22, 1887, *M. E. Jones* (m., f.; A.); City Creek Cañon, Wasatch Mts., 1500 m., April 20, 1900, *S. G. Stokes* (m., f.; St.). Beaver County: Milford, along a bottom, June 4, 1902, *L. N. Goodding* (No. 1019, m., f.; A., M.). Washington County: Santa Clara Creek, May 20, 1902, *L. N. Goodding* (No. 902, fr. im.; M.; specimen a cl. Ball pro *S. laevigata* determinatum, sed ab hac species satis diversum et magis ad f. *pilosiusculam* accedens; forma satis incerta ramulis novellis et partim annotinis petiolis costaque foliorum superne tomentellis, amentis laxis fructibus in pedicello sparse pilosis, foliis normalibus nondum satis evolutis).

COLORADO. Montrose County: Naturita, ditch bank, alt. 1620 m., May 26, 1914, *E. Payson* (No. 354, m., 355, f.; M.) ? Clear Creek County: Clear Creek Valley, May 27, 1916, *A. Eastwood* (Nos. 5390, f., 5391, m.; A.). Larimer County: without exact locality, foothills, alt. 1800 m., May 26, 1897, *C. S. Crandall* (No. 12, m., fr. juv.; M.; amentis fructiferis subaxioribus); Fort Collins, alt. 1500 m., May 15, 1896, *C. F. Baker* (m.; M.). Weld County: Greely, June 24, 1896, *L. H. Pammel* (No. 205, fr.; M.; parcissime pilosa); Evans, 1909, *E. L. Johnson* (No. 541, m., f.; M.). Morgan County: Fort Morgan, June 23, 1896, *L. H. Pammel* (No. 206, st.; M.). Las Animas County: bank of Purgatoire River near Trinidad, 2000 m., May 13, 1892, *C. S. Crandall* (No. 9, m., f.; C.).

¹ Professor J. S. Jack collected a very vigorous form at Holland near Pullman, Wash., Aug. 31, 1918 (No. 1241, st.; A.), that looks much like vigorous forms collected by Glatfelter near St. Louis, Mo., but in the western form the stipules are decidedly acute, not rounded as in the type. The young shoots and leaves are puberulous.

IDAHO. Bear Lake County: Montpelier, creek bank, May 15, 1910, *J. F. Macbride* (No. 17, m. tantum; M.). Ada County: Boise, along the river, alt. 900 m., May 26, 1911, *J. A. Clark* (No. 21, fr. juv.; C., M., St.; forma tantum parce pilosa). Washington County: Weiser, alt. 660 m., July 5, 1899, *M. E. Jones* (No. 6545, fr.; M.). Nez Perces County: about Lewiston, alt. 240 m., June 9, 1896, *A. A. & E. G. Heller* (No. 3201, m., f.; A., St.; forma parceissime pilosa).

WASHINGTON. Whitman County: Almota, May 27, 1893, *C. V. Piper* (No. 1776, m.; C.); near Pullman, Aug. 31, 1918, *J. S. Jack* (No. 1244, st.; A.; "15 ft. high, several stems 2-3 in. diam.").

OREGON. Lake County: Alkali, May, 1882, *Th. J. Howell* (m., f.; E. M.).

There is also a puberulous form from northwestern Texas, collected by *E. J. Palmer*, at Canyon, along streams, Randall County, July 12, 1917 (No. 12517, st.; A.) and near Amarillo, along streams, Potter County, July 13, 1917 (No. 12538, fr.; A.); this in my opinion belongs to the typical *S. amygdaloides* while, as stated above, the f. *pilosiuscula* s. str. is a form of the western *S. amygdaloides* which can probably be regarded as a distinct variety.

In the south we find the following well-marked variety:

4b. *S. amygdaloides* var. *Wrightii* Schneider in Bot. Gaz. LXV. 14 (1918). For further synonymy and literature see Schneider, l. c.; to the quotations may be added the following given under *S. amygdaloides* pro parte minima: Sargent in 1884, 1896 and 1905; Britton & Brown in 1896 and 1913; Small in 1903 and 1913; Hough in 1908. — *S. amygdaloides* Coulter in Contrib. U.S. Nat. Herb. II. 419 (1892), non Andersson. — *S. Wrightii* Rydberg, Fl. Colo. 93 (1906); Fl. Rocky Mts. 191 (1917), pro parte. — Britton and Shafer, N. Am. Trees, 185, fig. 142 (1908), pro parte maxima. — I am not yet well enough acquainted with this variety to decide the question whether it is possible to keep it as a distinct species. Judging by the following material¹ I prefer to regard it at present as only a variety, the geographical distribution of which needs further investigation, especially in southern Colorado to where its range seems to extend. Wright's Willow seems to have also a puberulous form, but sometimes young specimens of *S. Gooddingii* are mistaken for it. Both have the same yellowish branchlets, and the very young leaves of var. *Wrightii* do not always show the glaucescent lower surface. Where the two Willows meet there may occur hybrids as it is frequently the case between *S. amygdaloides* and *S. nigra*.

WESTERN TEXAS. El Paso County: El Paso, abundant along the Rio Grande, April 1851, *G. Thurber* (No. 195, m., f.; G., N.; "large tree"); vicinity of El Paso, 1911, *E. Stearns* (No. 151, fr. im.; A.); Belen, June 19, 1893, *E. A. Mearns* (Nos. 1510, fr.; St.; 1511, fr.; A., N.). Ward County: Barstow, bank of canal, April 14, 1902, *S. M. Tracy & F. S. Earle* (Nos. 52, m., 67 f.; A.). Potter County: Amarillo Creek, along the stream, May 29, 1902, *J. Reverchon* (No. 2926, fr.; A.). Oldham County: Magenta. "S.W. Shore of lake" (1625) and Railroad gravel pit. August 26, 1910, *C. R. Ball* (Nos. 1625, 1626, 1627, st.; G., M., O.; "1 ft. diam."; Ball also collected seedlings, No. 1622, "in small sandy flat back of section house."

¹ Since this was written I have seen also the material in Herb. W. which probably contains the richest collection of *Salix* specimens from Texas and New Mexico. It is a matter of personal opinion whether to regard *S. Wrightii* as a species or as a variety of *S. amygdaloides*. I prefer, however, to keep it as a variety.

NEW MEXICO. Dona Ana County: Las Cruces, Experiment Station, June 13, 1911, *C. R. Ball* (No. 1739, fr.; G., M., O.; "large tree"); Valley of the Rio Grande, near La Mesilla, June 19, 1858, *S. Hayes* (fr.; C.); at Mesilla, April, 1897, *T. D. A. Cockerell* (m., f.; N.); same locality, alt. 1150 m., June 21, 1897, *E. V. Wooton* (No. 44, fr.; G., M.; in *St. forma foliis subtus concoloribus porro observanda*); in the Mesilla Valley, alt. circ. 1150 m., April 19, 1907, *E. V. Wooton* & *P. Standley* (No. 3242, m.; C., M.). Sierra County: Tierra Blanca, 1904, *I. N. Beals* (fr.; A.). Otero County: Sacramento Mts., Fresno Canyon, below High Rolls, alt. 1800 m., August 26, 1916, *A. Rehder* (No. 445, st.; A.).

SECT. III. PENTANDRAE Dumortier, subsect. LUCIDAE, subsect. nov. — Sect. *Fragiles* Andersson in Öfv. Svensk. Vetensk. Akad. Förh. xv. 115 (1858), ex parte. — Sect. *Lucidae* sive sect. *Pentandrae* Andersson in Svensk. Vetensk. Akad. Handl. vi. 30 (Mon. Salic.) (1867), ex parte. — Sect. *Pentandrae* Ball in Coulter & Nelson, N. Man. Rocky Mts. Bot. 130 (1909), non Dumortier.

At present I think it best to keep the American forms which are most closely related to *S. pentandra* L. in a special subsection, although *S. serissima* may perhaps be more correctly referred to the true *Pentandrae*.

5. *S. serissima* Fernald in Rhodora, vi. 6 (Dec. 28, 1903); Robinson & Fernald, Gray's Man. 322, fig. 645 (1908). — Britton & Brown, Ill. Fl. ed. 2, 1. 594, fig. 1455 (1913). — Rydberg in Britton, Man. Fl. N. St. Can. ed. 2, 1061 (1905); Fl. Rocky Mts. 191 (1917). — ? *S. (pentandra) lucida ovatifolia densiflora* Andersson in Öfv. Svensk. Vetensk. Akad. Förh. xv. 115 (1858); in Proc. Am. Acad. iv. 54 (Salic. Bor.-Am. 8) (1858). — ? *S. (pentandra) lucida pilosa* Andersson in Öfv. Svensk. Vetensk. Akad. Förh. xv. 115 (1858), pro parte. — ? *S. (pentandra) lucida* var. *angustifolia* f. *pilosa* Andersson in Proc. Am. Acad. iv. 54 (1858), pro parte. — ? *S. lucida angustifolia rigida* Andersson in Svensk. Vetensk. Akad. Handl. vi. 32 (Monog. Salic.) (1867), pro parte. — ? *S. arguta erythrocoma* Andersson l. c. 33. — ? *S. erythrocoma* Barratt ex Andersson l. c., pro synonym. — Rydberg, Fl. Rocky Mts. 191 (1917), an tantum ex parte ? — *S. arguta* **S. pallescens* Andersson in Svensk. Vetensk. Akad. Handl., vi. 32 (1867), prob. incl. f. *hirtisquama* Andersson, l. c. 34, sed. excl. f. *alpigena* Andersson, l. c. 33. — *S. arguta* δ, *pallescens* Andersson in De Candolle, Prodr. xvi.² 206 (1868). — *S. lucida ovalifolia* Andersson, l. c. 205 (1868). — *S. lucida serissima* Bailey apud Arthur in Bull. Geol. Nat. Hist. Surv. Minn. iii. 19 (1887). — For further synonymy and literature see Fernald in Rhodora vi. 7 (1903). — This interesting and well-marked species has always been confused with *S. lucida* or *S. amygdaloides*, until its characteristic features were recognized by Bailey and later with more preciseness by Fernald. Unfortunately Fernald did not pay attention to the forms described by Andersson and enumerated above in the synonymy. Andersson had to deal with little and insufficient material, therefore, he was, apparently, not able to get a clear understanding of the different forms he referred to *S. lucida* and *S. arguta*. Without having seen all the material upon which Andersson based his descriptions it is impossible to elucidate his varieties and forms, but there can

hardly be any doubt that his *S. pallescens*¹ with the exception of f. *alpigena* and his *S. lucida pallescens* are the same as *S. serissima*. The type was collected by Bourgeau on the Saskatchewan and of f. *hirtisquama* by the same collector "ad lac. Winnipeg." Andersson describes the leaves as "subtus pallide glaucescentibus" and the fruits as "distinctius pedicellatis," and there is no other willow to which the name could be applied in the region from which the type came.

S. arguta erythrocoma Andersson or *S. erythrocoma* Barratt which is regarded by Rydberg (Fl. Rocky Mts. 191 [1917]) as a good species represents a mixture of forms from Lake Winnipeg (belonging, so far as I can judge by the specimen in Herb. G., to *S. serissima*) and from the Columbia (collected probably at the mouth of this river in April-May 1825 by Dr. Scouler). I have seen a specimen of the last named under No. 62 in Herb. N. consisting of male and female flowers. I cannot distinguish it from typical *S. lasiandra*. There is another specimen under No. 61 of Dr. Scouler from the Columbia in Herb. N. also labeled *S. erythrocoma* Barratt. It consists of very young female flowers of *S. lasiandra*, and also of a branch with male aments of which the flowers do not seem to be normal. It is too poor to be properly identified.

According to Fernald who gave an excellent account of this species it ranges "from the Housatonic Valley, Massachusetts, to the north shore of Lake Superior, south to Morris County, New Jersey, western New York, northern Ohio, Michigan, Wisconsin, and Minnesota." I have seen it also from northeastern Indiana (Steuben and La Grange Counties). In the northeast its range extends to Newfoundland (Valley of Exploit River) and Anticosti Island, whence its northern limit seems to run to the eastern shores of James Bay and to reach its northernmost point in Keewatin, on the Severn River (J. M. Macoun, No. 2028, O.), while from further west I have seen specimens from near Edmonton, Alberta. From here the western borderline runs south to Banff and Crow's Nest Lake in Alberta and then turns to the east to Sidney in Manitoba and to north-eastern Minnesota (St. Louis County).

6. *S. lasiandra* Benthams, Pl. Hartweg. 335 (1857). — Torrey in Pacific R.R. Rep. iv. Bot. 138 (1857). — Sargent, Rep. For. N. Am. 10 census U.S. ix. 167 (1884), excl. var.; Silva N. Am. ix. 115, t. 469 (1896), excl. var.; Man. Trees 173, fig. 145 (1905). — Bebb in Bot. Gaz. xvi. 103 (1891). — Greene, Man. Bot. San Francisco Bay, 299 (1894). — Sudworth in Bull. U.S. Dept. Agric. Div. For. xiv. 120 (Nomencl. Arb. Fl.) (1897), pro parte max. — Ball in Trans. Acad. Sci. St. Louis, ix. 71 (1899), pro parte; in Coulter and Nelson, New Man. Rocky Mts. Bot. 130 (1909). — Howell,

¹ This name cannot be used according to the Philadelphia Code because there is an earlier *S. pallescens* Schleicher (Cat. Pl. Helv. ed. 3. 26. 1815) which had probably been published first in ed. 2 (1807). The International Rules would permit the use of the name because Schleicher's name is a nomen nudum and represents nothing but a form of *S. nigricans* Smith, but as it is doubtful whether Andersson's binomial can be regarded as a correct publication of a species or only of a subspecies I abstain at present from using this name.

Fl. N.W. Am. 617 (1902). — Schneider, Ill. Handb. Laubh. i. 29, figs. 11c-d, 15a, (1904), excl. var. *caudata*. — Eastwood, Handb. Trees Cal. 38 (1905). — Piper in Contrib. U.S. Nat. Herb. xi. 212 (Fl. Wash.) (1906). — Jones, Willow Fam. 27 (1908), pro parte et excl. var. — Jepson, Fl. Cal. 338 (1909); in Mem. Univ. Cal. ii. 175, t. 56, figs. 1-3 (Silva Cal.) (1910). — Wooton in Bull. N. Mex. Coll. Agric. LXXXVII. 41, fig. p. 42 (1913). — Henry, Fl. S. Brit. Col. 96 (1915), excl. var. *caudata*. — Wooton & Standley in Contrib. U.S. Nat. Herb. xix. 160 (Fl. N. Mex.) (1915). — *S. lucida* Hooker, Fl. Bor.-Am. ii. 148 (1839), pro parte, non Muhlenberg. — *S. speciosa* Nuttall, N. Am. Sylva, i. 58, t. 17 (1843), and reprint 1852, probabiler pro parte, non Host, nec Hooker et Arnott. — *S. (pentandra) lucida angustifolia lasiandra* Andersson in Ofv. Svensk. Vetensk. Akad. Förh. xv. 115 (1858). — *S. Fendleriana* Andersson, l. c. (1858), pro parte, s. str. — Wooton & Standley in Contrib. U.S. Nat. Herb. xix. 160 (1915), pro parte. — *S. lucida* **macrophylla* Andersson in Svensk. Vetensk. Akad. Handl. vi. 32 (Monog. Salic.) (1867); in De Candolle, Prodr. xvi.² 205 (1868). — *S. arguta lasiandra* Andersson in l. c. 33 (1867); l. c. 205 (1868). — *S. arguta erythromoma* Andersson, l. c. 33 (1867), pro parte; l. c. 205 (1868), pro parte. — *S. lasiandra* var. *typica* Bebb in Watson, Fl. Cal. ii. 84 (1879). — Macoun, Cat. Can. Pl. i. 449 (1883); ii. 358 (1890). — *S. lasiandra* var. *Lyallii* Sargent in Gard. & For. viii. 463 (1895); Silva N. Am. ix. 115, t. 470 (1896). — Sudworth in Bull. U.S. Dept. Agric. Div. For. xiv. 120 (Nomencl. Arb. Fl.) (1897); For. Trees Pac. Slope 219, figs. 89-90 (1908). — Ball in Piper & Beattie, Fl. N.W. Coast, 114 (1915). — *S. Lyallii* Heller in Bull. Torr. Bot. Club, xxv. 580 (1898), ut videtur pro parte tantum. — Britton & Shafer, N. Am. Trees, 191, fig. 149 (1908). — Rydberg, Fl. Rocky Mts. 191 (1917), ex parte.

The history of this species of which its first describer Nuttall said that "no Willow of the American continent presents so remarkable and splendid an appearance" has been already discussed at a considerable length by Ball (1899). He explained the reason why the typical form has been so often misunderstood, and so many varieties have been described which in fact represent nothing but the type. According to Ball (1899) Andersson's *S. Fendleriana* is a synonym of *S. lasiandra caudata*, and the name has to be applied to this variety if we take it for a species. But in this respect I differ from Ball for the following reasons. Andersson based his *S. Fendleriana* on Fendler's No. 816 which came from New Mexico and was collected "probably about Santa Fe" (fide Wooton and Standley), and Andersson besides mentions Geyer's No. 287 from the Rocky Mountains. Only the last specimen belongs to var. *caudata* while No. 816, in my opinion, represents the typical *S. lasiandra* or at least a form of it which is different from var. *caudata*. Therefore, the name *S. Fendleriana* cannot be used for that species if we regard var. *caudata* as specifically distinct.

To the typical *S. lasiandra* also belongs Andersson's *S. lucida macrophylla* of which I have seen a photograph and fragments of the type in Herb. K. and a co-type in Herb. G. It was collected by Dr. Lyall in May

1859 at Sumas Prairie "Lower Frazer River 49. N. Lat." according to the label in Herb. K. The printed labels of both herbaria bear the inscription: "*Salix lucida tenuior* (*S. pentandra americana* Andr.)" Andersson probably later changed the name *tenuior* to *macrophylla*. Lyall's specimens show a large dorsal gland in the male flowers, and a similar gland may be observed in the flowers of other male specimens from British Columbia which otherwise are apparently not distinguishable from typical *S. lasiandra*. Further observation of more copious material must prove if this character is of any taxonomic importance; in this case we could distinguish this northern glabrous form as a special variety using the name *macrophylla*. Sargent founded his var. *Lyallii* upon Lyall's specimens in changing the older name *macrophylla*, and Heller raised var. *Lyallii* to specific rank, a fact already rightly deplored by Ball (1899). In 1915, however, Ball applied the name var. *Lyallii* to a form of *S. lasiandra* common within the area of Piper and Beattie's Flora of the Northwest Coast. I am not aware of the reason for which Ball has been induced to do this, but in my opinion, even if it should be possible to distinguish the northern glabrous form from the typical *S. lasiandra* of California the name var. *Lyallii* cannot be used.

In 1867 Andersson created two new species: *S. arguta* and *S. lancifolia*. To *S. arguta* he referred his *S. Fendleriana* of 1858 as a synonym but only "p. p." Nevertheless he cited both specimens upon which he previously based this species, and added to them in the first place a specimen collected by Bourgeau "ad fl. Saskatchewan, prope Carlton-house." This specimen (I have not yet seen the type in Herb. K.) probably belongs to *S. lucida* and is identical with one of Bourgeau's specimens from the "Saskatchewan, 1859," preserved in Herb. G. Therefore the typical *S. arguta* of Andersson consists of 3 different things, namely *S. lucida* (Bourgeau), *S. lasiandra* (Fendler's No. 816, as explained before), and *S. lasiandra caudata* ("Burke et Geyer No. 287"). Andersson himself said of *S. arguta* (1867): "Valde dubius sum, utrum a *S. lucida* distincta an cum ea conjugenda sit," and he was not sure whether it might be "quasi hybrida a *S. lucida* et *S. cordata*" (1868). In spite of all his doubts he adds (1867) the var. *lasiandra* which is nothing but the typical *S. lasiandra*, and var. *erythrocoma*. Under the name *S. erythrocoma* Barratt had distributed as No. 40 Herb. H. & T. a *Salix* "common on the Islands and shores of Lake Winnipeg" of which I have seen a male specimen in Herb. G. It seems to belong to *S. serissima*, but Rydberg (Fl. Rocky Mts. 191 [1917]) has taken up Barratt's name for a species which he places next to *S. serissima*, and which is found from Manitoba to British Columbia and the Mackenzie River valley. I have seen no material from these regions which I could identify with Rydberg's *S. erythrocoma*. Andersson had named his var. *erythrocoma* in 1858 *S. (pentandra) lucida pilosa*, and in both places he cites, besides the Winnipeg material, "Columbia River" and "Fort Franklin," mixing, apparently, forms of different affinity as I have already explained under *S. serissima*.

The second species created by Andersson in 1867, is *S. lancifolia* of which

the type was collected by Dr. Lyall "in insula Vancouver." Of this species a photograph and fragments of the type and a co-type from Herb. G. are before me. It represents, in my opinion, only a form of *S. lasiandra* with "ramulis puberulis," and if we keep it as a variety as Bebb did we have to include the hairy forms of California. It may be that we can separate the typical southern *lasiandra* from the northern variety, and that both varieties produce a hairy form, in which case the southern form should have a new name. I have tried to distinguish these two varieties by the difference in the length of the pedicels which seem to be usually shorter in the southern type, and by other characters, but as far as I can see there is hardly a character sufficiently constant to be found. Even the typical *S. lasiandra* often shows a partly rusty pubescence on the very young shoots and leaves, but some very tomentose specimens of the pubescent form from California look rather different. On the other hand we find on specimens from the Columbia in Oregon to the Yukon Territory all degrees of glabrousness to a well-marked tomentum on the shoots or on one-year-old branchlets, the presence of rufous hairs on the young leaves being sometimes rather conspicuous, while on other material the pubescence is entirely grayish. We need a series of well-collected specimens from each region to decide the taxonomic value of the different characters.

The typical *S. lasiandra* is found from southern California to the Columbia in Oregon, in New Mexico near Santa Fé (in a form which I have mentioned above) and in certain forms in southwestern Colorado (Montezuma, San Miguel and Gunnison Counties) which hitherto have been partly mistaken for *S. amygdaloides* and *S. laevigata*. In Nevada and Sierra Counties of California and in western Nevada it seems to grow together with var. *caudata*, and there are certain specimens before me which I am actually at a loss to refer to either variety. Towards the north *S. lasiandra* (in its glabrous form which as I said may possibly be separated under the varietal name *macrophylla*) occurs from Oregon (where I have seen it from the following counties: Josephine, Douglas, Marion, Multnomah, Wasco, Columbia), Washington (counties: W. Klickitat, Pierce, King, Chehalis, Clallam) to British Columbia (coast region, but also in Kootenay), and it has been collected in northwestern Alberta (Peace River Landing, J. M. Macoun, No. 21266; O.) and in the Yukon Territory (vicinity of Dawson). The hairy form may be separated at present as

6b. *S. lasiandra* var. *lancifolia* Bebb in Watson, Bot. Cal. II. 84 (1879), probabiliter tantum ex parte. — Macoun, Cat. Can. Pl. I. 450 (1883), pro parte; II. 358 (1890). — *S. lancifolia* Andersson in Svensk. Vetensk. Akad. Handl. VI. 34, t. 2, fig. 23 (Monog. Salic.) (1867); in De Candolle, Prodr. XVI.² 206 (1868). — A typo praecipue differt ramulis hornotinis dense saepius etiam annotinis biennilusque plus minusve vel partim pubescentia villosa grisea vel fusca vestitis, foliis initio (saltem parvis ad basim pedunculorum) subtus plus minusve distincte ferrugineo-sericeis.

In Andersson's type the pedicels of the fruits are somewhat pilose and measure from 1 to 1.5 mm. I refer to this variety the following specimens:

YUKON TERRITORY. Vicinity of Dawson, May 29, 1914, *A. Eastwood* (No. 113, f.; A.); June 29, 1914, *A. Eastwood* (No. 304, fr. im.; A.); June 30, 1914, *A. Eastwood* (No. 466, fr.; A.).

BRITISH COLUMBIA. Vancouver Island, 1858, *D. Lyall* (fr. type; K.); district of Renfrew, common along streams, August 7, 1902, *C. O. Rosendahl* (No. 900 [=60283, O., fr.; "4-10 m."); Victoria, in a field, July 23, 1887, *J. M. Macoun* (No. 24557, O., fr.); Cedar Hill, near Victoria, May, 1885, *Fletcher* (No. 24556, O., m., f.); New Westminster district, Chilliwack Lake, July 11, 1906, *W. Spreadborough* (No. 79555, O., fr.); New Westminster Junction, April 29, 1889, *J. M. Macoun* (No. 24553, O., f.); Agassiz, damp places, May 20, 1889, *J. M. Macoun* (No. 24552, O., m.); Kootenay district, Revelstoke, swamps, May 3 and 25, 1890, *J. M. Macoun* (No. 11 [=24554, O., n., f.); Deer Park, Lower Arrow Lake, June 10, 1890, *J. M. Macoun* (No. 24559, O., fr.).

WASHINGTON. Chehalis County: Gray's Harbor, May 13, 1897, *F. H. Lamb* (No. 1033, fr.; M.; amentis ad 9 cm. longis); Hoquiam, May 13, 1897, *F. H. Lamb* (No. 1032, m.; M.); Quinalt, at edge of lake, flooded at high water, June 25, 1902, *H. S. Conard* (No. 160, st.; G.; "20 ft. high"). Pierce County: Cascade Mts., upper valley of the Nisqually River, on banks of streams and in swamps, *O. D. Allen* (No. 109, f., fr.; A., M.; "tree 25 ft. high"). King County: Lake Union, June 25, July 12, 1898, *T. E. Savage*, *J. E. Cameron* and *F. E. Lenoeker* (fr.; M.; distributed sub nom. *S. cordata*). West Klickitat County: Columbia River, bottom lands, April 23, May, 1881, *W. N. Suksdorf* (m., f., fr.; A.); April, 1882, same coll. (m.; G.; ex Herb. Bebb).

OREGON. Douglas County: on the upper Umpqua River, August 17, 1880, *G. Engelmann* (fr.; M.); Calapooya Valley, woods near river, alt. 240 m., July 25, 1899, *M. A. Barber* (No. 101, fr.; G.). Marion County: Salem, low ground, along Mill Creek, at Center St. Bridge, April 12, July 13, 1918, *J. C. Nelson* (Nos. 2033, m., 2377, st.; A.; forma parce pilosa). Multnomah County: without exact locality, June, 1880, *J. Howell* (m., f.; G.); Sauvie's Island, April, 1879, *J.* and *Th. Howell* (m., f.; M.); same place, June, 1882, *Th. Howell* (m., fr.; M.).

CALIFORNIA. San Bernardino County: San Bernardino, January, 1881, *S. B.* and *W. F. Parish* (No. 546 partim, m.; A.); March, 1882, same coll. (No. 546 partim, m., f.; M.; this specimen shows a much less dense pubescence than the preceding one); March 19, 1894, *C. S. Sargent* (m.; A.; ut praecedens); same place, 1882, *C. C. Parry* (No. 303, n.; M.; agrees with the first No. 546); January 12, 1881, *W. S. Wright* (Nos. 23, 24, 25, m.; C.; ut praecedens, folia anni praeteriti partim persistentia); without locality, 1882, *C. C. Parry* (No. 304, fr.; M.; only young shoots thinly pubescent); Fawnokin (?) Park, alt. 2100 m., June 3, 1901, *S. B. Parish* (No. 4996, st.; St.; ut praecedens). Los Angeles County: Pasadena, March 7, 1882, *M. L. Jones* (No. 3042, m., f.; A.); Los Angeles, 1881, *J. C. Nevin* (No. 472, m., fr.; G.); river bottom, April 2, 1893, *A. J. McClatchie* (m., f.; N.). Santa Cruz County: Santa Cruz, March, 1894, *C. L. Anderson* (f.; A.). Tulare County: Kern Lake, Kern River, by river above falls, July 19, 1897, *W. R. Dudley* (No. 2028, f.; St.; ramuli tantum hornotini tomentelli); General Grant Park, meadow near Soldier's Camp, August, 1900, *W. R. Dudley* (No. 3095, fr.; St.; ut praecedens); same Park, meadow east of Dorst Creek, August 5, 1900, *W. R. Dudley* (No. 3058, st.; St.; ut No. 2028); Marble Fork at crossing of Colony Mill Trail, August 17, 1900, *W. R. Dudley* (No. 3039, fr.; St.; quam praecedentes glabrior).

I have seen from Tulare County in Herb. St. some specimens collected by Dudley (Nos. 1492^a, 1848, 2079, 2088, 3218) which seem to represent a forma foliis parvis anguste lanceolatis et breviter petiolatis quasi simulans var. *caudatam*. These specimens need further observation. Another small and narrow-leaved form of which the leaves are distinctly glaucous beneath

was collected by W. L. Jepson, Napa River Basin, Howell Mt., May 8, 1893 (No. 29s, fr. juv.; Jeps.; folia semi-evoluta ad 6:1 cm. magna).

6c. *S. lasiandra* var. *caudata* Sudworth in Bull. Torr. Bot. Club, xx. 43 (1893); in Bull. U.S. Dept. Agric. Div. For. xiv. 121 (Nomencl. Arb. Fl.) (1897), pro parte max. — Bebb¹ in Gard. & For. viii. 372 (1895), ex parte. — Sargent, Silva N. Am. ix. 116, t. 470 (1896); Man. Trees N. Am. 174 (1905), pro parte. — Ball in Trans. Acad. Sci. St. Louis, ix. 74 (1899), pro parte max. — Schneider in Ill. Handb. Laubh. i. 29, figs. 15b-c, 1904. — Piper in Contrib. U.S. Nat. Herb. xi. 213 (Fl. Wash.) (1906), pro parte max. — Piper & Beattie, Fl. S.E. Wash. 73 (1914). — Henry, Fl. S. Brit. Col. 96 (1915). — *S. pentandra caudata* Nuttall, N. Am. Sylva i. 61, t. 18 (1843). — *S. Fendleriana* Andersson in Öfv. Svensk. Vetensk. Akad. Förh. xv. 115 (1858), pro parte, quoad spec. Geyeri No. 287. — Howell, Fl. N.W. Am. i. 617 (1902), pro parte max. — Rydberg, Fl. Colo. 94 (1906), pro parte max.; Fl. Rocky Mts. 191 (1917), pro parte max. — Ball in Coulter & Nelson, New Man. Rocky Mts. Bot. 130 (1909), pro parte max.; in Bot. Gaz. lx. 397 (1915). — Visser in Muhlenb. ix. 71 (Add. Fl. S. Dak.) (1913). — Wootton & Standley in Contrib. U.S. Nat. Herb. xix. 213 (1915), pro parte. — *S. arguta* Andersson in Svensk. Vetensk. Akad. Handl. vi. 32, t. 2, fig. 22 (Monog. Salic.) (1867), pro parte et excl. var.; in De Candolle, Prodr. xvi.² 206 (1868), pro parte et excl. var. β , γ , δ . — ? *S. arguta* **S. pallescens alpigena* Andersson in Svensk. Vetensk. Akad. Handl. vi. 33 (Monog. Salic.) (1867). — ? *S. arguta* θ *alpigena* Andersson in De Candolle, Prodr. xvi.² 206 (1868). — *S. lasiandra* var. *Fendleriana* Bebb apud Watson Bot. Cal. ii. 84 (1879), pro parte max.; in Coulter, Man. Rocky Mts. Bot. 334 (1885), pro parte max. — Sargent, Rep. For. N. Am. 167 (1884). — *S. lucida* var. *lanceolata* Hooker ex Bebb in Gard. & For. viii. 373 (1895), pro synonym. — *S. lasiandra* Rydberg in Mem. N.Y. Bot. Gard. i. 110 (Cat. Fl. Mont.) (1900), non Bentham. — Britton & Shafer, N. Am. Trees 190, fig. 148 (1908), pro parte max. — *S. caudata* Heller in Muhlenb. ii. 186 (1906). — Daniels in Univ. Mo. Stud. Sci. Ser. ii. 247 (Fl. Bould., Colo. 99.) (1911).

In its typical form this variety is well marked, and its history has already been discussed by Ball (1899). As I have previously stated Ball included Andersson's *S. Fendleriana* which, however, sensu stricto belongs to typical *S. lasiandra* or to a new form of it. Britton and Shafer have applied the name *S. lasiandra* Bentham to var. *caudata* and taken up the name *S. Lyallii* for the true *S. lasiandra*. The distribution of var. *caudata* according to the material I have been able to examine is as follows: From northern New Mexico (Rio Arriba County, fide Wootton and Standley) the eastern

¹ According to Bebb the oldest name for this variety is *S. lucida* var. *lanceolata* said to have been used by Hooker, Fl. Bor.-Am. ii. 148 (1839), but Hooker did not make such a variety, he only mentions a *S. lucida* " β foliis lanceolatis" without indicating which of the specimens enumerated by him represents this form. Bebb stated that the type of Hooker's variety "is no. 39 of the Hooker, Barratt and Torrey distribution" in the Kew Herbarium. I have not yet seen this specimen which was collected by Drummond in the Rockies at Jasper Lake, and I believe it does not belong to var. *caudata* but to *S. lucida*.

borderline runs northward through eastern Colorado (where it seems not to cross the 103rd degree W. L.), Wyoming and Lawrence and Harding Counties in western South Dakota (Black Hills, vide Ball¹ and Visser) to Montana (where it seems to be present only in the south and west; I have seen specimens from Carbon, Gallatin, Jefferson, Powell, Sanders and Flat Head Counties). In the north I know var. *caudata* from eastern Kootenay (Farnie) in British Columbia, and from Calgary in Alberta. The western borderline² runs from Yale district in British Columbia southward through Washington (east of the Cascades), Oregon (Umatilla, Wallowa, Union, Morrow, Malheur and Klamath Counties) to Nevada (Washoe, Ormsby, Elko, Lincoln Counties) and part of the northeastern slopes of the Sierra Nevada in California (viz., A. Eastwood, No. 386, Placer County, Deer Park, Heller, No. 12720, Yuba River below Cisco and several specimens of Dudley's from Sierra County). In the south I have seen it from Utah (southward to Piute and Washington Counties) but not from Arizona. The typical form of var. *caudata*, according to Nuttall, is that with "ramulis junioribus hirsutis," and as it is the case with other species of this group we can also distinguish a glabrous form. I should regard var. *caudata* as a good species were it not for a series of forms which look rather intermediate between it and typical *S. lasiandra*. It may be that these intermediates might be regarded as hybrids but at present I think it best to defer a more decisive statement until I have been able to become better acquainted with certain forms of eastern California, western Nevada, southwestern Colorado, eastern Oregon and western Idaho. Very interesting are the specimens from Tulare County, California, mentioned on p. 18 which look more like var. *caudata* than typical *S. lasiandra*. It may be that these forms with small and narrow leaves together with similar ones from Sierra, Nevada, Placer and Eldorado Counties represent a new variety which is most closely related to var. *caudata* but possesses the same glaucescent lower leaf-surface as the typical *S. lasiandra*.

7. *S. lucida* Muhlenberg in Neue Schr. Ges. Naturf. Fr. Berlin, iv. 239, t. 6, fig. 7 (1803); in König & Sims, Ann. Bot. ii. 66, t. 5, fig. 7 (1806). — Michaux f., Hist. Arb. Am. iii. 327, t. 5, fig. 3 (1813); N. Am. Sylva iii. 81, t. 125, fig. 3 (1819). — Pursh, Fl. Am. Sept. ii. 615 (1814). — Hooker, Fl. Bor.-Am. ii. 148 (1839), pro parte, et prob. incl. var. β . — Barratt, Salic. Am. No. 17 (1840). — Torrey, Fl. N.Y. ii. 208, t. 119 (1843). — Carey in Gray, Man. 417 (1848); ed. 2, 417 (1856); ed. 3, 417 (1862); ed. 4,

¹ I have seen the specimens cited by Ball from Rochford, (*F. Murdock, Jr.*, No. 4375, st.; C.) and the Deadwood plant has been collected by Ball himself. On the other hand neither he nor Visser mentions *S. lucida* from this region, but there is a specimen before me collected by W. P. Carr, Deadwood, creek banks, July 10.13 (No. 44, st.; M.) which undoubtedly is *S. lucida*, as determined by Rydberg. In Herb. C. (sheet No. 385835) there is a sterile specimen of Visser's No. 112 from Little Missouri River, July 23, 1910, named *S. Fendleriana* which belongs to an entirely different section.

² Ball (1909) gives the range as "New Mexico to Canada and west to the coast" but he does not mention var. *caudata* (1915) in Piper & Beattie, Fl. N.W. Coast. So far as I know it is absent from the coast region.

417 (1863). — Andersson in Svensk. Vetensk. Akad. Handl. vi. 30, t. 2, fig. 21 (Monog. Salic.) (1867), excl. f. *angustifolia* et var. *macrophylla*; in De Candolle, Prodr. xvi.² 205 (1868), ut in 1867. — Macoun, Cat. Can. Pl. i. 450 (1883), pro parte max. — Newhall, Trees N.E. Am. 76, fig. 38 (1890). — Bebb apud Watson & Coulter, Gray Man. ed. 6, 481 (1890). — Britton & Brown, Ill. Fl. i. 495, fig. 1176 (1896); ed. 2, i. 593, fig. 1454 (1913). — Sargent, Silva N. Am. ix. 121, t. 473 (1896), excl. syn. ex parte; Man. Trees 174, fig. 146 (1905). — Sudworth in Bull. U.S. Dept. Agric. Div. For. xiv. 121 (Nomencl. Arb. Fl.) (1897), excl. syn. ex parte. — Ball in Proc. Iowa Acad. Sci. vii. 145 (1900). — Rydberg in Britton, Man. 313 (1901); Fl. Rocky Mts. 191 (1917). — Fernald in Rhodora, vi. 1 (1903). — Schneider, Ill. Handb. Laubh. i. 29, figs. 12k-k¹, 13 (1904). — Hough, Handb. Trees, 81, figs. 93-94 (1907). — Jones, Willow Fam. 27 (1908). — Robinson & Fernald, Gray's Man. 321, fig. 644 (1908). — Britton & Shafer, N. Am. Trees, 189, fig. 147 (1908). — Small & Carter, Fl. Lancaster Co., Pa., 92 (1913). — Illick in Bull. Dept. For. Pa. xi. 91, t. 29 (Penn. Trees) (1914). — *S. (pentandra) lucida* Andersson in Öfv. Svensk. Vetensk. Akad. Förh. xv. 115 (1858), quoad var. *latifoliam* et *ovatifoliam* pro parte. — The Shining Willow is as Fernald (1903) rightly observed "one of the handsomest and easiest recognized" not only of the New England but of all the American willows. Nevertheless it seems to have been often confused with *S. amygdaloides*, *S. lasiandra* and *S. serissima*, as the limits of its range as outlined on Hough's map (1907) and given by other authors are not borne out by the material I have been able to see and by a careful examination of the statements of different authors. If we commence in the northeast we find as the northeasternmost point of its geographical distribution the valleys of the Exploits and Gander Rivers in Newfoundland. From here the eastern borderline runs south through Nova Scotia to northern New Jersey (Essex and Passaic Counties) and northern Delaware (New Castle County, fide Keller & Brown, Handb. Fl. Philadelphia, 116 [1905]), where it turns to the west along the southern border of Pennsylvania (I do not know of its presence in Maryland and West Virginia or northern Kentucky which regions are included in its range on Hough's map) through central Ohio and the more northern parts of Indiana and Illinois, appearing in Iowa only in Fayette and Chickasaw Counties (see Ball, 1900), and so far as I can ascertain being absent from northern Missouri, northeastern Kansas and Nebraska (where it is indicated by Hough). From South Dakota I know the species only from a specimen collected in the Black Hills (see note on p. 20), and it is not mentioned by Saunders (in Bull. Exper. Sta. S. Dak. LXIV. 132 [1899]), while from North Dakota I have seen nothing but a specimen of Lunell's from the Turtle Mts. in Rolette County, and Lunell (in Am. Midl. Nat. iv. 298 [1916]) mentions no other locality but Willow Creek near Dumseith which is in the same county. Therefore I do not understand why Hough includes not only the whole of South and North Dakota but also the northeast corner of Wyoming and the eastern third of Montana in the *lucida* range. There is likewise no proof that it occurs in Manitoba, Assiniboia,

Saskatchewan, northeastern Alberta, Athabasca and the Northwest Territories as far north as Great Bear Lake. Apparently *S. serissima* and *S. lasiandra* have been taken for *S. lucida* of which the northeasternmost locality from where I have seen material is the Hill (or Hayes) River in Manitoba (R. Bell, August, 1880, No. 24585, fr.; O.). But it seems very rare (or represented by *S. serissima*) in these regions and in western Ontario, becoming frequent to the east of Lake Huron in southeastern Ontario and southern Quebec.

As Fernald has pointed out the typical *S. lucida* in the northeastern part of its range is frequently represented by var. *intonsa* Fernald in *Rhodora* vi. 2 (1903) (*S. lucida* var. *macrophylla* Fernald apud Williams in *Rhodora* iii. 277 (1901), non Andersson) which chiefly differs by the characters indicated in the key, p. 3. In this region occurs besides var. *intonsa* a narrow-leaved form to which the name f. *angustifolia* Andersson has been applied. Andersson published this name in 1858 (in *Öfv. Svensk. Vetensk. Akad. Förh.* xv. 115) as "*S. (pentandra) lucida angustifolia, foliis acuminatis, non cuspidatis,*" and he did not cite a type but he added as a subforma "*— lasiandra Bth.*" In *Proc. Am. Acad. Sci.* iv. 54 (*Salic. Bor.-Am.* 8) (1858), the arrangement differs in so far that we read "*var. angustifolia. — Forma lasiandra (S. lasiandra, Benth. . . .)*" and there is added a "*Forma pilosa*" which in *Öfv. Svensk. Vetensk. Akad. Förh.* xv. 115 (1858) was kept as a variety of the same taxonomic value as *angustifolia*. This f. *pilosa* has nothing to do with the narrow leaved form in question (see p. 16). In 1867 (in *Svensk. Vetensk. Akad. Handl.* vi. 32 [*Monog. Salic.*]) Andersson again kept a variety *angustifolia* but here he made the two forms *rigida* and *tenuis*. What he called *rigida* apparently belongs to *S. serissima* (see p. 13), while f. *tenuis* can hardly be correctly interpreted without type material. Much clearer is Andersson's statement in 1868 (in *De Candolle Prodr.* xvi.² 205) where he says under *S. lucida* "*3° angustifolia foliis anguste lanceolatis, basi subattenuatis, apice vulgo longius attenuatis. Locis alpestribus.*" We may apply this name to the narrow-leaved northeastern form, but in many respects it would be better to propose a new name for it because the application of Andersson's name is far from clear. Such a f. *angustifolia* occurs in the typical *S. lucida* as well as in var. *intonsa*, judging by the material before me. Its obtuser leaves often resemble those of a young plant or of a seedling of the type, while the normal upper leaves may be described as: e basi obtuse cuneata lanceolata, plus minusve sensim longe caudato-acuminata, ad 5:1-10:1.5 cm. magna.

SECT. IV. BONPLANDIANAE Schneider. See *Bot. Gaz.* LXV. 15 (1918). — *S. Harbisonii* with brittle-jointed branchlets needs further investigation and is referred to this section only provisionally.

8. *S. jaliscana* Jones. — See key, p. 4 and Schneider in *Bot. Gaz.* LXV. 16 (1918).

9. *S. Bonplandiana* Kunth. — See key, p. 4 and Schneider, l. c. 17.
- 9b. *S. Bonplandiana* var. *pallida* Andersson. — See key, p. 4 and Schneider, l. c. 19.
- 9c. *S. Bonplandiana* var. *Toumeyii* Schneider, l. c. 20. — *S. Bonplandiana* Sudworth in Bull. U.S. Dept. Agric. Div. For. xiv. 121 (Nomencl. Arb. Fl.) (1897), ex parte, non Kunth. — See key, p. 4. — This willow is often described as "evergreen" but this is not true. It only sometimes keeps part of its leaves until spring, a peculiarity that may be observed in other species, for instance in *S. lasiolepis* in southern California. So far as I know there is no willow that could be called evergreen.
10. *S. laevigata* Bebb in Am. Nat. viii. 202 (1874); in Watson, Bot. Cal. ii. 83 (1879); in Bot. Gaz. xvi. 103 (1891); apud Coville in Contrib. U.S. Nat. Herb. iv. 198 (Bot. Death Valley Exp.) (1892). — Sargent, Rep. For. N. Am. 10 Cens. U.S. ix. 167 (1884); Silva N. Am. ix. 113, t. 468 (1896); Man. Trees N. Am. 171, fig. 143 (1905). — Greene, Man. Bot. San Francisco Bay, 299 (1894). — Parish in Zoë, iv. 347 (1894). — Sudworth in Bull. U.S. Dept. Agric. Div. For. xiv. 120 (Nomencl. Arb. Fl.) (1897), incl. var.; For. Trees Pacif. Slope, 217, fig. 88 (1908). — Ball in Trans. Acad. Sci. St. Louis, ix. 70 (1899). — Jepson, Fl. W. Mid. Cal. 136 (1901); Fl. Cal. i. 339 (1909); in Mem. Univ. Cal. ii. 176, t. 56, figs. 4-6 (Silva Cal.) (1910). — Abrams, Fl. Los Angeles, 100 (1904); suppl. ed., 100 (1911). — Eastwood, Handb. Trees Cal. 37 (1905). — Jones, Willow Fam. 26 (1908). — Britton & Shafer, Trees N. Am. 187, fig. 144 (1908). — Rydberg, Fl. Rocky Mts. 191 (1917). — Schneider in Bot. Gaz. lxv. 21 (1918). — *S. laevigata angustifolia?* Bebb apud Rothrock in Wheeler Rep. vi. Bot. 374 (1878); in Watson, Fl. Cal. ii. 83 (1879). — *S. laevigata* var. *congesta* Bebb, l. c. (1879). — Ball in Trans. Acad. Sci. St. Louis, ix. 71 (1899).

A well-marked species obviously the western counterpart of the eastern *S. longipes*, and closely related to *S. Bonplandiana*. The typical glabrous *S. laevigata* corresponds to *S. longipes Wardii* while the pubescent type of *S. longipes* is analogous to *f. araquipa* of *S. laevigata*. Here, as in the sections previously dealt with, each species seems to develop a pubescent and glabrous form or variety which usually seem to be connected by intermediates. I have tried to indicate the main differences between the species and varieties of this section in the key. Ball (1899) regarded *S. lasiandra* and *S. nigra* as the nearest relatives of *S. laevigata* but apparently he was not, at that time, acquainted with *S. longipes* and *S. Bonplandiana*.

I have seen *S. laevigata* from almost every county in California. In Nevada I have seen it only from Lincoln County (Goodding's Nos. 608 and 636), and it occurs probably also in Ormsby and Washoe Counties, but all I have seen from those parts of the state are rather uncertain forms of partly hybrid origin. The easternmost point of its distribution is in Arizona (Mohave and Yavapai Counties). Rydberg (1917) mentions it also from Oregon and Utah, and I believe it is to be found in southern Oregon and southwestern Utah but I have not yet seen material from those states.

Bebb distinguished two varieties: *angustifolia* and *congesta*. For var. *angustifolia* which he himself calls an "ambiguous variety" he cites as type a specimen of E. L. Greene from Yreka, Cal., which is No. 795, May 18, June 30, August 31 (m., f., fr., st.; C., sheet Nos. 4343 and 4344). I fail to find a good character by which to distinguish it from normal *laevigata* of which, of course, narrow-leaved forms occur, but the type of var. *angustifolia* is in no way "approaching *S. nigra*" as Bebb stated. For var. *congesta* Bebb did not cite a type, but merely said: "Aments short, densely flowered, scarcely exceeding the ample leaves of the peduncle: capsules globose-conical, shortly pedicelled." In Herb. C. (sheet No. 3515) and G. I found Bolander's No. 4632, from New Castle, Placer County, April, 1865, determined by Bebb himself (1877) as var. *congesta*, but I am unable to distinguish this specimen from typical *laevigata*; Ball (1899) referred to var. *congesta* Howell's No. 1393, Kellogg and Harford's No. 925 and Palmer's No. 362. The last I regard as belonging to f. *araquipa*, while No. 925 (Herb. N.) is rather doubtful and looks to me more like a form of *S. lasiandra* with stunted aments. Howell (Fl. N.W. Am. 617 [1902]) has made *S. congesta* a species occurring "along rivulets near the Klamath River and southward," and in his herbarium at Eugene, Oregon, his No. 1393 is designated as the type. It came from Hornbrook, Siskiyou County, northern California, Klamath River region. The material is young, the leaves are not yet sufficiently matured, and they possess some stomata in the upper surface. It looks much like *araquipa*, but needs further observation. Bebb's varieties do not seem to possess any taxonomic value. There is however the pubescent form f. *araquipa* Jepson (Fl. Cal. 339 [1909]. — ? *S. occidentalis* Eastwood, Handb. Trees Cal. 36 [1905], pro parte) within the range of the species, and it apparently prevails in the southern and southwestern parts of the state. The main difference from the type is in the more or less tomentose branchlets of the first and partly also of the second season, and there is hardly another character by which it may be distinguished, for it seems to be connected with the type by many intermediates.

11. *S. longipes* Shuttleworth apud Andersson in Öfv. Svensk. Vetensk. Akad. Förh. xv. 114 (1858). — Glatfelter in Rep. Mo. Bot. Gard. ix. 43, t. 5, fig. 1, t. 6, fig. 1 (Note on *S. longipes*, 1) (1897), pro parte. — Small, Fl. S.E. States, 341 (1903). — Sargent, Man. Trees N. Am. 169, fig. 141 (1905), pro parte. — Hough, Handb. Trees 76 (1907), pro parte. — Britton & Shafer, N. Am. Trees, 186 (1908), pro parte. — *S. occidentalis* Sudworth in Bull. U.S. Dept. Agric. Div. For. xiv. 119 (Nomencl. Arb. Fl.) (1897), non Bosc. — *S. occidentalis longipes* Sudw., l. c., excl. synon., pro parte. — For further synonymy and literature see Schneider in Bot. Gaz. LXV. 21 (1918).

From the synonymy which I (1918) have given, it may be seen that this species was described first by Bosc apud Koch (1828), as *S. occidentalis*, from specimens collected by Sieber "in insula Cuba." I have not seen a type, but there can be no doubt that Poeppig's specimens from Cuba, Prov.

Camaguey, "ad las Pedras," February, 1824, which have been distributed as *S. occidentalis* Bosc represent the typical form of this species. Unfortunately this name cannot be used on account of the older *S. occidentalis* Walter (1788). This Willow is apparently mentioned next in 1824 by Elliott (Sketch Bot. S.-Carol. Georg. II. 671) who says: "We have a remarkable variety of this plant [*S. nigra*], the young branches and leaves pubescent, somewhat hoary, almost tomentose; but I have been able to perceive no other difference either in the shape or size of the leaves of the tree or in the period of flowering." To this willow Nuttall (N. Am. Sylva I. 79 [1843]) refers as follows: "*S. nigra*, Mich. Arb. vol. 2, plate 125, fig. 1. A variety of this tree occurs in South Carolina and Florida in which the leaves are villous and the scales of the ament densely lanuginous. In the herbarium of Mr. Schweinitz it is marked, on the authority of Elliott, as a species *S. subvillosa*." This name has to be regarded as nomen nudum. The next name given to our willow is *S. longipes* Shuttleworth apud Andersson (1858). Andersson describes at the same time a var. *pubescens* with the synonym *S. gongylocarpa* Shuttleworth, and he cites for both: "Hab. prope St. Marks, Florida: Ruel" (corrected in Proc. Am. Acad. IV. 53 [Sal. Bor.-Am. 7] into Rugel). In this publication Gray says in a note to var. *pubescens*: "This is the *S. subvillosa* Ell. in Herb. Schweinitz ex Nutt. N. Am. Sylva, I, p. 79, — a work to which Prof. Andersson had no access, — also mentioned in Ell. Bot. S. Car. & Georg. 2, p. 671, under *S. nigra*." So far as I can see the typical *S. longipes* as well as the type of var. *pubescens* cannot be separated, but represent only extreme states of the same form. In 1858 Andersson made no mention of *S. occidentalis* Bosc but in 1867 (Monog. Salic. 23) he treats it as a separate species, and refers *S. longipes* as a subspecies to *S. nigra* with the varieties *venulosa* and *gongylocarpa*, now using the last name for his var. *pubescens* of 1858. The same treatment is given by him in the Prodrömus in 1868, but here he reduces *S. longipes* to a distinct variety of *S. nigra* with the forms *venulosa* and *gongylocarpa*. In his remarks to *S. occidentalis*, Andersson, in 1867, said that this species "perspectis formis intermediis *S. nigrae*, quas *venulosam* et *gongylocarpam* hic nominavi" is connected with *S. nigra*, and in 1868 he stated that f. *venulosa* is "ad *S. nigram* transitus" while f. *gongylocarpa* is "*S. occidentali* proxima." There is hardly any doubt that *S. occidentalis* from Cuba and *S. longipes* (sensu str.) from Florida cannot be separated even as varieties. The last one has been again described by Chapman (1860) as *S. floridana*¹ and by Small (1913) as *S. amphibia*. Andersson's f. *venulosa* represents a different form with which I have to deal later.

According to the material I have seen the range of typical *S. longipes* extends from Cuba to northern Florida from which state I have examined specimens from the following counties (south to north): Monroe, Dade, Lee, Brevard, Lake, Volusia, Taylor, Wakulla, Franklin, Columbia, Duval, Palm Beach, and from Folkston, Charlton County, in adjacent south-

¹ *S. floridana* Small, Florida Shrubs 9 (1913), with 2 stamens is unknown to me, and I do not know whether or not it represents Chapman's species.

eastern Georgia. In northern Florida (Franklin, Wakulla, Leon, Gadsden, Jefferson, Duval Counties), in Georgia (Charlton and Richmond Counties), South Carolina (Aiken, Charleston and Saluda Counties), in eastern North Carolina (Craven County) and in the southeastern corner of Virginia (Norfolk County at Dismal Swamp) *S. longipes* is represented by a somewhat uncertain form which I at present cannot separate from what I call var. *venulosa* from the west. (See also my remarks under *S. Harbisonii* below); while north of the 36th parallel and in the central states var. *Wardii* takes the place of the typical form. The separation of these three varieties is by no means easy, and it needs well collected material properly to determine each of them.

11b. *S. longipes* var. *venulosa* Schneider in Bot. Gaz. LXV. 14 (1918). — *S. Pitcheriana* Barratt, Salic. Am. No. 22 (1840), nomen nudum, secundum specimen originale. — ? *S. nigra* **S. marginata* Andersson in Svensk. Vetensk. Akad. Handl. VI. 21 (Monog. Salic.) (1867). — ? *S. marginata* Wimmer in Herb. Vindob. ex Andersson, l. c., pro synonym.; Small, Fl. S.E. States 341 (1903), ex parte. — *S. nigra* *** *S. longipes venulosa* Andersson in Svensk. Vetensk. Akad. Handl. VI. 22 (Monog. Salic.) (1867). — *S. podocarpa* Engelmann MS. in Herb. Gray, confer Andersson, l. c. 22. — ? *S. nigra a. marginata* Andersson in De Candolle, Prodr. XIV. 201 (1868). — *S. nigra* γ *longipes* 1° *venulosa* Andersson, l. c. — Heller in Contrib. Herb. Frankl. & Marsh. Coll. I. 26 (Bot. Expl. S. Tex.) (1895). — *S. occidentalis* var. *longipes* Bebb in Gard. & For. VIII. 363 (1895), ex parte. — Sudworth, in Bull. U.S. Dept. Agric. Div. For. XIV. 119 (Nomencl. Arb. Fl.) (1897), ex parte. — *S. nigra* Heller in Contrib. Herb. Frankl. & Marsh. Coll. I. 26 (1895), sec. spec. citat. No. 1621, non Marsh. — *S. longipes* Glatfelter in Rep. Mo. Bot. Gard. IX. 43, t. 6, fig. 4 (1897), pro parte, non Shuttleworth. — Small, Florida Shrubs, 9 (1913), pro parte.

As may be imagined from the synonymy the history of this variety is a rather complicated one. It was first mentioned by Barratt as follows: "22. *Salix Pitcheriana* *Barratt, MSS. Hab. Arkansas. — Dr. Pitcher. Sea Islands of Georgia. This undescribed species is allied to *S. nigra*. I possess specimens which have been obligingly communicated by John Carey, Esq., of New York. This willow is killed by the winters of the Northern States." According to this *S. Pitcheriana* is a nomen nudum. I have seen co-types in Herb. G. and N., "raised from cuttings sent from Georgia to Mr. Carey." The name *S. marginata* Wimmer which is the next oldest one, was founded on a specimen of Drummond's "ad New Orleans America borealis" in Herb. Vindob. I have not yet seen the type but I have no doubt that Drummond's No. 303, New Orleans 1832, in Herb. N. can be regarded as a co-type. It seems to me to be referable to var. *venulosa*, but the ovaries of the New York specimen are partly pilose, and Wimmer's form needs further observation. Small has used the name *S. marginata* "Weimer" for a species which in my opinion partly belongs to *S. Harbisonii*. When Andersson in 1867 first described his f. *venulosa* he did not cite a type, but only said: "Hab. in Nova Mexico," but in 1868 he

cites "Wright n. 1879." This number, in all probability, did not come from New Mexico but from the banks of the Rio Grande in Texas or further north¹. I have seen two sheets of this number (in Herb. G. and N.) and there can be no doubt that *f. venulosa* Andersson has nothing to do with *S. nigra*. It represents, in my opinion, a distinct variety of *S. longipes* which has been named *S. podocarpa* by Engelm. in Herb. G. (on a sheet of Lindheimer, from the Pedernales River, Texas, 1847). This name has never been rightly published and was only mentioned by Andersson (1867). I have seen good material of var. *venulosa* from the following counties of southern and central Texas: Uvalde, Bandera, Kerr, Gillespie, Kendall, Blanco, Hood, Johnson, and as I said before, I refer to this variety forms from the southeast as indicated under *S. longipes* on p. 26. If Drummond's *S. marginata* from New Orleans in Louisiana should really belong to var. *venulosa*, this station would form a connecting link between the otherwise rather widely separated ranges. The var. *venulosa* should be looked for along the coast from eastern Texas to western Florida. I am still very badly acquainted with the *Salix* flora of this region because there is but little material at my disposal, and I can get no reliable information from existing Floras.

There are Texan specimens before me which much resemble var. *Wardii*, but if we take the shape of the stipules as a character of decisive taxonomic value, we have to refer all the material from Texas to var. *venulosa* which has the pointed stipules of typical *longipes*. See also my remarks under the following variety.

11c. *S. longipes*, var. *Wardii* Schneider in Bot. Gaz. LXV. 22 (1918). — *S. cordata* 2. *S. angustata discolor* Andersson in Svensk Vetensk. Akad. Handl. VI. 159 (1867), sec. specim. in G. a cl. Andersson determ. — *S. cordata* β , *angustata* 1^o *discolor* Andersson in De Candolle, Prodr. XVI.² 252 (1868). — *S. nigra* var. *Wardii* Bebb apud Ward in Bull. U.S. Nat. Mus. XXII. 114 (Guide Fl. Wash.) (1881); apud Watson & Coulter, Gray Man. ed. 6, 481 (1890). — *S. Wardii* Bebb in Gard. & For. VIII. 363 (1895). — Glatfelter in Science, n. s. II. 582 (1895). — Britton & Brown, Ill. Fl. I. 495, fig. 1174 (1896); ed. 2, I. 593, fig. 1453 (1913). — Sargent, N. Am. Silva, IX. 107, t. 464 (1896). — Gattinger, Fl. Tenn. 66 (1901). — Mohr in Contrib. U.S. Nat. Herb. VI. 465 (Pl. Life Ala.) (1901). — Robinson & Fernald, Gray's Man. 321, fig. 641 (1908). — Shreve & others, Pl. Life Maryland, 423 (1910). — *S. longipes* Glatfelter in Rep. Mo. Bot. Gard. IX. 43, t. 5, figs. 3-4, t. 6, figs. 3, 5, 8-10; t. 7, figs. 1-6 (1897), pro parte, non Shuttlew. — Rydberg in Britton, Man. 313 (1901), pro parte. — Small, Fl. S.E. States, 341 (1903), pro parte. — Sargent, Man. Trees N. Am. 169 (1905), pro

¹ The specimen in Herb. G. is expressly marked as collected in 1851. According to Gray (in Am. Jour. Sci. ser. 3. XXXI. 13 [1886] in Sargent, Sci. Papers Gray, II. 469 [1889]). Wright went in the spring of 1851, after having remained more than a year in central Texas, with Col. Graham's party to the border between Mexico and the United States. "He returned with him without reaching farther westward than about the middle of what is now the territory of Arizona." The specimens were probably collected in June in the southern parts of central Texas where var. *venulosa* seems to be very abundant.

parte. — Hough, Handb. Trees 76, figs. 89-90 (1907), pro parte. — Britton & Shafer, N. Am. Trees, 186 (1908), pro parte. — Ball in Elys. Mar. III. 21 (1910), pro parte. — This variety has been well treated by Glatfelter (1897) who, however, did not separate it from the typical *S. longipes*. The following statement of this excellent observer has certainly not lost anything of its value since he wrote it 21 years ago: "Whether or not *S. longipes* should be divided into several forms or varieties is a question, owing to insufficient accumulation of material, not yet determinable. In view of what we know at the present day of the instability of some of our species of Willows, it does not seem to fill the present demands of the scientific idea, to set up a number of forms from a limited number of herbarium specimens, and, besides, incomplete as we often find them. Without careful observations, such work must inevitably prove defective. The plant must be seen in its habitat and in quantity before a just conception of all its characters can be formed. In this way the supposedly good form will often vanish, to be supplanted by easily recognizable variations." Glatfelter did not have very copious material of the typical *S. longipes* at his disposal, neither was he well acquainted with the forms I refer to var. *venulosa*. So far as I can see, these varieties inhabit different geographical areas which, however, meet together in certain regions, and it is mostly in these that we may observe intermediate forms. The range of var. *Wardii* is not yet sufficiently known. The type was found by Ward near Washington, D.C., where it apparently reaches the most northern point of its distribution. The northern borderline thenceforward runs along the Potomac River to Allegany County, Maryland. The next station from which I have seen a specimen is Upshur County in W. Virginia, and it has been reported from Lexington in Fayette County, Kentucky. I have not yet seen specimens or reports of it from West Virginia, Ohio, or Indiana. In Illinois it was collected in St. Clair and Madison Counties, and it seems to show its best development in Missouri, from which I have seen specimens from the following counties: (east to west) Marion, Ralls, Pike, St. Louis, St. François, Madison, Iron, Washington, Phelps, Shannon, Carter, Howell, Wright, Christian, Taney, Stone, McDonald, Newton, Jasper, Jackson. In Kansas I have seen it only from the southeast corner (Cherokee County), a specimen from the Kiowa County being doubtful. From Oklahoma I have had specimens before me from Ottawa, Drage, Rogers, Creek and La Flore Counties in the northeast and east, while those from Comanche County in the southwest may probably better be referred to var. *venulosa*. The southern borderline of its range apparently runs from La Flore County in Oklahoma through adjacent western Arkansas (Howard County) and northwestern Arkansas (Benton and Carroll Counties) and southern Missouri, and northern Tennessee (Davidson and Robertson Counties); it has been collected by Harbison as far south as northeastern Mississippi (on the Tennessee River, near Iuka, Tishomingo County), and Mohr cites it from the northwestern corner of Alabama (Lauderdale County, Tennessee River). Farther to the east I have seen var. *Wardii* from Natural Bridge, James

River, Rockbridge County, Virginia. It also occurs in Fairfax County and Elizabeth County (near Buckroe), Virginia, and it is possible that the form mentioned under var. *venulosa* from Norfolk County (Dismal Swamp) belongs to var. *Wardii* or that both varieties meet in the southeastern corner of Virginia.

The best way to distinguish var. *Wardii* is by the obtuse stipules, all the other characters are apparently too unstable, but, of course, the extremes of each variety seem to be distinct. Collectors should look for var. *Wardii* in the southern part of Ohio, Indiana and Illinois as well as in different parts of West Virginia, western Virginia, Tennessee, northern Alabama, northern Missouri and Arkansas.

12. *S. Harbisonii*, sp. nov. — *S. marginata* Small, Florida Shrubs, 9 (1913), non Wimmer. — *S. nigra* Harper in Sixth Ann. Rep. Florida Geol. Surv. 401 (1913), ex parte, non Marshall. — Frutex (fide cl. Harbison) plerumque altus vel arbor ad 10–14 m. alta, trunco ad 30 cm. crasso cortice sulcato rugoso interdum squamato vestito, ramulis fragilibus; ramuli plerumque ab initio glabri vel novelli tantum satis sparse pilosi (sed interdum novelli ut in *S. longipede* dense breviter tomentosi), hornotini glabri, olivacei vel ut annotini obscure purpurascens vel rubro-fusci, vetustiores fusco-cinerascentes; gemmae bene evolutae nondum visae; folia matura papyracea, in typo infima minora linearia, lanceolata, elliptico-lanceolata, rarius latiora obovato-lanceolata, 1:0.2 ad 2.5–3.5:1 cm. magna, vel in aliis speciminibus majora oblanceolata ad 5:1.5 cm. magna, basi acuta ad rotundata, apice acuta ad breviter acuminata, superiora majora (normalia) anguste vel lineari-lanceolata, ad 5:1 vel 7:0.9 vel ad 10:1.6 cm. (interdum ad 13:2.7 vel in Harper No. 1499 ad 15:2 cm., basi obtuse cuneata, ab infra medium ad apicem sensim acuminata) magna, basi obtuse vel acute cuneata, apice plus minusve acuminata et saepe breviter caudata, margine satis dense breviter glanduloso-serrato-denticulata (vel in Harper No. 1499 subserrulata), dentibus circ. 3–4 pro 5 mm., superne ab initio (costa saepissime puberula vel tomentella excepta) glabra, intense viridia, ut in *S. nigra* nervata reticulataque, sed in epidermide haud stomatifera vel stomatibus sparsis (rarius numerosis) tantum secundum costam praedita, subtus ab initio glaberrima vel in costa plus minusve sericeo-pilosula (surculorum interdum distinctius pilosa), inferiora plus minusve, superiora distincte glaucescentia, pruinosa, costa flavescens plus minusve elevata, ceterum ut superne graciliter nervata et angustissime reticulata; petioli 2–10 mm. longi, superne sulcati et plus minusve tomentelli, ceterum glabri, flavescens, apice (basi folii) saepe minute glanduliferi; stipulae nullae vel minimae, semicordatae, acutae, glanduloso-denticulatae vel in ramis vegetioribus (Harbison, No. 17, Goldsboro, N.C.) semicordatae, ad 10 mm. longae, acutae, intus interdum pauci-glandulosae et pilosulae (in speciminibus paucis satis semicordato-subrotundae 2–5 mm. longae intus eglandulosae et iis *S. longipes* var. *Wardii* non absimiles). Amenta serotina, pedunculis initio pilosis demum saepe glabrescentibus 5–25 mm. longis foliatis

suffulta, rhachi villosula; mascula subdensiflora, pedunculo vix ad 1 cm. longo excluso demum vix ultra 6:1 cm. magna, vulgo leviter arcuata; bracteae ovatae vel ovato-oblongae, obtusae vel subacutae, flavescentes, venosae, utrinque breviter villosae vel extus ad apicem plus minusve glabrae; stamina vulgo 5-7 (rarius 3 vel 9), filamentis $1\frac{1}{2}$ -1 $\frac{1}{3}$ dense villosis bractea demum subduplo longioribus, antheris flavis parvis globosis; glandulae 2, ventralis pleraque late ovato-rhombica, truncata vel subrotundata, dorsalis pleraque irregulariter (2-)3-partita (saepe digitata); amenta feminea sub anthesi circ. 3-5 : 0.7 cm., fructifera pedunculo ad 10-15 mm. longo excluso 5-7:1.5 cm. magna, satis laxiflora; bracteae ut in floribus masculis vel plerumque magis lanceolatae acutiores; ovaria ellipsoideo-conica, glaberrima; styli distincti sed brevissimi (vix ad 0.4-0.5 mm. longi), apice vulgo divaricato-bifidi, stigmatibus minimis emarginatis pro sectione typicis; pedicelli graciles, sub fructu 2-3 mm. longi; glandula 1, ventralis, late ovata, apice truncata vel rotundata, basi semiamplectens, quam pedicellus initio 2-3-, dein 4-6plo brevior; fructus maturi e basi subacuta ad subrotunda ellipsoidei, plus minusve rostrati, pedicello excluso (5-)6 mm. longi.

TYPE LOCALITY: Savannah, Chatam County, Georgia.

SPECIMENS EXAMINED: GEORGIA. Chatam County: Savannah, in border of swamp, April 5, 1918, *T. G. Harbison* (No. 5, f., fr., type; A.; "wide-spreading tree 30 ft. tall and 10 in. in diameter; bark rough and scaly in thick narrow ridges; twigs brittle-jointed"; folia superne ut videtur estomatifera); on ditch bank, same date, *T. G. Harbison* (No. 2, m., syntype; A.; "small brittle-jointed shrub"). Charlton County: Trader's Hill, on bank of St. Mary's River, Aug. 11, 1902, *R. M. Harper* (No. 1499, st.; N.; foliis ad 14:2 cm. magnis satis serrulato-denticulatis subtus paulo glaucescentibus, stipulis distinctis); April 3, 1918, *T. G. Harbison* (Nos. 1, fr. juv., 2, m.; A.; "small tree; bark rough; twigs brittle-jointed"; stomata in foliis superne tantum pauca ad costam visa). Richmond County: Augusta, on river bank, April 6, 1918, *T. G. Harbison* (No. 7, f.; A.; "large tree; bark rough and scaly; twigs brittle-jointed"; stipulis minimis acutis, foliis juvenilibus sed subtus leviter glaucescentibus); in swamp near the river, April 6, 1918, *T. G. Harbison* (Nos. 8, m., 9, f.; A.; "large scaly barked shrub"; in specimine femineo stipulae plus minusve evolutae semicordato-subrotundae, obtusae, 2-5 mm. longae iis *S. longipes Wardii* non absimiles; forma porro observanda); in swamp, same date, *T. G. Harbison* (No. 4, m.; A.; "large shrub or small tree; bark shallowly furrowed; twigs brittle-jointed"; forma porro observanda). Stephens County: Toccoa, along creek, April 10, 1918, *T. G. Harbison* (No. 3, m.; A.; "small tree; bark shallowly furrowed; twigs brittle-jointed"). Decatur County: Bainbridge, on bank of Flint River, March 28, 1918, *T. G. Harbison* (Nos. 1, m., 2, f.; A.; "a straggling tree 40 ft. tall and 10 in. in diameter; bark scaly; twigs brittle jointed"; this form may be referable to the form of *S. nigra* mentioned on p. 6); on river bank, March 28, 1918, *T. G. Harbison* (No. 3, f.; A.; "a tree nearly a ft. in diameter and 35 to 40 ft. tall; bark rough, furrowed and scaly; twigs very brittle-jointed"; folia juvenilia subtus, satis glaucescentia); Climax, in swamp, March 28, 1918, *T. G. Harbison* (Nos. 1, f. [satis ad *S. nigram* spectans], 2, m.; A.; "tall upright shrub with brittle-jointed twigs"; omnibus partibus juvenilibus satis griseo-tomentosis, foliis subtus glaucescentibus).

FLORIDA. Franklin County: Apalachicola, on edge of swamp, March 26, 1918, *T. G. Harbison* (No. 9, m.; A.; "small shrub 5 ft. tall"; forma foliis juvenilibus porro observanda).

SOUTH CAROLINA. Aiken County: Hamburg, along Savannah River, September 24, 1913, *J. Tidestrom* (No. 6950, st.; M.). Beaufort County: Yemassee, open moist ground, April 22, 1917, *C. F. Batchelder* (fr. im.; stomata superne sparsa). Charleston County: Charleston, in low ground, April 8, 1918, *T. G. Harbison* (Nos. 1, f., 2, m.; A.; "small slender tree; bark shallowly furrowed; twigs brittle-jointed"; omnibus partibus juvenilibus tomentosis); in swamp, same date, *T. G. Harbison* (No. 3, fr. im.; A.; "small tree; twigs brittle-jointed; bark furrowed but not scaly; omnibus partibus multo magis glabrescentibus quam in no. 1-2; stomata superne in foliis non visa; No. 4, m.; A.; "small tree, twigs brittle-jointed"; agrees well with type; No. 5, m.; A.; "large shrub; twigs brittle-jointed"; ut praecedens; No. 7, m.; A.; "shrub 6 ft. tall; bark smooth; twigs brittle-jointed"; ut praecedens); Isle of Palms, May 30, 1902, *C. R. Ball* (No. 56, st.; O.; "12 ft."; stomata superne pauca ad nervos, folia ad 13: 2.5 cm. magna, petiolis 6-9 mm. longis). Georgetown County: Georgetown, in low ground, April 26, 1918, *T. G. Harbison* (No. 5, fr.; A.; "tall shrub; twigs brittle-jointed").

NORTH CAROLINA. Wayne County: Goldsboro, in low ground, June 8, 1918, *T. G. Harbison* (No. 17, st.; A.; "small tree"; folia ad 12: 2.6 cm. magna, superne stomatibus subnumerosis praedita; stipulae semicordatae plus minusve acutae, intus glanduliferae). Columbus County: swamps, June, 1895, *W. W. Ashe* (No. 1325, st.; C.; forma incerta).

VIRGINIA. Smyth County: about Falls of Holston River, 700 m., June 8, 1892, *J. K. Small* (fr.; A., C., M.; forma satis ad *S. Harbisonii* accedens). Norfolk County: borders of Dismal Swamp. May 16, 1877, *Th. Morong* (m., fr. im.; N.; forma porro observanda, ad *S. longipedem* accedens, sed folia superne sparse stomatifera).

The specimens referred by me to *S. Harbisonii* look, at the first sight, very much like *S. longipes* (especially var. *venulosa*). I would have taken them for this species if it were not for the brittle-jointed twigs. Besides this the presence of stomata on the upper side of the leaf, and the minute glands on the inner surface of the stipules induced me to describe a new species. After all, however, it seems hardly possible to draw a sharp line between it and *S. longipes venulosa* which has been collected in almost every locality where *S. Harbisonii* is found. I first thought that these forms might represent hybrids between *S. longipes* and *S. nigra*, a fact that would easily explain the brittle-jointed twigs, the presence of the stomata in the upper surface of the leaves, and of the glands on the stipules. *S. nigra* is, however, known only from a few of the localities where *S. Harbisonii* is growing, and this species seems to be the prevailing one in most of the places where it is found. It cannot be regarded as a mere variety of *S. longipes* on account of the brittleness of the twigs, even if we would lay no stress upon the presence of the stomata which after all seems to be a rather important taxonomic character. *S. Harbisonii* certainly needs a closer study in the field, and a final statement as to its specific value or hybrid origin can only be made when we have become much better acquainted with those forms of *S. nigra* which I have enumerated on p. 8. *S. nigra* may be more frequent than we have reason to believe now, and if it should be found together with *Harbisonii* the hybrid origin of this species could be easily understood.

I shall be glad to receive material of all the doubtful forms of the

Pleonandrae which I have mentioned, but it is necessary to collect from the same plant at different times, because only well-collected material will be sufficient to make more definite statements possible. Besides this it is very important that the collector make notes with regard to the habitat, the habit, the associated species of *Salix*, and whether the branchlets are more or less brittle or tough at the joint. The last character seems to be of great taxonomic value for the separation of the tough-jointed *Bonplandianae* from the very brittle-jointed *Nigrae* and the (more or less) brittle-jointed *Lucidae* and *Amygdalinae*.

A PHYTOGEOGRAPHICAL SKETCH OF THE LIGNEOUS FLORA OF KOREA

E. H. WILSON

KOREA, or Chosen, as it is now designated by the Japanese, is a peninsula bounded on the east by the Japan Sea, on the south and west by the Yellow Sea, and on the north by Manchuria and the Primorsk province of eastern Siberia from which it is separated by the Yalu River, Paiktu mountains and the Tumen River. Until quite recently it was styled the "Hermit Kingdom" by peoples of western lands and it had little or no intercourse with the outside world. The whole peninsula (including adjacent islands) is confined within Lat. $33^{\circ} 12'$ and $43^{\circ} 02' N.$ and Long. $124^{\circ} 13'$ and $130^{\circ} 54' E.$ and has a total area of 84,173 square miles (English). Geologically speaking nearly four-fifths of Korea is of granites and highly metamorphosed rocks of Pre-Cambrian age. In the central parts between Lat. 38° and $40^{\circ} N.$ and stretching almost from sea to sea is an area of Paleozoic rocks, chiefly mud-shales, slates, and a little limestone; in the southeast is an area of Mesozoic limestones with intrusive porphyritic rocks and isolated outcroppings of this combination of rocks obtrudes itself in other parts of Korea. Basalt underlies much of the peninsula and in the volcanic areas — Paiktu mountains, highlands south of Gensan, the islands of Quelpaert (Sai-shu-to) and Dagelet (Ooryöngtō) — it has been forced to the surface and is surmounted by trachyte lavas. Each of these geological formations has certain plants peculiar to it. For example, Larch (*Larix dahurica* var. *Principis-Rupprechtii* Rehd. & Wils.) grows only on the recent volcanic soils of the Paiktu region and there forms vast forests; a Birch (*Betula Schmidtii* Regel), one of the most valuable of Korean hardwood trees, is confined to the granites and metamorphic rocks; a Lilac (*Syringa dilatata* Nakai) is found only on the paleozoic rocks of north-central Korea. The climate is the best in the Far East and the country is destined to become the health resort of the Orient. It is essentially continental in character but in the extreme south and east-southeast, near the coast it is moderated by the influence of the Japan current — a warm ocean stream similar to our Gulf Stream. On Quelpaert Camphor and Orange trees grow at sea-level and the temperature there seldom falls below the freezing-point; in the

extreme north in the valleys of the Yalu and Tumen rivers it falls as low as twenty below zero Fahrenheit — that is 52° F. of frost; round Keijyo or Seoul, the capital of Korea, the rivers freeze solid or nearly so and in winter all vehicular traffic crosses the ice where bridges are not available.

Korea is a very mountainous country; there are no plateaus nor plains worthy of the name and the only flat land is confined to narrow valleys and estuaries of the rivers. The mean height of the broken country is from 300 to 600 m. and that of the mountains from 1000 to 1800 m.; the highest peak is Paiktu-san 2700 m. but there are many about 2000 m. high. Agriculture is the staple industry of the people and the whole of the most fertile soils in the most accessible and climatically best parts of the country have been brought under cultivation. Since the winters are very cold much fuel is necessary and unfortunately coal is found in one or two places only and the people are almost entirely dependent upon wood for fuel. These two facts, and more especially the absence of coal, have been mainly responsible for the disappearance of the forests from the greater part of the peninsula. It is true that in the extreme north, which is very difficult of access and the population very sparse, magnificent forests of great extent remain and on mountains, like the Diamond Mts. where Buddhist monks have managed to maintain their influence and round royal tombs the vegetation has been very little disturbed, but over fully two-thirds of the whole country the forests have been destroyed and where no cultivation is to-day attempted coarse grasses, shrubs and scrub Pine are all that remain. These constitute the chief fuel supply of the country. The scrub Pine is *Pinus densiflora* S. & Z. and this has been extensively planted both under the old Korean régime and by the present Japanese government and to the casual observer appears to be almost the only tree in the country. It is hacked and maimed annually to supply fuel yet it manages to maintain itself under the most adverse conditions, in the poorest of soils and on the barest of rocks; where left alone it develops into tall, handsome trees. From the railway which traverses the country from southeast to northwest the impression left on the minds of nearly all travellers is of treeless, scrub and grass clad hills, bare rocks, low scrub Pine scattered over mountain-slopes with patches of cultivation in the valleys. In winter when the crops are harvested and the grass is shorn and brown, the whole countryside looks cold, drab and cheerless. However, a more intimate acquaintance, a closer study, will show that, in spite of the naked appearance in winter and the marked absence of trees from accessible areas and routes, Korea can really boast a fairly extensive flora comparatively rich in trees, shrubs, and in herbs having conspicuous and beautiful flowers. Compared with that of its neighbours, China and Japan, the flora of Korea is much less rich and varied, yet in individuals of striking merit it has many claims, and these none the less strong for remaining virtually unknown until quite recently. For, although small collections have been made from time to time since 1854, when Baron Alexander Schlippenbach gathered the first plants in Korea, no real investigation of the flora had been undertaken prior to the country's annexation

by Japan in 1910. Since that date the Government-General has systematically undertaken an investigation of the natural resources of Korea and the botanical work is in the hands of Dr. T. Nakai. So far 2,822 species, varieties and forms, belonging to 780 genera, representing 151 families, have been recorded, but the work is by no means completed. About one-fourth of these are woody. Most of the families which occur in Japan, north China and northeast Asia are present but often much reduced in number of representatives. For example:—the family of *Magnoliaceae* is represented by two genera (*Magnolia*, *Schisandra*) with three species. The most prominent family that is missing is *Hamamelidaceae*. A genus that one might expect to be present and which is not is *Cercidiphyllum*.

Now whilst the seas are natural phytogeographical barriers the political boundaries of Korea, — i.e. the Yalu and Tumen rivers and the Paiktu mountains — are not and the flora is essentially part of that of the great region of northeast Asia including Manchuria and the northernmost parts of China proper as far west as Mt. Wutai in Shansi province. Of woody plants at least one genus (*Pentactina*) and a limited number of species (*Viburnum Carlesii* Hemsl., *Cornus officinalis* S. & Z., *Forsythia ovata* Nakai and a few others) are endemic, quite a number such as *Abies holophylla* Maxim., *Rhododendron Schlippenbachii* Maxim. do not cross the Yalu watershed to the plains of Manchuria, but the majority are widespread on the continent of northeast Asia and many cross to Hokkaido and to northern Hondo in Japan proper. Of the latter mention may be made of *Alnus japonica* S. & Z., *Rhododendron brachycarpum* G. Don, *Styrax obassia* S. & Z. Further, a few species, including five (*Quercus glandulifera* Bl., *Q. aliena* Bl., *Q. dentata* Thunb., *Q. serrata* Thunb., *Q. variabilis* Bl.) of the six species of deciduous leafed Oaks, are widely distributed in China and Japan. The two volcanic islands, Quelpaert off the extreme south, and Dagelet off the east coast, in the Japan Sea, are peculiar. The first-named, with its peak, Hallai-san, 1952 m. high, has largely a Japanese flora, and is marked by the presence of broad-leaf evergreens in great variety. A few species, for example, *Maackia Fauriei* Nakai, are possibly endemic and pure woods of Hornbeam (*Carpinus laxiflora* Bl. and *C. Tschonoskii* Maxim.), with *Daphniphyllum macropodum* Miq. and *Taxus cuspidata* S. & Z. as conspicuous undergrowths are a characteristic feature between 1000 m. and 1300 m. Such woods are unique in the Orient. The trifoliolate Orange (*Poncirus trifoliata* Raf.) is indigenous, growing in the beds of torrents or among boulders; nowhere else in my travels have I seen this plant truly wild. No species of *Spiraea*, *Deutzia* nor *Philadelphus* grows on Quelpaert, yet they are common shrubs on the mainland. On the other hand, *Hydrangea petiolaris* S. & Z., *Schizophragma hydrangeoides* S. & Z. and *Ostrya japonica* Sarg., unknown on the mainland, are common on this island. Two other very common plants are *Rhododendron Weyrichii* Maxim. and *R. poukhanense* Lév.; the first named does not grow elsewhere in Korea whereas the latter is widely spread through the peninsula. Such typical Japanese trees as *Pinus Thunbergii* Parl., *Torreya nucifera* S. & Z., *Myrica rubra* S. & Z. and *Machilus Thunbergii*

S. & Z., *Magnolia kobus* DC. are indigenous in Quelpaert but grow nowhere else in Korea. The Fir on the island is an undescribed species, similar in habit to *Abies Veitchii* Lindl., has cones like *A. sachalinensis* Mast., but less resinous, and bark like that of *A. nephrolepis* Maxim. It just crosses to the mainland but finds its northern range on Chiri-san about Lat. 35° N. The Chiri range is interesting phytogeographically since it is the southern limit of such characteristic Korean plants as *Rhododendron Schlippenbachii* Maxim., *Pinus koraiensis* S. & Z., *Abies holophylla* Maxim., *A. nephrolepis* and the widely spread *Picea jezoënsis* Carr. and *Alnus hirsuta* var. *sibirica* Schneid.; also it is the only region in Korea where grow *Stewartia pseudocamellia* Maxim. and *Rhododendron Tschonoskii* Maxim., two typical Japanese plants.

The flora of Dagelet Island is most singular, being much more closely related to that of Japan than to that of Korea. The Japanese *Pinus parviflora* S. & Z. and Hemlock, *Tsuga Sieboldii* Carr., find their western limits on this island and woods of a Beech (*Fagus multinervis* Nakai), considered endemic, are a feature of the forests high up on the mountains. No Beech grows on the mainland of eastern Asia nor in China until the province of Hupeh is reached. Among other endemic species worthy of mention are *Acer Okamotoi* Nakai, *Abelia coreana* Nakai, *Sambucus pendula* Nakai, *Cotoneaster Wilsonii* Nakai. The Keaki, *Zelkora serrata* Mak., common to Japan and Korea is also indigenous on Dagelet Island and so, too, is *Pinus densiflora* S. & Z. The Chinese Juniper (*Juniperus chinensis* L.) is wild on the sea cliffs and has huge trunks though the trees are not tall. The lovely *Viburnum Charlesii* Hemsl., a littoral species, also is indigenous, but has so far not been found on the contiguous east coast of Korea although it grows in one or two localities on the west coast and on Quelpaert. These two insular outposts of the Japanese flora are the more remarkable when it is remembered that although both are volcanic their basalt and trachyte lavas prove that they belong to the Korean and not to the Japanese system of volcanoes.

Omitting the foregoing anomalies the flora of Korea is specifically and markedly different from that of Japan and China. Yet though species are limited, genera are well represented, and the small size of the country, its severe climate, and the destruction wrought during centuries of deforestation duly considered, it compares not unfavorably with that of contiguous and adjacent regions of the same latitudes. The whole flora of the Korean peninsula is essentially boreal in character and its outstanding feature is the almost complete absence of broad-leaf evergreens. Of these fifteen species, *Zanthoxylum alatum* var. *planispinum* Rehd. & Wils., *Ilex cornuta* Lindl., *Eronymus radicans* Sieb., *Buxus microphylla* var. *coreana* Nakai, *Rhododendron brachycarpum* G. Don, *R. micranthum* Turcz., *R. chrysanthum* Pall., *R. parvifolium* Adams, *R. confertissimum* Nakai, *R. Redowskianum* Maxim., *Ledum palustre* L., *Vaccinium Vitis-idaea* L., *Phyllodoce coerulea* Bab., *Empetrum nigrum* L. and *Sasa spiculosa* Mak. only are found there. The first six are confined to central and southern Korea, the Sasa, although

widespread, is nowhere very abundant, the others are alpine plants and grow only in central and northern Korea. Except the social, alpine plants and the *Sasa* these broad-leaf evergreens are local in their distribution, few in numbers and nowhere a conspicuous feature of Korean vegetation. Mistletoe both with a greenish white and reddish fruit is a pest everywhere.

The deciduous broad-leaf trees which compose the woods and forests belong to familiar northern genera and include several species each of Willow, Alder, Birch, Poplar, Hornbeam, Elm, Oak, Maple, Cornel, Nettle Trees, and one or two each of Cherry, Bird Cherry, Crab Apple, Wild Pear, Ash, Walnut, Sweet Chestnut, Spiny Elm, Honey Locust, Linden, Apricot, *Sophora*, *Koelreuteria*, *Phellodendron* and the *Keaki*. The woods and forests of these trees are left on steep, rocky mountains unsuited to agriculture and where the soil is poor, so they are not large when compared with their congeners in America, Europe or Japan. Occasionally, when for religious or sentimental reasons groups of trees or individuals have been allowed to remain in valleys and by roadsides, good specimens may be seen, but in general Korean broad-leaf trees are small and their timber of less value than that of the same species from Manchuria or Hokkaido. The largest of these Korean trees is *Populus Maximowiczii* Henry which in the sparsely peopled north is often 100 ft. tall with a trunk 20 ft. in girth. A Black Ash (*Fraxinus mandshurica* Rupr.) ranks next but I have seen in Hokkaido far larger trees of this species, and logs rafted down the Yalu from its Manchurian tributary show that in Manchuria it is also a larger tree. The Mongolian Oak (*Quercus mongolica* Fisch.) probably ranks third in size but on a part of the Diamond Mts. only did I see any really noteworthy examples of this Oak. The most widely distributed trees are *Quercus mongolica* Fisch., *Betula Ermanii* Cham., and *Prunus serrulata* var. *pubescens* Wils. which are common from Quelpaert to the Manchurian border and northward. Almost as common are *Alnus hirsuta* var. *sibirica* Schneid., *Populus tremula* var. *Davidiana* Schneid., *Betula davurica* Pall., *B. japonica* Sieb., *Quercus dentata* Thunb., *Phellodendron amurense* Rupr., *Ulmus japonica* Sarg., *Acer pictum* Thunb., *Salix koreensis* Anderss. and *Maackia amurensis* Rupr. & Maxim. Trees with the least distribution are *Cornus officinalis* S. & Z., and *Sophora japonica* L., which are spontaneous on a mountain slope about thirty miles northeast from Keijyo and are found wild nowhere else in Korea. The genus *Salix* is richest in species and some like *S. nobilis* Nakai, *S. cardiophylla* Trautv. & Mey. and *S. koreensis* Anderss. are large and handsome trees; *Betula* and *Acer* with nine species each come next, followed by *Quercus* and *Cornus* each with six species and *Ulmus* with five. The Birches, except the shrubby *Betula fruticosa* Pall. and *B. chinensis* Maxim. which is always a small tree, are handsome and grow to a good size. The most remarkable is *B. Schmidtii* Regel, which has hard, close-grained wood, heavier than water, and much exported to Manchuria and China for making axletrees and felloes of carts. This species grows on steep, rocky slopes and the trees though not tall have a short,

stout trunk, clothed with thick, dark bark which flakes off, and a broad crown of no particular shape made up of massive branches. Curiously, the wood and bark of the very different *B. chinensis* Maxim. is almost identical with that of *B. Schmidtii* Regel, but the tree is always small and is found in lower altitudes and on any kind of soil. On the Diamond Mts. I saw the best examples of *B. chinensis* Maxim. Of true Maples only *Acer pictum* Thunb. grows to any real size and this calls for no special comment. Another (*A. pseudo-sieboldianum* Kom.) makes a poor looking tree of medium size but is abundant and in autumn its foliage assumes wonderful tints of orange, scarlet, and crimson and is responsible for much of the autumn beauty of forest and wood. In open country and especially by riversides and in swamps *A. ginnala* Maxim. is abundant as bushes or low, shapeless trees. Its leaves have considerable economic value, being gathered in late summer and after sun drying packed in bales and exported to China where blue, black, and khaki color dyes are prepared from them. Of the eight Maples two are Negundos and both make strikingly handsome trees. The oldest known of the two is *A. mandshuricum* Maxim. which grows 80 ft. tall, has a shapely crown and a straight trunk clothed with firm, pale gray, slightly fissured bark. The other, *A. triflorum* Kom., is of much the same size, has thicker branches and a thin, papery gray-brown bark which shreds off. The autumn tints of both are yellow, orange, and salmon, and singularly beautiful. Of the Oaks *Q. mongolica* Fisch. is the best and its wood the most valuable and when the soil is good, as on Nemonrei in the Diamond Mts., makes a fine tree in habit and size resembling the White Oak (*Q. alba* L.) of eastern North America. As usually seen, however, in Korea the Mongolian Oak is not attractive, being of moderate size only and frequently stagheaded. The less abundant *Q. glandulifera* Bl. is usually a better looking tree, and in the autumn its ruddy tinted foliage renders it most conspicuous. Of the Cornels besides the well known *Cornus kousa* Buerg. and *C. controversa* Hemsl., both strikingly beautiful in summer when in full flower, the less known *C. coreana* Wanger. deserves mention if only on account of its bark which on adult trees is almost black, and deeply fissured into tiny squares like that of *Diospyros virginiana* L. The Korean Cornel grows 60 ft. high and has a trunk from 4 to 5 ft. in girth; the leaves are opposite, but the flowers and fruit are similar to those of *C. controversa* Hemsl. It is interesting to note that the old *C. officinalis* S. & Z., long known as a cultivated tree in Japan, is endemic in Korea where it is a tree often 35 ft. tall with a trunk from 4 to 5 ft. in girth and thin pale gray bark which scales off in loose papery sheets. The common Elm is *Ulmus japonica* Sarg. but nowhere did I see large trees of this species such as are common in Hokkaido; indeed, the largest Elm in Korea is *U. pumila* L. which in the valleys of the north is often 80 ft. tall and has a trunk as much as 12 ft. in girth.

Trees with conspicuous flowers and striking objects in the landscape are *Prunus mandshurica* Koehne, distinguished among Apricots by its large size and by its thick, corky black bark which is red beneath, a Cherry

(*Prunus serrulata* var. *pubescens* Wils.), Wild Pear (*Pyrus ussuriensis* Maxim.), Crab Apple (*Malus baccata* var. *mandshurica* Schneid.), Tree Lilac (*Syringa amurensis* Rupr.), *Maackia amurensis* Rupr. & Maxim. and *Aralia chinensis* L., *Acanthopanax ricinifolius* Seem. and the two Lindens *Tilia amurensis* Rupr. and *T. mandshurica* Rupr. & Maxim. The above trees all grow in plenty and when in flower their effect on the landscape can easily be imagined. The Pear in particular is noteworthy as being the most cold-resisting of Asiatic species and as growing to a larger size than any other—trees from 60 to 75 ft. with crowns as much in diameter and trunks from 10 to 14 ft. in girth are not uncommon. It is widespread in Korea and is frequently found in the forest depths though more usually by the side of streams and on the edge of the forest. The fruit, which is depressed-globose and from one third to half an inch in diameter, may be ruddy or green and with or without the remains of the calyx; the leaves, which vary in shape and serration, assume rich bronze and purple tints in autumn. Cultivated forms of this species are grown in gardens in Korea, Manchuria and north China and yield palatable fruit of good size. The Crab Apple is a tree of moderate size and its wealth of white blossoms in spring is followed by an abundance of small, greenish red to scarlet fruits. It loves a cool soil and is particularly happy in thickets on the banks of mountain streams.

As in other boreal floras conifers are abundant. Besides the Red Pine (*Pinus densiflora* S. & Z.), whose prominence has already been alluded to, the Korean Nut Pine (*P. koraiensis* S. & Z.) is a very common tree on the mountains, and the Creeping Pine (*P. pumila* Regel) clothes the upper slopes and summits of most of the higher peaks from Kangaku-san, about Lat. 38° 30' N., northward except that of Paiktu-san itself from which it is entirely absent. Two Firs (*Abies holophylla* Maxim. and *A. nephrolepis* Maxim.) are both plentiful, the first-named being indigenous and confined to the low-levels and the other the mountain species. A third species restricted to Quelpaert and Chiri-san has been referred to already. A flat-leaf Spruce (*Picea jezoënsis* Carr.) and another with four-angled leaves (*P. Koyamai* Shiras.) grow in Korea. The latter is confined to the north and more especially the northeast but the flat-leaf species grows as far south as Chiri-san. An unnamed species of Thuja is common on high, non-volcanic mountains from the Diamond Mts. northward; in the forest it is a sturdy shrub or even a small tree often 30 ft. tall but on high treeless slopes it is an undergrowth to *Pinus pumila* Regel. One Juniper (*Juniperus rigida* S. & Z.) is very common, more especially in open country and thin woods of Red Pine or Oak; another (*J. communis* var. *montana* Ait.), grows only in the north, whilst a third (*J. chinensis* var. *Sargentii* Henry), is confined to rocky places high up on the mountains but is distributed from the extreme north to Quelpaert where it grows on Hallaisan at 1600 m. and upwards. To complete the list of conifers indigenous on the peninsula it remains to mention a Larch (*Larix dahurica* var. *Principis-Rupprechtii* Rehd. & Wils.) which covers much of the volcanic area

of the north and is not found elsewhere. This Larch with the two Spruces, the Nut Pine, and the Mountain Fir either grow together or form more or less pure forests and the wood of one and all is of good quality. The other Fir (*Abies holophylla* Maxim.) is of little value as a timber tree but for garden purposes it ranks with the Japanese *A. homolepis* S. & Z. as the best of the Asiatic species. The branches are moderately stout, spreading or ascending-spreading and crowded with dark green leaves. Trees 100 ft. tall with trunks 12 ft. in girth are not uncommon in fairly open country where the soil is rich and moist.

Of Taxaceae only *Cephalotaxus drupacea* S. & Z. and *Taxus cuspidata* S. & Z. grow on the mainland of Korea. The *Cephalotaxus* as a small shrub of no particular shape is scattered here and there from the vicinity of Keijyo, the capital, southward; the Yew is much more widely spread, growing as far north as the upper waters of the Yalu River. It is not a common tree, though on the Nemonrei, in the Diamond Mts., it is more plentiful and of greater size than I have seen it anywhere else in the Japanese empire.

At this point it seems opportune to say a little about the natural rotation of forests, or, the succession of forest growth as it may be termed — a subject little understood but clearly demonstrated in and by the virgin forests of north Korea. To appreciate this succession and to properly understand what follows, it is necessary to state that in the temperate regions of north-east Asia (and probably everywhere in the world) there are aggressive northern and southern types that are ever extending their geographical range at the expense of (a) types already in occupation of intervening regions, (b) those that flourish under peculiar conditions only, (c) themselves finally. Of these aggressive northern types in Korea may be mentioned Aspen (*Populus tremula* var. *Davidiana* Schneid.), Alder (*Alnus hirsuta* Turcz.), Birches (*Betula davurica* Pall., *B. Ermanii* Cham., *B. japonica* Sieb.), Creeping Pine (*Pinus pumila* Regel), Fir (*Abies nephrolepis* Maxim.), two Spruces (*Picea jezoënsis* Carr., *P. Koyamai* Shiras.). Of southern aggressive trees Red Pine (*Pinus densiflora* S. & Z.), Oaks (*Quercus mongolica* Fisch., *Q. dentata* Thunb., *Q. glandulifera* Bl.), Hornbeam (*Carpinus laxiflora* Bl., *C. cordata* Bl.), Ash (*Fraxinus rhynchophylla* Hance, *F. mandshurica* Rupr.) may be instanced; of types in possession, that is species endemic or nearly so, Fir (*Abies holophylla* Maxim.), Nut Pine (*Pinus koraiensis* S. & Z.) Birch (*Betula Schmidtii* Regel), Maple (*Acer pseudo-sieboldianum* Kom.), Box-elder (*Acer triflorum* Kom., *A. manshuricum* Maxim.), Wild Pear (*Pyrus ussuriensis* Maxim.), Apricot (*Prunus mandschurica* Koehne) may serve as examples.

After forest fires or deforestation by man Birch, usually *Betula davurica* Pall. or *B. Ermanii* Cham. less commonly *B. japonica* Sieb., is the first tree to appear in almost any part of Korea. In the south and at low altitudes and to a less degree in central Korea the Birch may be forestalled by coarse grasses (*Miscanthus* spp. and allies) and natural reafforestation long retarded, but normally, Birch is soon joined by other broad-leaved deciduous trees and

frequently by Red Pine and Fir (*Abies holophylla* Maxim.) and in the course of time develops into pure broad-leaf forest, mixed forest or pure Pine-forest according to the type which becomes dominant. On the east side of the Diamond Mts. where man has much thinned the former pure forest of Red Pine, broad-leaf trees are rapidly changing the whole character of the forest. On the west side of the same mountains, especially round the monastery of Choanji, the broad-leaf forests are being displaced by Nut Pine and Fir. In central Korea and northward coarse grasses are less aggressive and Birch is associated with Aspen in increasing quantity until the volcanic areas of the Paiktu region are reached where Larch becomes a prominent companion of the Birch and Aspen. It is in this Paiktu-san region that the succession of forest types is most clearly shown. The cycle is roughly as follows: In the course of time after volcanic activity in that region had ceased, as after forest fires at the present time, seedlings of Birch, Aspen and Larch sprang up from seeds transported from the north by wind. Then, as now, the three kinds of trees grew well together for a few years, the Birch and Aspen the faster at the commencement, but the Larch, though it needs when young a certain amount of shade just such as the twiggy branches of Birch and Aspen afford, is a light-demanding tree and after twenty or thirty years it outstrips its fellows in pace of growth, finally kills them and pure forests of Larch remain. Such forests are thin, open and park-like in aspect and the trees almost of the same age, for no Larch seedlings will vegetate in such forests except by the side of well-tramped paths, or on fallen, rotting trunks, but where fire breaks through they thrive exceedingly. As the Larch-trees increase in size, so the forest floor beneath becomes more and more shady and invites the presence of more shade-loving trees such as Fir and Spruce. When the Larch is from sixty to one hundred years old seedlings of these Fir and Spruce establish themselves, in the course of time grow into trees and finally kill out the Larch to form pure forests of themselves. Like the Larch the trees are of about the same age, for in such forests seedlings do not vegetate under the dense shade of the parent trees either because the shade is too great, because there is too much humic acid in the soil from the constant accumulation of rotting vegetation, or, because of both. On the edges of these forests, in glades, or on fallen rotting trunks only are young seedlings of Spruce and Fir to be found.

Larch with its deciduous leaves, and trunks clear of branches for a considerable distance from the ground, is in much less danger from fire than Fir and Spruce which are evergreen, keep their branches from near the ground upward and, moreover, have a very resinous bark and resinous leaves. However, sooner or later, either from electrical storms or through human agency, fire sweeps through the forests and the cycle is repeated.

The Fir (*Abies holophylla* Maxim.) and the Nut Pine (*Pinus horaiensis* S. & Z.) nowhere in Korea, to-day, form pure forests. Both are associated with broad-leaf trees and the conifers mentioned above. They love rich, cool soils and in the extreme north of Korea there are limited areas of forest fifty per cent pure Nut Pine.

The Larch forests being of open character are easy to traverse and have quite a rich undergrowth of shrubs among which Birch (*Betula fruticosa* Pall.), Blueberry (*Vaccinium uliginosum* L.) and *Ledum palustre* L. in many forms are prominent. The Fir- and Spruce-forests are less rich in woody undergrowth and those of pure Red Pine have none at all. The broad-leaf forests on the other hand are rich in shrubs and climbers of an ornamental character, though those reach their greatest exuberance where trees are fewest. Most abundant are Azaleas, Roses, Magnolias, Honeysuckles, Lilacs, Mock Orange, Deutzia, Forsythia, Spiraea, Indigofera, Symlocos, Viburnum, Berberis, and the climbers Actinidia, Celastrus, Pueraria, Smilax, and Vitis, whilst in central and south Korea on boulders, cliffs, walls, ramparts, and trunks of forest trees the familiar "*Ampelopsis Veitchii*" (*Parthenocissus tricuspidata* Planch.) luxuriates. In the rocky beds of summer torrents and on the banks of streams the Gray Willow (*Salix gracilistyla* Miq.) is superabundant. The tops of the higher mountains in north Korea are clothed with such alpine shrubs as Creeping Pine (*Pinus pumila* Regel), dwarf Junipers (*Juniperus chinensis* var. *Sargentii* Henry, *J. communis* var. *montana* Aiton), an unnamed Thuja, dwarf Willows in variety, Cowberry and other *Vacciniums*, the red fruited variety of Arctous (*Arctous alpinus* var. *ruber* Rehd. & Wils.), Crowberry, Dryas, and Rhododendrons such as *Rhododendron chrysanthum* Pall., *R. parvifolium* Adams and allied species. On the barest and most rocky hills and mountains slopes a few woody plants may be found. In spring, late May and early June according to latitude, the whole countryside is gaily decked with flowers. The Wild Pear, Crab Apple, Wild Cherry, Apricot, and other flowering trees which enliven the glades, edge of the forest, river bank, and open country must not be forgotten in this attempt to visualize Korea in spring, nor, the young unfolding leaves of the forest trees from the pure green of the Larch through the grays of some Oaks to the ruddy tints of other species of Oak and Maple. The undergrowth in the woods and the shrubberies when the trees have been destroyed are splashed with masses of white, yellow, pink, rose and purple. Not even in the richest parts of China or Japan have I seen such extensive displays of pure pink and white as on the Diamond Mts. where *Rhododendron Schlittenbachii* Maxim. and *Magnolia parviflora* S. & Z. dominate the undergrowth for many square miles and bloom to perfection.

On the bare hillsides and mountain slopes of central Korea — round Keijyo, the capital, for example — a Forsythia is plentiful and its yellow bells in spring are conspicuous. On the mudshales and limestone a little to the northwest of Keijyo grows a Lilac (*Syringa dilatata* Nakai) which opens its panicles of palest lilac tinted flowers early in spring. It is a bush of good habit often twelve feet high and nearly as much broad with dark green leathery foliage which colors finely in autumn. Examples two feet high bear flowers. In the woods and thickets grow two other species of Lilac and these produce their nearly white to ruddy purple flowers in early summer and the fragrance of one of them (*Syringa Palibiniana* Nakai) is

delightful. In early summer too a lovely *Weigelia* (*Diervilla florida* var. *renusta* Rehd.) and the Rose Indigofera (*Indigofera Kirilowii* Maxim.) are clothed with their attractive flowers and since the plants are plentiful the display is conspicuous. Very plentiful in open country and thin woods is that harbinger of spring *Rhododendron mucronulatum* Turcz. and so too is the less well-known *R. poukhanense* Lév. which with its compact, twiggy growth and wealth of fragrant, rosy-mauve colored flowers is a feature of the countryside in late April and May from Quelpaert northward to the latitude of Pingyang. On rocky, grass-clad slopes it covers areas which on the foothills of Chiri-san are acres in extent; on Quelpaert it grows in great plenty from sea-level to the summit of Hallai-san (alt. 1952 m.). The white-flowered Rambler Rose (*Rosa multiflora* Thumb.) and its more northern and handsomer relative *R. Jackii* Rehd., are also among the features of the early summer flora of Korea.

Since Pine and Fir are the dominant trees in the landscape over much of Korea the flowering shrubs and trees are well provided with a setting which enhances their beauty whether it be the flowers in spring and summer or the tinted foliage in autumn. Often in thin woods of Red Pine the undergrowth is almost entirely of pink, rose, or rosy-mauve Azaleas and the rose-colored Indigofera and such places are perfect gardens.

In species of climbing plants Korea is poor and it boasts no *Wistaria* nor anything approximating in beauty. However, climbing plants are plentiful if not varied, and in autumn the tints of Veitch's *Ampelopsis* and of the Amur Grape (*Vitis amurensis* Rupr.) are not exceeded in brilliancy anywhere. In early summer two *Actinidias* (*Actinidia kolomikta* Maxim., *A. polygama* Maxim.) with fragrant, white flowers in clusters hidden beneath the leaves, a great many of which are pure white or half white and half green, are striking objects on the mountain slopes. The white leaves change to pink and rose as the flowering period passes. In summer the most noteworthy climber is *Tripterygium Regelii* Sprague & Takeda, with its bright brown, lenticellate branches, large panicles of pure white flowers which are followed by white changing to pink, bladder-like fruits. It is abundant, sprawling over shrubs and small trees and sometimes over larger trees fifty feet and more tall.

Korea from early times has been the highway over which many Chinese plants of economic value and of ornamental character have travelled to Japan. For example: — Chinese Persimmon (*Diospyros kaki* L.), Sand Pear (*Pyrus serotina* var. *culta* Rehd.), Korean Apple (at present called *Malus asiatica* Nakai), Japanese Plum (*Prunus salicina* Lindl.), Bush-cherry (*P. tomentosa* Thunb.), Varnish Tree (*Rhus verniciflua* Stokes), Moutan Paeony (*Paonia suffruticosa* Andrews), the Paulownia (*Paulownia tomentosa* K. Koch) and others, all indigenous in China, reached Japan by way of Korea. Likewise certain Korean plants were long ago introduced to Japan and reached Europe and America from there at a later date. Among older examples may be instanced *Pinus koraiensis* S. & Z., *Cornus officinalis* S. & Z., and *Diervilla florida* S. & Z.; in more recent times *Rhodo-*

dendron Schlippenbachii Maxim. and *Viburnum Carlesii* Hemsl. The last named, probably the best known and most popular of Korean shrubs, was introduced from Japan into England in 1902.

By roundabout ways plants from China have, intermittently, found their way to western lands from the 16th cent. if not earlier, and from Japan since the 17th cent., though in each case often with long breaks in the periods. Yet, the 20th cent. had almost dawned before any seeds or living plants direct from Korea reached the Occident. In 1897, a Russian Botanist, Vladimir L. Komarov, made a trip through north Korea, collected herbarium material and probably some seeds, for in the *Gardener's Chronicle* (ser. 3, XLIV, 210 [1908]), there is a figure, and note about *Rodgersia tabularis* Kom., a typical Korean herbaceous plant, flowering in Kew gardens from seeds received from the Imperial Botanic Garden, Petrograd, in 1905. In December, 1904, the Arnold Arboretum received, through the Imperial Botanic Gardens, Tokyo, some seeds collected in Korea by T. Uchiyama which resulted in the introduction of *Abies holophylla* Maxim. and *Hemiptelea Davidii* Planch. In 1905, Mr. J. G. Jack, of the Arnold Arboretum staff, was in the Orient and visited Korea. The Russo-Japanese war was still in progress and it was impossible for any one to travel freely in Korea. Moreover, Mr. Jack's main purpose was not botanical collecting, nevertheless he sent back to this institution seeds and living material of quite a number of plants which have proved to be of exceptional interest and value. To Mr. Jack we owe such Korean plants of merit and hardiness as *Rhododendron poukhanense* Lév., *Diervilla florida* var. *venusta* Rehd., *Tripterygium Regelii* Sprague & Takeda, *Malus baccata* f. *Jackii* Rehd., *Rosa Jackii* Rehd., *Erodia Daniellii* Hemsl., an Oak (*Quercus aliena* Bl.) and the plants in this Arboretum of the lovely *Indigofera Kirilowii* Maxim. This list makes no pretense of being complete but their value was a sufficient incentive to further work in Korea and culminated in the Expedition, undertaken by the Arnold Arboretum, which lasted from 1917 to February, 1919. Among other things this expedition secured seeds and living plants of about two hundred species and varieties of woody plants. Of the behavior of these here it is too early to write and it would be unwise to enlarge upon their qualities. As they grow in Korea many are decidedly handsome and we may hope that they will successfully adapt themselves to the climates and soils of western lands.

Compared with the floras of China and of Japan that of Korea is a fairly simple study but it cannot be properly understood unless its relationship with that of contiguous and adjacent regions be given due consideration. It is not without its own peculiar problems and contains much of interest to the botanist and gardener.

NEW SPECIES, VARIETIES AND COMBINATIONS FROM THE
HERBARIUM AND THE COLLECTIONS OF THE
ARNOLD ARBORETUM

ALFRED REHDER

THE purpose of this paper is to publish a number of new combinations, new species, new varieties and forms, as well as to record various observations which have presented themselves in the course of a systematic rearrangement of the herbarium of the Arnold Arboretum and while working on a manual of cultivated trees and shrubs. Particularly the application of the International Rules of nomenclature to the material preserved in our herbarium has made new combinations necessary, and a few words therefore may be said of the principles guiding these nomenclatorial changes.

The interpretation of certain articles of the International Rules has been always subject to a diversity of opinion, due chiefly to more or less vagueness in the wording of these articles and to the introduction into the rules of the type method, to which nearly all American botanists now adhere and which apparently is gaining more and more foothold abroad, as shown by the additional recommendation, XVIII^b, in the revised code which reads: "When publishing names of new groups to indicate carefully the subdivision which is regarded as the type of the group: the typical genus in a family, the typical species in a genus, the typical variety or specimen in a species." One of the most important consequences of the acceptance of the type method is a different attitude in regard to articles 45 and 47 dealing with the division of groups.

It is not the place here to enter into a discussion as to how to determine the type of genera and species and it is, moreover, hardly possible to formulate general rules for the determination of types, as each case must be considered and judged on its own merits, but it may safely be stated that the number of cases where one cannot reach a conclusive decision is comparatively small. The difficulty lies chiefly with those who consider a group to be a conception, that is, a genus a group of species, and a species a group of individuals or minor forms joined together by common characters and circumscribed by a description, instead of taking the position that the groups or individuals are assembled around a group or an individual which is considered the typical representative; however much or however little a group is changed by additions or subtractions, it always keeps the same name with the citation of its original author as long as it contains the typical form. Those who view a group as a conception are easily led to abandon a specific name on the plea that it is composed of different elements, if it contains forms which according to our present point of view represent different species, or in the case of a genus to resort to counting the number of species and leaving the name with the largest number. There is, no doubt, great difficulty in determining the generic type in some of the old Linnaean genera like *Sorbus*, *Crataegus*, *Prunus*, and for such cases the doctrine of

residues may perhaps be put into practice. The method of taking the first species in a genus or the first citation or synonym in a species is an artificial makeshift and not to be recommended. In genera to make the selection of the type dependent, as recommended in the examples under art. 45, on subsequent publications where the original extent and circumscription of the genus often is considerably altered, is certainly against the principle of priority, and as it thus violates one of the fundamental principles of the Code, we may consider ourselves justified in disregarding this recommendation. There will be, of course, cases when the type method will result in displacing generally accepted names, or cause considerable inconvenience, but this is unavoidable, if one follows consistently any set of rules. In the case of a generic name it may be saved by including it under the nomina conservanda, and in a case like *Ulmus campestris* the name may be rejected by taking recourse to art. 51, 4 of the rules.

Another source of different opinions is article 50, arising chiefly from the fact that no distinction is made between valid names and valid taxonomic groups, that is between nomenclatorial and taxonomic validity. The wording of the rule: "No one is authorized to reject, change or modify a name . . . because of the existence of an earlier homonym which is universally regarded as non-valid," is unfortunate. The phrase "universally regarded as non-valid" seems contradictory in itself, for a name is either valid or non-valid, depending on whether it is formed according to the rules or not, and it cannot be made so by general consent. This becomes clear by the revised article 56 which reads in part: "By valid name is implied a name and especially a combination of names formed in accordance with the rules of nomenclature." The strict adherence to this ruling will exclude a considerable number of homonyms which otherwise tend to make nomenclature unstable. As names that have become synonyms by change of generic or specific limitations may be revived at any time by another change in the taxonomic valuation of genera or species, I have termed non-valid names unconditional synonyms, and synonyms for taxonomic reasons conditional synonyms (see *Rhodora* xvii. 61, footnote). As an example, *Picea canadensis* (Mill.) Britton, Sterns & Poggenburg, may be cited. This name cannot stand on account of the older *P. canadensis* (L.) Link which is the correct name of the Hemlock Spruce under the genus *Picea*. Even if *Tsuga* is now recognized as a distinct genus by almost all botanists and therefore *Picea canadensis* Link referred to *Tsuga canadensis* as a synonym, this should not make any difference, since at any time botanists may unite *Picea* and *Tsuga* again and thereby cause *P. canadensis* Link to be revived. A similar case is *Malus floribunda* Sieb., which if transferred to *Pyrus* should be changed to *P. pulcherrima* Ascherson & Graebner and not be called *P. floribunda* Voss, on account of the older homonym *P. floribunda* Lindley, even though according to the author's view that species belongs to *Sorbus* or *Aronia*, but as there are botanists who unite *Pyrus*, *Malus*, *Sorbus* and *Aronia*, and others who unite *Malus* and *Pyrus* and keep *Sorbus* distinct, *Pyrus floribunda* Voss would under certain generic limitations keep its

name, while under different generic limitations the name had to be changed to *P. pulcherrima*, if no distinction is made between taxonomic and nomenclatorial synonyms. As an example concerning specific names within the same genus, *Rosa microphylla* Roxburgh (1820), may be quoted; this name cannot be maintained, as there is an older *R. microphylla* Desfontaines (1798) which, though generally referred as a synonym to *R. sempervirens* L., does not represent the type of that species and therefore may be revived by an author favoring narrower specific limits. On the other hand, a name like *Quercus lanuginosa* Thuillier (1799) is to be considered valid, though there is an older *Q. lanuginosa* Lamarck (1778) which, however, is not valid, as it is a nomenclatorial synonym of *Q. Cerris* L. (1753) being based on that species.

One of the most difficult problems is the nomenclature of varieties and other subdivisions of species. Many botanists consider the different grades of subdivision of species as subject to the rules governing the change of rank, while others preserve even the original author citation when changing a variety to a form or vice versa. One of the chief objections against the former practice is the lack of restriction placed on the number of subdivisions, for according to art. 12 one is allowed to intercalate as many supplementary groups as one sees fit, and the absence in many cases of the exact designation of the nature of the different grades, which often are preceded only by letters, numerals or typographical signs, or are joined directly to the specific name (so-called trinomials). Even if such terms as variety or form are used, they are frequently employed in a vague sense and may have different value in different publications. It is difficult to see how we can apply to subdivisions whose grade is not clearly defined the strict rules governing change of rank without introducing many unnecessary changes on account of different opinions on the valuation of certain names. The possibility also is thereby given to change at will almost any name of a subdivision by changing the designation of the grade, e. g. by calling a form a *lusus*, a subvariety a form, a variety a subspecies; though such changes are against the recommendations, they are not against the rules, and once made, whether intentionally or inadvertently, they cannot be revoked.

To make the nomenclature of varieties as stable and simple as possible, it seems best to consider as groups of different rank only those restricted to definite numbers, that is the main groups as enumerated in article 10 and their subdivisions as given in article 11, counting the subdivisions of each main group as one unit, that is as one rank, while the different kinds of subdivisions as admitted by art. 12 which are of an indefinite number, may be considered grades or degrees of subdivision. Regarding the question whether the different subdivisions of species should be considered ranks, it seems significant that among the numerous examples illustrating change of rank, none is given which illustrates the change of any grade of subdivision to another grade of subdivision of the same species. It also is to be noted that apparently subdivisions of a genus, as subgenus and section, are not considered as constituting different ranks, as shown by the first example

under art. 48: "The subgenus *Alfredia* Less. of the genus *Rhaponticum* keeps its name when placed in the genus *Carduus*: *Carduus* sect. *Alfredia* Benth. & Hook. f."

I am therefore inclined to maintain in every case the oldest name regardless of change of grade or so-called rank. The name of the author, however, should be changed with a change in the grade, if the nature of the grade is clearly defined in both instances; if the original author failed to designate the grade, the fixation of the grade is an emendation and the name of the original author should be kept. If a combination is used as a trinomial the author of the original combination should be quoted regardless of any later change of grade.

To designate a certain subdivision of a species it is only necessary to add the name of this subdivision to the binomial, omitting the names of any higher grades which may have been placed between this particular subdivision and the specific name. A combination of three names should always be sufficient to designate any group below the species. This, of course, does not apply to exact taxonomic work where names and combinations should be cited exactly as published by their author.

As to precise citation, I want to draw attention to the fact, that in most publications names published as synonyms are cited as if published as valid names; it seems advisable to add in such cases always after the citation the words "as a synonym" or "pro synonym." and in exact citation also the name of the group under which the name in question is placed as a synonym. Likewise should the fact that a name has been published without description or reference to a previous description, and therefore not valid, be brought out by the addition of the words "nomen" or "nomen nudum," or of "nomen seminudum," if an insufficient reference, perhaps a reference to an illustration without description, is given.

When it seems desirable to abbreviate citations as much as possible, one may restrict the author citation in cases where two authors (the author of the manuscript name and the publishing author) are given to the name of the publishing author; this is particularly important in names cited as "Hort.": e. g. *Gesnera Donklarii* Hort. apud Hook. should be abbreviated *G. Donklarii* Hook. The citation "Hort." alone is almost meaningless, as it not infrequently happens that the same name has been used for different plants in different gardens and as this citation does not give the slightest hint when and where such a name may have started. The author who first publishes such a name with a description makes the name valid and is really the author of the name from a nomenclatorial point of view.

At this institution we have to deal to a great extent with forms of cultivated plants and their nomenclature presents some additional difficulties which cannot be entirely solved with the help of the International Rules of botanical nomenclature. We have therefore to take into consideration the rules accepted by the International Congress of Horticulture at Brussels in 1910. These rules were originally published in Bull. Soc. Bot. Belg. XLVII. 419-424, preceded by a detailed preliminary report (pp. 363-419); an Eng-

lish version preceded by the preliminary report of the Royal Hort. Society only appeared later in Jour. Roy. Hort. Soc. xxxvii. 149-151 from which we quote.

According to article 1. horticultural nomenclature is based upon the rules of botanical nomenclature as adopted by the International Congress of Botany held at Vienna in 1905, with some modifications, however, which concern the nomenclature of varieties and hybrids.

Art. II. dealing with the naming of horticultural varieties reads: "It is necessary in naming horticultural varieties of species and simple forms to employ the complete names of the species with the name of the author. The employment of Latin in naming horticultural varieties is authorized only when the character of the plants is expressed, e. g., nanus, fastigiatus, etc. The use of Latin proper names for such varieties is proscribed.

"The names of horticultural varieties must always be written in Roman characters. [E. g. *Alyssum maritimum compactum*, *Pelargonium zonale* 'Mrs. Pollock.']"

Before accepting the ruling of this article we have to answer the question what constitutes a horticultural variety or form, as neither the rules of botanical nor of horticultural nomenclature give a definition of this term.

Can we really make a distinction between a horticultural and a botanical form? Is there any inherent difference between a mutation which has sprung up in the field or forest and has by a lucky chance survived, and a mutation which has sprung up in the seed-bed of the nursery and saved by man's interference? A large number of so-called garden forms have originated spontaneously as is well known and afterwards transferred to the garden and propagated. Is e.g. *Ilex opaca* f. *xanthocarpa* Rehder, because it was found wild and named before it was introduced into cultivation, a botanical form, and *Ilex Aquifolium* f. *chrysocarpa* Zabel a horticultural form, because it originated in cultivation and was named from a cultivated plant? I think one can but answer no.

It therefore appears that the difference is not in the plant, but in the name or in the rules governing the name, whether one applies the name from a botanical point of view considering the form a group of similar individuals whose taxonomic limits one can modify without change of name, while a horticultural form applies to an individual or its equivalent. This named individual is usually perpetuated by vegetative propagation, or if propagated by seeds only the individuals which reproduce the parent exactly are considered as belonging to the named form in question, while every slight deviation is a "rogue" which is either disregarded or destroyed, or if possessing special horticultural merits, given another name and made the starting point of a new form. It is therefore only fitting that such individuals should bear vernacular names, which may be compared to the names of human individuals, while on the other hand we are justified in treating every form which bears a name indistinguishable from a so-called botanical name, according to the rules of botanical nomenclature, that is as a group which may include besides the typical individual other closely re-

lated individuals showing slight variations but possessing the chief characters of the form in question. This is probably the idea underlying the rule that Latin names like "nanus, fastigiatus" are allowed, while proper Latin names are proscribed, because the framers of that rule, though not clearly stating it, apparently considered these Latin names to be group names.

Horticulturists therefore should use names differing in form from botanical names, if they desire to have the name stand for exactly the plant they intend to name. This agrees with the way plant breeders generally look on the named forms they distribute and the practice is well adapted for the purpose it serves and should not be interfered with. A horticultural name lapses when the plant disappears from cultivation, while a botanical name remains still valid in such a case and should be used again, if at any time a form appears answering to the description of the original form.

A name like *Thuja occidentalis* f. *aurea* Nicholson may be applied to different yellow-leaved forms differing in the shade of yellow and perhaps slightly in other characters, but a name like "Meehan's Golden" stands for an individual form and for its vegetative progeny; if this plant had been named "Meehanii" one would be justified in treating it as a botanical name and make it a synonym of *T. occidentalis aurea*, or if that latter name did not exist, make it the type of a group of yellow-leaved forms in which it would lose its individuality.

In some instances names of new horticultural forms have been published consisting of two not connected Latin words, e. g. *Chamaecyparis pisifera* var. *plumosa aurea*; this name stands for a form which is different from *C. pisifera plumosa* and also from *C. pisifera aurea*. According to the rules of botanical nomenclature a varietal name can be used only once under the same species, while according to the rules of horticultural nomenclature varietal names consisting of two or three words are allowed, though one is probably correct in assuming that this rule really is intended for names in the vulgar tongue like "Madame Casimir Perier" or "Mrs. Pollock." If we consider "plumosa aurea" a horticultural name, it can be used, but may be written *C. pisifera plumosa aurea* or *C. pisifera* "plumosa aurea" to bring out the fact by the difference in type or by the quotation marks that the varietal name is not a part of the botanical name. If, however, "plumosa aurea" is considered a botanical name, it must be changed, as it is contrary to the rules of botanical nomenclature, and a new name chosen, consisting of a single word. It seems rather doubtful if it is advisable to coin new names for all cases where the name of a horticultural variety consists of two or more words, and therefore, it is probably better to leave and use these names as they are, indicating only by the manner of writing and quoting them, that they are not part of the botanical name and that the whole name is not a combination in the nomenclatorial sense of the term.

Of the modifications concerning hybrids, the most important adopted by the Horticultural Congress is contained in art. XIII, which reads: "Bigeneric hybrids are also designated by a name and a formula. The generic name is formed by the combination of the generic names of the parents. . . —

Multigeneric names known so far only in Orchids also receive distinct generic names according to article xiv.

The International Rules of botanical nomenclature do not favor the coining of new names for intergeneric hybrids. Art. 32 rules that the intergeneric hybrid is associated with the one of the two genera which precedes the other in alphabetical order. Against this ruling the following objections can be raised: 1° that such names give by their form, if used without their formula, not the slightest hint that the hybrid is an intergeneric hybrid, as it may as well be taken for a hybrid between two species of the same genus — 2° that it seems logical that a hybrid between two genera receives a distinct generic name, as long as a hybrid between two species of the same genus receives a distinct specific name — 3° that the insertion of an intergeneric hybrid under one of the parent genera would necessitate a change in the characters of the genus under which it is placed — 4° that the giving of new generic names to intergeneric hybrids is according to general usage, as almost every one of these hybrids has received a generic name.

A modification concerning specific names of hybrids is contained in art. viii. which reads: "The specific name of a hybrid may be expressed in Latin or in any language that is written in Roman characters." This partly contradicts art. 31. of the Rules of botanical nomenclature which reads: "Hybrids between species of the same genus or presumably so, are designated by a formula and, whenever it seems useful or necessary, by a name. . . . The name which is subject to the same rules as names of species, is distinguished . . . by the sign $\times$ before the name." As names in the vulgar tongue are not allowed for names of species, it follows that they should not be used for the specific names of hybrids. In the French preliminary report this question is discussed at length on pp. 389-392 where it is stated that opinions were almost equally divided between those who favored the admission of vernacular names and those who did not, but the opinion of those favoring admission prevailed. As an example $\times$ *Cattleya* *Princesse Clémentine* is cited, which should not have been translated into $\times$ *C. Clementinae*, as done by Hurst & Rolfe, but retained in its original form. According to my opinion, however, both names can be used, if the distinction I have made above between botanical and horticultural names of varieties is applied also to hybrids. In this case the vernacular form $\times$ *Cattleya* *Princesse Clémentine* would stand, following horticultural usage, only for the original cross, while $\times$ *C. Clementinae*, according to botanical usage, would include, distinguished as varieties if necessary, all later crosses between the same parent species.

However much we may be convinced that by taking into consideration the Latin names of forms of cultivated plants, we shall incur many inconveniences, we cannot avoid it. As shown above, there is no difference between a botanical and a horticultural form, and as long as a horticultural form has received a name indistinguishable from a botanical name, it must be treated according to the rules of botanical nomenclature. Neither is it possible to exclude names published in garden catalogues, nursery price-

lists and the like provided they are accompanied by a sufficient description, since art. 35 says that publication is effected by the sale or public distribution of printed matter or indelible autographs, which does not exclude any class of publication. The only way to exclude such names would be by taking advantage of art. 36 which rules, that after January 1, 1908, the publication of names of new groups will be valid only when they are accompanied by a Latin diagnosis, but this rule is practically a dead letter, and I have as yet no knowledge of any name disregarded for this reason; considered as a recommendation art. 36 is excellent.

TAXACEAE

Taxus chinensis (Pilger), spec. nov.¹ — *Taxus baccata* Franchet in Nouv. Arch. Mus. Paris, ser. 2, vii. 103 (Pl. David. i. 293) (1884), non Linnaeus; in Jour. de Bot. xiii. 264 (1899). — Pritzl in Bot. Jahrb. xxix. 214 (1900). — Masters in Jour. Linn. Soc. xxiv. 546 (1902); xxxvii. 414 (1906); in Jour. Bot. xli. 269 (1903). — *Taxus baccata* subsp. 2. *cuspidata* var. *chinensis* Pilger in Engler, Pflanzenr. iv. 5, 112 (Taxac.) (1903). — Patschke in Bot. Jahrb. xlviii. 630 (1913). — *Taxus baccata* var. *sinensis* Henry in Elwes & Henry, Trees Gt. Brit. Irel. i. 100 (1906). — *Taxus cuspidata* var. *chinensis* Rehder & Wilson in Sargent, Pl. Wilson. ii. 8 (1916).

Arbor 5-16-metralis; ramuli annotini et vetustiores plerumque cinereo-brunnei vel flavo-cinerei; gemmae pallide brunneae, perulis obtusiusculis, dorso fere planis v. inferioribus leviter carinatis, basi ramulorum non, vel partim tantum persistentibus. Folia biserialim expansa, pleraque satis distantia, vix vel raro arcte contigua, falcata, 1.5-3 cm. longa, 2.5-4 mm. lata, apice plus minusve abrupte mucronulata, mediano supra plerumque leviter elevata, rarius prominente, subtus basi excepta obsoleto. Semen late ovoideum, 6 mm. longum et 5-6 mm. crassum, vix compressum, apice leviter bicarinatum, ceterum laeve, hilo fere orbiculari.

CHINA. Western Hupeh: *A. Henry* (No. 6913), *E. H. Wilson* (Arn. Arb. Exped. No. 1265, in part). Eastern Szechuan: *A. Henry* (No. 7097, 7155, type), *E. H. Wilson* (Veitch Exped. No. 624). Western Szechuan: *E. H. Wilson* (Arn. Arb. Exped. No. 1265, in part. No. 4053). Chekiang: *F. N. Meyer*, 1907 (No. 433). Shensi: *W. Purdom*, 1910. Kansu: *F. N. Meyer*, 1914 (No. 1790).

Opinions may differ if it is better to consider the different geographical forms of *Taxus* distinct species or varieties or subspecies of *T. baccata*, but whatever view is taken, the same rank should be given to the Chinese form as to the other geographical forms, and it should not be made a subdivision of *T. cuspidata*, as it differs from that species as much as the other species differ from each other. Its place seems to be between *T. cuspidata* and *T. Wallichiana* Zuccarini. *Taxus cuspidata* which is its nearest relation differs chiefly in the following characters: Winter-buds with acute, keeled, and rather loosely imbricated scales persistent at the base of the branchlets: leaves straight or nearly straight, generally shorter and very crowded and

¹ *T. chinensis* Roxburgh, Hort. Beng. 73 (1814) is a nomen nudum and therefore not valid; it is considered a synonym of *Podocarpus macrophyllus* Don.

overlapping, usually not distinctly distichous, more abruptly acuminate at the apex, with the midrib prominent above and conspicuous beneath; seed more compressed and with an elliptic hilum.

PINACEAE

Cupressus lusitanica Mill. var. *Knightiana*, comb. nov. — *Cupressus Knightiana* Knight & Perry, Syn. Conif. 20 (1850), nom. — Carrière, Traité Conif., ed. 2, 158 (1867). — *Cupressus elegans* Low ex K. Koch, Dendr. II. pt. 2, 156 (1873), pro synon. — *Cupressus Bentharii* var. *Knightiana* Masters in Jour. Linn. Soc. xxxi. 340, f. 15 (1896). — Mottet, Conif. Tax. 92, fig. 10 (1902). — *Cupressus lusitanica* var. *Bentharii* Henry in Elwes & Henry, Trees Gt. Brit. Irel. V. 1177 (1910), pro parte, non Carrière.

This variety differs from the type chiefly in its distinctly pyramidal habit and in its regularly pinnate branchlet-system with the ultimate branchlets of nearly equal length and compressed; the leaves are acuminate and the mucro of the cone-scales large and conical. Henry identifies *C. Knightiana* with his *C. lusitanica* var. *Bentharii*, but the latter differs, as far as I can see, in the tetragonal, not or scarcely compressed, somewhat thicker branchlets, with the ultimate branchlets though likewise disposed in one plane less regular and not of almost equal length. The color of the leaves varies in both varieties from green to glaucous.

Chamaecyparis obtusa f. *tetragona*, comb. nov. *Retinispora tetragona aurea* Barron, Select. Cat. Conif. (opp. p. 12) (1875). — *Chamaecyparis obtusa tetragona aurea* Nicholson, Dict. Gard. I. 304 (1884-85). — *Cupressus obtusa tetragona-aurea* Masters in Jour. Linn. Soc. xxxi. 355 (1896).

The varietal name "aurea" is preoccupied by *C. obtusa aurea* Fortune apud Henckel & Hochstetter and as no other form named "tetragona" is known, this name should be used for the form under consideration.

× *Larix Henryana*, nom. nov. (*L. decidua* × *Kaempferi*). — *Larix ? europaea* × *leptolepis* Henry in Elwes & Henry II. 388 (1907). — *Larix hybrida* Farquhar, Cat. New Rare Pl. 7 (1916), nomen. — Rehder in Bailey, Stand. Cycl. Hort. VI. 3569 (1917).

Young branchlets yellowish, slightly bloomy; branchlets of the previous season yellow or grayish yellow, lustrous; bud-scales at the base of the shoots with scattered hairs inside; terminal buds conic-ovoid, red-brown, the lowest scales aristate, lateral buds globose-ovoid, obtuse, resinous, buds of spurs ovoid, their outer scales loose, with hairs at the base. Leaves glaucous, those of the spurs 2-5 cm. long, above with 1 or 2 lines of stomata on each side, below with 3-5 lines on each side and keeled; those of the shoots 1.5-2.5 cm. long and about 1.5 mm. broad, acute and mucronate, above with 2-4 lines on each side and below with 5-7 lines on each side, in cross-section compressed-rhombic, with a slightly raised midrib below. Cones not known.

Larix Kaempferi Sarg. is chiefly distinguished from the hybrid by the dense glaucous bloom covering the young branchlets and by the reddish color of the branchlets of the previous season, by the longer and broader

leaves, those of the shoots being about 3 cm. long and 1.75 mm. broad, flattened and with a distinctly raised midrib below; both kinds of leaves with more numerous rows of stomata.

Larix decidua Miller differs from the hybrid chiefly in the grayish yellow, not glaucous branchlets and the lustrous yellowish branchlets of the previous season, and in the narrower leaves of the shoots, about 1.25 mm. broad and not quite so compressed in the cross-section, the stomatiferous lines above composed of 2-3 lines and of 3-4 lines below, the leaves of the spurs with 1 line on each side above and with 2-3 lines beneath on each side.

This hybrid was first mentioned by A. Henry (l. c.) who states that plants were raised at his suggestion by the late D. Keir, head forester on the Atholl estates, from seeds of a tree of *L. Kaempferi* planted close to a common Larch, at Dunkeld, Scotland, and that Mr. D. Keir's son considers the plants intermediate between the two species.

Plants received from Dunkeld are growing at the Arboretum and form regularly pyramidal vigorous trees of which the tallest is now about 12 feet tall. In general appearance they resemble most *L. Kaempferi* except one plant which approaches somewhat *L. decidua*.

Pseudolarix amabilis, n. comb. — *Abies Kaempferi* Lindley in Gard. Chron. 1854, 255, 455, fig.; 1855, 644, fig.; non Lindley in Penny Cycl. 1. 34 (1833).¹ — *Larix Kaempferi* Carrière in Fl. des Serr. xi. 97 (1856). — *Pseudolarix Kaempferi* Gordon, Pinet. 292 (1858). — *Larix amabilis* Nelson, Pinac. 84 (1866). — *Pinus Kaempferi* Parlatore in De Candolle, Prodr. xvi. pt. II. 412 (1868), non Lambert. — *Pseudolarix Fortunei* Mayr, Monog. Abiet. Jap. 99 (1890). — *Laricopsis Kaempferi* Kent, Veitch's Man. Conif. 404 (1900).

As the combinations with the specific name "Kaempferi" are based on the non-valid name *Abies Kaempferi* Lindley of 1854, they must be all considered non-valid and the specific name must be replaced by the next oldest which is *Larix amabilis* Nelson. Mayr in giving the new name *P. Fortunei* to this tree was apparently not aware that it had been called *Larix amabilis* in the little known and usually neglected book of J. Nelson.

Abies homolepis Sieb. & Zucc. var. *tomomi*, var. nov. — *Abies tomomi* Bobbink & Atkins, [Cat.] 13 [1909?], sine descriptione.

This forms a slenderer and more sparingly branched tree than the type; the leaves are shorter, about 0.8-1.5 cm., rarely 2 cm. long.

A plant received from Bobbink & Atkins in 1916 is growing in the Arnold Arboretum. I have also seen it growing in the New York Botanic Garden

¹ *Abies Kaempferi* Lindley of 1833 is based on *Pinus Kaempferi* Lambert which is identical with *Abies leptolepis* Sieb. & Zucc. of 1842. As "Kaempferi" is the oldest specific name for this Larch, Sargent was correct in reestablishing this name; for the older homonym *Larix Kaempferi* Carrière which belongs to *Pseudolarix amabilis* is a non-valid name, as pointed out above, and according to the International Rules it cannot prevent the reestablishment of the older name. The result would be the same, if one considers *Larix Kaempferi* Carr. and also *Abies Kaempferi* Lindley of 1854 as belonging partly, as to the name-bringing synonym, to the Japanese Larch, and partly, as to the description, to the Chinese Gold-Larch. For a complete enumeration of synonyms of *L. Kaempferi*, the Japanese Larch, see Wilson, Conif. Jap. 30 (1916).

where it was received from Hicks & Son in 1907 and again in 1914 from Bobbink & Atkins. Specimens are preserved of all these plants in the herbarium of the Arnold Arboretum.

× *Abies insignis* Carrière apud Bailly in Rev. Hort. 1890, 230. (*A. Nordmanniana* X *Pinsapo*). — *A. pseudopinsapo* Carrière in Rev. Hort. 1879, 444, 474, sine descriptione. — *Pinus insignis* Voss in Putlitz & Meyer, Landlex. iv. 774, 775 (1913), non Douglas.

The original plant of this hybrid was raised by Renault, Bulgnéville, France, in 1872 from seed of *A. pinsapo* fertilized probably by *A. Nordmanniana refracta* Carr. (see Bailly in Rev. Hort. 1890, 230). Later hybrids of the same parentage were raised and subsequently described under binomial designations. This is not correct according to the International Rules which provide that such forms should be classed under the hybrid first described like subdivisions of a species.

× *A. insignis* var. *speciosa*, comb. nov. — *Abies Nordmanniana* Hort. apud Bailly in Rev. Hort. 1890, 231.

This cross was raised about the same time as the original cross by Croux of Sceaux near Paris from seed of *Abies Nordmanniana* fertilized by *A. pinsapo*.

× *A. insignis* var. *Beissneriana*, comb. nov. — *Abies Beissneriana* Mottet in Rev. Hort. 1902, 163.

This cross was raised like the following three forms by Moser of Versailles in 1878 from seed of *A. pinsapo* fertilized by *A. Nordmanniana*. Mottet's name cannot invalidate the later *A. Beissneriana* Rehder & Wilson, a species of China, as it is a non-valid name, being given to a hybrid which already was provided with a specific name.

× *A. insignis* var. *Kentiana*, comb. nov. — *Abies Kentiana* Mottet, l. c.

× *A. insignis* var. *Andreana*, comb. nov. — *A. Andreana* Mottet, l. c.

× *A. insignis* var. *Mastersiana*, comb. nov. — *A. Mastersiana* Mottet, l. c.

Abies spectabilis Spach var. *brevifolia*, comb. nov. — *A. Webbiana* var. *brevifolia* A. Henry in Elwes & Henry, Trees Gt. Brit. iv. 751 (1909).

This according to Henry is the form of the northwestern Himalayas where it grows above *A. pindrow* Spach at elevations of 10–14000 feet. It chiefly differs from the type in its shorter leaves not exceeding 3 cm. in length, grayish beneath with inconspicuous stomatic bands. The tree is in cultivation in England, but the date of its introduction is uncertain; it is certainly harder than the type.

Abies alba Miller, Dict. ed. 8, No. 1 (1768). — Nymann, Conspect. Fl. Eur. 673 (1878). — Ascherson & Graebner, Syn. Mitteleur. Fl. i. 191 (1897). — *Pinus Picea* Linnaeus, Spec. ii. 1001 (1753). — *Pinus Abies* Duroi, Obs. Bot. 39 (1771). — *Pinus pectinata* Lamarck, Fl. Franç. ii. 202 (1778). — *Abies vulgaris* Poiret in Lamarck, Encycl. Méth. vi. 514 (1804). — *Abies pectinata* De Candolle in Lamarck, Fl. Franç. iii. 276 (1805). — *Abies Picea* Bluff & Fingerhut, Comp. Fl. Germ. ii. 541 (1825), non Miller. — Lindley in Penny Cycl. i. 29 (1833). — *Picea pectinata* Loudon, Arb. Brit. iv. 2329 (1838).

As far as I can see *Abies alba* is the correct name for the European Silver Fir. Though the oldest name for the species is *Pinus Picea* Linnaeus, the combination *Abies Picea* Bluff & Fingerhut cannot be accepted, as there is the older homonym *Abies Picea* Miller which is a valid name being the correct name of the European Spruce under the genus *Abies*. One may possibly question the validity of Miller's name *Abies Picea*, as the oldest name is *Pinus Abies*, but if that specific name had been used for the combination, it would have been against art. 55, 2° and likewise against the usage of all the older botanists. Therefore it was necessary to select a new specific name. It is certainly unfortunate that Miller used the name *Abies Picea* for the European Spruce, but as Miller did not base his names under *Abies* on any of the species published previously by Linnaeus under *Pinus*, his name is not an erroneous transfer, but a new specific name, given by Miller for the reason that *Picea* was the generally accepted prelinnean name for the Spruce and therefore according to his view the correct name. The objection, however, may be raised against the name *Abies alba* Miller, that it could not be considered a valid name, as it has been formed against the rules, which no doubt is the case, but as the correct combination is preoccupied, it is the next oldest name and therefore the valid name for this species. For those who follow the Philadelphia Code there can be no question that *Abies alba* is the correct name, as the combination *Abies Picea* is preoccupied by an older homonym, and by those who still follow the so-called Kew Rule *Abies alba* is to be accepted as the first name under the correct genus.

Abies alba f. *columnaris*, comb. nov. — *Abies pectinata columnaris* Carrière in Rev. Hort. 1859, 39; *Traité Conif.* ed. 2, 282 (1867). — *Pinus Picea* f. *columnaris* (Carr.) Voss in Putlitz & Meyer, *Landlex.* iv. 774 (1913).

A form with very short branches of nearly equal length forming a columnar head. There is another columnar form *A. alba* f. *pyramidalis* (Carr.) Voss in which the columnar shape is caused by a different mode of branching similar to that of the Lombardy Poplar.

Abies lasiocarpa f. *compacta*, comb. nov. — *Abies subalpina compacta* Beissner in Mitt. Deutsch. Dendr. Ges. ix. 64 (1900); *Handb. Nadelholzk.* ed. 2, 183 (1909). — *Pinus lasiocarpa* f. *compacta* Voss in Putlitz & Meyer, *Landlex.* iv. 776 (1913).

This dwarf compact form was first described in 1900 by Beissner who states that he had seen specimens about 1 m. in diameter, but he says nothing about the origin. At the Arnold Arboretum a dwarf compact form was raised from seed sent by Dr. C. C. Parry in 1873 from Colorado. Beissner in 1909 also mentions a similar form originated in 1890 in the nursery of Mr. Ordnung in Eisenberg, Bohemia.

Picea Abies Karst. f. *argenteo-spica*, comb. nov. — *P. excelsa argenteo-spica* Hesse apud Beissner, *Handb. Nadelh.* 367 (1891). — *P. excelsa argenteo-spicata* Beissner in Mitt. Deutsch. Dendr. Ges. vi. 50 (1897); *Handb. Nadelh.* ed. 2, 240 (1909). — *Pinus Abies* f. *argentei-spicata* Voss in Putlitz & Meyer, *Landlex.* iv. 770 (1913).

Picea Abies f. *cinnamata*, comb. nov. — *Picea excelsa cinnamata* Hesse apud Beissner in Mitt. Deutsch Dendr. Ges. vi. 92 (1897).

Picea Abies f. *elegans*, comb. nov. — *Abies excelsa* β . *elegans* Forbes, Pinet. Woburn, 90 (1839). — *Pinus excelsa elegans* Rinz in Gartenfl. vi. 334 (1857), nomen. — *Picea excelsa elegans* Beissner, Handb. Nadelh. 363 (1891).

Picea Abies f. *Ellwangeriana*, comb. nov. — *Picea excelsa Ellwangeriana* Beissner, Handb. Nadelh. 366 (1891). — *Abies excelsa Ellwangeriana* Hort. ex Beissner, l. c., as synonym.

Picea Abies f. *Merkii*, comb. nov. — *Picea excelsa* var. *Merkii* Beissner in Jaeger & Beissner, Ziergeh. ed. 2, 440 (1884). — *Abies excelsa Merkii* Dieck, Haupt-Cat. Zoeschen, 86 (1885), nom.

Picea Abies f. *monstrosa*, comb. nov. — *Abies excelsa* 11. *monstrosa* (Hort.) Loudon, Arb. Brit. iv. 2295 (1838). — *Abies aelada* Savi in Flora, xxvii. 519 (1844). — *Pinus Abies* 11. *monstrosa* Antoine, Conif. 92 (1842-45). — *Pinus Picea* var. λ . *monstrosa* Endlicher, Syn. Conif. 118 (1847). — *Pinus excelsa monstrosa* Rinz in Gartenfl. vi. 334 (1857), nom. — *Picea excelsa* l. *monstrosa* Regel, Russk. Dendr. ed. 2, 33 (1883). — Beissner, Handb. Nadelh. ed. 2, 266 (1909), non ed. 1 (1891), nec 1884, necque *P. excelsa monstrosa* Carrière. — *Picea excelsa* ϵ . *monocaulis* Noerdlinger apud Willkomm, Forst. Fl. ed. 2, 76 (1887). — Boehm in Zeitschr. Forst. Jagdwes. xxv. 227, fig. (1895). — *Picea vulgaris* f. *monocaulis* Beck, Niederoestr. Fl. i. 7 (1890). — *Picea excelsa* l. *monocaulis* Ascherson & Graebner, Syn. Mitteleur. Fl. i. 198 (1897). — *Picea excelsa* lus *montrosa* [sic] Schroeter in Vierteljahrsschr. Naturf. Ges. Zuerich, XLIII. 170 fig. 18 (Vielgestalt. Fichte, 50) (1898).

The name *monstruosa* had been applied by Carrière and *monstrosa* by Beissner in his earlier publications to a sparingly branched form, but Loudon describes a form with a single unbranched thick stem.

Picea Abies f. *parviformis*, comb. nov. — *Abies excelsa parviformis* Maxwell in Horticulturist xxix. 201 (1874). — R. Smith, Pl. Fir. Tribe, 5 (187.?). — *Picea excelsa parviformis* Otto in Hamburg. Gart. Blumenzeit. xxii. 158 (1866), nom. — Beissner, Syst. Einth. Conif. 37 (1887).

Picea Abies f. *procumbens*, comb. nov. — *Abies excelsa procumbens* A. Murray, in Ravenscroft, Pinet. Brit. ii. 138 (1867). — *Picea excelsa procumbens* Carrière, Traité Conif. 251 (1855).

Picea Abies f. *pygmaea*, comb. nov. — *Abies excelsa* 8. *pygmaea* Loudon, Arb. Brit. iv. 2295 (1838). — *Pinus Abies* 8. *pygmaea* Antoine, Conif. 91 (1842-45). — *Pinus Picea* var. θ . *pygmaea* Endlicher, Syn. Conif. 118 (1847). — *Abies pygmaea* (Fisch.) Wenderoth, Pflanz. Bot. Gaert. i. Conif. 17 (1851). — *Picea excelsa pygmaea* Carrière, Traité Conif. 250 (1855). — *Pinus excelsa pygmaea* Rinz in Gartenfl. vi. 334 (1857), nom.

Picea Abies f. *pyramidata*, comb. nov. — *Picea excelsa pyramidata* Carrière, Traité Conif. 247 (1855). — *Abies excelsa* Hort. apud Gordon, Pinet. Suppl. 5 (1862). — *Picea excelsa pyramidalis* Vos, Bered. Woordenb. Heest. Conif. 176 (1867). — *Picea excelsa* f. *pyramidalis* Berg in Schrift. Naturf.

Ges. Dorpat, II. 17, t. 6 (1887). — *Picea excelsa* lusus *erecta* Schroeter in Vierteljahrsschr. Naturf. Ges. Zuerich, XLIII. 89 (1898). — *Picea excelsa* var. *europaea* lusus *pyramidata* Schroeter in Ber. Schweiz. Bot. Ges. XIII. 107, fig. 3 (1903). — *Picea excelsa* var. *pyramidalis* subvar. *pyramidata* Schneider in Silva-Tarouca, Uns. Freil.-Nadelh. 230 (1913). — *Picea Abies* var. *pyramidalis* Nash in Jour. N.Y. Bot. Gard. XVIII. 89 (1917).

Picea Abies f. *Remontii*, comb. nov. — *Abies excelsa* *Remontii* R. Smith, Pl. Fir Tribe, 5 (187?). — *Picea excelsa* *Remontii* Beissner, Syst. Einth. Conif. 37 (1887). — Purpus in Moeller's Deutsch. Gaertn.-Zeit. XXI. 557, fig. 4 (1906). — Schneider in Silva-Tarouca, Uns. Freil.-Nadelh. 230, fig. 206 (1913).

Picea glauca f. *aurea*, comb. nov. — *Abies canadensis* *aurea* Nelson, Pinac. 32 (1866). — *Picea alba aurea* Seneclauze, Conif. 23 (1868). — Beissner, Handb. Nadelh. 343 (1891). — *Picea laxa* f. *aurea* Voss, Vilmorin's Blumengaert. ed. 3, I. 1241 (1896). — *Picea canadensis aurea* Sudworth in U.S. Dept. Agric. Div. For. Bull. XIV. 38 (Nomencl. Arb. Fl.) (1897).

Though the oldest name for the White Spruce is *Abies canadensis* Miller, the specific name "*canadensis*" cannot be used under *Picea*, as there exists already the older homonym *P. canadensis* Link which is the valid name for the Hemlock Spruce under the genus *Picea*. Therefore the specific name of the next oldest binomial which is *Pinus glauca* Moench (1785) has to be used and the correct name of the White Spruce becomes *Picea glauca* Voss (see also Sargent in Bot. Gaz. LXVII. 208, 1919).

Picea glauca f. *coerulea*, comb. nov. — *Abies alba glauca* Dimsdale apud Knight & Perry, Syn. Conif. 36 (1850), nom. — Plumbly apud Gordon, Pinet. 3 (1858). — *Abies alba coerulea* Nelson, Pinac. 47 (1866). — *Picea alba coerulea* Carrière, Traité Conif. ed. 2, 320 (1867), pro parte. — *Picea alba glauca* Hort. apud Seneclauze, Conif. 23 (1868). — *Picea laxa* f. *coerulea* Voss, Vilmorin's Blumengaert. ed. 3, I. 1241 (1896). — *Picea canadensis glauca* (Moench) Sudworth in U.S. Dept. Agric. Div. For. Bull. XIV. 37 (Nomencl. Arb. Fl.) (1897). — *Picea alba* var. *argentea* Zederbauer in Sitzber. Akad. Wiss. Wien Math.-Nat. Kl. CXVI. 1938 (1907). — *Picea canadensis* var. *coerulea* Schneider in Silva-Tarouca, Uns. Freil.-Nadelh. 224 (1913). — *Pinus glauca* f. *coerulea* Voss in Putlitz & Meyer, Landlex. IV. 771 (1913).

This is a form with very glaucous, sometimes nearly silvery white leaves. The varietal name *coerulea* starts with *Abies alba coerulea* Nelson which is not based on any previously published name; the earlier varietal name *glauca* cannot be used, as it would repeat the specific name without designating the type. The plant described as *Abies rubra* var. *coerulea* Loudon, *Picea coerulea* Link or *Pinus rubra* β . *violacea* Endlicher has been often referred to this form, but according to the description it is apparently a form of *P. mariana* Britton, Sterns & Poggenburg.

Picea glauca f. *nana*, comb. nov. — *Abies alba* var. *nana* Jacques in Ann. Fl. Pom. V. 326 (1836); Monog. Conif. 67 (1837). — Loudon, Arb. Brit. IV. 2311 (1838). — *Pinus alba nana* Antoine, Conif. 87 (1842-45). — *Pinus*

alba β . *nana* (Loud.) Endlicher, Syn. Conif. 113 (1847). — *Picea alba nana* Carrière, Traité Conif. 239 (1855). — *Abies alba prostrata* Hort. ex Beissner, Handb. Nadelh. 342 (1891), as synonym of *P. alba nana*. — *Picea canadensis nana* (Loud.) Sudworth in U.S. Dept. Agric. Div. For. Bull. xiv. 38 (Nomencl. Arb. Fl.) (1897).

GRAMINEAE

Sasa Veitchii, n. comb. — *Phyllostachys bambusoides* β . *albo-marginata* Miquel in Ann. Mus. Bot. Lugd.-Bat. ii. 284 (Prol. Fl. Jap. 172) (1866). — *Bambusa senanensis*? β . *albo-marginata* Franchet & Savatier, Enum. Pl. Jap. ii. 606 (1879). — *Bambusa Veitchii* Carrière in Rev. Hort. 1888, 90. — Watson in Gard. Chron. ser. 3, iii. 382 (1888). — *Arundinaria Veitchii* N. E. Brown in Gard. Chron. ser. 3, v. 521 (1889). — *Bambusa albo-marginata* Makino in Descr. Prod. For. Paris Exp. 37 (1900); in Tokyo Bot. Mag. xiv. (62) (1900), nomen. — *Arundinaria albo-marginata* Makino in Tokyo Bot. Mag. xiv. 30 (1900). — *Sasa albo-marginata* Makino & Shibata apud Makino & Shirasawa, Icon. Bamboos Jap. 45, t. 11, figs. 21-27 (1900); in Tokyo Bot. Mag. xv. 25 (1901).

JAPAN.

Makino took up the oldest varietal name for the species, but the existence of a previous binomial makes that new combination inadmissible according to the International Rules, as in the case of the following species.

Sasa Veitchii f. *minor*, n. comb. — *Arundinaria albo-marginata* f. *minor* Makino in Tokyo Bot. Mag. xiv. 32 (1900). — *Bambusa albo-marginata* f. *minor* Makino ex Makino, l. c., pro synonym. — *Sasa albo-marginata* f. *minor* Makino & Shibata in Tokyo Bot. Mag. xv. 25 (1901). — *Sasa albo-marginata* f. *nana* Camus, Bambus. 21, t. 3, fig. c (1913).

Sasa senanensis, comb. nov. — *Arundinaria kurilensis* γ . *paniculata* Fr. Schmidt in Mém. Acad. Sci. St. Pétersb. ser. 7, xii. no. 2, 198 (Fl. Sacchal.) (1868). — *Bambusa senanensis* Franchet & Savatier, Enum. Pl. Jap. ii. 182, 606 (1879). — Hackel in Bull. Herb. Boiss. vii. 719 (1899). — *Arundinaria palmata* Marliac apud Bean in Gard. Chron. ser. 3, xv. 368, f. 19 (p. 167) (1894). — *Bambusa tessellata* Makino in Tokyo Bot. Mag. ix. 73 (1895), non Munro. — *Bambusa paniculata* Makino in Descr. Prod. For. Paris Exp. 37 (1900); in Tokyo Bot. Mag. xiv. (62) (1900), nomen. — *Arundinaria paniculata* Makino in Tokyo Bot. Mag. xiv. 50 (1900). — *Sasa paniculata* Makino & Shibata apud Makino & Shirasawa, Icon. Bamboos Jap. 47, t. 11, figs. 7-15 (1900); in Tokyo Bot. Mag. xv. 25 (1901). — Camus, Bambus. 24, t. 2, figs. c, d (1913).

JAPAN.

Sasa senanensis f. *nebulosa*, comb. nov. — *Bambusa palmata* f. *nebulosa* Makino in Descript. Prod. For. Paris Exp. 37 (1900); in Tokyo Bot. Mag. xiv. (61) (1900), nomen. — *Arundinaria paniculata* f. *nebulosa* Makino in Tokyo Bot. Mag. xiv. 61 (1900). — *Arundinaria paniculata* f. *nebulosa* Makino in Tokyo Bot. Mag. xiv. 52 (1900). — Makino & Shirasawa, Icon. Bambus. Jap. 49, t. 7, figs. 6-9 (sub *Sasa* in tab.) (1900). — *Sasa paniculata*

f. *nebulosa* Makino & Shibata in Tokyo Bot. Mag. xv. 26 (1901). — *Sasa paniculata* var. *nebulosa* Camus, Bambus. 24 (1913).

Sasa senanensis var. *stenantha*, n. comb. — *Bambusa stenantha* Makino in Descript. Prod. For. Paris Exp. 37 (1900), nomen; in Tokyo Bot. Mag. xiv. (62) (1900). — *Arundinaria paniculata* var. *stenantha* Makino in Tokyo Bot. Mag. xiv. 52 (1900). — *Sasa paniculata* var. *stenantha* Makino & Shibata in Tokyo Bot. Mag. xv. 26 (1901). — Camus, Bambus. 24 (1913).

Sasa paniculata var. *nana* Makino & Shibata is *S. nana* Makino in Tokyo Bot. Mag. xxvi. 11, fig. 1 (1912). Of *S. paniculata* var. *Ontakensis* (Franch. & Sav.) Camus, Bambus. 24, t. 2, fig. B (1913) and var. *depauperata* Camus, l. c. 25 I am not quite certain if they belong here.

JUGLANDACEAE

Carya cathayensis Sargent, Pl. Wilson. III. 187 (1916).

This interesting recent addition to the Chinese flora had been known only from the type locality, the mountains round Changhua Hsien in the province of Chekiang, where it was discovered in 1915 by F. N. Meyer and later also collected by D. Macgregor; therefore it was considered a tree of very restricted distribution. A collection of Chinese woody plants, however, recently received at the Arboretum contained a specimen of this species from Kweichow where it had been found by Dr. H. von Handel-Mazetti as a cultivated tree between Kutchou and Liping at an altitude of 950 m. near the village of Mantunggai in the extreme southeastern part of Kweichow near the border of Hunan and Kwangsi. This of course leaves it doubtful whether the tree is growing spontaneously in that region or not, but it seems more likely that it was brought from the neighboring mountains than that it has been introduced from the province of Chekiang, a distance of about 750 miles. If the Chinese Hickory were frequently cultivated by the Chinese, it would seem strange that such a distinct and handsome tree had not been discovered earlier in some of the better explored regions of China. The spontaneous occurrence of *Carya cathayensis* in Kweichow would extend its range southwestward from 119° to 109° E. Long. and would make probable the occurrence of this tree in Kiangsi, Hunan and possibly Kwangsi.

BETULACEAE

Carpinus Handellii, spec. nov.

Arbor "speciosa"; ramuli novelli dense molliter villosi-pilosi, annotini glabrescentes vel glabri, fusco-brunnei, obscure lenticellati. Folia oblongo-ovata vel elliptico-lanceolata, satis longe acuminata, basi leviter obliqua, late cuneata vel subrotundata, 5-10 cm. longa et 1.8-3.6 cm. lata, subsimpliciter mucronato-serrulata dentibus modice inaequalibus saepe fere ad mucronem reductis plerisque nervos terminantibus, nervis utrinque 14-16, supra leviter impressis, subtus prominentibus et trabeculis approximatis elevatis conjunctis, juniora utrinque dense villosa, maturitate chartacea,

supra costa minute puberula excepta glabra, subtus praecipue ad costam, nervos et venulos dense breviter pilosa, in costa pilis sericeis interspersis, in axillis barbulata; petioli 2–4 mm. longa, dense breviter pubescentes. Inflorescentia fructifera satis densa, pedunculo 1.5–2 cm. longo incluso 8–9 cm. longa; bracteae semiovatae, circiter 2 cm. longae et 8 mm. latae, margine convexiore dentatae dentibus paucis latis brevibus interdum fere obsoletis, latere recto integrae vel subintegrae, basi leviter inflexae et basin nuculae amplexantes, basi circiter 5-costatae costis et nervis extus adpresse pubescentibus intus fere glabris; nuculae late ovoideae, compressae, 8–9-costatae, perigonio coronatae, minute pilosulae, apice longius pilosae, resinosae.

CHINA. Hunan: inter urbes Linling (Yungehoufu) et Sinning in silvis collium supra vicum Tjientesse, alt. 400 m., Aug. 14, 1917, *H. von Handel-Mazetti* (No. 421, type); in silva infra Tungdjiapai prope minas Hsikwangshan, dist. Hsinhwa, alt. 550 m., May 20, 1918, *H. von Handel-Mazetti* (No. 534, "arbor excelsa").

This is a well-marked species of the section *Eucarpinus*, characterized chiefly by the rather large, short-petioled, closely veined, nearly simply serrate leaves with small mucronate teeth, by the dense villose pubescence of the young branchlets and leaves, by the short-pilose pubescence of the under side of the mature leaves, silky or wanting in most other species, by the shallowly dentate, not lobed bracts and the minutely pilose resin-dotted nutlets. *Carpinus Handelii* is apparently most closely related to *C. Tschonoskii* Maxim. and *C. polyneura* Franch.; the first differs chiefly in its longer petioles 0.5–1.5 cm. long, in the doubly serrate leaves glabrous beneath except a silky pubescence on the veins, and in the glabrous nutlets; the second species in its smaller, slender-petioled leaves with larger and fewer simple teeth, in the smaller fruiting catkins and in the absence of resin-dots on the nutlets. In the size, shape and serration of the leaves the new species resembles the Himalayan *C. faginea* Lindley, but that species has the leaves glabrous beneath, at least at maturity except the silky-pubescent midrib and secondary veins, and has smaller more sharply serrate-dentate bracts and apparently no resin-dots on the nutlets (only immature fruit seen).

Betula pendula Roth f. *viscosa*, comb. nov. — *Betula dentata viscosa pyramidalis* L. Chenault & Fils, Cat. 1912/13, 3. — *Betula verrucosa* var. *dentata viscosa* Bean, Trees & Shrubs, 1. 264 (1914).

A slow-growing bushy tree of dense pyramidal habit; young branchlets densely glutinous-verrucose; leaves triangular-ovate, 3–6 cm. long, acuminate, truncate or occasionally subcordate at the base incisely and doubly dentate and lobulate, glabrous with glandular dots beneath; petioles 0.4–1 cm. long. In the shape of its leaves it resembles somewhat *B. alba* var. *urticaefolia* Spach, but it is perfectly glabrous and the branchlets are very resinous. In habit it has some resemblance to *B. pendula* f. *fastigiata* K. Koch, but the leaves are more deeply and coarsely toothed, the petioles are shorter and the branchlets more densely resinous.

(To be continued)

NOTES ON NORTH AMERICAN TREES. V¹

C. S. SARGENT

Populus tacamahacca Mill. — This name has recently been taken up² for the Balm of Gilead or Ontario Poplar, *Populus candicans* Ait. Miller's description, however, of *Populus tacamahacca*, "foliis subcordatis, inferne incanis," applies equally well to the common Balsam Poplar of northeastern North America. In his detailed description Miller speaks of the leaves as "differing from each other in shape and size, most of them almost heart-shaped, but some are oval and rather nearer to spear-shaped. In the Balsam Poplar the leaves vary from ovate to lanceolate, and are subcordate, rounded or cuneate at base, and are not broad-ovate, deeply cordate and abruptly pointed at apex, as are the leaves of *P. candicans* Ait. Miller describes the staminate flowers of his *P. tacamahacca*, but as only pistillate trees of *P. candicans* have been seen, his description of the staminate flowers cannot apply to that species. According to Aiton *P. candicans* was not introduced into England until about 1772, or fourteen years after Miller's description of his *P. tacamahacca* was published. The evidence certainly seems to show therefore that Miller included in his description of *Populus tacamahacca* the different forms of the Balsam Poplar which all authors but Miller have called *P. balsamifera* and for which Miller's name should be adopted.

With the material found in herbaria which I have seen it has not been possible to determine the western range of *Populus tacamahacca*, for without the pistillate flowers or the fruit it is impossible to distinguish this species from the western *P. trichocarpa* Torr., and specimens with leaves only collected in Montana, Idaho, northern California and on the coast of Alaska can be equally well referred to one of these species as to the other.

Populus tacamahacca var. **Michauxii** Farwell in *Rhodora*, XXI. 101 (1919). — *P. candicans* Sargent, *Silva N. Am.* IX. t. 490, f. 1, 2 (staminate flowers), (1896), not Aiton. — *P. Michauxii* Dode, *Extr. Monog. Ined. Populus*, 62, (1905). — *P. balsamifera* var. *Michauxii* A. Henry, *Gard. Chron.* ser. 3, LIX. 230 (1916). — This is a common northern variety with cordate or subcordate leaves slightly pilose on the under side of the midribs and veins, and distributed from Aroostook County, Maine, to the Province of Quebec, Newfoundland and the shores of Hudson Bay.

Populus acuminata var. **Rehderi**, n. var.

A typo recedit foliis majoribus plerisque longius petiolatis, ramulis junioribus et gemmis pubescentibus, fructibus minoribus.

A large tree with smooth gray or greenish yellow bark, becoming deeply

¹ The preceding parts of this series have appeared in *Botanical Gazette*: I. *Quercus*. (LXV. 423-459. 1918). — II. *Carya*. (LXVI. 229-358. 1918). — III. *Tilia*. (LXVI. 428-438, 494-511. 1918). — IV. (LXVII. 208-242. 1919).

² Farwell in *Rhodora*, XXI. 101, 1919.

furrowed on old trunks. Leaves 8–11 cm. long and 6–7 cm. wide, their petioles up to 7 cm. in length. Fruit 3–5 mm. long in crowded aments 6–7 cm. in length.

DISTRIBUTION. River banks, Silver City, Grant County, New Mexico, *A. Rehder*, August 10, 1914 (No. 275); *Alice Eastwood*, April and May, 1919 (Nos. 8175, 8176, 8178, 8179, 8201, 8296, 8345, 8347, 8348, 8356, 8357, 8358, 8379, 8383 [type], 8384, 8393, 8423, 8424, 8433, 8453, 8455, 8456, 8479. River banks near Fort Whipple (Nos. 8831 and 8841) and Prescott (Nos. 8853 and 8854), Yavapai County, Arizona, *Alice Eastwood*, May, 1919.

***Populus Fremontii* var. *macrodisca*, n. var.**

A typo recedit disco lato et alto capsulam fere includente.

A tree with glabrous branchlets, reddish brown when they first appear, becoming light yellow-brown in their first winter. Leaves broad-ovate, abruptly long-pointed and acuminate at apex, subcordate at the broad base, and gradually narrowed and cuneate to the insertion of the petiole, coarsely crenately serrate, glabrous, 7–9 cm. long and broad; petioles slender, 5–8 cm. in length. Fruit in aments 10–12 cm. long, ellipsoidal, rounded at the ends, 7–8 mm. long, enclosed to above the middle or nearly to the apex in the broad cup-like disk slightly undulate on the margins; pedicels 2–3 mm. long.

DISTRIBUTION. Near Silver City, Grant County, New Mexico, *Alice Eastwood*, May, 1919 (Nos. 8429 [type], 8435).

In the peculiar shape of the base of its leaves this variety resembles *Populus Fremontii* var. *Toumeyi* Sargent which has been collected by Miss Eastwood in the neighborhood of Silver City, but the leaves are larger. The size of the disk under the fruit distinguishes this tree from all other American Poplars.

Populus balsamifera Linnaeus, Spec. 1034 (1753). — *P. angulata* Michaux f., Hist. Arb. Am. III, 302, t. 12 (1813). — *P. angulata* var. *missouriensis* A. Henry in Elwes & Henry, Trees of Great Britain, VII, 1811 (1913). — *P. deltoidea* var. *missouriensis* A. Henry in Gard. Chron. ser. 3, LVI, 46 (1914).

The fact has long been known to students of American trees that the *Populus balsamifera* of Linnaeus was one of the Cottonwoods and not the Balsam Poplar of northeastern North America for which Linnaeus's name has long been used, but it is only recently that the correct application of the name has been suggested in print.¹ Linnaeus based his species on the *Populus nigra*, folio marimo, gemmis balsamum odoratissimum fundentibus of Catesby (*Hist. Nat. Car.* I, 34, t. 34). Catesby's specimen from which his figure was made is preserved in the British Museum and through the courtesy of Dr. Rendle the Arboretum possesses an excellent photograph of this specimen which must be taken as the type of *P. balsamifera* Linnaeus. It does not represent the common Cottonwood of the eastern states but a tree which, although widely distributed, is now rare and local. The leaves

¹ Farwell in *Rhodora*, XXI, 101 (1919).

are ovate, longer than broad, abruptly acuminate at apex, subcordate or rarely truncate at base, finely crenately serrate, 12–15 cm. long and 10–12 cm. wide. The flowers and fruit do not differ from those of the common Cottonwood, and the angular branchlets, which have often been considered a specific character of this tree, have no significance for such branchlets occur on all forms of *P. balsamifera* and on the Rocky Mountain *P. Sargentii*.

I have seen specimens of *P. balsamifera* from the shore of Lake Champlain at Shelburne Point, Chittenden County, Vermont; near Rochester, Munroe County, New York; from an island in the Delaware River above Easton, Northampton County, Pennsylvania; North Bend on the Ohio River, Hamilton County, Ohio; banks of the Potomac River opposite Plummer's Island, about Bare Hills and near Copper Mine, Baltimore County, Maryland; banks of the Chattahoochee River at Columbus, Muscogee County, Georgia; River Junction, Gadsden County, Florida; Starkville, Oktibbeha County, and Artisia, Lowndes County, Mississippi.

The *Populus angulata* of the younger Michaux, although he did not describe or figure the staminate flowers, is probably the *P. balsamifera* of Linnaeus, but it is impossible to determine if the *P. angulata* of Aiton is the *P. balsamifera* of Linnaeus or the tree now cultivated in Europe as *P. angulata*, on which the scales of the flowers are dentate, not fimbriate at apex. Trees with such scales have not been found growing wild in the United States, and it is possible that all the trees with these peculiar scales have been propagated from one abnormal individual. For the common Cottonwood of the eastern states, which differs only from *P. balsamifera* of Linnaeus in its smaller ovate-deltoid leaves, the following name can be adopted:

***Populus balsamifera* var. *virginiana*, n. comb.**

P. deltoidea Marshall, Arbust. Am. 107, 106 (1785), at least in part. *P. nigra* β. *virginiana* Castiglioni, Viag. negli Stati Uniti, II. 374 (1790). — *P. deltoidea* var. *angulata* Sargent, Trees and Shrubs, II. 212 (1913), in part.

The leaves of northern trees of this variety are quite glabrous, but south of the Potomac and Ohio Rivers many individuals occur on which the under side of the midribs and principal veins are pilose, especially early in the season. This form, which is probably the *P. angulata* var. *missouriensis* A. Henry in part and the *P. deltoidea* var. *angulata* Sargent in part, may be called

***Populus balsamifera* var. *pilosa*, n. nom.**

***Betula papyrifera* var. *elobata*, n. comb.** — *B. alba* var. *elobata* Fernald in Rhodora, xv. 169 (1913).

***Betula papyrifera* var. *occidentalis*, n. comb.** — *B. occidentalis* Hooker, Fl. Bor. Am. II. 155 (1839). — *B. papyracea* var. *occidentalis* Dippel, Laubh. II. 177 (1892). — *B. Lyalliana* Koehne in Mitt. Deutsch. Dendr. Ges. VIII. 53 (1899), nom. nud. — *B. papyrifera* var. *Lyalliana* Koehne apud Schelle in Beissner, Schelle & Zabel, Handb. Laubholz.-Ben. 55 (1903).

***Betula papyrifera* var. *subcordata*, n. var.** — *B. subcordata* Rydberg apud Butler in Bull. Torrey Bot. Club, xxxvi. 496, f. 15 (1909).

This variety of the Canoe Birch differs from the type in the slightly cordate or rounded base of the leaves which are acute on the type specimen but are as often acuminate or abruptly acuminate as acute; the spreading teeth of the leaves, which have been used to distinguish this tree, more often point forward and appear to have no specific importance. The bark separates in thin layers and is usually white but is sometimes on occasional trees dark red-brown or orange color.

This is the common White Birch of the northern Rocky Mountain region from Alberta to northern Montana and Idaho, and westward to eastern Washington, Oregon and British Columbia where it grows with the var. *occidentalis* Sarg. from which it differs chiefly in its smaller leaves subcordate or rounded at base, and its usually smaller strobiles. The leaves of the var. *occidentalis* Sarg. are rounded or cuneate at base, and only rarely cordate usually only on vigorous shoots. The color of the bark, as in *B. papyrifera* and its varieties, differs on different individuals from white to reddish brown and to orange color.

Much reliance has been placed on the color of the bark for distinguishing species among the Canoe Birches which cross the continent in the north, but late collections indicate that this character cannot be depended on. The pubescence on the leaves and branchlets do not furnish specific characters in this group, and the shape of the scales of the mature strobiles, which usually vary in all species of *Betula*, cannot be used to separate successfully the different varieties of the Canoe Birch as here considered.

Betula papyrifera var. *montanensis*, n. var. — *B. montanensis* Butler in Bull. Torrey Bot. Club, xxxvi. 439, f. 17 (1909).

From other forms of *Betula papyrifera* this variety differs in its thicker, darker green leaves and in the unusually long base of some of the mature scales under the nutlets which below the middle of the strobile is rather more than twice the length of the expanded upper part of the scale, while near the apex of the strobile it is only about as long. The leaves of the type of *B. montanensis* from Yellow Bay on the eastern shore of Flathead Lake, Montana, are represented as broadly ovate, truncate at base and acute at apex; and the bark of this tree is described as of the same bronze color as that of *B. occidentalis* but "is dull, never peeled, and is always mottled with gray." What is evidently the same variety was collected by J. G. Jack September 13, 1919, at Sandpoint, Bonner County, Idaho, where close to the railroad station are growing a number of trees 14–17 m. tall with white bark. On one of the two branches collected by Mr. Jack the leaves resemble exactly the leaf of *B. montanensis* as figured in the Bull. Torrey Bot. Club, but on the fruiting branch of the same tree the leaves are all coarsely doubly serrate, long-pointed and acuminate, and vary from broad-ovate with a rounded base to oblong-ovate or lanceolate, and narrowed and rounded at base, and are 10–12 cm. long and 4–5 cm. wide. The branchlets during the first season are puberulous. In the stoutness of the mature catkins and in the shape of their scales, and in the shape and thickness of the leaves this appears the most distinct of the different forms of the Canoe Birch.

Betula fontinalis Sarg. — The type of this species is from Manitou, Colorado, on the eastern foothills of the Rocky Mountains. The strobiles of some of the Manitou plants are 4 cm. long and 10 or 12 mm. in diameter; on other plants in the same locality the strobiles are only 2.5 cm. long and 5 mm. in diameter. Specimens from other parts of Colorado show a similar variation in the size of the strobiles. The length and thickness of the strobiles and the shape of their scales have been used to distinguish *B. Piperi* Britt. from *B. fontinalis*. The longest strobiles of *B. Piperi* are 4 cm. long and 5 cm. thick and are longer than the longest of *B. fontinalis*, but the size of the strobile varies so much on different individuals that it has no value in distinguishing species. The shape of the scales of the strobiles has also been used as a character for distinguishing *B. Piperi* from *B. fontinalis*, those of *B. fontinalis* being described with "lateral lobes ascending or erect, shorter than the middle one," and those of *B. Piperi* with "lateral lobes widely spreading and obtuse, about as long as the narrower acute middle one." These descriptions are true of the scales of some individuals, but, as in other species of *Betula*, the scales vary greatly in shape, and scales of the two forms occur on thick and slender strobiles, and often on the same tree.

Betula Piperi is a tree sometimes 16 or 17 m. high, with a tall single stem occasionally 3 dm. in diameter. On the strength of its habit therefore *B. Piperi* had perhaps best be distinguished as

Betula fontinalis var. *Piperi*, n. var. — *B. Piperi* Britton in Bull. Torrey Bot. Club, xxxi. 165 (1904).

This appears to be a rare and local tree and to be confined to western Washington where it occurs in the neighborhood of Pullman and Almota, Whitman County, and at Spokane, Lincoln County, where it probably grows to its largest size.

The Birch of this group from California has the short slender catkins of some of the Colorado specimens of *B. fontinalis* and probably should be referred to that species.

I have seen Californian specimens from Sisson, Siskiyou County, *J. G. Jack*, August 26, 1907; Metcalf's ranch, northeast base of Mt. Eddy, Siskiyou County, *A. A. Heller*, No. 12, 133, July 18, 1915 (in Herb. Arnold Arboretum); Upper Sacramento River, Butte County, *W. R. Dudley*, August, 1899; Lone Pine Canyon and Cottonwood Canyon, Inyo County, *E. L. Morris*, April 3, 1905; near Sisson and Salmon Mountains, Siskiyou County, *W. R. Dudley*, August 3, 1899, and August 26, 1901; Upper Sacramento River below Sheldon's Mill, *W. R. Dudley*, August, 1897; Wyand Creek Canyon near Deep Springs Valley, Inyo County, *Roxana, S. Ferris*, July 15, 1918; Round Mountain, *J. F. Phares*, August, 1915; Silver Canyon in the White Mountains east of Laws, Inyo County, *A. A. Heller*, No. 8266, May 9, 1906 (all in Dudley Herbarium, Leland Stanford Jr. University).

NOTES

Arboretum Expedition to Eastern Asia. After an absence of twenty-six months passed in the Japanese Empire Mr. E. H. WILSON returned to the Arboretum on March 17. He had passed 1914 in Japan, and his last journey was undertaken for the purpose of exploring the forests and studying the trees of outlying parts of the Japanese Empire, Korea, the Bonin, and Liukiu Islands, and Formosa. From his last journey Mr. Wilson has brought to the Arboretum 30,000 herbarium specimens, 700 photographs of trees and types of vegetation, and a large collection of seeds and living plants. A picture of every conifer and Taxad of the Japanese Empire, and of every other native tree of Japan proper, Korea, and the Bonin Islands and of most of the trees of Formosa and the Liukiu Islands is found in the Arboretum collection of photographs which offers a good opportunity to study these trees as they grow naturally in their native forests, and well supplements the photographs of the vegetation of western China made by Mr. Wilson during his two journeys in Hupeh and Szechuan for the Arboretum.

From the seeds collected by Mr. Wilson on his last journey a large number of plants have already been raised, including many now first cultivated in western gardens. Of the plants introduced the most important is *Taiwania cupressoides* Hayata, the Redwood of Formosa, the tallest tree in the world outside of California and Australia, and in its young state one of the most beautiful of all conifers. Seeds of *Taiwania* have been distributed by the Arboretum to Botanic Gardens in every country in the world where there is a chance that this tree may grow. There are also a few young plants of *Taiwania* in the Arboretum nursery which can be increased from cuttings in case the seeds, which appear to have a low germinating power, do not produce plants. Seeds of three other important Formosa conifers, *Picea morrisonicola* Hayata, *Abies Kawakamii* Ito, and *Cunninghamia Konishii* Hayata, were also collected by Wilson and have been widely distributed. As a result of Mr. Wilson's visit to the Liukiu Islands the Arboretum has been able to distribute the seeds of *Pinus luchuensis* Mayr. In the Bonin Islands a supply of seeds of the endemic *Juniperus taxifolia* Hooker and Arnott was secured and has been distributed. At least two different plants have been cultivated under the incorrect name of *Juniperus taxifolia*, but this is the first time that seeds have been collected of this interesting Juniper which has not been seen before by an American or European botanist since 1827 when Captain Beechey visited the Bonin Islands.

Assistant Director of the Arboretum. — Since his return Mr. E. H. WILSON has been appointed by the President and Fellows of the University Assistant Director of the Arboretum.

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NOTES ON AMERICAN WILLOWS. VI.

CAMILLO SCHNEIDER

a. THE SPECIES OF THE SECTION *PHYLICIFOLIAE*

THE following study of the species of the section *Phylicifoliae* is chiefly based on the collections of the herbaria of the Arnold Arboretum, the Field Museum of Chicago, the Californian Academy, the Missouri Botanic Garden, the Geological Survey of Canada, the Leland Stanford University, of Professor W. L. Jepson, Berkeley, Cal., and of the Gray Herbarium and the National Herbarium, but I have been able to consult also some types from the Kew Herbarium and some specimens from the herbaria of the University of Washington and of the University of Wyoming. My thanks are due to the gentlemen in charge of these collections.

It is not without reluctance that I adopt the name *Phylicifoliae* Dumortier for the group to which I refer the following species. I have dealt with the forms of eastern Asia of this section in Sargent, Pl. Wils. III. 122 (1916). To the synonyms there given is to be added: Sect. *Argenteae* Ball in Coulter & Nelson, New Man. Rocky Mts. Bot. 136 (1909), non Koch, and sect. *Argentea* Rydberg, Fl. Rocky Mts. 189 (1917), pro parte. Even if we should place *S. pellita* and the other species with permanently hairy leaves in a different section, the name *Argenteae* used by Ball could, in my opinion, not be adopted because the American species cannot be united with those forms which have been referred by Koch (De Salic. Comm. 46. [1828]) to his section *Argenteae* for which the oldest name is sect. *Incubaceae* Dumortier (Fl. Belg. Prodr. 12 [1827]). Rydberg's *Argentea* group is a mixture of forms of very different relationship. He proposed, in 1906 (Fl. Colo. 93) a sect. *Pellitae*, and it might be the best to use this name for our group if a more thorough study of the relationship of the different sections should prove that the American forms of the *Phylicifoliae* are more closely related to each other than to the species of the Old World.

I am doubtful whether a species like *S. pulchra* Chamisso should be included in this section. It seems to me that it may have closer relations with *S. Richardsonii* Hooker and its allies. But, of course, that is a question which only can be decided if one is better acquainted with all these forms than I am at present. *S. pulchra* differs from the other species of this section by its well-developed and more or less persistent stipules.

The following key is mainly based on the characters afforded by the leaves. I have not yet been able to elaborate separate keys for male and female specimens of which the determination is a rather difficult task owing to the precociousness of the aments and the great similarity especially of the male flowers. It needs a careful comparison of a well-collected series of flowering specimens of each species to thoroughly establish the differences between them without the aid of the leaves.

CLAVIS SPECIERUM VARIETATUMQUE

Folia normalia superiora adulta glabra vel fere glabra (confer etiam 6b. *S. pellitam* var. *psilam*); ramuli hornotini annotinique plus minusve castanei vel purpureo-brunnei et nitiduli sed haud vel raro leviter pruinosi.

Stipulae fere semper valde evolutae, lineares ad lanceolatae, denticulatae, saepe persistentes, 0.5–2.5:0.1–0.6 cm. magnae; folia superiora plus minusve rhombico-oblanccolata, obovato-oblonga vel rhombico elliptica, utrinque acuta vel apice fere subaeuminata, 4:1.5 ad 6:2.5 vel surculorum ad 10:3.2 cm. magna, margine integerrima vel satis indistincte rarius subdensius glanduloso-subserrata, superne intense viridia, saepissime estomatifera, subtus albo-glauescentia; petioli 5–10 mm. longi; amenta mascula circiter 2.5–3.5:1.2 cm., fructifera ad 6.5 cm. magna; fructus ovoideo-rostrati pedicello brevissimo glandula $\frac{1}{2}$ -ad 2-plo breviora excluso 7–8 mm. magni; styli 1.2–2 mm. longi. Ramuli novelli glabri vel sparse (interdum etiam annotini parce unilateraliter) pilosi 1. *S. pulchra*.
Ramuli novelli dense griseo- vel flavescenti-villosi-tomentosi.

1b. *S. pulchra* var. *yukonensis*.

Stipulae semper nullae vel etiam in ramulis vegetis quam petioli duplo breviores, deciduae et plantae aliis signis diversae.

Filamenta basi pilosula; folia superiora ramulorum breviorum vel (infima et) media ramulorum vegetorum anguste ad late obovata vel obovato-oblonga, basi plusminusve cuneata, apice subito brevissime acuta vel plicato-acuta, 4:1.8 — 6:3.3 vel ad 7.5:3 vel angustiora ad 6:2 cm. magna, initio subtus plus minusve breviter sericeo-pilosa; amenta feminea 4.5–6.5 (–8) cm. magna; fructus ellipsoidei subrostrati, ad 8 mm. longi pedicello ad 1.5 mm. longo excluso.

5. *S. pennata*.

Filamenta glaberrima; folia haud vel rarissime late obovalia et plantae aliis signis diversae.

Fructus perfecte maturi 5–6 mm. longi pedicello brevi glandulam haud vel vix $\frac{1}{2}$ -plo superante excluso; styli 0.8–1.5 mm. longi; amenta fructifera vix ultra 4:1.2 cm. magna, mascula 1–2:1–1.2 cm. magna; folia (surculorum ex parte excepta) integerrima vel (pleraque tantum partim) satis indistincte glanduloso-crenato-denticulata, lanceolata, elliptico-lanceolata, elliptica vel obovato-oblonga, utrinque acuta vel apice obtusiora, rarius ovali-lanceolata, 2:0.7 ad pleraque haud ultra 5:2–1.5 cm. magna, superne vivide viridia, (novella saepe excepta) glaberrima, estomatifera vel stomatibus plusminusve numerosis praedita, subtus valde discoloria, glaucescentia, glabra vel sparse breviter pilosa (confer etiam *S. Nelsonii*, p. 80).

4. *S. planifolia* et var.

Fructus perfecte maturi 7–10 mm. longi pedicello glandulam 2- vel pluriplo superante excepto et plantae aliis signis diversae.

Folia normalia plus minusve distincte (interdum tantum partim) crenato-vel dentato-serrata, adulta subrigide chartacea, 4:1.5 ad 8:3 cm. magna, superne glaberrima vel initio ad costam puberula, demum lucide viridia, subtus glaucescentia, glaberrima vel novella sparse (pilis interdum rufis)

pilosa; ramuli etiam novelli glabri vel initio parce pilosuli; amenta mascula plusminusve sessilia, 1-3.5:1.5-1.8 cm., feminea sub anthesi 1.2:0.5-0.8 cm., fructifera 4-7:1.4-1.5 cm. magna, saepe pedunculo brevi foliolis parvis 2-3 instructo suffulta; fructus e basi ovoideo conico-subrostrati, 6-8 (-10) mm. longi, stylis 0.5-2 mm. longis; pedicelli glandulam 2-3-plo superantes 2. *S. phyllicifolia*.

Folia normalia indistinctius crenato- vel undulato-dentata, subtenuiora, 5.5:1.7 ad 10:2.7 cm. magna, superne saltem initio pube tenui villosulo griseo vel rufescenti praedita, demum costa excepta glabra vel subglabra, subtus glaucescentia, initio pleraque magis quam superne villosula, demum glabrescentia; ramuli novelli (hornotinique ex parte) plusminusve villosuli; amenta mascula ignota, feminea adulta vel fructifera 2-3:0.7-1 cm. magna, pedunculo 2-4 mm. longo foliolis parvis paucis obsito suffulta; fructus e basi ovoideo conico-rostrati, ad 10 mm. longi, stylis 0.6-1.1 mm. longis; pedicelli glandulam ad 3-plo superantes, ad 2 mm. longi.

3. *S. paraleuca*.

Folia normalia superiora adulta subtus dense sericea vel sericeo-velutina, saepe micantia.

Ramuli hornotini annotinique plusminusve distincte pruinosi, etiam novelli glabri vel parcissime pilosi et cito glabrescentes.

Pagina inferior foliorum omnium pilis strictis brevibus adpressis dense (in ramulis vegetis satis tenuiter argenteo-tomentosa, costa elevata flavescens) vel fuscescente subglabre, folia adulta chartacea, majora anguste ad late lanceolata vel oblanceolata, basi obtusa vel sensim acuta, apice acuta vel breviter acuminata, 4:0.9 ad 6:1.5 vel majora latiora ad 8-10:2-2.8 cm. magna, integerrima vel satis indistincte undulato-crenata; petioli 2-7 (-10) mm. longi; amenta mascula 2-3.5:1.1 cm. magna, feminea sub anthesi 2-2.5:0.7, fructifera 2.5-5:1 cm. magna; fructus ovoideo-subrostrati vel ovoideo-conici, circ. 5 mm. longi, pedicello glandula subduplo breviora excluso; styli 0.8-1.5 mm. longi 7. *S. subcoerulea*.

Pagina inferior (saltem foliorum superiorum et surculorum) subtus pilis sericeo-lanuginosis vix strictis longioribus vix vel haud adpressis velutino-tomentosa, folia adulta in *S. pellita* saepe plusminusve glabrescentia et plantae aliis signis diversae.

Folia lingulato-lanceolata, oblanceolata, lineari-lanceolata ad lanceolata, basi obtusa vel sensim cuneata, apice sensim acuta vel subacuminata, maxima surculorum late lanceolata, 3:0.6 ad 5:1 vel ad 9:1 vel latiora 8:1.5, maxima ad 13:3 vel 12:1 cm. magna, integerrima vel indistincte subcrenata, saepe margine subrevoluta, superne brevopilosa adulta costa excepta glabra, nervis lateralibus subimpressis, subtus novella densissime sericeo-tomentosa vel velutina, demum plus minusve glabrescentia et saepe tenuiter reticulata; petioli 2-10 mm. longi; amenta mascula ignota, feminea 2-5:1 cm. magna et in fructu paullo majora; fructus maturi ovoideo-conici, subrostrati, pedicello glandulam paullo vel ad duplo superante excluso circ. 5 mm. longi, quam ovaria subglabrescentes; styli 1-1.5 (-2) mm. longi 6. *S. pellita*.

Folia inferioribus oblongioribus exceptis pleraque lanceolata, basi plus minusve obtuse cuneata, apice acutiora, 6:1.3 ad 8:1.6 vel maxima ad 11:2.5-3 cm. magna, integerrima vel obscure repando-crenulata, superne cito glabrescentia vel fere glabra nervis lateralibus subimpressis, subtus dense albido- vel subargenteo-sericeo-velutina, costa elevata glabrescente; petioli 4-14 mm. longi; amenta mascula 2-2.5:1.5 cm., feminea sub anthesi 2-3:1 cm., fructifera ad 4.5 (-6):1.5 cm. magna; fructus submaturi 4.5-5.5 mm. pedicello ad 1.25 mm. longo glandulam $\frac{1}{4}$ ad duplo superante excepto longi; styli 1-1.5 mm. longi. 8. *S. bella*.

Ramuli hornotini et saepe etiam annotini plusminusve pilosuli vel tomentelli, nunquam (vel rarius levissime) pruinosi.

Folia subtus ut in *S. bella* velutino-tomentosa, obovata, obovato-oblonga, elliptico-oblanccolata vel rarius elliptica, apice obtusa vel (pleraque subito) late acuta, basi cuneata ad obtusa, majora latiora ad 6:3, oblongiora ad 8.5:9:2 2.8 cm. magna; petioli 5-10 mm. longi; stipulae in ramulis vegetis semiovato-lanceolatae, petiolo $\frac{1}{2}$ vel vix breviores; fructus elliptico-subrostrati, 5-7 mm. longi, pedicello ad 1.5 mm. longo excluso; styli 0.5-1 mm. longi.

Folia subtus ut in *S. subcoerulea* sericeo-tomentosa, anguste oblanceolata, apice obtusa ad acuta, basi cuneata, majora angustiora 6.5:9:1.2 vel ad 10:2.5 cm., latiora ad 5:1.3 cm. magna; petioli vix ultra 7-8 mm. longi; stipulae tantum in surculis distinctae, semicordatae, ad 11 mm. longae; fructus 4.5-5.5(-6) mm. longi pedicello ad 1.25 mm. longo excluso; styli 0.75-1 mm. longi.

. 9. *S. Drummondiana*.

. 10. *S. Jepsonii*.

ENUMERATIO SPECIERUM

1. *S. pulchra* Chamisso in Linnaea, vi. 543 (1831). — Coville in Proc. Wash. Acad. Sci. iii. 319, t. 38 (1901), excl. syn. ex parte. — Ostenfeld in Dansk. Vidensk.-Selsk. Skrift. i. Math.-Nat. Kl. 1909. no. 8, 34 (Vasc. Fl. Arct. N.-Am. Gjöa Exp. 1904-6) (1910), excl. syn. ex parte. — *S. fulcrata* a. *subglauca* Andersson in De Candolle, Prodr. xvi.² 244 (1868). — *S. phyllicoides* Bebb in Bot. Gaz. xiii. 186, t. 10 (1888), pro parte maxima, non Andersson.

The type of this species came from Cape Espenberg, Alaska, and Chamisso also collected specimens on St. Lawrence Island. Not having seen the type which is preserved in the herbarium at Berlin, I rely on specimens from Port Clarence and St. Lawrence Island to supplement the ample description of the author. Judging by these specimens I believe that the typical form is one with glabrous or soon glabrescent twigs of which the one-year-old branchlets show very little or no trace of pubescence. But there occurs a pubescent form which I shall describe later. Chamisso's name *S. pulchra* has been overlooked by most of the salicologists; it is not even mentioned in the Index Kewensis, and in 1866 Wimmer & Krause described another *S. pulchra* which has nothing whatever to do with our plant. Andersson mentioned Chamisso's species only in 1858 (in Öfv. Svensk. Vet.-Akad. Förh. xv. 120) under *S. lapponum* to which he refers specimens collected by Beechey at Kotzebue Sound unknown to me, in the following manner: "Non sine hesitatione permulta hic refero Salicem eam 'pulchram,' de qua Chamisso, a se in America arctica pluries lecta, mentionem fecit. . . . Amenta sessilia, capsulae non pedicellatae, sed folia, fere ut in *S. phyllicifolia*, utrinque acutata viridia subtus pallidiora glaberrima, stipulae lineares persistentes. Unicum tantum specimen hujus formae ex herb. Berolinensi (a Chamisso lectum) vidi." In 1867 and 1868 Andersson does not mention this name, and I have not yet been able to discover to which species he referred Chamisso's specimen. He described, in 1858, a *S. phyllicoides* (in Öfv. l. c. 123) from specimens collected by Seemann: Awatcha Bay, "in arctica America occidentali." The Awatcha

(Avatcha, Avatchka, or Avacha) Bay is, however, as Coville (1901) already explained in southern Kamtchatka. On the northside of it is the harbor Petropavlosk where the ship "Herald," on which Seemann traveled, was in August 1848 when the type of *S. phylicoides* was collected according to the specimen in the Kew Herbarium. Andersson probably drew up his description from other specimens also collected by Seemann in the autumn of 1848 or 1849 in northwestern Alaska, but he does not cite them. In 1867, however, in his note to *S. fulcrata* (see later), the type of which has not been collected by Seemann, he mentions specimens of this collector without identifying them, and he cites, under *S. phylicoides*, only Seemann's plant from Awatcha Bay.

S. phylicoides has been regarded by Bebb (see later) as identical with the forms referred here to *S. pulchra*, but after having seen a good photograph and fragments of Andersson's type (Seemann, no. 1294, fr. im.; K.) I believe that it represents a different species not known from America. In *S. phylicoides* the stipules are, as Andersson correctly stated, small, linear-lanceolate, hardly more than 2 mm. long, and apparently deciduous or entirely wanting.

As to *S. fulcrata* Andersson (in Svensk. Vet.-Akad. Handl. vi. 139 [1867]) the following can be said. The author mentions as a synonym *S. cordata* var. Seemann, Voy. Herald 54, where only the locality "Fort Simpson to Bear Lake River" (Andersson quotes "to Great Barelake") is given. The collector was Capt. W. J. S. Pullen. I have not seen this specimen, nor the one cited by Andersson of Stubbendorff from Kamtchatka. In his remarks Andersson says: "Hujus formae tantum specimina perpauca examinare mihi licitum fuit, ut de iis vix certi quidquam urgere audeam. *S. phylicoidi* et *S. chlorophyllae* sine dubio maxime est affinis." From both it differs by its large linear-lanceolate stipules. The leaves are said to measure from "3 4 pollices" in length being above the middle " $\frac{3}{4}$ -1 poll." wide. Such leaves may be observed on strong shoots of *S. pulchra*, and I believe that this American form of *S. fulcrata* can be regarded as identical with our species but I have not yet seen a specimen of *S. pulchra* from the region between Fort Simpson and Great Bear Lake or from any other part of the western Northwest Territories except a doubtful fragment of Richardson's from Fort Franklin (no. 64, Hb. H.B. & T., f., m.; N.¹). See also my remarks under *S. planifolia* the northwestern form of which seems to meet *S. pulchra* in the Mackenzie region.

If Andersson's fig. 73 on plate vii, in his monograph (1867) really represents the typical *S. fulcrata* it certainly does not fit the description because the stipules are not very large, linear-lanceolate and longer than the petioles but more or less ovate and as long as the petiole. Neither does the drawing agree with the Asiatic form which, in 1868, was made the type of *S. fulcrata* β . *subphylicifolia* of which the author expressly states that it "a vera *S. phylicifolia* . . . optime distinguitur stipulis petiolum brevem . . . saepe quadruplo superantibus." I doubt if this variety is identical

¹ For abbreviations for herbaria see footnote on p. 1.

with any American form, and I am unable to decide what the true *S. fulcrata* is. In 1868, Andersson described a form from "Ameriac arctica occidentali (B. Seemann, Hb. Hook.)" the type of his *S. fulcrata* a, *subglauc*. Fortunately I have a photograph and fragments of it (Seemann, no. 1789, in 1849, f.; K.) before me which show that it belongs to *S. pulchra*. This is the plant which Bebb (1888) in the explanation of plate X, figs. 1-7 calls "Seemann's plant, 'N.W. America,' type of *S. phylicoides* and afterwards of *S. fulcrata*," while, as I have just pointed out, it is not the type of either species but only of *S. fulcrata subglauc*. In his remarks on this variety Andersson, strange to say, made the following statement (cited already by Bebb): "Huc forsitan etiam pertinet *S. phylicoides* And., Sal. amer. boreal. l. c. p. 123" but nevertheless he gives a full description of the last species on the following page in the Prodromus.

Coville (1901) accepted Bebb's critical investigation, but he was the first to restore the name *S. pulchra* of which Bebb apparently had no knowledge. Coville, however, thought it probable that the type of *S. phylicoides* came from the American coast instead of from Awatcha Bay, but as I have shown above there is no reason for this.

S. pulchra ranges, as Coville already said, in Alaska from "the islands of Bering Sea to Point Barrow on the Arctic Coast, to Kodiak Island on the south coast, and to the upper Yukon valley in the interior." In the north I have seen it from as far east as Herschel Island and Dawson in the Yukon Territory, and Lake Bennett in the northwestern corner of British Columbia. As already mentioned it may occur as far east as Fort Franklin and Fort Simpson, but the specimens from these regions are uncertain. Coville also quotes a specimen from the Siberian Coast which I have not yet seen.

There are a good many specimens which differ from the type by their densely hairy branchlets, and I propose the following variety:

1b. *S. pulchra*, var. *yukonensis*, var. nov. — A typo nonnisi differre videtur ramulis novellis dense griseo-vel flavescenti-villoso-tomentosis (pilis vix $\frac{1}{2}$ mm. longis), amentinis plerisque etiam satis dense sed interdum tantum partim tomentosis, vetustioribus saepissime glabris et nitidulis, ut in typo castaneis vel intense purpurascensibus.

TYPE LOCALITY: vicinity of Dawson, Yukon Territory.

SPECIMENS EXAMINED: YUKON TERRITORY: vicinity of Dawson, June 26, 1914, A. Eastwood (no. 373, fr. submat., type; A.); June 11, 1914, A. Eastwood (No. 181, st.; 182., fr.; A.); May 7, 9, and 14, 1914, A. Eastwood (Nos. 37, f., 40, m., 55, f.; A.; amentis praecocibus in ramulis sordide flavescenti-tomentosis); June 9, 1914, A. Eastwood (No. 171, st.; A.); June 23, 1914, A. Eastwood (No. 359, st.; A.); along Forty Mile Creek, near Yukon River, May 26, 1893, F. Funston (No. 40, f.; W.).

ALASKA. Rampart on the Yukon, low marshy ground, May 26, 1901, J. Jones (No. 2, m.; W.); "tree 6 to 9 ft., bark on trunks and old wood rough and dark in color, new wood smooth and shiny bright brown"; a fruiting specimen under the same number is typical); June 16, 1901, J. Jones (No. 21, fr. im.; W.); along river bank, June 5, 1905, J. Jones (No. 5, f.; W.); Vicinity of Cape Lisbourne, Collie River, July 27, 1904, C. Washburne (fr.; W.); "not seen over 4 or 5 inches in height"); Copper River region, along river banks, June 23, 1902, W. L. Poto (No. 58, fr.; W.); "slightly

inclined to be bushy, 8 feet high"); ridge north of camp 8/5-8, 1150 m., common at high elevations, August 8, 1902, *W. L. Poto* (No. 131, fr.; W.; "1-2 ft. high").

The systematic position of *S. pulchra* is by no means certain to me. As already stated it differs from all the other Willows of this group by the development of large persistent stipules, a character found in species like *S. Richardsonii* to which var. *yukonensis* bears a certain resemblance, but *S. Richardsonii* has a much more hirsute pubescence and glabrous ovaries.

2. *S. phylicifolia* Linnaeus, Spec. II. 1016 (1753), exclud. var. β . — For further literature see Schneider in Sargent, Pl. Wils. III. 123 (1916). — The first author who adopted Linnaeus' name for an American Willow was Tuckerman (1843), who was followed by Carey (1848) as stated later under *S. planifolia*. When, in 1858, Andersson commenced his study of American *Salix* he referred Carey's plant with a query to what he then called *S. (phylicifolia*) discolor*, and said: "Specimina numerosa, quae attente examinavi, parum differunt a vera *S. phylicifolia* . . ." In 1867, however, he proposed *S. chlorophylla* for these forms, saying "est species parum dubiae affinitatis, ut jam propositum est, inter *S. disclorem* americanam et *S. phylicifoliam* boreali europaeam evidenter ambigans, nunc illi nunc huic adscripta." In the 5th edition of his Manual (p. 464 [1867]) Gray followed Andersson in taking up the name *S. chlorophylla*, but Bebb who (in 1889) studied the matter, first expressed the opinion that the differences between *S. phylicifolia* and *S. chlorophylla* given by Andersson did not exist. He said: "Carey, Tuckerman, Barratt and all the early New England botanists were quite right in referring the plant in question to the old Linnean species." Therefore, in the 6th edition of the Manual, Bebb reinstated the name *S. phylicifolia* but, as explained later, his own remarks prove that he was not fully convinced of the identity of the two plants. Robinson & Fernald (1908) and Britton & Brown (1913) also have adopted the name *phylicifolia*.

In 1899, Ball dealt with the 'western' *S. chlorophylla*, and he explained "the story of the confusion of *S. phylicifolia* and *S. chlorophylla*." He came to the conclusion that the typical *S. phylicifolia* is only found in Labrador, and that "the few White Mt. specimens examined, though old and imperfect, present a decidedly American variation towards the Rocky Mt. form." Ball gave a comparison of *phylicifolia* with *chlorophylla*, but, at that time, he, apparently, was very imperfectly acquainted with the eastern forms. To decide the question whether or not the true *S. phylicifolia*, or a form inseparable specifically from it occurs in North America we must determine the characters by which this species is to be recognized.

Linnaeus' type is "351. *Salix* foliis serratis glabris lanceolatis, crenis undulatis" in his Fl. Lap. 283, t. 8, fig. d (1737). From his description I take the following characters: ". . . ramuli recentes purpurascetes. Folia lanceolata, glabra, distincte serrata, . . . superne saturate viridia, nitida . . ." S. J. Enander, the foremost living salicologist (in his Stud. Salices Linnés Herb. 17, no. 7a, and 83, no. 89 [1907]) has not only given an exact description of the material of *S. phylicifolia* preserved in Linnaeus'

herbarium, but he has also distributed among his *Salic. Scand. Exsiccateae* under no. 118 $\frac{1}{2}$ a photograph of "*Salix phylicifolia* L. originalis et typica," and besides this under no. 116, 117 and 119 a-c he has distributed male and female specimens of what he regards as typical *phylicifolia*. Therefore I base my judgment as to the characters of this species on Enander's specimens and descriptions. Of the so-called American *phylicifolia* I have all the material before me that can, possibly, be brought together from existing collections.

In 1868, Andersson said under *S. chlorophylla*: "Cum nostra *S. phylicifolia* congruit forma et colore foliorum ut etiam habitu amentorum sessilium, sed differt foliis pilis argenteis plus minusve dense conspersis etiam demum subderelictis, amentis angustioribus et compactoribus, capsulis subsessilibus, stylo multo longiore (saepe capsulae longitudine aequante et filiformi, stigmatibusque elongatis integris)." He believed his var. *denudata* to be most closely related to *phylicifolia*, saying: "Jam monui me specimina *Salicis* a White Mountains vidisse quae nullo modo, nisi foliis ellipticis integerrimis, a nostra *S. phylicifolia* recedunt. Num hujus speciei forma maxime *denudata*?" In 1889, Bebb, as I have already pointed out, declared that these differences mentioned by Andersson had not been confirmed by his investigations. He had compared material from Lapland, collected by Dr. Hankenson, which he, at first, could not distinguish from specimens collected by Faxon in the White Mountains. But a few months later in the same year (in *Bull. Torr. Bot. Cl.* xvi. 211), in a note, Bebb made the following statement: "Concerning the general character of the White Mountain *S. phylicifolia*, my remarks were unguarded and do not fairly state the amount of actual divergence from the Old World type. While I do not wish to qualify at least what was said of the closeness of resemblance observed between some of Mr. Faxon's specimens and certain others of genuine *phylicifolia* from Lapland, it is nevertheless true that from the common meeting ground thus indicated, the European forms vary mainly in the direction of *S. nigricans*, *S. caprea*, etc., whereas in this country the variation is in the direction of *S. chlorophylla*, and hence in so far as any difference appears in a series of specimens, it is a difference marked by shorter pedicels, longer styles, and more slender aments. I intended my closing words to cover this, but was not sufficiently explicit." I have investigated the Lapland material which Bebb had before him. It is preserved in his herbarium in herb. C. under Nos. 11449-11452 from Prteå (?), Gustafsho, and Skadsön (?), collected at different times during 1879, 1883, 1885 and 1886. The differences are not very obvious but a careful comparison shows that these forms are distinguished by larger fruits, larger and thicker fruiting aments, more distinctly crenate leaves, and especially by the fact that the larger leaves point to forms different from those observed in America. In my key I have tried to indicate the main differences between *S. phylicifolia* sensu stricto and *S. chlorophylla denudata* (now *S. planifolia*). The young branchlets of the American species very often show, more or less distinctly, a glaucous hue which never seems to be present in *S. phylicifolia*

of which the dried twigs are less decidedly blackish purple. That the pubescence of the European species sometimes also shows a mixture of bright red brown hairs is expressly stated by F. B. White (Jour. Linn. Soc. xxvii. 396 [1890]).

There seems to be no doubt that *S. planifolia* is closely related to *S. phylicifolia* but the only American specimen I have seen which might represent typical *S. phylicifolia* is a sterile one collected by Fernald & Wiegand at Brigus Junction in the southeast corner of Newfoundland, August 5, 1911 (No. 5272; G.). Without flowers or fruits I am unable to decide the identity of this plant, but I suspect that it belongs to *S. discolor* to which species Fernald refers a specimen collected by him and Wiegand at St. Johns a few miles east of the former locality, August 1, 1911 (No. 5256, st.; G.).

3. *S. paraleuca* Fernald in *Rhodora* xvi. 175 (1914). — *S. stenocarpa* Fernald, l. c. 176, non Gandoger, 1890. — Professor Fernald agrees with me that *S. stenocarpa* cannot be separated from *S. paraleuca*; the differences pointed out by him are too insignificant and disappear entirely in certain specimens. This species of which the male plant is still unknown needs further study. Its existence again proves how rich the Gaspé region is in endemic species.

SPECIMENS EXAMINED: QUEBEC. Gaspé Peninsula, Gaspé District, banks of the Grand River, June 20–July 3, 1904, *M. L. Fernald* (fr. type of *paraleuca*; G.). Bonaventure District, Matapedia, ledgy banks of Restigouche River, June 28, 1904, *M. L. Fernald* (fr. type of *S. stenocarpa*; G.).

4. *S. planifolia* Pursh, Fl. Am. Sept. ii. 611 (1814); ed. 2. ii. 611 (1816). — Poiret in Lamarck, Enc. Suppl. vi. 62 (1817). — Hooker, Fl. Bor.-Am. ii. 150 (1839), tantum pro parte minima. — *S. phylicifolia* Tuckerman in Am. Jour. Sci. Arts, xcv. 35 (1843), non Linnaeus. — Carey in Gray, Man. 428 (1848); ed. 2. 416 (1856). — Bebb in Bull. Torr. Bot. Cl. xvi. 39 (1889); apud Watson & Coulter, Gray Man. ed. 6. 484 (1890). — Britton & Brown, Ill. Fl. i. 502, fig. 1195 (1896); ed. 2. i. 600, fig. 1475 (1913). — Ball in Trans. Acad. Sci. St. Louis ix. 83 (1899). — Robinson & Fernald, Gray's Man. 328, fig. 668 (1908). — *S. (phylicifolia) discolor* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 123 (1858), pro parte. — ? *S. arbuscula labradorica* Andersson, l. c. 130. — *S. chlorophylla denudata* Andersson in Svensk. Vet.-Akad. Handl. vi. 138 (1867); in De Candolle, Prodr. xvi.² 244 (1868). — *S. chlorophylla* Gray, Man. ed. 5. 464 (1867), prob. haud Andersson sensu stricto. — Macoun, Cat. Can. Pl. i. 446 (1886). — Britton, Man. 318 (1901); ed. 2. 318 (1905).

Pursh's description is very short and is based on specimens from Anderson's ¹ garden which had been introduced from Labrador. There is, in my

¹ It may be stated that this is George Anderson, an English salicologist (see Britten & Boulger, Biogr. Ind. Brit. Bot. 4 [1893]) who is not to be confounded with N. J. Andersson, the Swedish botanist, as apparently the printer did in my second note in Bot. Gaz. LXvi. 343, when he changed Anderson into Andersson.

opinion, only one species among the Willows of Labrador to which the description can be applied, namely the so-called *S. phylicifolia* or *chlorophylla*. Pursh says: "*S. erectiuscula, divaricata; ramulis laevigatis, foliis oblongo-lanceolatis utrinque acutis medio serrulatis glaberrimis patentibus glaucis discoloribus, stipulis nullis.*" "This singular species distinguishes itself at first sight by its plain and patent leaves; it is inclined to rise from the ground on a single low stem, and approaches to the following division" (*caule erecto*). Professor Fernald agrees with me that there is nothing in this description that does not fit the species for which I now take up this name.

Hooker (1839) referred to *S. planifolia* specimens from Labrador collected by Miss Brenton. According to a photograph and fragments before me they belong to *S. cordifolia* Pursh. (See my remarks in Bot. Gaz. LXVI. 344 [1918].) Hooker also mentions specimens collected by Richardson in the Northwest Territories and by Drummond in the Rocky Mountains, of which No. 58 Hb. H. B. & T. in N. from Fort Franklin seems to represent Richardson's plant. Of this number some sterile pieces apparently belong to *S. planifolia* while others (partly with fruits) represent *S. glauca glabrescens* (And.) Schn. Of Drummond's specimens I saw a photograph and fragments (Herb. K.). The locality is "Lac la Pierre" which I have been unable to find on any map at my disposal. Andersson determined two sterile pieces marked (no. 1) quite correctly as *S. Richardsonii* and referred the four others (no. 2) to "*S. glauca (villosa glabrata)*" having apparently in mind his *glaucops glabrescens* now *glauca glabrescens* to which the male, the fruiting pieces and the remaining two sterile ones seem to belong. Hooker also mentions a var. "*foliis unicoloribus*" without indicating a type, only saying " β , though not marked as a var. by Barratt, has the leaves of the same color on both sides, and decidedly serrated." I suspect that this form belongs to one of the *Cordatae* group.

As the type of Andersson's *S. chlorophylla* has to be taken his var. *vestita* for which he, unfortunately, did not indicate a type specimen. He, probably, based it, at least partly, on specimens collected by Richardson at "Norway House Fort," because he cites as the first synonym Hooker's *S. discolor* β . (Fl. Bor.-Am. II. 147 [1839]) of which Richardson's plant is the type. I have not yet seen it. Andersson's second synonym, "*S. (phylicifolia) discolor* Ands." "p.p." for the most part belongs to *S. discolor* Muhl., but there are specimens in Herb. N. which partly represent *S. discolor*, like those collected apparently by Bourgeau, "Lac Winnipeg 26 Juin," and partly are very like *S. planifolia*. The sheet on which they are mounted has also a label in Andersson's handwriting: "Specimina haec, habitu et characteribus *S. nostram phylicifoliam* omnino simulant mihi tamen ad *S. discolor* pertinere videntur." According to a note on the sheet these specimens have been regarded as the type of *S. chlorophylla*, but one of them is clearly a very glabrescent *S. discolor* while the other has the fruits of *S. planifolia* although the young twigs are rather densely villose, and even the one-year-old branchlets show distinct traces of pubescence. The half-

grown leaves are narrowly oblanceolate, at first sparsely pubescent with grayish and fulvous hairs, very soon becoming glabrous (except a few hairs on the midrib of the upper side). This plant, therefore, does not agree with var. *vestita*, and probably represents a form closely related to *S. planifolia*. I am not yet sure whether Andersson's var. *vestita* is only a form of the latter or has to be regarded as a distinct species. See also my remarks under *S. pellita*, p. 82.

In 1867, Andersson furthermore described as a "varietas singularis" *S. chlorophylla* **S. pychnocarpa* from specimens collected by Bourgeau "ad Carlton-house" which, in 1868 he called *S. chlorophylla* δ . *pychnocarpa*. In his note (1867) he said: "Est forma valde singularis ad sequentem [*S. pellitam*] transitum evidentissimum efficiens. Frutex non altus videtur, ramis glaberrimis fusco-castaneis. Foliis iis *S. chlorophyllae* sat similia sed fere angustiora et subtus tomento haud denso subargentea; amenta ut in *S. grisea* et capsulae eximie condensatae ut fere undique divaricatae adpareant." I have seen a photograph and fragments of a specimen collected by E. Bourgeau at "Carlton, bord de la rivière, 6 Mai 1858" (No. 13, m., f.; K.). The flowers generally agree with those of *S. planifolia* but the filaments are sparsely pilose, and, owing to the absence of leaves, I cannot decide whether it belongs to one of Andersson's forms or to *S. pellita* (see later). It certainly does not represent the type of var. *pychnocarpa*. Of this form Bebb (1889) spoke as follows: "The characters specified by Prof. Andersson as serving to distinguish his *S. chlorophylla* from the Old World *S. phylicifolia*, are most noticeable in the Rocky Mountain *S. chlorophylla* var. *pycnostachya* (sic!) . . ." So far as I can judge by Bebb's statement he did not see Andersson's type but was entirely guided in his deductions by the description. The type came from Carlton in central Saskatchewan, and before we can judge its relationship it is necessary to investigate what the typical *S. chlorophylla* (var. *vestita*) is. This cannot be done without comparing the types of Andersson which, if at all, must be preserved in the Hookerian Herbarium (K.) or in the herbarium at Stockholm or Upsala.

I have seen material of typical *S. planifolia* (*S. chlorophylla denudata*) from Labrador (where the most northern point of its known distribution seems to be Nain), northeastern Quebec (Saguenay County, as far north as Lake Mistassini, Rupert Land, J. M. Macoun, No. 24706, O.; m., f., and the Gaspé Peninsula), Maine (Mt. Katahdin), New Hampshire (White Mountains) and Vermont (Mt. Mansfield). In addition to these I have before me the following specimens from Keewatin and the Northwest Territories which come very near *S. planifolia*. The most typical one is a specimen collected by J. W. Tyrull at Chesterfield Inlet on the southwestern coast of Hudson Bay, September 11, 1893 (No. 1763, fr.; O.). The twigs are glabrous, the fruits measure up to 7 mm. in length, and the leaves possess a good many stomata in the upper surface, which seem to be entirely wanting in the leaves of the type. More different is J. M. Macoun's (No. 179153, O.; fr. adult.) from Churchill on Hudson Bay. Here the fruits are up to 8 mm. long, and the young twigs are more or less covered with a short.

pubescence of grayish and fulvous hairs. From Churchill is also E. A. & A. E. Preble's No. 23, st.; W. which looks rather typical. In other fragments brought by J. W. Tyrull from the region between Athabasca and Chesterfield Inlet, August 11, 1893 (No. 1763^a, O; fr. juv.) and September 1, 1893 (No. 1763^b, O; fr.) the pubescence of the twigs is less developed and the leaves are even more narrowly lanceolate. Seton & Preble collected a specimen in the region of Great Slave Lake and near Stone Island, July 14, 1907 (No. 37 [=78399, O], fr.). It has larger aments (up to 5.5:3 cm.), and the fruits are about 7 mm. long with a style 1 mm. in length. Another specimen is A. E. Preble's from Fort Resolution, July 14, 1901 (No. 143, st.; W.). The same collector brought some more specimens from the Mackenzie River in 1904. One, collected at Fort Norman, June 12 (No. 322^a, fr. im.; W.), has half-developed young leaves without any stomata in their upper epidermis and no trace of stipules. It looks like typical *S. planifolia*. The others came from Fort Simpson, May 12 (No. 303^B, f; W.) and May 15 (No. 305, m. and st., with very young leaves; W.) In the male flowers the bracts are acute, otherwise there seems to be no difference between the last two numbers and No. 322^a. I have suspected that *S. pulchra* might grow in this region, but I have not yet seen specimens of it from the Northwest Territories except very poor and uncertain fragments mentioned under *S. pulchra* on p. 71, which after all may be referable to *S. planifolia*; but the Mackenzie region is, probably, the meeting ground of these species.

It is possible that typical *S. planifolia* also occurs in the northern Rocky Mountains from Alberta to northern Wyoming. On the other hand the western form hereto referred to *S. chlorophylla* seems to represent a distinct variety. The name *S. chlorophylla* cannot be used, and the majority of the western specimens before me (I have a well-collected representative series at hand) are most closely related to *S. monica* Bebb. This species is nothing but the dwarfed high alpine form of this western variety for which I propose the name.

4b. *S. planifolia* var. *monica*, nov. var. — *S. monica* Bebb in Watson, Bot. Cal. II. 90 (1879); in Bot. Gaz. XVI. 107 (1891). — Ball in Trans. Acad. Sci. St. Louis, IX. 84 (1899). — Jepson, Fl. Cal. I. 344 (1909), pro parte. — Hall, Yosemite, Fl. 69 (1902), prob. tantum pro parte. — *S. chlorophylla* Bebb¹ in Coulter, Man. Rocky Mts. Bot. 337 (1885). — Porter & Coulter in U.S. Geol. Surv. Misc. Publ. no. 4. 128 (Syn. Fl. Colo.) (1874). — Macoun, Cat. Can. Pl. I. 446 (1886), pro parte. — Nelson in Bull. Wyo. Exp. Sta. XXVIII. 179 (1st Rep. Fl. Wyo.) (1886). — Ball in Trans. Acad. Sci. St. Louis, IX. 83 (1899), excl. syn.; in Coulter & Nelson, New Man. Rocky Mts. Bot. 137 (1909). — Rydberg, Fl. Colo. 96 (1906); Fl. Rocky Mts. 198 (1917). — Daniels in Univ. Mo. Stud. Sci. Ser. II. 248 (Fl. Boulder, Colo. 100) (1911).

Bebb described his species from "poor stunted specimens" collected by Bolander at Mono Pass Summit. The real collector was probably W. H.

¹ Bebb and the following authors also include the forms of the northern Rockies which, as I have already stated, may, at least partly, be referable to the typical eastern *S. planifolia*.

Brewer, and his No. 1732 from the given locality, June 27, 1863, of which I have seen specimens in Herb. G. and W., represents the type number. There are, however, only female specimens under this number. Later (1891) Bebb thought it would be best to drop "a species of such questionable validity" which possibly might represent a form of *S. chlorophylla*. Ball (1899) discussed the question, and suggested "that the staminate aments of *S. monica* with their linear scales, may be found to belong to some other species" but he had not seen Bebb's type. Jepson (1909) mixed *S. monica* with forms with glabrous ovaries that really belong to a variety of *S. Eastwoodiae* Cock. He, however, collected good flowering material at the type locality on July 19, 1911, at an altitude of about 3500 m. (No. 4466, m., f.; A.) which is identical with Brewer's No. 1732. The difference of the bracts of the male and female flowers alluded to by Bebb cannot be observed in Jepson's plants. The scales of both the sexes are narrowly oblong to ovate-lanceolate, and in the male plant only somewhat more acute; after all their shape is variable to a certain degree in both plants. The aments are from subglobose to short-cylindric, the female measuring up to 1.5:1 cm., while the male are subglobose and hardly more than 1 cm. long and thick. In the young leaves the different (glaucous) color of the lower surface is scarcely visible, and only the lowermost (first) leaves are sometimes covered beneath with a few silky hairs. The number of stomata is almost equal in the epidermis on both surfaces. There are a few remaining old leaves of a narrowly elliptic or oblanceolate shape which measure up to 22:9 mm. The style is a little longer (up to 0.8 mm.) than in Brewer's No. 1732, and the ovaries are subsessile in both, the very short pedicel being about half the length of the gland. On July 14, 1899, Jepson already had collected a very similar form on the saddle of Mount Dana, at the same altitude (No. 3308, fr.; A.) with a few old male aments, and rather adult female aments, and also with almost fully developed narrowly or broadly elliptic or obovate-elliptic leaves measuring up to 2:1 cm. They are more or less distinctly glaucous beneath; the lowest ones bear some fulvous silky hairs beneath, and the youngest show a scanty pubescence on both surfaces soon becoming glabrous. The main difference between these specimens and those mentioned above is found in the ovaries which have a more distinct pedicel which in the oldest flowers is somewhat longer than the gland.

In describing his *S. pennata* (see later) Ball said that "little *S. monica* is found in the central Sierra Nevada." I have carefully compared many specimens from the Rockies referred to *S. chlorophylla*, and there are quite a number among them, especially from high alpine regions in Colorado, which I cannot distinguish at all from typical *S. monica*. They also are provided with numerous stomata in the upper surface of the leaves, and often have short styles hardly as long as the stigmas. The leaves, as a whole, are smaller and broader, more elliptic or obovate-elliptic than in the eastern type, but the shape is rather variable, and seems not to afford a good taxonomic character. Such forms are for instance: J. H. Cowen's

No. 470, Colorado, mountains northwest of Boreas, Summit County, mountain slopes near timber line, about 3500 m., August 2, 1895 (f., fr. juv.; N., W.), and C. L. Shear's No. 4280, Mt. Blanca, Costilla County, about 4300 m., July 31, 1900 (fr. ; N., W; "spreading, 2 ft. high"). They gradually pass into the more vigorous forms with stouter aments and larger leaves which have more or less numerous stomata in the epidermis of the upper surface until we come to forms in Wyoming (like Albany County, August 23, 1904, *F. V. Coville*, No. 2070, fr.; W.) and in Alberta (Calgary, June 5, 1897, *J. Macoun*, No. 94427, O., fr.; stomata in pagina superiora non visa; and Jumping Pound Creek, June 12, 1897, *J. Macoun*, No. 94425, O., st; magis intermedia inter var. *typicam* et var. *monicam* videtur) which I am at a loss how to distinguish from certain forms of the White Mountains, New Hampshire. A vigorous western specimen does not look more different from the typical dwarf high alpine var. *monica* than an eastern specimen, grown in a protected situation in the Great Gulf on Mt. Washington, diverges in habit, etc., from the "depressed and prostrate shrub, seldom rising more than one foot from the ground" (Faxon) in exposed situations of the Alpine Garden on the same mountain, where I had an opportunity to observe it myself in September 1918. Therefore, I leave it, at present, an open question where the line can be drawn between the range of the type and var. *monica*. I have seen specimens which I refer (partly only provisionally) to this variety from California (Mono and Tuolumne Counties), Utah (Salt Lake, Wasatch, Duchesne or Summit, and Sevier Counties), New Mexico (Mora County), Colorado (through the Rockies from Costilla to Larimer County), Wyoming (Albany, Frémont, Sheridan Counties, and Yellowstone Park), Montana (Madison and Park Counties), to Alberta (see above). There is a specimen said to have come from the "interior of Washington Territory," 1841, *C. L. Pickering & W. O. Breckenridge* (Wilke's Exped. No. 481, f.; N., W.) which had been in 1909 named *S. chlorophylla* by Ball (W.) who in 1915 cites it under his *S. pennata*. Judging by Piper's remarks (Fl. Wash. 15) as to the labeling of this collection it seems that the locality is not correct. It does not look to me like *S. pennata* but is extremely alike var. *monica* sensu meo. While on the other hand, the *chlorophylla* mentioned by Bebb (1891) as occurring "on Mt. Adams and the higher summits of the Cascades" is *S. pennata*.

In 1905 (Bot. Gaz. XL. 379, t. 13, figs. 8-11) Ball described a *S. Nelsonii* the type of which was collected by A. Nelson on Laramie Peak, Albany County, Wyoming, along creek, July 13, 1890 (No. 7580, fr.; L.). Professor A. Nelson has kindly loaned me all the material from Herb. L. I also have had an opportunity to discuss this plant with Mr. Ball, who tells me that he is now inclined to believe that *S. Nelsonii* is nothing but a form of *S. chlorophylla* (= *S. planifolia*). In his remarks with the original description Ball said that *S. Nelsonii* "is most closely related to *S. chlorophylla*" but that "it is readily distinguished by the oblanceolate leaves which, when mature, are prominently nerved above and reticulated beneath." In his treatment of the Rocky Mountain Willows (apud Coulter &

Nelson, New Man. 137 [1909]) Ball contrasted the two Willows as follows: leaves broadly elliptic-ovate or obovate, mostly obtuse at apex; styles 1-1.5 mm. long: *S. chlorophylla*, and leaves oblanceolate, acute at both ends, styles 0.5-1 mm. long: *S. Nelsonii*. I have been able to examine most of the specimens enumerated by Ball, and I believe that almost all of the Colorado specimens and Tweedy's No. 47 from the Bighorn Mountains in Wyoming are not separable from *S. planifolia monica* and *typica*. But in specimens of A. Nelson and E. Nelson named by Ball *S. Nelsonii* I find that the color of the one-year-old branchlets is more brownish red and not chestnut colored as in *S. planifolia* and that the narrower lanceolate or oblanceolate leaves very often show a rather distinct but fine glandular crenulate denticulation. Their nervation is about the same as in *S. planifolia*, and Ball's statement (1909) that the mature leaves are "rather strongly veined on both surfaces" applies as well to certain specimens of *S. planifolia*. J. G. Jack collected at Centennial, Wyoming, at an altitude of about 2700 m., on August 19, 1918 (Nos. 1068, 1069, st.; A.; "bushes 6-8 ft. high, stems yellow or purplish green") good material of a form with ovate-lanceolate or narrow-lanceolate (sometimes oblanceolate), rather acuminate leaves which are more or less distinctly crenate-serrate, firm, and prominently nerved beneath. This form, too, seems to represent typical *S. Nelsonii* which, after all, may be regarded as another variety of *S. planifolia* more closely connected with var. *typica* than with var. *monica*. There is no male material of *S. Nelsonii* known, and before I dare express a definite opinion on it, I must study a larger set of specimens, and get a better understanding of the forms of the Athabasca Region and the Northwest Territories which I mentioned on p. 77. Some of these forms closely resemble *S. Nelsonii* which has been quite amply described by Ball, but he says: "stipules none" while the type specimen as well as A. Nelson's No. 8822 are provided with distinct lanceolate or ovate-lanceolate rather acute, glandular-denticulate stipules which are 2 to 4 mm. long. Jack's Nos. 1068 and 1069 show the same kind of stipules which become dry and fall off later.

All the forms of *S. planifolia*, and especially *S. Nelsonii*, need a careful study in the field. Without having before me young material of both sexes and mature leaves and fruits of the same individuals I am not able to decide the taxonomic value of *S. Nelsonii*. There are some sterile specimens which look much like *S. monticola* Bebb but may be referable to a form like *S. Nelsonii*. I shall deal with them later.

5. *S. pennata* Ball in Bot. Gaz. LX. 45, fig. 1 (1915); in Piper & Beattie, Fl. Northwest Coast, 117 (1915). — *S. chlorophylla* Bebb in Bot. Gaz. xvi. 107 (1891), pro parte, non Andersson. — Piper in Contr. U.S. Nat. Herb. ix. 216 (Fl. Wash.) (1906). — This rather rare and local species has been amply described by Ball but he states that the filaments are "glabrous," while I find that they are distinctly but minutely pilose at base in all the flowers I have examined. In this character *S. pennata* differs from all the species included by me in this section to which it otherwise shows the

closest relationship. Ball says: "In relationship it lies between *S. chlorophylla* and *S. pulchra*, geographically, also, it occupies a position between these two species." He states that on a sterile shoot (Applegate, No. 2758, Oregon, Marion County, 10 miles west of Olay Butte, September 4, 1898) stipules were present and 4-8 mm. long. I did not see this specimen, and on the shoots of such specimens as W. N. Suksdorf's No. 9271, Washington, Skamania County, Chiquash Mts., August 12, 1886, there is hardly a trace of stipules, while on the specimens of Jack cited below, the youngest leaves have ovate-lanceolate stipules of about half the length of the petioles.

The type of *S. pennata* was collected by W. N. Suksdorf on Mount Paddo (Adams) in Washington, and it also has been found in Washington by J. G. Jack in Pierce County, Mt. Rainier, Longmire Springs, on August 20, 1904. It is also known from Mt. Hood, Hoods River County, and from Marion County, Oregon (see above).

6. *S. pellita* Andersson in Svensk. Vet.-Akad. Handl. vi. 139, t. 7, fig. 72 [excl. fig. sinistra g] (Monog. Salic.) (1897), quasi subspecies *S. chlorophyllae*, pro parte. — Ball in Trans. Acad. Sci. St. Louis, ix. 81 (1899) pro parte. — Fernald in Rhodora vi. 191 (1904). — Robinson & Fernald, Gray's Man. 327, fig. 667 (1908). — Britton & Brown, Ill. Fl. ed. 2, i. 598, fig. 1468, (1913). — Rydberg, Fl. Rocky Mts. 197 (1917), pro parte. — *S. chlorophylla* β. *pellita* Andersson in De Candolle, Prodr. xvi. 244 (1868), pro parte. — As Fernald (1904) has already explained in his note on "the identity of Andersson's *Salix pellita*," this author mixed two different plants in basing his new species on specimens from Lake Winnipeg, collected by E. Bourgeau, and also on a Rocky Mountain plant found by Lyall. The first which has to be taken for the type represents an eastern species while the second is *S. subcoerulea* Piper. Until Fernald pointed out this fact, the eastern form usually has been referred to *S. candida* Fluegge from which, however, *S. pellita* is easily separated by its different shining velvety or silky pubescence while *S. candida* possesses a "dull whitish lanate or flocculent tomentum" (Fernald). As to the differences between *S. pellita* and *S. subcoerulea* see under this species.

When Andersson described *S. pellita* he made it a quasi subspecies of *S. chlorophylla* saying: "Difficile sane est dijudicatu cuinam Salicum formae magis sit affinis," and he thought that it probably might be a "modificatio maxime tomentosa" of *S. chlorophylla* "aut e *S. chlorophylla* et *sericea* hybrida." As I have already stated I do not yet know what the typical *S. chlorophylla* (id est var. *vestita*) really is. It came from the same region (Winnipeg) where it also was collected by Bourgeau, and Andersson's description of it is: "— *vestita*: foliis initio utrinque, praecipue subtus tomento argenteo micante obtectis; capsulis fere sessilibus obtusis, dense argenteo-lanatis." From this diagnosis I strongly suspect that the typical *chlorophylla* may turn out to be almost identical with *S. pellita*, in which case the first name would have to be used for it. From Andersson's remarks quoted above I can only surmise that he was far from having a good idea

of the real relationship of these intricate forms. He had before him nothing but a few specimens which were in part at least rather poor, and it is not surprising that frequently he was not able to understand the scanty material upon which he based his opinions.

I have seen forms which I refer to *S. pellita* from southern Labrador (Fernald & Wiegand, No. 3182, st.; G., O.; forma quamvis incerta, porro observanda), western Newfoundland, New Brunswick (as far north as Woodstock in Carleton County), Maine (Aroostook and Somerset Counties), Vermont (Bloomfield in Essex County), and westward from Quebec (as far north as Lake St. John), Michigan (Isle Royale, Houghton County), Ontario (Savanne, Thunder Bay County), and the Lake Winnipeg region. These specimens include the type and the glabrescent form for which I propose the name *S. pellita* f. *psila*,¹ nov. forma: a typo ut videtur nonnisi differt foliis normalibus tantum novellis plus minusve pilosis citissime glabris. — For the type I take Fernald & Wiegand's No. 5282, from Newfoundland, Valley of Exploits River, Grand Falls, thickets along river, July 4, 1911 (fr.; G.). It seems to be associated with the type everywhere in the northeastern part of its habitat from Newfoundland through northern Maine, the Gaspé Peninsula to the Quebec District in Quebec. I do not think it represents a good variety but is apparently connected with the typical form by many intermediates. In a young state, if the branchlets are not pruinose, it is much like *S. planifolia* but it differs a good deal from that species in the shape of the narrowly lanceolate leaves. Some specimens the leaves of which show a rather distinct reticulation beneath and are a little more rugulose, too, on the upper surface, look not unlike the glabrous form of *S. candida* which is called var. *denudata* Andersson, but this form usually shows distinct traces of the peculiar pubescence of *S. candida* on the branchlets.

There may be hybrids with species with which *S. pellita* is growing, and I am at present unable to interpret properly some specimens before me. Among them are the following collected by Fernald & Wiegand which Fernald has determined as *S. phylicifolia*. In part they are nearly identical with *S. pellita psila*, and in part they look like a very narrow-leaved form of *S. planifolia* of which I have not yet seen the typical form from Newfoundland. The specimens came from Birchy Pond Stream in the eastern drainage area of the Humber River system, July 11, 1910 (No. 4239, fr.; A., G.; "shrub 1-4 m. high"; very similar to var. *psila*); river bank between Mt. Musgrave and Humber Mouth Bay (Bay of Islands Station), July 15, 1910 (No. 3190, fr.; G.; looks a little more like *S. planifolia*), and Laurentian area at the head of Exploits River system, granite barrens, slopes and summits of hill near Quarry, July 7, 1911 (No. 5270, fr.; G.; as the preceding). The pubescence of the young shoots is partly ferrugineous. In a later note I shall discuss under *S. humilis* Marshall a form from Quebec, Newfoundland and New Brunswick of which the pubescence of the leaves closely simulates that of *S. pellita*.

¹ Derived from ψιλός, with little hair.

7. *S. subcoerulea* Piper in Bull. Torr. Bot. Club xxvii. 400 (July, 1900),¹ excl. specim. Torreyi No. 489. — Ball in Coulter & Nelson, New Man. Rocky Mts. Bot. 136 (1909). — Wootton & Standley in Contr. U.S. Nat. Herb. xix. 161 (Fl. N. Mex.) (1915). — Henry, Fl. S. Brit. Col. 99 (1915). — Rydberg, Fl. Rocky Mts. 197 (1917). — *S. cuneata* Nuttall, N. Am. Sylva i. 66 (1843), pro parte, non Turczaninow. — *S. pellita* Andersson in Svensk. Vetensk.-Akad. Handl. vi. 139 (Monog. Salic.) (1867), ex parte. — Ball in Trans. Ac. Sci. St. Louis, ix. 81 (1899), pro parte. — Howell, Fl. Northwest Am. 621 (1902). — Jones, Willow Fam. 25 (1908), pro parte. — Rydberg, Fl. Rocky Mts. 197 (1917), pro parte. — *S. chlorophylla*, var. *pellita* Andersson in De Candolle, Prodr. xvi.² 244 (1868), pro parte. — *S. sitchensis*, var. *angustifolia* Bebb in Watson, Bot. Cal. 87 (1879), quoad synonym. — *S. Covillei* Eastwood in Zoë, V. 8 (October, 1900). — *S. pachnophora* Rydberg in Bull. Torr. Bot. Cl. xxxi. 403 (1904); Fl. Colo. 95 (1906); Fl. Rocky Mts. 197 (1917). — *S. sitchensis* Piper in Contr. U.S. Herb. xi. 216 (Fl. Wash.) (1906), quoad specim. Sandbergii & Leibergii No. 72, non Sanson. — *S. glaucops* Jones, Willow Fam. 16 (1908), pro parte, non Andersson. — *S. macrocarpa argentea* Jepson, Fl. Cal. 342 (1909), pro parte, non Bebb. — This species was first mentioned by Nuttall (1843) as *S. cuneata* which, however, is a mixture of *S. sitchensis* Sanson and *S. subcoerulea* so far as I can judge by his description. Nuttall says that the branches are "at first villous and downy, but at a later period brown, and sometimes quite blue, with a glaucous bloom." He, apparently, did not collect fruiting material of *S. subcoerulea* but only of *S. sitchensis*, but he distinguished narrow-leaved and broad-leaved varieties, the first probably being *S. subcoerulea*. He found his plants "growing in clumps near the rocky margin of the Oregon [Columbia] at its confluence with the Wahlamet" [Willamette], a region from which I have hitherto seen only *S. sitchensis*, but a Willow with pruinose twigs and leaves which are "always clad beneath with a whitish close tomentum, producing all the brilliant display of the finest velvet" can be nothing but *S. subcoerulea* which also in a rather young state has been mistaken for *S. sitchensis* by such an acute observer as C. V. Piper, who probably relied on Bebb's determination of Sandberg & Leiberg's No. 72 from Hangman Creek, Spokane County, Washington, May 24, 1893 (fr. im., W.) as *S. sitchensis* but the slightly pruinose branchlets and the aments at once point to *S. subcoerulea*. W. N. Saksdorf collected the same form near Spangle, Latah Creek, July 17, 1889 (No. 9306, st.; A.).

The pubescence of the species is indeed very similar to that of *S. sitchensis* but that species differs widely in every other respect, and never has pruinose twigs. From *S. pellita* with which *S. subcoerulea* had been mixed by Andersson, it differs by the characters given in the key. *S. pachnophora* Rydberg of which I have seen the type cannot, in my opinion, be distin-

¹ This name has already been used by Gandoger (Fl. Eur. xxi. 136 [1890] for a quasi subspecies of *S. nigricans* Smith, and cannot be applied to our species according to the Philadelphia Code. The International Rules however seem to allow the use of the later *S. subcoerulea* because Gandoger's *subcoerulea*, like most of his countless new names, represents nothing but a mere synonym. If *S. subcoerulea* is rejected the name *S. Covillei* Eastwood has to be taken up.

guished even as a variety. Rydberg indicates practically no other difference than "the sessile and naked aments" which are said to be peduncled and leafy in *S. subcoerulea*. Unfortunately the type of the latter has distinctly subsessile aments which hardly can be called pedunculate (as Piper says in his description) while the type of *pachnophora* has several almost sessile aments but also one with a distinct peduncle bearing a few small leaflets. Rydberg himself states in his description of the aments that they are subsessile.

As to *S. Covillei* Eastwood of which I have also seen the type it is rather strange that the author did not herself suspect its extremely near relationship or identity with *S. subcoerulea*. She believed that Coville & Funston's No. 1427 was identical with her species which, I think, was quite correct, and she herself refers to the fact that this specimen has been regarded by Piper as probably belonging to his *S. subcoerulea*. There may be a slight difference between the forms of the typical *subcoerulea* from Alberta to Oregon and northern New Mexico, and the Californian *S. Covillei* to which certain forms from Utah are extremely alike, but it will need a series of more copious and well-collected specimens than I have at present at hand to decide this question. Jepson obviously mistook *S. Covillei* because he puts this name in the synonymy of *S. macrocarpa argentea* without having seen the type. Miss Eastwood is quite right in saying that her new species "is so unlike that species that it would be a waste of time to enumerate the differences" because, as she states, *S. macrocarpa* (now *S. Geyeriana*) has peduncled aments subtended with leaves, and the flowers and the long pediceled fruits are entirely different from those of *S. Covillei*. In determining Willows one is only too often entirely misled at first, and even by a slow and careful examination it is not always possible to determine the proper identity of the plant.

I have seen specimens of what I am inclined to call typical *S. subcoerulea* (including *S. Covillei* sensu stricto) from eastern Oregon (Union County where the type was collected by W. C. Cusick, No. 1302, in the Powder River or Wallowa Mountains, in wet meadows near the head of Eagle Creek, in July-August, 1886, and in Harney County), northeastern Washington (Spokane County), Idaho (Idaho, Adams, Canyon, Blaine Counties; Lyall's syntype of *S. pellita* which came from "49 N. Lat." may have been collected in Boundary County), Montana (Glacier National Park, Flathead and Gallatin Counties), Wyoming (Yellowstone Park, Sheridan and Albany Counties), northeastern Nevada (Elko County), Utah (Salt Lake, Summit, Piute and San Juan Counties), Colorado (Routt, Larimer, Clear Creek, Lake, Gunnison, Ouray, Montrose, Dolores, Huernfano Counties), New Mexico (Rio Arriba, San Miguel County), and California (Fresno and Tulare Counties). A special form of *S. subcoerulea* may be represented by specimens collected by W. N. Suksdorf on Mt. Paddo (Adams) in Washington, July 11, August 28, 1886 (No. 9259, m., st.; A.; and in C. without No. [sheet 2644]). The slender branchlets are hardly pruinose and rather yellowish brown becoming purplish later. The leaves are linear-lanceolate,

measuring from 2:0.3 to 5:0.8 cm., bearing the same pubescence as the typical *subcoerulea*. The male aments are coetaneous, up to 2 cm. long and 1 cm. thick, with very short leafy peduncles. This form needs further observation; it somewhat resembles the forms with pubescent branchlets mentioned under *S. Drummondiana* but the twigs bear only a few scattered hairs at their tips.

8. *S. bella* Piper in Bull. Torr. Bot. Cl. xxvii. 399 (1900). — Rydberg, Fl. Rocky Mts. 196 (1917). — *S. glaucops glabrescens* Jones, Willow Fam. 16 (1908), quoad syn., non Andersson. — The type of this species came from Whitman County, Washington, 6 miles east of Pullman, near Garrison, where it was collected by L. F. Henderson in 1895 and 1896. I have seen the type (Herb. Pu.) and Piper's No. 2922 which is marked in Herb. G. "from type tree." *S. bella* is certainly a beautiful Willow but its relations to *S. subcoerulea* and *S. pellita* are not yet fully understood. I have pointed out the differences in the key. Piper states that the branches are very brittle, while in *S. subcoerulea* he does not note this fact. According to the information which Professor J. G. Jack has given me, it seems that all the species of this group have brittle jointed branches. Piper furthermore said in the note to his description that *S. bella* belongs to "the obscure *S. pellita* group," and that "its relationship is with *S. candida*." This species, however, belongs to a different section.

I add an enumeration of the specimens of *S. bella* which I have seen. Among them are some in which the lower (first) leaves are not distinguishable from those of *S. subcoerulea*, and bear the pubescence characteristic of that species, while the upper (later) leaves are distinctly covered with the less adpressed, not so lustrous silvery pubescence of *S. bella*. After all I am not sure if *S. bella* represents a variety of the other species. It is true that the pubescence of the lower surface of the leaves of *S. bella* is not unlike that of *S. pellita*, but in this species the lower leaves usually become more glabrous, glaucous and reticulate. To detect good characters in the male and female flowers of these very closely related species it would need an investigation of a series of well collected specimens accompanied, in order to be sure of their identity, by mature leaves of the same plant. Of *S. pellita* I have not yet seen male flowers, and perfectly ripe fruits of all the species are rare in herbaria because the specimens were mostly collected before the fruits were mature.

SPECIMENS EXAMINED: EASTERN WASHINGTON. Whitman County: near Garrison, August 18, October 14, 1895, April 4, m., May 5, f., 1896, L. F. Henderson (type material, Pu.); April 30, July 2, 1899, C. V. Piper (No. 2922 partim, f., st.; A., G.); same place, August 31, 1918, J. G. Jack (No. 1227, st.; A.; "bushes 10-12 feet high") 6 miles east of Pullman. April 30, July 2, 1901, C. V. Piper (No. 2922 partim, f., m., st.; A., W.); April 13, September, 1901, C. V. Piper (No. 3590, m., f., st.; A. G., W.); Spokane, October 1, 1900, C. V. Piper (No. 3517, st.; G.; forma quamvis incerta foliis inferioribus satis late obovatis, ad 6:2.5 cm. magnis, summis satis typicis.)

NORTHWESTERN IDAHO. Latah County: Jansville, July, 1898, C. V. Piper

(No. 2919, st.; a form with narrow leaves, much resembling *S. pellita*, but with twigs finely puberulous and stipules distinctly developed); Boville, thickets along stream, September 5, 1918, *J. G. Jack* (No. 1355, st.; A.; "8-10 feet high"; same as preceding). Shoshone County: Coeur d'Alene Mts., north fork of Coeur d'Alene River, 950 m., August 13, 1895, *J. B. Leiber* (No. 1533, st.; A., M., N., W.). Kootenai County: Coeur d'Alene, in sand along Fernau(?) Creek, April, 1914, August, 1913, *H. J. Rust* (No. 492, fr. partly teratological, st.; W.; "scrubby willow"); Fernau(?) Lake Shore, in sandy soil, same date and collector (No. 502, m., st.; W.; mixed with *S. Scouleriana* leaves). Bonner County: Priest Lake, August, 1901, *C. V. Piper* (No. 3742, st.; W.); west fork of Priest River, alt. 900 m., August 4, 1897, *J. B. Leiber* (No. 2841, st.; W.).

NORTHEASTERN MONTANA. Flat Head County: Swan Lake, alt. 1000 m., August 24, 1908, *M. E. Jones* (No. 9138, st.; M., W.). Glacier National Park, St. Mary, September 14, 1918, *J. G. Jack* (No. 1517, st.; A.; "5-6 feet high").

ALBERTA. Rocky Mountain District: Crow's Nest Pass, Oldman River, alt. 1300 m., August 14, 1897, *J. Macoun* (No. 7, st.; N.; folia inferiora ut in *S. subcoerulea* sericeo-pilosa); Banff, side of Cascade Creek by bridge, alt. 1550 m., June 6, August, 1899, *W. C. McCalla* (No. 2247, f., st.; N.; same as the preceding).

9. *S. Drummondiana* Barratt apud Hooker, Fl. Bor.-Am. II. 144 (1838). — Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 123 (1858); in Svensk. Vet.-Akad. Handl. vi. 137 (Monog. Salic.) (1867); in De Candolle, Prodr. xvi.² 243 (1868). — Macoun, Cat. Can. Pl. 448 (1886). — Henry, Fl. S. Brit. Col. 99 (1915). — Rydberg, Fl. Rocky Mts. 196 (1917). — This is apparently a rare and rather critical species. The material before me is not sufficient to understand properly its taxonomic value, and to determine clearly its relationship to the preceding group of species and to the following one. The type was collected by Drummond in the "Rocky Mts.," probably in the Edson District of Alberta. I have before me a photograph and fragments of the type from the Kew Herbarium consisting of a piece with young female flowers, another with half-ripened fruits, and a third one with mature leaves. Besides this I saw a co-type in the Herbarium of the New York Botanic Garden. Both specimens have rather broad, obovate or obovate-elliptic leaves "below white with dense tomentum" as Hooker says, and glabrescent on the midrib. The pubescence is opaque as in *S. bella*, and not shining as in *S. subcoerulea*. The female aments and flowers are very much like those of *S. subcoerulea*, only the bracts of the flowers seem to be narrower and more acute, and the pedicels are mostly a little longer but their length seems to be rather variable in *S. subcoerulea* too, as also in other species of this group. The main difference are the broader leaves which in specimens like that of Rehder (see below) become rather elliptic-lanceolate or elliptic-ob lanceolate, a shape I have never noticed in *S. bella* but sometimes in *S. subcoerulea*, in which however the pubescence is thinner, adpressed, and silky, the veins being much more prominent. Besides the shape of the leaves there is the almost entire absence of the glaucous bloom of the branchlets which is so conspicuous in the two preceding species. If we have a better knowledge of the flowers and fruits they may afford additional good characters to separate these species, but at present I dare not to put much stress on the differences I have observed. I am not yet sure

whether the following specimens really all belong to *S. Drummondiana*, but I hope that we shall soon get more copious material from such frequently visited places as the vicinities of Banff and Laggan in Alberta. This species is mentioned by Macoun (1885) also from "on the beds of snow-slides, summit of the Selkirk Mountains, B.C." but I have not yet seen specimens from there. J. K. Henry (1915) does not cite a definite locality.

Hooker also mentions a form "*β. ovariiis glabris*." He does not cite a type, and states that in *β* the pistils are quite glabrous, and that "in this var. the silky hairs of the scales are longer than in the usual state of the plant." Andersson said (1867) that he did not see a specimen belonging to this variety, neither have I.

SPECIMENS EXAMINED: ALBERTA. Edson District: Rocky Mountains, locality uncertain, *Drummond* (No. 672, f., st.; type in K.; No. "2. Hb. H. B. & T."¹ in N.); Jasper Park, Jasper, near Athabasca River, July 26, 1917, *J. M. Macoun* (No. 95,387, O., st.; A.). Rocky Mountain District: Lake Louise near Laggan, August 12, 1904, *A. Rehder* (fr.; A.; the specimen bears only one catkin with very poorly developed fruits, and the upper leaves are elliptic-lanceolate measuring up to 9:2.8 cm., the lowermost are small and very narrow); vicinity of Banff, Cave Ave., July 4, 1891, *J. Macoun* (No. 31, st.; C.); bank of Cascade Creek by bridge, June 6, August 2, 1899, *B. C. McCalla* (No. 2247, f., st.; Cor.; "6 feet high"; leaves rather small obovate-lanceolate); at edge of snow-drift in a ravine on Mt. Aylmer, alt. 2300 m., August 4, 1899, *V. C. McCalla* (No. 2242^a, fr., 2247^a, f., m., female aments partly abnormal; Cor.; "3 feet high"; the fruiting aments measure up to 5.5:1.5 cm.); National Park, Banff, July 1897, *C. Van Brunt* (st.; N.; forma incerta porro observanda).

I am not sure whether McCalla's specimens present the real *S. Drummondiana* or the same form as the following specimens which partly look like *S. Jepsonii*, and to which I wish to draw the special attention of collectors and students.

MONTANA. Flat Head County: Flat Head Lake and vicinity, MacDougal Peak, 2000 m., July 31, 1908, *Mrs. J. Clemens* (fr. im., M.; fructus crasse ovoideo-conici, pedicelli glandulam 2-plo superantes, 1.5 mm. longi, styli valde breves); same place and date, *M. E. Jones* (st.; M., W.); Old Marias Pass, circ. 2260 m., August 1, 1883, *C. S. Sargent* (st.; A.); Teton County: Midvale, streams, July 9, 1902, *L. M. Umbach* (No. 310, f., fr., M.). Park County: Emigrant Gulch, alt. 2250 m., August 23, 1897, *P. A. Rydberg & E. A. Bessey* (No. 3412, st.; N.; forma porro observanda).

BRITISH COLUMBIA. Kootenay District: north side of Wapta Lake, August 2, 1904, *J. Macoun* (No. 68,890, O., st.; G., N.).

ALBERTA. Rocky Mountain District: Lake Agnes, 2260 m., August 11, 1897, *C. S. Sargent* (st.; A.; "3-4 feet"); Laggan, July 11, 1911, *M. O. Malte* (No. 86,842, O., fr.; fructus satis longe pedicellati); Banff, east of Spray River, wet places, June 3, 1891, *J. Macoun* (No. 24,711, O.; st.; folia etiam superne satis sericea; Cammore, damp places, June 3, 1885, *J. Macoun* (25 [=24,286, O.], st.; like the preceding); Crows Nest Pass, August 4, 1897, *J. Macoun* (No. 94,322, O., st.; same Pass, the

¹ In Bot. Gaz. LXVI, 322 (1918) I spoke of a specimen labeled No. "6. Hb. H. B. & T.," consisting of a fruiting catkin of *S. glauca acutifolia* Hooker) Schneid., and a sterile branchlet of the identity of which I then was not sure. This piece apparently belongs to *S. Drummondiana*.

Gap, August 6, 1897, *J. Macoun* (No. 94,323, O., st.). Calgary South District: Elbow River, Bragg's Creek, July 4, 1897, *J. Macoun* (No. 94,324, O., st.; "a small tree").

There is also a specimen before me collected by W. C. Cusick in 1886 (No. 1302^a, st.; W.) in wet alpine meadows apparently at the type locality of *S. subcoerulea*, which in the pubescence of the young twigs and of the upper surface of the leaves agrees more with some of the forms just mentioned than with typical *subcoerulea* but the branchlets are partly somewhat glaucescent.

10. *S. Jepsonii*,¹ spec. nov. — *S. sitchensis* var. *angustifolia* Bebb in Watson, Bot. Cal. II. 87 (1879). — Jepson, Fl. Cal. 342 (1909). — *S. pellita* Bebb in Bot. Gaz. XVI. 105 (1891), non Andersson. — Ball in Trans. Acad. Sci. St. Louis, IX. 81 (1899), pro parte. — *S. sitchensis* Hall, Yosemite Fl. 67 (1912), non Sanson. — Frutex ut videtur erectus, habitu et altitudine mihi ignota; ramuli novelli laxè vel dense breviter villosulo-tomentosi, hornotini plusminusve glabrescentes et ut annotini glabri (vel tantum partim parce tomentelli) castanei vel atro-purpurascens, plerique nitiduli, vetustiores cinerascens; geminae perfecte evolutae nondum visae, novellae ut ramuli pilosae; folia matura satis chartacea, firma, anguste oblanceolata, basi cuneata, apice obtusa ad acuta, minimis infimis exceptis 2:0.6 ad 6.5:1.2 cm. vel latiora obtusiora ad 5:1.3 cm., surculorum ad 12.5:1.5 cm. (Jepson no. 386) vel anguste elliptica vel etiam ovato-lanceolata ad 9:1.2 vel 10:2.5 cm. magna, margine integerrima, interdum leviter undulata, saepe subrevoluta, superne initio plusminusve sparse (vel in surculis dense) breviter sericeo-villosula, dein costa tomentella excepta glabrescentia, intense sed ut videtur satis obscure viridia, costa nervisque lateralibus subplanis, epidermide estomatifera, subtus tomento sericeo denso adpresso micante vel subopaco ut in *S. sitchensi* (vel in *S. subcoerulea*) vestita, costa elevata flava etiam tomentella (rarius fere glabrescente), nervis lateralibus utrinque circ. 10–16 fere occultis vel paullo prominulis; petioli plusminusve tomentosi, 2–6, etiam in surculis vix ultra 7–8 mm. longi; stipulae nullae vel pleraeque parvae, semiovato-lanceolatae, integrae vel glanduloso-denticulatae, ut folia pilosae, ad 3 mm. longae, vel in surculis (specim. Jackii) semicordatae, ad 11 mm. longae et 5 mm. latae. Amenta subpraecocia vel coetanea, cylindrica; mascula subsessilia vel pedunculo ad 3 mm. longo foliola minima 2–4 dense normaliter pilosa gerente suffulta, 1–2:1 cm. magna; bractae oblongo-obovatae, satis dilute brunneae vel apice subfuscae, dense sericeae pilis bracteam vix aequantibus; stamina 2, filamentis liberis vel in parte inferiore amenti saepe basi vel ad medium coalitis glabris bracteam denum ad 2 2 1 4-plo superantibus, antheris ut videtur semper aureis ellipsoideis circiter 1 mm. longis thecis inaequalibus; glandula 1, ventralis, ovoideo-conica, truncata, bractea 1/2 vel 1/3 brevior; feminea sub anthesi 1.5–2.5:0.6

¹ It gives me great pleasure to dedicate this species to Professor W. L. Jepson without whose rich collections of Willows I should not have been able to elucidate several of the interesting but little understood Californian species.

cm., fructifera 2-4:1-1.3 cm. pedunculo foliolato 0.8-2 cm. longo excluso magna; bracteae ut in floribus masculis; ovaria sub anthesi ellipsoidea vel oblongo-ovoidea, dense breviter sericeo-tomentosa, pedicello brevi vix ad 1 mm. longo glandulam vix superante; styli breves, circiter 0.75-1 mm. longi, integri (vel in no. 12138 *Helleri* subbifidi), stigmatibus oblongis bifidis vix vel 1/2-plo longiores; glandula 1 ut in flore masculo; fructus maturi e basi ovoideo vel crasse ellipsoideo conici vel subrostrati, 4.5-5.5(6) mm. longi pedicello ad 1.25 mm. (in no. 12318 ad 2 mm.) longo glandulam ad fere 2-plo superante excluso.

TYPE LOCALITY: high mountain near Donner Pass, Placer County, California.

SPECIMENS EXAMINED: CALIFORNIA. Placer County: high mountain near Donner Pass, 1865, *J. Torrey* (No. 489, fr. im.; type; G.); by brook between Donner Lake and Summit, July 14, 1900, *W. R. Dudley* (No. 5063, fr.; st.; an typica?); Lake shore above McKinney's June 24, 1900, *W. R. Dudley* (No. 5527, fr.; St.; mixed with sterile *S. Lemmonii* Bebb); Placer-Eldorado County line, lower valley of McKinney's Creek, June 24, 1900, *W. R. Dudley* (No. 5534, fr.; St.). Eldorado County: Lake Tahoe Region, Gilmore Lake, alt. 2700 m., July 29, 1911, *L. R. Abrams* (No. 4854, fr. im.; G.); Susie Lake, 1909, *A. Eastwood* (No. 1262, f.; Cal.); Tahoe Region, creek bank between Heather and Suzy Lakes, 2600 m., July 18, 1913, *F. J. Smiley* (No. 144, fr.; G.); moist shores of Echo Lake, in granite, alt. circ. 2500 m., August 15, 1915, *A. A. Heller* (Nos. 12137, 12138, fr.; A., G., M., St.; fructibus pedicellis ad fere 2 mm. longis bracteam subaequilongis suffultis, amentis pedunculo ad 1.5 cm. longo excluso ad 3.5:1.3 cm. magnis); Glen Alpine Region, Trail to Lake Lucille, July 21 to August 15, 1906, *A. Eastwood* (No. 1038, f.; Cal.); near Glen Alpine Springs, June 1900, *W. R. Dudley* (No. 5662, fr.; St.); below Lake Lucille, June 1900, *W. R. Dudley* (No. 5653, fr.; St.); Lily Lake, August 2, 1906, *A. Eastwood* (No. 1202, m., Cal.); Heather Lake, same date and collector (No. 1212, m., Cal.); Tuolumne County: Sonora Pass Road, 2900 m., August 27, 1915, *A. L. Grant* (No. 386, st.; Jeps.; foliis anguste lanceolatis ad 11:3 cm. longis). Mariposa County: Yosemite National Park, Bear Valley, 1872, *H. N. Bolander* (f.; G.); Lake Tenaja, August 18, 1917, *A. Eastwood* (No. 447, st.; Cal.; resembles Jack's specimen enumerated below); Yosemite Valley, 1300-1500 m., July 10, 1911, *L. R. Abrams* (No. 4672, fr. im.; G.); by brook beside Nevada Fall and Cloud's Rest Trail, June 11, 1894, *W. R. Dudley* (f.; St.); Lake Merced, Merced River, 2400 m., July 10, 1909, *W. L. Jepson* (Nos. 3200, 3206, f.; Jeps.; forma porro observanda); Stubblefield Canyon, 2500 m., July 28, 1911, *W. L. Jepson* (No. 4531, f.; Jeps.); Illiuhette Canyon, 2100 m., June 20, 1912, *E. B. Babcock* (No. 1057, f.; N.); Chihuahua Trail, August 1, 1898, *J. W. Congdon* (m., fr.; G.). Madera County: Shuteye Mt., creek bank, 2600 m., July 19, 1914, *F. J. Smiley* (No. 563, fr. im.; G.); same mountain, 2200 m., August 8, 1907, *J. G. Jack* (st.; A.; shoots with long narrowly elliptic acute leaves up to 9.5:2.3 cm., and with distinct semicordate lanceolate stipules somewhat surpassing in length the petioles. In the shape and nervation of the leaves it recalls *S. Coulteri* but the pubescence is typical).

This puzzling Willow was described in 1879 by Bebb as *S. sitchensis* var. *angustifolia*. The type was collected by Torrey on a "high mountain near Donner Pass" in 1865. This is Torrey's No. 489 in the Gray Herbarium and in the Herbarium of the New York Botanic Garden. Bebb quoted as a synonym *S. chlorophylla* var. *pellita* Andersson stating that it "accords essentially (excepting the pointed leaves) with the description of *S. chlorophylla* var. *pellita* Anders., though when compared with Dr. Lyall's speci-

mens from the Rocky Mountains, cited by the author, the discrepancy is greater." Later, in 1891, Bebb declared that "it was a mistake to arrange the little willow collected on a high mountain near Donner Pass by Dr. Torrey, as a variety of *S. sitchensis*," and that it belonged to *S. pellita*. Ball (1899) expressed the same opinion, in both cases *S. pellita* meaning *S. subcoerulea* to which as I have already explained on p. 82 Lyall's specimen belongs. I have before me Torrey's No. 489, and all the specimens enumerated below which apparently represent the same form. Almost all of them are female, but fortunately Eastwood's Nos. 1202 and 1212 are males and on a specimen of Congdon's I have also found a male ament. These specimens show that the flowers always have two distinct stamens, the filaments of which are mostly free, and the anthers obviously golden-yellow. This fact proves that var. *angustifolia* cannot be united with *S. sitchensis* nor with *S. Coulteri* notwithstanding the extreme similarity of the pubescence of the leaves with that of *S. sitchensis*. On the other hand it is certainly not identical with *S. subcoerulea* but may after all be best placed in the same section.

A. A. Heller's specimen from Butte County, west branch of the North Fork of the Feather River near Stirling, circ. 1000 m., June 7, 1913 (No. 10832, fr.; A., G., M., N.) is so much alike typical *S. sitchensis* which otherwise seems to be absent from California (unless some forms referred by me to *S. Coulteri* prove to belong to it) that I cannot decide whether it ought to be taken for *S. Jepsonii* as long as male flowers from the same locality are unknown. There is a specimen from Nevada, Churchill County, Carson Sink Region, alt. 1400 m., July 15, 1908, *P. B. Kennedy* (No. 1777, fr.; M., Reno), distributed as *S. Scouleriana*, which in the shape of the fruits and stigmas, somewhat longer than the very short style, points indeed to this species but otherwise can hardly be distinguished from *S. Jepsonii*. The leaves partly show an obscure glandular dentation. This Willow comes from a region which is not yet sufficiently explored.

In 1909 Jepson (Fl. Cal. 342) described a *S. sitchensis* f. *Ralphiana* from Sequoia National Park, Giant Forest, Marble Fork of the Kaweah River, Tulare County, 2300 m., June 24, July 2, 1900, *W. L. Jepson* (No. 690 f.; Jeps.). The type is before me, and it shows that the character of the pubescence is rather intermediate between that of *S. sitchensis* and *S. Coulteri*, and in all the flowers which I have examined I have found a distinct dorsal gland. The leaves measure up to 9.5:2.2 cm., and the aments up to 6:1.4 cm. This form apparently is closely related to *S. Jepsonii* or comes nearer *S. Coulteri*. It needs further study of young female and male material. This also applies to *W. R. Dudley's* No. 2837 from Bear Creek, Grant National Park, July 29, 1900 (fr.; St.).

b. THE SPECIES OF SECTION SITCHENSES

In 1891, Bebb (in Bot. Gaz. xvi. 105) proposed the sect. *Sitchenses* for *S. sitchensis* Sanson because this Willow differs from all the other American species (except *S. Uva-ursi* Pursh) in having only one stamen. In 1903

von Seemen (*Salices Japonicae* 21) referred several Japanese species which have only one stamen (at least in part of the flowers) to a new section *Sieboldianae*, and he also mentioned (p. 13) *S. sitchensis*, *S. Coulteri*, and *S. ivigtutiana* as belonging to his group *Submonandrae*. Neither he nor I in 1904 when I published the *Salices* of my *Fl. Handb. Laubh.* i. 69, were aware of the fact that Bebb had already proposed a sect. *Sitchenses*. In 1916 (in Sargent, *Pl. Wils.* iii. 161) I dealt with the sect. *Sieboldianae*, but I do not yet know if the Japanese species really ought to be united with *S. sitchensis* in the same group. *S. Uva-ursi*, of which *S. ivigtutiana* is only a synonym, cannot be included in this section, and its relationship is still doubtful as I have already pointed out (in *Bot. Gaz.* XLVII. 50 [1919]). To which of the other American sections the *Sitchenses* approach most closely is still a question I cannot definitely answer at present.

CLAVIS SPECIERUM

Bracteae florum plus minusve distincte, praesertim ad apicem, fuscесcentes; antherae (an semper?) violaceae; folia pleraque plusminusve oblanceolata, obovato-lanceolata vel obovato-elliptica, subtus tomento denso brevi plusminusve adpresso argenteo micante oblecta, etiam adulta submembranacea . . . 1. *S. sitchensis*.
 Bracteae florum satis flavесcentes vel ad apicem flavo-brunneae, sed vix fuscесcentes; antherae aureae; folia normalia obovato-oblonga ad elliptico-oblonga, subtus tomento denso albescente subsericeo-villoso magis opaco quam argenteo-micante oblecta adulta chartacea, satis crassa . . . 2. *S. Coulteri*.

1. *S. sitchensis* Sanson apud Bongard in *Mém. Acad. Imp. Sci. St.-Petersb. sér. 6.* II. 162 (1833). — Hooker, *Fl. Bor.-Am.* II. 153, in nota apud no. 41 (1839). — Andersson in *Öfv. Svensk. Vet.-Akad. Förh.* xv. 126 (1858); in *Proc. Am. Acad.* IV. 66 (*Sal. Bor. Am.* 21) (1858); in Walpers, *Ann. Bot.* v. 752 (1858); in *Svensk. Vet.-Akad. Handl.* VI. 106, t. 6, fig. 59 b, d, g (Monog. *Salic.*) (1867), excl. planta masc., et **S. ajanensis*; in De Candolle, *Prodr.* XVI.² 233 (1868), pro parte maxima et excl. var. γ . — Bebb in Watson, *Bot. Cal.* II. 87 (1879), pro parte minima; in *Bot. Gaz.* VII. 25 (1852); XVI. 105 (1891), excl. *S. Coulteri*. — Sargent, *Silva N. Am.* IX. 149, t. 486 (1896) excl. syn. *S. Coulteri*; *Man. Trees N. Am.* 187, fig. 159 (1905), excl. specim. cal. — Coville in *Proc. Wash. Acad. Sci.* II. 278. (1900); I. c. III. 307, t. 33 (1901). — Howell, *Fl. Northwest Am.* 620 (1902), ex parte. — Piper in *Contr. U.S. Nat. Herb.* XI. 216 (*Fl. Wash.*) (1906). — Britton & Shafer, *N. Am. Trees* 202, fig. 165 (1908), excl. specim. cal. — Ball in Piper & Beattie, *Fl. Northwest Coast*, 116 (1915). — Henry, *Fl. S. Brit. Col.* 98 (1915). — Rydberg, *Fl. Rocky Mts.* 196 (1917). — *S. Scouleriana* Barrat apud Hooker, *Fl. Bor.-Am.* II. 145 (1839), pro parte, quoad folia, fide Andersson. — *S. cuneata* Nuttall, *N. Am. Sylva*, 66 (1843), pro parte, non Turczaninow. — *S. sitchensis congesta* Andersson in *Svensk. Vet.-Akad. Handl.* VI. 107 (1867); in De Candolle, *Prodr.* XVI.² 233 (1868).

The type of this peculiar and handsome species came from Sitka where it, as stated by Coville, was collected along Indian River by "Henry Martens, the botanist of Lütke's Expedition, in an excursion from Sitka to the

summit of the neighbouring Mount Verstovia, in the year 1827." As Coville says, it "is a characteristic plant of the Sitkan floral district extending from the southernmost limit of Alaska northward and westward along the coast to Cook Inlet and the eastern end of Kadiak Island." South of Sitka it is a "very common plant at the coast" J. K. (Henry) of British Columbia, from where I have also seen specimens from the Yale and Kootenay Districts. In the United States it has been found in western Washington and western Oregon, but also in southeastern Oregon (Blue Mountains) and eastern Washington (Wallowa and Steins Mts.), in Idaho (Elk River, Clear County), and Montana (Belton, Flathead County). The species is readily distinguished by the satiny pubescence of the lower surface of its mostly more or less obovate leaves. Sometimes specimens of a pubescent form of *S. Scouleriana* with which I shall deal in a later article, have been taken for *S. sitchensis*, but the villose pubescence of these forms is very different as also usually is the shape (more elliptic) of their leaves.

Andersson (1867) proposed two varieties of *S. sitchensis*: "— *congesta*; foliis angustioribus; amentis ob capsulas crassissimas et breves subsessiles valde densifloris," and "— *denudata*; foliis subtus demum glabratis tenuibus." The types of both were collected by Lyall along the lower Frazer River. There is before me a specimen of Lyall's from this region collected in 1859 (m., f.; N.). The sheet on which it is mounted bears a label "*Salix sitchensis* Bong. *congesta* Ands." in Andersson's own handwriting. On the label is written by another hand "Lower Fraser River, C. B. Wood, 1839," and it is referred to a piece with rather old female aments. I do not know of a collector C. B. Wood. All the pieces, in my opinion, represent typical *S. sitchensis*. Another specimen of Lyall's, lower Frazer River, Sumass, swamps, April 20, 1857, does not agree with either variety. Whether var. *denudata* really belongs to *S. sitchensis* remains doubtful, especially as Andersson (in 1868) states that the leaves of it are "iis *S. silesiacae* v. *S. cinereae* haud absimilibus." There are specimens collected by Coville & Kearney (No. 442) and B. E. Fernow, on June 5, 1899, at Fort Wrangell, southeastern Alaska, which Coville regards (Herb. W.) as "probably a denudate" *S. sitchensis*. Fernow's plant in Herb. Cor. is mixed with *S. Barclayi*, and without mature leaves, flowers or fruits it is impossible to decide whether it is a hybrid or a variety of *S. sitchensis*. Andersson's third var. *ajanensis* (1868), which he (1867) first published as a quasi subspecies as *S. sitchensis* **S. ajanensis*, came from northeastern Asia, and is unknown to me.

2. *S. Coulteri* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 19 (1858); in De Candolle, Prodr. xvi. 264 (1868). — Bebb in Watson, Bot. Cal. II. 90 (1879). — Behr, Fl. Vic. San Francisco, 217 (1888). — *S. sitchensis* Bebb in Bot. Gaz. VII. 25 (1882), pro parte, non Sanson; l. c. xvi. 105 (1891), pro parte. — Jepson, Fl. W. Middle Cal. ed. 2. 119 (1911). — *S. sitchensis* f. *Coulteri* Jepson, Fl. Cal. 342 (1909). — In 1882, Bebb discussed the specific value of this species which at this time was only known from Coulter's

type specimens collected probably near Monterey, and Bolander's poor and uncertain specimen from Marin County. Therefore, Bebb, at this time and in 1891, regarded *S. Coulteri* as representing "nothing more than an abnormal development of *S. sitchensis*." Judging by the material enumerated below it seems to me that *S. Coulteri*, although certainly closely related to *S. sitchensis*, nevertheless presents some peculiar characters of its own which lead me to keep it as a species until more abundant material convinces me that no rigid line can be drawn between the two species. The difference in the pubescence of their leaves is much the same as that between *S. subcoerulea* and *S. bella* or *S. pellita*. In *S. Coulteri* the rather rigid old leaves bear a much more woolly and dull felt-like tomentum on their lower surfaces, which often is rather yellowish on the young leaves at the top of the branchlets which are clothed with the same kind of pubescence. The lowermost (first) leaves and those of the peduncles show a more or less shining covering of long silky adpressed hairs. The aments are more slender than those of *S. sitchensis*, the yellowish or light brown bracts are more lustrous silky, and the anthers are golden yellow. The fruiting aments sometimes measure up to 13:1.3 cm., and the well-matured fruits are usually from 0.5 to 1 mm. shorter than those of *S. sitchensis*. I refer the following specimens to *S. Coulteri*.

CALIFORNIA. Santa Barbara County: May, 1879, *E. Cooper* (f.; G.); without date, *J. C. Lemmon* (st.; G.). Monterey County: locality and date uncertain, *Coulter* (No. 635, m.; type in K., cotype in G.); Santa Lucia Mountains, near seashore, 1880, *G. R. Vasey* (st.; A.); Pacific Valley, near Mansfield's, May 1-12, 1897, *A. Eastwood* (f., fr.; G.; aments ad 9 cm. longis flexuosis); Willow Creek, same date and collector (m., fr.; A.; amentis fructiferis ad 12:1.2 cm. magnis); Santa Lucia Mountains, February, 1898, *R. A. Plaskett* (No. 29, m., st.; G.); March, 1898, same collector (No. 51, f., st.; G.); Lucia, June 14-20, 1901, *W. L. Jepson* (No. 1621, fr.; lepis.; folia ad 13.5:7 cm. magna, obovati-elliptica); Monterey, May, 1875, *C. L. Andersson* (st.; A., M.); Point Sur, July, 1888, *T. S. Brandegee* (st.; A.). Santa Cruz County: Santa Cruz, 1875 and 1877, *C. L. Andersson* (fr., st.; A., G., M.; some of the specimens only partly). Santa Clara County: Wrights, August 3, 1895, *A. Eastwood* (No. 41, f., m.; G.); June, 1903, *A. D. E. Elmer* (No. 4687, fr.; M.); Black Mountain, April, 1903, *A. D. E. Elmer* (No. 4684, m., f.; M.); Stevens Creek Road, March 5, 1905, *W. R. Dudley* (f.; G.). San Mateo County: King's Mountain, along streams near the summit of the range, March 18, May 1, 1902, *C. F. Baker* (No. 390, m. f., fr. im.; G., M.); same mountain, March and September, 1902, *L. R. Abrams* (No. 2272, m., f., st.; M.); same place, March, 1902, *A. D. E. Elmer* (No. 4115, m., f.; M.); Portola, April, 1903, same collector (No. 4917, fr.; M.); Bear Gulch, 230 m., March 7, 1904, *W. R. Dudley* (No. 69, f., 70, m.; A.). Marin County: Lagunitas, March 28, 1915, *A. Eastwood* (No. 3992, m., f.; A.). Sonoma County: Sonoma Creek, foot of Mt. Hood, March 12, June 26, 1902, *A. A. Heller* (No. 5044, m., f., st.; A., G., M., St.; forma paullo ad *S. sitchensis* vergens, porro observanda); Fort Ross, April 23, 1903, *A. A. Heller* (No. 6602, fr.; M., G.). Humboldt County: vicinity of Eureka, March 6, 1904, November 5, 1905, *J. P. Tracy* (No. 2398, f., st.; G.).

The specimens collected by Bolander near San Francisco (No. 2451, m.; G.) represent an uncertain form with pilose filaments.

The form described by Jepson (Fl. Calif. 342 [1909]) as *S. sitchensis* f.

parvifolia, from Mendocino County, Melbourne to Comptche, June-July 1903, *W. L. Jepson* (No. 2229, st.; Jeps.) seems to be a small-leaved form of *S. Coulteri* judging by the pubescence of its branchlets and leaves which measure up to 3.8:0.9 cm. Therefore I propose for it the name *S. Coulteri* f. *parvifolia*, nov. comb.

c. SECTION BREWERIANAE

As I shall presently explain, *S. Breweri* Bebb represents such an unique type among American Willows that it seems best to refer it to a separate section in which I also place *S. delnortensis* described below which apparently is most closely related to *S. Breweri*. Therefore, I propose sect. **Brewerianae**, sect. nov. — Frutices ut videtur satis parvi ramis divaricatis probabiliter basi tenacibus tenuioribus subangulatis. Folia matura crasse chartacea, lanceolata vel obovata, subtus densissime albescenti-tomentosa, distincte elevato-reticulata. Amenta praecocia vel coetanea, sessilia vel subsessilia, anguste cylindrica, densiflora, saepe flexuosa; flores masculi diandri, filamentis liberis glabris vel basi parce pilosis, glandula 1 ventrali anguste conica; feminei fructusque sessiles, dense sericeo-villoso-tomentosi; styli distincti, circ. 1 mm. longi, saepe plusminusve bifidi, stigmatibus brevissimis oblongis bifidis circ. $2\frac{1}{2}$ -plo longiores; glandula 1 ut in flor. masc.; fructus ovoideo-conici, 4.5-5 mm. longi, ut ovaria pilosi. — For further remarks see under *S. Breweri*.

CLAVIS SPECIERUM

Folia anguste lanceolata; glandula florum satis longa et fere filiformis 4-5 plo longior quam crassa; antherae ut videtur semper aureae 1. *S. Breweri*.
Folia obovata; glandula brevior et subcrassior $2\frac{1}{2}$ -3-plo longior quam crassa; antherae (saltem initio) violaceae 2. *S. delnortensis*.

1. *S. Breweri* Bebb in Watson, Bot. Cal. II. 89 (1879); in Bot. Gaz. XVI. 106 (1891). — Jepson, Fl. Cal. 343 (1909). — When Bebb described this species from specimens collected by W. H. Brewer "on San Carlos Mountain in a dry ravine" he spoke of it as of a "genuine American representative of the *Viminales*." Later (1891) he said: "Beyond all comparison this is the rarest and most obscure of the North American willows." Having seen probably all available herbarium material I can speak as follows about this peculiar species. The most complete description which has been given of it is by Jepson, as Bebb did not know the male plant. Its normal upper leaves are oblong or narrowly lanceolate to almost linear-lanceolate, measuring from 4:0.5-1.2 to 6:0.8-1 cm.; they are rather dull green and never quite glabrous above, and densely villose-tomentose beneath where the reticulation is quite distinct. The petioles are very short, hardly up to 2 mm. long, and the stipules are wanting or ovate-lanceolate, and 1-3 mm. in length. The almost sessile narrowly cylindric aments appear before (or sometimes with) the leaves. The male aments measure up to 1.5-2:0.5-0.6 cm., while the fruiting aments attain 3.5:1 cm. Both have yellowish

scales which sometimes become reddish brown at the obtuse apex. They are densely clothed with long silky hairs. There are 2 stamens with free filaments which usually seem to be glabrous but occasionally bear a few hairs at the very base; the gland is very long and almost linear, resembling indeed that of *S. viminalis* L. Glands and bracts are alike in the two sexes. The ovaries are sessile, ovoid-ellipsoid, and bear a distinct filiform style about 1 mm. in length which usually is bifid at apex and has small, narrow, more or less bifid stigmas. The shape of the stigmas is rather different from that of the *S. viminalis* stigmas which are narrowly linear and much longer. I am not convinced that *S. Breweri* is at all closely related to the *Viminalis*. The species of this European-Asiatic section have dark fuscous bracts, stouter male aments and longer petioles, and their leaves usually have a very different kind of pubescence of silky shining hairs. Although I am at present unable to make a definite statement as to the real relationship of *S. Breweri*, it seems best to regard it as the representative of a new section.

This Willow is an inhabitant of the arid region of the Inner Coast Range, and I have seen the following specimens. In the northwest corner of California an apparently very closely allied form is found which I describe below as *S. delnortensis*.

SPECIMENS EXAMINED: CALIFORNIA. San Benito County: San Carlos¹ Mountain, in a ravine, 1150 m., July 23, 18(60-62), *W. H. Brewer* (No. 788, fr.; G.; co-type); San Carlos Range, 1300 m., May 12, 1907, *W. L. Jepson* (No. 2957, f., m.; Jeps.); in the semiarid section of the inner South Coast Range, head waters of San Benito River, alt., 950 m., May 27, 1915, *H. M. Hall* (No. 9937, f., m., fr.; A.; "clumps 1 m. high"; Hernandez, April 11, 1903, *L. M. Lathrop* (m.; St.; amentis ad 3.5:0.6 cm. longist); near Hernandez, May 18, 1893, *A. Eastwood* (fr.; Cal.); Cantua Creek, near New Idria, May 19, 1893, *A. Eastwood* (m., f., St.; Clear Creek, May 31, 1899, *W. R. Dudley* (fr.; St.); above New Idria Falls, same date and collector (m., f., fr.; St.); Trail to Hepsadan Peak, June 2, 1899, *W. R. Dudley* (fr.; St.). Santa Clara County: San Antonio Valley, May, 1903, *A. D. E. Elmer* (No. 4648, f.; M., St.). Napa County: Mt. St. Helena, *Mrs. Brandegee* (No. 1299, f.; C.; mixed with fruiting *S. lasiolepis*). Lake County: 3 mi. northwest of Glenbrook, Sweetwater Valley, May 17, 1902, *J. A. Gunn* (m., f.; St.; floribus juvenilibus porro observandis, femineis abnormalibus fere semper 2-3 connatis); Middleton Grade, just beyond Mt. St. Helena, on the serpentine, May 5, 1893, *W. L. Jepson* (No. 27², m.; Jeps.); Mt. Hannah, *A. Eastwood* (m.; Cal.; filamentis ex parte basi paullo coalitis, forma incerta). Colusa County: Epperson, *Mrs. Brandegee* (No. 18², f.; C.).

2. *S. delnortensis*, spec. nov. — Frutex ut videtur habitu *S. Breweri*, altitudine mihi ignota; ramuli hornotini dense breviter griseo-tomentosi, etiam annotini plusminusve angulati sordide purpurascens, satis tomentelli, vetustiores plusminusve glabrescentes; gemmae perfecte evolutae nondum visae, ut rami tomentosae et coloratae; folia tantum juvenilia et semimatura satis chartacea visa, obovato-oblonga, obovata vel late obovata, basi cuneata, apice obtusa ad rotundata, subito brevissime apiculata, ad 2.5:1-1.6 cm. magna, integerrima, superne initio dense plusminusve ad-

¹ This is in my opinion identical with Santa Carlos Peak southeast of Idria. I had an opportunity to discuss this Willow with Prof. L. R. Abrams, who has kindly given valuable information about the vegetation of the Inner Coast Range.

presse villosulo-tomentosa, demum ut videtur paullo glabrescentia, sordide viridescencia, costa nervisque paullo impressis, subtus dense albescenti-vel flavescenti-tomentosa, costa nervisque lateralibus utrinque 6-9 elevatis tomentosus et etiam (matura probabiliter distinctius) reticulata; petioli vix ultra 2 mm. longi, dense tomentosi; stipulae nullae vel minimae punctiformes. Amenta coetanea (an semper?), pedunculis brevibus minime vel distinctius foliolatis suffulta; mascula ad 2.5:0.7 cm. magna, pedunculo ad 5 mm. longo excluso; bractae oblongae, obtusae, brunnescentes (an in vivo roseae?), utrinque satis dense sericeae (pilis plerisque bractea brevioribus); stamina 2, filamentis liberis glabris bracteam dein ad fere 2-plo superantibus, antheris minimis crasse ellipsoideis vix ultra 0.6 mm. longis ut videtur violaceis; glandula 1, ventralis, anguste conica, truncata, bractea 2-plo brevior; feminea subpraecocia, sub anthesi ad 2.5:0.6 cm., fructifera ad 5:1 cm. magna pedunculo 2-8 mm. longo excluso; bractae ut in flore masculo vel magis obovatae; ovaria ovoidea, dense breviter villosulo-tomentosa, sessilia; styli circiter 1 mm. longi, integri vel subbifidi, stigmatibus brevibus bifidis stylo circiter 2½-plo brevioribus; glandula 1 ut in flore masculo; fructus ellipsoideo-conici, circ. 5.5 mm. longi, ut ovaria pilosi.

TYPE LOCALITY: Gasquets, Del Norte County, California.

SPECIMENS EXAMINED: CALIFORNIA. Del Norte County: Waldo-Crescent City Road, Gasquets, April 23, 1907, *A. Eastwood* (No. 52, fr. submat.; Cal.; type!); Rock Creek, April 29, 1907, *A. Eastwood* (No. 177, f.; Cal.); Smith River near Adams, May 4, 1907, *A. Eastwood* (No. 233, m. paratype; Cal.).

At first, I was inclined to regard this plant as only a broad-leaved variety of *S. Breweri*, but the shape of the gland in the male and female flowers is different in the two. In *S. Breweri* the gland is narrower and often almost filiform, especially in the female flowers in which it is half the length of the young ovary. In *S. delnortensis* the gland is also narrow but shorter and never filiform. The anthers seem to be always yellow in *S. Breweri* and violet in the new species, but, of course, a careful observation is needed of more copious material with mature leaves and a study of the plants in the field to fix the specific value of *S. delnortensis*. It apparently also grows in a semiarid region; and Miss Eastwood collected another peculiar willow near Gasquets, which too seems to represent a new species the relation of which, however, is with *S. Scouleriana* notwithstanding a certain similarity to *S. delnortensis* in its external appearance. I shall deal with it when I speak of *S. Scouleriana* in a later note.

THE BONIN ISLANDS AND THEIR LIGNEOUS VEGETATION

E. H. WILSON

SOME 520 miles almost due south of Tokyo, Japan, is a group of small islands known to the western world as the Bonin Islands and to the Japanese as Ogasawara-shima. These islands are governed by the Tokyo prefect, and communication is maintained by a monthly steamer plying from Yokohama. They lie between the parallels of Lat. 27° 5 m. and 26° 30 m. N.,

with the chief port, Omura, — Port Lloyd of our maps — in Lat. $27^{\circ} 4.35$ m. and Long. $142^{\circ} 11.3$ m. E., and are divided into three groups, the central being the largest and most important. The northern, the Parry group of our maps, is called Mukō-jima (Son-in-law Islands) by the Japanese, and consists of four tiny islands having a total area of 1096 acres and a population of 40. The central group, Chichi-jima (Father Islands) of the Japanese, consists of eight islands of a total area of 9472 acres and a population of 2230. Five of these islands are uninhabited. The three largest on our maps are called Peel, Buckland, and Stapleton Islands. The first named is the Chichi-jima proper of the Japanese; it is the principal one of the group being 5932 acres in extent with a population of 2140, and boasts the only safe anchorage in the Bonin Islands. The southern group, known as Haha-jima (Mother Islands), the Bailey or Coffin group of the western maps, consists of nine islands having a total area of 6219 acres and a population of 2030. Haha-jima proper (the Hillsboro Island of our maps) is itself 5121 acres in extent and has 2000 persons living on it. Five of the others are uninhabited.

The islands are steep and hilly and six of them are merely bare rocks less than 100 ft. high. The highest point is Chibusa-yama (Nipple Mt.) on Haha-jima which is 1527 ft. above sea-level. The highest point on Chichi-jima is Chuo-yama, 1060 ft. high and on Mukō-jima, Oyama only 295 ft. above the sea. The coast line of all is steep, and is much indented, and the tide-rips between the islands are very dangerous. Storms accompanied by high winds are frequent. Except at the port of Omura (Port Lloyd), embarking and disembarking is far from easy even in calm weather and the landing of cargo can only be done at such times.

The history of the Bonin Islands, little as it is, is of more than ordinary interest. Their very ownership was not definitely settled until November, 1875, when they passed into the possession of Japan. From Japanese records it appears that these islands were known to Japan in A.D. 1593 if not before, when they were held as a fief by the Daimio Ogasawara Sadayori and communication was maintained with them up to 1624. According to Kaempfer (*Hist. Jap.* i. 60, [1729]) about the year 1675 the "Japanese accidentally discovered a very large island, one of their barks having been forced there in a storm from the island Hachijo, from which they computed it to be 300 miles distant toward the east. They met with no inhabitants, but found it to be a very pleasant and fruitful country, well supplied with fresh water and furnished with plenty of plants and trees, particularly the Arrack tree, which, however, might give room to conjecture that the island lay rather to the south of Japan than to the east, these trees growing only in hot countries. They called it Bune-sima or the Island Bune, and because they found no inhabitants upon it they marked it with the character of an uninhabited island. On the shores they found an incredible quantity of fish and crabs, some of which were from four to six feet long." This description fits the islands exactly if Kaempfer's conjectures be accepted as to the locality being south and not east, and the crabs as turtles, which for-

merly were very abundant there. In both these errors the Japanese sailors might, under the circumstances, be readily excused. In 1728 a descendant of Ogasawara Sadayori temporarily established communication with the islands again but after this the Japanese took no further interest in them until 1861. It appears, however, from the researches of the late Archdeacon King in the libraries of the British Museum and the Royal Geographical Society that credit belongs to the Spaniard, Ruy Lopez de Villalobos, commanding an exploring expedition that sailed from Mexico sometime in 1543. After reaching the Philippines on August 26, 1543, he sent off a small ship, the "San Juan," to explore in a northerly direction. Sometime about the middle of October this ship sighted some islands which from the description the crew afterwards gave were almost certainly some of the Bonin group. Apparently no landing was effected but that this ship first discovered the group may be confidently accepted, and that some fifty years before the earliest Japanese claim.

On some old charts a group of islands, under the name of Arzobispo Islands, is marked roughly where the Bonins lie and some have considered them identical. The Marianos and Ladrões groups, known to navigators early in the sixteenth century, are not so very far south of the Bonins, and these same sailors might well have visited both groups. Be this as it may, in 1823 an American whaling ship, the "Transit," commanded by Captain Coffin touched at the southern group (Haha-jima). In 1825, the "Supply" an English whaler, visited Port Lloyd (Omura, Chichi-jima) and left a record of her visit by nailing a board to a tree. This board was found by Captain Beechey of the English war-ship "Blossom" which anchored there on June 9, 1827, and found living on the island two castaways from the English whaling ship "William," wrecked there in November, 1826. Captain Beechey stayed until June 15, and a full account of the visit is given in his *Voyage to the Pacific*, II. Chapter 6, pp. 227-240 (1831). During the stay a number of plants were collected and are enumerated with those from Liukiu in Hooker and Arnott's *Botany of Captain Beechey's Voyage*, 258-275. This is the first record of plants being collected on the islands whose very position was not properly charted until this visit. Before leaving a sheet of copper nailed to a board was affixed to a tree and on this the following words were punctured: "H. M. S. 'Blossom,' Captain Beechey, R. N., took possession of this group of islands in the name and on behalf of His Majesty King George, the 14th of June, 1827."

In May of the following year (1828) Captain Lütke, Commander of the Russian corvette "Senjavin" arrived at the Bonins and annexed them in the name of Russia. On board was F. H. von Kittlitz who was evidently no mean artist. His sketches and notes were first published in 1844 in German. In 1861 Berthold Seemann translated and edited them under the title of "*Twenty-four Views of the Vegetation of the Coasts and Islands of the Pacific*." Plates XIV, XV, XVI give views of the vegetation of the Bonin Islands and are accompanied by delightfully written descriptive notes.

In May 1830, an American seaman, native of Bradford, Essex County,

Massachusetts, named Nathaniel Savory, with four other white men and twenty-five Kanakas including some women, sailed from Honolulu, being furthered in their adventure in every way by the British consul, at that time Mr. Richard Charlton. On June 26, 1830, they reached the Bonin Islands and hoisted an English flag which had been given them by Mr. Charlton. In 1842 one Mazarro received the official title of governor from the Acting British Consul for the Sandwich Islands, Alexander Simpson. A vessel from the British China Squadron visited the Islands, and whaling ships frequently put in for supplies of fresh water and vegetables. In 1848 Mazarro died and his widow became the wife of Nathaniel Savory, who finally succeeded to the headship of the Islands and seems to have been a wise and sensible man. In 1851 the English war-ship "Enterprise," under Captain Collinson, visited the Islands and found four of the original white settlers still in possession. On June 14, 1853, Commodore Perry with the American war-ships "Susquehanna" and "Saratoga" anchored at Port Lloyd. He purchased a piece of property there, made Nathaniel Savory his agent, drew up a code of rules which the islanders adopted on August 28, 1853, when Nathaniel Savory was made Chief Magistrate. In October of the same year Commodore Perry dispatched Captain Kelley in the ship "Plymouth" with instructions to survey and take formal possession of the southern group (Bailey Islands) in the name of the United States and to rename them Coffin Islands after their first discoverer, Captain Coffin. This was carried out. A full account of Commodore Perry's visit is recorded in *The Official Report of United States Japanese Expedition* by Commodore M. C. Perry, Vol. I. pp. 196-213 and pp. 282-285.

The next visit of men-of-war after the "Plymouth" was that of four Russian ships which came to Port Lloyd in 1854. This was followed by that of the United States Frigate "Macedonian" by which Commodore Perry sent implements of husbandry and seeds. In a letter he writes "it must be understood that the sovereignty of the Bonin Islands has not yet been settled, the interest taken by me in the welfare and prosperity of the settlement has solely in view the advantage of commerce generally."

In 1855 the United States man-of-war "Vincennes" visited Port Lloyd and remained ten days. In 1861 an attempt to colonize Peel Island was made by Japanese. This failed miserably, and the commissioner and last batch of colonists withdrew to Japan early in 1863 some fifteen months after they cast their lot upon the Islands. In 1874 the United States man-of-war "Tuscarora," while engaged on her line of soundings, visited Port Lloyd. On November 24, 1875, a Japanese steamer the "Meiju Maru" entered the port, formally annexed the Islands and since then Japan has been accepted as the rightful sovereign lord of the Bonin Islands. Two days after the arrival of the Japanese "Meiju Maru" the English war-ship "Curlew" also reached the Bonins with Mr. Russell Robertson, British Consul at Yokohama on board. Subsequently, on March 15, 1876, Mr. Robertson gave an excellent account of the Bonin Islands before the Asiatic Society of Japan, which is published in that Society's *Transactions*, Vol. IV. (1876).

Nathaniel Savory died in 1874 and remained nominal head of the Bonin Islanders until the day of his death. He left behind considerable correspondence which ultimately was placed by his descendants in the hands of Reverend Lionel B. Cholmondeley of St. Andrew's Mission, Tokyo, who incorporated it in a book entitled *History of the Bonin Islands*, which he published in 1915. From this work it appears that during the period of Savory's life many whaling ships touched at the Islands. One or two piratical raids were made on them by ships from China commanded by white men. Also that the colony was augmented by men from whalers and from the island of Guam. On the whole the settlers appear to have lived together harmoniously and for this undoubtedly thanks are due to the wise counsel of Nathaniel Savory. After the Japanese annexations this mixed race of white and Kanaka became Japanese subjects. To-day whaling ships are there no more; Japanese have settled there in numbers, all available land is under crops, chiefly sugar; the seas have been denuded of their swarms of turtles and fish and altogether the struggle for existence made as hard as in Japan proper. Some sixty or seventy English-speaking descendants of the Bonin Islanders remain. A church, under the auspices of the St. Andrew's Mission, has been built and one of the Bonin Islanders, the Reverend Joseph Gonzales, is pastor. The younger generation of adults have taken Japanese wives and in a few years virtually all traces of this interesting colony will have disappeared.

The Bonin Islands lie right within the warm Japan stream (Kuro-suwo) and this accounts for the fact that the mean temperature is higher than that of Hongkong which is five degrees farther south. As proof of this the Coconut ripens its fruit in Bonin but does not in Hongkong. The winters are warmer and the summer less hot than in Formosa and Hongkong. The rainfall, according to the reports of the Central Meteorological Observatory of Japan, averages about 1550 mm. only, which is less than that of Tokyo in Japan. From the statistical tables available there does not appear to be any marked wet or dry season. December, January, March, April, May, June, July and August appear to be the wettest months. My visit was in the latter part of April and early May and we enjoyed fair weather the whole time. Windstorms and thunderstorms are frequent and arise and fall very quickly.

It is a region of old submarine volcanoes and the islands are of this origin. They are considered to have been ejected from the ocean's bed in Eocene times. Geologically they are all alike, consisting of a kind of andesitic lava, called Boninite, and sedimentary agglomerate tuffaceous rocks. Limestone from solvent corals is found on the tops of several of the higher peaks — Sekimonzan in particular — where it is weathered into sharp edges which cut one's boots and hands if touched. The surface soil is mainly the reddish clay (laterite) generally so common in tropical regions. Fossil shells (Nummulites) are common, especially in Haha-jima. The coastline is steep and much indented by sea erosion and caves, some of them extensive as on Mukō-jima, are common. The four tiny harbors are due to sinkage

and erosion. Many of the islands have been eroded almost to sea-level and are barren of vegetation or nearly so. At the southern end of Haha-jima, there is a little marshy land but I saw none elsewhere. A few leagues to the south are the Sulphur Islands, a tiny group of volcanic islets of more recent origin than the Bonins, but as I did not visit there no further reference to them will be made.

Leaving Yokohama on the morning of April 18, 1917, we touched at Hachijo and Tori-shima Islands and reached Chichi-jima in the forenoon of April 21. Hachijo is an interesting volcanic island belonging to the Idzu group, and was in old days used as a penal settlement for political offenders. Tori-shima, or Bird Island, is an active volcano over 650 meters high; and bare save for *Vitex orata* Thunb. and a few herbs at sea-level. It is a breeding place for two species of Albatross (*Diomedea immutabilis* Roths. and *D. albatrus* Pall.) and these birds are so tame that they may be caught by hand. Formerly a Japanese was engaged in the reprehensible trade of exporting feathers and had fully a hundred people engaged on this island killing the birds. The volcano erupted, about ten years ago, killed nearly every inhabitant, and scared the birds from this haunt. The birds are now returning and some five or six people live on the island where landing, except in the calmest weather, is out of the question. The temperature of the water at the landing place is nearly 100° F. On the outward journey we managed to land for a short time but found it impossible to do so on our return.

Seen from the sea, the central and southern groups of the Bonin Islands are extremely picturesque with irregular, bold, black, wall-like cliffs worn into rude shapes. The strong winds which prevail keep the vegetation, in all but the sheltered parts, down to a mean height and from the sea there are no apparent outstanding features of forest-growth. A dense thicket where no cultivation exists is the impression given. As the harbor in Chichi-jima is reached a Palm (*Livistona chinensis* R. Br.) is seen to be especially abundant, and its mop-like crown of gray-green fan-shaped leaves, with their long pendent edges, is reared well above the other vegetation. In gullies, and indeed in every place affording some shelter, grows a variety of trees and shrubs and chief among them is a Cabbage Palm (*Cyphokentia Savoryana* Rehd. & Wils.) which in the past made the Islands famous among whaling and other sea-faring men. This Palm is not abundant today but is in no danger of extermination. On the beaches grow such wide-spread, maritime plants as *Vitex orata* Thunb., *Scaevola Koenigii* Vahl, *Ipomaea biloba* L., *Canaralia obtusifolia* DC. *Caesalpinia Bonducella* Flem., *Hernandia peltata* Meisn., *Calophyllum Inophyllum* L., *Hibiscus tiliaceus* L., and *Erythrina indica* L., all typical of the tropics. From sea-level to high on the mountain slopes a Screw Pine (*Pandanus boninensis* Warb.) is abundant and is perhaps the most common plant on the islands. Where the vegetation has been undisturbed on the hills, and more especially in places protected from the strong winds, trees grow thickly and on their trunks are epiphytes in profusion. Among these epiphytes are such Orchids as *Cirrhopse-*

talum boninense Schlecht. and *Luisia boneninsis* Schlecht., and Cryptogams like *Psilotum triquetrum* Sw. *Lycopodium cernuum* L., *Asplenium nidus* f. *intermedia* Mett., *Vittaria boninensis* Chr. and several species of Trichomanes, Polypodium and other Ferns. Three species of Tree Ferns with *Angiopteris erecta* Hoffm. and the scandent *Freyinetia formosana* Hemsl. are prominent features of the vegetation. The undergrowth in the forests is mainly of *Ardisia Sieboldii* Miq., *Rapanea Maximowiczii* Koidz., *Sambucus javanica* Bl. and Ferns, especially Aspidiums. In more open places *Alpinia boninsimensis* Mak. and *Crinum asiaticum* L. abound. But interesting and varied as the vegetation of the Bonins now is they can no longer be described as clothed with luxuriant vegetation from the water's edge to the tops of the highest peaks as they were when visited by the English and Russian ships in 1827 and 1828. In quite recent years Sugar-cane has been introduced and almost all the land suitable for its culture has been cleared by fire and axe and planted. Windbreaks have been found necessary to protect the sugar-cane and for this purpose *Pandanus boninensis* Warb. *Livistona chinensis* R. Br., *Calophyllum Inophyllum* L. and *Boninia glabra* Planch. are much used. On the south end of Haha-jima, an undulating and rather marshy promontory clothed with scrub and coarse grasses, *Casuarina equisetifolia* Forst. imported from Hawaii has been planted and promises to be a success. An attempt to grow *Ficus elastica* Roxb. for rubber has ended in failure, the tree being unable to withstand the wind. A few Coconut-trees are grown, the Papaya is common in gardens, also a number of vegetables and ornamental plants, but the only agricultural industry that amounts to anything is sugar-growing.

I spent two weeks on the Islands, visiting Chichi-jima and Ani-jima, the larger islands of the central, and Haha-jima and Mukō-jima the principal ones of the southern group. The other islands have very little vegetation and I had not the time to visit them. The currents are very strong and sailing from island to island in the small boats available is dangerous. Thanks to the courtesy of the Department of Agriculture, Tokyo, every arrangement was made for me to see as much as possible in the time at my disposal. The forestry officer of the Islands, Mr. Hidemasa Otomo, whose knowledge of localities where special plants grow is remarkable, accompanied me everywhere and through his services I saw, with one or two exceptions, every woody plant known to grow on the Bonins. Of those I did not see Mr. Otomo furnished me with specimens from the Government Museum. The trip to and from was unpleasant owing to the poor accommodation on the ship and to the choppy seas, but the stay on the Islands was delightful. My main object was to see and collect *Juniperus taxifolia* Hook. & Arn. and whatever else I could in the time at my disposal. The result so far exceeded expectations that it warrants the publication of this short account of the whole ligneous vegetation.

The first account of the flora of the Bonin Islands is that of Hooker & Arnott in their *Botany of Captain Beechey's Voyage*, pp. 258 to 274 where 42 plants are recorded from Bonin, 23 of them being woody. Figures of two

new trees (*Sideroxylon ferrugineum* Hook. & Arn., *Elaeocarpus photiniacifolius* Hook. & Arn.) and of an *Evonymus*, now considered a new species (*E. boninensis* Koidz.), are given. This collection was the only one of importance made so far as I can discover until the Japanese began to take a serious interest in botany. Some plants were collected on the Commodore Perry Expedition, for Gray in his *Botany of Japan* (388) says, "Mr. Wright found the Californian *Photinia arbutifolia* at the Bonin Islands along with the *Osteomeles* of the Sandwich Islands. On page 398 Gray describes a new Composite as *Ixeris?* *Ixeridium linguaefolia* and says it was collected by Wright in the Bonins. Maximowicz afterwards referred this plant to the genus *Crepis*. Decaisne described the *Photinia* mentioned by Gray as a new species, under the name of *Photinia Maximowiczii*. In the *Ann. Sci. Nat. sér. 5*, xiv. 309 (1872) Planchon describes an endemic Rutaceous genus *Boninia* with two species and mentions a specimen in Herb. Acad. Petrop. and another in Herb. Hook., no. 56. It would appear that it was collected by the Russians and possibly by Beechey. It is evident that men of the ships which visited the Bonin Islands after Captain Beechey made collections of plants but they do not appear to have been systematically described.

In the *Journal of the College of Science, Tokyo*, xxiii, art. 10 (1908) is a phytogeographical article by H. Hattori on a very elaborate plan but its usefulness is curtailed by the author enumerating every name given to Bonin plants irrespective of their correct application. He enumerates 70 families comprising 164 genera and 220 species as growing on the Bonin Islands. Of these 54 species are Cryptogams and 74 phanerogamous herbs. Of the 92 woody plants 34 are now known to belong to other species and eight are suffruticose, roadside weeds wide spread in the tropics. He regards 11 species of woody plants as endemic. One family Hattori includes (*Capparidaceae*) must be eliminated, for the plant he refers to here (*Coronopus didymus* Smith) belongs to the Cruciferae. His "*Gardenia radicans*" is *G. augusta* Merr. and his "*Zanthoxylum piperitum*" is the same as *Z. Arnottianum* Maxim. both of which he includes.

In the last few years the Japanese botanists and especially Messrs. Makino, Nakai and Koidzumi, have described many new species from the Bonin Islands. Today the ligneous flora excluding those for ornamental or æsthetic purposes introduced by man is known to belong to 57 families comprising 100 genera and 107 species and 5 varieties. Of these six are now described for the first time in this Journal. These woody plants are divisible into 43 trees, 54 shrubs and 15 climbers. Of these one genus and fifty-four species and four varieties are endemic, thirty species are widely spread in the tropics, and seventeen species grow also in south Japan, Liukiu, Formosa and southern China. Considering the proximity to southern Japan and Liukiu the number of species common to these areas and to the Bonins is remarkably small. The Bonin Islands are really very isolated and being entirely erupted from the ocean their origin sufficiently explains the high percentage of endemic plants; nevertheless, the flora is in all its essential characters an outpost of the Chino-Malayan floras and is not

Polynesian. The Cocconut has, of course, drifted to the Bonins in the ocean currents, but it is quite a rare tree though now its planting is being sparingly undertaken. The *Hernandia* doubtless came in the same way for its fruits with their pink bladder-like vesicle are specially adapted for such distribution; also the *Calophyllum* and *Terminalia*. Migratory wild fowl doubtless brought others either in their crops, on their feet or among their feathers. But apart from a coastal fringe of wide-spread tropical and subtropical plants the flora is mainly endemic. Prior to its general clearance for sugar-cane it must have been densely covered with ligneous growth. The windstorms must always have kept this growth comparatively low and even, except in sheltered places, just as it occurs today.

Though the Islands are small and the area of the three groups inconsiderable there is some marked dissimilarities in their ligneous growth. For example *Morus* grows only on Haha-jima, the *Juniper* grows on Chichi-jima and Ani-jima and Mukō-jima but not on Haha-jima. On Mukō-jima no Tree Fern, *Freycinetia* nor *Viburnum* grows. On Haha-jima *Juniperus*, *Distylium*, *Osteomeles* and *Viburnum* do not grow, otherwise this island supports probably the richest flora of the whole group, certainly on it grow the largest trees. From the whole group Bamboos, Mangroves, Tree Figs (such as *Ficus retusa* L., *Ficus Wightiana* Wall.), the climbing *Ficus pumila* L., *Myrica rubra* S. & Z., *Garcinia spicata* Hook. and *Bischofia javanica* Bl. are absent though they might reasonably be expected to occur. The presence of a shrubby *Lobelia* is interesting since no other species of this section grows in eastern Asia. The absence of any species of *Rhododendron* makes this group unique among the islands of eastern Asia. The presence of a shrubby *Statice* is also a noteworthy feature whilst the absence of the wide-spread *Pandanus tectorius* Soland. and the presence of such a well-marked endemic species as *Pandanus boninensis* Warb. is most surprising. The maritime *Tournefortia argentea* Linn. f. is rare, but *Cassytha filiformis* L., *Ipomaea biloba* L. and *Scaevola Koenigii* Vahl, its companions on Liukiu, are abundant. The *Freycinetia formosana* Hemsl. abounds, forming dense jungle on the upper slopes of the highest peak (Chibusa-yama) on Haha-jima, and in the forests scaling the highest trees. The only other place it grows outside of the Bonins is in the extreme north of Formosa which is the type locality, where it is both local and rare.

The herbs which grow on the Bonins are not noteworthy: among the Monocotyledons some of the Orchids, and Scitamineous plants are pretty and *Crinum asiaticum* L. is handsome, but the Dicotyledonous herbs are mostly wide-spread roadside weeds and weeds of cultivation. The Ferns are lovely, their variety considerable and their number multitudinous. I could not spare the time to collect them, to my lasting regret. The three Tree Ferns are *Cyathea spinulosa* Wall., *Alsophila latebrosa* Hook., and *A. Bongardiana* Mett., and certainly they are as handsome as any of their family. Trees from 8 to 10 m. tall crowned with tabular heads of wide-spreading green fronds and likewise the old type *Angiopteris evecta* Hoffm. are abundant. Also the striking Birdsnest-Fern (*Asplenium nidus* var. *inter-*

media Mett.), a spreading, vase-shaped plant with a rosette of bright green leaves, a meter long abounds on the limestone and on trees, but nowhere more so than on Sekimonzan. On this mountain I did collect the endemic Hounds-tongue (*Scolopendrium Ikenoi* Makino) with its 7 cm. long, cordate-acuminate, delicate fronds. It is outside the province of this paper to enter further into details regarding the Ferns, but since they are the dominant undergrowth in the forests and everywhere abundant, they are a most important feature of the flora of the Bonin Islands.

CLIMBERS

Freycinetia formosana Hemsl.
Smilax china L.
Piper futokadsura Sieb.
Clematis boninensis Hay.
Cassytha filiformis L.
Canavalia obtusifolia DC.
Mucuna gigantea DC.
Vigna retusa A. Gray

Colubrina asiatica Brongn.
Cissus japonica Willd.
Elaeagnus rotundata Nakai
Trachelospermum divaricatum Kanitz
Ipomaea biloba L.
Argyreia tiliaefolia Wight
Psychotria serpens var. *macrophylla*
 Koidz.

There are fifteen climbers as shown above and they belong to 12 families and fifteen genera. Of the two Monocotyledonous species the *Smilax* is a common plant, on the larger islands at least, and calls for no special remark. The *Freycinetia* on the other hand ranks with the *Clematis*, the *Elaeagnus* and the *Trachelospermum* as one of the four principal climbers of the Islands. As before mentioned it forms dense impenetrable thickets on the upper mountain slopes and in the forest scales the highest trees. The stems put out roots which cling to the moist tree-trunks and rocks. The dark green, spirally arranged leaves are smooth on the margin and flaccid, and the finger-like fruit, in a cluster of three, is red and soft and disappears soon after it is ripe in August. When in Formosa I closely examined the species in the type locality and could find no difference between it and the Bonin plant. The *Piper* is a wide-spread species in south Japan, Liukiu, and Formosa and in the Bonins it is common on trees and rocks. Its orange-yellow spicate flowers are quite attractive. The *Clematis* is allied to the Japanese *C. paniculata* Thunb. and is common in thickets and on the margins of forests where it can enjoy the sunlight. The *Cassytha* is not common and, curiously enough, grows on the grassy hilltops and not on the seashore, its normal habitat in Liukiu, Formosa and the other places where I have met with it. Of the three Leguminous genera the *Mucuna* is rare and is confined to shady forests and thickets. The *Canavalia* and *Vigna* are scarcely woody and abound in open grassy places near the sea, and if the site is brackish and swampy so much the better; both are cosmopolitan in the tropics. The *Mucuna* is also widely spread, though there is a possibility of the Bonin plant with its pink flowers being a distinct but critical species. The *Colubrina*, which in growth and appearance strongly suggests *Celastrus*. I saw on Haha-jima in one place only and it is evidently rare. The *Cissus* I did not see and I am indebted to Mr. Otomo for a specimen; it is certainly

strange that a plant so abundant from Japan to Formosa and through China should be so rare in the Bonins. The *Elaeagnus* is perhaps the largest of the Bonin climbers and finds its way to the tops of the tallest trees, from which its rope-like stems hang down. It is near *Elaeagnus macrophylla* Thunb. and is an autumn-flowering species. I could find neither flower nor fruit. The *Trachelospermum* has relatively large, inodorous flowers, and in late April and May is singularly attractive and conspicuous on rocks, tree-trunks and shrubs in sunny places. On the seashore the cosmopolitan *Ipomaea biloba* L. is common with its string-like stems firmly anchored at and above tide-mark. The climbing *Argyrea tiliacfolia* Wight grows only near habitations and was undoubtedly introduced from Hawaii. Lastly the *Psychotria* with its leaves much broader than that of the wide-spread type, grows on rocks and tree-trunks in the forests although it cannot be described as common.

SHRUBS

Piper Postelsianum Maxim.	Melastoma sp.
Boehmeria boninensis Nakai	Vaccinium bracteatum var.
Procris laevigata Bl.	Wrightii Rehd. & Wils.
Pseudixus japonicus Hay.	Statice arbuscula Spr.
Bryophyllum calycinum Salisb.	Symplocos Otomoi Rehd. & Wils.
Pittosporum boninensis Koidz.	Ligustrum japonicum Thunb.
Osteomeles anthyllidifolia Lindl.	Osmanthus insularis Koidz.
Rubus Nishimuranus Koidz.	Geniostoma glabra Matsum.
Caesalpinia bonducella Flem.	Vinca rosea L.
Lespedeza striata Hook. & Arn.	Asclepias curassivica L.
Leucaena glauca Benth.	Tournefortia argentea Linn. f.
Mimosa pudica L.	Callicarpa glabra Koidz.
Rhynchosia minima DC.	Callicarpa Nishimurae Koidz.
Evodia Kumagiana Rehd. & Wils.	Vitex ovata Thunb.
Zanthoxylum Arnottianum Maxim.	Lycium sp.
Phyllanthus Niruri L.	Myoporum boninense Koidz.
Ilex Matanoana Mak.	Gardenia augusta Merr.
Ilex Mertensii Maxim.	Morinda citrifolia L.
Evonymus boninensis Koidz.	Morinda umbellata L.
Dodonaea viscosa Jacq.	Oldenlandia cordata Matsum.
Triumfetta subpalmata Soland.	Oldenlandia Grayi K. Sch.
Malvastrum tricuspidatum, A. Gray	Rubiaceae
Sida rhombifolia L.	Sambucus javanica Bl.
Eurya boninensis Koidz.	Viburnum japonicum var. bonin-
Stachyurus macrocarpus Koidz.	simense Mak.
Wikstroemia pseudoretusa Koidz.	Lobelia boninensis Koidz.
Eugenia boninensis Koidz.	Scaevola Koenigii Vahl
Eugenia microphylla Abel	Cacalia crepidifolia Nakai

The 54 shrubby plants are distributed among 35 families and 50 genera; 24 species and one variety are endemic. The *Bryophyllum*, *Leucaena*, *Rhynchosia*, *Mimosa*, *Lespedeza*, *Phyllanthus*, *Triumfetta*, *Malvastrum*, *Sida*, *Vinca* and *Asclepias* are roadside weeds and very probably have been quite recently introduced. I did not collect the *Mimosa* and *Lespedeza*.

The *Pseudixus* is a pest and grows on nearly every kind of shrub and tree. The *Piper*, *Procris*, *Sambucus*, *Boehmeria* and the two *Oldenlandias* are not very woody; the first three are common as undergrowth in moist shady places and the two latter prefer more sunny places. The *Caesalpinia*, *Wikstroemia*, *Statice*, *Vitex*, *Lycium*, *Myoporum*, *Tournefortia*, *Lobelia* and the *Scaevola* are littoral plants. The *Myoporum* I did not see, but it was described from Chichi-jima by Koidzumi in 1918. The *Vitex* is a useful plant for holding down sand, shingle, and loose earth, and is always found at and near sea-level. The *Scaevola*, with its fleshy leaves and stiff branches, is one of the most common shrubs on the island from sea-level to a few hundred feet above in open windswept places, and is quite a handsome plant. The *Tournefortia* is rare and I saw a few plants in two localities only, the *Lycium* I only saw on Mukō-jima on bare rocks within reach of the sea's spray, but the *Lobelia* is common in many places but in none more so, however, than in Mukō-jima; it is an interesting extension of the known distribution of the genus. The *Statice* I did not see growing and it is probably wrongly determined. The *Wikstroemia* is widely scattered and is quite common. The wide-spread *Caesalpinia* is not very abundant; the *Pittosporum* is plentiful and is remarkable for its globose, woody, strongly decurved fruit. I was much interested to find *Osteomeles anthyllidifolia* Lindl. which seems to be identical with the Hawaiian plant. It is absent from Haha-jima but is common on Chichi-jima, Ani-jima and other islands. When growing freely its slender branches arch gracefully and the leaves are only slightly hairy, and from this it varies to a stunted shrub hugging rocky ground with leaves densely covered with a white tomentum. The fruit is said to be as often white as black and is edible, being considered a wild plum by the Bonin Islanders. The two Rutaceous shrubs are uncommon and so is *Ilex Matanoana* Mak., but the other *Ilex* is very plentiful; its thick, shining green leaves are reddish when young and are variable in size; sometimes it is almost a tree. It is the plant referred to by Hooker & Arnott (*Botany of Beechey's Voyage*, 261). Makino has described (in *Jour. Jap. Bot.* 1. 21 [1917]) an *Ilex bonincola*, but from the description I think this is simply a state of his *Ilex Matanoana* with large leaves such as are found on free-growing shoots. The *Evonymus* is rather rare, at least on Haha-jima where I collected it. It is well figured by Hooker & Arnott (l. c. 54, 261) who erroneously referred it to *Evonymus japonicus* Thunb. The *Dodonaea* and *Eurya* are common and call for no special remark, but the *Stachyurus* is rare and though similar to the Japanese species in habit and flowers has a remarkably large, rounded fruit. It is a very distinct and interesting addition to the genus. The *Eugenia boninensis* Koidz. I did not see, but the other species is a common shrub, from 0.6 to 2 m. tall with edible fruit, and is often stoloniferous in habit. It is a feature of the rather bare hilltops of Ani-jima. The *Melastoma* I did not see and the *Vaccinium* only on Ani-jima where it is a bush from 2 to 3 m. high. The *Symplocos* I did not see growing, the specimen being given to me by Mr. Otomo. The *Ligustrum* is very plentiful and differs in no way from speci-

mens collected in Japan and Liukiu. The *Osmanthus* is abundant and is often 6 m. high. It seems to be closely related to the Liukiu *Osmanthus bracteatus* Matsum. The two *Callicarpas* are fairly common shrubs in the more open country; in *Callicarpa glabra* Koidz. the undersurface of the leaves often glistens with lepidote glands. The wide-spread *Gardenia augusta* Merr. (better known as *Gardenia florida* L.) is one of the most common shrubs and grows quite tall. The Rubiaceous shrubs not already mentioned are common undergrowth in forests and shady places. The *Viburnum* has handsome foliage and flowers but seems to be confined to the Chichi-jima group. The *Cacalia* is not common and is a bush from 2 to 3 m. high, much branched, with gray, corky bark and grows on the margins of woods. Nakai describes another species *C. ameristophylla*, but this is probably only a condition of the *C. crepidifolia*.

TREES

<i>Juniperus taxifolia</i> Hook. & Arn.	<i>Erythrina indica</i> Lam.
<i>Pandanus boninensis</i> Warb.	<i>Boninia glabra</i> Planch.
<i>Cocos nucifera</i> L.	<i>Zanthoxylum ailanthoides</i> var. <i>inermis</i> Rehd. & Wils.
<i>Livistona chinensis</i> R. Br.	<i>Claoxylum centenarium</i> Koidz.
<i>Cyphokentia Savoryana</i> Rehd. & Wils.	<i>Putranjiva integerrima</i> Koidz.
<i>Celtis boninensis</i> Koidz.	<i>Melia Azedarach</i> L.
<i>Trema argentea</i> Bl.	<i>Sapindus mukorossi</i> Gaertn.
<i>Ficus boninsimae</i> Koidz.	<i>Elaeocarpus photiniaefolius</i> Hook. & Arn.
<i>Ficus Iidaiana</i> Rehd. & Wils.	<i>Hibiscus tiliaceus</i> L.
<i>Ficus Nishimurae</i> Koidz.	<i>Hibiscus tiliaceus</i> var. <i>glabra</i> Matsum.
<i>Morus boninensis</i> Koidz.	<i>Schima boninensis</i> Nakai
<i>Calpidia Nishimurae</i> Rehd. & Wils.	<i>Calophyllum Inophyllum</i> L.
<i>Cinnamomum scrobiculatum</i> Nakai	<i>Terminalia catappa</i> L.
<i>Machilus boninensis</i> Koidz.	<i>Eugenia oxygona</i> Koidz.
<i>Machilus kobu</i> Maxim.	<i>Fatsia oligocarpella</i> Koidz.
<i>Machilus pseudokobu</i> Koidz.	<i>Ardisia Sieboldii</i> Miq.
<i>Neolitsea gilva</i> Koidz.	<i>Rapanea Maximowiczii</i> Koidz.
<i>Neolitsea boninensis</i> Koidz.	<i>Sapotacea</i> ?
<i>Hernandia peltata</i> Meisn.	<i>Sideroxylon ferrugineum</i> Hook. & Arn.
<i>Distylium lepidotum</i> Nakai	<i>Symplocos boninensis</i> Rehd. & Wils.
<i>Photinia Maximowiczii</i> Decne.	<i>Paralstonia clusiacea</i> Baill.
<i>Raphiolepis integerrima</i> Hook. & Arn.	

We now come to the most interesting group, namely, the trees of which there are 41 species and two varieties belonging to 37 genera and 27 families. Of these 26 species and two varieties are endemic. The solitary Gymnosperm *Juniperus taxifolia* Hook. & Arn. is one of the most interesting of the Bonin trees and the one my visit was principally concerned with. It grows on Mukō-jima, Chichi-jima and Ani-jima and is today most plentiful on the last. In the sheltered gullies growing with Palms and Tree Ferns it is a tree 15 meters tall with a trunk 1.3 meters in girth and ascending-spreading branches and long, slender branchlets hanging straight down. Such trees are as ornamental and beautiful as any Juniper can be. On windswept areas it is a low mat-like shrub hugging the ground closely, with gnarled

and twisted branches and between these extremes there is every conceivable condition, but the tree form is rare. The leaves are bright green and not pungent, and the fruit is shining chestnut brown and glaucous along the edges of the confluent scales. Formerly it was a common tree and was called "Spruce" by the original Bonin Islanders and used by them for posts in their houses and for fuel. It is peculiar to these Islands but in books the, Liukiu Juniper, which is nothing but the wide-spread littoral *J. conferta* Parl., and the Formosan and Chinese *J. formosana* Hay., have been confused with it. It had not been introduced to cultivation until I sent to the Arnold Arboretum seeds gathered on my visit.

Of the four Monocotyledonous trees three of them together form the dominant features of the whole arborescent flora of the Bonins. The Screw Pine (*Pandanus boninensis* Warb.) is a handsome species often 8 meters tall with many rope-like aerial roots and a dichotomously much-branched crown of dull green leaves. On young plants the leaves are clear green. The fruit is orange-colored, as large as a man's head and very heavy; the seeds are edible and are much sought after by the Fruit-bat (*Pteropus pselaphon* Andersen), the only mammal indigenous to the Islands. The *Pandanus* is common from sea-level to mountain tops but is a light-demanding tree and does not thrive in the dense forest shade. It is probably the most common tree on the Islands and is much used as a windbreak with the Fan Palm (*Livistona chinensis* R. Br.) and *Calophyllum Inophyllum* L. around sugar-cane plantations.

The Cocoanut has been sparingly planted by Japanese but it also occurs as a strand tree although it is rare. Planted in front of the cottage of the Rev. J. Gonzales at Omura, Chichi-jima, is a fruiting Cocoanut-tree grown from a nut picked up on the beach and planted by him a number of years ago. The other two Palms are abundant, and it was the Cyphokentia together with fresh water that made the Islands famous in the days of whaling ships. It is the Cabbage Palm mentioned in all the accounts of the Islands. As a vegetable it is the core of the stems of young trees say 2 meters tall and not more than 20 centimeters in girth, that is esteemed and which I tried and found delicious, but this means the destruction of the plants. In spite of this annihilation carried on for nearly a century this Palm is still plentiful in gullies on the sparsely populated Mukō-jima and Ani-jima. It is not uncommon on Chichi-jima but comparatively scarce on Haha-jima, the two large islands. It is a slender tree from 10 to 15 meters tall, crowned with a tuft of pinnate, arching, dark green leaves. It is the "Areca oleracea" of Captain Beechey and has been wrongly referred by botanists to *Ptychosperma elegans* Bl. which is an Australian Palm. The Fan Palm is *Livistona chinensis* R. Br. which I have also seen growing wild on Aharen Island of the Liukiu group, and by Japanese botanists is considered to be indigenous in parts of south Japan. The oval, bluish green fruit is a favorite food of pigeons, and thus might easily be carried long distances when the birds are blown out to sea by storms. It is a sturdy tree often 16 meters tall, rearing itself above its companion plants and topped by a mop-like head of large,

gray-green, fan-shaped leaves, pendent at the edges. It is unlike other trees on the Islands, and being common is a decided feature. Behind the town of Omura there is a preserved forest and here this Palm is abundant. Also it is plentiful on Mukô-jima and Ani-jima and is also used as a windbreak as already mentioned. On young plants the petioles are armed with strong, curved prickles, but this armature disappears as the adult condition is reached. Although its leaves get sadly tattered the tree is seldom blown down by the windstorms, fierce though they are. Five (*Hernandia peltata* Meisn., *Erythrina indica* L., *Hibiscus tiliaceus* L., *Calophyllum Inophyllum* L., *Terminalia catappa* L.) of the Dicotyledonous trees are strand trees widespread in the tropics. The *Terminalia* with its tiers of branches spreading at right angles to the trunk and the *Hibiscus* are not common, but a smooth-leaved form of the latter (var. *glabra* Matsum.) is abundant on the mountains where in the forests it is often 3 meters in girth of trunk and 15 meters tall. The wood of both is used to make the struts to which the outrigger is attached on canoes. The *Erythrina* and *Hernandia* are ugly trees when bare of leaves and have many warty excrescences on the trunks. The fruit of the *Hernandia* is remarkably adapted for distribution by ocean currents as previously told, and the wood is soft and is used in the hulls of canoes. The *Calophyllum* is the handsomest of these strand trees and decidedly useful both as a windbreak and for its wood, which is beautifully figured. Formerly whaling ships traded in it considerably, and under the name of "Tremona" it was much used and valued by the Bonin Islanders. Around the more sheltered coves at sea-level it grows 25 m. tall and has a trunk 3 m. in girth and a shapely umbrageous crown and dark green leaves. Its globular, plum-like fruit contains a very hard seed which will germinate after long immersion in sea-water.

The *Celtis* ranks among the finest of the genus. In the bit of virgin forest on Kuwanoki-yama (Mulberry Mt.), Haha-jima, and similar other places it is often 25 m. tall with a trunk 5 m. in girth above the large buttressed roots. The bark is smooth, pale gray, and the fruit orange-colored, the size of a large pea and edible; the green shoots and leaves are used as cattle feed.

The *Trema* and the three *Figs* are small trees endemic and unimportant, but the Mulberry or "Kuwa" of the Japanese is the most valuable timber tree on the Islands. The largest living tree I saw grows with the *Celtis* and was about 23 meters tall and 3 meters in girth of trunk, but a fallen, dead tree I measured was 9 meters in girth of trunk. The wood is yellowish when first cut and changes to nearly black with age. It is finely figured, heavier than water, and is especially valuable for cabinet work though difficult to handle. This Mulberry is an upstanding tree with a straight trunk, clean of branches for 6 or 7 meters, has dark brown, scaly, fissured bark which flakes off, and large, dark green cordate leaves. The flowers appear in October and the fruit is ripe in December. The value of its wood has almost brought about the tree's extinction, in fact it has done so on Chichi-jima, but the Japanese Government is now planting it, and felling it is prohibited.

The *Calpidia*, or *Pisonia* as it was formerly called, is in bulk the biggest tree now on the Bonins being often 8 meters in girth of trunk and from 20 to 25 m. tall. The bark is smooth, gray and the branches massive and well clothed with large dark green leaves, but the wood, although fibrous, is brittle, soft and absolutely useless. It is everywhere common but the largest trees are found only on Sekimonzan in Haha-jima.

With six species, all endemic, Lauraceae is the family richest in trees but they are all of small size and, except the *Cinnamomum*, of no particular value. The *Cinnamomum* was called by the Bonin Islanders "Sassafras," and among the published correspondence of Nathaniel Savory are many references to this tree, especially from his acquaintances down on the island of Guam who often ask for "Sassafras bark and seed." Another name for it was "Tea Tree" and its wood was used for making hulls of canoes. I am a little sceptical about Koidzumi's *Machilus pseudokobu* being distinct from Maximowicz's species, but my material is insufficient. My visit was not a seasonable one for Lauraceae, as fruiting material is so necessary for determination in this family.

The *Distylium* is more often a bush than a tree and the same is true of the *Photinia* and *Raphiolepis*. The last named furnished the wood for making tool-handles, being both tough and strong and not too heavy. It was first known as "Axe-handle-wood" and then as illiteracy became more general it became "Areki-san-doru" and finally "Sandal-wood," and as such is mentioned by Robertson. This small tree is common everywhere and its bloomy black, globose fruit in upright clusters are most handsome. I prefer to keep it as a species under Hooker & Arnott's name than to refer it as a variety to the variable Japanese *R. umbellata* Makino, more generally known under Siebold and Zuccarini's name of *R. japonica*.

The *Boninia* as the sole endemic genus is interesting. More often a large bush than a tree, yet it is sometimes 10 meters tall with a trunk 0.6 m. in girth, clothed with smooth gray bark; the leaves are persistent, variable in size, usually shining, but often dull, green. It is dioecious and the small white flowers are borne in axillary cymose clusters; the fruit is capsular. It is everywhere abundant and is often used as a hedge plant. Planchon (in *Ann. Sci. Nat. sér. 5*, xiv. 310 [1872], founded the genus on material from Herb. Acad. Petrop. and in Herb. Hook. no. 56, and distinguishes two species (*Boninia grisea* and *Boninia glabra*) on trivial characters. Koidzumi (in *Tokyo Bot. Mag.* xxxi. 260 [1917]) reduces them to one species (*B. glabra*) and rightly so, I think, though he is in error in citing them as nomina nuda. The other Rutaceous tree here described as a new variety of *Zanthoxylum ailanthoides* Sieb. & Zucc. was known to the Bonin Islanders by the sinister name of "Poison Tree." It is very common, but the only large trees I saw grew on Mulberry Mt. and were 20 meters tall and from 2 to 2.5 meters in girth of trunk. The bark is smooth, pale gray, and the pinnate leaves are 0.3 meters long. It has not the prickles found on the Japanese type with which it has been confused.

The *Claoxylum* is a recently described species and is a slender tree con-

fined to the forest shade. The Putranjiva is the "White Iron-wood" of the Bonin Islanders and it is in request for general building purposes. It is a common tree from 15 to 20 meters tall and from 1.5 to 2.5 meters in girth of trunk and has gray bark. It was a surprise to me to find the Pride of India (*Melia Azedarach* L.) luxuriating in the depth of the forest on Mulberry Mt. and elsewhere. Until then I knew it only as a tree delighting in open country or the margins of woods, but since I have seen it in the rich forests of northeastern Formosa. On the Bonins it is a common tree and on the mountain mentioned grow specimens 25 meters tall and 6 meters in girth of trunk. The wood is of excellent quality, beautifully figured and was known to the Bonin Islanders as "Cedar," and by them employed to make the floors of their houses. In its wide distribution this tree has been helped by its seed, which can be carried in the crops of migratory birds and by ocean currents. Also man's fondness for this tree has caused it to be carried to so many distant lands that it is not easy to say just when and where it is indigenous. The Sapindus is another wide-spread tree in the Orient, but on the Bonins I saw none of any size though small trees were plentiful in the forests on Haha-jima.

The Elaeocarpus is endemic (though the Japanese *E. ellipticus* Mak. has been confused with it) and very abundant, growing from 10 to 20 meters tall and from 0.5 to 2.5 meters in girth of trunk. The wood was used by the Bonin Islanders for roofing purposes and the tree known as "Shaddock." The Schima is also peculiar to the Bonins and formerly large trees were abundant, but clearings made for a foolish and foredoomed-to-failure experiment to grow Rubber (*Ficus elastica* Roxb.) resulted in the destruction of many handsome trees. This Schima grows from 20 to 25 meters tall with a trunk from 3 to 4 meters in girth and a round-topped crown of massive branches often 15 to 20 meters through. It goes by the name of "Rose-wood" and the timber is considered valuable by the Japanese.

The *Eugenia oxygona* Koidz. is the "Red Iron-wood" of the Islanders and is a slender tree from 4 to 6 meters tall with brownish scaly bark and is everywhere common. The Fatsia is a small tree common among the undergrowth of the forest and like its Japanese relative has handsome foliage.

The two Myrsinaceous trees, Ardisia and Rapanea, form the principal arborescent undergrowth in the forests and are also common in thickets. They are slender trees, seldom more than 8 meters tall; the wood of the Rapanea is reddish and that of the Ardisia white. The latter was known as "White Oak" to the early settlers and by them used in house-building. It is possible that the Bonin Ardisia, which has dark reddish fruit, should be regarded as a variety of the wide-spread type.

The Sideroxylon or "Black Iron-wood" of the Islanders is one of the commonest plants on the Bonins but large trees are now rare. On the windswept hilltops it forms scrub from a foot to a yard high, in less exposed places it is a small to a moderate-sized tree, and on Sekimonzan in a bit of sheltered virgin forest are trees 30 meters tall and 5 meters in girth of trunk with wide-spreading buttressed roots sprawling on the ground like

hundreds of large wriggling snakes. The trunk is deeply furrowed and bilowy in outline and is clothed with firm, nearly smooth, gray bark. It is a singular tree, striking in appearance, and the contrast between young leaves covered with a soft rufous pubescence and the shining green of mature leaves is most marked. This tree is also considered to grow in Formosa, but the trees pointed out to me as such appeared to be different. The other Sapotaceous tree if, indeed, it really belongs to his family, may also be a species of *Sideroxylon*, but I saw only one tree without flowers and fruit. It was small — 6 meters tall and 0.3 m. in girth — and was said to bear yellow, flattened, round, edible fruits. It grows on the upper-middle slopes of Chibusa-yama, Haha-jima.

The *Symplocos* and *Paralstonia* are both small trees, the first I found on Mukō-jima only, but the *Paralstonia* is everywhere plentiful and is the "Yellow-wood" of the Islanders; it is a tree sometimes 10 meters tall by one meter in girth of trunk.

CONCLUSION

The Bonin Islands are too small and too windswept to ever become important in tropical agriculture. Sugar-cane grows well and the high price of sugar during the last few years has caused its extensive planting on the Bonins as elsewhere. When sugar falls in price it is doubtful if its cultivation at a profit can be maintained in such small, out-of-the-way places with the consequent high transport rates. The turtles are now scarce and the waters have been very closely fished. With a decline in its sugar industry following that of its marine products the future of these islands is not particularly bright and in all probability many of the Japanese will leave them. With these thoughts in mind it seems worth while to note down the few trees which have been introduced to the Islands and the favorite garden plants of the early settlers, since as they escape in a century's time future visitors may think them indigenous. The Bonin Islanders do not appear to have introduced many plants economic or otherwise. The Papaya (*Carica Papaya* L.) is common and yields excellent fruit; the Banana, formerly a most important crop, has been attacked by disease and has virtually disappeared from the Islands. The Lemon grows and fruits well and in one garden grows a very large tree of a kind of "Grape fruit." The present owners know nothing of its history but most probably it came from the island of Guam. The Passion fruit (*Passiflora edulis* Sims), a Guava (*Psidium Cattleianum* Sab.) have also been introduced and so too has *Ficus retusa* var. *nitida* Miq., the common Banyan Fig of Luikiu and Formosa. For ornament in the gardens I noted *Russelia juncea* Zucc., Poinsettia (*Euphorbia pulcherrima* Willd.), Oleander (*Nerium odorum* Soland.) Pomegranate (*Punica Granatum* L.), two Hibiscus (*H. rosa-sinensis* L. and *H. schizopetalus* Hook. and *Cuphea eminens* Planch. & Lindl. As hedge plants *Lagerstroemia subcostata* Koehne, and a Jasmine (*J. undulatum* var. *elegans* Hemsl.) are common and the latter has escaped. The Japanese have introduced a number of plants and in Omura, Chichi-jima, there is

a small experimental garden, but the above-mentioned plants should be credited to the early white settlers. For forest planting the Japanese have introduced, from Honolulu, I believe, *Casuarina equisetifolia* Forst. and have also planted *Acacia confusa* Merrill, *Pinus luchuensis* Mayr and *Ficus elastica* Roxb. To their temple ground the Japanese priests have introduced *Ficus pumila* L. and *Buxus liukiuensis* Mak.

For native plants which the original white settlers found useful or interesting they most naturally coined names, and these are given in Robertson's paper already mentioned on page 100. To aid in the identity of these I was fortunate enough to enlist the services of the Rev. J. Gonzales who has known the plants by their vernacular names from his childhood. He procured me specimens of all but one or two, and the list of these with their scientific names may fitly conclude this sketch of the ligneous flora of the interesting Bonin Islands.

- Axe-handle-wood (*Raphiolepis integerrima* Hook. & Arn.)
- Cedar (*Melia Azedarach* L.)
- Hao-wood, Mountain (*Hibiscus tiliaceus* var. *glabra* Matsum.)
- Hao-wood, Narrow leaf (*Raphiolepis integerrima* Hook. & Arn.)
- Hao-wood, Soft (*Hernandia peltata* Meisn.)
- Hao-wood, Swamp (*Hibiscus tiliaceus* L.)
- Iron-wood, Black (*Sideroxylon ferrugineum* Hook. & Arn.)
- Iron-wood, Red (*Eugenia oxygona* Koidz.)
- Iron-wood, White (*Putranjiva integerrima* Koidz.)
- Kehop (*Crinum asiaticum* L.)
- Milk-wood (*Ficus boninsimae* Koidz.)
- Mulberry (*Morus boninensis* Koidz.)
- Plum, Wild (*Osteomeles anthyllidifolia* Lindl.)
- Poison-wood (*Zanthoxylum ailanthoides* var. *inermis* Rehd. & Wils.)
- Rose-wood (*Schima boninensis* Nakai)
- Sage tree, Wild (*Vitex ovata* Thunb.)
- Sassafras (*Cinnamomum scrobiculatum* Nakai)
- Shaddock (*Elaeocarpus photiniaefolius* Hook. & Arn.)
- Spruce (*Juniperus taxifolia* Hook. & Arn.)
- Tea-wood tree (*Cinnamomum scrobiculatum* Nakai)
- Tremona or Tomana-wood tree (*Calophyllum Inophyllum* L.)
- White Oak-wood (*Ardisia Sieboldii* Miq.)
- Yellow-wood (*Paralstonia clusiacea* Baill.)

NEW WOODY PLANTS FROM THE BONIN ISLANDS

ALFRED REHDER AND E. H. WILSON

Cyphokentia Savoryana, sp. nov. — *Ptychosperma elegans* Hattori in Jour. Coll. Sci. Tokyo, XXIII. art. 10, 22, 44, t. 2, fig. 1¹ (1908), non Blume.

Arbor ad 16 m. alta, trunco annulato laevi, circiter 0.5 circuitu, glabra paleis rufis foliorum erumpentium cito caducis exceptis. Folia paripinnata,

¹ The explanations to plates 2 and 4 have been interchanged.

circiter 12, erecto-patentia vel patentia, leviter arcuata, pinnis pendentibus, 1-3 m. longa; pinnae utrinque 50-60 (in planta juniore pauciora et partim confluentia), anguste lanceolata, ensiformia, apicem versus sensim angustata, 35-55 cm. longa et 2.5-3 cm. lata, basin versus leviter angustata et interstitiis 2-3 cm. latis separata, pleraque nervis 3 conspicuis instructa; petiolus 45-60 cm. longus, supra canaliculatus, inermis, basi in spatham circiter 70 cm. longam truncum amplexentem dilatatus. Flores monoeci, in spadice paniculato infrafoliaceo ante anthesin in spathis 2 concavis, dein deciduis circiter 70 cm. longis et una circiter 12 altera 20 cm. latis incluso, spiraliter dispositi satis approximati, bracteis latis brevibus abrupte acuminulatis ciliolatis apice longe sparse pilosis et bracteolis minutis suffulti, ut videtur terni, medius femineus, laterales masculi vel axium apicem versus omnes masculi (masculi in specimine praestante paucissimis exceptis decidui, ideoque spadix totus femineus videtur); panicula ampla, ramis patentibus axi angulato; axes tertii ordinis distiche dispositi, 30-40 cm. longi, compressi et leviter flexuosi, simplices vel inferiores bifurcati. Flores masculi: sepala 3, imbricata et plus minusve connata, triangulari-ovata, obtusiuscula, alato-carinata, scariosa, petalis duplo breviora; petala 3, valvata, oblongo-ovata, acutiuscula, 5 mm. longa; stamina 6, petalis paullo breviora, filamentis filiformibus basin versus paullo incrassatis, antheris oblongis 2 mm. longis sagittatis dorsifixis versatilibus; rudimentum ovarii filamentis paullo brevius, apice trifidum. Flores feminei: sepala imbricata, orbiculari-ovata, obtuse apiculata, 3 mm. longa, chartacea; petala imbricata, orbiculari-ovata, obtuse minute apiculata, 4 mm. longa, tenuiora; staminodia desunt; ovarium oblique ovoideum, stigmatibus 3 lateralibus, brevibus latisque, uni-ovulatum; ovulum parietale, pendulum. Inflorescentia fructifera pendula, satis dense fructibus instructa; fructus ovoidei, 1.2 cm. longi et 6-7 cm. diam., nigri, leviter pruinosi, infra apicem rudimento stigmatum valde laterali instructi et apiculati, basi perianthio persistente vix incrassato suffulti; pericarpium crassiusculum; semen ovoideum, facie ventrali leviter applanatum, 7 mm. longum et 5 mm. diam., fusco-brunneum, rapheos ramis a hilo ascendentibus et sparse anastomosantibus et ad situm embryonis convergentibus in testam impressis; albumen corneum, aequabile; embryo basilaris.

BONIN ISLANDS: Mukō-jima, sea-level to 250 m. alt., April 28, 1917, *E. H. Wilson* (No. 8334, type); Chichi-jima, sea-level to 250 m. alt., April 22, 1917, *E. H. Wilson* (No. 8212).

This graceful and handsome Palm agrees well in its generic characters with *Cyphokentia*, though it is geographically far removed from the other species of the genus which are all endemic to New Caledonia. It is still quite common in the more sheltered places on all the larger islands of the Bonin group and especially on Ani-jima. From a distance old trees resemble the Coconut in appearance with their spreading and arching leaves, but the leaves are smaller. It was the presence of this Palm and fresh water that made the Islands famous resorts for the old whaling ships. It is the "Arrack-tree" of Kaempfer and the "Arca oleracea" of Captain Beechey;

von Kittlitz refers to it (Twenty-four views Veget. Pacif. 48) as "the slender growing *Areca*." In the published accounts of the Islands this Palm is frequently mentioned; and since it proves to be peculiar to the Bonins, it appears to be most fitting that we should associate with it the name of one of the pioneers and chief founder of the settlement of Bonin Islands — Nathaniel Savory.

Ficus Iidaiana, sp. nov.

Arbor tenuis, sparse ramosa, ad 8 m. alta, trunco 0.3 m. circuitu; rami rubro-brunnei; juniores adpresse canescenti-pubescentes pilis longioribus villosis intermixtis. Folia membranacea, longe petiolata, ovata, subito breviter acuminata, basi rotundata vel subcordata, 7–15 cm. longa et 5–11 cm. lata, margine leviter undulata, supra saturate viridia, initio adpresse pubescentia, mox glaberrima, subtus pallide viridia, sparse et minute ad costam et venas densius puberula, utrinque nervis 5–7 erecto-patentibus secus marginem curvatis et anastomosantibus; petioli 3.5–7 cm. longi, minute adpresse pubescentes; stipulae membranaceae, ovato-lanceolatae, acuminatae, 1.5–2 cm. longae et 5–8 mm. latae. Receptacula axillaria, solitaria vel bina, pedunculo 1.5–3 cm. longo pubescenti, obovoidea vel ellipsoidea, 2–2.5 cm. longa et circiter 1.5 cm. diam., pleraque basi in stipitem ad 1 cm. longum contracta, minute adpresse pubescentia, basi bracteis 3 membranaceis late ovatis acutis 2–3.5 mm. longis instructa; flores masculi, feminei et galliferi in eodem receptaculo; flores masculi perianthio 4-fido; segmenta oblongo-lanceolata, obtusa vel acutiuscula, brunnea; stamina 2, raro 3 vel 1, segmentis breviora vel subaequilonga, antheris quadrangularelipsoideis quam filamenta longioribus vel rarius subaequilongis; flores feminei, ut videtur, immaturi, segmentis 3–4 anguste lanceolatis; stylus lateralis ovario brevior, stigmate obliquo acuto interdum leviter et inaequaliter bilobo; flores galliferi segmentis 3–4 inaequalibus lanceolatis ovarium late obovoideum paullo superantibus vel brevioribus, rudimento styli laterali. Fructus maturus ignotus.

BONIN ISLANDS: Haha-jima, Sekimonzan, alt. 300 m., April 26, 1917, E. H. Wilson (No. 8310).

A remarkably distinct species belonging to the section *Eusyke* and not closely related to any species known to us; well characterized by its leaves and by its relatively large and long-peduncled receptacle. It is apparently rare, for I saw it only on Sekimonzan.

It is named for Mr. S. Iida of Yokohama, Japan, my friend and genial traveling companion to the Bonin Islands. E. H. W.

Calpidia Nishimurae, comb. nov. — *Pisonia Nishimurae* Koidzumi in Tokyo Bot. Mag. xxxiii. 120 (1919).

BONIN ISLANDS: *M. Yai* and *S. Nishimura* (type), ex Koidzumi; Haha-jima, common, Sekimonzan, alt. 0–500 m., April 26, 1917, E. H. Wilson (No. 8311; tree 10–25 m. tall, 2–8 m. in girth).

As we are following Heimerl (in Oestr. Bot. Zeitschr. LXIII. 279 [1913]) in

considering *Calpidia* Du Petit-Thouars a distinct genus, we have to refer Koidzumi's species which is apparently very near *C. excelsa* (Bl.) Heimerl to that genus.

Evodia Kumagaiana, sp. nov. — *Erodia triphylla* Hattori in Jour. Coll. Sci. Tokyo, xxiii. art. 10, 28 (1908), non De Candolle.

Frutex 2-4-metralis, ramosissimus, glaber, ramis crassis subteretibus, cortice laevi rubro-brunneo striis pallide cinereis notato, ligno denso. Folia trifoliolata, coriacea, persistentia; foliola petiolulata petiolulis 0.5-2.5 cm. longis, medio lateralibus paullo longiore, supra canaliculatis, obovata vel elliptica vel oblongo-obovata, apice rotundata et saepissime emarginata, basi cuneata et saepe obliqua, 3-10, pleraque 6-9 cm. longa, et 1.5-4.5 cm. lata, integra, supra luteo-viridia, lucida, subtus opaca, minute glanduloso-punctulata, nervis utrinsecus 7-10 sub angulo fere recto divergentibus; petioli 2-7 cm. longi, subteretes. Inflorescentia axillaris, paniculata, pedunculo crasso 0.5-2 cm. longo glabrescenti incluso 2-6 cm. longa et 2-3 cm. lata, axibus crassiusculis floribusque tomento velutino brevi cinereo-flavescente obtectis; flores 4-meri, unisexuales, albidi, circiter 5 mm. diam., brevissime pedicellati, bracteis bracteolisque triangularibus acutiusculis minutis suffulti. Flores masculi: sepala semiorbicularia, 1 mm. longa et 1.5 mm. lata, basi decurrentia; petala patentia, ovata, 3 mm. longa, acutiuscula, extus velutina, intus fere glabra, glanduloso-punctulata; stamina erecta, petala aequantia, filamentis subulatis glabris, antheris subglobosis; rudimentum ovarii dense tomento velutino fusco-flavescenti obtectum. Flores feminei (deflorati tantum visi) similes, sed sepala ovata, acutiuscula, vix 1 mm. longa et paullo angustioribus; staminodia pistillum superantia, antheris sterilibus; pistillum dense velutinum, stylo brevi piloso, stigmatibus capitato. Fructus desideratur.

BONIN ISLANDS: Ani-jima, thickets, alt. 100-200 m., May 3, 1917, *E. H. Wilson* (No. 8370).

This species belongs to the section *Lepta*, subsect. *Trifoliolatae* Engl. and has been confused by Japanese botanists with *E. triphylla* De Candolle which, however, is easily distinguished by its thin acuminate leaves and glabrous ovary; from the species with coriaceous leaflets known to us, as *E. acuminata* Merrill, *E. benguetensis* Elmer, *E. Kingii* Engler, *E. pachyphylla* King, *E. retusa* Merrill and *E. robusta* Hooker f., it differs in its emarginate leaflets, small paniculate inflorescence, velutinous petals and in its densely tomentose ovary.

Evodia Kumagaiana is fairly common on Ani-jima, but I did not see it elsewhere. It is named for Mr. Y. Kumagai, Okitsu Experimental Station, Shizuoka-ken, who was detailed by the Japanese Government to accompany me to the Bonin Islands, in appreciation of many valued services.

E. H. W.

Zanthoxylum ailanthoides Sieb. & Zucc. var. *inermis*, var. nov. — *Zanthoxylum ailanthoides* Hattori in Jour. Coll. Sci. Tokyo, xxiii. art. 10, 28 (1908), non Siebold & Zuccarini.

A typo recedit defectu aculearum, omnibus partibus plantae aculeis omnino destitutis.

BONIN ISLANDS: Haha-jima, woods and thickets, alt. 100–400 m., April 29, 1917, E. H. Wilson (No. 8265, type; tree 8–16 m. tall; leaves and old fruits); Chichi-jima, without precise locality *H. Otomo* (flowers).

By Japanese botanists this tree has been referred to *Zanthoxylum ailan-thoides* Sieb. & Zucc. which, however, is easily distinguished from it by the prickles on the trunk, the branches, and often on the leaf-rhachis. The Bonin form is without prickles on any of its parts, but in all other characters it agrees perfectly with the typical form as we know it from Japan and Korea. It is common on all the larger islands and emits a very strong rue-like odor. The Bonin Islanders call it Poison-wood tree and use its wood in making the hulls of their canoes.

Symplocos Otomoi, sp. nov.

Frutex glaberrimus, sepalis et petalis ciliolatis exceptis; rami juniores crassiusculi alato-angulati, flavidi, vetustiores acute angulati. Folia crasse coriacea, ad tertium annum persistentia, breviter petiolata, elliptica vel ovato-elliptica, apice rotundata vel retusa, basi late cuneata, 2–4 cm. longa et 1–2.5 cm. lata, margine integra, valde revoluta, supra laete luteo-viridia, nitentia, rugosa, subtus pallidiora, costa supra impressa, subtus elevata, nervis utrinsecus circiter 6, supra impressis, subtus obsoletis; petioli 2.5 cm. longi. alati. Flores 0.8–1 cm. diam., subsessiles, in racemis axillaribus vix 1 cm. longis densis circiter 5-floris; bracteae ovatae, 1.5–3 mm. longae; calyx 3–3.5 cm. longus, lobis late ovatis vel semiorbicularibus rotundatis circiter 2 mm. longis et latis ciliolatis in tubum brevem vix aequilongum connatis; petala calycem duplo superantia, elliptica, leviter concava, obtusa, 5–6 mm. longa et 3–3.5 mm. lata, ciliolata; stamina manifeste pentadelphica, circiter 75, longiora petala subaequantia, filamentis filiformibus glabris, antheris suborbicularibus; stylus brevis, 1.5 mm. longus, glaber, sulcatus, stigmatibus 3 parvis leviter divergentibus; ovarium triloculare, apice leviter pubescens.

BONIN ISLANDS: Chichi-jima, without precise locality, *H. Otomo*.

A very distinct species characterized by its small crowded rugose obtuse or emarginate leaves and winged shoots. It seems most closely related to *S. crassifolia* Benth. and to *S. lucida* Sieb. & Zucc., but these are both easily distinguished by the acute or acuminate leaves smooth above, serrate in *S. lucida*, and by the stamens exceeding the petals and fewer, 30–60, in number, and by the less winged shoots.

I take pleasure in associating this new species with Mr. Hidemasa Otomo, Forestry officer for the Bonin Islands, to whom I am indebted for the specimen and whose knowledge of the flora and energetic help did so much toward making my visit to the Bonin Islands a pleasant and successful one.

E. H. W.

Symplocos boninensis, sp. nov.

Arbor 3–6-metralis, trunco 0.3–0.5 m. circuito, ramosissima, omnino

glabra, pilis paucis mox deciduis in apice foliorum et in apice gemmarum et florum partibus ciliolatis exceptis; rami hornotini praesertim apicem versus angulati, annotini teretes, ut hornotini plerumque virides, vetustiores brunneo-fusci. Folia coriacea, per duos vel tres annos persistentia, longe petiolata, elliptica vel elliptico-ovata vel oblongo-ovata, rarius obovata, rotundata vel emarginata, rarius obtusiuscula et mucronulata, basi cuneata, 1.5–9 cm., pleraque 5–8 cm. longa et 0.5–4.5, pleraque 2–4 cm. lata, margine leviter undulata et glandulis minutis remotis caducis instructa, supra luteo-viridia, nitentia, subtus paullo pallidiora et opaca, nervis utrinsecus 5–6 ut costa subtus et supra leviter elevatis, venulis obsoletis; petioli crassiusculi, 1.5–3 cm. longi, supra applanati, apicem versus lamina decurrente marginata. Flores albi, axillares, 1–3, 0.8–1 cm. diam.; pedunculus floris centralis 3–5 mm. longus, bracteis pluribus rotundatis 2.5–3.5 mm. longis viridibus minute puberulis ciliolatis obtectus, plerumque 1 vel 2 flores laterales gerens; calyx 4–5 mm. longus, lobis ovatis ciliolatis quam tubus longioribus; petala obovata, concava, 5 mm. longa et 2.5–3 mm. lata, ciliolata; stamina pentadelphica, 90–100, longiora petalis paullo longiora, filamentis glabris; stylus 4 mm. longus, triangularis, stigmatibus 3 minutis; ovarium 3-loculare, apice pubescens. Fructus solitarius, oblongo-ellipsoideus, circiter 1.6 cm. longus, 1 cm. diam., calyce persistente coronatus, pedunculo brevi dense bracteato suffultus.

BONIN ISLANDS: Mukō-jima, woods, alt. 50–100 m., April 28, 1917, *E. H. Wilson* (No. 8336, type); Chichi-jima, Hatsune-yama, *H. Otomo*.

A well-marked species characterized by its leaves, the 1–3-flowered inflorescence and by the large fruit. It appears related to *S. lucida* Sieb. & Zucc. which has smaller serrate leaves, shorter petioles, fascicled flowers and smaller fruit. This new species is common on Mukō-jima, but Wilson did not see it elsewhere. The Chichi-jima specimen from the herbarium of Mr. Otomo looks quite different at first sight with its slenderer branchlets, smaller obovate to oblong-obovate leaves, but on critical examination we are satisfied that it belongs to the same species and is from a weak branch.

Lobelia boninensis Koidzumi in Matsumura Icon. Pl. Koisikav. II. 19, t. 94 (1914).

Suffrutex 1–2 m. altus, glaber, monocarpicus, caule crasso glabro circiter 3 cm. diam., in parte superiore medulla ampla alba repleto, in parte inferiore fistuloso, cortice albido foliorum cicatricibus triangularibus vel semi-orbicularibus conspicuis 0.8–1.4 cm. diam. notato. Folia numerosissima, basalia conferta oblanceolata-oblonga vel lanceolato-oblonga, subito acutata, 8–20 cm. longa et 2–3.5 cm. lata, basi in petiolum circiter 1 cm. longum alato-marginatum contracta, remote et sparse crenato-serrata, supra laete viridia, nitentia, subtus pallidiora, glabra, utrinque nervis 12–18 supra leviter impressis subtus elevatis ante marginem anastomosantibus, caulina sparsa, ligulata, 30–35 cm. longa et 3–3.5 cm. lata, sensim in petiolum alatum angustata, nervis fere duplo numerosioribus, ceterum ut basalia. Inflorescentia terminalis paniculata pubescens, e racemis 40–50 cm. longis compo-

sita; flores non visi. Capsula ovoidea vel ellipsoidea 1.4 cm. longa et 5 mm. lata, pedicello circiter 1 cm. longo pubescente erecto, 10-costata costis anguste alatis, calycis lobis coronata.

BONIN ISLANDS: Mukō-jima, sea-level to 200 m. alt., April 28, 1917, *E. H. Wilson* (No. 8343, type); Chichi-jima, cliffs, sea-level to 200 m. alt., common, April 23 1917, *E. H. Wilson* (No. 8277).

This very interesting addition to the flora of eastern Asia is fairly common in open grassy places on all the islands which Wilson visited, and it seems strange that it should have remained without a name. It had been apparently first found by C. Wright according to a statement by Hillebrand in his *Flora of the Hawaiian Islands*, p. 237 (1888), who mentions under *Lobelia Gaudichaudii* De Candolle a specimen collected by Wright on the Loo-choo Islands (apparently a mistake for Bonin Islands, for there is no such *Lobelia* known from the Liukiu Islands) and says that it resembles the present species (*L. Gaudichaudii*) greatly and that it is preserved in the Harvard Herbarium, but there is now no *Lobelia* from the Bonin Islands in the Gray Herbarium and none is mentioned in Dr. Gray's manuscript list of Bonin and Loo-choo plants. Our new species is undoubtedly near *L. Gaudichaudii*, but that species has sessile leaves with a broad base and a conspicuous row of resinous glands on the margins.

At the last moment, when this article was already in press, we discovered that Koidzumi had described and figured this *Lobelia* which we had supposed to be an undescribed species in Matsumura's *Icones Plantarum Koisikavenses*.

NEW SPECIES, VARIETIES AND COMBINATIONS FROM THE HERBARIUM AND THE COLLECTIONS OF THE ARNOLD ARBORETUM¹

ALFRED REHDER

FAGACEAE

Castanopsis Spach

IN the limitation of this genus I am following Schottky and unite the section *Chlamydobalanus* Endlicher (sub *Quercu*; Oersted sub *Pasania*) with *Castanopsis*. From *Castanea* the genus is easily distinguished by the evergreen often entire leaves. From *Lithocarpus* it differs in the thin cupula usually enclosing the nut entirely and splitting at maturity to liberate it; the cupula is furnished with spines or tubercles arranged in usually oblique zones, it is never covered by closely imbricate scales nor by concentric distinct rings; the number of flowers varies from 3-1 in a cupula. The leaves are usually distichously arranged.

Castanopsis acuminatissima, comb. nov. — *Quercus lineata* Miquel, Pl. Junghuhn. 1. 10 (1850), non Blume. — *Castanea acuminatissima* Blume, Mus. Bot. Lugd.-Bat. 1. 283 (1850). — *Quercus fagiformis* Junghuhn in

¹ Continued from p. 60.

Bonplandia vi. 82, fig. (1858).¹ — *Quercus Junghuhnii* Miquel, F. Ind. Bat. i. pt. i. 853 (1858). — Oudemans in Verh. Akad. Wet. Amsterd. xi. No. 3, 15, t. 9 (Annot. Crit. Cupulif. Jav.) (1865). — King in Ann. Bot. Gard. Calcutta, ii. 78, t. 73 (1889). — *Quercus acuminatissima* A. De Candolle, Prodr. xvi. pt. ii. 102 (1864). — *Pasania acuminatissima* Oersted in Naturh. For. Vidensk. Meddel. xviii. 84 (1866).

JAVA.

Castanopsis Blumeana, comb. nov. — *Quercus Blumeana* Korthals in Verh. Nat. Geschied. Bot. 208, t. 44 (1842). — King in Ann. Bot. Calcutta, ii. 75, t. 69B (1889). — *Cyclobalanus Blumeana* Oersted in Naturh. For. Vidensk. Meddel. xviii. 81 (1866). — *Synaedrys Blumeana* Koidzumi in Tokyo Bot. Mag. xxx. 186 (1916).

SUMATRA, BORNEO.

Castanopsis encleisocarpa, comb. nov. — *Quercus encleisocarpa* Korthals in Verh. Nat. Geschied. Bot. 208, t. 45 (1842). — King in Ann. Bot. Gard. Calcutta, ii. 80, t. 75, figs. 1-3 (1889). — *Cyclobalanus encleistocarpa* [sic] Oersted in Naturh. For. Vidensk. Meddel. xviii. 81 (1866). — *Synaedrys encleisocarpa* Koidzumi in Tokyo Bot. Mag. xxx. 186 (1916).

SUMATRA.

Castanopsis reflexa, comb. nov. — *Quercus reflexa* King in Ann. Bot. Gard. Calcutta, ii. 78, t. 72 (1889). — *Synaedrys reflexa* Koidzumi in Tokyo Bot. Mag. xxx. 187 (1916).

BORNEO.

Lithocarpus Bl.

Blume's name *Lithocarpus* of 1825 must replace *Synaedrys* Lindley of 1836 taken up by Koidzumi and *Pasania* Oersted of 1866 which has been so far the generally accepted name for the genus. For citations of literature and further remarks see foot-note in Sargent, Pl. Wilson. iii. 205 (1916).

Lithocarpus acuminata, comb. nov. — *Quercus acuminata* Roxburgh, Fl. Ind. ed. 2, iii. 636 (1832). — Wight, Icon. i. t. 221, figs. 6-9 (1840). — King in Ann. Bot. Gard. Calcutta, ii. 41, t. 32B (1889). — *Quercus fenestrata* var. *acuminata* Wenzig in Jahrb. Bot. Gard. Berlin, iv. 224 (1886). — *Pasania acuminata* Oersted in Naturh. For. Vidensk. Meddel. xvi. 83 (1866). — *Synaedrys acuminata* Koidzumi in Tokyo Bot. Mag. xxx. 193 (1916).

MALESIA.

Lithocarpus amygdalifolia, comb. nov. — *Quercus amygdalifolia* Skan in Jour. Linn. Soc. xxvi. 506 (1899). — *Pasania amygdalifolia* Schottky in Bot. Jahrb. xlvii. 660 (1912). — *Synaedrys amygdalina* (sic) Koidzumi in Tokyo Bot. Mag. 188 (1916).

CHINA.

¹ Junghuhn's article is stated to be a translation from the *Natuurk. Tijdschr. Ned.-Ind.* ser. 3, iv. of 1857 but the Dutch original article was not published until the following year (in ser. 4, i. 23-138) and contains no reference to *Q. fagiformis*, the paragraph of the German translation from "Hier besteht der Wald" to "*Q. fagiformis*," including the figure and foot-note, being entirely omitted from the Dutch article.

Lithocarpus apoensis, comb. nov. — *Quercus apoensis* Elmer in Leaflet. Philip. Bot. III. 945 (1910).

PHILIPPINE ISLANDS.

Lithocarpus attenuata, comb. nov. — *Quercus Eyrei* Hance in Jour. Bot. XXII. 229 (1884), non Champion. — *Quercus attenuata* Skan in Jour. Linn. Soc. XXVI. 506 (1899). — *Pasania attenuata* Schottky in Bot. Jahrb. XLVII. 675 (1912).

CHINA: Hongkong.

Lithocarpus Bennettii, comb. nov. — *Quercus Bennettii* Miquel, Fl. Ind. Bat. I. pt. I. 857 (1856). — King in Ann. Bot. Gard. Calcutta, II. 64, t. 58a (1889). — Merrill in Philip. Jour. Sci. III. Bot. 328 (1908). — *Quercus Llanosii* Fernandez-Villar, Nov. App. Fl. Filip. 208 (1883), non A. De Candolle. — *Quercus Wenzigiana* Merrill in Philip. Jour. Sci. I. suppl. 41 (1906), non King. — *Synaedrys Bennettii* Koidzumi in Tokyo Bot. Mag. XXX. 190 (1916).

PHILIPPINE ISLANDS.

Lithocarpus brevicaudata, comb. nov. — *Quercus brevicaudata* Skan in Jour. Linn. Soc. XXVI. 508 (1899). — *Pasania brevicaudata* Schottky in Bot. Jahrb. XLVII. 666 (1912). — *Synaedrys brevicaudata* Koidzumi in Tokyo Bot. Mag. XXX. 194 (1916).

FORMOSA.

Lithocarpus Carolinae, comb. nov. — *Quercus Carolinae* Skan in Jour. Linn. Soc. XXXV. 518 (1903). — *Pasania Carolinae* Schottky in Bot. Jahrb. XLVII. 673 (1912). — *Synaedrys Carolinae* Koidzumi in Tokyo Bot. Mag. XXX. 194 (1916).

CHINA: Yunnan.

Lithocarpus cathayana, comb. nov. — *Quercus cathayana* Seemen in Fedde, Rep. Spec. Nov. III. 53 (1906). — *Pasania cathayana* Schottky in Bot. Jahrb. XLVII. 663 (1912). — *Synaedrys cathayana* Koidzumi in Tokyo Bot. Mag. XXX. 188 (1916).

CHINA.

Lithocarpus caudatifolia, comb. nov. — *Quercus caudatifolia* Merrill in Philip. Jour. Sci. III. Bot. 324 (1908). — *Synaedrys caudatifolia* Koidzumi in Tokyo Bot. Mag. XXX. 190 (1916).

PHILIPPINE ISLANDS.

Lithocarpus celebica, comb. nov. — *Quercus celebica* Miquel in Ann. Mus. Bot. Lugd.-Bat. I. 110 (1863). — *Cyclobalanus celebica* Oersted in Naturh. For. Vidensk. Meddel. XVIII. 81 (1866). — *Synaedrys celebica* Koidzumi in Tokyo Bot. Mag. XXX. 194 (1916).

CELEBES.

Lithocarpus clathrata, comb. nov. — *Quercus clathrata* Seemen in Bot. Jahrb. XXVII. beibl. LXIV. 15 (1900). — *Synaedrys clathrata* Koidzumi in Tokyo Bot. Mag. XXX. 190 (1916).

JAVA.

Lithocarpus conocarpa, comb. nov. — *Quercus conocarpa* Oudemans in Versl. Akad. Wetensch. Amsterd. Afdel. Natuurk. XII. 206 (1861); in

Verh. Akad. Wet. Amsterd. xi. No. 3, 18, t. 10 (Annot. Cupulif. Jav.) (1865). — King in Ann. Bot. Gard. Calcutta, ii. 61, t. 56a (1889). — *Cyclobalanus conocarpa* Oersted in Naturh. For. Vidensk. Meddel. xviii. 81 (1866). — *Synaedrys conocarpa* Koidzumi in Tokyo Bot. Mag. xxx. 191 (1916).

JAVA.

Lithocarpus cooperta, comb. nov. — *Castanea cooperta* Oersted in Vidensk. Selsk. Naturvid. Skrift. ser. 5, ix. 379 (1873). — *Quercus cooperta* Blanco, Fl. Filip. ed. 2, 503 (1845). — *Castanopsis costata* Fernandez-Villar, Nov. App. Fl. Filip. 209 (1883), non A. De Candolle. — *Quercus Fernandezii* Vidal, Sinops. Atl. xli. t. 92, fig. E (1883). — *Synaedrys cooperta* Koidzumi in Tokyo Bot. Mag. xxx. 186 (1916).

PHILIPPINE ISLANDS.

Lithocarpus Copelandii, comb. nov. — *Quercus Copelandii* Elmer in Leatl. Philip. Bot. VI. 1984 (1913).

PHILIPPINE ISLANDS.

Lithocarpus costata, comb. nov. — *Quercus costata* Blume, Fl. Jav. Cupulif. 25, t. 13 (1828-50). — King in Ann. Bot. Gard. Calcutta, ii. 82, t. 76a (1889). — *Lithocarpus scutigera* Oudemans in Meded. Akad. Amsterd. Afd. Natuurk. xii. 207 (1861); in Verh. Akad. Wet. Amsterd. xi., No. 3, 20, t. 12 (Annot. Cupulif. Jav.) (1865). — *Cyclobalanus costata* Oersted in Naturh. For. Vidensk. Meddel. xviii. 81, t. 1-2, fig. 14 (1866). — Koorders & Valetton, Bijdr. Jaav. Booms. x. 60 (1904). — *Synaedrys costata* Koidzumi in Tokyo Bot. Mag. xxx. 188 (1916).

MALESA.

Lithocarpus Curranii, comb. nov. — *Quercus curranii* Merrill in Philip. Jour. Sci. iii. Bot. 329 (1908). — *Synaedrys Curranii* Koidzumi in Tokyo Bot. Mag. xxx. 189 (1916).

PHILIPPINE ISLANDS.

Lithocarpus crassinervia, comb. nov. — *Quercus crassinervia* Blume, Mus. Bot. Lugd.-Bat. i. 292 (1850). — *Quercus pseudo-molucca* Bl. β. *crassinervia* Miquel, Fl. Ind. Bat. i. pt. i. 849 (1855). — *Pasania crassinervia* Oersted in Naturh. For. Vidensk. Meddel. xviii. 84 (1866). — *Synaedrys crassinervia* Koidzumi in Tokyo Bot. Mag. xxx. 194 (1891).

JAVA.

Lithocarpus cyrtorhyncha, comb. nov. — *Quercus cyrtorhyncha* Miquel, Fl. Ned. Ind. Suppl. 350 (1840). — King in Ann. Bot. Gard. Calcutta, ii. 66B (1889). — *Synaedrys cyrtorhyncha* Koidzumi in Tokyo Bot. Mag. xxx. 191 (1916).

SUMATRA.

Lithocarpus dasystachya, comb. nov. — *Quercus dasystachya* Miquel in Ann. Mus. Bot. Lugd.-Bat. i. 221 (1864-65). — *Synaedrys dasystachya* Koidzumi in Tokyo Bot. Mag. xxx. 194 (1916).

BORNEO.

Lithocarpus dealbata, comb. nov. — *Quercus dealbata* Hooker f. & Thomson apud A. De Candolle, Prodr. xvi. pt. ii. 85 (1864). — King in

Ann. Bot. Gard. Calcutta, II. 46, t. 40, figs. 1-4 (1889). — *Pasania dealbata* Oersted in Naturh. For. Vidensk. Meddel. XVIII. 84 (1866). — *Quercus fenestrata* Roxb. var. *a. dealbata* Wenzig in Jahrb. Bot. Gard. Berlin, IV. 224 (1886). — *Synaedrys dealbata* Koidzumi in Tokyo Bot. Mag. XXX. 194 (1916).

INDIA: Nepal.

Lithocarpus densiflora Rehd. f. *lanceolata*, comb. nov. — *Pasania densiflora* f. *lanceolata* Jepson, Fl. Calif. 362 (1909); Silv. Calif. 237 (1910).

CALIFORNIA: Mendocino and Del Norte Counties.

Lithocarpus densiflora var. *montana*, comb. nov. — *Quercus echinoides* R. Brown Campst. in Ann. Mag. Nat. Hist. ser. 4, VII. 251 (1871). — *Quercus densiflora* Greene, West Am. Oaks, t. 24 (1889), non Hooker & Arnott. — *Quercus densiflora* var. *montana* Mayr, Wald. Nordam, 264, t. 2, fig. (1890). — *Quercus densiflora* var. *echinoides* Sargent, Silv. N. Am. VIII. 183, t. 488, fig. 9 (1895). — *Pasania montana* Mayr, Wald- & Parkb. 487, t. 14, fig. (1906). — *Pasania densiflora* var. *echinoides* Jepson, Fl. Calif. 363 (1909); Silv. Calif. 237 (1910).

OREGON, CALIFORNIA.

Lithocarpus dolichocarpa, comb. nov. — *Quercus dolichocarpa* Seemen in Bot. Jahrb. XXVII. beibl. LXIV. 14 (1900). — *Synaedrys dolichocarpa* Koidzumi in Tokyo Bot. Mag. XXX. 191 (1916).

SUMATRA.

Lithocarpus edulis, comb. nov. — *Quercus glabra* Siebold & Zuccarini, Fl. Jap. I. 170, t. 89 (1841), non Thunberg. — Shirasawa, Icon. Ess. For. Jap. I. t. 32, figs. 14-24 (1900). — *Quercus edulis* Makino in Tokyo Bot. Mag. XI. (38) (1897). — *Pasania edulis* Makino, l. c. (39) (1897). — *Synaedrys edulis* Koidzumi in Tokyo Bot. Mag. XXX. (28), 191 (1916). — *Pasania glabra* Oersted in Naturh. Forh. Vidensk. Meddel. XVIII. 83 (1866), pro parte, quoad cit. Sieb. & Zucc. — Schottky in Bot. Jahrb. XLVII. 669 (1912). — *Lithocarpus glabra* Rehder in Bailey, Stand. Cycl. Hort. VI. 3569 (1917), pro parte, quoad descriptionem.

JAPAN.

This species had been erroneously identified by Siebold & Zuccarini with *Q. glabra* Thunberg and this identification has been accepted by all subsequent botanists until Makino in 1897 showed that Thunberg's name properly belongs to the species described as *Q. thalassica* by Hance. See note under *Lithocarpus glabra*.

Lithocarpus Elizabethae, comb. nov. — *Quercus Elizabethae* Tutchet in Jour. Bot. XLIX. 273 (1911). — *Pasania Elizabethae* Schottky in Bot. Jahrb. XLVII. 685 (1912).

CHINA: Hongkong.

Tutchet places this species under the section *Claymlobalanus*, but according to the specimens before me it belongs into the affinity of *L. dealbata* and *L. fenestrata*.

Lithocarpus Eyrei, comb. nov. — *Quercus Eyrei* Champion apud Ben-
tham in Hooker Jour. Bot. VI. 114 (1854).

CHINA: Hongkong.

Lithocarpus fenestrata, comb. nov. — *Quercus fenestrata*, Roxburgh, Fl. Ind. ed. 2, III. 633 (1832). — Wight, Icon. t. 219 (1840). — King in Ann. Bot. Gard. Calcutta, II. 45, t. 39 (1889). — *Quercus callicarpifolia* Griffith, Itin. Not. II. 87, No. 1268 (1848), pro parte. — *Pasania fenestrata* Oersted, in Naturh. For. Vidensk. Meddel. XVIII. 84 (1866). — *Synaedrys fenestrata* Koidzumi in Tokyo Bot. Mag. XXX. 195 (1916).

HIMALAYAS.

Lithocarpus formosana, comb. nov. — *Quercus formosana* Skan in Jour. Linn. Soc. XXVI. 513 (1899). — *Pasania formosana* Schottky in Bot. Jahrb. XLVII. 670 (1912). — *Synaedrys formosana* Koidzumi in Tokyo Bot. Mag. XXX. 195 (1916).

FORMOSA.

Lithocarpus glabra Rehder in Bailey, Stand. Cycl. Hort. VI. 3569 (1917), ex parte, quoad synonym. Thunberg. — *Quercus glabra* Thunberg, Fl. Jap. 175 (1784); Icon. Pl. Jap. IV. t. 5 (1802). — Willdenow, Spec. Pl. IV. 427 (1805). — Makino in Tokyo Bot. Mag. XI. (37) (1897). — *Quercus thalassica* Hance in Hooker Kew Jour. I. 176 (1849). — Shirasawa, Icon. Ess. For. Jap. I. t. 33 (1900). — *Quercus inversa* Lindley & Paxton, Flow. Gard. I. 58, fig. 36 (1850). — Seemann, Bot. Voy. Herald, 414, t. 88 (1852-57). — *Quercus Sieboldiana* Blume, Mus. Bot. Lugd.-Bat. I. 290 (1850). — *Quercus reversa* Benth in Hooker Kew Jour. VI. 112 (1854). — *Pasania glabra*, Oersted in Naturh. For. Vidensk. Meddel. XVIII. 83 (1866), ex parte, excl. syn. Sieb. & Zucc. — *Pasania thalassica* Oersted, l. c. (1866). — *Synaedrys glabra* Koidzumi in Tokyo Bot. Mag. XXX. (28), 195 (1916). — *Lithocarpus thalassica* Rehder in Bailey, Stand. Cycl. Hort. VI. 3569 (1917).

JAPAN.

Siebold & Zuccarini's identification of Thunberg's *Quercus glabra* with another Japanese species enumerated above as *Q. edulis*, had unfortunately been accepted by all later botanists, until Makino in 1897 pointed out that *Q. glabra* Thunberg is identical with *Q. thalassica* Hance and that *Q. glabra* Sieb. & Zucc. is a species hitherto unnamed for which he proposed the name *Q. edulis* or *Pasania edulis*. A careful comparison of herbarium material with Thunberg's description and with the figure in his Icones and also with an excellent photograph of the type specimen kindly sent to me by Professor O. Juel of Upsala has convinced me that Makino is right. Thunberg's description of the leaves as "utrinque glabra" has apparently misled botanists, as the leaves are distinctly pubescent only when young, while at maturity the underside is covered with a close scurfy tomentum which to the naked eye does not appear as tomentum, but the words "oblongo-lanceolata, cuspidata" fit only *Q. thalassica* Hance, and so does the description of the inflorescence as "spicae florum terminales . . . tomentosae," for in *L. edulis* the staminate spikes are axillary and glabrous. Moreover Thunberg's figure which is a fairly faithful representation of his type specimen agrees exactly with specimens of *Q. thalassica* before me and has little resemblance to *L. edulis*.

Lithocarpus Hancei, comb. nov. — *Quercus Hancei* Benth. in Fl. Hongkong. 322 (1861). — *Pasania Hancei* Schottky in Bot. Jahrb. XLVII. 669 (1912). — *Synaedrys Hancei* Koidzumi in Tokyo Bot. Mag. xxx. 191 (1916).

CHINA: Hongkong.

Lithocarpus Harlandii, comb. nov. — *Quercus Harlandii* Hance in Walp. Ann. III. 382 (1852). — *Pasania Harlandii* Oersted in Naturh. For. Vidensk. Meddel. XVIII. 83 (1866). — *Synaedrys Harlandii* Koidzumi in Tokyo Bot. Mag. xxx. 191 (1916).

CHINA: Hongkong.

Lithocarpus heliciformis, comb. nov. — *Quercus heliciformis* Seemen in Bot. Jahrb. XXVII. beibl. LXIV. 15 (1900). — *Synaedrys heliciformis* Koidzumi in Tokyo Bot. Mag. xxx. 191 (1916).

JAVA.

Lithocarpus hystrix, comb. nov. — *Quercus hystrix* Korthals in Verh. Nat. Geschied. Bot. 201, t. 43 (1842). — King in Ann. Bot. Gard. Calcutta, II. 54, t. 50 (1889). — *Quercus Korthalsii* Bl. var. *hystrix* Blume, Mus. Bot. Lugd.-Bat. I. 293 (1850). — *Cyclobalanus hystrix* Oersted in Naturh. For. Vidensk. Meddel. XVIII. 81 (1866). — *Synaedrys hystrix* Koidzumi in Tokyo Bot. Mag. xxx. 195 (1916).

MALESIA.

Lithocarpus induta, comb. nov. — *Quercus induta* Blume in Verh. Bat. Genoot. Wetensch. IX. 220 (1823); Fl. Jav. Cupulif. 23, t. 12 (1828-51). — King in Ann. Bot. Gard. Calcutta, II. 55, t. 51 (1889). — *Cyclobalanus induta* Oersted in Naturh. For. Vidensk. Meddel. XVIII. 80, t. 1-2, fig. 17 (1866). — *Synaedrys induta* Koidzumi in Tokyo Bot. Mag. xxx. 195 (1916).

JAVA.

Lithocarpus Irwinii, comb. nov. — *Quercus Irwinii* Hance in Ann. Sci. Nat. ser. 4, XVIII. 229 (1862). — *Pasania Irwinii* Oersted in Naturh. For. Vidensk. For. Meddel. XVIII. 83 (1866). — *Synaedrys Irwinii* Koidzumi in Tokyo Bot. Mag. xxx. 195 (1916).

CHINA: Kwangtung, Hongkong.

Lithocarpus iteaphylla, comb. nov. — *Quercus iteaphylla* Hance in Jour. Bot. XXII. 229 (1884). — *Pasania iteaphylla* Schottky in Bot. Jahrb. XLVII. 669 (1912). — *Synaedrys iteaphylla* Koidzumi in Tokyo Bot. Mag. xxx. 196 (1916).

CHINA: Hongkong.

Lithocarpus Jordanae, comb. nov. — *Quercus Jordanae* Laguna, Apunt. Nuev. Roble Filip. 7, t. (1875). — *Quercus Vidalii* Fernandez-Villar, Nov. App. Fl. Filip. 209 (1883). — Vidal, Sin. Pl. Leñ. Filip. Atl. t. XLI. t. 92, fig. B (1883). — *Quercus caraballoana* Fernandez-Villar. l. c. 209 (1883). — *Quercus Havilandii* Seemen in Perkins, Fragm. Fl. Philip. 42 (1904), non Stapf. — *Quercus sundaca* Merrill in Philip. Jour. Sci. I. suppl. 41 (1906), non Blume. — *Synaedrys Jordanae* Koidzumi in Tokyo Bot. Mag. xxx. 196 (1916).

PHILIPPINE ISLANDS.

Lithocarpus lamponga, comb. nov. — *Quercus lamponga* Miquel, Fl. Ind. Bat. Suppl. 347 (1860). — King in Ann. Bot. Gard. Calcutta, II. 53, t. 49 (1889). — *Cyclobalanus lamponga* Oersted in Naturh. For. Vidensk. Meddel. XVIII. 81 (1866). — *Quercus brevipetiolata* Scheffer, Obs. Phyt. II. 47 (1869). — *Synaedrys lamponga* Koidzumi in Tokyo Bot. Mag. XXX. 196 (1916).

MALESIA.

Lithocarpus lappacea, comb. nov. — *Quercus lappacea* Roxburgh, Fl. Ind. ed. 2, III. 637 (1832). — Wight, Icon. I. t. 220 (1840). — King in Ann. Bot. Gard. Calcutta, II. 41, t. 33 (1889). — *Quercus hirsuta* Lindley in Wallich, Cat. no. 3734 (1829), nomen. — *Quercus Mackiana* Hooker, Icon. III. t. 224 (1840). — *Pasania lappacea* Oersted in Naturh. For. Vidensk. Meddel. XVIII. 84 (1866). — *Synaedrys lappacea* Koidzumi in Tokyo Bot. Mag. XXX. 196 (1916).

HIMALAYAS.

Lithocarpus lipacon, comb. nov. — *Quercus lipacon* Elmer in Leaflet Philip. Bot. VI. 1983 (1913).

PHILIPPINE ISLANDS.

Lithocarpus Llanosii, comb. nov. — *Quercus Llanosii* A. De Candolle, Prodr. XVI. pt. II. 97 (1864), excl. syn. Blancoi. — *Cyclobalanus Llanosii* Oersted in Naturh. For. Vidensk. Meddel. XVIII. 80 (1866). — *Quercus campanoana* Vidal, Sin. Pl. Leñ. Filip. Atl. XLI. t. 92, f. D (1883). — *Quercus sundaica* Fernandez-Villar, Nov. App. Fl. Filip. 207 (1883), non Blume. — *Synaedrys Llanosii* Koidzumi in Tokyo Bot. Mag. XXX. 196 (1916).

PHILIPPINE ISLANDS.

Lithocarpus lucida, comb. nov. — *Quercus cuneata* Herb. Roxburgh apud Wallich, Cat. no. 3732 (1829), nomen, non Wangenheim. — A. De Candolle, Prodr. XVI. pt. II. 108 (1864), nomen. — *Quercus lucida* Roxburgh, Fl. Ind. ed. 2, III. 635 (1832). — King in Ann. Bot. Gard. Calcutta, II. 69, t. 64 (1889). — *Synaedrys lucida* Koidzumi in Tokyo Bot. Mag. XXX. 192 (1916).

MALAY PENINSULA.

Lithocarpus Maingayi, comb. nov. — *Quercus Maingayi* Benth in Hooker, Icon. XIV. t. 1314 (1880). — King in Ann. Bot. Gard. Calcutta, II. 82, t. 77 (1889). — *Synaedrys Maingayi* Koidzumi in Tokyo Bot. Mag. XXX. 189 (1916).

MALAY PENINSULA.

Lithocarpus Mairei, comb. nov. — *Pasania Mairei* Schottky in Bot. Jahrb. XLVII. 665 (1912). — *Synaedrys Maieri* [sic] Koidzumi in Tokyo Bot. Mag. XXX. 197 (1916).

CHINA: Yunnan.

Lithocarpus Merrittii, comb. nov. — *Quercus merrittii* Merrill in Philip. Jour. Sci. III. Bot. 325 (1908). — *Synaedrys Merrittii* Koidzumi in Tokyo Bot. Mag. XXX. 192 (1916).

PHILIPPINE ISLANDS.

Lithocarpus mindanaensis, comb. nov. — *Quercus philippinensis* Merrill

in Philip. For. Bur. Bull. i. 16 (1903), non A. De Candolle. — *Quercus celebica* Seemen in Perkins, Fragm. Philip. Fl. 41 (1904), non Miquel. — *Quercus acuminatissima* Merrill in Philip. Jour. Sci. III. Bot. 326 (1908), non A. De Candolle. — *Quercus mindanaensis* Elmer in Leaflet Philip. Bot. III. 942 (1910). — *Synaedrys acuminatissima* Koidzumi in Tokyo Bot. Mag. xxx. 190 (1916).

PHILIPPINE ISLANDS: Mindanao.

Lithocarpus monticola, comb. nov. — *Quercus monticola* King in Ann. Bot. Gard. Calcutta, II. 44, t. 37 (1889). — *Synaedrys monticola* Koidzumi in Tokyo Bot. Mag. xxx. 197 (1916).

SUMATRA, BORNEO.

Lithocarpus omalokos, comb. nov. — *Quercus omalokos* Korthals in Verh. Nat. Geschied. Bot. 214 (1850). — *Cyclobalanulus omalokos* Oersted in Naturh. For. Vidensk. Meddel. XVIII. 80, t. 1-2, figs. 15-16 (1866). — *Quercus omalokos* Hooker f., Fl. Brit. Ind. v. 614 (1888). — King in Ann. Bot. Gard. Calcutta, II. 70, t. 63B (1889). — *Pasania omalokos* Schottky in Bot. Jahrb. XLVII. 676 (1912). — *Synaedrys omalokos* Koidzumi in Tokyo Bot. Mag. xxx. 192 (1916.)

SUMATRA.

Lithocarpus ovalis, comb. nov. — *Quercus glabra* Blanco, Fl. Filip. 727 (1837), non Thunberg. — *Quercus ovalis* Blanco, Fl. Filip. ed. 2, 502 (1845). — Merrill in Philip. Jour. Sci. III. Bot. 325 (1908). — *Quercus Blancoi*, A. De Candolle, Prodr. XVI. pt. II. (1864). — Vidal, Sin. Pl. Leñ. Filip. Atl. XLI. t. 92, fig. c (1883). — *Cyclobalanulus ovalis* Oersted in Naturh. For. Vidensk. Meddel. XVIII. 81 (1866). — *Quercus induta* Fernandez-Villar, Nov. App. Fl. Filip. 207 (1883), non Blume. — *Quercus Teysmannii* Fernandez-Villar, l. c. (1883), non Blume. — *Synaedrys ovalis* Koidzumi in Tokyo Bot. Mag. xxx. 192 (1916).

PHILIPPINE ISLANDS.

Lithocarpus pachyphylla, comb. nov. — *Quercus pachyphylla* Kurz in Jour. As. Soc. Beng. XLIV. pt. II. 197, t. 14, figs. 1-4 (1875). — King in Ann. Bot. Gard. Calcutta, II. 44, t. 38 (1889). — *Quercus Andersoni* King inscr. apud C. B. Clarke in Jour. Linn. Soc. xv. 125 (1877), nomen. — *Pasania pachyphylla* Schottky in Bot. Jahrb. XLVII. 671 (1912). — *Synaedrys pachyphylla* Koidzumi in Tokyo Bot. Mag. xxx. 197 (1916).

INDIA: Sikkim.

Lithocarpus pallida, comb. nov. — *Quercus pallida* Blume, Bijdr. 524 (1825); Fl. Jav. Cupulif. 12, t. 4, 5 (1828-50). — King in Ann. Bot. Gard. Calcutta, II. 57, t. 53A (1889). — *Quercus pseudo-molucca* var. *rostrata* Blume, Mus. Bot. Lugd.-Bat. I. 295 (1850). — *Quercus pseudo-molucca* var. *pallida* Miquel in Ann. Mus. Bot. Lugd.-Bat. I. 108 (1864-65). — *Synaedrys pallida* Koidzumi in Tokyo Bot. Mag. xxx. 1917 (1916).

JAVA, SUMATRA.

Lithocarpus philippinensis, comb. nov. — *Quercus philippinensis* A. De Candolle, Prodr. XVI. pt. II. 97 (1864). — Merrill in Philip. Jour. Sci. III. Bot. 328 (1908). — *Cyclobalanulus philippinensis* Oersted in Naturh. For.

Vidensk. Meddel. xviii. 80 (1866). — *Synaedrys philippinensis* Koidzumi in Tokyo Bot. Mag. xxx. 192 (1916).

PHILIPPINE ISLANDS: Luzon.

Lithocarpus platycarpa, comb. nov. — *Quercus platycarpa* Blume, Fl. Jav. Cupulif. 27, t. 15 (1828-51). — King in Ann. Bot. Gard. Calcutta, ii. 70, t. 65 (1889). — *Cyclobalanus platycarpa* Oersted in Naturh. For. Vidensk. Meddel. xviii. 80 (1866). — *Synaedrys platycarpa* Koidzumi in Tokyo Bot. Mag. xxx. 192 (1916).

JAVA.

Lithocarpus polystachya, comb. nov. — *Quercus polystachya* Wallich, Cat. 2789 (1829), nomen. — A. De Candolle, Prodr. xvi. pt. ii. 107 (1864) — King in Ann. Bot. Gard. Calcutta, ii. 50, t. 44 (1889). — *Quercus bancana* Kurz, For. Fl. Burma, ii. 485 (1877), non Scheffer. — *Pasania polystachya* Schottky in Bot. Jahrb. xlvii. 667, 668 (1912). — *Synaedrys polystachya* Koidzumi in Tokyo Bot. Mag. xxx. 197 (1916).

INDIA: Burma, Shan Hills. CHINA: Yunnan.

Lithocarpus pruinosa, comb. nov. — *Quercus pruinosa* Blume in Verh. Bat. Genoot. ix. 217 (1823); Fl. Jav. Cupulif. 9, t. 1 (1828-51). — King in Ann. Bot. Gard. Calcutta, ii. 56, t. 53B (1889). — *Pasania pruinosa* Oersted in Naturh. For. Vidensk. Meddel. xviii. 83 (1866). — *Quercus pseudomolucca* var. γ . *pruinosa* Weizig in Jahrb. Bot. Gard. Berlin, iv. 227 (1886). — *Synaedrys pruinosa* Koidzumi in Tokyo Bot. Mag. xxx. 197 (1916).

JAVA.

Lithocarpus pseudo-molucca, comb. nov. — *Quercus pseudo-molucca* Blume in Verh. Bat. Genoot. ix. 214, t. 4 (1823); Fl. Jav. Cupulif. 14, t. 6 (1828-51). — King in Ann. Bot. Gard. Calcutta, ii. 43, t. 36 (1889). — *Quercus angustata* Blume, l. c. 212 (1823); Fl. Jav. Cupulif. 15, t. 7 (1828-51). — *Quercus pseudo-molucca* var. γ . *angustata* Blume, Mus. Bot. Lugd.-Bat. i. 292 (1850). — *Quercus thelecarpa* Miquel in Pl. Junghuhn. i. 9 (1851-56). — *Pasania pseudomolucca* Oersted in Naturh. For. Vidensk. Meddel. xvii. 83 (1866). — *Synaedrys pseudomolucca* Koidzumi in Tokyo Bot. Mag. xxx. 197 (1916).

JAVA.

Lithocarpus pyriformis, comb. nov. — *Quercus pyriformis* Seemen in Bot. Jahrb. xxvii. beibl. lxiv. 17 (1900). — Koorders & Valetton, Bijdr. Booms. Java, x. 62 (1904). — *Synaedrys pyriformis* Koidzumi in Tokyo Bot. Mag. xxx. 198 (1916).

JAVA.

Lithocarpus rassa, comb. nov. — *Quercus rassa* Miquel, Fl. Ind. Bat. Suppl. 350 (1860). — King in Ann. Bot. Gard. Calcutta, ii. 66, t. 60A (1889). — *Synaedrys rassa* Koidzumi in Tokyo Bot. Mag. xxx. 192 (1916).

MALESIA.

Lithocarpus Robinsonii, comb. nov. — *Quercus Robinsonii* Merrill in Philip. Jour. Sci. x. Bot. 297 (1915).

PHILIPPINE ISLANDS: Luzon.

Lithocarpus Skaniana, comb. nov. — *Quercus Skaniana* Dunn in Jour. Linn. Soc. xxxviii. 366 (1908). — *Pasania Skaniana* Schottky in Bot. Jahrb. xlvii. 675 (1912).

CHINA: Fokien.

Lithocarpus Soleriana, comb. nov. — *Quercus molucca* Blanco, Fl. Filip. 726 (1837), non Willdenow. — *Quercus concentrica* Blanco, Fl. Filip. ed. 2, 502 (1845), non Loureiro. — *Quercus costata* var. *conveza* Naves in Blanco, Fl. Filip. ed. 3, t. 441 (1883), non Blume. — *Quercus Reinwardtii* Fernandez-Villar, Nov. App. Fl. Filip. 207 (1883), non Korthals. — *Quercus Soleriana* Vidal, Rev. Pl. Vasc. Filip. 261 (1886). — *Quercus clementiana* Merrill in Philip. Jour. Sci. i. Suppl. 41 (1906), non King. — *Quercus Llanosii* Merrill in Philip. Jour. Sci. ii. 270 (1907), non A. De Candolle. — *Synaedrys Soleriana* Koidzumi in Tokyo Bot. Mag. xxx. 193 (1916).

PHILIPPINE ISLANDS.

Lithocarpus spicata (Smith) Rehder & Wilson var. *chittagonga*, comb. nov. — *Quercus spicata* var. *Chittagonga* King in Hooker f., Fl. Brit. Ind. v. 610 (1883; in Ann. Bot. Gard. Calcutta, ii. 49, t. 42, fig. 7 (1889)). — *Pasania spicata* var. *chittagonga* Schottky in Bot. Jahrb. xlvii. 665 (1912).

INDIA: Chittagong.

Lithocarpus spicata var. *gracilipes*, comb. nov. — *Quercus gracilipes* Miquel, Fl. Ind. Bat. Suppl. 347 (1860). — *Quercus spicata* d. *gracilipes* Miquel in Ann. Mus. Lugd.-Bat. i. 106 (1864-65). — King in Ann. Bot. Gard. Calcutta, ii. 48, t. 42, fig. 4 (1889). — *Pasania spicata* var. *gracilipes* Schottky in Bot. Jahrb. xlvii. 664 (1912).

INDIA: Kashia, Burma. MALESIA.

Lithocarpus submonticola, comb. nov. — *Quercus submonticola* Elmer in Leaf. Philip. Bot. iii. 943 (1910).

PHILIPPINE ISLANDS: Mindanao.

Lithocarpus sundaica, comb. nov. — *Quercus sundaica* Blume in Verh. Bat. Genoot. ix. 216 (1823); Fl. Jav. Cupulif. 11, t. 2, 3 (1828-51). — King in Ann. Bot. Gard. Calcutta, ii. 51, t. 47, 48 (1889). — *Quercus muricata* Roxburgh, Fl. Ind., ed. 2, iii. 635 (1832). — *Quercus mappacea* Korthals in Verh. Nat. Geschied. Bot. 202 (1839-42). — *Quercus Korthalsii* var. *mappacea* Blume, Mus. Bot. Lugd.-Bat. i. 293 (1850). — *Quercus Korthalsii* var. *kajan* Blume, l. c. (1850). — *Quercus Kajan* Miquel msc. apud Zollinger, Syst. Verz. 87 (1854). — *Pasania sundaica* Oersted in Naturh. For. Vidensk. Meddel. xviii. 83 (1866). — *Quercus pseudo-molucca* var. *δ*. *Korthalsii* Wenzig in Jahrb. Bot. Gart. Berlin, iv. 227 (1886), pro parte. — *Quercus pseudo-molucca* var. *ε*. *sundaica* Wenzig, l. c. (1886). — *Synaedrys sundaica* Koidzumi in Tokyo Bot. Mag. xxx. 198 (1916).

MALESIA.

Lithocarpus Teysmannii, comb. nov. — *Quercus annulata* Korthals in Verh. Nat. Geschied. Bot. 213, t. 46, figs. 21, 22 (1842), non Smith. — *Quercus Teysmannii* [sic] Blume, Mus. Bot. Lugd.-Bat. i. 300 (1850). — *Quercus Teysmannii* Miquel, Fl. Ind. Bat. i. 850 (1855). — Oudemans in Verh. Akad. Wet. Amsterd. xi. No. 3, 14, t. 8 (Annot. Cupul. Jav.) (1865). —

King in Ann. Bot. Gard. Calcutta, II. 71, t. 66 (1889). — *Quercus Korthalsii* Endlicher, Gen. Suppl. IV. pt. II. 28 (1847), non Blume. — *Quercus laurifolia* Miquel, Pl. Junghuhn. I. 11 (1850), non Michaux. — *Quercus hypoleuca* Miquel, Fl. Ind. Bat. I. 869 (1855). — *Quercus pseudo-annulata* Blume, Mus. Bot. Lugd.-Bat. I. 299 (1855). — *Cyclobalanus Tysmannii* Oersted in Naturh. For. Vidensk. Meddel. XVIII. 80 (1866). — *Pasania Tysmannii* Prantl in Engler & Prantl, Nat. Pflanzenfam. III. 1, 55 (188). — *Synaedrys Tysmannii* Koidzumi in Tokyo Bot. Mag. XXX. 193 (1916).

JAVA.

Lithocarpus Thomsonii, comb. nov. — *Quercus Thomsonii* Miquel in Ann. Mus. Bot. Lugd.-Bat. I. 109 (1864-65), nomen. — Hooker f., Fl. Brit. Ind. V. 615 (1888). — King in Ann. Bot. Gard. Calcutta, II. 73, t. 69A (1889). — *Quercus turbinata* Roxburgh, Fl. Ind. ed. 2, III. 636 (1832), non Blume. — *Quercus leucocarpa* Hooker f. & Thomson msc. apud Wenzig in Bot. Jahrb. Bot. Gard. Berlin, IV. 225 (1886). — *Synaedrys Thomsonii* Koidzumi in Tokyo Bot. Mag. XXX. 193 (1916).

INDIA: Kasha, Burma.

Lithocarpus truncata, comb. nov. — *Quercus truncata* King in Ann. Bot. Gard. Calcutta, II. 84, t. 80 (1889). — *Pasania truncata* Schottky in Bot. Jahrb. XLVII. 663 (1912). — *Synaedrys truncata* Koidzumi in Tokyo Bot. Mag. XXX. 190 (1916).

INDIA: Assam.

Lithocarpus uvariifolia, comb. nov. — *Quercus uvariifolia* Hance in Jour. Bot. XXII. 227 (1884). — *Pasania uvariifolia* Hance in Jour. Bot. XXII. 227 (1884). — *Synaedrys uvariifolia* Koidzumi in Tokyo Bot. Mag. XXX. 198 (1916).

CHINA: Kiangsi, Kwantung.

Lithocarpus Wallichiana, comb. nov. — *Quercus Wallichiana* Lindley in Wallich, Cat. No. 2778 (1829). — Hance in Seemann Jour. Bot. VIII. 4 (1870). — King in Ann. Bot. Gard. Calcutta, II. 51, t. 46 (1889). — *Synaedrys Wallichiana* Koidzumi in Tokyo Bot. Mag. XXX. 193 (1916).

MALAY PENINSULA.

Lithocarpus Wenzelii, comb. nov. — *Quercus Wenzelii* Merrill in Philip. Jour. Sci. X. Bot. 267 (1915). — *Synaedrys Wenzelii* Koidzumi in Tokyo Bot. Mag. XXX. 193 (1916).

PHILIPPINE ISLANDS.

Lithocarpus Zschokkei, comb. nov. — *Quercus Zschokkei* Elmer in Leaflet. Philip. Bot. III. 944 (1910).

PHILIPPINE ISLANDS: Mindanao.

Quercus L.

Quercus Ilex L. var. *rotundifolia*, comb. nov. — *Quercus-Ilex Ilex* var. 4 *rotundifolia* Weston, Univ. Bot. I. 234 (1770). — *Quercus rotundifolia* Lamarck, Encycl. Méth. I. 723 (1785). — *Quercus Ballota* Desfontaines in Mém. Acad. Sci. Paris, 1790, 394, t. 6; Fl. Atlant. II. 350 (1800). — *Quercus Ilex* β . *Ballota* A. De Candolle, Prodr. XVI. pt. II. 39 (1864). — *Quercus Ilex* β . *Ballota* B. *rotundifolia* Coutinho in Bol. Soc. Broter. VI. 95 (1888).

There seems little reason to doubt that Weston's variety is the same as *Q. rotundifolia* Lam. and *Q. Ilex* β . *Ballota* A. DC., though the description is very short, but the only form with which it could have been confused is *Q. Ilex* var. *gramuntia* Loudon which is enumerated as a distinct variety by Weston.

Quercus lanuginosa Thuill. var. *Tenorei*, comb. nov. — *Quercus Dalechampii* Tenore, Ind. Sem. Hort. Neap. 1830, 15; Not. Syll. 469 (1831). — Ascherson & Graebner, Syn. Mitteleur. Fl. iv. 478 (1911). — *Q. pinnatifidobata* K. Koch in Linnaea, xxii. 326 (1849). — *Q. vulcanica* Boissier apud Kotschy, Chênes Eur. Or. t. 18 (1864). — *Q. Robur* II. *sessiliflora* B. *Tenorei* A. De Candolle, Prodr. xvi. pt. II. 7 (1864). — *Q. sessiliflora* γ . *pinnatifida* Boissier, Fl. Or. iv. 1164 (1879). — *Q. sessiliflora* var. *australis* Kotschy apud Wenzig in Jahrb. Bot. Gart. Berlin, iv. 190 (1886). — *Q. Tergestina* Wenzig, l. c. 191 (1886). — *Q. pubescens* f. *australis* Beck & Szyszyłowicz in Rozpr. Wydz. Mat.-Przyrod. Akad. Krakow. xix. 59 (Pl. Cernag. Alban.) (1888). — *Q. croatica* β . *Tenorei* Pospichal, Fl. Oester, Kuestenl. i. 320 (1897). — *Q. lanuginosa* ζ *pinnatifida* Halacsy, Consp. Fl. Graec. III. 128 (1904), non C. Schneider. — *Q. sessilis* β . *decipiens* f. *australis* Beck, Fl. Bosn. II. 124 (1909). — *Q. Tenorei* Borzi in Boll. Ort. Bot. Palermo, x. 56, t. 4 (1910).

This variety differs from typical *Q. lanuginosa* chiefly in its deeply sinuately lobed leaves with about 5 narrow acute lobes on each side and can hardly be considered specifically distinct from the polymorphous *Q. lanuginosa*.

As the name for the species I have taken up *Q. lanuginosa* Thuillier (1799, not Lamarek 1778 which is a synonym of *Q. Cerris* L.) in preference of *Q. pubescens* Willdenow of 1796, since Willdenow states definitely under *Q. pubescens* in Species plantarum (iv. 450. 1805) that the species described under the same name in 1796 (Berlin. Baumz. 279) is not the same plant as the one described in his Species plantarum, but a variety of *Q. alba* L. which he now calls *Q. alba* γ . *pubescens*. Without this note one may easily be led to identify the *Q. pubescens* of 1796, the habitat of which is given as southern France, with *Q. lanuginosa* of Thuillier, except that Willdenow describes the leaves as attenuate at the base and on the shoots sometimes to 8 inches long, a size never attained by the leaves of *Q. lanuginosa*. It is, however, not quite clear what his *Q. alba* γ . *pubescens* really is, possibly a form of *Q. bicolor*.

× *Quercus hispanica* Lamarek, Encycl. Méth. i. 712 (1783), excl. var. γ . — (*Q. Cerris* × *Suber.*). — *Q. pseudosuber* Santi, Viaggio Mont'Am. i. 156, t. 3 (1795). — Kotschy, Chênes Eur. Or. t. 35 (1864). — Ascherson & Graebner, Syn. Mitteleur. Fl. iv. 463 (1911). — *Q. Fontanesii* Gussone Ind. Sem. Hort. Boccadifalco, 10 (1826). — *Q. Ilex* var. *suberosa* Visiani, Fl. Dalmat. i. 208 (1842). — *Q. pseudosuber* 2. *Fontanesii* Loudon, Encycl. Trees, 885, fig. 1624 (1842). — *Q. Cerris* ϵ . *subperennis* A. De Candolle, Prodr. xvi. pt. II. 42 (1864).

Lamarck based his *Q. hispanica* on three different trees of unknown origin cultivated in the park of Trianon near Paris. The first two forms called α . Chêne de Gibraltar and β . Chêne à feuilles d'Aegylops are apparently identical with the Fulham and Lucombe Oaks of English gardens which originated about 1765 and are undoubtedly hybrids between *Q. Cerris* L. and *Q. Suber* L. The third form called γ . turnère is *Q. Turneri* Willd. probably a hybrid between *Q. Ilex* and *Q. robur*. The *Q. pseudosuber* of Santi of which I have seen numerous specimens from different localities I am unable to distinguish from the cultivated forms of the hybrid between *Q. Cerris* and *Q. suber*. It seems to occur in southern Europe only in scattered individuals in regions where *Q. Cerris* is native and where *Q. suber* is found either wild or cultivated; e.g. near Pola, Istria, where *Q. pseudosuber* has been observed, old trees of *Q. suber* exist, as stated by Hempel & Wilhelm (Bäume & Sträuch. II. 82). Even if *Q. pseudosuber* should be found in localities where at present no cultivated trees of *Q. suber* exist, this would be no proof against its hybrid origin, as trees of *Q. suber* may have existed and succumbed to a severe winter, while the hybrid which is more resistant has survived.

Several distinct forms of this hybrid occur in cultivation of which the following are the most distinct and best known. To avoid confusion I have preserved for the typical form its oldest varietal name.

× *Q. hispanica* var. *dentata*, comb. nov. — *Q. hispanica* α . "Chêne de Gibraltar" Lamarck, Encycl. Méth. I. 712 (1783). — *Q. Cerris* var. *dentata* Watson, Dendr. Brit. II. t. 93 (1825). — *Q. Cerris* 8. *fulhamensis* Loudon, Arb. Brit. III. 1850, fig. 1710 (1838). — *Q. pseudosuber* ϵ . *gibraltarica* A. De Candolle, Prodr. XVI. pt. II. 44 (1864). — *Q. Cerris* ϵ . *subperennis* α . *Fulhamensis* Dippel, Handb. Laubh. II. 96 (1892). — *Q. fulhamensis* Zabel in Beissner, Schelle & Zabel, Handb. 70 (1903). — *Q. Lucombeana* var. α . *fulhamensis* Henry in Elwes & Henry, Trees Gt. Brit. v. 1261, t. 335, fig. 21 (1910).

This form is chiefly characterized by its pyramidal habit with moderately corky branches, by its generally elliptic-ovate leaves with 5-8 teeth, and by the hemispheric cup with the scales usually all reflexed. It is the typical form and is not identical with *Q. Cerris* *Lucombeana dentata* Loud. (*Q. Lucombeana* var. *dentata* Henry).

× *Q. hispanica* var. *latifolia*, comb. nov. — *Q. Lucombeana* var. *fulhamensis latifolia* Henry in Elwes & Henry, Trees Gt. Brit. v. 1262 (1910). — *Q. fulhamensis latifolia* Hort. ex Henry, l. c., pro synon.

This form differs from the preceding chiefly in its broader, less strongly dentate leaves.

× *Q. hispanica* var. *Lucombeana*, comb. nov. — *Q. hispanica* β . "Chêne à feuilles d'Aegylops" Lamarck, Encycl. Méth. I. 723 (1783). — *Q. aegylopiifolia* Persoon, Syn. II. 570 (1807). — *Q. Lucombeana* Sweet, Hort. Brit. 370 (1827). — Henry in Elwes & Henry, Trees Gt. Brit. v. 1259, t. 335, fig. 23 (1910). — *Q. Cerris* var. *Lucombeana* Loudon, Arb. Brit. III. 1851, figs. 1711-14 (1838). — *Q. exoniensis* Loddiges ex Loudon, l. c., pro synon. —

Q. pseudosuber δ . *aegylopiifolia* A. De Candolle, Prodr. xvi. pt. II. 44 (1864). — *Q. Cerris* e. *subperennis* β . *Lucombeana* Dippel, Handb. Laubh. II. 97 (1892). — *Q. fulhamensis* *Lucombeana* Zabel in Beissner, Schelle & Zabel, Handb. 71 (1903).

This variety forms a round-headed tree with the bark not corky; the leaves are narrower and longer than in the typical form and have about 7 pairs of triangular large teeth; the subulate scales of the turbinate cup are partly reflexed and partly erect.

× *Q. hispanica* var. *crispa*, comb. nov. — *Q. Cerris* 10. *Lucombeana crispa* Loudon, Arb. Brit. III. 1856 figs. 1715, 1717c, 1718 (1838). — *Q. Lucombeana* var. *crispa* Henry in Elwes & Henry, Trees Gt. Brit. v. 1261 (1910).

This differs from the preceding variety chiefly in the very corky bark and in the smaller leaves with wrinkled margin.

× *Q. hispanica* var. *heterophylla*, comb. nov. — *Q. Cerris* 14. *heterophylla* Loudon, Arb. Brit. III. 1857, fig. 1719 (1838). — *Q. Lucombeana* var. *heterophylla* Henry in Elwes & Henry, Trees Gt. Brit. v., 1261 (1838).

Leaves oblong, irregularly and deeply lobed, in the middle often with a deep wide sinus on each side leaving only a narrow margin at the midrib.

× *Q. hispanica* var. *diversifolia*, comb. nov. — *Q. Ilex* var. *diversifolia* Hort. apud Nicholson, Hand-list Arb. Kew, II. 189 (1896). — *Q. Lucombeana* var. *diversifolia* Henry in Elwes & Henry, Trees Gt. Brit. v. 1262, t. 339, fig. 71 (1910).

The leaves are somewhat similar to those of the preceding form, but are smaller; the cup of the fruit is hemispheric with shorter partly appressed scales; the branches ascending, the bark corky.

Quercus sessiliflora Salisb. f. *insecata*, nom. nov. — *Q. sessiliflora* γ . *laciniata* Koehne, Dendr. 130 (1893), not Duchartre. — Spaeth in Mitt. Deutsch. Dendr. Ges. XXII. 138, figs. 18–20 (1913).

This is a peculiar form with deeply incisely lobed leaves, the narrow lobes pointing forward. It had to receive a new name on account of the older homonym *Q. sessiliflora laciniata* DC. apud Duchartre in Jacques & Hérincq, Man. Pl. IV. 254 (1857) which is probably the same as *Q. robur* β . *laciniata* Lamarek, Encycl. Méth. I. 717 (1785) and represents a form with deeply lobed leaves, but otherwise similar to those of the type.

Quercus robur f. *holophylla*, nom. nov. — *Q. sessiliflora longifolia* Jurrissen & Zoon, Prijs-Cour. 49 [190. ?], nomen. — *Q. pedunculata* var. *longifolia* Bean, Trees & Shrubs, II. 321 (1914), not Kirchner.

This very distinct and peculiar form differs from the type in its elliptic to oblong entire leaves obtuse at apex and auricled at base; the fruits are borne on a very long and slender stalk. Nothing is known to me of its origin; it was received at the Arnold Arboretum in 1903 from the nursery of Jac. Jurrissen & Zoon of Naarden, Holland. The form had to receive a new name on account of the older *Q. pedunculata* 22. *cucullata longifolia* Kirchner in Petzold & Kirchner, Arb. Musc. 622 (1864) (*Q. robur* var. *cucullata longifolia* Hartweg & Rümpler, Bäum. Sträuch. 440 1875).

***Quercus aliena* Bl. var. *pubipes*, var. nov.**

A typo praecipue differt foliis minoribus latioribus subtus pilis fasciculaist suberectis ad costam nervosque densius in facie sparsius obsitae, petiolis pubescentibus circiter 1 cm. longis, ramulis novellis parce strigoso-pilosis. — Folia obovata, 7–10 cm. longa et 4–8 cm. lata, obtuse dentata dentibus utrinque 8–10, supra opace cyaneo-viridia, fere glabra, subtus cinereo-viridia, molliter pubescentia.

CHINA. Chikung-shan, border of Honan and Hupeh, alt. 1500–2500 feet, low shrub, 3–4 feet, June 13, 1917, *L. H. Bailey*.

Though the specimen before me is sterile I have little doubt that it belongs to *Q. aliena* Blume from the typical form of which it differs, however, markedly in the sparingly pilose branchlets, in the pubescent petioles and in the grayish and soft pubescence of the under side of its leaves, particularly dense on the midrib and on the nerves which are quite glabrous in the typical form, while the surface is covered by a whitish dense tomentum. On account of the broadly obovate grayish pubescent leaves this variety has the appearance of a small-leaved form of *Q. dentata* Thunberg, but that species is easily distinguished by the tomentose branchlets and by the nearly sessile more coarsely toothed and usually very large leaves.

In the same locality Dr. Bailey collected a specimen of *Q. aliena* which has the under side of the leaves nearly glabrous or only sparingly pubescent and which I refer to *Q. aliena* var. *pellucida* Blume. To the same variety apparently belong specimens collected by Dr. Bailey near Kioshan in the province of Honan of which one is remarkable for its slender petioles 2–3 cm. long and for the auricled base of the leaves which are 9–15 cm. long.

***Quercus dentata* Thunberg.**

Though Thunberg's description of *Q. dentata* can hardly be applied to any other species than the one generally known under that name, a glance at his figure in his *Icones Plant. Jap.* v. t. [6] creates a suspicion that Thunberg's species may possibly not be our *Q. dentata*. The branch represented in that plate looks much more like *Q. aliena* var. *acuteserrata* Maximowicz than our *Q. dentata*. Upon my request Professor O. Juel has kindly sent an excellent photograph of Thunberg's type consisting of a flowering branch with half-grown leaves and tells me that this specimen is the only one labeled *Q. dentata* in Thunberg's own handwriting. The photograph shows that the specimen represents without the slightest doubt our *Q. dentata*, but as the leaves are only half-grown, they have not yet reached their full width and their uncompletely developed lobes look more like acutish teeth. In comparing the photograph with the plate one readily sees that the drawing has been based on this specimen, but the artist apparently took many liberties particularly in representing the leaves as distinctly petioled and the lobes of the leaves as more acute and more regular than they really are, and in selecting as the type for the leaves the narrowest of the half-grown leaves, neglecting entirely the more developed broader leaves on the specimen.

ULMACEAE

Ulmus glabra f. *cornuta*, comb. nov. — *U. campestris cornuta* David in Rev. Hort. ser. 2, iv. 102 (1845-46). — *U. triserrata* Hort. apud Kirchner in Petzold & Kirchner, Arb. Musc. 567 (1864). — *U. intermedia* Hort. ex Kirchner, l. c., as synonym. — *U. scabra* e. *U. tricuspis* K. Koch, Dendr. ii. pt. i. 415 (1872). — *U. tridens* Hort. ex Koch, l. c., as synonym. — *U. montana* var. *triserrata* Lavallée, Arb. Segrez. 237 (1877). — *U. montana* var. *tridens* Lange, Haandb. Dansk. Fl. 267 (1887). — *U. scabra* f. *tricuspis* Dippel, Handb. ii. 29 (1892). — *U. montana* f. *lobata* Waisbecker in Oestr. Bot. Zeitschr. XLIX. 67 (1899). — *U. montana* ? *tricuspis* Schelle in Beissner, Schelle & Zabel, Handb. 86 (1903). — *U. scabra* f. *heterophylla* Schneider, Handb. Laubh. i. 218 (1904), pro parte. — *U. montana* a. *corylifolia* Zapałowicz, Consp. Fl. Galic. ii. 98 (1908). — *U. glabra* f. *tricuspis* Rehder in Mitt. Deutsch. Dendr. Ges. XXIV. (1915) 216 (1916).

This form has large leaves which are partly, at least at the ends of the more vigorous branches, 3- or sometimes 5-lobed at the broad apex. It has usually been confused with *U. laciniata* Mayr (*U. major* var. *heterophylla* Maxim. & Rupr.), a species of Eastern Asia, chiefly distinguished by its light colored branchlets and by the leaves which are nearly all 3-lobed at the apex, such leaves not being confined to the end of the more vigorous branches, as in this form of *U. glabra*.

Ulmus laciniata Mayr var. *nikkoensis*, var. nov.

A typo praecipue recedit foliis minoribus latioribus subtus sparse pubescentibus junioribus plus minusve purpurascentibus. — Folia late obovata apice plerumque triloba, 6-11 cm. longa, subtus scabrida pilis brevibus satis sparsis in costa et nervis venulisque, ceterum glabra; ramuli annotini fusco-cinerei.

JAPAN. Hondo; Nikko region, Lake Chuzenji, alt. 1600 m., plants collected by J. G. Jack, October, 1905, and growing now in the Arnold Arboretum.

This variety differs chiefly in its smaller, usually broadly obovate leaves rather sparingly short-pubescent on the nerves and veinlets beneath and scabrid to the touch, while in the typical form the under side of the leaves is covered by a grayish rather dense and soft pubescence and the leaves are oftener oblong-obovate and usually more than 10 cm., often to 15 cm. long. According to our growing plants the variety forms a smaller tree of slenderer habit particularly striking in spring on account of the purplish color of the unfolding leaves which is retained a long time and changed in summer to dark green, while the leaves of the typical form are light green when unfolding.

I have seen no herbarium material of *U. laciniata* from Hondo, but according to Japanese botanists it occurs in central Japan. The specimens from Hokkaido I have seen belong to the typical form and agree with specimens from Manchuria.

Ulmus procera Salisbury, Prodr. Stirp. Allerton, 391 (1796). — *Ulmus campestris* Linnaeus, Spec. i. 225 (1753), pro parte.; Fl. Angl. 11 (1754). — Miller, Dict. ed. viii. No. 1 (1768).¹ — Weston, Univ. Bot. i. 314 (1770). — Henry in Elwes & Henry, Trees Gt. Brit. vii. 1903, t. 412, fig. 14 & t. 396 (1913). — Moss in Gard. Chron. ser. 3, LI 199 (1912); Cambridge Brit. F. II. 94, t. 102 (1914). — *U. campestris* a. *vulgaris* Solander apud Aiton, Hort. Kew. I. 319 (1789). — Planchon in Ann. Sci. Nat. sér. 3, x. 273 (1848); in De Candolle, Prodr. xvii. 156 (1873). — *U. suberosa* Smith, Engl. Bot. xxxi. t. 2161 (1810), non Ehrhart, nec Moench. — *U. atinia* Walker, Essays Nat. Hist. 70 (1812). — *U. surculosa* var. *latifolia* Stokes, Mat. Med. II. 37 (1812). — *U. vulgaris* Dumortier, Fl. Belg. 25 (1827). — *U. suberosa* var. *vulgaris* Hooker & Arnott, Brit. Fl. 376 (1850), ex parte. — *U. germanica* Hartig, Forstl. Kulturpl. 460 (1851). — *U. campestris* var. *major* Trautvetter in Bull. Acad. Sci. St. Petersb. xv. 351 (1857), pro parte, non Walpers. — *U. campestris* a. *vulgatissima* Miller apud Boulger in Gard. Chron. n. ser. xii. 298 (1897). — *U. glabra* b. *pilifera* Borbas, Bekesvarmeg. Fl. 55 (1881). — *U. pilifera* Borbas, Közl. Bekesvarmeg. Fl. in Vandorg. Munkal. xxv. (486) (1881), ex Ascherson & Graebner. — *U. asperima* Nagi, Varad. Termesz. 124 (1890). — *U. campestris* β . *germanica* f. *pubescens* Pospichal, Fl. Oester. Kuestenl. i. 347 (1897). — *U. glabra* Mill. b. *pubescens* Schneider, Ill. Handb. i. 220 (1904). — *U. surculosa* Ley in Jour. Bot. XLVIII. (1910). — *U. campestris* a. *latifolia* l. *pubescens* Ascherson & Graebner, Syn. Mitteleur. Fl. IV. 557 (1911).²

The correct name for this species which had been confused by many authors with *U. foliacea* Gilib. (*U. glabra* Mill., non Huds., *U. nitens* Moench) has been a matter of much dispute. There can be no doubt that like the other European species it formed a part of Linnaeus' *U. campestris*, but to consider it the type of that species is certainly not correct. If we try to ascertain the type of *U. campestris* L., we should turn for a clue first to the citations of Linnaeus in his own publications. The first citation in the Species plantarum is Hort. Clifort. 83; where we find under *Ulmus fructu membranaceo* three varieties "a, β , γ " enumerated; the first which must be considered the type of this aggregate is "a. *Ulmus folio latissimo scabro* Tournefort" which is *U. glabra* Hudson; also the following citation Fl. Suec. 219 must refer to *U. glabra* Huds., as this is the only or at least the most widely distributed species in Sweden; this is confirmed by the figure in Svensk Botanik by Palmstuch & Venus (1802) where the species figured as *U. campestris* on plate 13 represents *U. glabra*

¹ Henry refers *Ulmus campestris* Miller to *U. montana* With. (= *U. glabra* Hudson), but Miller describes that species under the name *U. scabris* to which he ascribes leaves six inches long, while of his *U. campestris* he says that the leaves are about 3 inches long and come out late, which is true of *U. procera* as compared with *U. glabra* Hudson. Furthermore it is most likely that Miller's *U. campestris* is the same species as the *U. campestris* of his contemporaries Weston and Solander; this is also the opinion of Moss.

² Ascherson & Graebner cite as a synonym *Ulmus campestris* var. *pubescens* Planchon in De Candolle, Prodr. xvii. 156, but no such combination can be found there; the word *pubescens* is the beginning of the description; they also cite Ann. Sci. Nat. 3, sér. "III" [ix] where no reference at all to a pubescent form occurs.

Huds., and also by the material in our herbarium. The third citation Mat. Med. 105 refers without doubt to the same species, as he gives Europae nostrae pagi as the habitat. A further proof that Linnaeus had *H. glabra* Huds. in mind, is the fact that he places the genus in Pentandria, the native *U. glabra* being probably the only species of which he had examined the flowers; if he had examined *U. procera*, he ought to have placed the genus in Tetrandria. Finally may be added that the specimen of *U. campestris* in Linnaeus' herbarium represents *U. glabra* Huds., though this is no conclusive evidence, as the specimen in this case is not the type of his species. All this shows, that if we restrict *U. campestris* L. to one of the species now recognized, it must be considered the oldest name for *U. glabra* Hudson, but it is probably better to take advantage of art. 51. 4 of the International Code and let the name lapse, as it would make the nomenclature of *Ulmus* still more confused than it is already. The reason advanced by Moss and by Henry for restricting the name *U. campestris* to *U. procera* is the fact that Linnaeus in his *Flora Anglica* (p. 11), published one year after the *Species plantarum*, cites under *U. campestris* a reference to Ray's *Synopsis* 468-1; this reads in Ray's work "1. *Ulmus vulgatissima folio lato scabro*" which is *U. procera*. Whatever the reason may have been to omit *Ulmus* 2-4 of Ray's *Synopsis*, it was certainly not the intention of Linnaeus to change his conception of *U. campestris*, for in the second edition of his *Species plantarum* he did not make the slightest change in the wording of the diagnosis or of the citations. The type of a species, moreover, cannot be changed by any subsequent publication, and moreover the *Flora anglica* is a simple compilation containing only the bare names followed by a reference to Ray's *Synopsis*, and is without the slightest taxonomic importance. If we follow Henry *Ulmus sativa* Mill. would be the next oldest name, but this view is not shared by Moss who takes up *U. sativa* as the oldest name for the species called by Henry *U. minor* Mill., and I am more inclined to follow Moss. Miller's citation under *U. sativus* certainly favors the opinion of Moss. Miller in his description says little, but under his *U. campestris* states that "the branches do not grow as erect as those of the third sort" (= *U. sativus*), this might point to the Cornish Elm which is not mentioned otherwise by Miller, but according to Weston was in cultivation at that time. In any case the status of *U. sativus* Mill. is rather doubtful, while *Ulmus procera* of Salisbury is based exclusively on *U. campestris a. vulgaris* Solander which is the *Ulmus vulgatissima folio lato scabro* of Gerard and without doubt the species known at present as the English Elm.

Ulmus procera f. *argenteo-variegata*, comb. nov. — *U. campestris* 2. *argenteo-variegata* Weston, Bot. Univ. I. 314 (1770). — *U. campestris* var. *foliis variegatis* Loddiges apud Loudon, Arb. Brit. III. 1376 (1838). — *U. campestris a. vulgatissima* 1. *variegata* (Loud.) Boulger in Gard. Chron. n. ser. XII. 298 (1879). — *U. campestris* var. *variegata* Dippel, Handb. Laubh. II. 25 (1892).

Weston's *U. campestris argenteo-variegata* is certainly referable to this

species as he characterized his *U. campestris* as *U. vulgatissima foliis latis scabris*.

Ulmus procera f. *purpurea*, comb. nov. — *Ulmus campestris* var. *purpurea* H. Vily. apud Wesmael in Bull. Fed. Soc. Hort. Belg. 1862, 390 (1863). — *U. campestris* 17. *purpurea* Kirchner in Petzold & Kirchner, Arb. Musc. 557 (1864). — *U. purpurea* Hort. ex Kirchner, l. c., as synonym.

Ulmus procera f. *purpurascens*, comb. nov. — *U. campestris myrtifolia purpurea* De Smet, Cat. No. 10, 59 (1877), not *U. campestris* var. *purpurea* Wesmael. — ? *U. campestris* var. *purpurascens* Lavallée, Arb. Segrez. 236 (1877), nomen. — *U. glabra* Mill. var. *pubescens* f. *purpurascens* Schneider, Ill. Handb. i. 220 (1904). — *U. campestris* a. *latifolia* l. *pubescens* c. *Berardii* lus. *purpurascens* Ascherson & Graebner, Syn. Mitteleur. Fl. iv. 558 (1911). — *U. campestris* var. *purpurascens* Henry in Elwes & Henry, Trees Gt. Brit. vii. 1905 (1913).

Ulmus procera, f. *Vanhouttei*, comb. nov. — *U. campestris* "Louis Van Houtte" Deegen in Ill. Monatsh. Gartenb. v. 103 (1886). — *U. montana lutescens Vanhouttei* Schelle in Beissner, Schelle & Zabel, Handb. 86 (1903). — *U. glabra* Mill. var. *pubescens* f. *van houttei* Schneider, Ill. Handb. i. 220 (1904). — *U. campestris* a. *latifolia* l. *pubescens* c. *Berardii* lus. *Van Houttei* Ascherson & Graebner, Syn. Mitteleur. Fl. iv. 558 (1911). — *U. campestris* var. *Vanhouttei* Henry in Elwes & Henry, Trees Gt. Brit. vii. 1905 (1912).

Ulmus procera var. *Berardii*, comb. nov. — *U. campestris* var. *Berardi* Simon-Louis, Cat. 1869, p. 96, fig. 7. — Carrière in Rev. Hort. 1873, 340. — *U. glabra* Mill. var. *pubescens* f. *berardii* Schneider, Ill. Handb. i. 220, figs. 136 1-m. (1904). — *U. campestris* a. *latifolia* l. *pubescens* c. *Berardi* Ascherson & Graebner, Syn. Mitteleur. Fl. iv. 558 (1911). — *U. nitens* var. *Berardi* Bean, Trees & Shrubs, ii. 618 (1914).

This variety approaches in its nearly glabrous leaves *U. foliacea* Gilib., but the petioles and the young branchlets are pubescent. Flowers and fruits are yet unknown.

Ulmus procera var. *viminalis*, comb. nov. — *U. campestris* var. *viminalis* Loudon, Arb. Brit. iii. 1376, vii. t. 185a (1838). — *U. viminalis* Loddiges ex Loudon, l. c., pro synonym. — K. Koch, Dendr. ii. pt. i. 418 (1872), pro forma *U. scabrae*. — *U. antarctica* Hort. apud Kirchner in Petzold & Kirchner, Arb. Musc. 551 (1864). — *U. gracilis* Hort. ex Kirchner, l. c., pro synonym. — *U. campestris* a. *vulgatissima* 3. *viminalis* Masters apud Boulger in Gard. Chron. n. ser. xii. 298 (1879). — *U. campestris* var. *gracilis* Hartwig & Rümpler, Bäum. Sträuch 580 (1879). — *U. scabra* var. *viminalis* Dippel, Handb. Laubh. ii. 30 (1892). — *U. scabra* f. *major viminalis* Voss, Vilmorin's Blumengaert. ed. 3, i. 906 (1895). — *U. montana* var. *viminalis* f. *gracilis* Baenitz, Herb. Dendr. (1901), in sched. — *U. montana viminalis* Schelle in Beissner, Schelle & Zabel, Handb. 85 (1903). — *U. montana viminalis gracilis* Schelle, l. c. (1903). — *U. glabra* Mill. var. *pendula* f. *viminalis* Schneider, Ill. Handb. i. 220, fig. 136 n (1904). — *U. glabra* var. *pendula* f. *antarctica* Schneider, l. c. fig. 136 o (1904). — *U. campestris* a.

glabra a. *vulgaris* lus. *viminalis* Ascherson & Graebner, Syn. Mitteleur. Fl. iv. 554 (1911). — *U. campestris* a. *glabra* a. *vulgaris* lus. *antarctica* Ascherson & Graebner, l. c. (1911). — *U. viminalis* Loddiges apud Bean, Trees & Shrubs, II. 621 (1914).

The form named *gracilis* (*antarctica*) has been distinguished from *viminalis* by the more deeply incised usually obovate leaves, but the two forms of leaves pass gradually into each other and may be found even on the same plant.

Ulmus procera var. *viminalis* f. *aurea*, comb. nov. — *U. campestris* var. *aurea* Morren in Belg. Hort. xvi. t. 356–57 (1866). — Lemaire in Ill. Hort. xiv. t. 513 (1867). — *U. Rosseelsii* K. Koch, Dendr. II. pt. I. 412 (1872), pro forma *U. scabrae*. — *U. campestris* var. *antarctica aurea* Nicholson, Hand-list Arb. Kew, II. 135 (1896). — *U. montana viminalis gracilis aurea* Schelle in Beissner, Schelle & Zabel, Handb. 86 (1903). — *U. campestris* *Rosseelsii* [sic] Schelle, l. c. 83 (1903). — *U. campestris* var. *viminalis aurea* Henry in Elwes & Henry, Trees Gt. Brit. VII. 1907 (1913). — *U. viminalis* var. *aurea* Bean, Trees & Shrubs, II. 621 (1914).

Ulmus procera var. *viminalis* f. *marginata*, comb. nov. — *U. campestris* 14. *viminalis marginata* Hort. apud Kirchner in Petzold & Kirchner, Arb. Musc. 556 (1864). — *U. campestris* var. *viminalis variegata* Nicholson, Hand-list Arb. Kew, II. 137 (1896). — *U. montana viminalis marginata* Schelle in Beissner, Schelle & Zabel, Handb. 85 (1903). — *U. viminalis* var. *variegata* Bean, Trees & Shrubs, II. 621 (1914).

Ulmus procera var. *australis*, comb. nov. — *U. campestris* var. *australis* Henry in Elwes & Henry, Trees Gt. Brit. 1904, t. 412, fig. 17 (1910).

Ulmus pumila L. var. *pilosa* Rehder, var. nov.

A typo recedit ramulis junioribus rubro-brunneis dense pilosis pilis patulis, tomento ad tertium annum persistente, foliis junioribus supra pilis accumbenti-setulosis scabra, subtus ad costam et nervos pilosis, petiolis brevibus pilosis. — Arbor 10-metralis: folia elliptico-ovata, acuminata, subsimpliciter serrata, 2–3.5 cm. longa; petioli 1–2 mm. longi, pilosuli: samara brevissime pedicellata, suborbicularia vel rotundato-ovalia, 12–14 mm. longa et 10–12 mm. lata, apice profunde emarginata, sinus lateribus valde curvatis et sese tegentibus.

CHINA. Yunnan: Pe-yen-tsin, May 7, 1916, *Siméon Ten* (No. 89, ramuli foliiferi, type); March 1, 1917, *Siméon Ten* (No. 307, ramuli fructiferi).

This variety agrees in size and shape of leaf and fruit exactly with typical *U. pumila*, but differs in the dense pilose pubescence and in the reddish brown color of the young branchlets and in the pubescence of the leaves and their short petioles. Typical *U. pumila* as a rule is quite glabrous and the only specimens with pubescent branchlets I have seen are F. N. Meyer's No. 928, a specimen collected by Purdom near Peking, and Wilson's No. 1565 from Kiangsi, but the pubescence of the first two of these specimens is minutely villous and not at all pilose, while Wilson's specimen has

the branchlets sparingly pilose; Meyer's specimen approaches our variety also in the red-brown color of the branchlets and in the very short petioles.

Ulmus pumila has not before been recorded from Yunnan, but I suspect that the Elm enumerated by Lévillé in his Cat. Pl. Yun-Nan, p. 276 (1917) as *U. parvifolia* Jacquin is this new variety.

***Zelkova serrata* Makino**

CHINA. Hunan: prope urbem Wukang, in silva frondosa elata umbrosa montis Yun-shan, alt. 1000 m., August 7, 1917, *H. v. Handel-Mazzetti*, No. 399 (Diar. No. 2204).

The material in the Arboretum herbarium from China proper, formerly referred to *Zelkova serrata* (*Z. acuminata* Planch.) has been found to belong to *Zelkova sinica* Schneider (in Sargent, Pl. Wilson. III. 286 [1916]). We therefore concluded that *Z. serrata* is restricted to Japan and Korea. The specimen cited above, however, which is undoubtedly true *Z. serrata*, as it agrees exactly with specimens from Japan proves that *Z. serrata* extends far into southern China; Wukang being situated in the southwestern part of Hunan not very far from the border of Kwangsi.

Zelkova sinica is apparently a species of more northern distribution, ranging from Shansi to Kansu and south to Hupeh and northern Chekiang. To which species Carles' specimen from Tahoe Lake in Chekiang cited by Hemsley belongs I am unable to say, as I have not seen it.

MORACEAE

***Morus mongolica* Schneid. var. *vestita* var. nov.**

A typo recedit foliis supra satis dense setuloso-pubescentibus, subtus dense molliter villosis; petiolis pedunculisque villosulis.

CHINA. Yunnan: Sou-pin-chao via Pe-yen-tsin ad Pien-kio, April 20, 1917, *Siméon Ten* (No. 321; arbor 5–10 m. altus, floribus albis, typus); "rochers des couteaux à Pan-pien-kai," alt. 2500 m. May, 1912, *E. E. Maire*.

These specimens agree in all characters exactly with typical *M. mongolica* except in the pubescence of the leaves and of the peduncles which are glabrous or nearly glabrous in the type.

BERBERIDACEAE

***Mahonia repens* f. *subcordata*, f. nov.**

A typo recedit foliolis 5–7, rarius 9, approximatis late ovatis basi subcordatis, dentibus paucis remotis fere ad mucronem reductis interdum fere integris.

Cultivated at Highland Park, Rochester, N.Y. (Type specimen coll. May 10–11, 1913, by *R. E. Horsey* & *J. Bishop*, preserved in the Arnold Arboretum Herb.)

This is a rather distinct looking form characterized by the 5–9-foliate leaves with broad and crowded leaflets partly overlapping at the subcordate base.

× *Mahonia Wagneri*, comb. nov. — (*M. Aquifolium* × *pinnata*. — *Maho-*

nia pinnata var. *Wagneri* Jouin in Mitt. Deutsch. Dend. Ges. xix. 90, fig. 290 (1910). — Fedde, Rep. Spec. Nov. xiii. 364 (1914). — *Berberis pinnati* var. *Wagneri* Rehder in Mitt. Deutsch. Dendr. Ges. xxi. 184 (1912).

This hybrid resembles in its habit and in the axillary inflorescences *M. pinnata* Fedde, but the leaflets are thinner and slightly lustrous and the petioles are slenderer, often attaining 3 cm. in length, while on other parts of the same plant they may be scarcely 5 mm. long; the usually 9 or 11 leaflets are mostly ovate-lanceolate and sinuately dentate with 4 or 5 spiny teeth on each side. *Mahonia Wagneri* is about as hardy as *M. Aquifolium*, but grows much taller, reaching a height of 2.5. m. When and where it originated is not known; it has been in cultivation in the Nursery of Simon-Louis Frères at Plantières near Metz since 1863. In gardens it is sometimes found under the name of *M. fascicularis*.

CALYCANTHACEAE

Calycanthus fertilis var. *ferax*, comb. nov. — *C. ferax* Michaux, Fl. Bor.-Am. i. 305 (1803). — *C. laevigatus* Willdenow, Enum. Pl. Hort. Berol. 559 (1809). — *C. pennsylvanicus* Loddiges ex Loudon, Arb. Brit. ii. 937 (1838), pro synon. — *Butneria nana* Small, Fl. S. E. U. S. 528 (1903), pro parte. *Butneria fertilis* b. *ferax* Schneider, Ill. Handb. i. 344 (1905). — *Calycanthus fertilis* var. *laevigatus* Bean, Trees & Shrubs, i. 283 (1914).

This variety differs chiefly in the green under side of the leaves which is glaucous in typical *C. fertilis*. The closely related *C. fertilis* var. *nanus* Schelle (*C. nanus* Lois.) is likewise green on the under side of the leaves, but smaller in every part.

LAURACEAE

Umbellularia californica Nutt. f. *pendula*, nom. nov. — *U. californica* "pendulous form" Jepson, Silv. Cal. 243, t. 76 (1900).

Near Olema, Marin Co. and northward, according to Jepson.

A tree with wide-spreading branches forming a crown broader than high and with slender pendulous branchlets. A very ornamental form to be recommended for cultivation.

Litsea sericea Hooker f., Fl. Brit. Ind. v. 156 (1886). — Gamble in Sargent, Pl. Wilson. ii. 75 (1914). — *Tetranthera sericea* Wallich, Cat. No. 2545 (1829), nomen. — Nees in Wallich, Pl. As. Rar. ii. 67 (1831). — *Tetranthera sikkimensis* Meissner in De Candolle, Prodr. xv. pt. i. 181 (1864). — *Lindera umbellata* Hemsley in Jour. Linn. Soc. xxvi. 393 (1891), pro parte, non Thunberg. — Gamble in Sargent, Pl. Wilson. ii. 81 (1914). — *Lindera membranacea* Hemsley, l. c. 389 (1891), pro parte, non Maximowicz. — Gamble, l. c. (1914).

The Chinese specimens referred to *Lindera umbellata* and *L. membranacea* by Hemsley and Gamble, as far as I have seen them, belong to *Litsea* except a specimen from Ningpo which may be true *Benzoin umbellatum*, and except Wilson's No. 1634 from Kiangsi and his No. 3675 from Szechuan

which may or may not belong to *Litsea*. The flowering specimens have 4-celled anthers which is the chief character in which *Litsea* differs from *Benzoin* with 2-celled anthers. The specimens agree very well with *L. sericea* Hook. f.; the only difference I find is that Hooker attributes 12 stamens to this species, but as Meissner says that the number may vary in one and the same species from 9 to 12 and as the specimens referred by Gamble to *Litsea sericea* have only 9 stamens, I do not think that this is a specific difference. The specimens show considerable variation in the pubescence of the under side of the leaves; in some specimens they are densely silky pubescent beneath (Wilson's Nos. 3678, 3671, 3681, referred by Gamble to *Lindera membranacea*) while others are glabrescent at maturity (Wilson's Nos. 3673, 3680 and 3684 referred by Gamble to *L. umbellata*). The glabrescent and pubescent forms look quite distinct and may be worthy of varietal rank, but as I have seen neither the type of *L. sericea* nor sufficient Himalayan material, I do not feel justified to propose a new variety. Where Gamble's *Lindera umbellata* var. *latifolia* belongs, I do not know, as I have not seen it. Possibly *Litsea Veitchiana* Gamble is only a variety of *L. sericea*.

From *Benzoin umbellatum* Rehder fruiting specimens of *Litsea sericea* may be distinguished by the more chartaceous leaves finely but distinctly reticulate beneath, less so above, by the glabrous or nearly glabrous winter-buds and the smaller fruits only 4-5 mm. long and borne on slenderer pedicels.

Benzoin Fabricius

Benzoin published in 1763 by Fabricius (Enum. Meth. Pl. Helmstad. ed. 2, 401) is the oldest name for the genus usually called *Lindera* Thunberg (1783, non Adanson, 1763). As Fabricius gives a good generic description and cites as synonym *Laurus* 9 of Linnaeus' *Species plantarum* which is *Laurus Benzoin*, there can be no doubt that the name given by Fabricius is valid and I fail to understand why almost all European and Japanese botanists retain *Lindera* of Thunberg as the correct name for this genus.

Benzoin aromaticum, comb. nov. — *Lindera aromatica* Brandis in Hooker's Icon. xxviii. t. 2784 (1905).

BURMA.

Benzoin cercidifolium, comb. nov. — *Lindera cercidifolia* Hemsley in Jour. Linn. Soc. xxvi. 387 (1891).

CHINA: Hupeh.

Benzoin commune, comb. nov. — *Lindera communis* Hemsley in Jour. Linn. Soc. xxvi. 387 (1891).

CHINA.

Benzoin erythrocarpum, comb. nov. — *Benzoin Thunbergii* Siebold & Zuccarini in Abh. Akad. Muench. iv. pt. iii. 204 (Fl. Jap. Fam. Nat. ii. 80) (1846), pro parte, quoad descriptionem; non *Sassafras Thunbergii* Sieb. — *Lindera umbellata* Blume, Mus. Bot. Lugd.-Bat. i. 324 (1851), pro parte, quoad descriptionem, non Thunberg. — *Lindera erythrocarpa* Makino in

Tokyo Bot. Mag., XI. (219) (1897), XIII. 138 (1899). — *Lindera Thunbergii* Makino, l. c. XIV. 184 (1900), non *Benzoin Thunbergii* Sieb. & Zucc.

JAPAN.

The reason Makino gives in Tokyo Bot. Mag. XIII. 140 for proposing a new name for this species is perfectly correct, while his transfer the following year of Siebold & Zuccarini's misapplied specific name "Thunbergii" is not correct according to our interpretation of the rules. The type of *Benzoin Thunbergii* is *Lindera umbellata* Thunberg and that name therefore becomes a synonym of *Benzoin umbellatum*.

Benzoin fragrans, comb. nov. — *Lindera fragrans* Oliver in Hooker's Icon. XVIII. t. 1788 (1888). — *Lindera* ? *Rosthornii* Diels in Bot. Jahrb. XXIX. 350 (1900).

CHINA: Hupeh.

Benzoin fruticosum, comb. nov. — *Lindera fruticosa* Hemsley in Jour. Linn. Soc. XXVI. 388 (1891).

CHINA: Hupeh.

Benzoin grandifolium, nom. nov. — *Lindera megaphylla* Hemsley in Jour. Linn. Soc. XXVI. 388 (1891).

CHINA.

Hemsley's specific name cannot be maintained, as there is the older valid combination *Benzoin megaphyllum* Kuntze.

Benzoin-pedunculatum, comb. nov. — *Lindera pedunculata* Diels in Bot. Jahrb. XXIX. 350 (1891).

CHINA: Szechuan.

Benzoin Prattii, comb. nov. — *Lindera Prattii*, Gamble in Sargent, Pl. Wilson, II. 83 (1914).

CHINA: Szechuan.

Benzoin obovatum, comb. nov. — *Lindera* ? *obovata* Franchet in Nouv. Arch. Mus. Paris, sér. 2, x. 76 (Pl. David. II. 114) (1887).

CHINA.

Benzoin Oldhamii, comb. nov. — *Lindera* ? *Oldhami* Hemsley in Jour. Linn. Soc. XXVI. 390 (1891).

FORMOSA.

Benzoin puberulum, comb. nov. — *Lindera puberula* Franchet in Nouv. Arch. Mus. Paris, sér. 2, x. 77 (Pl. David. II. 115) (1887).

CHINA.

Benzoin reflexum, comb. nov. — *Lindera reflexa* Hemsley in Jour. Linn. Soc. XXVI. 391 (1891).

CHINA: Kwangtung.

Benzoin rubronervium, comb. nov. — *Lindera rubronervia* Gamble in Sargent, Pl. Wilson, II. 82 (1914).

CHINA: Kiangsi.

Benzoin setchuenense, comb. nov. — *Lindera setchuenensis* Gamble in Sargent, Pl. Wilson, II. 82 (1914).

CHINA: Szechuan.

Benzoin strychnifolium Kuntze var. **Hemsleyanum**, comb. nov. — *Lin-*

dera strychnifolia var. ? Hemsley in Jour. Linn. Soc. xxvi. 392 (1891). — *Lindera strychnifolia* var. *Hemsleyana* Diels in Bot. Jahrb. xxix. 352 (1900).

CHINA: Hupeh, Szechuan.

Benzoin supracostatum, comb. nov. — *Lindera supracostata* H. Lecomte in Nouv. Arch. Mus. Nat. Hist. Paris, sér. 5, v. 113 (1913).

CHINA: Yunnan.

Benzoin umbellatum, comb. nov. — *Lindera umbellata* Thunberg, Fl. Jap. 145, t. 21 (1784). — *Sassafras Thunbergii* Siebold in Verh. Bat. Genoot. xii. pt. i. 23 (Syn. Pl. Oec. Jap.) (1830). — *Benzoin Thunbergii* Siebold & Zuccarini in Abh. Akad. Muench. iv. pt. iii. 204 (Fl. Jap. Fam. Nat. ii. 80) (1846), ex parte, excludenda descript. — *Lindera membranacea* Maximowicz in Bull. Acad. Sci. St. Pétersb. xii. 72 (1867); in Mém. Biol. vi. 175 (1867). — *Benzoin membranaceum* Kuntze, Rev. Gen. Pl. i. 569 (1891).

JAPAN. CHINA: Chekiang.

From China I have seen only a specimen from Ningpo, Chekiang, collected by D. Macgregor in 1908 which probably belongs here. All the other specimens referred by Hemsley and Gamble to *Lindera umbellata* as far as I have seen them, belong to *Litsea sericea* which see.

Benzoin umbellatum var. **hypoglaucum**, comb. nov. — *Lindera hypoglauca* Maximowicz in Bull. Acad. Sci. St. Pétersb. xii. 72 (1867); in Mém. Biol. vi. 274 (1867). — *Benzoin hypoleucum* Kuntze, Rev. Gen. Pl. i. 569 (1891). — *Benzoin hypoglaucum* Rehder in Bailey, Cycl. Am. Hort. i. 153. (1901). — *Lindera umbellata* var. *hypoglauca* Makino in Tokyo Bot. Mag. xiv. 185 (1900).

JAPAN.

Benzoin umbellatum var. **sericeum**, comb. nov. — *Benzoin sericeum* Siebold & Zuccarini in Abh. Akad. Muench. iv. pt. iii. 204 (Fl. Jap. Fam. Nat. i. 80) (1846). — *Lindera sericea* Blume, Mus. Bot. Lugd.-Bat. i. 324 (1851). — *Lindera umbellata* var. *sericea* Makino in Tokyo Bot. Mag. xiv. 185 (1900).

JAPAN.

Benzoin urophyllum, nom. nov. — *Lindera caudata* Diels in Bot. Jahrb. xxix. 352 (1900), non *Benzoin caudatum* (Nees) Kuntze.

CHINA: Szechuan.

(To be continued)

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NOTES ON AMERICAN WILLOWS. VII

CAMILLO SCHNEIDER

a. THE SPECIES OF THE SECTION ADENOPHYLLAE

THIS section consists of two main types of which one is characterized by the more or less bluish white undersurface of the leaves while the other has the leaves greenish beneath. I do not, however, wish to say that the species with discolor leaves are to be regarded as more closely related to each other than to the species of the other group. It is, at present, very difficult to judge the true relationship of the different forms referred by me to this section. Furthermore, it is by no means easy to separate this group from the section *Cordatae* or from other species of different sections. As to the *Cordatae*, I am not yet well enough acquainted with some of the western forms of this group to be able to draw a sharp line between them and the *Adenophyllae*. I think, however, that the structure of the stigma and the style combined with other peculiarities of the flowers are the best characters by which to separate those two sections. I hope to point out these characters more clearly in the keys which I shall prepare for all the American species.

A very remarkable species is *S. Chamissonis*, which I refer only provisionally to this section. The characters of its flowers are very similar to those of the other species but the habit and the leaves distinguish it at the first glance from them. *Salix adenophylla*, the type of this section, seems to be closely related to *S. commutata* and *S. Eastwoodiae*, but it is a well-marked species. The last two species are rather difficult to separate, and *S. commutata* may be connected with *S. Barclayi* by certain forms which need further study. There are, besides, hybrids between the two species, and I suppose that a better understanding of the variability of both species will enable us to distinguish other varieties or even subspecies. With *S. Barclayi* seems to be very closely connected a form from Alaska named by Coville *S. Walpolei* in the herbarium only, and apparently distributed under this name because it is mentioned by Gärtner (see later under *S. Barclayi*). I have seen the material of this interesting form in the National Herbarium at Washington and I regret that the name has not yet been published. For this reason I am not able to deal with this variety or species. There is another form collected by Miss Eastwood in the Yukon Territory and north-

ern British Columbia which looks to me like a new species and has been provided with a name by the collector. Unfortunately this name has been used before and cannot be used again. Therefore, I think it best not to describe it as a new species as long as I have not had an opportunity to study more copious material. I shall speak of this form under *S. Barclayi*.

S. oresteria is in some respects rather intermediate between *S. Eastwoodiae* and *S. Lemmonii* but the relationship of this species seems to lie with *S. Geyeriana* which belongs to another section with which I shall deal later.

In 1909, Ball regarded *S. Wolfii* as closely related to *S. Barclayi* and *S. monticola*. The male flowers of the first have, however, two glands, and I believe it represents a group of its own of which I shall speak later. A very uncertain form is *S. latiuscula* mentioned later under *S. Barclayi*.

As to the name of this section, I wish to say that in 1904 I took *S. adenophylla* for the type of a new section, and I referred *S. Barclayi* to the *Hastatae*, a section I now believe not represented in the New World. In 1909, Ball created the section *Commutatae*, probably not knowing my older name, therefore the synonymy of the group is as follows: Sect. *Adenophyllae* Schneider, Ill. Handb. Laubholz. i. 52 (1904). — Sect. *Hastatae* Schneider, l. c. 51, quoad *S. Barclayi*. — Sect. *Commutatae* Ball apud Coulter & Nelson, New Man. Rocky Mts., Bot. 134 (1909), excl. *S. Wolfii*.

It should be mentioned that Fernald believed that his *S. cryptodonta* is closely related to *S. californica* (*S. Eastwoodiae*) but I think that Fernald's species shows a closer relationship with *S. candida* of which I shall speak in another note.

Before I take up the discussion of the different species and varieties I wish to state that I base my investigations on the same collections mentioned in note 3, on p. 1 of this journal, and I beg leave to offer my very best thanks to the gentlemen in charge of all these herbaria, and also to Miss A. Eastwood, San Francisco, Professor J. K. Henry, Vancouver, and Mr. J. C. Nelson, Salem, Ore.

CLAVIS SPECIERUM

Planta prostrata; folia parva, vix ad 3.5: 1.5–2.1 cm. magna, late obovata (fere suborbicularia) ad obovato-oblonga, basi cuneata, apice plus minusve rotundata, margine dense (saltem infima) et acute glanduloso-serrulata, subtus vix vel satis pallidiora; amenta coetanea; filamenta glabra, fructus plus minusve breviter griseo-villosuli, subsessiles 1. *S. Chamissonis*.
Plantae erectae et aliis signis diversae.

Folia matura normalia subtus discoloria, glaucescentia vel albescencia; filamenta semper glabra; ovaria pedicellique glabri (si pedicelli sunt pilosi vide *S. monticola*, si ovaria fructusve sunt sparse villosi vide *S. Barclayi* var. *hebecarpam*).
Folia novella et saepe matura laxa vel densius (saltem superne) pubescentia, in epidermide pleraque estomatifera; ramuli novelli et saepe annotini laxa vel densius villosi; amenta pleraque coetanea et pedunculis distinctis foliolatis suffulta; bracteae saepissime lanceolatae et satis acutae, atrofuscae, longe sericeae; fructus 6–9 mm. longi, pedicello 1–2 mm. longo excluso; styli 1–2 mm. longi (in formis *S. glaucophylloidis* ramuli sunt plus minusve tomentosi sed folia costa excepta cito glaberrima) 2. *S. Barclayi*.

Folia etiam novella glaberrima vel citissime glabra; ramuli novelli sparse pilosi vel ab initio glabri; amenta saepe praecocia, sessilia vel subsessilia, vel bracteae plus minusve oblongae et apice obtusiores vel rotundatae.

Amenta sessilia vel subsessilia, etiam fructifera densiflora et vix ad 4.5:1.5 cm. magna; fructus maturi 5-7 (-7.5) mm. longi pedicello vix ultra 1.25 mm. longo excluso; styli circiter 1.5 mm. longi; folia normalia superiora (surculorumque excepta) vix ultra 8:2.6 cm. magna, superne ut videtur semper stomatibus satis numerosis instructa 3. *S. monticola*.

Amenta fere semper pedunculo brevi foliolato suffulta, fructifera pleraque satis laxiflora, saepissime ultra 5 cm. longa ad 8:2 vel 12:2.5 cm. magna; fructus maturi 9-10 mm. longi, pedicello 1.5-2.5 (3) mm. longo excluso; styli 0.5 ad 1.25 mm. longi; folia superiora normalia saepissime longiora vel latiora, circiter ad 9:3.8 vel 10:6 cm. magna, epidermide stomatifera.

4. *S. glaucophylloides* et var.

Folia matura normalia subtus concoloria, viridescencia (in *S. orestera* interdum pallidiora sed satis anguste lanceolata, ovaria et filamenta basi pilosa), superne in epidermide stomatibus numerosis instructa.

Ovaria filamentaque glabra.

Folia circumcirca dense vel densissime glanduloso- (saepe fimbriato-) serrulata vel serrata, normalia (superiora basi fere semper) plus minusve cordata; bracteae florum fere semper fuscae; pedicelli saepissime vix ad 1 mm. longi.

5. *S. adenophylla*.

Folia minimis exceptis integerrima vel saltem versus basim plus minusve brevissime glanduloso-denticulata subserratave, basi obtusa ad rotundata, rarius subcordata; bracteae florum satis flavo-brunneae; pedicelli saepissime 1-1.8 mm. longi 6. *S. commutata*.

Ovaria et filamenta (basi) pilosa.

Folia normalia superiora elliptica, elliptico-lanceolata vel elliptico-oblonga, ad 5.5:1.5 vel (surculorum excepta) 6.5:2.1 cm. magna, plus minusve integerrima vel distanter et saepe obscure glanduloso-denticulata, sed inferiora minora satis dense glanduloso-denticulata: fructus maturi 6-6.5 (rarius ultra) longi, pedicello vix ultra 0.5-1 mm. longo excluso; styli 1-1.5 mm. longi 7. *S. Eastwoodiae*.

Folia normalia superiora anguste lanceolata ad late oblanceolata, 4:0.8 ad 7.5:2 cm. (surculorum excepta) magna, integerrima vel distanter et sparse glanduloso-denticulata subserratave, etiam minora satis obscure glanduloso-denticulata, adulta subtus glabrescentia subpallidiora vel paullo glaucescentia; fructus maturi 7-8.5 mm. longi pedicello ad 1.5 mm. longo excluso; styli 0.8-1.2 mm. longi 8. *S. orestera*.

ENUMERATIO SPECIERUM

1. *S. Chamissonis* Andersson. — See Bot. Gaz. LXVII. 63 (1919). As I have mentioned in a foot-note, I did not know this species well enough when I wrote my third note and referred it to a group of "species sectionis incertae." After having seen good male material I think it best to put it in this section, but *S. Chamissonis* is easily distinguished from all the other species by its creeping habit and the fine and close serration of the leaves, the teeth being acute and not distinctly glandular as in *S. adenophylla*. *Salix Chamissonis* may prove to be more closely related to certain willows of northern Asia with which I am not yet well enough acquainted. I have seen the following specimens of this very rare species.

ALASKA. Port Clarence, July 12, 1899, *Trelease & Saunders* (No. 3427, fr. im.;

M.); same place and date, *Coville & Kearney* (Nos. 1877, 1878, fr., cuminat., 1879 m.; A., W.), same place, *L. J. Cole* (fr.; W.); St. Lawrence Isl., July 13, 1899, *B. E. Fernow* (m.; Cor.); Cape Nome, summer 1900, *F. E. Blaisdell* (m., f.; W.); Lake Iliamna region, on tundra, Nogheling trail, not abundant, August 5, 1902, *M. W. Gorman* (st.; W.).

2. *S. Barclayi* Andersson in Öfv. Svensk. Vetensk. Akad. Förh. xv. 125 (1858). — Macoun, Cat. Canad. Pl. II. 445 (1883); in Svensk. Vetensk. Akad. Handl. vi. 164, t. 8, fig. 96 [incerta] (1867); in De Candolle, Prodr. xvi.² 254 (1868), excl. var. *latiuscula*. — Howell, Fl. N.W. Am. I. 620 (1902). — Coville in Proc. Wash. Acad. Sci. III. 316 t. 36 (1901). — Piper in Contrib. U.S. Nat. Herb. XI. 215 (Fl. Wash.) (1906). — Jones, Will. Fam. 16 (1908), pro parte. — Ball apud Coulter & Nelson, New Man. Rocky Mts. Bot. 134 (1909); apud Piper & Beattie, Fl. N.W. Coast, 116 (1915). — Henry, Fl. S. Brit. Col. 100 (1915). — Rydberg, Fl. Rocky Mts. 193 (1917). — *S. Barclayi* a) *rotundifolia* Andersson in Svensk. Vetensk. Akad. Handl. vi. 164 (Monog. Salic.) (1867); in De Candolle, Prodr. xvi.² 254 (1868). — *S. Barclayi* b) *grandifolia* Andersson, l. c. 165 (1867); l. c. 254 (1868).

I have before me a photograph of the type of this species and some fragments from the Kew Herbarium. Andersson's description is correct except the statement "capsulis glabris," the old ovaries being hairy at the top and on the pedicel. Peculiar are the rather long and thin stigmas and the styles which measure up to 2 mm. This may partly be due to the fact that the flowers are old. With the exception of the uppermost the bracts are covered with long straight silky hairs, but at the top of the ament there is a pubescence of curled hairs. The gland is relatively narrow, and as long as the pedicel. The leaves of the type are only half developed and are blackened in drying. I have not been able to recognize stomata in the upper surface.

The type ranges, as Coville already has said, in Alaska throughout the southern coast region "from Dixon entrance northward and westward as far as Unalaska." The original specimens were collected in 1839 at a point near Cape Greville on Kadiak Island, Alaska, by George Barclay, the botanical collector of the British ship "Sulphur." From British Columbia I have seen material from Lake Atlin in the northwest, from Yellow Head Pass in Caribou County, and many specimens from New Westminster and Kootenay Counties. In Alberta the species occurs in Edson (Jasper Park) and Rocky Mountain Districts. In the United States typical *S. Barclayi* is found in Washington (Clallam, Chelan, Okanogan, Kittitas, Pierce and Skamania Counties), and in Montana (Teton and Cascade Counties, and in the vicinity of "Trail Lake," a locality I have not been able to identify; also E. C. Shear's no. 209 from the Electric Peak in the northern Yellowstone Park seems at least in part to belong to this species, as probably does also no. 110 of the same collector [fr. im.; W.]). Specimens like A. Nelson's nos. 7781 and 8947 from the Albany County in Wyoming need further observation and may be more closely related to *S. monticola*. In 1867, Andersson described 3 varieties, *rotundifolia*, *grandifolia* and *angustifolia*. The first is nothing but the type which is cited under *rotundifolia* by the

author himself in 1868. The second variety had originally been described without a type specimen, but in 1868 Andersson cites "*Unalascha* [*sic*] (*Eschscholz*)."¹ It seems to me that this form too cannot be distinguished from the type. The third variety is according to the author's quotation in 1868 founded on specimens collected "in *Sitcha et Unalaschka* (*Herb. Petrop.*)" which are unknown to me. So far as I can judge by the description "*folia paullum breviora*, $\frac{1}{4}$ poll. *lata, exacte lanceolata, tenuia, glabriuscula, integra, subconcoloria facile nigrescentia, stipulis fere nullis ornata*," this form may be identical with what has been described by Bebb as *S. conjuncta*. The type was collected by Parry on Mt. Adams in Washington, and I have seen it and the other co-types cited by Bebb in his herbarium at the Field Museum. Bebb himself said later (*apud Coville in Contr. U.S. Nat. Herb.* iv. 198 (*Bot. Death Val. Exp.*) (1893)) that his *S. conjuncta* "does not differ from the Alaskan type" of *S. Barclayi*, and it is indeed very difficult to distinguish Bebb's type from typical *Barclayi*. As to its identity with var. *angustifolia* I cannot decide without having seen the specimens of the *Herb. Petrop.* Even the typical *S. conjuncta* is at present rather uncertain because I have not yet seen mature leaves which undoubtedly belong to the form which Bebb cites as his type. In 1914, Ball in the Herbarium of the Geological Survey of Canada has made *S. conjuncta* a variety of *S. Barclayi*, and there are the following specimens which may be referable to such a variety *sensu* Ball. All of them need further observation.

WASHINGTON. Skamania County: Mt. Paddo (Adams), August, 1880, *C. C. Parry* (No. 7, m., f.; C., type, G. co-type of *S. conjuncta* Bebb); same mountain, 1883, *L. F. Henderson* (No. 79, m., f.; C., G.); same Mt., on a meadow, 2000 m., July 13, 1886, *W. N. Suksdorf* (No. 9263, f.; A.); Little Klickitat River, north trail to Mt. Adams, wet meadows, August 4, 1892, *L. F. Henderson* (fr.; Pu.).

OREGON. Wallowa County: Higher Wallowa Mts., near the Lake, August 2, 1899, *W. C. Cusick* (No. 2302, m., f.; C., G., M.; "a low shrub"; of the male specimen in Cor. the filaments are partly united).

MONTANA. Gallatin County: Bold Mt., 2300-2600 m., July 21, 1880, *S. Watson* (No. 372^a, f.; G.; one of the co-types of *S. conjuncta*, a rather uncertain form).

BRITISH COLUMBIA. Kootenay District: Revelstoke, marshy woods, May 6, 1890, *J. Macoun* (No. 9 [= 24266, 0.], m., f.; named by Ball in 1914 *S. Barclayi conjuncta*, but without old leaves difficult to identify properly); same locality, date and coll. (No. 2, m., f.; A.; bracteis plus minusve subcrispato-sericeis, ceterum ut praecedens, foliis superne stomatiferis). New Westminster District: Chilliwack Valley, about 1850 m., July 29, 1901, *J. M. Macoun* (No. 26907, O., f.; G.; same state as No. 24266, pedicellis pilosis, foliis superne stomatibus numerosis instructis).

S. conjuncta Rydberg, Fl. Rocky Mts. 194 (1917) seems to me an uncertain form.

The type of *S. Barclayi* **hebecarpa* Andersson in *Svensk. Vetensk. Akad. Handl.* vi. 165 (*Monog. Salic.*) (1867) was collected by Kastalski in Unalaschka, and the author said: "*Cum S. Barclayi nuperrime descripta omnibus partibus exacte congruit sed differt capsularum indumento opaco.*" As I have already stated, even the ovaries of Andersson's type of *S. Barclayi*

show evidence of a pubescence, and there are probably to be found such forms with a more or less hairy ovary everywhere in the region of the typical form. I refer to var. *hebecarpa* specimens collected by A. Rehder and also by J. G. Jack in British Columbia at Asulkan Valley on August 14, 1904 (m., f.; A.). Some of them resemble *S. commutata* f. *puberula* (see later) but the stigmas are much more like those of *S. Barclayi*.

Still absolutely uncertain is the form described by Andersson, l. c. as *S. Barclayi* * *S. latiuscula*, and later in De Candolle, Prodr. xvi.² 255 (1868) as *S. Barclayi* B) *latiuscula*. Andersson said "specimen singulum in herb. Candolleano vidi e Terra Nova a De la Pylaie missum." Fernald (in Rhodora xvi. 173, 1914) states that "the Newfoundland *S. latiuscula* Andersson, which has also been confused with *S. Barclayi* has densely sericeous-tomentose capsules and remarkable long reflexed stigmas, much longer than any other species known to the writer, and its foliage is not conspicuously glaucous beneath." Fernald did not see the type, and he regards as *S. latiuscula* a specimen of Waghorne's from Newfoundland, Bay of Islands, McIver's Cove, May 31, 1898 (No. 38, f. adult.; G.) which I have seen. The aments are subsessile with two or three small leaves at the base, which are covered beneath with rather long and partly reddish brown hairs; the peduncle also bears towards the base a somewhat reddish tomentum. Without the peduncle the aments measure about 4:1.5 cm. The ovaries are thinly pubescent and the stigmas are as stated by Fernald very long and revolute. I am not sure if this condition is normal. The young leaves much resemble those of *S. discolor* Muhl.; the largest one is oboval-lanceolate, 2.7 cm. long and 1.1 cm. wide with a distant glandular dentation. The upper surface is sparsely covered with grayish and fulvous hairs, while the lower surface is entirely glabrous with the exception of a few hairs along the midrib. The first small leaves show a denser glandular dentation and below a pubescence of longer hairs. The one year old branchlets are glabrous, dark fuscous, while the youngest bear a few hairs. I am by no means convinced that Waghorne's specimen can be regarded as identical with Andersson's var. *latiuscula*. He says (1867) "nectarium valde tenue et elongatum" and (1868) "nectarium valde tenue," a character not found in the flowers of Waghorne's plant. As to the stigmas there is no mention in either of Andersson's rather long descriptions, and in 1868 he said "*S. Barclayi* huic simillima sed recedit capsulis omnino glabris." After all the type of Andersson's form as well as Waghorne's specimen seem to represent different forms, and I hope that I may be able to examine the type in Herb. De Candolle in order to explain the identity of this interesting form.

As I have already mentioned on p. 147 there is another Alaskan form which bears a close resemblance to *S. Barclayi*. This form has been named *S. Walpolei* by Coville (and Ball) in the National Herbarium. This name has not yet been published, and I would not mention it if I had not found it in Gärtner's dissertation: Vergl. Blatt Anatomie Syst. Gatt. Salix, 44 (Goettingen, 1907). This author cites a specimen from the Museum at

Berlin, and therefore this Willow must have been distributed under the name *S. Walpolei* long ago. I am sorry that neither Coville nor Ball published this name, and in spite of several requests I have not obtained permission to deal with this form in my present note. I can only say that I have seen the material preserved in the National Herbarium, and that it seems to me that this form is very closely related to *S. Barclayi* and may represent nothing but a variety of it, which occurs farther north than the type on Seward Peninsula.

Still another form closely related to *S. Barclayi* has been collected by Miss A. Eastwood in the Yukon Territory and near Lake Atlin in northern British Columbia. In a field note the collector says of it: "This is related to *S. Barclayi* but differs in the catkins being borne on the old wood. It seems to be confined to the Yukon. It is a very beautiful shrub with its young leaves red, and broad smooth leaves. There was only one bush in Dawson that bore flowers and that was female. I did not discover it while in flower as the bush resembled *S. arbusculoides* and the flowers came out before the leaves." This form looks indeed like a distinct species, but the name *prunifolia* provisionally chosen by Miss Eastwood cannot be used because this name was applied long ago by Smith, Seringe, Host and others to different plants. I do not wish to propose a new name at present, since I think it best to wait for more material and a better understanding of this peculiar plant. It may, however, be said, that it seems to differ from *S. Barclayi* chiefly in the following characters: ramulis ab initio glabris, foliis novellis rubescentibus, tantum superne pilis villosis deciduis praeditis, adultis tenuioribus magis crenato-serratis, amentis ut in *S. monticola* praecocibus, sessilibus subsessilibusve, bracteis obtusioribus, antheris ut videtur violaceis, fructibus minoribus (? tantum 5-6 mm. longis). I am not sure of the constancy of these characters, the fruits of the Atlin specimens are partly up to 8 mm. in length and hardly distinguishable from those of typical *S. Barclayi*. In its glabrousness and in the sessile aments this new form points toward *S. monticola* (see later) the leaves of which usually seem to possess numerous stomata in their upper surface while I have not observed any in the upper epidermis of the leaves of the Yukon plant. The following specimens have been examined.

YUKON TERRITORY. Dawson, near corner of big fence, June 9, 1914, *A. Eastwood* (No. 173, f.; A.; this number should be regarded as the type); July 4, 1914, same coll. (No. 508, st., same plant according to the collector), June 14, 1914, same coll. (No. 230, f.; A.; young leaves purplish); June 9, 1914, same coll. (No. 166, st.; "small bush near my cabin," like 230); Ogilvie, July 8, 1914, same coll. (No. 541, fr.; A.; amentis ad 6 cm. longis, partim pedunculatis, fructibus ad 8 mm. longis; this resembles *S. Barclayi*, but is entirely glabrous, the leaves are large, ovate-elliptical and measure up to 8:3.1 cm.); Coffee Creek, July 10, 1914, same coll. (No. 552 a. m., 553, m., A.); Hardcreek Slough, July 11, 1914, same coll. (No. 581, fr., A.; amentis 4.5:1.3 cm. magnis, fructibus tantum 5 mm. longis pedicello 1.8 mm. longo excluso); Yukon River above Rink Rapids, river flat, July 9, 1902, *J. Macoun* (No. 54405 a, O., st.).

BRITISH COLUMBIA. Lake Atlin, July 14, 1914, *A. Eastwood* (No. 635, fr.; A.; fructibus maturis circ. 6 mm. longis, basi ovoideis, forma *S. monticolae* satis similis);

same place, date and coll. (No. 653 fr.; A.; No. 661, fr. adult.; A.; ramulis pilosis, probabiliter ad *S. Barclayi* referenda).

3. *S. monticola* Bebb apud Coulter, Man. Rocky Mts. Bot. 336 (1885). — Ball apud Coulter & Nelson, New Man. Rocky Mts. Bot. 134 (1909). — Wootton in Bull. New Mex. Coll. Agric. LXXXVII. 46 (1913). — Rydberg, Fl. Rocky Mts. 194 (1917), prob. tantum ex parte. — *S. padifolia* Rydberg in Bull. Torr. Bot. Club, XXVIII. 272 (1901), non Andersson. — *S. pado-phylla* Rydberg, l. c. 499 (1901), Fl. Rocky Mts. 194 (1917).

Of these species I have seen the type mentioned below and the different co-types in Bebb's herbarium. Ball was the first to recognize its wide distribution. I have tried to give its main characters in the key, but I think that *S. monticola* is one of those species which need careful observation in the field. Many specimens in the herbarium are easy to recognize, while quite a number of them cannot be identified properly on account of the lack of mature leaves or of flowering branchlets. Sterile specimens often are similar to forms of other groups especially those of sect. *Cordatae*. In its normal state the leaves are not large while on offshoots they reach a great size, and therefore may appear different. I believe that the following specimens can be taken for typical *S. monticola* but some of them need further observation. The enumeration of the specimens clearly shows the geographical distribution of the species, which probably occurs in other localities in the Rocky Mountains where the centre of its distribution seems to be Colorado. Its northern limits are still uncertain, and I have seen specimens of the northern Rockies as far as Alberta (Banff, Cave Avenue, July 4, 1891, *J. Macoun* [Nos. 40 and 41, fr., st.; C.]), which I am not able to determine properly at present.

MONTANA, Madison County: 10 mi. east of Monida, along a creek, June 18, 1899, *A. & E. Nelson* (No. 5427, f.; Cor., S., M., N.; 5446; f.; Cor., G.; the last one has rather long pilose pedicels and may belong to a species of Sect. *Cordatae*). Flathead County: Columbia Falls, June 5, 1893; *R. S. Williams* (No. 970, m., f.; Cor.); Summit, G. N. Ry., July 25, 1894, same coll. (m., fr.; Cor.). Gallatin County: Bozeman, April 26, 1900, *Blankinship* (f.; Cor.).

SOUTHERN WYOMING. Carbon County: Battle, Continental Divide, 3000 to 3500 m., July 17, 1891; *F. Tweedy* (No. 4534, fr.; N., W.). Albany County: Medicine Bow Mts., Nash's Fork, common, July 28, 1900, *A. Nelson* (No. 7781, fr.; Cor.; "in clumps, 1.2 to 2.4 m. high"); Sand Creek, moist ground, very common, May 30, 1900, same coll. (No. 6964, fr., m.; C., Cor., G., H., W.). Centennial, 2700 m., August 19, 1918, *J. G. Jack* (No. 1062, st.; A.; "bushes 3 to 3.6 m. high, bright yellow green branches"; forma porro observanda).

NORTHERN WYOMING. Eastern slopes of the Big Horn Mts., headwaters of Clear Creek and Crazy Women River, about 2300 to 3000 m., July 20 to August 15, 1900, *F. Tweedy* (No. 3428, st.; N.; forma incerta parvifolia).

COLORADO. Larimer County: Estes Park, June 10, 1916, *E. L. Johnston* (No. 860, f.; G., W.); same place, Thompson's River bank, August 11, 1910, same coll. (No. 766, st.; N.; forma mihi quamvis incerta); Chamber's Lake, about 3150 m., July 13, 1896, *C. F. Baker* ([Rowlee 3], fr.; N.); Sheep Creek, above Campton's, August 4, 1896, same coll. ([Rowlee 1] st.; N.). Grand County: east of Middle Park, Beaver Dam, 1861, *C. C. Parry* (No. 342, m., f.; G.); on Grand River near Hot Sulphur Spring, August 1, 1881, *G. Engelmann* (No. 5, st.; C., G.; "bark yellow, stem 1-1½ inch thick, 6-8 feet high, densely caespitose bushes"); Middle Park,

August, 1892, *H. C. Beardslee* (fr.; M.); Forest City, about 3300 m., June 25, 1880, *G. Engelmann & C. S. Sargent* (f.; A.). Clear Creek County: Georgetown, *Wolf & Rothrock* (No. 826, f.; G.; the male piece is *S. Bebbiana*); same place, August 17, 1895, *P. A. Rydberg* (fr.; N.); mountain sides near Georgetown, about 2800 m., July 15, 1885, *H. N. Patterson* (fr.; st.; C.; syntype [sheet 7589]; "0.9 m. high"); Clear Creek bottoms, June 28–August 7, 1875, same coll. (fr.; C. [sheet 7588]); without locality and date, *Brandegee* (fr.; C. [sheet 6432]); marshy places in Bard Creek Valley, opposite Empire City, August 11, 1881, *G. Engelmann* (fr.; C.; G.; "2.4–3.6 m. high, cespitose, 2.5–5 cm. diam."); Empire City, on Bard Creek, August 3, 1874, *G. Engelmann* (st.; M.). Lake County: Leadville, bank of streams, 3400 m., June 20, 1916, *J. W. Clockey* (No. 2668 m., f.; C., G.); same place, June 19, 1918, *A. Eastwood* (Nos. 7112, m., 7143, 7144, f., 7154, m.; A.). Denver County: Denver, July 13–15, 1872, *T. C. Porter* (fr.; C.). Jefferson County: mountains near Golden City, March 30, August 1, 18...?, *Greene* (No. 8, fr. im., st.; type in C. [sheet 1147]); same place, March 25, May 30, August 1, same coll. (No. 7, f., fr., st.; C., [sheet 1148]). Chaffee County: near Granite, September 13, 1898, *J. G. Jack* (st.; A.; forma quamvis incerta); Buena Vista, June 18, 1818, *A. Eastwood* (No. 7071, fr. adult.; A.; forma incerta). Montrose County: Tabeguache Basin, near creek, about 2700 m., June 4, 1914, *E. Payson* (Nos. 386, m., 388, f.; C., G.; sub nomine *S. chlorophylla* distributa); without exact locality, high alpine summits, 3600 to 4000 m., July 11 to August 11, 1876, *H. N. Patterson* (st.; C.). Ouray County: near Ouray, along Uncompahgre River, 2330 m., September 10, 1901, *L. M. Underwood & A. D. Selby* (No. 248, st.; N.). Gunnison County: Gunnison, about 3350 m., August 27, 1901, *C. F. Baker* (No. 941, st.; N.; "an occasional large bush in bottoms, only sterile seen"; forma porro observanda foliis ovato-ellipticis, basi leviter cordatis, subtus tenuiter reticulatis glabris stipulis reniformibus vel obtusis); Elk Mts. Mt. Baldy, July 9, 1906, *J. P. Anderson* (g., M.; mixed with ? *S. Wolfii*); Mt. Carbon, 2750 m., June 11, 1910, *W. W. Eggleston* (No. 5671, fr., W.); vicinity of Mt. Carbon, common, June 1, 1910, *I. Tidestrom* (No. 3458, fr.; W.; "shrub 2 m. or higher"); same Mt., 2700 m., forms dense colonies along the creek, same coll. (No. 3898, st.; A., W.). San Juan County: Silverton, about 3500 m., July, 1895, *F. Tweedy* (Nos. 268, 269, f.; W.). Hinsdale County: Carson, about 3600 m., July 2, 1901, *C. F. Baker* (No. 306, f.; G., N., W.). Huerfano County: on Turkey Creek and tributaries, 2800 to 2900 m., June 8–9, 1900, *Rydberg & Vreeland* (No. 6389, fr., type of *S. padophylla*; N.); Ojo, 2400–2500 m., May 26, 1900, same coll. (Nos. 3686 m., 3687 f., N.). Conejos County: Los Pinos, about 2300 m., May, 1899, *C. F. Baker* (No. 271, m., f., A., C., Cor., N., S., W.). Costilla County: Veta Pass, Sangre de Christo Range, 3000–3600 m., June 9–16, 1890, *G. H. Hicks* (No. 15, m., 17, f.; G.); headwaters of Sangre de Christo Creek, 2700 m., June 22, 1900, *Rydberg & Vreeland* (No. 6378, fr.; N.). ? County: W. La Plata Mts., Bob Creek, common in west places, about 330 m., June 28, 1898, *Baker, Earle & Tracy* (No. 175, f. adult.; A., C., Cor. G., W.; "bush 1.8 to 3 m. high; twigs yellowish"; in the herbarium the branchlets are dark brown; in N. the pedicel is partly pilose); Rocky Mts., without exact locality, 1862, *Hall & Harbour* (No. 4, fr., im.; C.; No. 175, m., f., fr.; G.; pedicellis fructuum pilosis).

UTAH. Summit (or Duchesne) County: Uinta Mts., 1902, *H. D. Langille* (No. 104, f.; W.; mixed with *S. lutea* Nuttall).

NEW MEXICO. Santa Fé County: Santa Fé Cañon, 9 miles east of Santa Fé, about 2600 m., June 2, 1897, *A. A. & E. Heller* (No. 3636, fr. im.; A., Cor., W., N.; pedicelli partim paullo pilosi). Valencia County: Atarque, July 26, 1904, *E. O. Wooton* (No. 2719, st.; W.; det. Ball).

ARIZONA. Black Mesa Forest Reserve: McClintock Canyon, June 2, 1900, *F. V. Coville* (No. 1057, st.; W.). Apache County: south of Thomas Peak, July 2, 1904, same coll. (No. 2009, f.; W.). ? County: Leonard Canyon, June 2, 1900, same coll. (No. 1066, m., W.). Navajo Reservation, arroyos, common, July, 1916, *C. F. Vorhies* (No. 64, st.; A., M.; forma incerta).

A specimen from South Dakota, Black Hills, South Rapid Creek, sandstone, about 2050 m., September 16, 1910, *J. Murdoch, jr.* (No. 4374, st.; C.), is, according to Ball, closely related to *S. monticola*, but I am not sure of its true relationship.

There are several more specimens before me from New Mexico, Colorado and Wyoming the pedicels of which and in part also the ovaries are more or less hairy. I am unable to understand them at present. There may be hybrids among them, but the variation of *S. monticola* is far from being sufficiently known.

4. *S. glaucophylloides* Fernald in *Rhodora* xvi. 173 (1914). — *S. glaucophylla* Robinson & Fernald, *Gray's Man.* 323, fig. 652 (1908). non Bebb, sensu str. — Britton & Brown, *Ill. Fl.* ed. 2, 596, fig. 1462 (1913). — This species is, in my opinion so closely related to *S. glaucophylla* Bebb that I think it best to regard it only as a variety of that Willow. Unfortunately the name *glaucophylla* cannot stand because it was used long ago by Schleicher, Besser and Andersson for some very different plants. Therefore I am obliged to take up Fernald's name, and to make Bebb's *glaucophylla* a variety of it, as I shall explain later. When Fernald proposed his new species he stated that *S. glaucophylla* differed from it mainly in the following characters. 1. "Foliage . . . very much heavier or thicker," but in the description of *S. glaucophylloides* Fernald says that the mature leaves are subcoriaceous. Judging from the copious material before me I do not think that the texture of the leaves is a good character by which to distinguish the two species, because there is hardly a difference between the mature leaves. 2. "The fruiting aments are much longer" in *S. glaucophylla*, but among the specimens which Fernald and I have been able to compare there seem to be no well matured fruiting aments of *S. glaucophylloides*. All of them gave the impression that the fruits were not sufficiently fertilized. Therefore the capsules too, as Fernald said, are smaller in *S. glaucophylloides* and sometimes almost cordate at their base which, however, as a rule is rounded. Those fruits are, in my opinion, not well ripened, and good seeds are wanting. 3. "The pubescence of the peduncle and rachis longer and denser" in *S. glaucophylla*. This character too is by no means of real taxonomic value, and I have seen specimens of both forms which in this respect were entirely alike. This is the case too as to the pubescence of the bracts of the flowers, which according to Fernald are more copiously long-villose in *S. glaucophylla*. The best character to separate it from the eastern form is found in the length of the pedicels which, as Fernald states, are "distinctly exceeding the scales and many times longer than the nectaries." According to my observations the pedicel even of the best matured fruits (Jack, Montmorency Falls) does not exceed 1.5 mm. in length, while it measures from 2 to 2.5 (-3) mm. in *glaucophylla*. The styles, too, are a little longer in the western form. Taken all in all, however, the eastern form can hardly be regarded as a distinct species, although not a few of the specimens referred to it need further observation. As Fernald said, *S. glaucophylloides*

sensu stricto is "a very common riparian species in the calcareous districts from Aroostook County, Maine, and adjacent Quebec to Newfoundland." Omitting the specimens already mentioned by Fernald I can enumerate the following.

QUEBEC. Anticosti Island: Salt Lake, wet places August 11, 1883, *J. Macoun* (st., No. 24564, O.; forma incerta). Quebec District: Montmorency Falls, June 1, 1903, *J. G. Jack* (fr.; A.; this form is very much like the typical *glaucophylla*, the branchlets are partly glabrous, partly pubescent, in the male plant the leaves are more or less obovate); same locality, June 30, 1905, *J. Macoun* (No. 68792, O., st.; ramulis etiam annotinis pilosis). Champlain County: St. Maurice River near junction of Matawin River, September 4, 1896, *J. G. Jack* (st., A.). Lake St. John District: Roberval, shore of Lake St. John, August 22-23, 1895, same coll. (st.; A.; foliis cordatis, ramulis tomentosis, forma perro observanda).

Geographically these last specimens seem to connect the eastern with the western form. For the one which is first described by Bebb as *S. cordata* var. *glaucophylla* I wish to propose this new combination.

4b. *S. glaucophylloides* var. *glaucophylla* Schneider. — *S. cordata* var. *glaucophylla* Bebb apud Babcock in The Lens, II. 249 (Fl. Chicago Vic. Suppl.) (1873); apud Patterson, Cat. Pl. Ill. 39 (1876). — *S. Barclayi* var. *grandifolia* Bebb in Bot. Gaz. III. 21 (1878), in textu, non Andersson. — *S. glaucophylla* Bebb apud Wheeler & Smith, Cat. Phaen. Vasc. Crypt. Pl. Mich. 72 (1881), non Schleicher (1807), nomen nudum, nec Besser (1822) nec Andersson (1851); in Rep. Nat. Hist. Northwest Univ. (1889) 23, apud Watson & Coulter, Gray Man. ed. 6, 485 (1890). — Glatfelter in Rep. Miss. Bot. Gard. v. 57, t. 3, fig. 18 (Stud. Ven. Salix, 12) (1893). — Griggs in Proc. Ohio Acad. Sci. IV. 311, t. 15 (1905). — *S. cordata* [subsp.] *S. Babcockii* Gandoger, Fl. Eur. XXI. 166 (1890). — After having described this form as a variety of *S. cordata* Bebb in 1878 believed that it was identical with *S. Barclayi*, and especially with Andersson's var. *grandifolia*. Later, in 1881, Bebb, however, made its first variety a distinct species, unfortunately choosing for it the already used name *glaucophylla*. Gandoger proposed the name *S. Babcockii* for apparently the very same form but his name can only be regarded as of subspecific rank, otherwise I should have adopted it for our species. Gandoger's description, too, is very short and therefore I think it best to use Fernald's name *glaucophylloides* for the species. As I have already shown that the main difference between Bebb's type and Fernald's eastern form consists in the somewhat longer styles and pedicels of var. *glaucophylla*, which also has larger fruiting aments and fruits than *S. glaucophylloides* sensu stricto but this seems to be mainly due to the fact that the specimens which Fernald had before him did not have sufficiently matured fruits. Those collected by Jack and enumerated above approach var. *glaucophylla*, of which I have seen material from northern Ohio (Erie County), northern Indiana (Porter County), Illinois (Cook, Lake and Winnebago Counties), the type is Bebb's No. 4, Herb. Salic., from Fountaineau, Wisconsin (Sauck and Manitowoc Counties), Michigan (Berrien and Huron Counties) and Ontario (Lambton District).

In 1881 Bebb proposed three varieties. The first var. *latifolia* is nothing

but the type. The second, var. *angustifolia*, is according to the type in Bebb's herbarium in the Field Museum at Chicago, collected by H. H. Babcock, Chicago (No. 14, f.; [sheet 6996, C.] and the male co-type of the same collector (No. 2 $\frac{1}{2}$, [sheet 6994, C.] distinguished from the typical *glaucophylla* by foliis anguste lanceolatis, lanceolatis vel elliptico-lanceolatis, inferioribus 2.5:0.5 ad 4.5:1.2, superioribus 6.5:1.7 ad 9:2.3, in surculis ad 12.5:2.8 cm. magnis, basi acutis ad obtusis, apice subito breviter acuminatis. It can hardly be regarded as more than a form but it ought to be mentioned that the male flowers which I examined did show a dorsal gland which I have not seen in specimens of the typical form. Bebb's third variety, *S. glaucophylla* var. *brevifolia*, looks at first sight rather different. The type was collected by C. F. Wheeler, July 30, 1879, on the sand dunes of Little Traverse Bay, Michigan, and is preserved in the herbarium of the Field Museum [sheet No. 3459]). A typo praecipue differt foliis minoribus magis obovatis 1:0.5 ad 3.5:5:0.8 cm. magnis, basi sensim cuneatis, apice subito breviter acutis, utrinque satis nervatis, subtus reticulatis. This specimen seems to represent an ecological form, and further observations must prove whether it can be regarded as more than a form of var. *glaucophylla*, probably connected by intermediate forms with f. *angustifolia*.

5. *S. adenophylla* Hooker, Fl. Bor.-Am. II. 146 (1839). — Andersson in Öfv. Svensk. Vetensk. Akad. Förh. xv. 125 (1858); in Proc. Am. Acad. Sci. IV. 64 (Salic. Bor.-Am. 20) (1858); in Walpers, Ann. Bot. v. 750 (1858); in Svensk. Vetensk. Akad. Handl. VI. 164, t. 8., fig. 95 [mala] (Monog. Salic.) (1867), in De Candolle, Prodr. XVI.² 254 (1868). — Bebb apud Babcock in The Lens II. 249 (Fl. Chic. Suppl.) (1873); apud Wheeler & Smith, Cat. Pl. Mich. 73 (1881); apud Watson & Coulter, Gray Man. ed. 6, 485 (1890). — Britton & Brown, Ill. Fl. I. 504, fig. 1203 (1896); ed. 2, I. 597, fig. 1464 (1913). — Britton, Man. ed. 2, 319 (1905). — Griggs in Proc. Ohio State Acad. Sci. IV. 309, t. 14 (Will. Ohio) (1905). — *S. syrticola* Fernald in Rhodora IX. 225 (1907). — Robinson & Fernald, Gray's New Man. 324, fig. 654 (1909).

Hooker gave an excellent description of this well marked species. Andersson only knew the type which had been collected in Labrador (at an uncertain place, probably in the south) by Morrisson. Bebb, in 1873 and 1890, referred to it specimens from the Great Lakes. Fernald, however, in 1907, stated that a careful study of Hooker's original description of *S. adenophylla* and of Andersson's fuller description of the type material shows that the shrub of the Great Lakes can have no close connection with *S. adenophylla*. He, therefore, proposed his new *S. syrticola*. Unfortunately, Fernald, did not see Hooker's type of which I have before me an excellent photograph and some fragments from the Kew Herbarium. Hooker placed his species next to *S. speciosa* and *S. Barrattiana*, and not in the *Cordatae* group to which according to Fernald his *S. syrticola* belongs. Barratt's section *Cinereae* to which Hooker referred *S. adenophylla*, comprises, however, a number of very different species (as for instance besides the two mentioned

also *S. candida*, *S. glauca*, *S. Scouleriana* and *S. rostrata* [*S. Bebbiana*]), and this fact proves that neither Barratt nor Hooker made an attempt to separate these forms according to their true relationship. *Salix adenophylla* does not, in my opinion, belong to the *Cordatae*, but its closest connection is with *S. commutata* and *S. Eastwoodiae*. Fernald lays too much stress upon Hooker's characterization of the serrature of the leaves: he says: "This remarkable character of the foliage is sufficient, even if the habitat, Labrador, were not almost convincing, to show that Hooker's plant could not have been the same as the common sand dune shrub of the Great Lakes." I see, however, no reason why Hooker's description should not apply exactly to *S. syrticola*, which also undoubtedly is characterized by "foliis ovatis basi cordatis acutis . . . argute serratis serraturis elongatis glanduliferis . . . stipulis ovato-cordatis grosse glanduloso-serratis." Fernald emphasizes the fact that *S. syrticola* has larger leaves of which even the smallest are 3 cm. long while Hooker's type according to Andersson has only "folia majora ad pollicem longa." But Hooker himself states that the "leaves are an inch or more long." In fact, on the type they measure up to 1 inch and a half in length, and they were probably not fully grown. On the other hand I have seen several forms of *S. syrticola* which in no way could be distinguished from Hooker's type. The fruiting aments of this type are (without the peduncle) only 3.5 cm. long, but apparently not very well developed. The bracts of the old fruits of the fragments which I have seen are partly rather densely pubescent and not only "pilis raris adpersae" or "glabriusculae" as Andersson says. His statement "pelicello cinereo" is regarded by Fernald as another character to separate *S. adenophylla* and *S. syrticola*, because the latter has a glabrous and straw-colored pelicel. In my opinion, Andersson did not intend to say that the pedicel is pilose but he evidently used the word cinereus only in the sense of "grayish." When Fernald proposed his new species he did not know of the specimens collected by Macoun, Ross and Spreadborough in the James Bay region. They connect the original habitat of (probably southern) Labrador with that of *S. syrticola*. The only difference between the forms of James Bay and those of the Great Lakes, so far as I can judge, is in the length of the styles, which mostly measure about 1.5 mm. in typical *S. adenophylla*, while they rarely are longer than 1 mm. in *S. syrticola*. We need, however, more copious material to decide whether this is a constant character sufficient to separate the form of the Great Lakes as a variety. I have seen the following specimens which undoubtedly represent typical *S. adenophylla*.

KEEWATIN. Gravelly bank of Severn River, July 30, 1885, *J. M. Macoun* (No. 2004, O., fr. adult.)—ONTARIO. Hudson Bay, Cape Henrietta Maria, August 14, 1904, *W. Spreadborough* (No. 62631, O., fr. adult.); The Beacon, mouth of Moose River, July 19, 1904, same coll. (62630, O., fr. adult.).—N. E. TERRITORY. East Main 1892, *A. H. D. Ross* (No. 2438, O., st.; fragment).—LABRADOR, without exact locality, *Dr. Morrison* (fr.; K.; type).—QUEBEC: Saguenay District: Natashquan River, July 24, to August 10, 1912, *C. W. Townsend* (fr.; G.). Lake St. John District: Roberval, shore of Lake St. John, August 22, 1895, *J. G. Jack* (st.; A.).

Of the western form (*S. syrticola* Fern.) I have seen specimens from western Ontario (Cockburne Isl., Prince Edward District), Wisconsin (Manitowoc County), Michigan (Allegan, Huron, Berrien, Lake, and Porter Counties), Illinois (Cook County), Ohio (Erie County), Pennsylvania (Erie County).

6. *S. commutata* Bebb in Bot. Gaz. XIII, 110 (1888). — ? *S. livida* a. *rostrata* a. *lanata* Dippel, Handb. Laubh. II, 256 (1892). — Coville in Proc. Wash. Acad. Sci. III, 317, t. 37 (1901). — Piper in Contrib. U.S. Nat. Herb. XI, 216 (Fl. Wash.) (1906). — Ball apud Piper & Beattie, Fl. N.W. Coast, 116 (1915). — Henry, Fl. S. Brit. Col. 100 (1915), excl. synon. — Rydberg, Fl. Rocky Mts. 194 (1917). — *S. Barclayi* Jones, Will. Fam. 16 (1908), pro parte, non Andersson. — In 1901, Coville explained the history of this species. It was described by Bebb from specimens collected by Cusick on the Eagle Creek Mountains, near Snake River in Oregon, which I have seen in the herbarium of the Field Museum. As type must be taken Cusick's No. 826 (sheet 7751 of Herb. Bebb. in C.).¹ Bebb, then, distinguished *S. commutata* from his *S. conjuncta* (see above on p. 151), but he did not compare both sufficiently with *S. Barclayi*. Coville was the first to separate correctly this and *S. commutata*.

I have seen specimens of the typical form from Oregon (Umatilla, Walla, Union, Klamath and Grant Counties), Washington (Pierce, Mason, King, Chelan, and Okanogan Counties), Montana (Glacier Nat. Park and Teton County), British Columbia (Kootenay, Yale, New Westminster, and Cassiar Districts), Alberta (Rocky Mountain District) and Alaska (from White Pass and Lake Atlin to Prince William Sound and Kukak Bay). There are also some specimens of J. N. Rose's (No. 170 and 404, fr. C.) from the Yellowstone Park which may belong to this species, which probably also occurs in northern Nevada (Pine Forest Lake, Griffith & Morris, No. 226, Herb. Brooklyn Bot. Gard.), and in northern California (Modoc County, Warner Mts., Austin & Bruce, No. 33, m., Cal., filamentis glabris, see later under *S. Eastwoodiae*).

Bebb made 3 varieties. First *S. commutata* var. *sericea*, of which the type came from Mt. Hood in Oregon where it was collected by Howell and also by Henderson. This is a form with a very dense white tomentose pubescence of the leaves, and apparently connected with the type by many intermediate

¹ On this sheet there is the following extract of a letter of the collector which seems worth quoting: "826. This I saw in great abundance in the high Mts. It is commonly 3° 4°, but in sheltered localities is rarely 8' or 10' in length and is often but a few inches. Many spec. were seen that I could not decide whether they were of this or the preceding (*S. Barclayi*). I have enclosed such under 1304 b-c, and e. Nothing but fruit could be had and often not that, and perhaps the matter cannot be definitely settled till good spec. of all can be had. 826 must be a local form. When sent to Watson some years ago he said 'I cannot match it, and unless you have it from Howell or Suksdorf we may say that it does not extend farther west than our Blue Mountains. In them it seems to be limited to a small district. East of them is a range (near Snake River) known as Eagle Creek (on the South) or Wallowa Mts. (on the N.) very high and rugged, a part of the Idaho system rather than the Blue Mts. In these I find it in great abundance, as no doubt it is on the other side of the Snake River. If it extended to the Rocky Mts. some one would certainly have found it ere this."

forms. Its synonym is as follows: *S. commutata* var. *sericea* Bebb in Bot. Gaz. XIII. 111 (1888). — *S. glauca* var. *villosa* Howell. Fl. N.W. Am. 621 (1902), pro parte, non Andersson. — *S. commutata* var. *mixta* Piper in Contr. U.S. Nat. Herb. XI. 216 (Fl. Wash.) (1916). I refer to it the following specimens.

WASHINGTON. Mason County: Olympic Mts., August 11, 1890, *C. V. Piper* (m., f., Pu.); same loc., July 19, 1897, *J. B. Flett* (No. 112, m.; Pu.). Chelan County: Skagit Pass, Horseshoe Basin, August 24, 1892, *Lake & Hull* (No. 765, m., f.; Pu.). Pierce County: Mt. Rainier, 2000 m., August, 1889, *E. C. Smith & C. V. Piper* (m., fr.; M.; forma quasi ad var. *typicam* transiens).

OREGON. Hood River County: moraines near the snow line on the north side of Mt. Hood, July 29, 1886, *Th. Howell* (m., f., fr.; C., N.; type; stylis apice bifidis, stigmatibus parvis, pedicellis ad 1.5 mm. longis interdum pilosis bracteam sub-superantibus); August 1, 1886, same coll., (m., f., fr.; G.; stylis integris, pedicellis plus minusve aequilongis glabris, glandulam ad 3-plo superantibus); near or on the glaciers, July, 1884, *L. F. Henderson* (m., fr.; G.); south west slope of Mt. Hood, at timber line. 200–2300 m., 1896, *C. N. Merriam* (m.; W.).

Bebb's second variety is var. *denudata* which came from the same locality as the typical *S. commutata*. This is a very uncertain form, Bebb's description being very insufficient: "Young leaves smooth or nearly so, more or less distinctly serrulate." Cusick collected it on the Eagle Creek Meadows in Oregon but, unfortunately, there is no type sheet preserved in Bebb's herbarium. Ball, who looked over the *commutata* material in herb. Bebb in 1908 marked sheet 7750 (Cusick's No. 1304 c) as "type materia of var. *denudata* Bebb." Bebb has drawn a figure of a fruit on this sheet and written in pencil: "Capsule glabrous ped. pilose short scarcely exceeding the gland, leaves elliptical or ovate-lanceolate tomentose both sides," which is quite correct, but it does not agree with the original diagnosis given above. There are some more sheets of Cusick's collection. Of these the sheet with the Nos. 7741–42 may be regarded as the type material. It consists of 2 branchlets with rather old female flowers and two with male flowers which are marked No. 968 (in pencil by a hand unknown to me) and two sterile branchlets which are numbered 981 (this is No. 7741, C.). I should refer the flowering specimens to *S. Barclayi* (like Cusick's No. 2302 of 1899, Higher Wallow Mts., of which the young leaves are more or less bluish gray beneath; this number is named var. *denudata* in Herb. C.), but the leaves remain underneath rather pale green if the leaves of some elder branchlets (No. 981) represent the same form. The ovaries are partly rather copiously pubescent, but partly glabrous, as it is not unfrequently the case in *S. Barclayi*. The dark color of the bracts, too, points to *S. Barclayi*, but much better material is needed to decide the question whether this is a good variety of *S. Barclayi* or *S. commutata*. Bebb's note in pencil on sheet 7741–42 runs as follows: "Capsule glabrous (abnormally slightly hairy), style short, stigmas mostly entire, scale dark, thinly villous, leaves ovate-lanceolate glabrous, green both sides, the earliest finely glandular serrulate, mature leaves less conspicuously so, stipules ovate, pointed glandular-serrulate, buds large smooth." I regard this sheet as Bebb's type. Ball's type (sheet 7750) I am unable to distinguish from typical

commutata, likewise sheet 7745 which Ball also refers to var. *denudata* though the branchlets partly look more like those of var. *sericea*. On the other hand sheet 998 (which bears No. 1304 of Cusick) can be taken for var. *denudata*, as also the material on the sheets 999 and 1000, which represent Cusick's No. 1304. After all I am not well enough acquainted with the variability of *S. commutata* to make a decisive statement as to the taxonomic value of var. *denudata* and its true relationship. Provisionally, I refer to it the following forms which certainly need a thorough investigation in the field.

OREGON. Baker County: Eagle Creek Meadows, August, 1886, *W. C. Cusick* (No. 1304 m., st.; sheets 999-1000 in C.; 1304^a, f., ex parte; sheet 998 in C.; without number, f., sheet 7742, 7741, st. in C.; which I regard as the type as already explained); Eagle Creek Mts., about 2300 m., alt., August and September, 1881, same coll. (No. 968, f., at least partly; sheet 205445 in C.; this form resembles much Cusick's No. 2302 but in No. 968 the leaves are green beneath: named by Ball var. *denudata*, in the specimen in Herb. G. the fruits are pubescent); highest Powder River Mts., 1897, same coll. (No. 1810^a, fr.; Cor.; foliis anguste lanceolatis). — Union County: Wallowa Mts., Bear Creek Watershed, meadow in Basin Creek, 2050 m., September 8, 1907, *F. V. Coville* (No. 2481, f., fr.; W.; "the specimens had recently emerged from a snowbank"; the pedicels are pilose). Harney County: Highest Stein Mts., wet sides near top, July 5, 1898, *W. C. Cusick* (No. 2009, m., f.; Cor., Pu.; stomata in pag. sup. foliorum numerosa, pedicelli pilosi).

WASHINGTON. Pierce County: Mt. Rainier, about 2100 m., August 12, 1884, *Piper & Smith* (No. 701, fr., C. [sheet no. 5205]; Nos. 702 seem to be typical *S. Barclayi*); same Mt. August 1890, *E. C. Smith* (f., sheet 6582 in C.; rather typical *commutata* or a transitional form). County unknown: Cascade Mts., Lake south of three Sisters, meadow at head of lake, August 7, 1897, *Coville & Applegate* (No. 551, st.; W.; forma satis incerta).

Bebb's third variety is *S. commutata* var. *puberula*, in Bot. Gaz. XIII. 111 (1888) of which he says: "Capsule thinly puberulous. Transition to *S. californica*." He does not cite a type nor is there a specimen in his herbarium. There are apparently forms of *S. commutata* with more or less pubescent ovaries and fruits, but it is difficult to separate them from *S. Eastwoodiae* unless one has male specimens. So far as I can judge by the rich material I have seen, the filaments of true *S. commutata* are always glabrous while those of *S. Eastwoodiae* are more or less distinctly pilose, at least at the very base. There are, however, forms from those regions where the two species seem to meet which at present I am unable to refer to one species or the other. See also under *S. Eastwoodiae*. It may be possible that Bebb had before him a form of the latter species, but I am inclined to refer to var. *puberula* the following, at least provisionally.

IDAHO. Region of the Cœur d'Alene Mts., Divide between St. Joe and Clearwater River, July 11, 1895, *J. B. Leiber* (No. 1246, f.; G., N., W.; ovariis sparse pilosis).

OREGON. Grant County: Strawberry Mts., streambank, 2600 m., July 29, 1910, *C. W. Cusick* (No. 3580, f., fr.; G., M.; forma amentis ad 8 cm. longis, pedunculo ad 2 cm. longo excluso, fructibus laxe villosis; bogs, 2660 m., same date and coll. (No. 3585, m.; C.; G., M., N.; filamentis pl. m. coalitis glabris. Union County: without exact locality (see letter quoted on p. 160), same coll. (No. 1304 b, same as No. 997, fr. im.; C.; referred by Ball to *S. californica*); Wallowa Mts.; August, 1896.

C. V. Piper (No. 2532, fr.; Cor., Pu.). Klamath County: camp at Crater Lake 2050 m., *Coville & Leiberg* (No. 396, f., m., W.; filamentis glabris); near Crater Lake, August 2, 1897, *F. V. Coville & Applegate* (No. 356, f.; W.); Crater Lake Nat. Park, spring below Pole Bridge, August 15, 1902, *F. V. Coville* (No. 1297, fr.; W.; this and the preceding form may belong to *S. Eastwoodiae*, but the male specimen ought to be seen). Josephine County: without exact location, July 9, 1887, *Th. Howell* (No. 16, m.; fr.; C.).

WASHINGTON. Pierce County: Mt. Rainier, August, 1890, *E. C. Smith* (f.; this is sheet 6583 in C. of Herb. Bebb, and agrees well with Bebb's description).

7. *S. Eastwoodiae* Cockerell apud Heller, Cat. N. Am. Pl. ed. 2, 89 (1910), sphalmate *Fastwoodiae*, corrected in *Torrey*, xi. 264 (1911). — *S. californica* Bebb in Watson, Bot. Calif. ii. 89 (1879), non Lesquereux in Mem. Mus. Comp. Zoöl. vi. 10, t. l. fig. 18–21 (Rep. Foss. Pl.) (1878); in Bot. Gaz. xiii. 109 (1888); l. c. xvi. 106 (1891). — Jepson, Fl. Cal. 344 (1909).

This species was described by Bebb from specimens collected by different collectors in California: "from Mariopsa Co. northward (Brewer, Belander, Lemmon, Greene, Mrs. Austin)." I have seen all the specimens in herbarium Bebb, of the Field Museum. Brewer's plant (No. 7192 in C.; No. 2788 of Brewer, "about Mt. Brewer") is not identical with the type because this is said to have "grayish-tomentose" capsules, the ovaries however of Brewer's plant are glabrous, a fact noted also by Bebb in his remarks in pencil on the sheet ("capsule glabrous, stigmas entire, pedicel short scarcely exceeding the glands, leaves of the peduncle glandular-serrulate, stipules more so"). On the other hand, Brewer's No. 2162, near Donner Pass, August 27, 1875. (No. 7191 in C.) is typical sterile *S. Eastwoodiae*. The same sheet bears Bolander's No. 6336, Mono Trail, about 3300 m., August 23, 1886, No. 7381 in C. It is a form more like *f. callicoma* (see later) than the type.

Lemmon's specimens which are named by Bebb himself *S. californica*, which is not the case in the specimens of Brewer and Bolander, consist of 5 sheets; one, No. 7783 in C., bears a reprint of Bebb's diagnosis, and it agrees in every respect with it, so that I take this sheet for the type. With it are identical sheets, Nos. 7782 (fr.), 7781 (m., fr. juv.), 3689 (m.) and 3700 (fr.); No. 3699, however, is much more like *S. orestera*, Greene's No. 457, Sierra Nevada, 3000 m. by a streamlet near perpetual snow, October 14, 1874, named by Bebb *S. californica* (sheet No. 4350 in C.) is typical, but the leaves are similar to those of *S. orestera*.

As to the name, I think it best to adopt Cockerell's new name. According to the International Rules there may be a doubt whether a name has to be changed on account of an older one used for a paleontological species. Sooner or later, however, we shall need a list also of these names, and then we certainly shall avoid their use.

S. Eastwoodiae seems to be very closely related to *S. commutata* and the main characters to distinguish these two species are the pubescence of the filaments, the normally hairy ovaries, and the closer more distinct glandular serration of at least the lowermost and middle leaves; besides this *S. East-*

woodiae seems to have distinctly darker bracts. The serration sometimes suggests that of *S. adenophylla*.

I have seen what I call typical *S. Eastwoodiae* from the following counties in California (north to south): Lassen, Plumas, Sierra Nevada, Placer, Eldorado, Tuolumne, Mariposa, Mono, Fresno and Tulare. This Willow inhabits the Sierra Nevada between about 2300 and 3500 m. alt. It is also known to me from Washoe County, Nevada, and there are forms from the Siskiyou Mts. in Jackson County, southern Oregon, which may belong to this species. Unfortunately I have not yet seen male specimens. Specimens from eastern Oregon, Wallowa Mts., which have been referred to it, are more closely related to *S. commutata* (see var. *puberula*, above).

There is a form which corresponds to var. *sericea* of that species. I wish to propose for it the name *S. Eastwoodiae* f. *callicoma*, nov. forma: a typo non nisi differre videtur foliis (saltem junioribus) utrinque et ramulis densissime sericeo-lanuginosis. For the type may be taken a specimen collected by G. B. Grant, Tulare County, Sequoia Nat. Park, Marble Fork of the Kaweah River, about 2500 m., July 15, 1902 (f., fr.; St. [sheet 83180]). I have seen quite a number of forms which connect this very hairy form with the typical form. It occurs also in Nevada, Ormsby County, about Marlette Lake, 2460 m., July 10, 1902, C. F. Baker (No. 1299, fr., m.; G., M., W.).

In *S. commutata* and in *S. Barclayi* I have observed besides the typical form with glabrous ovaries one with more or less hairy pistils. In *S. Eastwoodiae* the type has pubescent ovaries and fruits but there is also a form with more or less glabrescent ovaries and almost or wholly glabrous fruits. I have already mentioned Brewer's No. 2788 with glabrous capsules. There are more specimens like this, but all need further observation. In a later article I shall describe a new species which looks somewhat like a variety of *S. Eastwoodiae* with glabrous ovaries but, in my opinion, belongs to a different section.

8. *S. orestera*,¹ spec. nov. — *S. glauca villosa* Bebb apud Coville in Contrib. U.S. Nat. Herb. iv. 198 (1893), non Andersson. — Eastwood, Fl. S. Fork of Kings River, 18 (1902). — Jepson, Fl. Cal. i. 343 (1909). — Hall, Yosemite Fl. 68 (1912). — Frutex erectus fide cl. Jepson et Hall, 0.6 ad 3.5 m. altus; ramuli novelli plus minusve dense et adpresse sericeo-villosuli, hortenotini laxe villosuli vel fere glabri, flavo-brunnescentes vel plus minusve ut annotini glabri, atrofuscescentes vel purpureo-brunnescentes, vetustiores interdum levissime pruinosi (Brewer, No. 2116), lenticellis sparsis satis magnis flavis praediti, demum epidermide flavescenti solubili obtecti; gemmae oblongae, obtusiusculae, lateraliter plus minusve carinatae, adpressae vel leviter divaricatae, ut ramuli coloratae, pilosae glabrae, maximae visae 9 m. longae; folia adulta satis firma, chartacea, anguste lanceolata, oblanceolata, lanceolata vel angust elliptico-lanceolata, basi acuta vel obtusa, minora apice saepe obtusa, cetera pleraque acuta, interdum subacuminata, minora inferiora pedunculorumque 1:0.4 ad 3:0.8–1 cm., majora superiora 4:0.8–1.1

¹ Derived from *ὄρεστρος*, dwelling in the mountains.

ad 6.5:1(-1.5 vel 7.5:2 vel 7:2.4) cm. magna, vel in ramulis vegetis plus minusve obovato-oblonga ad 9:1.8-2.3 cm. magna, majora margine integerrima vel rarius distanter sparse glanduloso-dentato-serrata, minora fere semper (sed saepe satis obscure) glanduloso-denticulata; superne novella dense adpresse subargenteo-sericea vel sericeo-villosula (interdum ut videtur pilis ferrugineis paucis immixtis) pleraque cito plus minusve glabrescentia, sed semper pilis tenuibus adpressis difficile recognoscendis oblecta vel plus minusve villosula, cano-viridescencia, vel dilute viridia, costa flavesciente nervisque lateralibus planis vel paullo prominulis, epidermide stomatibus numerosis instructa, cuticula cellularum saepe striata; subtus ut superne sericea, demum paullo pallidiora vel pleraque leviter glaucescentia (pruinosa), interdum magis glabrescentia, costa plus minusve elevata, nervis lateralibus utrinque 4-10 angulo satis acute a costa abeuntibus et versus apicem currentibus, haud vel tenuissime reticulata; petioli 2-5 (-8), raro ad fere 10 mm. longi, superne sulcati, ut costa pilosi; stipulae nullae, minimae vel parvae, lanceolatae, acuminatae, plus minusve glanduloso-denticulatae, ut folia pilosae, petiolis 2-3-plo breviores vel in surculis aequilongae; amenta coetanea, cylindrica, densiflora, pedunculos normaliter foliatis terminantes, rhachi villosa; mascula (1-) 1.5-2.5:1-1.2 cm. magna pedunculo 3-8 mm. longe 3-5-foliato excluso, satis stricta, divaricata; bractae oblongae ad obovate-oblongae, apice pleraque obtusae ad rotundatae, atrofuscae, utrinque plus minusve sericeo-pilosae pilis summis quam bractea saepissime brevioribus; stamina 2, filamentis liberis (rare circ. $\frac{1}{3}$ coalitis, ? normaliter), $\frac{1}{4}$ ad $\frac{1}{2}$ (rarius ad $\frac{1}{2}$) pilosis, demum bracteam duplo superantibus, antheris aureis ellipsoidalibus circiter 0.8 mm. longis; glandula una ventralis, satis anguste ovoideo-conica, truncata, bractea circiter duplo brevior; amenta feminea sub anthesi circiter 2:0.8 cm. magna, fructifera 2.5:1.5 ad 5:1(-2), in numero 800 Hansenii ad 8:1.8 cm. magna pedunculo 0.5 ad fere 1.5 cm. longo excluso; bractae ut in masculis vel interdum sublineari-oblongae, acutiusculae, pedicellum etiam sub fructu $\frac{1}{2}$ ad duplo superantes; ovaria anguste ovoideo- vel ellipsoideo-conica, breviter sericeo-tomentosa vel sericeo-villosula; styli distincti, fere semper integri, rariter apice breviter bifidi, 0.8 ad 1.2 mm. longi; stigmata satis anguste oblonga, plus minusve bifida, stylo $\frac{1}{2}$ ad 2-plo breviores; pedicelli sub anthesi glandulam vix ad $\frac{1}{3}$ superantes, in fructu vix ad 1.5 mm. longi, ut ovaria pilosi; glandula una ut in masculis, in fructu quam pedicellus interdum duplo brevior; fructus perfecte maturi e basi ovoideo-conica rostrati, pedicello excluso 7-8.5 mm. longi, ut ovaria vel laxius villosiusculi, raro subglabri (Dudley, No. 3178).

TYPE LOCALITY: Mount Goddard, Fresno County, California.

SPECIMENS EXAMINED: CALIFORNIA. Tulare County: region of Mineral Gap, Bullion Flat to Mineral King, trail to Gap, abundant, August 4, 1897, *W. R. Dudley* (No. 956^a, f.; St.): north of Farewell Gap, August 4, 1895, same coll. (No. 1129, m.; St.); near Little Kern River, about 3500 m., August 11, 1897, same coll. (No. 2548, fr.; St.; amentis ad 5:1.8 cm. magnis); region of same river, Chagoopah Creek, July 24, 1897, same coll. (No. 2266, fr.; St.); $1\frac{1}{2}$ mile below Gap, north side, August 11, 1897, same coll. (No. 2601, fr., 2601^a, m.; St.); Head of Middle Kaweah River,

Marble Canyon, about 200–2300 m., August 14, 1895, same coll. (No. 1297, m., fr.; St.); region of Kaweah River, Horsecamp near Black Peak, July 20, 1897, same coll. (No. 2129, m., f.; St.); region of Kaweah Peaks, near Kaweah Lakes, August 2, 1897, same coll. (No. 2397, m., f.; St.); East Fork of Kaweah River, Alta Peak brook, August 1, 1896, same coll. (No. 1523, m., f.; St.); Grant National Park, Cone Meadow, July, 1900, same coll. (No. 2778, f.; St.; foliis maximis ad 9:2.5 cm. magnis); Bear Creek, July 28, 1900, same coll. (No. 2905, m., fr.; St.); Alta Meadow, July 31, 1900, same coll. (No. 2946, fr.; St.); same meadow, 3300 m., 1902, *G. B. Grant*, (No. 5321, f.; St.; ovarii partim glabrescentibus); Boulder Creek, August 15, 1900, *W. R. Dudley* (No. 3294, f.; St.); Evelyn Lake, 3000 m., July 5, 1902, same coll. (N., f.; St.; pedicelli bracteis plusminusve aequilongi); Sequoia Nat. Park, Alta Meadows, 3300 m., July 17–18, 1902, *G. B. Grant* (Nos. 5002, m., 5008, f., 5012, f., fr.; St.); near Mt. Whitney, Crabtree Meadow, about 3600 m., August 6, 1904, *J. D. Culbertson* (No. 4583, fr.; M., N.; pedicellis fere 3 mm. longis, bracteis paullo superantibus, forma porro observanda); region of Middle Tule River, shores of mountain lake, August 30, 1896, *W. R. Dudley* (No. 956, m., fr.; St.; filamentis $\frac{1}{2}$ ad $\frac{3}{4}$ coalitis); trail Farewell Gap to Mineral King, above upper Soda Spring, July 13, 1902, same coll. (m.; St.; foliis obovato-oblongis ad 7:2.4 cm. magnis); in a lateral canyon, same date and coll. (m.; St.); canyon halfway to Gap, same date and coll. (m.; St.); region of Mineral King, Upper Monarch Lake, 3500–4000 m., August 16, 1896, same coll. (No. 1601, fr. im.; St.; stylis apice bifidis); White Chief Mine, above timber line, August 8, 1904, *H. M. Hall & H. D. Babcock* (No. 5653, m., f.; G., St.); above Monarch Lake, 3500–3700 m., August 9, 1904, same coll. (No. 5693, m., fr.) Mono County: Bloody Canyon, August 13, 1898, *J. W. Congdon* (fr.; G.); same canyon, about 3000 m., July 23, 1907, *R. A. Ware* (f.; G.); Mono Pass, about 2800 m., same date and coll. (m., G.; “shrub 1.2 to 3 m. high”); same pass, about 3500 m., same date and coll. (m., f.; G.; 0.90 m. high); same pass, about 3450 m., July 17, 1911, *W. L. Jepson* (No. 4432, f.; Jeps.); Mt. Dana, August 27, 1895, *J. W. Congdon* (fr.; St.); Dana Fork, near Mt. Dana, in moist bottoms, about 3050 m., July 14, 1909, *W. L. Jepson* (Nos. 3319 m., f., 3320, f.; A.). Fresno County: Mt. Goddard, along lake shore, above timber line, about 3700 m., July 24–26, 1900, *H. M. Hall & H. P. Chandler* (No. 695, f. type and m. syntype; Jeps., N., M., St., W.); same mountain, along south fork of S. Joaquin River, about 3000 m., same date and coll. (No. 664, fr.; St. “bark gray, 0.9–1.2 m. high”); East Lake, July, 1899, *A. Eastwood* (m., f.; G.); Nelly Lake, about 3800 m., July 15, 1917, *A. L. Grant* (No. 1087, fr.; A.); King’s River region; Kettle Mt. Ridge, meadow, August 23, 1904, *W. R. Dudley* (fr., st.; St.); Horse Corral Meadow, August 11, 1900, same coll. (No. 3178, St.; fr. fere glabratis); meadows near Black Mt., shores of Red Mt. Lake, about 3150 m., July, 1900, *Hall & Chandler* (No. 733, fr.; St.); Upper King’s River, Rowell Meadow, August 23, 1904, *W. R. Dudley* (fr.; St.; forma porro observanda); Nellie Lake, July 15, 1917, *A. L. Grant* (No. 1087, fr.; St.); King’s River, Bullfrog Lake, up Paradise Creek, July 9, 1910, *K. D. Jones* (No. 733, m. tantum; Herb. Univ. Cal.). Mariposa County: Cathedral Trail, August 7, 1898, *J. W. Congdon* (m., f.; G., St.; stylis apice breviter bifidis, fructibus pedicello excepto ad 8.5 mm. longis); Chilnualna Trail, August 1, 1898, same coll. (fr. im.; G.; forma mihi quamvis incerta fructibus pedicellis ad 3 mm. longis bracteis superantibus suffultis; an hybrida cum *S. Lemmonii*?); Crescent Lake, August 9, 1890, same coll. (fr., G.); Johnson Lake, August 2, 1898, same coll. (m.; G.; forma porro observanda, filamentis $\frac{1}{2}$ coalitis); Bridal Veil Trail, August 4, 1898, same coll. (fr. G.); Mt. Hoffmann, June, 1864, *W. H. Brewer* (No. 1677, fr.; C., W.; low bush); August 14, 1907, *A. Eastwood* (No. 361, f.; C. Vogelsang Pass, about 3250 m., July 14, 1911, *W. L. Jepson* (No. 4429 L., m., f.; A.); Seavey Pass, 3000 m., July 27, 1911, same coll. (No. 4525, m., f.; Jeps.); Benson Pass, July 24, 1911, same coll. (No. 4504, m., f.; Jeps.); along brooks east of Cathedral Pass, July 21, 1901, *W. R. Dudley* (m.; St.); Troia, August 24, 1907, *A. Eastwood* (No. 615, m.; Cal.); Mono Pass Trail, August

20, 1907, same coll. (No. 518, m., f.; Cal.); shores of Elisabeth Lake, about 3600 m., August 15, 1916, *F. J. Smiley* (No. 790, f.; G.); Tuolumne Meadow, August 19, 1907, *A. Eastwood* (No. 494, fr.; Cal.); same meadow, July 17, 1907, *R. A. Ware* (f.; G.). Tuolumne County: Summit Sonora Pass, 3200 m., August 15, 1915, *A. L. Grant* (No. 304, fr.; G. 321, m., fr.; Jeps.); on Lambert's Dome, crevices of dry ledge, 3600 m., July 20, 1907, same coll. (m.; G.); Soda Spring Canyon, above Kennedy's Lake, 3000 m., September 3, 1915, *A. L. Grant* (No. 470, m., fr.; Jeps.); Fort of Mt. Leavitt, 3500 m., August 29, 1915, same coll. (No. 417, fr.; Jeps.). Alpine County: Highland Lake, about 2800 m., July 24, 1911, *L. R. Abrams* (No. 4751, f.; St.); Tryon Meadows, and north slope of Folger Peak, Stanislaus Forest, 2540-2760 m., July 12, 1913, *W. W. Eggleston* (Nos. 9644, m., 9645, f.; W.); Blue Lakes, about 2300 m., July 25, 1911, *L. R. Abrams* (No. 4755, f.; St.); Carson Spur, about 2800 m., October, 1894, *G. Hansen*. (No. 800, fr.; A. B. M., St.; forma incerta amentis maximis ad 7.5:1.8 cm. magnis). Placer County: Summit, about 2300 m., July 16, 1899, *A. A. Heller* (No. 9842, f.; W.). Sierra County: Salmon Lake, July, 1899, *E. C. Sutcliffe* (fr.; A.). ? Inyo County: Bullfrog Lake to Kearsarge Pass, July 5-15, 1900, *W. L. Jepson* (No. 851, m., f.; Jeps.).

NEVADA. Elko County: East Humboldt Mts., about 3000 m., August, 1868, *S. Watson* (No. 1099, f., fr.; C., N., W.); Rattlesnake Canyon near Lee Post Office, about 3300 m., August 25, 1908, *A. A. Heller* (No. 9566, fr.; A., G., M., Reno, St.); same Mts., ridge in the north side of Lamville Canyon, about 3000 m., August 8, 1908, same coll. (No. 9360 m., f.; W.) canyon at the head of South Fork of Humboldt, about 3250 m., August 11, 1908, same coll. (No. 9410, f.; W.; foliis satis discoloribus).

This species is the *S. glauca villosa* of the Californian botanists, but it is in no way related to Andersson's *S. glauca villosa*, which belongs to sect. *Glaucæ* (see my note II. in Bot. Gaz. LXVI. 327), while *S. oresteræ* seems to be most closely related to *S. Eastwoodiæ*. It differs from it by the narrower leaves which are entire with the exception of the lowermost of which the margin is slightly glandular, and by the longer fruits which measure up to 7-8.5 mm. in length (in *S. Eastwoodiæ* only 6-6.5 mm.). There may be hybrids between the two species. On the other hand the leaves of *S. oresteræ* sometimes resemble those of *S. Lemmonii* with which I shall deal later. In this species the leaves are much more glabrous, and distinctly glaucescent beneath, and it has longer pedicels. *Salix oresteræ* may also have leaves with a rather pruinose under surface, and there are certainly quite a number of forms which need a careful observation in the field. A. L. Grant's No. 1087 with its long pediceled fruits and the rather discolor leaves comes very near *S. Lemmonii* and may be of hybrid origin.

S. oresteræ inhabits the Sierra Nevada from Sierra to Tulare County and the adjacent parts of Nevada. It is a distinct species to which I wish to direct the special attention of all collectors.

b. SECT. BALSAMIFERÆ

When I proposed this new section in my Ill. Hand. Laubholzk. i. 57 (1904), I did not know much of the American Willows but I had the impression that *S. balsamifera* Barratt represented a distinct type. After having been able to study almost all the species hitherto known I still believe that this species cannot be united with the other *Cordatæ* from which it well

differs by the short thick and blunt gland of its flowers, the light bracts, and the reticulation of the undersurface of the leaves which have a balsamic odor when expanding. I am not aware whether there is a species in northern Asia which can be regarded as closely related to the Balsam Willow, but the strange *S. obtusata* which I deal with below may have the closest affinity with it of all the American species.

S. pyrifolia Andersson in Svensk. Vetensk. Handl. vi. 162, t. 8, fig. 93 (Monog. Salic.) (1867), excl. var. *obscura*. — Britton & Brown, Ill. Fl. ed. 2, i. 596, fig. 1461 (1913). — Fernald in Rhodora xvi. 116 (1914). — *S. cordata* Richardson in Franklin, Narr. Jour. Polar Sea, Bot. App. vii. 752 (1833), non Muhlenberg. — *S. cordata* β . *balsamifera* Hooker, Fl. Bor.-Am. ii. 149 (1839). — *S. balsamifera* Barratt apud Hooker, l. c., pro synonym. — Bebb in Bot. Gaz. iv. 190 (1879); in Bull. Torr. Bot. Club, xv. 121, t. 81, figs. 1-5 (White Mt. Will. i) (1888); apud Watson & Coulter, Gray Man. ed. 6, 485 (1890). — Jack in Gard. & Forest, i. 246 (1888). — Britton & Brown, Ill. Fl. i. 504, fig. 1201 (1896). — Sargent, Silva, xiv. 63, t. 728 (1902). — Schneider, Ill. Handb. Laubh. i. 57, fig. 23 k, 20 a-b (1904). — Britton, Man. 314 (1901); ed. 2, 314 (1905). — Robinson & Fernald, Gray Man. 324, fig. 653 (1909). — Fernald in Rhodora xiv. 69 (1912). — *S. pyrifolia* α . *laeta* Andersson in De Candolle, Prodr. xvi.² 254 (1868). — *S. Columbiae* Nelson in Bot. Gaz. lvi. 473 (1913).

This excellent species has been first described by Hooker as var. β *balsamifera* of *S. cordata*. In using Barratt's name *balsamifera* Hooker expressly stated: "It is only fair to observe, that Dr. Barratt is disposed to consider the β and γ [which is *S. Mackenziana*] good species." Andersson (in Öfv. Svensk. Vetensk. Akad. Förh. xv. 125 [1858]), under *S. cordata* mentions Barratt's species in the following way: "Sub hac specie duas formas attulit Hooker, l. c. 1. *S. balsamiferam* Barratt, et 2. *S. Mackenzianam* Barratt. Quantum e speciminibus in herb. Hookeriano judicare possum *S. balsamifera*, cujus ramus foliis tectus tantum adest, ad *S. acutifoliam* W. pertinet. Ramus cortice coerulescente-castaneo obductus, stipulae lanceolatae, curvatae, geminae magnae acutae, folia fere 4-pollicaria, semiunciam lata, argute sed remotiuscule serrata, subtus glaucescentia." Andersson, as Bebb already explained, probably took his notes from a piece of Drummond's collected in 1825 at Cumberland House. It is preserved in Herb. H. B. & T. (N.) as No. 35 (Bebb quotes No. 55), and it is named by Barratt *S. balsamifera angustifolia*. I agree with Bebb that this piece belongs to *S. petiolaris*. In 1867 and 1868 Andersson cites *S. balsamifera* Barratt as a synonym under *S. discolor* Muhl. To this species does indeed belong No. 54 Herb. H. B. & T. which Barrett named *S. balsamifera intermedia*. His type is No. 53 of the same collection, and we find it under the name *S. cordata* β Hooker in the Kew Herbarium (from which I saw a sketch of Oliver's in the Gray Herbarium) and also in the herbarium of the New York Botanic Garden. Here it consists of 3 (not 2 as Bebb says) pieces. One was collected by Richardson at Lake Winnipeg, and this is to be taken

for the type. It is but a fruiting ament with its peduncle which bears two leaflets. The second was found by Drummond "between N.Y. and Cumberland House." It has male aments, and it is not mentioned by Bebb. The third is a sterile branchlet collected in 1825 by Drummond at Cumberland House. This piece apparently is identical with the specimen at Kew where the sheet bears still another fragment with a fruiting ament. By a hand unknown to me it is marked "*cordata* Muhl. fide Ands. 1857."

In 1867, Andersson described his *S. pyrifolia* from specimens collected "in America boreali ad lacum Winipeg (in paludibus prope Brochet) et in regione fl. Saskatchewan (Bourgeau)." Neither in 1867 nor in 1868 does Andersson make mention of the piece of Drummond which he in 1858 named *S. cordata*. In the Gray Herbarium there is a male piece of Bourgeau from "Winipeg Valley" which Andersson himself marked "*S. pyrolaefolia* Ledeb." He apparently made this determination before he decided to describe a new species because in 1867 he states that *S. pyrifolia* is "sine dubio *S. pyrolaefoliae asiaticae* in America analoga."

The name *pyrifolia* has already been used by Schleicher (Cat. Pl. Helv. ed. 3, 26 [1815]) but this is a nomen nudum, and according to the international rules Andersson's name can stand. Nelson's name *S. columbiae* has to be adopted by those who follow the Philadelphia Code, but this is a very unsuitable name because the species is wanting or at least extremely rare in British Columbia and not known from the region of the Columbia River at all. Nelson probably has been misled by Ball's use of the name *S. pyrifolia* (apud Coulter & Nelson, New Man. Rocky Mts. Bot. 133 [1909]) for a species of sect. *Cordatae* for which he has since proposed a new name which unfortunately has not yet been published. As Fernald already explained (in *Rhodora* xvi. 116 [1914]) "the highly appropriate and long used name, *S. balsamifera* Barratt, was published as a specific name merely in synonymy and was not validated as a specific name until 1879, when Bebb brought it forward (Bot. Gaz. iv. 190). In the mean time *S. pyrifolia* Andersson was properly published . . . in 1867 and as the first valid specific name must stand."

Andersson . . . in 1867, also proposed a *S. pyrifolia* **obscura* citing as type "in Rocky Mountains (Bourgeau)." This name is mentioned by Ball, apud Coulter & Nelson, l. c. 133 (1909) with the synonym *S. rotundifolia* Nutt. Later, as stated above, Ball gave to his *pyrifolia* a new name, and he at present regards Andersson's var. *obscura* as a form of his new species. In my opinion Andersson's form is really an obscure one, which cannot be properly interpreted without seeing the type specimen. In 1868, Andersson gives the type locality as "vallée des Arcs (August, 1858: Bourgeau)" and says: "— forma β . *obscura* est *pyrolaefolia* adhuc similior, sed capsulis longius pedicellatis, obtusiusculis, stylo multo productiori et foliis subovalibus differt. potius cum *S. cordata* comparanda; folia autem subtus viridula, i.e. concoloria, breviora et latiora, et amenta affinitatem cum vera *pyrifolia* demonstrant." I cannot find a mention of a locality "vallée des Arcs" in Palliser's Papers Explor. Brit. N. Am. (1859) where Bourgeau's route is not

distinctly indicated, but this variety *obscura* certainly does not seem to belong to *S. pyrifolia* sensu stricto which is the same as Andersson's var. *laeta* in 1868.

Bebb, who in 1879 dealt with *S. balsamifera* and took up this name, discussed it again in 1888 when he proposed besides a var. *typica* three more varieties. Of these var. *vegeta*, too, coincides with the type while according to Fernald (in *Rhodora* xvi. 116 [1914]) var. *lanceolata* can be retained as *S. pyrifolia* var. *lanceolata* Fernald because it "is found in some of the swamps of eastern New Foundland to be so uniform and to occur in such extensive areas that it seems well worth recognition." There is no type in Bebb's herbarium in the Field Museum, and his figure (t. 81, fig. 7) shows a leaf as it is often found in the typical form. Bebb's var. *alpestris* seems to be nothing but a lower small leaved form of which the leaves are only partly green on both sides, as is shown by the type which was collected by E. Faxon on Mt. Lafayette, White Mts., Eagle Lake, 1400 m., July 20, 1885 (sheet No. 276971 in C.).

As to the relationship of *S. pyrifolia* Bebb, in closing his remarks on *S. balsamifera* (in 1888) says: "A well defined species, not shading off into any other, not even into its nearest congener, *S. cordata*, from which it is always distinguished by the peculiar texture and veining of the leaves, absence of stipules and very loosely flowered fertile aments." As I have already said, I believe that the most distinct character by which *S. pyrifolia* may be separated from the *Cordatae* is the short thick and blunt gland. All the species of sect. *Cordatae* known to me have narrow elongated glands which look very different. Only one species, *S. myrtillifolia*, has similar glands, but as is the case with the other *Cordatae* its bracts are fuscous (at least at the tip), and it does not have the distinct nervation or reticulation of the mature leaves so conspicuous in *S. pyrifolia*, which besides has the remarkable balsamic odor of the unfolding leaves which it does not lose even in the herbarium.

Salix pyrifolia is principally found in the region from Newfoundland and southern Labrador westward to the Winnipeg region; it also occurs (but apparently sporadically) in Saskatchewan, British Columbia and the southwestern part of the Northwest Territories. The exact limits of its known distribution may be given as follows: Northwest Territories (between Lake Athabasca and Chesterfield Inlet, *J. W. Tyull*, No. 1715; Hill Island Lake, halfway between Lake Athabasca and Great Slave Lake, *F. Harper*, No. 99021, O.), Saskatchewan (specimens of Drummond's and Bourgeau's mentioned above), Manitoba (Lake Winnipeg region, *Richardson & Bourgeau*; Berens River, *J. M. Macoun*, No. 24252, O.), Ontario (Kenora, Thunder Bay, and Carleton Districts), Quebec (Abitibi, Terrebonne, Chateaugay, Chambly, Stanstead, Champlain, Portneuf, Temiscouata, Rimouski Districts, Magdalen Islands), Labrador (Sandwich Bay Château, Caribou Isl.), Newfoundland (from the eastern drainage area of the Humber River system to the Avalon Peninsula), New Brunswick (Northumberland, Kent, Westmoreland, Sunbury and St. John Counties),

Nova Scotia (Pictou County), Prince Edward Island, Maine (Aroostook, Pisquataquis, Hancock Counties), New Hampshire (White Mountains), Vermont (Lamoille, Orleans Counties), New York (Essex County), Michigan (St. Clair, Genesee, Chippewa, Houghton, Keweenaw Counties), Minnesota (Millelacs, Aitkin Counties). From British Columbia I have only seen two specimens, one collected by J. Macoun under 54, Telegraph Trail, June 18, 1875 (No. 1666, f.; G.) and the other by J. M. Macoun, Nacho (? Nazko) River, in swamps, June 18, 1875 (No. 24254, f.; O.). Both specimens need further study, but possibly *S. pyrifolia* will be found in more places between Lake Winnipeg, the Great Slave Lake and northern British Columbia.

I refer to sect. *Balsamiferae* not without a good deal of doubt, also the following species which on the other hand shows some relationship to the *Commutatae*.

S. obtusata Fernald in *Rhodora* ix. 223 (1907). — This remarkable species is so far only known from the Gaspé Peninsula. The type has been collected by Fernald & Collins on inundated gravelly bars and beaches, River St. Anne des Monts, near the head of the Grand Rapids, July 15, 1906 (No. 203, fr.) and August 16, 1906 (No. 203^a, st.), and by Williams and Fernald in Bonaventure County, New Carlisle, Arborvitae swamp, July 28, 1902 (st.; Cor.; 0.9 to 1.2 m. high). The last specimen apparently belongs to this species, but it has no stipules which are rather large and persistent in the type.

According to Fernald "the leaves are glabrous, or the youngest arachnoid-tomentose," but I have been unable to find a trace of an arachnoid pubescence on them. The following description seems to me more correct: folia novella superne paullo (praesertim ad costam) puberula, demum costa basi pilosula excepta glabra, subtus ab initio glaberrima. Fernald says: "Closely allied to and strongly simulating the Siberian *S. pyrolae-folia* Ledeb., but differing in its more shallowly toothed leaves, shorter sessile aments and very short styles." I am by no means convinced, however, that the Siberian species is closely related to *S. obtusata* of which much more copious material is needed to decide the question of its true relationship.

VIENNA, November, 1919

THE LIUKIU ISLANDS AND THEIR LIGNEOUS VEGETATION

E. H. WILSON

THE Liukiu Archipelago is a group of small islands between Lat. 28°, 30' and 24° N. which like a string of stepping stones connect south Japan with Formosa. It is divisible into three lesser groups, a northern, the Oshima group, a central, the Okinawa group, and a southern, the Sakishima group. All the islands are washed by the warm Japan current and enjoy an equi-

table, warm-temperate climate. The Oshima group is the most rugged; and it has the heaviest rainfall in the whole of the Japanese Empire, the average annual precipitation being 3300 mm. The Sakishima group I had no opportunity of visiting, but from photographs I gather that the vegetation is subtropical in character. The central is the largest and most important of the three groups, Okinawa, the main island, being 268 miles in circumference and 98 miles from north to south. The chief seaport is Naha, situated in the southwest corner of the island. A few miles inland from Naha is the town of Shuri, formerly the seat of government of the native kings.

The Liukiu people are mild and inoffensive and are a distinct race, probably of Malay origin. At one time independent, they succumbed to Chinese invaders and afterwards owed dual allegiance to China and Japan. In 1879 the islands passed definitely to Japan; the native king was removed to Tokyo and later given the rank of Marquis. As a race the Liukiu people are smaller than the Japanese and their manners and customs are primitive. The women, in particular, work hard and carry all loads on their heads. Children abound. The houses are very small, one-storied, constructed of bamboo-wattle sides and thatched roofs. Each is enclosed by a wall or fence, the people apparently being fond of privacy. Unlike the houses the graves are enormous and exceed in size even those of the Chinese. It would appear that all the wealth of the people is lavished on the building of tombs in rock and masonry — huge, imposing horse-shoe shaped, conspicuous structures.

Part farmer, part fisherman best describes the Liukiu man and in the latter capacity he excels. In farming he depends largely on his women. Rice, sweet potatoes, and sugar-cane are the chief crops. Of rice, two crops are obtained annually, the first being planted about the end of February. The Japanese have introduced new methods and new industries; the education of the children has been taken in hand and much is being done toward the improvement of the conditions and social life of the Liukiu people.

For several centuries prior to the formal annexation of the Liukiu Islands by Japan the powerful feudal lords of the Satsuma had exercised a strong influence over the islands. That the connection has been close is shown by the number of Liukiu plants cultivated round Kagoshima from long ago. The Sweet Potato, known generally in Japan as the "Satsuma-imo," is in the neighborhood of Kagoshima called "Liukiu-imo" indicative of its origin. The Bamboo which yields edible shoots (*Phyllostachys mitis* Riv.) and now widely planted in Japan is of similar origin. In the garden behind Prince Shimazu's home in Kagoshima, there is a grove of this Bamboo and a stone tablet in its midst records the fact that the original plants were in 1726 brought from Liukiu by the Prince's ancestor. Neither the Bamboo nor the Sweet Potato are indigenous in Liukiu and probably came first from China. A favorite garden shrub in and around Kagoshima and now wide-spread in the warmer parts of Japan is *Rhododendron sub-lanceolatum* Miq., an endemic Liukiu species. The common *Cycas re-*

voluta Thunb. and the familiar *Lilium longiflorum* Thunb. are other Liukiu plants which from Japan have been widely distributed over the world.

Naha, the chief port of Okinawa Island, is reached by steamer from Kagoshima from which it is distant 415 miles. The steamers ply weekly but they are small and the passage is seldom a pleasant one. The journey is past the islands of Tanega and Yaku and the group islets, mostly uninhabited, known as the Kawanabe Islands which are strung out toward Oshima, the most northern of the Liukius proper. The island of Yaku is important phytogeographically as representing generally the southern limit of the Japanese flora. The Kawanabe Islands are all small and have very little vegetation but such as it is belongs in character to the Liukiu group. The chief port of Oshima is Naze which is favored with a small, safe anchorage. On the journey down I had opportunity to spend a few hours ashore there and was able to collect a number of plants.

Oshima is a bold, mountainous island with a rugged coast line. The highest peak is Yuwan-dake 865 m. above sea-level. From the sea the mountain slopes appear to be well-forested, chiefly with Pine. Okinawa has a much-indented coast line. The northern half of the island is decidedly mountainous, though the highest peak does not exceed 500 metres; the southern half is undulating. Geologically Okinawa is largely composed of coral rock, with granite trap ejected here and there by submarine volcanic action. The Karama Islands west of Okinawa are mainly of volcanic origin and on one of them copper is mined. The vegetation of all the islands is essentially evergreen, the scenery is pleasing and I do not think I have visited a prettier land. On Okinawa, Palm and Pine meet and the effect is striking. On Aharen Island in the Karama group, *Juniperus conferta* Parl. clothes the sandy foreshore at and above tide-mark, with it grows *Pandanus tectorius* Soland., *Hernandia peltata* Meisn. and on the rising slope behind *Hibiscus tiliaceus* L., *Livistona chinensis* R. Br. and *Pinus luchuensis* Mayr. with *Didymosperma Engleri* Warb. and *Asplenium nidus* var. *intermedia* Mett. as undergrowth. Nowhere else in the Orient is such a curious mixture of woody plants to be found.

The flora of the Liukiu Islands is not properly known. Japanese botanists have described quite a number of plants from these islands, but the references are much scattered and considerable work remains to be done. The first plants collected on the islands were gathered by the officers of the English war-ships, commanded by Captain Basil Hall, who visited the islands in 1816. These specimens were subsequently lost at sea. The next specimens were those gathered on Captain Beechey's voyage and described by Hooker & Arnott who enumerate forty-one species of woody plants. Since Beechey's voyage a number of small collections have been made but Liukiu plants are today rare in western herbaria. The particular object of my visit was to study the species of Pine and Juniper known to grow there and incidentally to collect as many dried specimens as possible. In all I spent about three weeks in Okinawa and gathered 150 species of woody plants.

In general the ligneous vegetation of the Liukiu Archipelago consists of a littoral fringe of plants wide-spread in warm-temperate and sub-tropical regions. On the mountains are found a comparatively small number of Japanese and a considerable number of endemic species. Evergreen, mostly shining foliage, is a marked feature of the vegetation. The presence of Mangrove-like trees and the endemic *Cycas revoluta* Thunb. and *Pinus luchuensis* Mayr are the three plants which give character to the vegetation.

The Pine is the commonest tree on the islands from sea-level to high up on the mountain, and is not only wild but has been abundantly planted. Here and there, and especially on the highways leading from the old capital of Shuri, some fine avenues of it may be seen. It is one of the most beautiful of Asiatic Pines and is a very distinct and easily recognized species. The bark is always gray, quite smooth on young trees, early becoming scaly and finally deeply fissured and cracked into plates of irregular size and shape. The winter-buds are reddish; the cone is chocolate-brown, small and not very persistent; the foliage is blackish green. At its best the Liukiu Pine is a handsome tree fully a hundred feet tall with a straight trunk some ten feet in girth and a crown of rather irregular shape often flattened on top. The wood is of fair quality and is very resinous. The trunk hollowed out forms the canoe which is commonly used by the fishermen. The Pine forms pure woods with usually a dense undergrowth of evergreen shrubs and low trees among which Tree Ferns, Palms, and *Cycas revoluta* Thunb. are conspicuous. This Pine, which was first recognized by H. Mayr in 1891, grows also on the small islands of the Kawanabe group south of Yakushima but is not known elsewhere. It is a singular fact that so distinct a species should have such a limited distribution. The only other Conifer indigenous in the Liukiu Islands is *Juniperus conferta* Parl., a maritime species, that has a most remarkable geographical range. The Liukius represent the southern limit of its range and it is found northward on the coasts to the shores of the Okhotsk Sea, ranging in all over twenty-three degrees of latitude. Its centre of distribution is probably Idzu Oshima, and the Boshu peninsula on the east coast of central Japan and doubtless migratory wild fowl have carried it north and south, possibly the Japan stream has also played a part in its distribution. This littoral Juniper forms, on sandy strands and rocks, at and above tide-mark, low mats often acres in extent. The color of the foliage is pea-green and the leading shoots are red-brown; the ripe fruit is subglobose, flattened at the base, plum-colored and slightly pruinose. It remains for a long time on the plant and I noticed seeds germinating while the fruit was still attached. It grows on several of the islands of the Karama group and also in Yagaji Island some forty miles north of Naha. It is essentially a sand-loving plant and in western lands should have great value as a ground cover in sea-shore gardens and on sand-dunes.

The well-known *Cycas revoluta* Thunb. is a feature everywhere in Okinawa and Oshima and also grows on the Kawanabe Islands. It is spontaneous

on coral rocks and cliffs near the sea and is a common undergrowth in Pine woods. Also it has been much planted and in times of food scarcity starch obtained from the stems was formerly a common article of diet. The plants are from one to eight feet tall and have many stems and short leaves which are cut, dried and used as fuel in the native houses and in the process of boiling sugar at the native mills. The Japanese name for this plant is "Sotetsu," which signifies "never die," and aptly describes its hardiness and power of recovering from harsh treatment. From a distance it has a very black appearance and being extraordinarily abundant is a most conspicuous feature of the vegetation.

On Yagaji, a small island on the west coast some forty miles north of Naha, there is a swamp covered with Mangrove-like trees — the only one known in the Okinawa group. The width is inconsiderable and the length about a mile. It is composed of *Bruguiera gymnorrhiza* Lam. and *Kandelia Rheedii* Wight & Arn. — bushy trees from 6–10 ft. high, growing thickly together. At low tide it is possible to scramble through the swamp but knobby growths everywhere obtrude from the roots and make walking difficult.

Round the coast *Pandanus tectorius* Soland. is an ubiquitous pest. It makes an impenetrable hedge and the leaves are used by the Liukiu people in making hats and basketware. An Agave, considered by Japanese botanists *A. rigida* Miller, but probably *A. fourcroydes* Lem., has become naturalized, and has spread rapidly round the coast, and where it grows with the *Pandanus* there is no passing.

The wide-spread *Scaevola Koenigii* Vahl with its pale green, fleshy leaves, its small, lipped flowers in axillary cymes and white fruits is abundant and forms a broad shrub often 10 feet high. Much more ornamental is *Myoporum bontiodoides* A. Gray, a rare plant in Liukiu except on Yagaji Island. This is a large shrub, from 6 to 10 feet high and more in diameter, with dull green, rather fleshy leaves and blue-purple to white, axillary, tubular flowers each an inch long. In foliage and flower it is an attractive plant. The interesting *Tournefortia argentea* L. also grows on Liukiu but is rare. With these littoral shrubs and on sand and shingle often covered at high tide grows *Cassytha filiformis* L., and *Ipomaea biloba* L. The first-named with its golden-yellow leafless stems forms a regular net and the *Ipomaea* trails long distances, rooting at every node — I measured one stem carefully; it was 110 feet long!

Of Palms which with the littoral shrubs above mentioned give a tropical aspect to the vegetation only two species are indigenous. The most common is *Didymosperma Engleri* Warb. which is plentiful as undergrowth in woods and thickets near the sea. It grows from 8 to 10 feet tall, has several stems and pinnate leaves from 4 to 6 feet in length; the petiole and stem is cased in strong, coarse blackish fibres. The fruit borne in large panicles, is spheroid, slightly 3-angled, orange-colored and subtended by the colored calyx which is blackish at the base. This species also grows in Formosa. The other Palm is *Livistona chinensis* R. Br. and this is very rare on Okinawa

Island, but abundant on some of the Karama group — Aharen Island for example. With its mop-like crown of gray-green leaves over-topping the other vegetation this Palm is conspicuous from a distance; it is often associated with the Liukiu Pine. Three other Palms (*Trachycarpus excelsus* Wendl., *Rhapis flabelliformis* Aiton, and *Cyphokentia Savoryana* Rehd. & Wils.) are occasionally cultivated. The presence of a few old trees of the *Cyphokentia*, an endemic Bonin species, shows that there has been intercourse in the past between the two groups of islands.

Of broad-leaf trees quite a number grow at sea-level and a majority are wide-spread in sub-equatorial regions of the Old World. The most common are *Terminalia Catappa* L., *Calophyllum inophyllum* L., *Hernandia peltata* Meisn., *Erythrina indica* Lam., *Bischofia javanica* Bl., *Thespesia populnea* Soland., *Ficus Wightiana* Wall., *F. retusa* var. *nitida* Miq., *Melia Azedarach* L., *Hibiscus tiliaceus* var. *hamabo* Maxim., *Garcinia spicata* Hook., *Ehretia acuminata* R. Br., *Maba burifolia* Pers., *Pongamia glabra* Vent. and *Celtis liukiuensis* Nakai. The *Garcinia*, with its large leathery black-green leaves, is a very distinct looking tree and much used by the people for planting round their dwellings. The *Ficus retusa* var. *nitida* Miq. might well be termed the Liukiu Banyan. Shading houses and by bridges some picturesque old specimens are often seen with crooked stems and pendent matlike masses of aerial roots. The *Celtis* is closely related to *Celtis sinensis* Pers. and grows to a very large size. In the old palace grounds at Shuri grow some magnificent old trees of this *Celtis* and also of the *Bischofia*, *Terminalia* and *Erythrina*. As a street tree in Naha the Formosan *Acacia confusa* Merrill has been much planted. Coarse grasses belonging to the genus *Miscanthus* are common at low altitudes, especially beside streams and with a tangle of shrubs and climbers make a veritable jungle. Another herb worthy of mention is the familiar Easter Lily (*Lilium longiflorum* Thunb.) which is indigenous and grows in pockets in the coral rocks near the sea. Forms with green and purplish brown stems grow side by side.

On the mountain slopes the flora is quite different from that of the low-level areas. Nearly every tree and shrub is evergreen and shining leaves are a feature. The species are largely endemic but the whole aspect is strongly suggestive of the flora of Yakushima and south Kynshu in general.

Two Taxads (*Podocarpus macrophyllus* D. Don and *P. nagi* Zoll. & Moritzi) grow wild on the wooded mountain-slopes. Trees of both are rare owing to their wood being highly valued for construction purposes.

Lauraceae are prominent and most of them grow also in Japan. *Symplocos*, *Ilex* and *Eurya* each with several species are among the most common shrubs. In gulleys and along the side of streams the vegetation is rampant and many Ferns, including such tree forms as *Cyathea spinulosa* Wall. luxuriate. A Banana (*Musa sapientum* var. *liukiuensis* Matsum.) grows wild in moist ravines and is also cultivated for its fibre. The Japanese *Castanopsis cuspidata* Schottky is a conspicuous feature and with *Lithocar-*

pus edulis Rehd., the endemic *Quercus Miyagii* Koidz., a species resembling *Q. salicina* Bl. but with a larger and different fruit, and *Q. yayeyamensis* Koidz. are the sole representatives of Fagaceae on the Liukiu Islands. No Willow, Alder, Birch nor Carpinus grow there, in fact the familiar types of trees which make up the northern forests are all absent. Tree Figs are numerous, indeed. *Ficus* is the genus richest in species of trees. Both Saxifragaceae and Rosaceae are poorly represented, as is Leguminosae, but genera of Euphorbiaceae are numerous.

On Aka Island in the Karama group grows the handsome large-leaved Liukiu Box (*Buxus liukiuensis* Mak.). It is often a tree 20 ft. tall with a trunk 3 ft. in girth, and a much branched rounded or flattened crown.

An Orange with small, loose-skinned fruit (*Citrus nobilis* var. *spontanea* Ito & Matsum.) is one of the most interesting Liukiu trees. I saw none that could be considered unquestionably wild but I have no reason to question that it is endemic. It is often cultivated and grows full 12 metres tall forming a bushy crown; the fruit is bitter but of passable flavor. The red-flowered *Thea japonica* Nois is a rare plant on Okinawa, but the endemic *T. lutchuensis* Ito with its small white flowers is a common shrub. Of Ericaceae there are few, but this is not surprising when it is remembered that the rocks are mostly coral. On Mt. Genka some 45 miles north of Naha I found the pink-flowered *Rhododenron Tashiroi* Maxim., and in a thicket nearer the sea *R. sublancoletum* Miq. The last named, with its very large scarlet flowers, has been long cultivated in south Japan but is endemic on the Liukiu Islands. The small-flowered *R. serpyllifolium* Miq. is reported from Okinawa and with *Vaccinium bracteatum* var. *Wrightii* Rehd. & Wils., a common plant, completes the list. The black-fruited *Ardisia Sieboldii* is abundant, more usually as a large shrub than a small tree. Rubiaceae is well represented but none of the species are particularly noteworthy. Of the three species of *Viburnum* that grow on Liukiu the endemic *V. suspensum* Lindl., better known as *V. sandankwa* Hassk., is the most interesting, as its real home has only recently become known though long cultivated in Japan.

The following is a list, complete as far as my researches go, of the woody plants known from the three groups of islands which make up the Liukiu Archipelago. The flora of the northern (Oshima) group is naturally most closely related to that of south Japan and especially to that of the islands of Yaku and Tanega. The southern (Sakishima) group is rich in sub-tropical elements and is related to that of south Formosa: the central (Okinawa) group is richest in endemic plants. Analysis of the list shows that 351 species and 23 varieties belonging to 233 genera representing 87 families have been recorded. Of these two genera, *Tashiroa* and *Tetraplasia*, respectively belonging to Melastomaceae and Rubiaceae, together with seventy-one species and six varieties and forms are endemic. Round the coast cosmopolitan warm-temperate and sub-tropical elements abound, but on the mountains the flora is largely of endemic species. Its outstanding feature is its evergreen character, all but 12 of the endemic plants being

of this nature. The affinity of the flora is of course with the adjacent warm-temperate regions of south Japan, eastern China and Formosa.

Species marked with an asterisk are endemic.

CYCADACEAE

- **Cycas revoluta* Thunb.

TAXACEAE

- Podocarpus macrophyllus* D. Don
Podocarpus nagi Zoll. & Moritzi

PINACEAE

- Juniperus conferta* Parl.
**Pinus luchuensis* Mayr

PANDANACEAE

- Pandanus tectorius* Soland.

GRAMINEAE

- Arundinaria linearis* Hack.
**Bambusa liukiensis* Hay.
Bambusa vulgaris var. *striata* Gamble

PALMAE

- Didymosperma Engleri* Warb.
Livistona chinensis R. Br.

LILIACEAE

- Smilax china* L.
**Smilax liukiensis* Hay.
**Smilax nervo-marginata* Hay.
**Smilax stenopetala* A. Gray

PIPERACEAE

- Piper futokadsura* Sieb.

MYRICACEAE

- Myrica rubra* S. & Z.

FAGACEAE

- Castanopsis cuspidata* Schottky
Lithocarpus edulis Rehd.
**Quercus Miyagii* Koidz.
**Quercus yayeyamensis* Koidz.

ULMACEAE

- **Celtis liukiensis* Nakai

MORACEAE

- Broussonetia papyrifera* Vent.
Cudrania javanensis Trec.
Ficus Beecheyana Hook. & Arn.
Ficus erecta Thunb.
**Ficus Fachikoogi* Koidz.

- Ficus gibbosa* Bl.

- Ficus leucantatoma* Poir.
**Ficus Miyagii* Koidz.
Ficus pumila L.
Ficus retusa var. *nitida* Miq.
Ficus Thunbergii Maxim.
Ficus Wightiana Wall.
Ficus sp.
Morus alba L.
Morus bombycis Koidz.

URTICACEAE

- Boehmeria densiflora* Hook. & Arn.
Boehmeria nivea Hook. & Arn.
Debregeasia edulis Wedd.

LORANTHACEAE

- Loranthus yadoriki* Sieb.
Pseudixus japonicus Hay.

OLACACEAE

- Schoepfia jasminodora* S. & Z.

ARISTOLOCHIACEAE

- Aristolochia?* *Kaempferi* Willd.

NYCTAGINACEAE

- Calpidia* sp.

MAGNOLIACEAE

- **Illicium Tashiroi* Maxim.
Kadsura japonica Dunal
Michelia compressa Maxim

TROCHODENDRACEAE

- Trochodendron aralioides* S. & Z.

RANUNCULACEAE

- Clematis apiifolia* DC.
Clematis Benthiana Hemsl.
Clematis Meyeniana Walp.
Clematis paniculata Thunb.
Clematis Pierotii Miq.
**Clematis Tashiroi* Maxim.

LARDIZABALACEAE

- Stauntonia hexaphylla* Decne.

BERBERIDACEAE

- Nandina domestica* Thunb.

MENISPERMACEAE

- **Cissampelos insularis* Nakai
- Cocculus laurifolius* DC.
- Stephania discolor* Spreng.

LAURACEAE

- Actinodaphne lancifolia* Meisn.
- **Beilschmiedia Tanakae* Hay.
- Benzoin citriodorum* S. & Z.
- Benzoin umbellatum* var. *sericeum* Rehd.
- Cassytha filiformis* L.
- **Cinnamomum Doederleinii* Engl.
- Cinnamomum Loureirii* Nees
- Cinnamomum pedunculatum* Nees
- Cinnamomum sericeum* Sieb.
- Litsea glauca* Sieb.
- Litsea japonica* Juss.
- Machilus longifolia* Bl.
- Machilus Thunbergii* S. & Z.

HERNANDIACEAE

- Hernandia peltata* Meisn.

CAPPARIDACEAE

- Crataeva religiosa* Forst.

SAXIFRAGACEAE

- Deutzia crenata* S. & Z.
- Deutzia scabra* Thunb.
- Hydrangea chinensis* Maxim.
- **Hydrangea liukuensis* Nakai
- Itea chinensis* Hook. & Arn.
- Pilostegia viburnoides* var. *parviflora* Oliv.

PITTOSPORACEAE

- Pittosporum glabratum* Lindl.
- **Pittosporum pauciflorum* Hook. & Arn.

HAMAMELIDACEAE

- **Distylium liukuensis* Nakai

ROSACEAE

- **Osteomeles subrotunda* C. Koch
- Photinia Maximowiczii* Decne.
- Prunus macrophylla* S. & Z.
- Prunus spinulosa* S. & Z.
- **Raphiolepis umbellata* var. *liukuensis* Koidz.
- Rhodotypos tetrapetala* Mak.
- Rosa bracteata* Wendl.
- Rosa Luciae* Fr. & Roch. var.
- **Rubus abortivus* O. Kuntze
- **Rubus bracteosus* A. Gray

Rubus corchorifolius var. *glaber* Matsum.

- **Rubus Grayanus* Maxim.
- **Rubus nesiotis* Focke
- Rubus reflexus* Ker-Gawl.
- Rubus rosifolius* var. *coronarius* f. *simpliciflorus* Mak.
- Rubus Sieboldii* Bl.
- Rubus tagallus* Cham. & Schl.
- Rubus triphyllus* Thunb.

LEGUMINOSAE

- Acacia Farnesiana* Willd.
- Acacia pennata* Willd.
- Aeschynomene indica* L.
- Bauhinia japonica* Maxim.
- Bauhinia retusa* Ham.
- Caesalpinia Bonduc* Roxb.
- Caesalpinia Bonducella* Flem.
- Caesalpinia nuga* Sit.
- Caesalpinia pulcherrima* Swartz
- Canavalia obtusifolia* DC.
- Cassia occidentalis* L.
- Derris uliginosa* Benth.
- Desmodium Cephalotes* Wall.
- Desmodium laburnifolium* DC.
- Desmodium oxyphyllum* DC.
- Desmodium podocarpum* DC.
- Desmodium polycarpum* DC.
- Desmodium pulchellum* Benth.
- **Desmodium Tashiroi* Matsum.
- Desmodium triflorum* DC.
- Desmodium umbellatum* DC.
- Entada scandens* Benth.
- Erythrina indica* Lam.
- Euchresta Horsfieldii* Benn.
- Flemingia nana* Roxb.
- Flemingia stricta* var. *pteropus* Baker
- Indigofera hirsuta* L.
- **Indigofera liukuensis* Mak.
- Indigofera trifoliata* L.
- Indigofera trita* L.
- **Intsia Tashiroi* Hayat.
- Lespedeza striata* Hook. & Arn.
- Lespedeza virgata* DC.
- **Maackia Tashiroi* Mak.
- Milletia reticulata* Benth.
- Mucuna gigantea* DC.
- Ormocarpum glabrum* Teijsm.
- Ormocarpum sennoides* DC.
- Pongamia glabra* Vent.
- Pueraria hirsuta* Matsum.
- Rhynchosia minima* DC.
- Rhynchosia volubilis* Lour.
- Sophora tomentosa* L.
- Thermopsis chinensis* Benth.

RUTACEAE

- **Citrus nobilis* var. *spontanea* Ito & Matsum.
Evodia meliaefolia Benth.
Evodia triphylla DC.
Glycosmis cochinchinensis Pierre
Murraya exotica L.
Skimmia japonica Thunb.
Toddalia asiatica Lam.
 **Zanthoxylum Arnottianum* Maxim.
 **Zanthoxylum Hemsleyana* Mak.
 **Zanthoxylum liukiense* Hay.
Zanthoxylum nitidum DC.
 **Zanthoxylum okinawense* Wils.¹

SIMARUBIACEAE

- Picrasma quassioides* Benn.

MELIACEAE

- Aglaia odorata* Lour.
Melia Azedarach L.

MALPIGHIACEAE

- Tristellateia australis* A. Rich.

EUPHORBIACEAE

- Alchornea trewioides* Muell. Arg.
Antidesma japonica S. & Z.
Bischofia javanica Bl.
Breynia rhamnoides Muell. Arg.
Cleidion ulmifolium Muell. Arg.
Croton Cumingii Muell. Arg.
Daphniphyllum glaucescens Bl.
Daphniphyllum macropodum Miq.
Excoecaria Agallocha L.
Excoecaria japonica Muell. Arg.
Glochidion Arnottianum Muell. Arg.
Glochidion bicolor Hay.
Glochidion obovatum S. & Z.
Glochidion zeylanicum A. Juss.
Homonoya riparia Lour.
Macaranga Tanarius Muell. Arg.
Mallotus philippinensis Muell. Arg.
 **Phyllanthus liukiensis* Matsum.
Phyllanthus Urinaria L.
 **Putranjiva Matsumurae* Koidz.
Securinega fluggeoides Muell. Arg.

BUXACEAE

- **Buxus liukiensis* Mak.

ANACARDIACEAE

- Rhus succedanea* L.

AQUIFOLIACEAE

- Ilex cinerea* Champ.
 **Ilex Hanceana* f. *rotundata* Mak.
Ilex integra Thunb.
 **Ilex liukiensis* Loes.
 **Ilex Maximowiczii* Loes.
 **Ilex mutchagara* Mak.
Ilex rotunda Thunb.
 **Ilex Warburgii* Loes.
Ilex sp.

CELASTRACEAE

- Celastrus articulatus* Thunb.
Evonymus japonicus Thunb.
 **Evonymus lutchuensis* Ito
 **Evonymus Tanakae* Maxim.
 **Evonymus Tashiroi* Maxim.
Gymnosporia diversifolia Maxim.
Otherodendron japonicum Mak.

STAPHYLACEAE

- Euscaphis japonica* Pax
Turpinia nepalensis Wall.

ICACINACEAE

- Mappia ovata* var. *insularis* Matsum.

ACERACEAE

- Acer acuminatum* Wall.
 **Acer insulare* Mak.
Acer oblongum var. *microcarpum* Hiern

SAPINDACEAE

- Dodonaea viscosa* Jacq.
Sapindus mukorossi Gaertn.

SABIACEAE

- **Meliosma lutchuensis* Koidz.
Meliosma Oldhamii Miq.
Meliosma rigida S. & Z.

RHAMNACEAE

- Berchemia lineata* DC.
Colubrina asiatica Brong.
Rhamnella franguloides Weber

¹ *Zanthoxylum okinawense* Wilson, n. comb. — *Fagara schinifolia* Ito & Matsumura in Jour. Coll. Sci. Tokyo, XI: 356 (Tent. Fl. Luchu. 89) (1900), pro parte, non Engler. — *Fagara okinawensis* Nakai in Tokyo Bot. Mag. XXVIII: 306 (1914).

LIUKIU ISLANDS: Okinawa and Oshima.

**Rhamnus davuricus* var. *liukuensis*
Wils.¹

**Rhamnus Kanagusukii* Mak.
Sageretia theezans Brongn.

VITACEAE

Ampelopsis brevipedunculata Koehne
Cissus corniculata Planch.
Tetrastigma angustifolia Planch.
Vitis formosana Hemsl.
Vitis lanata Roxb.
Vitis Thunbergii S. & Z.

ELAEOCARPACEAE

Elaeocarpus ellipticus Mak.
Elaeocarpus japonicus S. & Z.

TILIACEAE

Triumfetta procumbens Forst.
Triumfetta rhomboidea Jacq.

MALVACEAE

Abutilon Abelmoschus L.
Abutilon indicum G. Don
Hibiscus mutabilis L.
Hibiscus rosa-sinensis L.
Hibiscus syriacus L.
Hibiscus tiliaceus L.
Hibiscus tiliaceus var. *hamabo* Maxim.
Sida rhombifolia L.
Thespesia populnea Soland.
Urena lobata L.
Urena sinuata L.

STERCULIACEAE

Firmiana simplex Wight
Helicteres angustifolia L.

Heritiera littoralis Dryand.
Melochia corchorifolia L.

DILLENIACEAE

Actinidia callosa var. *rufa* Mak.
Actinidia melanandra Fr.

THEACEAE

Adinandra Millettii Benth.
Eurya emarginata Mak.
Eurya japonica Thunb.
Eurya ochnacea Szyszl.
Eurya symplocina Bl.
**Schima liukuensis* Nakai
Ternstroemia japonica Thunb.
Thea japonica Nois.
**Thea lutchuensis* Ito
**Thea Miyagii* Koidz.
**Thea tegmentosa* Koidz.
**Thea virgata* Koidz.

GUTTIFERAE

Calophyllum inophyllum L.
Garcinia spicata Hook.
Hypericum patulum Thunb.

FLACOURTIACEAE

Idesia polycarpa Maxim.

STACHYURACEAE

Stachyurus lancifolius Koidz.

THYMELAEACEAE

**Wikstroemia retusa* A. Gray

ELAEAGNACEAE

**Elaeagnus liukuensis* Rehd.²
Elaeagnus macrophylla Thunb.

¹ *Rhamnus davuricus* var. *liukuensis* Wilson, var. nov.

A typo recedit foliis majoribus magis chartaceis grossius crenato-serratis glaberrimis nunquam latoribus supra medium, perulis gemmarum ut videtur numerosioribus.

LIUKIU ISLANDS: Okinawa Island, sea-coast, February 28, 1917, *E. H. Wilson* (No. 8003, type; bush 2-3 in. tall; flowers greenish); Naha, Onoyama, common, May 1, 1917, *E. H. Wilson* (No. 8157; bush 2-3 in. tall).

Quite likely this Liukiu plant is a distinct species, but I have specimens bearing male flowers and adult leaves only. On the coast near Naha it is quite a common shrub.

² *Elaeagnus liukuensis* Rehder, sp. nov.

E. H. W.

Frutex sarmentosus, 3-4-metralis, ramis elongatis non spinescentibus sub angulo circiter 45° divergentibus. Folia perennia, chartacea, ovato-elliptica vel elliptica, apice acutiuscula vel subito breviter acuminata, basi rotundata, 4-7 cm. longa et 2.5-3.8 cm. lata, margine leviter revoluta vel fere plana, initio utrinque squamis plerisque ferrugineis obtecta, maturitate supra glabra, nitidula, intense luteo-viridia, subtus fulvescentia vel fere argentea, ad costam pleraque ferruginea, utrinsecus nervis secundariis 5-7 supra in sicco et subtus leviter elevatis, reti nervulorum utrinque obsolete; petioli supra canaliculati, ferruginei, 0.5-1 cm. longi. Flores solitarii, mutantes, 2-6 in ramulis brevibus primo vere vel antea in axillis foliorum evoluti; pedicelli graciles, 0.6-1 cm. longi, ferruginei ut perigonii pars inferior; perigonii pars

LYTHRACEAE

Lagerstroemia subscostata var. *hirtella*
Koehne

SONNERATIACEAE

Sonneratia alba Smith

LECYTHIDACEAE

Barringtonia racemosa Roxb.
Barringtonia speciosa Forst.

RHIZOPHORACEAE

Bruguiera gymnorhiza Lam.
Kandelia Rheedii Wight & Arn.
Rhizophora mucronata Lam.

ALANGIACEAE

Alangium chinense Rehd.

COMBRETACEAE

Lumnitzera racemosa Willd.
Terminalia Catappa L.

MYRTACEAE

Eugenia Jambos L.
Eugenia microphylla Abel
Psidium Guyava var. *pyriferum* Ruthie
Rhodomyrtus tomentosa Wight

MELASTOMACEAE

Blastus cochinchinensis Lour.
Bredia hirsuta Bl.
Melastoma candidum Don
Osbeckia chinensis L.
**Tashiroea okinawensis* Matsum.
**Tashiroea yaeyamensis* Matsum.

ARALIACEAE

Acanthopanax ricinifolius Seem.
Fatsia japonica Decne.

Gilibertia trifida Mak.
Hedera japonica Tobl.
Schefflera octophylla Harms
Tetrapanax papyrifera C. Koch

ERICACEAE

**Rhododendron ellipticum* Maxim.
Rhododendron serphyllifolium Miq.
**Rhododendron sublanceolatum* Miq.
Rhododendron Tashiroi Maxim.
Vaccinium? *Donianum* Clark.
Vaccinium bracteatum var. *Wrightii*
Rehd. & Wils.

MYRSINACEAE

Ardisia Sieboldii Miq.
Maesa formosana Mez
Rapanea neriifolia Mez

PLUMBAGINACEAE

Statice Wrightii Hance

SAPOTACEAE

Sideroxylon? *ferrugineum* Hook. & Arn.

EBENACEAE

**Diospyros liukiuensis* Mak.
Maba buxifolia Pers.

SYMPLOCACEAE

Symplocos caudata Wall. var.
**Symplocos japonica* var. *Nakaharai*
Hay.
Symplocos lancifolia S. & Z.
Symplocos lucida S. & Z.
**Symplocos microcalyx* Hay.
Symplocos neriifolia S. & Z.
**Symplocos okinawensis* Matsum.
Symplocos spicata Roxb.
**Symplocos Tanakae* Matsum.
**Symplocos Tashiroi* Matsum.

superior tubuloso-campanulata, basi subito constricta, 6 mm. longa, intus glaber ut pars inferior, extus squamis argenteis rufescentibus intermixtis obtecta ut lobi late ovati, acuti, 4 mm. longi, intus stellato-pilosi; antherae oblongae, lobos dimidios non superantes, filamentis 0.75 mm. longis medio affixae; stylus antheras medias vix superans, pilis stellatis perpaucis munitus, stigmatibus leviter curvato; discus inconspicuus. Fructus non visi.

LIUKIU ISLANDS: Okinawa Island, common round Naha, March 1, 1917. *E. H. Wilson* (No. 8159).

This species seems to be most closely related to *E. Henryi* Warburg and *E. sarmentosa* Rehder, which both are readily distinguished by the narrower acuminate leaves and the longer perigon. The Japanese botanists seem to have confused it with *E. glabra* Thunberg, as the latter is credited to the Liukiu Islands by Nakai (in Tokyo Bot. Mag. xxx. 74 [1916]), but that species differs chiefly in the longer perigon slightly constricted and the upper part gradually narrowed, in the shorter pedicels and the acuminate leaves. *Elaeagnus rotunda* a Nakai from the Bonin Islands which is somewhat similar in the shape of its leaves, is easily distinguished by its slender and longer petioles, more or less persistent scales on the upper surface of the leaves, by their often broadly cuneate base and by the short pedicels. A. R.

STYRACACEAE

Styrax formosanus Matsum.

OLEACEAE

Fraxinus insularis Hemsl.

**Fraxinus minute-punctata* Hayat.

**Jasminum superfluum* Koidz.

Ligustrum japonicum Thunb.

**Ligustrum liukuense* Koidz.

**Osmanthus bracteatus* Matsum.

LOGANIACEAE

Buddleia curviflora Hook. & Arn.

APOCYNACEAE

Alstonia scholaris R. Br.

Anodendron laeve Maxim.

Cerbera odollam Gaertn.

Hoya carnosa R. Br.

Marsdenia tinctoria R. Br.

Marsdenia tomentosa Morr.

**Stephanotis lutchuensis* Koidz.

Trachelospermum divaricatum var. *brevispalum* Schneid.

Tylophora japonica Miq.

**Tylophora liukuensis* Matsum.

**Tylophora stenoloba* Warb.

CONVOLVULACEAE

Erycibe obtusifolia Benth.

Ipomaea biloba L.

BORAGINACEAE

Ehretia acuminata R. Br.

**Ehretia ovalifolia* var. *liukuensis* Matsum.

Tournefortia argentea L.

VERBENACEAE

**Callicarpa australis* Koidz.

Callicarpa mollis S. & Z.

**Callicarpa oshimensis* Hay.

Clerodendron fragrans Vent.

Clerodendron inerme Gaertn.

Clerodendron japonicum Mak.

Clerodendron trichotomum Thunb.

Lantana camara L.

Premna integrifolia L.

Vitex Negundo L.

Vitex ovata Thunb.

SOLANACEAE

Solanum verbascifolium L.

MYOPORACEAE

Myoporum bontioides A. Gray

RUBIACEAE

Adina racemosa Miq.

Chomelia corymbosa K. Schum.

Damnacanthus indicus var. *genuinus* Mak.

Gardenea augusta Merr.

Ixora chinensis Lam.

**Lasianthus Tashiroi* var. *pubescens* Matsum.

Morinda umbellata L.

Mussaenda parviflora Miq.

Paederia tomentosa Bl.

Psychotria elliptica Ker-Gawl.

Psychotria serpens L.

Randia canthioides Champ.

Serissa foetida Comm.

**Tetraplasia biflora* Rehd.¹

Thysanosperrum diffusum Champ.

Tricalysia viridiflora DC.

Wendlandia glabrata DC.

CAPRIFOLIACEAE

**Lonicera japonica* var. *Miyagusukiana* Mak.

Sambucus formosana Nakai

Viburnum japonicum Spreng.

Viburnum odoratissimum Ker.

**Viburnum suspensum* Lindl.

GOODENIACEAE

Scaevola Koenigii Vahl.

APPENDIX

LIST OF WOODY PLANTS OF THE KAWANABE ISLANDS
COMPILED BY MR. USHIWO

The Kawanabe or Tokara Islands are situated between Lat. 28° 30' and 30° 10' N., and Long. 129° to 130° E. They are eleven in number and stretch from south of the islands of Yaku and Tanega lying south of Japan nearly to Oshima. All are small in size and are composed of coral and volcanic rock and are windswept and

¹ See p. 190.

very difficult of access. None of them rise more than a few hundred feet above sea-level. Three are treeless and uninhabited; on the others a few fishermen live. In 1914 I visited Yaku-shima where *Pinus Thunbergii* Parl. is indigenous and in 1917 Oshima where *Pinus lutchuensis* Mayr grows. In relation to the geographical distribution of these two Pines it seems desirable to know what species grew on the intervening Kawanabe Islands.

On my return to Kago-shima from the Liukiu Islands in March, 1917, I discussed the matter with Dr. Naito, chief of the local forestry bureau, to whom I was greatly indebted for valuable assistance in 1914 and again in 1917. Dr. Naito shared my view on the importance of this subject and detailed one of his assistants to make a tour of the islands and to collect all the Conifers he found there. Mr. Ushiwo, who had been my companion to the Liukiu Islands, was selected for the task and he most successfully carried it out. He visited the principal six of the eleven islands. Of the other five, three he states are treeless and on the other two he was unable to land. The tides and currents are very strong and it is only at certain seasons that fishing boats can make a landing. Mr. Ushiwo collected specimens and compiled a list of all the woody plants found on the six islands he visited. The list is phyto-geographically of much importance and is here published as an appendix to the preceding account of the Liukiu Islands. The Conifers were sent to me for determination and it is interesting to note that the only Pine that grows there is *Pinus lutchuensis* Mayr.

Mr. Ushiwo in his list enumerates 114 species and 13 varieties belonging to 93 genera of 53 families. Of these *Rhododendron indicum* var. *eriocarpum* Hay. appears to be endemic. If comparison be made with my list of Liukiu plants it will be seen that the woody vegetation of the Kawanabe Islands is essentially the same as that of the Liukiu Islands. It appears that on Yaku-shima and Tanega-shima most of the typical woody plants of Japan reach their southern limit.

E. H. WILSON

CYCADACEAE

Cycas revoluta Thunb.

TAXACEAE

Podocarpus macrophyllus D. Don

Podocarpus nagi Zoll. & Moritzi

PINACEAE

Juniperus conferta Parl.

Pinus luchuensis Mayr

PANDANACEAE

Pandanus tectorius Soland.

GRAMINEAE

Arundinaria linearis Hack.

Arundinaria tootsik Mak.

PALMAE

Didymosperma Engleri Warb.

Livistona chinensis R. Br.

LILIACEAE

Smilax china L.

MYRICACEAE

Myrica rubra S. & Z.

SALICACEAE

Salix purpurea L.?

BETULACEAE

Alnus firma var. *hirtella* Schneid.

FAGACEAE

Castanopsis cuspidata Schottky

Castanopsis edulis Mak.

Quercus glauca Thunb.

ULMACEAE

Celtis sinensis var. *japonica* Nak.

Trema orientalis Planch.

MORACEAE

Ficus erecta Thunb.

Ficus nervosa Heyne

Ficus pumila L.

Ficus retusa var. *nitida* Miq.

Ficus Wightiana Benth.

Morus bombycis Koidz.

NYCTAGINACEAE

Calpidia sp.

LORANTHACEAE

Loranthus yadoriki Sieb.

Pseudixus japonicus Hay.

MAGNOLIACEAE

Illicium anisatum L.

Kadsura japonica Dunal

LARDIZABALACEAE

Stauntonia hexaphylla Decne.

LAURACEAE

Actinodaphne acuminata Meisn.

Benzoin citriodorum S. & Z.

Cinnamomum pedunculatum Nees

Cinnamomum sericeum Nees

Litsea glauca Sieb.

Litsea japonica Juss.

Machilus longifolia Bl.

Machilus Thunbergii S. & Z.

CAPPARIDACEAE

Crataeva religiosa Forst.

SAXIFRAGACEAE

Deutzia crenata Thunb.

Deutzia gracilis S. & Z.

Hydrangea chinensis Maxim.

Hydrangea paniculata Sieb.

PITTOSPORACEAE

Pittosporum tobira Ait.

ROSACEAE

Prunus serrulata f. *spontanea* Wils.

Raphiolepis umbellata Mak.

Raphiolepis umbellata var. *liukiensis* Koidz.

Rubus rosaefolius Smith

Rubus triphyllus Thunb.

LEGUMINOSAE

Albizzia Julibrissin Durraz.

Maackia Tashiroi Mak.

RUTACEAE

Evodia meliaefolia Benth

Zanthoxylum ailanthoides S. & Z.

Zanthoxylum piperitum DC.

Zanthoxylum schinifolium S. & Z.

MELIACEAE

Melia Azedarach L. (planted)

EUPHORBIACEAE

Daphniphyllum glaucescens Bl.

Daphniphyllum macropodum Miq.

Gelonium aequoreum Hance

Glochidion honkongense Muell. Arg.

Glochidion odoratum S. & Z.

Mallotus japonicus Muell. Arg.

Phyllanthus flexuosus Muell. Arg.

ANACARDIACEAE

Rhus succedanea L.

AQUIFOLIACEAE

Ilex crenata var. *Fukasawana* Mak.

Ilex integra Thunb.

Ilex rotunda Thunb.

CELASTRACEAE

Celastrus articulatus var. *punctata* Mak.

Evonymus japonicus Thunb.

Evonymus sp.

Evonymus Tanakae Maxim.

Otherodendron japonicum Mak.

STAPHYLEACEAE

Euscaphis japonica Pax

Turpinia nepalensis Wall.

SABIACEAE

Meliosma myriantha S. & Z.

ELAEOCARPACEAE

Elaeocarpus ellipticus Mak.

Elaeocarpus japonicus S. & Z.

MALVACEAE

Hibiscus mutabilis L.

Hibiscus tiliaceus var. *hamabo* Maxim.

THEACEAE

Eurya emarginata Mak.

Eurya japonica Thunb.

Eurya ochnacea Szysz.

Ternstroemia japonica Thunb.

Thea japonica var. *spontanea* Mak.

STACHYURACEAE

Stachyurus lancifolius Koidz.

FLACOURTIACEAE

Idesia polycarpa Maxim.

ELAEAGNACEAE

- Elaeagnus glabra* Thunb.
Elaeagnus macrophylla Thunb.

THYMELAEACEAE

- Daphne cannabina* Wall.

ARALIACEAE

- Aralia chinensis* var. *glabrescens* L.
Fatsia japonica Decne. & Planch.
Gilibertia trifida Mak.
Schefflera octophylla Harms.

CORNACEAE

- Aucuba japonica* Thunb.

ERICACEAE

- Rhododendron indicum* var. *eriocarpum*
 Hay.
Rhododendron Tashiroi Maxim.
Vaccinium bracteatum Thunb.

MYRSINACEAE

- Ardisia crispa* DC.
Ardisia hortorum Maxim.
Ardisia Sieboldii Miq.
Maesa japonica var. *latifolia* Miq.
Myrsine neriifolia Mez.

SAPOTACEAE

- Sideroxylon ferrugineum* Hook. & Arn.

SYMPLOCACEAE

- Symplocos caudata* Wall.
Symplocos lucida S. & Z.
Symplocos neriifolia S. & Z.

STYRACACEAE

- Styrax japonicus* S. & Z.

OLEACEAE

- Fraxinus insularis* Hemsl.
Ligustrum japonicum S. & Z.
Ligustrum sp.
Osmanthus bracteatus Matsum.

APOCYNACEAE

- Trachelospermum divaricatum* K.
 Schum.

VERBENACEAE

- Callicarpa japonica* Thunb.
Clerodendron trichotomum Thunb.
Vitex ovata Thunb.
Vitex trifoliolata L.

BORAGINACEAE

- Tournefortia argentea* L. f.

RUBIACEAE

- Damnacanthus indicus* var. *genuinus*
 Mak.
Gardenia augusta Merr.
Lasianthus japonicus Miq.
Mussaenda parviflora Miq.
Psychotria elliptica Ker-Gawl.

CAPRIFOLIACEAE

- Lonicera affinis* var. *pubescens* Maxim.
Viburnum japonicum Spr.
Viburnum odoratissimum Ker-Gawl.

GOODENIACEAE

- Scaevola Koenigii* Vahl

FOUR NEW CONIFERS FROM KOREA

E. H. WILSON

- Thuja koraiensis* Nakai in Tokyo Bot. Mag. xxxiii. November (1919).
 — *Thuja japonica* Komarov in Act. Hort. Petrop. xx. 206 (Pl. Mandsh.
 I.) (1901), non Maximowicz. — Nakai, Veget. Mt. Waigolbon, 32 (1916).
 — *Thuja Standishii* Nakai in Jour. Coll. Sci. Tokyo, xxxi. 382 (Fl. Kor.
 II.) (1911), non Carrière. — *Thuja odorata* Doi in Tokyo Bot. Mag. xxix.
 [422] (1915), nom. nudum, non Marshall. — *Thuja kongonensis*¹ Doi apud
 Nakai, Rep. Veget. Diamond Mts. 163 (1918), nom. nudum.

¹ Such a specific name derived from Kongo-san or Diamond Mountains in Korea is apt to mislead people into assuming that the plant is from the Congo (Kongo) region in Africa; to avoid this contingency I suggested to Dr. Nakai that it be rejected.

Arbor gracilis, 6-9-metralis, trunco 0.5-0.75 m. in circuitu, cortice tenui, squamoso, purpureo-brunneo (chocolate-brown), coma anguste pyramidalis, vel saepius frutex ramis patentibus, habitu indistincto, ramis sparsis decumbentibus, rarius horizontaliter patentibus, apice ascendentibus; ramuli applanati, frondosi. Folia compressa, in turionibus triangularia vel triangulari-ovata, acuminata, dorso glandulifera, demum brunnescentia et ad quartum annum persistentia, ea ramulorum lateralium deltoidea vel obdeltoidea vel rhomboidea, acutiuscula vel obtusa, supra lucide viridia et glandulifera, subtus glauca. Strobili erecti, ovoides, circiter 1 cm. longi et 6 mm. diam., avellanacei; squamae tenues, 6, paria duo inferiora fertilia, eae paris infimilatae, paris superioris fertilium anguste obovatae, 7 mm. longae et 4-5 mm. latae, acutiusculae vel rotundatae, margine puberulae, dorso paulo infra apicem mucrone leviter recurvo nigrescente instructae; semina ala inclusa ovalia, 4 mm. longa et 2.5-3 mm. lata, profunde emarginata, ut videtur 10 in strobilo quoque.¹

KOREA: prov. Kogen, Kongo-san, summit of Miroku-ho, alt. 1500 m., October 12, 1917, *E. H. Wilson* (No. 9244, type); same locality, alt. 1000-1500 m., July 6, 1918, *E. H. Wilson* (No. 10,481); same range of mountains, round Hermitage, alt. 800-1000 m., September 13, 1918, *E. H. Wilson* (No. 10,725); prov. North Heian, near Kanin, alt. 1200-1300 m., September 11, 1917, *E. H. Wilson* (No. 9138); same province, near Nanshatongu, September 1, 1917, *E. H. Wilson* (No. 9088); prov. South Kankeyo, Laoling-san, middle and upper slopes, alt. 1000-2000 m., September 17, 1917, *E. H. Wilson* (No. 9175).

This is a very interesting addition to the genus and is remarkable in its variation in habit from a sprawling shrub of nondescript shape to a slender, graceful, narrow-pyramidal tree. The Japanese species (*T. Standishii* Carr.) to which it is most closely related and with which it has been confused by Komarov and others, is always a tree and is sometimes as much as 17 meters tall with a trunk 3.5 meters in girth; its branches are never decumbent, its leaves are uniformly smaller, less compressed, green on both surfaces and the fruit is broader and of a more mahogany-brown color, and the cone-scales are thicker.

The Korean *Thuja* is found on the middle and upper slopes of all the higher mountains, except those of volcanic origin, from the Diamond Mts. northward. On many peaks of the Diamond Mts. it is abundant and is especially so on Miroku-ho and in the descent of the Nemon-rei pass toward Makaen-an Temple. Usually it forms an impenetrable tangle from 0.3-2 meters tall, but in sheltered ravines it is often a pretty tree from 1.5-3 meters tall and from 15-30 centimeters in girth of trunk. The wood is moderately heavy, reddish brown with white sap-wood and is very fragrant. In forests its growth judging by the annual rings is very slow. Its habit of growth on the forest floor resembles that of *Thujopsis dolabrata* S. & Z. The foliage is very white below and often the whole plant has a decided bluish appearance. The branches grow downward and outward and are

¹ When this number was already in page form I received a letter from Dr. Nakai informing me that he had described this *Thuja* in the November number of the Tokyo Botanical Magazine under the name of *Thuja koraiensis* Nakai.

upturned toward the end. The habit of the trees is decidedly graceful, but the branches are sparse. Near the village of Nanshatongu, on the borders of South Kankyo and North Heian provinces, in forests of Spruce and Fir this *Thuja* is abundant and small, slender trees are common. In the middle upper slopes of Laoling-san — a peak some 2000 meters high — in northern Korea it forms an undergrowth to *Pinus pumila* Regel. As a garden plant this *Thuja* should be valuable as a ground cover and also as a shrub or small tree. I collected seeds on the Diamond Mts. in 1917 and the plants raised from them are now growing well in the Arnold Arboretum.

Abies koreana, sp. nov. — *Abies nephrolepis* Nakai, Rep. Veget. Chirisan, 23, no. 27 (1915); Rep. Veget. Quelpaert Isl. 13, no. 142 (1915), non Maximowicz.

Arbor 10–15-metralis, trunco 1–2.5 m. in circuitu, cortice arborum juvenilium purpuracente ad pallide cinereo, laevi, lenticellis prominentibus transversalibus et pustulis resiniferis paucis vel nullis praedito, in arboribus vetustis in lamellas irregulares asperas fisso, cinereo-albido subtus rubro-brunneo; rami numerosi, patentes; ramuli leviter sulcati, sparse cinereo-pubescentes, demum glabri, initio pallidi, demum purpurascens; gemmae subglobosae, leviter resinosae, lucide castaneo-brunneae, perulis membranaceis obtusis vel acutiusculis per plures annos basin ramulorum cingentibus persistentibus. Folia congesta, flexilia, 0.8–2 cm., pleraque 1–1.5 cm. longa et 2–2.5 mm. lata, pleraque apicem versus latiora, rotundata et emarginata, interdum integra et mucrone pungente instructa, supra canaliculata, lucida et intense viridia, subtus albida vel pallida, carinata, margine revoluta; ductus resiniferi duo, laterales, sub epidermate. Strobili violaceo-purpurei, bracteis stramineis exsertis et reflexis muniti, globulis resinosis paucis vel nullis praediti, cylindrici, 5–7 cm. longi et 2.5–2.8 cm. diam., apice applanati et saepe leviter umbilicati; squamae reniformes, 1.7–2 cm. latae et unguiculo excluso 6–8 mm. altae, rotundatae, leviter inflexae, margine laterali membranaceae, basi auriculatae, unguiculo ligneo; bractee squamas circiter aequilongae, spathulatae, 1.2–1.4 cm. longae, truncatae et leviter erosae, mucrone rigido 2–2.5 mm. longo instructae, in strobilo maturo apice reflexo tantum exserto; semina intense violaceo-purpurea, ala inclusa 1.1–1.2 cm. longa, ala dolabriformi violaceo-maculata truncata vel rotundata.

KOREA: Quelpaert Island, Hallai-san, alt. 1000–1900 meters, October 31, November 5, 1917, *E. H. Wilson* (Nos. 9486, type, 9486a); same locality, May, June, July, August, 1907, *U. Faurei* (Nos. 1517, 1518, 1519, 1520, 1522); same locality, June, July, 1909, *Émile Taquet* (Nos. 3263, 3265, 3266); prov. South Keisho, Chiri-san, alt. 1000–1840 meters, November 16, 1917, *E. H. Wilson* (No. 9602).

This new Fir is a most interesting addition to the flora of Korea where it is confined to the volcanic island of Quelpaert and to the Chiri-san range in the south of the peninsula. It is characterized by its pyramidal habit, its deeply fissured rough bark and by its cones with exserted bracts. It combines most of the characters of the three related species *Abies nephrolepis* Maxim., *A. sachalinensis* Mast. and *A. Veitchii* Lindl. The first has

similar but less rough bark, longer leaves with median resin-ducts and the bracts of the cone are included; *Abies sachalinensis* has a cone with exserted reflexed bracts but is greenish purple in color; the leaves have median resin-ducts and the bark is perfectly smooth with prominent resin pustules; *Abies Veitchii* has a similar habit and leaves with lateral resin-ducts, but in this species the bark is always smooth and the bracts of the cone-scales are shorter or only slightly longer than the scales. The new species is certainly very distinct and its very rough bark is unique among the species of its group.

Abies koreana Wils. is an alpine species and on Hallai-san is abundant above altitudes of 1000 meters, either forming pure woods or mixed with *Betula Ermani* Cham., but the trees are not large. On Chiri-san, on the mainland, it is common above 1200 meters to the summit (1850 meters), growing with mixed deciduous leaved trees and *Picea jezoënsis* Carr., and there the trees reach their maximum development. From youth to middle age it is a handsome tree, densely branched and with its lower branches sweeping the ground; the habit is rather broadly pyramidal, and the lustrous green leaves with their white undersurfaces add character to the tree. It produces cones rather freely but less so than *A. nephrolepis* Maxim. Old trees are scrawny and not attractive. Dr. T. Nakai confused this species with *A. nephrolepis* Maxim., but when traveling together on Hallai-san I pointed out differences and he readily concurred that the two were quite distinct species.

Père U. Faurie was the first to discover this Fir, and his specimens together with those of Père Taquet have been for some years in this herbarium unnamed. When studying the Chinese Firs for *Plantae Wilsonianae* and those of Japan for my *Conifers and Taxads of Japan* I noted the difference of the Quelpaert plant and in 1917 visited the island to study the living tree. I was able to secure a supply of seeds of this Fir which were sent to the Arnold Arboretum where plants are now growing.

Abies nephrolepis f. *chlorocarpa* Wilson, forma nov. A typo recedit colore viridi strobili, margine superiore squamarum tantum leviter violaceo-purpurea.

KOREA: prov. Kogen, Kongo-san, round Yutenji Monastery and on Mt. Mirokuho, alt. 600–1600 m. July 7, 1918, *E. H. Wilson* (No. 10,509).

This variety only differs from the type in the color of the cone which is green with the upper edge of the cone-scale faintly tinged with violet-purple. It is common where it grows mixed with type. This is the third instance of a green-coned variety among the species of *Abies* of the Orient with typical violet-purple colored cones — the others being *Abies homolepis* var. *umbellata* Wils. and *Abies Veitchii* var. *olivacea* Shiras. I collected seeds in the autumn of 1918 of this new variety and a stock of young plants are now growing in the Arnold Arboretum.

Larix dahurica var. *Principis-Rupprechtii* f. *viridis* Wilson, forma nov.

A typo recedit strobilis viridibus plerisque majoribus.

KOREA: prov. Kogen, planted, grounds of Yutenji Monastery, Kongo-san, alt. 500 m., July 7, 1918, *E. H. Wilson* (No. 10,508 type); Makaen-an Monastery, Kongo-san planted, October 11, 1917, *E. H. Wilson* (No. 9287).

This form is characterized by its unusually large, clear green cones. Two trees are planted in the grounds of the Yutenji Monastery and one in those of the Makaen-an Monastery on the Kongo-san (Diamond Mts.). I could not find out their origin but they must have been brought from northern Korea since the Larch grows in Korea on the volcanic soils of the north only. In the extreme north the typical *L. dahurica* Turcz. is found, but most of the Larch in Korea is referable to the large-coned variety, *Principis-Rupprechtii* Rehd. & Wils. The cone of this variety is exceedingly variable in size even on the same branch, and individual trees bearing green and reddish cones are occasionally found. But I did not see wild trees with such uniformly large, green cones as those here described. I gathered seeds in 1918 and plants are now growing in the Arnold Arboretum.

TETRAPLASIA, A NEW GENUS OF RUBIACEAE

ALFRED REHDER

FLORES tetrameri, hermaphroditi; calyx late campanulatus, ovario adnatus, lobis brevibus latisque erectis; corolla infundibuliformis, extus glabra, tubo intus praesertim ad faucem piloso, lobis ovatis valvatis; stamina inclusa, 4, filamentis brevibus paulo supra medium tubi affixis, antheris oblongis dorsifixis; stylus apice 4-fidus, stigmatibus filiformibus recurvis; ovarium inferum, 4-loculare, loculis uni-ovulatis, ovulis pendentibus. Fructus drupaceus, bacciformis, carnosus; putamen subglossum, crustaceum, monospermum; semen majusculum, subglobosum, endospermate copioso; embryo parvus, rectus, cotyledonibus brevibus latis. — Frutex glaber, foliis ellipticis coriaceis, stipulis intrapetiolaribus, floribus parvis in cymis bifloris terminalibus et axillaribus, fructu bacciformi rubro.

Species unica in insulis Liukiu dictis.

This new genus apparently belongs to the tribe Vanguerieae which is characterized by uni-ovulate locules of the ovary, pendent ovules, valvate corolla-lobes, stamens inserted near the mouth, drupaceous fruit and copious endosperm. *Tetraplasia*¹ seems most closely related to *Plectronia* and *Vangueria* from which it differs chiefly in the 4-parted style, the 4-celled ovary and in the small, 2-flowered inflorescence.

Tetraplasia biflora, sp. nov.

Frutex 2–3-metralis, glaber, ramis dichotomis, junioribus quadrangularibus viridibus, vetustioribus flavo-griseis teretibus. Folia crasse coriacea, elliptica, utrinque acuta vel apice leviter acuminata, margine vix vel leviter recurva, 5–10 cm. longa et 2–5.5 cm. lata, supra lucidula, laete viridia, subtus pallide viridia, costa media supra leviter impressa, subtus leviter elevata,

¹ From Greek τετραπλάσιος, fourfold, referring to the tetramerous flowers.

crassa, utrinsecus nervis 5-7 obsolete, interdum in sicco supra leviter impressis, subtus tantum colore pallidiore notatis; petioli crassiusculi, supra canaliculati, 0.5-1 cm. longi; stipulae intrapetiolares parvi abrupte acuminati, cartilagineae, pallidae. Flores ut videtur albi, in sicco nigrescentes, in cymis bifloris axillaribus et terminalibus, interdum pedunculo brevi bracteis 4-8 per paria basi connatis parvis pallidis acuminulatis instructo suffultis; pedicelli 2-3 mm. longi; calyx late campanulatus, lobis brevibus late semiorbicularibus acuminulatis; corolla infundibuliformis, tubo 7-9 mm. longo intus supra medium et praesertim ad faucem piloso, lobis ovatis acutiusculis 4-5 mm. longis utrinque glabris; antherae basin loborum non attingentes, 2.5 mm. longae; filamenta brevina, glabra; stylus glaber, corollae lobis brevior. Fructus subglobosus, 6-7 mm. diam., ruber, calycis lobis brevissimis vix conspicuis coronatus et apice cicatricibus corollae et styli notatus, putamen 4 mm. diam., flavescens, laeve.

LIUKIU ISLANDS: Okinawa Island, Mt. Genka, March 6, 1917, *E. H. Wilson* (No. 8094.)

This evergreen shrub is interesting as representing a genus endemic to the Liukiu Islands, but it has no conspicuous characters in its general appearance and its flowers and fruits, which are probably produced throughout the year, are insignificant.

NEW SPECIES, VARIETIES AND COMBINATIONS FROM THE HERBARIUM AND THE COLLECTIONS OF THE ARNOLD ARBORETUM ¹

ALFRED REHDER

TAXACEAE ²

Taxus cuspidata Sieb. & Zucc. f. *aurescens*, forma nova.

A typo recedit foliis ramulorum juvenilium plus minusve luteis et statura humiliore.

Cultivated at the Arnold Arboretum. Type specimens collected October 30, 1919, preserved in the herbarium of the Arboretum.

This is the first variegated form known of the Japanese Yew. It is a low and apparently slow-growing plant with the leaves of the current year's growth colored deep yellow. The color is most pronounced on the more exposed branchlets; on most of the individual leaves and particularly on the lower ones the color passes into green toward their base and after the first season the whole leaf changes gradually to green. The plant has been secured from Japanese dealers who offer it as "*Taxus tardiva* yellow-variegated."

PINACEAE ³

Juniperus squamata Lambert f. *Wilsonii*, forma nova. — *J. squamata* Rehder & Wilson in Sargent Pl. Wilson II. 57 (1914), pro parte, non Lambert.

¹ Continued from p. 146.

² See also p. 51.

³ See also p. 52.

A typo recedit habitu erecto, ramulis brevibus congestis apice plerisque recurvis, foliis densissime imbricatis latoribus et paulo brevioribus, late lanceolatis vel ovato-lanceolatis 4-5 mm. longis et basi 1.5 mm. latis dorso vix sulcatis.

CHINA. Western Szechuan: neighborhood of Tachien-lu, alpine regions, alt. 3000-5000 m., July and September, 1908, *E. H. Wilson* (No. 985, in part); west and near Wên-chuan Hsien, moorlands, alt. 3000-4300 m. September, 1908, *E. H. Wilson* (No. 985, in part); west of Kuan Hsien, Pan-lan-shan, alpine moorlands, alt. 4000-4600 m., October, 1910, *E. H. Wilson* (No. 4085). Western Hupeh: Fang Hsien, Ta-pa-shan, moorlands and open rocky country, alt. 3000-3600 m., May 16, 1907, *E. H. Wilson* (No. 985, in part). Shensi: Tai-peï-shan, 1910, *W. Purdom*.

This is apparently only an ecological form which may pass according to altitude and exposure gradually into the typical prostrate form, but occasionally attains 2.5 m. in height. As cultivated at the Arboretum it looks very different from the typical form assuming the shape of conical bushes consisting of several stems close together with the short crowded branchlets usually recurved at the tips. The leaves are shorter and broader than in the type and more closely imbricate. The tree form, *J. squamata* var. *Fargesii* Rehder & Wilson, is easily distinguished, even as a small plant, by the longer and slenderer leaves and the upright or spreading tips of the branchlets. The plants in cultivation were raised from seed sent by E. H. Wilson from Wên-chuan Hsien and from Pan-lan-shan in western Szechuan in 1909 and 1911. A picture of this shrub will be found under No. 228 of the collection of Wilson's photographs and in his *Vegetation of Western China*, No. 265.

Picea glauca Voss var. *albertiana* Sarg. f. *conica*, forma nova.

A typo varietatis recedit habitu anguste conico, ramulis brevibus tenuibusque dense congestis in sulcis saepe sparse pilosis, foliis radiatim patentibus tenuibus 0.5-0.75 mm. crassis et circiter 1 cm. longis plerumque curvatis apice in mucronem longum attenuatis, perulis basilaribus gemmae terminalis non ciliatis.

Cultivated at the Arnold Arboretum, grown from seedling plants collected near Laggan, Alberta, in 1904 by J. G. Jack. Type specimens collected November 3, 1919, preserved in the herbarium of the Arboretum.

This very peculiar form of the Western White Spruce is of slow growth and forms dense bushes of narrow conical shape consisting of closely packed thin and short branchlets, which are light yellowish gray during their first year and glabrous or sparingly hairy in the furrows between the pulvini. The leaves are very different from the type and very characteristic; they are radially disposed around the stem, thin and slender, less than 1 mm. thick and 0.8-1.2 cm. long, narrowed into a long and slender spiny point and more or less curved; the four stomatiferous bands consists of 1-3 more or less interrupted lines and are not conspicuous. The winter buds are brown and but slightly resinous, the scales are usually rounded at the apex

and the basal scales of the terminal buds are acuminate, as characteristic in var. *albertiana*, while in typical *P. glauca* the scales are emarginate at the apex.

Picea glauca conica on account of its very characteristic habit and aspect promises to become one of the most favorite dwarf Spruces. Like other dwarf conifers it is easily increased by cutting so that it may become a common garden plant.

Picea mariana Brit., Sterns & Pogg. f. *ericoides*, forma nova. — *P. ericoides* Masters in Kew Hand-list Conif. 65 (1896), nom. nudum.

A typo recedit habitu humiliore late pyramidalis, ramulis flavo-brunneis, robustioribus apicem versus saepe glabrescentibus, foliis parvis 5–8 mm. longis, obscure cyaneo-viridibus nec glaucescentibus.

Cultivated at the Arnold Arboretum; received from the Roy. Botanic Gardens, Kew, in 1900. Type specimens collected April 5, 1917, preserved in the herbarium of the Arboretum.

This form of the Black Spruce forms a pyramidal bush loosely branched, of slow growth with short and slender light reddish or yellowish brown branchlets, the leading shoots glabrescent toward the apex. The leaves are less than one cm. long, of dull bluish green color and finely pointed. Our plant is undoubtedly the one enumerated by Masters as *P. ericoides*, as it was received from Kew under that name which is fairly descriptive of its appearance. It is of little ornamental value, which accounts for the fact that it has not been mentioned elsewhere nor described in horticultural literature.

LILIACEAE

Yucca flaccida Haworth var. *major*, comb. nov. — *Y. glaucescens* Haworth, Suppl. Pl. Succ. 34 (1819). — Sweet, Brit. Flow. Gard. I. t. 53 (1824). — *Y. orchioides* var. *major* Baker in Bot. Mag. CHH. t. 6316 (1887). — *Y. filamentosa* var. *Y. glaucescens* Baker in Jour. Linn. Soc. XVIII. 228 (1880). — *Y. filamentosa* var. *Y. antwerpensis* hort. apud Baker, l. c. (1880). — *Yucca flaccida glaucescens* (Haworth) Trelease in Missouri Bot. Gard. Rep. XIII. 51, t. 12, fig. 2, t. 13–15, t. 17, fig. 1, t. 76, fig. 2, t. 79, fig. 2 (1902).

This variety differs from the type chiefly in the mostly broader, more glaucous leaves remaining upright a longer time, in its almost tomentose panicle and the attenuate petals. It is much cultivated in American gardens.

RANUNCULACEAE

Paeonia suffruticosa var. *spontanea*, var. nov. — *Paeonia suffruticosa* Rehder & Wilson, in Sargent, Pl. Wilson. I. 319 (1913).

A typo recedit foliolis ovatis vel late ovatis inciso-dentatis vel trifidis, basi rotundatis vel late cuneatis, 3–7 cm. longis, subtus ad nervos praesertim basin versus pilosis, floribus 10–12 cm. diam. roseis, petalis circiter 10, interdum staminibus petaloideis praeditis.

CHINA. Shensi: 50 li west of Yunan Fu, 1910, *W. Purdom* (No. 338); Tai-pei-shan, 1910, *W. Purdom* (sterile).

The wild form differs from the cultivated garden forms chiefly in the broader and smaller leaflets rounded or broadly cuneate at the base and pilose on the nerves beneath, particularly toward the base of the leaflets. It also produces suckers freely, while the cultivated forms do not sucker. From the nomenclatorial type of the species which is *P. suffruticosa* var. *rosea* Bailey it further differs in the smaller flowers with fewer petals, but a plant of the wild form introduced by Purdom into cultivation which has flowered in the garden of Professor C. S. Sargent had larger flowers and more petals than the wild specimens. The disk is very high and envelops the carpels entirely up to the stigmas.

P. suffruticosa Andr. f. *Anneslei*, comb. nov. — *P. Moutan* *Anneslei* Sabine in Trans. Hort. Soc. vi. 482, tab. (1826).

A form with purple, nearly single flowers which seem to come nearest to the wild form.

× *Paeonia Lemoinei*, nom. nov. (*P. lutea* × *suffruticosa*). — *Paeonia* "l'Espérance" Lemoine & Fils, Cat. No. 173, vii. (1909). — *P.* "La Lorraine" Lemoine & Fils, Cat. No. 182, tab. (1912). — Gard. Chron. ser. 3, LVII. 56, 68, tab. col. (1915).

This new hybrid was raised by V. Lemoine & Fils, of Nancy, about 1900 and "La Lorraine" flowered for the first time in 1904. The form "l'Espérance" may serve as the type of this hybrid which in general appearance and in foliage resembles *P. suffruticosa*, but the large flowers which measure up to 20 cm. across, are yellow and the 8–10 petals have a carmine blotch at the base; the filaments are red. "La Lorraine" has double yellow flowers with a salmon tinge when opening.

× *Clematis Morelii*, nom. nov. (*C. Simsii* × *texensis*). — *C. Pitcheri* × *coccinea* André in Rev. Hort. 1893, 376, tab.

A handsome hybrid intermediate between the parents, with campanulate flowers of violet-purple color, in shape resembling those of *C. Simsii*, but with sepals not so much recurved at the apex. It was raised before 1893 by F. Morel of Lyon, France.

Clematis florida var. *Sieboldii* Sweet, Brit. Fl. Gard. ser. 2, iv. t. 396 (1837). — Planchon in Fl. des Serr. v. t. 487 (1849). — *C. florida* var. *bicolor* Lindley in Bot. Reg. xxiv. t. 25 (1838). — *C. Sieboldii* Paxton in Paxton's Mag. Bot. iv. 147, t. (1838). — Don apud Moore & Jackman, *Clematis*, 141, t. 16 (1872). — *C. florida* β *C. Sieboldii* D. Don apud Steudel, Nomencl. Bot. ed. 2, i. 379 (1841). — *C. bicolor* Bot. Mag. ex Steudel, l. c., pro. synonym.

A complete enumeration of the synonyms of this variety is given here, because in Bailey's Standard Cyclopedia of Horticulture I had used the varietal name *bicolor* which has to give way to the older, but generally overlooked combination of Sweet.

Clematis patens var. *Standishii*, comb. nov. — *C. Standishii* Van Houtte in Fl. des Serr. xvi. 39 (1865), pro. synonym. — *C. florida* var. *Standishii* Th.

Moore in Proc. Hort. Soc. Lond. III. 227, 280 (1863). — *C. Standishii* Th. Moore in Moore & Jackman, *Clematis*, 143 (1872).

This garden variety which is usually placed under *C. florida* is better referred to *C. patens* on account of the large flowers, the plumose style and the always ternate leaves.

× *Clematis violacea* DC. var. *rubro-marginata*, comb. nov. — *C. rubro-marginata* Jouin in Mitt. Deutsch. Dendr. Ges. XVI. 236 (1907). — *C. Flammula* var. *rubro-magrinata* Cripps ex Jouin, l. c., pro synonym.

This garden form is apparently of the same origin as *C. violacea* DC. which is considered a hybrid between *C. flammula* and *C. viticella*; it differs in the whitish sepals bordered with reddish violet.

Clematis glauca Willd. var. *akebioides* f. *phaeantha*, f. nov.

A typo varietatis recedit floribus extus violaceis.

Cultivated in Highland Park, Rochester, N.Y. (type specimen coll. by W. L. J. Edson, Sept. 20, 1918, preserved in herb. Arnold Arboretum).

C. glauca phaeantha agrees with the narrow-leaved variety of *C. glauca* in all particulars except in the color of the flowers which is dull violet outside. The leaflets are oblong to oblong-lanceolate sparingly dentate or incised-dentate or occasionally entire; the sepals measure about 2 cm. in length and 6–7 mm. in width. Of the origin of this form nothing is known to me.

Clematis paniculata Thunberg var. *dioscoreifolia*, comb. nov. — *C. dioscoreifolia* Léveillé & Vaniot in Fedde, Rep. Sp. Nov. VII. 339 (1909).

This variety differs from the type in the generally ovate and cordate leaflets usually rounded and mucronate at the apex, those of the floral region often emarginate, and in their firmer somewhat fleshy texture, and in the broader, obovate-oblong or oblong sepals. The plant was first collected in 1908 by Taquet in hedges near Hongno on the island of Quelpaert, Korea, and described the following year as a new species by Léveillé & Vaniot who compared it only with *G. recta* L. and overlooked its much closer relationship with *C. paniculata*. It was introduced into cultivation in 1911 by M. L. de Vilmorin who also sent seeds to the Arnold Arboretum where it has proved an attractive climber, similar to *C. paniculata*, but apparently not quite as hardy, though with handsomer foliage of firmer texture.

SAXIFRAGACEAE

Philadelphus L.

Philadelphus rhombifolius, spec. nov.

Frutex; ramuli hornotini sparse pilosi, pallide brunnei, annotini cortice cinereo-brunneo vel cinereo sparse horizontaliter fissis persistentibus obtecti. Folia rhombico-ovata vel rhombico-elliptica acuta vel acutiuscula, basi late cuneata, 5–7 cm. longa, minute et sparse denticulate vel integra, supra glabra, intense viridia, subtus pallidiora, dense villosa, basi plerumque paribus nervorum duobus satis distantibus instructa; petioli 4–7 mm. longi, pubescentes. Racemi 5–9-flori, rhachi sparse hirsutula; par inferior florum in axillis foliorum et 1.2–2 cm. a superiore distans; pedicelli

3-5 mm. longi, pubescentes; calycis lobi ovati acuminati, extus ut tubus sat dense accumbenti-pilosi, intus apice excepto glabri, tubum paulo superantes; petala ovalia, 1.8-2 cm. longa, leviter erosa; stylus 7 mm. longus, staminibus longioribus brevior, apice tantum quarta parte divisus, glaber; stigmata parva, antheris breviora et angustiora.

JAPAN. Prov. Musasi, Chichibu, June 30, 1910, sine collectore (sub nomine *P. coronarius* var. *satsumi*).

This species seems very closely related to *P. pubescens* Loiseleur (*P. latifolius* Schrader) which differs chiefly in its larger, ovate, acuminate leaves usually rounded at the base, and dentate or denticulate, in the style usually divided to the middle and in the larger stigmas. It is apparently a rare species, as I have seen only one specimen and no Japanese botanist seems to have noticed this species which differs from all other Japanese *Philadelphus* in its pubescent calyx.

Philadelphus Gordonianus var. *columbianus*, comb. nov. — *P. Gordonianus* var. *californicus* Dippel, Handb. Laubh. iii. 342 (1893). — *P. oregonus* Nuttall ex Torrey & Gray, F. N. Am. i. 595 (1840), pro synonym.; secundum Rydberg in Fl. N. Am. Fl. xxii. 166 (1905). — *P. Californicus* hort. ex K. Koch, Dendr. i. 344 (1869), pro synonym. — *P. columbianus* Koehne in Gartenfl. xliv. 542 (1896). — Rydberg in N. Am. Fl. xxii. 166 (1905).

This variety differs from the type chiefly in its smaller leaves, those of the shoots with few coarse teeth, and in its smaller flower. As the first varietal name given by Dippel is a misapplied name being based on *P. californicus* hort., not Benth. and therefore not valid, a new combination is necessary.

Philadelphus subcanus Koehne var. *Wilsonii*, comb. nov. — *P. Wilsonii* Koehne in Sargent, Pl. Wilson. i. 4 (1911), 145 (1912).

This variety differs from the type only in its larger leaves, somewhat more reticulate beneath and in the larger inflorescence, and I cannot consider it specifically distinct from *P. subcanus*. Plants raised from seed of No. 4384 do not yet differ at all from *P. subcanus*, but they have not flowered here.¹

Philadelphus Delavayi L. Henry var. *calvescens* Rehder, var. nov.

A typo recedit foliis subtus glaucescentibus et tantum ad costam nervosque strigosis vel interdum fere glabris.

CHINA. Yunnan: in collibus prope Lichiang, versus occ., alt. 2900 m.,

¹ This and the two following species I refer to a new well-characterized group restricted to China which I place between the groups *Gordoniani* Koehne and *Coronarii* Koehne. It may be briefly described as follows:

Ser. *Sericanthi* Rehd., ser. nov. Cortex ramulorum brunneus, horizontaliter fissus, demum plus minusve exfolians; folia serrato-denticulata dentibus pronis, nunquam integra, subtus plus minusve pubescentia, raro glabra; flores subcampanulati in racemis 7-11-floris secundis; calyx plerumque pubescens vel glaber et violaceo-purpureus; stylus staminibus brevis; stigmata antheris angustiora. — To this group the type of which is *P. sericanthus* Koehne belong besides the species mentioned the following: *P. Magdalenae* Koehne, *P. purpureus* Rehd. and *P. venustus* Koehne. It is chiefly characterized by the denticulate-serrate leaves with the teeth pointing forward and by the nodding subcampanulate flowers.

July 18, 1914, *C. Schneider* (No. 1896, frutex ad 4 m., fl. albis); Tali Range, Lat. 24° 40', alt. 9–10,000 ft., July, August, 1906, *G. Forrest* (No. 5036, in parte quoad specimina calyce glabro); Mo-tao-tsin, Kou-ty, circa Pe-yen-tsin, April 15, 1917, *Siméon Ten* (No. 469).

From typical *P. Delavayi* L. Henry which is also represented in our herbarium by cultivated specimens raised from Forrest's No. 2195 and by Schneider's Nos. 1529 and 1806 from Yunnan the new variety differs in the under side of the leaves which is pubescent on the veins only and glaucescent or nearly glabrous, while the upper surface shows the same pubescence as in the type, though somewhat less dense.

A peculiar form is Schneider's No. 3505 collected between Yungning and Yungpeh. In this form the leaves resemble the type, but the sepals are thinly strigose-pubescent, while the calyx-tube shows only a few scattered hairs or is nearly glabrous; the pedicels and rachis are glabrous as in the type. Thus it approaches *P. Henryi* Koehne, but in that species the young branchlets, the rachis and the pedicels are more or less pubescent and the calyx-tube is usually rather densely strigose, while the sepals are much less pubescent and sometimes nearly glabrous.

Philadelphus Henryi Koehne may possibly be only a variety of *P. Delavayi*, but it is easily distinguished by the pubescence of the branchlets and inflorescence, by the narrower leaves, the somewhat smaller flowers and by the less highly colored calyx. Of this species I have seen the following specimens from Yunnan: Mengtze, *A. Henry* (No. 10,749 B, type, No. 10,749); Yunnan-Fu, June 1, 1916, *O. Schoch* (No. 148); La-pa-ho, Tie-so, near Pe-yen-tsin, June 18, 1916, *Siméon Ten* (No. 195a); Tali Range, *G. Forrest* (No. 5032, No. 5036, pro parte, quoad specimen calyce pubescente). — Forrest's specimen differs from the type in the less pubescent calyx, the sepals and the upper part of the calyx-tube being often glabrous or nearly so; these specimens had been determined by Diels (in Not. Bot. Gard. Edinburgh, VII. 291, 292 (Pl. Forrest.) [1912]) as *P. nepalensis* Koehne which is a different not very closely related species, easily distinguished by the leaves being quite smooth and glabrous on both sides except a villous pubescence in the axils of the main nerves on the under side, and by the pale green quite glabrous calyx. Ten's No. 195a exhibits in regard to pubescence a tendency toward the opposite extreme; the young branchlets, the inflorescence and the calyx are densely grayish pubescent, and the leaves are thinly strigose pubescent on the whole undersurface; it differs also in the narrower ovate-lanceolate sepals. Schoch's No. 148 is almost intermediate between Ten's specimen and typical *P. Henryi*.

Philadelphus pekinensis Rupr. var. *dasycalyx*, var. nov. — A typo recedit praecipue calycibus extus pedicellisque strigoso-villosis. — Ramuli juniores glabri: folia elliptico-lanceolata, 3–5 cm. longa, glaberrima, subtus glaucescentia; petioli graciles, 3–6 mm. longi, purpurascens ut nervi foliorum; racemi 5–7-flori, satis densi; pedicelli 3–5 mm. longi: flores circiter 2.5 cm. diam.; sepala ovata, acuminulata; stylus apice circiter quarta

parte divisus et staminibus subaequilongus, stigmatibus quam anterae minoribus.

CHINA. North Honan: Hwei Hsien, Shansi border, June 19, 1919, *Joseph Hers* (No. 713).

This new variety is easily distinguished from the type by the calyx and pedicels being loosely covered with setose slightly appressed nearly straight or slightly curled hairs.

Philadelphus laxus Schrad. var. *strigosus*, comb. nov. — *P. inodorus strigosus* Beadle, Biltmore Bot. Stud. I. 159 (1902). — *P. strigosus* Rydberg in N. Am. Fl. xxii. 168 (1905).

The only difference I can see between *P. laxus* Schrad. and *P. strigosus* (Beadle) Rydb. of which I have seen the type specimen is the denser pubescence of the under side of the leaves.

The theory has been advanced that *P. laxus* is not an American plant, but of Chinese origin. I have, however, not yet seen a Chinese specimen referable to this species. Rydberg (l. c. 179) apparently misunderstood Koehne who does not say that he had seen Chinese specimens, but states that he received from Vilmorin specimens from cultivated plants raised from seed sent from China (see Mitt. Deutsch. Dendr. Ges. xiii. 79, 1904). Specimens from the same plant which I collected myself in 1901 in Vilmorin's Fruticetum at Les Barres, France, and sent to Koehne, bear in his own handwriting the note "Wilde Exemplare dieser Art habe ich nicht gesehen." There is probably a mistake somewhere regarding the origin of this plant. That such mistakes are likely to happen is shown by the fact that I collected in 1909 at the same place a *Philadelphus* marked *P. spec. China* No. 4619 which I am unable to distinguish from *P. Gordonianus* var. *columbianus*.

Philadelphus laxus is apparently a very rare species, though well known in cultivation for more than ninety years. The only wild specimens I have seen are one collected in Tennessee by Wilkinson (Gray Herb.) and two collected near Augusta, Georgia, one by C. S. Sargent, April 28, 1910, and one by T. G. Harbison, April 4, 1914 (No. 1448), while another specimen collected by Sargent near the same locality, on the cliffs of the Savannah River at the locks, on March 30, 1904, and one collected by Harbison at Calhoun Falls, Abbeville County, South Carolina, resemble *P. laxus* in their pubescence, but have the larger and broader leaves of *P. grandiflorus*.

Philadelphus floridus Beadle, Biltmore Bot. Stud. I. 160 (1902). — *P. speciosus* Rydberg in N. Am. Fl. xxii. 169 (1905), non Schrader.

I cannot agree with Rydberg in making *P. floridus* Beadle a synonym of *P. speciosus* Schrader. Koehne (in Gartenfl. xlv. 507) refers *P. speciosus* to *P. laxus* Schrader, and as the author's citation is followed by an exclamation point, I assume that he saw Schrader's type. I see no reason not to accept Koehne's identification, inasmuch as there is very little difference between Schrader's descriptions of the two species. The figures cited by Rydberg under his *P. speciosus* do not at all belong here; *P. speciosus* Bot.

Reg. pl. 2003 is either a very large-flowered form of *P. pubescens* or a hybrid between that species and *P. grandiflorus*, while *P. grandiflorus* Watson, Dendr. pl. 46 is apparently typical *P. pubescens* Lois. Both figures show racemose flowers and have not the slightest resemblance to *P. floridus*.

***P. floridus* var. *Faxonii*, var. nov.**

Frutex ramis gracilibus divaricatis: folia anguste elliptica vel elliptico-oblonga, acuminata, basi cuneata, 3.5–5 cm. longa, remote minuteque denticulata, plus minusve curvata et pendentia, supra glabra, subtus satis dense strigoso-pubescentia, ea surculorum ovata, basi fere rotundata, ad 8 cm. longa; pedicelli 3–5 mm. longi, ut calyx dense strigoso-villosi; styli stamina paulo superantes, apice ad quartem partem divisi, stigmatibus latis.

Plant in Hort. Chandler, Jamaica Plain, Mass., of unknown origin (type specimen collected June 28, 1907, by C. E. Faxon, preserved in the Arnold Arboretum herb.). — Also growing in the Arnold Arboretum from cuttings taken from the type plant.

This peculiar form suggests in its habit and in the shape and size of its leaves *P. laxus*, while in the pubescence of the calyx and of the under side of the leaves it agrees with *P. floridus*, though the hairs are more strigose than villous. It is hardly possible that it is a hybrid between these two species, as the plant was growing here before *P. floridus* was introduced into cultivation. It is more likely that the plant was brought from the South and represents a form of *P. floridus* approaching *P. laxus*.

HYBRIDS AND GARDEN FORMS

× ***Philadelphus verrucosus* Schrader var. *nivalis*, comb. nov.** — *P. nivalis* Jacques in Hort. Universel, II. 19 (1841).

This variety differs from the type chiefly in its exfoliating chestnut-brown bark; the leaves are generally smaller and less coarsely dentate. Jacques states that it was raised from seed of *P. latifolius* Schrad. (= *P. pubescens* Lois.), and he also says that seeds of *P. latifolius* and of *P. grandiflorus* rarely reproduce the typical parent form.

× ***P. verrucosus* var. *nivalis* f. *plenus*, comb. nov.** — *P. nivalis spectabilis plenus* Hort. — *P. coronarius* ? *nivalis plenus* Schelle in Beissner, Schelle & Zabel, Handb. 128 (1903.) — *P. coronarius nivalis spectabilis plenus* hort. Spaeth ex Schelle, l. c., pro synonym. — *P. pubescens fl. pleno* hort. ex Schelle, l. c., pro synonym.

A form with double flowers.

× ***Philadelphus monstrosus* Schelle in Beissner, Schelle & Zabel, Handb. 129 (1903), nom. seminud.** — (? *P. Gordonianus* × *pubescens*). — *P. Gordonianus monstrosus* Hort. (*Gord.* × *latifolius*) Spaeth, Cat. No. 100, 95 (1897), nomen.

Tall shrub; bark of the previous year's branchlets grayish or light yellowish brown, close, with cross-cracks; young branchlets nearly glabrous: leaves ovate to ovate-oblong, usually rounded at the base, acuminate, 3–8 cm. long, remotely denticulate, very sparingly pubescent above,

densely grayish villous-pubescent beneath, leaves of shoots usually broadly ovate, with 4-8 broad and rather shallow teeth on each side; flowers 3-4 cm. across, in 5-13-, usually 7-9-flowered racemes 5-10 cm. long, usually the two lower pairs in the axils of leaves and rather remote; lower pedicels 3-5 mm. long, pubescent; calyx loosely pubescent outside; sepals oblong-ovate, acuminate; petals elliptic-oblong, rarely elliptic; style divided about $\frac{1}{3}$, shorter than the stamens; stigmas slightly shorter and narrower than the anthers.

Cultivated at the Arnold Arboretum as No. 6965 received from Spaeth's Nursery in 1911 as *P. Gordonianus monstrosus* (type specimen collected July 3, 1917, preserved in herb. Arnold Arboretum).—To this hybrid belong also plants received from Ellwanger & Barry, Rochester, N.Y., as *P. Zeyheri* in 1908, from Spaeth as *P. latifolius sanguineus*, from Hesse, Weener, Germany, as *P. Zeyheri* in 1910, from Kew Gardens as *P. cordifolius* in 1897.

This hybrid is similar to *P. verrucosus*, but differs chiefly in the lighter colored close bark, the longer racemes, oblong-elliptic petals, shorter pedicels; from *P. Gordonianus* it is easily distinguished by the pubescent calyx and from *P. pubescens* by the brownish bark, the smaller more coarsely dentate leaves and the oblong-elliptic petals.

× *Philadelphus congestus*, hybr. nov. (? *P. latus* × *verrucosus* or *P. Gordonianus*).

Shrub with slender spreading branches; bark of last year's branchlets chestnut-brown, exfoliating; young branchlets strigose; leaves of flowering branchlets narrowly elliptic to elliptic-lanceolate, more or less curved and pendent, 3-4 cm. long, minutely and sparingly denticulate, sparingly strigose-pubescent beneath, those of the shoots elliptic-ovate, broadly cuneate at the base, 4-6 cm. long, coarsely dentate, strigose-pubescent on both sides, more densely so beneath, 3-nerved at the base; flowers about 3 cm. across, usually 5, rarely 3 or 7, in short and dense racemes about 3.5 cm. long; pedicels 2-4 mm. long, strigillose; calyx-tube strigose at the base and usually sparingly strigose along the 4 stronger ribs; sepals oblong-ovate, acuminate; petals oval; style shorter than stamens, divided about $\frac{1}{3}$; the stigmas longer and nearly as broad as the anthers.

Cultivated at the Arnold Arboretum under No. 5854, received from Spaeth's Nursery near Berlin, Germany, in 1908 as *P. inodorus speciosus grandiflorus*¹ (type specimen collected June 24, 1912, preserved in herb. Arnold Arboretum.)

In habit and in the shape and pubescence of the leaves this hybrid resembles *P. latus*, but the racemose flowers, the rather coarsely dentate leaves and their more copious pubescence and the slightly pubescent calyx indicate the influence of *P. verrucosus*, or possibly of *P. Gordonianus* var. *columbianus*, but the latter would not explain the pubescence of the calyx. A form of apparently similar origin, but with larger flowers and

¹ According to Schelle (in Beissner Schelle & Zabel, Handb. 129) the plant of this name from "Hort. Spaeth" belongs to *P. umbellatus*.

larger leaves and with the style as long as the stamens is cultivated in the Harvard Botanic Garden.

Philadelphus coronarius f. *deutziaeflorus*, nom. emend. — *P. coronarius* var. *deutziaeflorus plenus* Hartwig, Ill. Gehölzb. 258 (1892).

A form with double flowers in 3-5-flowered racemes; petals elliptic-oblong to narrow-oblong, mostly acutish; pedicels glabrous: leaves villous along the veins near the base, otherwise glabrous. From the other double-flowered forms of *P. coronarius* this differs in its narrow mostly acutish petals.

× *Philadelphus Zeyheri* Schrad. var. *Kochianus*, comb. nov. — *P. Kochianus* Koehne, Dendr. 183 (1893).

This variety differs from the type chiefly in the longer style which exceeds the stamens. The pure white cup-shaped flowers are very handsome.

× *Philadelphus Zeyheri* var. *umbellatus*, comb. nov. — *P. umbellatus* Koehne, Dendr. 181 (1893).

This form differs from *P. Zeyheri* chiefly in the flowers being borne in 7-15-flowered cymes; the style is about as long or sometimes longer than the stamens: leaves glabrous beneath or villous only along the midrib. The cymose inflorescence is apparently derived from *P. grandiflorus* or *P. inodorus* which show the cymose character of their inflorescence by the presence of bractlets on the lateral pedicels.

× *Philadelphus polyanthus*, nom. nov. (? *P. insignis* × *Lemoinei*). — *P. Lemoinei multiflorus* Schelle in Beissner, Schelle & Zabel, Handb. 129 (1903).

Upright shrub; bark of the previous year's branches chestnut-brown, tardily exfoliating; young branchlets sparingly pubescent; leaves ovate, acuminate, rounded at base, 2-4, on shoots to 5 cm. long, remotely denticulate or entire, glabrous above, rather densely strigose-pubescent beneath, 3-nerved at the base; petioles about 5 mm. long, pubescent; flowers 3.5-4 cm. across in 7-9-flowered cymes or short panicles: calyx densely appressed-pubescent; calyx-lobes ovate, acuminate; petals oval; style shorter than the stamens, divided only at apex, with rather small connivent stigmas.

The type of this hybrid is "Gerbe de neige" (Lemoine, Cat. No. 124, VIII.) raised by Lemoine and distributed in 1893. Here belongs also "Pavillon blanc" sent out by Lemoine in 1896 or before, which differs chiefly in its smaller leaves and in the flowers being borne in 5-7-flowered racemes; the slender pedicels are 0.5-1 cm. long, with two bracts about the middle.

I have not used Schelle's varietal name for the binomial to avoid any confusion with *P. multiflorus plenus* hort., a double-flowered form of *P. coronarius*.

× *Philadelphus cymosus*, nom. nov. (? *P. grandiflorus* vel spec. affinis × *P. Lemoinei*).

Upright rather tall shrub; bark of two year old branchlets chestnut-brown exfoliating; young branchlets glabrous: leaves elliptic-oblong to elliptic-

lanceolate, acuminate, cuneate at the base, 5-8 cm. long and 1.5 to 3 cm. broad, on shoots to 10 cm. long and to 3.5 cm. broad, dentate with 4-8 teeth on each side, or denticulate, rarely entire, glabrous above, hairy beneath near the base and along the veins; petioles 4-8 mm. long, pubescent above or nearly glabrous; flowers large, 5-6 cm. across, in 3-9-flowered cymes or occasionally solitary, or in 5-flowered racemes with bracted slender pedicels to 1.5 cm. long, glabrous; calyx glabrous, its lobes about twice as long as the tube, ovate-lanceolate to oblong-lanceolate, long-acuminate; petals obovate; styles divided to the base, 1-1.3 cm. long, somewhat shorter or nearly as long as the stamens, with small stigmas.

As the type of this group of hybrids I have taken "Conquête" (Lemoine, Cat. No. 155, viii. [1903]. — Fig. in *Gartenwelt*, xvii. 102 [1913]) raised by Lemoine and distributed in 1903. To this group I refer also the following hybrids: "Bannière" (Lemoine, Cat. No. 164, 24 [1906]), with ovate leaves and semidouble flowers. — "Mer de Glace" (Lemoine, Cat. No. 173, 25 [1909]. — Fig. in Lemoine, Cat. No. 176, pl. [1910]. — *Gartenwelt* xvii. 102 [1913]); with double flowers according to Lemoine, though the plant I have seen had single flowers. — "Norma" (Lemoine, Cat. No. 173, 33 [1909]) similar to the preceding with single or double flowers — "Nuée blanche" (Lemoine, Cat. No. 160, 20 [1905]) with the leaves sparingly pubescent beneath; said to be a hybrid of *P. microphyllus* and *P. nepalensis*, but I can see no influence of *P. nepalensis*. — "Rosace" (Lemoine, Cat. No. 158, viii. [1904]), similar to "Conquête," with double flowers according to Lemoine, but the plants I have seen had single flowers. — "Voie lactée" (Lemoine, Cat. No. 161, vii. [1905]. — Fig. in *Garden*, lxxxii. 267 [1918]. — *Jour. Hort. Soc.* xxxviii. cxlv, fig. 117. [1912]. — *Gardeners' Mag.* lv. 554 [1912], with single flowers, similar to "Conquête" — "Perle blanche" (Lemoine, Cat. No. 146, xi. [1900]) with ovate, dentate leaves sparingly pubescent beneath and double flowers probably also belongs to this group, though the calyx is slightly pubescent.

× *Philadelphus virginalis*, nom. nov. (? *P. Lemoinei* or possibly *P. polyanthus* × *P. verrucosus plenus*).

Upright tall shrub; bark of last year's branches brown, exfoliating; young branchlets glabrous; leaves ovate, acuminate, rounded or broadly cuneate at the base, 3.5-6, on shoots to 8 cm. long, dentate or denticulate, nearly glabrous above, villous-pubescent beneath; petioles 0.5-1 cm. long, pubescent; flowers about 5 cm. across, double or semidouble, in 5-7-flowered racemes; pedicels 0.5-1 cm. long, pubescent, with or without bractlets; the lower ones occasionally longer and 3-flowered; calyx pubescent, the lobes ovate, somewhat longer than the tube; style much shorter than the stamens, divided to the middle or nearly to the base, 6-8 mm. long, with small stigmas.

This group of hybrids is chiefly characterized by the ovate leaves, rather densely villous beneath and by the double racemose flowers with pubescent calyx. As the type I have taken "Virginal" (Lemoine, Cat. No. 174, 8

[1910]. — Fig. in Lemoine, Cat. No. 176, p. 26, t. [1910]; No. 179, pl. [1911]. — Gard. Chron. ser. 3, LXIV. 3, fig. [1918]. — Gard. LXXXII. 267 [1918]. — Rev. Hort. 1910, 408, 409). — Here belong also the following hybrids: "Argentine" (Lemoine, Cat. No. 190, 20 [1916], or before?) with scarcely exfoliating bark, smaller leaves rounded at the base and very double flowers usually in three's. — "Glacier" (Lemoine, Cat. No. 190, 21 [1916], or before) with still smaller leaves and smaller double flowers in very dense 5-7-flowered racemes and with the calyx only thinly pubescent. — "Bouquet blanc" (Lemoine, Cat. 155, VII. [1903]. — Fig. in Jour. Hort. Soc. XXXVIII. CXLV. fig. 116 [1912]. — Gartenwelt, XVII. 101 [1913]). This is similar to the last named, but as the calyx is quite glabrous it may possibly be an offspring of *P. polyanthus*.

× *Philadelphus purpureo-maculatus* Lemoine, Cat. No. 152, VIII. (1902). — Bean in Bot. Mag. CXXXIV. t. 8193 (1908). — (*P. Lemoinei* × *P. Coulteri*). — *P. Lemoinei* var. *maculatus* Gard. Chron. ser. 3. XXXVI. 14 (1904).

Raised by Lemoine from seed of *P. Lemoinei* "Fantaisie" (Lemoine, Cat. No. 146, x [1900]), which is according to Lemoine a hybrid of *P. Coulteri* and *P. Lemoinei*. To this group of hybrids of which *P. purpureo-maculatus* is the oldest binominal belong the following forms: Étoile rose, Fantaisie (*P. phantasia* A. H. Moore), Nuage rose, Oeil de pourpre, Romeo, Sirène, Surprise and Sybille.

Fendlera Engelm. & Gray

The species of this interesting little genus characteristic of the upper Sonoran zone show great uniformity in their floral characters, but may be easily distinguished by their leaves.

Leaves ovate-oblong to narrow-lanceolate.

Leaves beneath sparingly strigose or nearly glabrous, rarely with scattered minute branched hairs, not revolute.

Leaves glabrous and smooth above, ovate-oblong to oblong-lanceolate, obscurely 3-nerved 1. *F. rupicola*.

Leaves more or less scabrid above, oblong-ovate to linear-lanceolate, mostly falcate, 1.5-4 cm. long, often strongly 3-nerved

2. *F. rupicola* var. *falcata*.

Leaves beneath densely covered with a tomentum of branched hairs and with strigose hairs, scabrid above, usually narrow-oblong, 1-2 cm.

long, revolute 2. *F. Wrightii*.

Leaves linear, 1.5-2.5 cm. long and 1-1.5 mm. wide, coriaceous, strongly revolute, smooth or nearly smooth above 3. *F. linearis*.

1. *Fendlera rupicola* A. Gray in Pl. Wright. I. 77, t. 5 (except figs. 2, 6, 7) (1852). — *F. rupicola* var. *a Lindheimeri* A. Gray, I. c.

TEXAS. Comal County: on perpendicular rocks on the upper Guadalupe above New Braunfels, March, 1851, *F. Lindheimer* (No. 506, flowers); 1850, *F. Lindheimer* (No. 257, old fruit); Comanche Springs, New Braun-

fels, May, 1850, *F. Lindheimer* (No. 792, fruit), March, 1851 (No. 793, flowers and fruit), 1851 (No. 794, fruit).

NEW MEXICO. Otero County: Sacramento Mts., Fresno Canyon, August 24, 1916, *A. Rehder* (No. 420).

MEXICO. Sonora: Huchuarachi, December 6, 1890, *C. V. Hartmann* (No. 304).

Typical *F. rupicola* is characterized by its comparatively broad 1-nerved or faintly 3-nerved leaves quite smooth above and sparingly strigose beneath. It seems to have a rather restricted distribution, and has been found so far only in southwestern Texas and in southern New Mexico. By Wootton & Standley the plant of the Sacramento Mountains has been referred to the following variety, but the specimens I collected there seem nearer to the type. Hartmann's No. 304 from Mexico differs in its much narrower, linear-oblong to linear-lanceolate leaves.

F. rupicola var. *falcata*, comb. nov. — *F. falcata* Thornber in Contrib. U.S. Nat. Herb. xvi. 129 (1913).

NEW MEXICO. Sierra County: Tierra Blanca, 1904, *Mrs. Ida M. Beals*. Socorro County: slopes of San Francisco River north of Alma, August 12, 1914, *A. Rehder* (No. 276).

ARIZONA. Coconino County: Navaho Reserv., June, 1916, *C. T. Vorhies* (No. 80, Herb. Univ. Ariz.); Grand Canyon, 1894, *C. S. Sargent*, July 19, 1914, *A. Rehder* (Nos. 102, 111), June 16, 1916, *Alice Eastwood* (No. 5717).

COLORADO. Conejos County: Los Pinos, May 27, 1899, *C. F. Baker*, (No. 367; partly *F. Wrightii*). La Plata County: Durango, September 2, 1894, *C. S. Sargent*; October 7, 1911, *D. H. Andrews*, May 21, 1916, *Alice Eastwood* (No. 300). Montezuma County: Mancos, July 8, 1898, *C. F. Baker*, *F. S. Earle* & *S. M. Tracy* (No. 393); Dolores, June 17, 1892, *C. S. Crandall* (No. 199). Dolores County: August 14, 1896 (Biltmore Herb. No. 1565). Montrose County: Paradox, June 22, 1912, *E. P. Walker* (No. 162). Delta County: Oak Mesa, July 7, 1892, *J. H. Cowen*. Mesa County: Grand Junction, May 15, 1916, *Alice Eastwood* (No. 5107). ? Cerro Summit, June 17, July 12, 1901, *C. F. Baker* (No. 165).

This variety differs chiefly in its narrower and longer, often falcate leaves more or less scabrate above. Andrew's specimen from Durango and my No. 102 from the Grand Canyon show a slight covering of minute branched hairs on the under side of the leaves, as does also one branch of Miss Eastwood's No. 5300, while the leaves of the other branch are only strigose. This variety ranges from southwestern Colorado to northern Arizona and to Sierra County in western New Mexico.

2. *Fendlera Wrightii* Heller in Bull. Torr. Bot. Club, xxiv. 537 (1897). — *F. rupicola* var. β . *Wrightii* A. Gray, Pl. Wright. i. 77, t. 5, figs. 2, 6, 7 (1852). — *F. rupicola* Sargent in Gard. & For. ii. 112, fig. 98 (1889), non A. Gray. — Hemsley in Bot. Mag. cxxix. t. 7924 (1903). — *Edwinia*

Wrightii Heller in Bull. Torr. Bot. Club, xxiv. 477 (1897). — *F. tomentella* Thornber in Contrib. U.S. Nat. Herb. xvi. 129 (1913).

TEXAS. Valverde County: hills of Devil's River, *C. Wright*, July 25 (No. 728) and November 2–12, 1849 (No. 1381, marked also 228a in pencil.)¹ Jeff Davis County: Limpia Canyon, April 26, 1902, *S. M. Tracy* & *F. S. Earle* (No. 257, distributed as *Philadelphus serpyllifolius*). El Paso County: *C. Wright*, 1852 (No. 1049). Without locality, *C. Wright*, 1851 (No. 1099).

NEW MEXICO. Grant County: Mimbres, May, 1851, *G. Thurber* (No. 203); Mangas Springs, April 29, 1903, *O. B. Metcalfe* (No. 39); Santa Rita del Cobre, 1877, *E. L. Greene*; Knight's Station, April 5, 1877, *E. L. Greene*. Sierra County: Lookout Mines, August 11, 1904, *O. B. Metcalfe* (No. 1217). McKinley County: Fort Defiance, Dr. *E. Palmer*. ? Tendelero, April 5, 1880, *H. H. Rusby* (No. 22).

COLORADO. Conejos County: Los Pinos, May 23, 1899, *C. F. Baker* (No. 367, partly *F. rupicola falcata*). Montrose County: Naturita, May 12, 1914, *E. Payson* (No. 290).

ARIZONA. Cochise County: Bisbee, May 24, 1915, *J. I. Carlson*. Pima County: Santa Rita Mts., May 1, 1881, *C. G. Pringle*; near Tucson, August 4, 1892, *J. W. Toumey*; Santa Catalina Mts., Oak Camp, July 1, 1917, *Forrest Shreve* (No. 5326); ? Blue River, September 8, 1902, *A. Davidson* (No. 776); without precise locality, 1876, *E. Palmer*. Coconino County: Grand Canyon, May 24, 1903, *G. B. Grant* (No. 5737).

MEXICO. Chihuahua: mountains 25 miles south of San Diego Ranch, 1891, *C. V. Hartman* (No. 586); Chuichupa, September 15, 1899, *C. H. T. Townsend* & *C. M. Barber* (No. 424), Santa Eulalia Mts., April 20, 1885, *C. G. Pringle* (No. 22).

This species differs from *F. rupicola* chiefly in the peculiar irregularly branched hairs which form a grayish white tomentum on the under side of the leaves interspersed with long strigose hairs; the upper surface of the generally oblong leaves is more or less scabrid and the margins usually revolute. *Fendlera tomentella* Thornber I am unable to distinguish from *F. Wrightii*. This species ranges from southwestern Texas to southwestern New Mexico, southeastern and northern Arizona and to the province of Chihuahua in northern Mexico.

3. *Fendlera linearis*, spec. nov.

Frutex ramis gracilibus; ramuli hornotini dense puberuli, flavescentes, annotini obscure grisei, vetustiores cortice longitudinater rimoso leviter fungoso obtecti. Folia coriacea, subsessilia, linearia, mucronulata et acutiuscula, basi cuneata, 1.5–2.5 cm. longa et 1–1.5 mm. lata, supra nitidula, laevia vel parcissime pilis brevibus strigosis obsita, costa impressa, subtus ad costam elevatam et ad marginem parce strigosa, marginibus revolutis

The locality and the dates of Wright's Nos. 728 and 1381 are here given according to his field notes preserved in the library of the Gray Herbarium. A. Gray in *Plantae Wrightianae*, l. c., gives "crevices of rocks of the San Pedro River" as the locality. San Pedro River is another now obsolete name of the Devil's River.

costam dilatatam planam attingentibus et canaliculos duos clausos pilis ramosis albidis repletos formantibus. Flores in apice ramulorum 1-3 vel in racemis 5-floris; pedicelli 2-5 mm. longi, dense canescenti-puberuli; sepala triangularia, 4 mm. longa, late lanceolata, in fructu ovata, extus intusque tomentella ut tubus calycis; petala late obovata, unguiculata, apice rotundata, crosa, 7-8 mm. longa et 5 mm. lata; stamina sepalis breviora, dentibus filamentorum antheras superantibus, antheris 2 mm. longis, apice in appendicem subulatam fere 0.5 mm. longam productis; styli pilosuli, stamina subaequantes. Capsula ovoidea stylis persistentibus exceptis circiter 8 mm. longa, sepalis persistentibus reflexis paulo supra basin circumcincta.

MEXICO. Nuevo Leon: Sierra Madre near Monterey, June 17, 1889, C. G. Pringle (type in herb. Arnold Arboretum).

This new species is well characterized by its coriaceous linear leaves which show a peculiar structure; the margins are strongly recurved and touching the broad flattened midrib they form two closed canals filled with a dense white mass consisting of short, much and irregularly branched hairs similar to those of *F. Wrightii*; these hairs are not visible from the outside and only a cross-section reveals their presence as well as a well-developed continuous hypoderm under the epidermis of the whole upper surface and that of the midrib below. The flowers are smaller than in the two preceding species and borne usually in clusters of 3 or 5 at the end of the branchlets which are longer and not so regularly arranged as in the other species; the petals are roundish-obovate, not rhombic, the anthers smaller with a slender rather large appendage. This species marks the southern limit of the range of the genus.

Deutzia Thunb.

Deutzia scabra Thunberg.

The name *D. scabra* has been applied by different botanists to three different species; by some it has been identified with *D. crenata* Siebold & Zuccarini, by others with *D. Sieboldiana* Koernicke and by Maximowicz it was applied to a form named below *D. heterotricha*. Apparently none of the authors who dealt with this species has seen Thunberg's types, though Koernicke (in *Gartenfl.* xvi. 75) and Voss (in *Gartenfl.* xlv. 354) state that they had seen original specimens of Thunberg's from the herbarium at Stockholm, but as Thunberg's types are in Upsala, they could have seen only duplicates. The only way to solve the question seemed to be to get definite information about the specimens in Thunberg's herbarium of which there are three (see Juel, *Pl. Thunberg.* 290 [1918]). I therefore wrote to Professor Juel sending him leaves of the different species for comparison. Professor Juel very obligingly sent me detailed notes on the specimens accompanied by excellent photographs, which enabled me to determine the three specimens designated as α , β , and γ . The specimen designated as α consists of a flowering branch of *D. Sieboldiana*, β of a flowering branch of *D. crenata* and γ of a fruiting branch of the same species.

The form supposed by Maximowicz to be the true *D. scabra* is not represented in Thunberg's herbarium. The figure on plate 24 in Thunberg's *Flora Japonica* which is a reproduction of the original plate in his *Dissertatio Nov. Gen. Pl.* (1781) is not based on any single specimen, but apparently on a combination of all three. The leaves and flowers are taken from specimen β , the fruit from specimen γ , while specimen α seems to have been used only for the outline of the general habit of the branch.

Thunberg clearly based the generic and specific characters of *Deutzia scabra* on the specimen β and partly on γ ; this is particularly evident in the description of the filaments as "filaments . . . sub apice emarginata trifida" (*Fl. Jap.* 10), as they are in *D. crenata*, while in *D. Sieboldiana* they are subulate or abruptly contracted below the apex, but never trifid. Also other characters as "caulis arborescens orgyalis . . . folia petiolata, ovata, acuminata, . . . pedunculi et pedicelli angulati, tomentoso-scabra . . . petioli lineam longi" agree well with *D. crenata*, but not with *D. Sieboldiana* which is usually a low shrub, scarcely 1 m. tall, with, at least on the flowering branchlets, subsessile leaves, oval or broadly elliptic-obovate in outline and abruptly short-acuminate; the pedicles and peduncles are slender and usually pilose. Also the plate, as stated above, agrees in its characters with *D. crenata* and not with *D. Sieboldiana*; in representing the inflorescence as a simple raceme the artist took apparently only the upper part of the inflorescence which is described correctly by Thunberg as "pannicula composita."

Though according to botanical usage one might be inclined to consider the specimen designated as α as the type, I think there can be no doubt that in this case the specimen β is to be considered the type of the species, as Thunberg's description and the plate is based nearly exclusively on β and to a lesser extent on the conspecific specimen γ , while specimen α has apparently not entered at all into the description.

Deutzia heterotricha, nom. nov. — *D. scabra* Maximowicz in *Mém. Acad. Sci. St. Pétersb. sér. 7, x. No. xvi. 24, t. 2, figs. 1-18* (1867), non Thunberg. — *D. scabra* var. *Thunbergiana* Maximowicz, l. c. 45 (1867), nomen dubium. — *D. Sieboldiana* var. *c. Thunbergiana* Schneider in *Mitt. Deutsch. Dendr. Ges. xiii. 178* (1904).

JAPAN. HONDO. PROV. Shinano: Kisogawa, September 3, and Ogawa, September 4, 1905, *J. G. Jack* (fruiting); Otakegawa, thickets, common, June 10, 1914, *E. H. Wilson* (No. 6985); "Senano," *Tschonoski*, 1864, ex Maximowicz (type).

This species has been well described and figured by Maximowicz who took it for *D. scabra* Thunberg. In the appendix to his paper, however, he states that according to Koernicke *D. scabra* Thunberg is identical with *D. crenata* Sieb. & Zucc. and that he has come to the conclusion after seeing additional material that his *D. scabra* and *D. crenata* are not specifically different. He further says that only Thunberg's herbarium will show which one is the true *D. scabra*, and that Thunberg may not have distinguished

these two forms at all; he then proceeds to distinguish as var. *Thunbergiana* one of the forms, his *D. scabra*, which according to his opinion is *D. scabra* of Thunberg, and the other form as var. *crenata*. This clearly shows that Maximowicz gave the name var. *Thunbergiana* to his *D. scabra* only on the supposition that it represented typical *D. scabra* Thunberg, which is not the case as shown above under *D. scabra*, and therefore it can hardly be retained for his plant. Schneider later transferred Maximowicz's variety to *D. Sieboldiana*, but it is certainly much more closely related to *D. scabra* than to *D. Sieboldiana*. The Japanese botanists do not mention this form at all.

In general appearance *D. heterotricha* resembles *D. scabra*, but the hairs on the under side of the leaves of *D. heterotricha* are very different; the pubescence appears soft to the touch, as most of the hairs and particularly those on the veins and veinlets have a central upright ray, while the lateral rays are fewer than in *D. scabra* and on the veins are often nearly or entirely wanting; also the pubescence of the inflorescence is heteromorphous, the well-developed central rays giving the impression that the stellate pubescence was interspersed with long pilose hairs. The panicle itself appears nearly cylindric on account of the short lower branches which are usually only 3-flowered. The flowers are somewhat smaller, the stamens exceed the petals, and the longer filaments are indistinctly toothed or nearly subulate. It is chiefly the difference in the pubescence which induces me to consider this *Deutzia* a distinct species, as I have found the form of the pubescence a very constant and reliable character in this genus. *Deutzia heterotricha* seems to occur only in the province Shinano and Tselonoski's specimen represents the type of the species; the specimens from other localities cited by Maximowicz may not belong here. Another closely related species is the incompletely known *D. hebecarpa* Nakai (in Matsumura, Icon. Pl. Koisikav. 1. 127, t. 64 [1913]) from the island of Oki which differs according to the author's description and figure chiefly in the quite glabrous branchlets, the 3 4-rayed hairs of the upper surface of the leaves and the simple hairs of the lower surface, the pilose petioles and the pilose inflorescence and fruit, no mention being made of stellate pubescence except that of the upper surface of the leaves.

***Deutzia calycosa* Rehder var. *macropetala*, var. nov.**

A typo recedit praesertim foliis subtus vix molliter pubescentibus ob pilos stellatos radio centrali instructus sparsiores, pilis praesertim versus marginem fere omnibus radio centrali destitutis, floribus majoribus petalis ad 15 mm. longis et 11 mm. latis, pilis stellatis calycis radio centrali destitutis.

CHINA. Yunnan: in silvis La-pa-ho, Tie-so, circa Pe-yen-tsin, Jun. 18, 1916, *Siméon Ten* (No. 195, frutex 3 m. altus, floribus rubro-albis).

This variety appears at the first glance quite distinct from *D. calycosa* on account of the larger flowers and the less villous pubescence of the under side of the leaves and of the calyx, but a closer examination reveals no strong

morphological differences. The most striking difference consists in the pubescence of the calyx which is quite destitute of central rays in the variety, while in the type it is nearly villous from the numerous spreading central rays. The central rays of the stellate hairs on the under side of the leaves which are well developed in the type, are less numerous in the variety and disappear toward the margin. In the length and shape of the calyx-lobes there is no difference. The petals are much broader, about 11 mm. broad, though scarcely longer than in the larger-flowered form of the type. The teeth of the outer stamens equal or exceed the anthers, while in the type they are shorter.

***Deutzia longifolia* Franch. f. *elegans*, forma nov.**

A typo recedit ramis gracilibus arcuatis paniculas numerosas satis laxas ramulos breves subaequilongos terminantes gerentibus corolla extus purpureo-rosea fere 2 cm. diam.

This handsome form of *D. longifolia* is characterized by slender arching branches studded almost their whole length with rather loose panicles of rose-purple flowers borne on short branchlets of nearly equal length; the panicles are about 5 cm. long and broad, and the flowers nearly 2 cm. across on pedicels 4-8 mm. in length. The flowering branchlets bear 3-4 pairs of lanceolate leaves 3-5 cm. long and 1-2 cm. broad and covered with a close white tomentum beneath; the leaves of the shoots are similar, but 7-11 cm. long and 2-3.3 cm. broad.

This is one of the handsomest forms of *D. longifolia*; the flowers are not as large as those of var. *Veitchii*, but the habit is more graceful, and the plant has proved hardier at the Arboretum than other forms of the species. It was raised from seed sent by Mr. Wilson in 1908 from Wa-shan in Szechuan. As a botanical form it is of little significance, but from a horticultural point of view it certainly is worth noting.

× *Deutzia Wilsonii* Duthie in Bot. Mag. cxxxii. t. 8083 (1906). — *D. discolor* × *mollis* Rehder in Sargent, Pl. Wilson. i. 20 (1911).

When I published my synopsis of the Chinese *Deutzias* in *Plantae Wilsonianae*, I only knew *D. Wilsonii*, which is based on a cultivated plant, from the description and the plate in the Botanical Magazine. Since then Mr. Wilson has collected specimens in the Veitchian Nursery from the type plant, and a plant received from Veitch is now growing at the Arnold Arboretum. A close examination of this material shows that *D. Wilsonii* is a hybrid of apparently the same origin as the specimen I described as *D. discolor* × *mollis*. At the first glance *D. Wilsonii* looks quite different; the flowers are much larger and have well developed anthers; the leaves are larger and in shape more like those of *D. discolor*, but the pubescence of the under side of the leaves shows the same intermediate character between that of *D. discolor* and *D. mollis*. The serration, too, of the leaves, the denser pubescence of their upper surface, and the shorter and stouter petioles show the influence of *D. mollis*. Still more clearly is the hybrid character of the plant shown by the aestivation of the flowers which is

partly imbricate and partly valvate; the sepals, too, are intermediate in shape between those of the two species. Probably the plants raised from seed sent by Wilson to Veitch in 1901 under No. 1254 were not quite uniform and may have represented different intergradations between the two parent species. The plant which is growing here, but has not yet flowered, differs from the specimen supposed to have been taken from the type plant, somewhat in the pubescence of the leaves, the central rays of the stellate hairs being less profusely developed than in that specimen.

***Deutzia parviflora* Bunge var. *ovatifolia*, var. nov.**

A typo recedit foliis ovatis basi rotundatis vel truncatis, breviter acuminatis, 3.5–6 cm. longis et 2–3.5 cm. latis argutius minutiusque serrulatis, corymbis satis densis 3–4 cm. diam, floribus flavescenti-albis.

CHINA. Chili: Weichang, 1909, 1910, *W. Purdom* (No. 40, in part); growing at the Arboretum from seed received under the same number; type collected June 3, 1918.

The typical form differs from this variety in its larger, usually elliptic-ovate to oblong leaves, more or less cuneate at the base and rather irregularly serrate with more spreading teeth, and in the larger and looser corymbs of pure white flowers. The new variety looks rather distinct with its smaller, ovate, broad leaves and the dense corymbs of creamy-white flowers. Purdom's No. 40 collected in different localities is not uniform and consists only of flowering specimens.

(*To be continued*)

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NOTES ON AMERICAN WILLOWS. VIII

CAMILLO SCHNEIDER

a. THE SPECIES OF THE SECTION CHRYSANTHEAE

This study of the species of section *Chrysantheae* is based on the same material as mentioned on p. 67 of this Journal and I wish to express my best thanks to the gentlemen in charge of these collections, and also to Professor J. K. Henry, Vancouver, and to Mr. J. C. Nelson, Salem, Oregon.

I am not sure whether the following species should be combined in one section, nor am I convinced that *Chrysantheae* is the correct name for such a section. It has been proposed by Koch for a group containing a single species: *S. lanata* Linnaeus. This is a very well marked species of northern Europe and Asia but is not found in the New World.¹ I believe, however, that species like *S. Richardsonii* Hooker are rather closely related to it. I place, therefore, this American species and the related *S. calcicola* Fernald and *S. Barrattiana* Hooker in this section. Andersson did the same in 1868, uniting *S. lanata*, *S. Richardsonii* and *S. Barrattiana* into a subsection *Lanatae* of his section "*Niveae* s. *Glaucæ*." He cites Koch's name *Chrysanthæ* (!) as a synonym. Andersson also added *S. Hookeriana* Barratt to the same subsection; he placed, however, *S. speciosa* Hooker & Arnott (now *S. alaxensis* Coville) in a second subsection B. *Villosae*. This last subsection contains, besides some European species and a number of hybrids the American *S. candida* Flügge. The affinity of the Hoary Willow is by no means certain. Köhne (1893) referred it with *S. Elaeagnos* Scopoli (*S. incana* Schrank) to section *Incanae* Andersson while Ball (1909) placed it near *S. brachycarpa* Nuttall in his section *Arcticae*. I shall deal with *S. candida* later as I regard it a representative of a special group.

As to the affinity of *S. Hookeriana* I can only state that it might be taken for a distinct type which combined with *S. Piperi* Bebb, *S. amplifolia* Coville, *S. alaxensis* Coville and *S. laurentiana* Fernald may form a separate section. I think it best, however, at present to place all these species in the same group with *S. Richardsonii* and *S. Barrattiana*. A closer study

¹ Lange, Consp. Fl. Groenl. II. 28 (1887), cites: "221. *S. lanata* (chrysanthos) L. V. Gr.: Narsarsuk- og Kvanefjord ved Godthaab (Raben)." He adds however the following note: "Obs. Specimina in his locis lecta in herbariis desunt, quare incertum videtur, an recte determinata sit."

of these species probably will elucidate more distinctly the true relationship between them. Of *S. laurentiana* the male plant is not yet known. The color of the anthers of all the species seems to be yellow with the possible exception of *S. alarensis* of which the young anthers may be violet. The filaments are glabrous and free, sometimes, however, slightly pilose at their base and somewhat united. I cannot yet state whether there are some forms which always show a few hairs at the base of the filaments.

The main difference of the species with which I am here dealing can be taken from the keys. As to the synonymy of the section the following is to be said.

Section *Chrysanthae* Koch, *Salic. Europ. Com.* 11 (1828). — Sect. *Chrysanthos* Fries, *Novit. Fl. Suec. Mant.* i. 37 (*Com. Salic.*) (1832). — Sect. *Cinereae* Barratt apud Hooker, *Fl. Bor.-Am.* ii. 144 (1838), pro parte. — Sect. *Discolores* Barratt, l. c. 147 (1838), pro parte. — Sect. *Arcticae* vel *Subarcticae* Andersson in *Öfv. Svensk. Vet.-Akad. Förh.* xv. 119 (1858), pro parte maxima. — Sect. *Niveae* s. *Glaucæ* [subsect.] A. *Lanatae* Andersson in De Candolle, *Prodr.* xvi.² 275 (1868), pro parte. — Sect. *Lanatae* Köhne, *Deutsche Dendr.* 94 (1893) — Ball apud Coulter & Nelson, *New Man. Rocky Mts. Bot.* 135 (1909). — Sect. *Lanatae*, subsect. *Chrysanthae* Schneider, *Ill. Handb. Laubh.* i. 47 (1904). — Sect. *Argentæ* Rydberg, *Fl. Rocky Mts.* 189 (1917), pro parte.

CLAVIS SPECIERUM VARIETATUMQUE

A. SECUNDUM SPECIMINA FEMINEA

Ovaria et pedicelli glabri.

Amenta etiam fructifera sessilia; pedicelli nulli, subnulli vel in *S. Barrattiana* var.

Tweedyi ad 1 mm. longi; styli 1.5 ad 2.5 mm. longi; ramuli novelli dense hirsuto-villosi vel lanuginosi; stipulae distinctae, persistentes.

Stipulae lineari- ad semicordato-lanceolatae, apice plus minusve acuminatae, ad 1-2.5 cm. longae, in surculis saepe latiores et lobulatae, margine glanduloso-serrato-dentatae. 1. *S. Richardsonii*.

Stipulae semicordatae ad semiorbiculares vel reniformes, margine dense glanduliferae.

Petoli brevissimi, vix ultra 4 mm. longi; folia majora superiora late ovata ad orbicularia, basi pleraque cordata, apice obtusa vel leviter acutata, margine fere semper integerrima; amenta fructifera ad 6-8.5: 1.2-1.8 cm. magna; fructus ad 6 mm. longi, ovoideo- vel elliptico-conici, subrostrati.

2. *S. calcicola*.

Petoli 8-15 mm. longi; folia majora superiora elliptica vel ovalia, basi acuta ad subobtusa, margine plus minusve glanduloso-subspinuloso-denticulata.

3. *S. Barrattiana* var. *Tweedyi*.

Amenta pedunculo distincto foliolato suffulta, vel breviter pedunculata (saltem fructifera) et pedicelli 1-2 mm. et styli vix ultra 1.3 mm. longi; stipulae nullae vel etiam in ramulis vegetioribus parvae, caducae.

Ramuli novelli hornotinique plus minusve dense tomentosi.

Styli 2-2.5 mm. longi; amenta distincte pedunculata (pedunculo 2-4-foliolato ad 1.5 vel interdum ad 2 cm. longo) 4. *S. amplifolia*.

Styli 1-1.3 mm. longi; amenta subsessilia, pedunculo ad 5 mm. longo foliola 3-5 parva gerente suffulta.

- Folia etiam adulta subtus dense argenteo-lanato-tomentosa, supra obscure viridia 5. *S. Hookeriana* var. *typica*.
 Folia adulta subtus glabra vel plus minusve pubescentia, glaucescentia, supra subnitida. 5a. *S. Hookeriana* var. *laurifolia*.
 Ramuli novelli tantum sparse pilosi vel laxe villosuli, cito glaberrimi; styli 1-1.3 mm. longi; amenta subsessilia vel breviter pedunculata . . . 6. *S. Piperi*.
 Ovaria et pedicelli (vel in *S. Richardsonii* interdum tantum pedicelli) pilosi.
 Styli tantum 1-1.2 mm. longi; amenta subsessilia vel pedunculata (confer etiam *S. Piperi*).
 Fructus 7-9 mm. longi; stipulae nullae; folia subtus satis dense tomentosa, supra obscure viridia 5. *S. Hookeriana* var. *tomentosa*.
 Fructus 6-7 mm. longi; stipulae semicordatae ad 10 mm. longae, caducae; folia subtus glabrescentia, glaucescentia, supra lucido-viridia. 7. *S. laurentiana*.
 Styli 1.2-2.5 mm. longi; amenta sessilia vel subsessilia.
 Stipulae lineari-lanceolatae ad filiformes, ad 22.2 mm. magnae, margine distanter glandulosae, subtus ut pagina inferior foliorum tomento densissimo albo vel flavescenti opaco molli vestita.
 Ramuli novelli hornotinique dense tomentosi, etiam biennes nunquam pruinosi 8. *S. alaxensis* var. *typica*.
 Ramuli novelli laxius vel sparse villosi, annotini glabri et ut etiam biennes saepissime pruinosi 8b. *S. alaxensis* var. *longistylis*.
 Stipulae semicordato-lanceolatae ad semicordatae, ad 8 mm. longae, margine intusque dense glanduliferae (balsameae), glabriusculae. 3. *S. Barrattiana*.

B. SECUNDUM SPECIMINA MASCULA

(in *S. laurentiana* ignota)

Ramuli novelli laxi vel sparse villosi, annotini glabri.

Bractaeae ovato-oblongae, acutae vel subacuminatae; filamenta libera, glabra; antherae ut videtur initio violaceae; ramuli annotini plus minusve pruinosi.

8b. *S. alaxensis* var. *longistylis*.Bractaeae obovatae, apice plus minusve rotundatae; filamenta libera vel subcoarctata, glabra vel basi parce pilosa; antherae aureae, ramuli annotini atropurpurei, epruinosi 6. *S. Piperi*.

Ramuli novelli annotinique (et saepe biennes) distincte tomentosi, villosi vel subhirsuti.

Amenta subsessilia vel distincte pedunculata; filamenta interdum basi parce pilosa; stipulae nullae (vel in ramulis vegetioribus parvae caducae).

Pedunculi distincte foliolati, ad 1.5-2 mm. longi; folia adulta subtus tantum in costa tomentosa 4. *S. amplifolia*.Pedunculi subnulli vel vix ultra 5 mm. longi, foliolis minimis instructi; folia etiam adulta subtus in facie villosa-tomentosa (sed confer etiam var. *laurifoliam*) 5. *S. Hookeriana*.

Amenta sessilia; filamenta libera, glabra; stipulae distinctae.

Stipulae lineares ad semicordato-lanceolatae.

Folia subtus tomento densissimo albo vel flavescenti opaco molli vestita.

8. *S. alaxensis*.Folia adulta glaberrima 1. *S. Richardsonii*.

Stipulae semicordatae ad semiorbiculares vel reniformes.

Petioli 8-15 mm. longi.

Folia subtus etiam adulta villosula. 3. *S. Barrattiana*.Folia subtus glabrescentia. 3. *S. Barrattiana* var. *Tweedyi*.Petioli vix ultra 4 mm. longi. 4. *S. calcicola*.

ENUMERATIO SPECIERUM

1. *S. Richardsonii* Hooker, Fl. Bor.-Am. II. 147, t. 182 (1839). — Andersson in De Candolle, Prodr. XVI.² 273 (1868), incl. var. *latifolia* et *angustifolia*. — Seemann, Bot. Voy. Herald, 40 (Fl. West-Eskim.-Land) (1852-57). — Bebb in Bot. Gaz. XVI. 50 (1889), ex parte. — Coville in Proc. Wash. Acad. Sci. II. 315, fig. 19 (1901). — Ostenfeld in Vid.-Selsk. Skrift. I. Math.-Nat. Kl. 1909, no. 8, 35 (Vasc. Pl. Arct. N. Am. Gjöa Exp.) (1910). — *S. (lanata) americana* b. *Richardsoni* Andersson in Ofv. Svensk. Vet.-Akad. Förh. XV. 119 (1858); in Walpers, Ann. Bot. V. 747 (858). — *S. lanata*, var. *americana* forma β . *S. Richardsoni* Andersson in Proc. Am. Acad. VI. 59 (Sal. Bor.-Am. 13) (1858). — *S. lanata americana* Andersson in De Candolle, Prodr. XVI.² 274 (1868), pro synonym. — In 1889, Bebb, and in 1901 Coville already dealt with this interesting Arctic species the type of which was collected by Dr. Richardson at Fort Franklin on the Mackenzie River. I have seen a photograph and fragments of the female type preserved in Herb. Kew. Hooker did not know the male plant, but Richardson also collected specimens with staminate aments as Bebb has already pointed out. Bebb, however, referred to *S. Richardsonii* a specimen from Labrador which belongs to *S. calcicola*.

The leaves of *S. Richardsonii* are not entire as Hooker stated. On his own plate he clearly shows a denticulate base of a leaf. Sometimes the leaves are even rather distinctly denticulate as in Eastwood's no. 385 and in Chapman's 41a.

The geographical distribution of this species is clearly indicated by the specimens enumerated below. There are two specimens which I am not able to identify correctly. One was collected by J. Macoun on Hunker Creek in the Yukon Territory, July 24, 1902 (No. 54396, O.; fr. im.; G., N., W.). It had been named *S. Lyallii* (Sarg.) Heller?, and by Rydberg *S. Barclayi*. The fruiting aments are quite like those of *S. Richardsonii* but the pedicels are as long as the gland. The young twigs are rather yellowish and partly glabrescent, and the older branchlets are more like those of *S. Richardsonii* with a looser pubescence. The leaves and stipules do not differ from those of this species, and it may be only a form of it, or a hybrid from it. The second doubtful specimen was brought by F. Johansen from Bernard Harbour, August 7, 1915 (No. 308 b = 93781, O.; f., fr.; "a bush"). On this specimen the ovaries are partly sparsely pilose but the fruits are glabrous. I presume that *S. Richardsonii* also has a form with more or less hairy ovaries as this occurs in certain groups in almost every species with glabrous pistils.

Andersson, in 1868, described two forms: *latifolia* and *angustifolia*. I do not think that they are of any taxonomic value because both forms of leaves are to be found on the same plant.

As Ostenfeld has already pointed out, the most prominent characters of this Willow are: "the stout hairy young twigs, the large persistent glandular-serrate stipules, and the smooth leaves with at the base sparingly glan-

dular-denticulate margins." In some respect this species seems to be closely related to *S. pulchra* Chamisso with which I have dealt on p. 70 of this Journal, and to which var. *yukonensis* is rather similar. I also stated, on p. 73, that the systematic position of *S. pulchra* is by no means clear to me. The species most nearly related to *S. Richardsonii* is *S. calcicola*, the representative of that western Willow in eastern Canada.

The following specimens of typical *S. Richardsonii* have been seen:

ALASKA. Camden Bay, Collinson Point, June 15, 1914, *F. Johansen* (No. 6 c. = 93795, O.; f. fragm.; No. 100, 33803, O.; f.; dwarf Arctic form); Anvik (on Yukon River, southeast of Norton Sound), April, *J. W. Chapman* (No. 41a, 41b, m.; G.; folia juvenilia satis dense glanduloso-denticulata); Seward Peninsula, Teller, June 21, 1916, *Ella Gehrman* (f.; C.); between Cape Nome and Port Clarence, June, 1901, *A. J. Collier* (m., f.; W.); near Nome, June 21, 1903, *F. L. Hess* (No. 8a, m.; St.; "dry creek, 1 mile north of Nome, tundra along creek bottom, plentiful," 0.9 to 1.2 m.); tundra behind Nome, along water courses, June 17, 1903, same coll. (No. 2, m.; St.; "2-3 feet high"); Porcupine River, without exact locality, summer 1891, *J. W. Turner* (No. 1, m.; Jeps.); vicinity of Port Clarence, on Rocky banks, northwest shore of Imuruk Basin, July 30, 1891, *F. A. Walpole* (Nos. 1626, 1627, fr.; W.); at Teller Reindeer Station, on tundra, July 14, 1901, same coll. (No. 1441 m.; July 13, 1901, No. 1403, f.; 1426, f.; m.; W.); meadows at east end of Grantley Harbour, July 30, 1901, same coll. (No. 1601, fr.; W.); banks of tundra near Beach at Teller Reindeer station, August 7, 1901, same coll. (No. 1771, fr.; W.); banks north side of Grantley Harbour, August 5, 1901, same coll. (No. 1753, fr.; W.); East Fork of John River at camp, July 16-17, 1901, *F. C. Schrader* (st.; W.); southeastern Alaska, Glacier W. P. & Y. R. R., June 9, 1900, *F. A. Walpole* (No. 1069, m.; W.).

NORTHWESTERN BRITISH COLUMBIA. Between Log Cabin and Fraser, June 7, 1900, *F. A. Walpole* (No. 1062, m., f.; W.).

YUKON TERRITORY. Selkirk Trail, September 6, 1898, *J. B. Tyrrell* (No. 19450, O.; st.); Carcross (Caribou Crossing), on shores of Lake Bennett near bridge, July 26, 1914, *A. Eastwood* (Nos. 709, st.; 710, fr.; A., M.; "shrub 1.2 m. high"); Twenty-four miles House, in a springy place, June 25, 1914, *A. Eastwood* (Nos. 384, fr.; 385, m.; A., M.; in No. 385 folia partim satis dense serrata); Herschel Island, August, 1914, *F. Johansen* (No. 209, 93485, O.; fr.).

NORTH WEST TERRITORIES. Fort Franklin, Mackenzie River, "near Lake" *Richardson* (f., type; K.; st.; G.); Minto Inlet, 1852, coll. ? H.M.S. Enterprise (f.; K.; on the same sheet with the type); between Great Bear Lake and mouth of Coppermine River, without date and coll. (fr.; K.; on same sheet with type); Bernard Harbour, July, 1915, *F. Johansen* (No. 308a = 93779, O.; f.); Repulse Bay, south of Melville Peninsula August 22, 1821, *Parry* (f.; G.; same as No. 93 Hb. H.B. & T.; pedicello piloso).

2. *S. calcicola* Fernald & Wiegand in *Rhodora* XIII. 251 (1911). — *Salix* spec. Macoun in Bot. Gaz. XIII. 117 (Notes Fl. of James Bay) (1888). — *S. Richardsonii* Bebb, l. c. XIV. 50 (1889), quoad specim. Bellii, non Hooker. — *S. Richardsonii* var. *Macouniana* Bebb, l. c. 50, t. 9 (1889). — *S. lanata* var. *Macouniana* Bebb according to Macoun in Ann. Rep. Geol. Surv. Can. n. s. III. 70, J (1889), nomen nudum. — *S. Macouniana* Rowlee in Herb. Cor., nom. ined., non *S. Macounii* Rydberg. — This interesting and well marked species has been fully described by Bebb and by Fernald who gives the best account of it. The type was collected by J. M. Macoun on the south Twin Island, according to the original label, a statement already made by Bebb, while Macoun himself in his account of the expedition

to James Bay said "on the north Twin Island" as cited by Fernald who probably did not see the type specimen.

I have been able to examine the following specimens which, so far as I know are all that exist in herbaria.

KEEWATIN (Manitoba). Hudson Bay, Churchill, August 3, 1910, *J. M. Macoun*.
ONTARIO. James Bay, South Twin Island, July 17, 1887, *J. M. Macoun* (No. 79154, O.; st.; C., Cor., G., N.) (No. 25, m.; C. sheet No. 7626, type of var. *Macouniana* Bebb).

QUEBEC. Northwestern Ungava, east coast of Hudson Bay, River Kovik, Lat. 61° 59', August 13, 1898, *A. P. Low* (No. 23038, st.; O.); along the Ungava River, August 23, 1896, *W. Spreadborough* (No. 13694, fr.; C., Cor., N., O.); Gaspé peninsula, Table-top Mt., calcareous cliffs, facing north, 900–1125 m., August 7, 1906, *Fernald & Collins* (No. 211, m., fr.; G., N.).

NORTHERN LABRADOR. Nachvak, crevices of rocks, July 1885, *Bell* (No. 34, fr.; C.; referred by Bebb to *S. Richardsonii*); Port Burwell, Hudson Strait, July 29 and 31, 1904, *L. E. Border* (No. 63044/5, fr.; O.); July 18, 1910, *J. M. Macoun* (No. 79155, fr.; C., Cor., N., O.); Kangulaksiorvik Bay, September 1–10, 1908, *O. Bryant* (No. 75, m.; G.).

WESTERN NEWFOUNDLAND. Ingornachoix Bay, dry rocky limestone barrens, near sea-level, August 1, 1910, *Fernald & Wiegand* (No. 3151, fr.; G.; "prostrate"); Point Riche, limestone barrens, near sea-level, August 4, 1910, same coll. (No. 3152, fr.; G.).

3. *S. Barrattiana* Hooker, Fl. Bor.-Am. II. 146, t. 181 (1839). — Andersson in De Candolle, Prodr. XVI.² 274 (1868), incl. var. *latifolia*. — Bebb in Bot. Gaz. XIV. 51 (1889). — Rydberg, Fl. Rocky Mts. 196 (1917). — *S. (lanata) americana* a. *Barrattiana* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 119 (1858); in Walpers, Ann. Bot. v. 747 (1858). — *S. lanata* var. *Americana* forma a. *S. Barrattiana* in Proc. Am. Acad. IV. 59 (Sal. Bor.-Am. 13) (1858). — *S. lanata Barrattiana* Andersson in De Candolle, Prodr. XVI.² 274 (1868), pro synonym. — *S. Albertana* Rowlee in Bull. Torr. Bot. Club, XXXIV. 157 (1907). — *J. K. Henry*, Fl. S. Brit. Col. 100 (1915). — This species has been well described and figured by Hooker from specimens collected by Drummond in alpine swamps of the Canadian Rockies where it is found in Alberta and British Columbia. The history of *S. Barrattiana* has already been fully given by Bebb. It had not been rediscovered since Drummond until 1885 when J. Macoun found it in the Kootenay District of British Columbia at Kicking Horse Lake. Andersson (in 1858) gave the correct type locality but in 1868 made a mistake and cited "Fort Franklin Americae subarcticae (Richardson, Douglas)" a quotation apparently taken from his note in 1858 to *S. Richardsonii*. As Bebb has already explained Douglas never collected at Fort Franklin.

In 1868, Andersson proposed two forms: *latifolia* and *angustifolia* without mentioning a type. His var. *latifolia* is nothing but typical *S. Barrattiana*. His var. *angustifolia* is scarcely worth keeping as a distinct form, although it has been made a species by Rowlee who described it as *S. Albertana* saying that "it is quite probable that our species is *S. Barrattiana* var. *angustifolia* And." He, however, states that his new species "differs fundamentally in form and vesture of the leaf" from *S. Barrattiana*, but he also said: "*S.*

Albertana has thick opaque leaves acute at the base and apex and agrees with *S. Barrattiana* in vestiture." The shape of the leaves is very variable, and we may distinguish a forma *angustifolia* but I do not think that is it of great taxonomic value. The length of the style too varies from 1.2 to 2.5 mm., and in very young flowers it is often difficult to measure its exact length.

I have seen the following specimens of typical *S. Barrattiana* :

ALBERTA. Rocky Mts., locality uncertain, alpine swamps, *Drummond* (m., f.; K.; same as No. 77 Hb. N. B. & T.; No. 650, N.; copy and fragment in C.); Edson District, Athabaska River, near Lac Brulé, alpine slopes, 1650 m., June 30, 1898, *W. Spreadborough* (No. 20348, O.; fr.); Brulé, near tree limit, June 24, 1918, *W. Spreadborough* (No. 95809., O; m.; A.); Jasper Park, Great Goat Mt., around a spring in woods, about 2000 m., July 24, 1918, *J. M. Macoun* (No. 95780, f.; o., A.); Fitzhugh Mt. about 2000 m., August, 1917, *J. M. Macoun* (No. 95402, st.; O.: "1.2 m. high"); Mt. Edith Cavell, about 2300 m., August 27, 1917, same coll. (No. 95306, st.; O.); Shovel Pass, about 2250 m., August 9, 1918, same coll. (95742, 95744, fr.; A., O.); same place, swampy place near tree limit, August 1, 1918, same coll. (No. 95730, fr.; 95731 m.; A., O.); Rocky Mountain District, Rocky Mt. Park, Lake Agnes near Laggan, about 2200 m., August 11, 1897, *C. S. Sargent* (st., A.; "low shrub"); Lake Louise, July 27, 1895, *W. M. Canby* (No. 5, f.; C.); same lake, August 10, 1904, *A. Rehder* (fr.; A.); same place and date, *J. G. Jack* (st.; A.); same place, August 15, 1909, *Olson* (fr.; G.); Laggan, June 28, 1904, *J. Macoun* (No. 68885, st.; N., O.); vicinity of Banff, summit of Mt. Edith Pass, about 2250 m., June 30, 1899, *Dawson* (No. 22337, f.; O.); high mountain slopes in rather wet ground, 2150-3600 m., June 30, July 18, August 4, 1899, *W. C. McCalla* (No. 2251, m., f., fr.; Cor.; type of *S. Albertana* Rowlee); Summit of Pipe Stone Creek, July 5, 1904, *J. Macoun* (No. 68884 m., f.; N., O.); Sulphur Mt., damp spots, July 22, 1891, *J. Macoun* (No. 24 in C., No. 24280, O., fr. im.; Cor.); Mt. Aylmer, 2600 m., August 6, 1891, same coll. (No. 24281, fr.; C., O.).

BRITISH COLUMBIA. Kootenay District, Kicking Horse Lake, swamps, July 28, 1885, *J. Macoun* (No. 26, 24284, fr.; C., O.); mountains at Kicking Horse Lake, by alpine rivulets, August 12, 1890, same coll. (No. 242282 fr., O.; No. 22 in C.); without exact locality, summit of Rocky Mts., August, 1889, *J. Macoun*, (No. 22, fr.; A., G.; in M. from August, 1890, large leaves very similar to those of var. *Tweedyi*, but rather pubescent); Selkirk Mts., at Glacier, August 13, 1897, *W. M. Canby* (No. 262, st.; G.); Asulkan Pass, August 23, 1904, *J. Macoun* (No. 68886, f.; O.); Dumnut (?) Lake, 1900 m., June 30, 1904, *H. Petersen* (No. 64, m.; G. M. N.); Yoho (?) Valley, Flat, 2000 m., July 2, 1903, *M. A. Barber* (No. 298 partim. m., G.; mixed with m. specimen of a species of sect. *Cordatae*).

S. Barrattiana seems not to occur in the United States, but there is the following variety which represents the type in Montana and Wyoming. Ball regarded it as a good species and in Herb. W. he also referred to it a specimen from British Columbia, Emerald Lake, Avalanche Path, collected on June 20, 1904, by R. T. Shaw (No. 1, m., f.; named *S. conjuncta* by Macoun). If this specimen really belongs to this variety it would connect its range with that of the type. The synonymy of the variety is as follows:

3b. *S. Barrattiana* var. *Tweedyi* Bebb apud Rose in Contrib. U.S. Nat. Herb. III. 572 (Pl. Bighorn Mts. Wyo.) (1896).¹ — *S. Barelayi* Rydberg in

¹ Bebb gave the description in May 1894 in a letter. But "the varietal name [*denudata*] used by Mr. Bebb being preoccupied has been changed to the one given above." Rose in note.

Mem. N.Y. Bot. Gard. I. 111 (Cat. Fl. Mont.) (1900), quoad specim. Coulteri, non Andersson. — *S. Tweedyi* Ball in Bot. Gaz. XL. 377, pl. 12, figs. 3-7 (1905); apud Coulter & Nelson, New Man. Rocky Mts. Bot. 135 (1909).

I am not fully convinced of the accuracy of Ball's statement "that this Willow is specifically distinct from *S. Barrattiana*." In 1905, he said: "Not only do the nearly glabrous leaves and the glabrous capsules serve to distinguish it, but the leaf margin thickly set with conspicuous glands is a marked character." In his diagnosis he, however, states: "capsules green and glabrous, or sometimes finely pubescent near the apex." The glands or glandular dentations of the leaf margin very often occur in *S. Barrattiana* where they are usually hidden by the pubescence of the leaf. The shape of the leaves varies in the same manner in both forms. In the characters of the flowers I cannot detect any difference; the bracts, too, are obovate-lanceolate, not obovate. In var. *Tweedyi* the leaves usually possess some stomata in the epidermis of the upper surface while these are wanting in the type. This character needs further observation. In 1909 Ball gives the range as follows: "In bogs and along mountain streams, 2500-3000 m. altitude, not common; known only from the Bighorn Mountains of northern Wyoming, the Yellowstone Park, and Teton Basin." From what I have seen I can record the following specimens of var. *Tweedyi*.

WYOMING. Sheridan County: head of Big Goose Creek, Bighorn Mountains, July 15-24, 1893, *F. Tweedy* (No. 11, fr. im., type; G.; in C. No. 11 f., 12 m., fr. im.; same in W.); Tongue River, about 3070 m., July 13, 1900, *J. G. Jack* (fr.: A.); Bighorn Mountains, about 3200 m., August, 1899, *F. Tweedy* (No. 2447, fr.; N.; amentis 7.5:1.8 cm. magnis); head waters of Tongue River, July, 1889, *F. Tweedy* (No. 87, fr. im. 86. fr.; N.). Lincoln County: Two-Two (?) Tea Pass, about 3300 m., August, 1897, *F. Tweedy* (No. 300, st.; N.). ? County: Chug Creek, June 10, 1898, *E. Nelson* (No. 4349, f. tantum [m. = *Bebbiana*]; C., N.; Ball refers the female to *S. monticola* in W.).

MONTANA. Park County: Trail River Mountains, 1872, *J. M. Coulter* (f.; N., W.); Madison, Spanish peaks, July 20, 1901, *J. Vogel* (m., f.; Cor.); Yellowstone Park, Electric Peak, July 26, 1902, *E. C. Shear* (No. 109, f., ex parte; N., W.; part of the number belongs to *S. Barclayi*).

4. *S. amplifolia* Coville in Proc. Am. Acad. Sci. II. 282, t. xv (1900); III. 314, t. 35 (1901). — I cannot add anything to Coville's excellent description and plate after having seen the type which was collected at Indian Village on June 22, 1899, by Coville and Kearney (No. 1153, f.; W.). So far the species is only known from Yakutat Bay, Alaska, where it "was first observed on the west shore of the bay growing on and near the sand dunes that lie back of the beach, and has afterward been collected in Disenchantment Bay, Egg Island, Hubbard Glacier, and Haenke Island, and later at the Indian village at the head of Yakutat Bay east shore." As Coville says: it "bears considerable resemblance to *richardsonii* and *barclayi*, but the species from which it differs least is *Salix hookeriana*." Both lack the stipules so conspicuous in *S. richardsonii* and the main difference between *amplifolia* and *Hookeriana* is indicated in the key on p. 213. *S. Hookeriana*, too, has a

short peduncle often provided with very small leaves. The development of a more or less leafy peduncle is a character of no great stability in certain species, and it apparently varies a good deal in *S. Hookeriana*. At present it is difficult to make a definite statement as to the true relationship of *S. amplifolia* which has the long styles of the *Richardsonii* group while in *S. Hookeriana*, *S. Piperi*, and *S. laurentiana* the styles scarcely measure up to 1.3 mm. in length.

Of *S. amplifolia* I have only seen the specimens already cited by Coville.

5. *S. Hookeriana* Barratt apud Hooker, Fl. Bor.-Am. II. 145, t. 18 (1839). — Nuttall, N. Am. Sylva, I. 64 (1843). — Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 119 (1858); in Proc. Am. Acad. IV. 59 (Sal. Bor.-Am. 13) (1858); in Walpers, Ann. Bot. v. 747 (1858). — Bebb in Bot. Gaz. XIV. 25 (1889); xv. 53 (1890). — Sargent, Silva, ix. 147, t. 485 (1896). — Howell, Fl. N. W. Am. I. 619 (1902). — Schneider, Ill. Handb. Laubh. I. 48, fig. 26g, 27n-o (1904). — Ball apud Piper & Beattie, Fl. Northw. Coast, 116 (1915). — Henry, Fl. S. Brit. Col. 99 (1915). — The history of this species and the origin of the type has been explained by Bebb. I have seen a photograph of the type and fragments from Herb. Kew. According to my observations the type has glabrous ovaries, and the gray pubescence of the leaves is mixed with a few fulvous hairs. Such a mixture often points to a hybrid with *S. Scouleriana* Barratt, but judging by the flowers there is no indication of such an influence in the type of *S. Hookeriana*. As a rule the number of the fulvous hairs in the pubescence of *S. Hookeriana* is very small, and it is usually difficult to detect them.

The type was collected by Scouler somewhere at the "N. W. Coast of America" (probably on Vancouver Island), but Hooker quoted in the first place "near Grand rapids of the Saskatchewan, rare. Douglas." This is a mistake as shown by Bebb; Andersson repeated the mistake and made it worse by only quoting the obscure Douglas specimen and omitting Scouler's plant. I have seen a photograph of Scouler's plant, and it agrees well with the plate as Bebb explained in 1890.

The range of *S. Hookeriana* is restricted to the sea coast from Vancouver Island to Coos County in Oregon. It is according to Howell "plant of the sea coast and salt marshes, usually growing on the margin of ponds, but confined in its range to the immediate proximity of the sea." Professor J. K. Henry at Vancouver, to whom I am indebted for good material of the species, has proposed (Fl. S. Brit. Col. 99 [1915]) a var. *laurifolia* which he describes as follows: "Stem ascending, twigs stout, as in species; less tomentose to nearly or quite glabrous, leaves finally shining above, strongly glaucous and more or less pubescent (not tomentose) beneath; petioles 1-1.25 cm. long; capsule glabrous or slightly pubescent at apex. The yellow leaves are very striking in the autumn, while in the species the leaves usually blacken. Near *S. Piperi* from which it differs mainly in the pubescence. Forms of *S. Hookeriana* with leaves approaching those of this var. and with tomentose twigs are not rare; and there can be no doubt that

the capsule of *S. Hookeriana* is often nearly or quite glabrous." According to a letter from the author of March 9, 1919, var. *laurifolia* prefers a drier position than the species. This is very abundant at Vancouver and especially about New Westminster where it is usually found in very wet places. "Probably this is the explanation of the difference in the autumn colours." *S. Hookeriana* "grows in clumps usually 1.5-3 m. high, or occasionally 5 m. high. Only rarely have I seen a single stem attaining the size Howell mentions" [rarely even 30 feet in height]. So far as I can judge by the material which I have seen, var. *laurifolia* is a variety well worth its name. Not unfrequently it seems to be somewhat intermediate between typical *Hookeriana* and *S. Piperi* (see for example Lamb's No. 1104) which, as I shall presently explain, needs further observation, and may represent nothing but an extreme form of the species.

As Bebb has already stated, there is a rather common form with more or less hairy ovaries which are entirely glabrous in the type. J. K. Henry has sent to me specimens with totally tomentose ovaries and fruits named var. *tomentosa* (which however neither in the pubescence nor in the flowers show any influence of *S. Scouleriana*). I think we may accept this name for such a form, and — it being not published — I propose

5c. *S. Hookeriana* var. *tomentosa* J. K. Henry, in Herb., var. nov. — A typo nonnisi differt ovariis et saepissime etiam fructibus omnino vel pro parte maxima tomentosis.

I have seen the following specimens of *S. Hookeriana* which partly (as indicated) belong to one of the two varieties mentioned.

BRITISH COLUMBIA. Vancouver Island, locality uncertain, *Scouler* (m., f.; K.; ovariis glaberrimis, filamentis ima basi pilosis et coalitis; type; same as No. 9 Barratt in N.); district of Renfrew, edge of the forest along the beach, August 12, 1902, *C. O. Rosendahl* (No. 922, f.; A.; ovariis tantum apice pilosis); near Victoria, June, 1896, *J. R. Anderson* (fr.; A.; fructibus maturis glabris); Beaver Lake, May, 1897, same coll. (m., f.; W.); Blue Lake, May 2, 1897, same coll. (m.; A.); Vicinity of Ucleslet, May 24, 1899, *J. Macoun* (fr.; 17240, O. C.); Vicinity of Victoria, May 18, 1893, *J. Macoun* (No. 481, f.; A., C.; ovariis glabris); same locality, May 26, 1893, same coll. (No. 480, fol. juv. tantum; C., M.); May 25, 1908, same coll. (No. 76784, m.; C., N.); April 25, 1908, same coll. (No. 76785, f.; C., N.); May 13, 1908, same coll. (No. 76781, fr. subnat. dense villosis vel tomentose; N.); Cowichan Park, May 22, 1911, *Spreadborough* (No. 83861, st. Cor.); vicinity of Comox, June 26, 1893, *J. Macoun* (No. 479, st.; C.) without exact locality, June 16, low wet places, *J. Macoun* (No. 1, in C. [sheet 7543]; m., f., fr., st.); New Westminster County, by the sea, April 11, 1889, *J. Macoun* (No. 3a, C. [sheet 7544]; m., f., st.); New Westminster Road, April 20, 1889, *J. M. Macoun* (m., f.; G.; ovariis parte inferiore glabrescentibus); Lower Fraser River, 49, N. Lat., 1859, *Lyall* (m., G.; filamentis partim ut videtur glabris); near New Westminster, low ground, May 10, 1914, *J. K. Henry* (No. 1424, fr., 1426, m.; A.; ovariis apice et pedicellis pilosis); May 10, September 27, 1914, same coll. (No. 21, fr., st., A.); Lulu Island, low ground, April 10, September 21, 1914, same coll. (m., f.; st.; A.); May 4, 1915, same coll. (f.; A.); same Island, May 20, 1914, *A. J. Hill* (m., f., Brookl.); Mayne Island, May 20, 1914, *J. M. Macoun* (No. 90154, st.; O.); Douglas, May 6, 1906, *W. Spreadborough* (No. 79561, f.; Cor.).

WASHINGTON. King County: Seattle, June 8, 1890, *C. V. Piper* (fr.; G., M.;

fructibus glabris; foliis partim subtus pilis sparsis fulvis preaditis). Chehalis County (Gray's Harbor): Cohasset Beach, May 25, 1897, *F. H. Lamb* (No. 1126, fr. im.; M.; var. *tomentosa*); Hoquiam, May 10, 1897, same coll. (No. 1004, fr.; M., N.; var. *laurifolia*; by Piper referred to *S. Piperi*); Gray's Harbor City, May 13, 1897, same coll. (No. 1035, m., N. M.); same locality, without date and coll. (Capt. Wilkes Exp. No. 217, st.; W.); Westport, May 26, 1897, *F. H. Lamb* (No. 1124, m., N.); same loc., dunes, July 10, 1907, *H. C. Cowles* (No. 506, st.; C.). Pacific County: Long Beach, Ocean Beach, September 6, 1891, *L. F. Henderson* (st.; A., C., Pu., W.; ex parte tantum).

OREGON. Clatsop County: Astoria, mouth of Columbia River, July 13, 1880, *G. Engelmann* (st.; M.); same place and date, *Engelmann & Sargent* (No. 14, f.; A., C.); mouth of Columbia, May, 1887, *Th. Howell* (f., fr.; C.); same place, August 31, 1898, *F. C. Coville* (No. 842, st.; W.); Morrison, March 28, April 10, May 1, 1900, *F. A. Walpole* (Nos. 1006, m., f.; 1017 m.; 1033, fr.; W.). Douglas County: mouth of Umpqua River, on marine beach, August 11, 1880, *Engelmann & Sargent* (No. 18, f.; A., C.; "tree 20 ft. high, 12 in. diam."; ovarii apice et pedicellis pilosis; in A. mixed with *S. Scouleriana*). Curry County: near Agness, swamp, June 13, 1913, *J. C. Nelson* (No. 1452, fr.; G.); Chetco, March near Chetco River, May 4, 1902, *F. A. Walpole* (No. 2142, f.; W.); same place, on bank along beach, May 8, 1902, same coll. (No. 5152, f.; W.). Lincoln County: Yaquina Bay, April and May, 1886, *Th. Howell* (m., f.; N., W.); in C. without date, near Cape Foulweather (20 ft. high, 6 feet diam.). Coos County: Ross Slough, May 10, 1911, *H. H. Smith* (No. 3669, fr.; C.); South Fork Coos River, March 30, 1911, same coll. (No. 3599, f.; C.); Coos River, April 5, 1911, same coll. (Nos. 3607, f., 3608, m.; near var. *laurifolia*); same place, March 22, 1911, same coll. (No. 3570, f.; C.; same as preceding); Coos Bay, swamps ins and dunes near seashore, August 19, 1911, *H. D. House* (No. 4726, st.; W.); Empire, on exposed coast, October 12, 1909, *V. Bailey* (st.; W.). ? County hillsides near coast, July-August, 1901, *J. E. Kirkwood* (No. 165, st.; N.).

6. *S. Piperi* Bebb in Gard. and Forest VIII, 482 (1895). — Ball apud Piper & Beattie, Fl. Northw. Coast, 116 (1915). — *S. lasiolepis* var. *Bige-lorii* Auct., non Bebb, ex parte. — This willow has been best described in a field note sent to Bebb by Piper who collected it first. He said: "During several seasons that I was especially interested in the collection of Willows, I found, near Seattle, only three plants, with one or two at other points. Two of these, staminate, grew, one in a swamp near Lake Union, the other not far distant in a Splagnumbog on high ground. Both had several stems rising from the same root eighteen to twenty feet high, not much branched till near the top; branchlets dark colored and smooth. The one pistillate plant grew at the edge of Lake Washington, three miles from the staminate mentioned above, in the old gravel beach of the lake. This, also, had several stems three to four inches in diameter, with a smooth dark grayish bark, sparingly branched; branches erect. Owing to its extreme isolation the aments were imperfectly fertilized — perhaps by the pollen of *Salix Scouleriana*, which grew in the vicinity and flowered at the same time." Bebb stated that *S. Piperi* is most nearly related to *S. Hookeriana* but differs "in the entire absence of that grayish pubescence on both leaves and twigs so characteristic of *S. Hookeriana*. The leaves in one form are similar in outline, in others much narrower, with a very irregular repand margin. The beautiful silky aments are like those of *S. Hookeriana*. The filaments,

occasionally united at base, is a marked characteristic of *S. lasiolepis*, and it is not improbable that *S. Piperi* will be found to vary in the direction of that species. It seems . . . to combine the characters, of . . . *S. Hookeriana* and *lasiolepis*, while abundantly distinguished from both."

I have seen Bebb's type in Herb. C., and I find that the capsules are not "smooth" as said in the original description and repeated by Ball, but slightly hairy at apex. This is also true of specimens collected by Piper and preserved in Herb. G., marked by the collector "duplicate type material." The filaments in both specimens are somewhat united and hairy at the base.

This species much resembles *S. Hookeriana* var. *laurifolia* as already stated. It also reminds me of what is called *S. lasiolepis* var. *Bigelovii* of Washington and Oregon. Unfortunately I am not well enough acquainted with the *Cordatae*-group to which the last variety belongs. Therefore, I do not wish to express to-day a definite opinion on the taxonomic value and the true affinity of *S. Piperi*. Some of the specimens I am going to quote seem to represent a good species, while as a whole the material which I have seen is by no means sufficient to decide whether it consists of forms of different (partly hybrid) origin or can be regarded as belonging to one variable species. The fact that some specimens point to the *Cordatae* and some to *S. Hookeriana* may be explained by the hybridization of *S. Piperi* with the last species and with forms of the *Cordatae*. After all it needs a careful study in the field. I have not yet seen well matured fruits which are said by Ball to measure 6 to 7 mm. in length. The following specimens have been seen.

WASHINGTON. King County: Union Lake and Lake Washington near Seattle, 1888, *C. V. Piper* (No. 458 and 560, type in Herb. Bebb in C., sheet 2462, f. 2464 m.) probably same place, April-September, 1889, *Piper & Smith* (m., f., st.; G. marked by Piper "duplicate type material"; mixed with typical female *S. Hookeriana*); March 29, 1889, *E. C. Smith* (m.; M.; filamentis satis pilosis); April 4, 1889, same coll. (m., f.; M.; ramulis annotinis biennibusque sparse puberulis; resembles much *S. Hookeriana* var. *laurifolia*); July 11, 1889, same coll. (st.; M.); April 20, 1892, *C. V. Piper* (m.; A.); damp and marshy places, April 22, 1911, *E. M. Bardell* (m., f.; M.; amentis praecocibus); swamp near Olympia, August 23, 1892, *L. P. Henderson* (m., st.; C.); Tacoma, stagnant pools and springs, April 24, May 9, June 7, 1901, *J. B. Flett* (No. 1875, m., f., fr., st.; W.). Cowlitz County: Lake Merrill, July 18, 1898, *F. C. Coville* (No. 751, st.; W.).

OREGON. Clackamas County: Oregon City, April, 1885, *Th. Howell* (m., f.; W.; sub nomine *lasiolepis Bigelovii*, but determined by Ball *S. Piperi*); Ball (1915) states that in Oregon it ranges "southward through the Willamette Valley to Curry County."

7. *S. laurentiana* Fernald in *Rhodora* ix. 220 (1907). — I have seen the type material and besides that only one specimen from southern Labrador. The male plant is not yet known, and this species needs further investigation. There are a few statements in Fernald's original description which according to my observation are not quite correct. He says that the fruiting aments measure up to 9 cm. in length while I have not seen any longer than 7 cm., and the style is not very short (*brevissimo*) but up to 1 mm.

long. The capsules are from 5 to 7 mm., and the pedicels about 1 mm. long, and from one half to twice (not 3 times) longer than the gland.

The type was collected by Fernald & Collins in Quebec, Gaspé County, at Mechins, on July 12, 1906 (No. 202, fr.; G.), and the species also occurs in Matane County and, as I have already said, in southern Labrador where it has been found by A. C. Waghorne, at Blanc Sablon, July 27, 1893 (No. 1, ex parte, fr.; W.; mixed with *S. planifolia* Pursh). Fernald says in his remarks that *S. laurentiana* suggests in its foliage and tomentose branchlets *S. amplifolia* which, however, can be distinguished at once by its glabrous ovaries, the long style and the absence of stipules; he compares it also with *S. glaucophylloides* which belongs to section *Adenophyllae*. In my opinion it comes nearest to *S. Hookeriana*, but the male plant as I have stated is still unknown; and I have not seen enough material to get a good idea of the real relationship of this interesting species.

8. *S. alaxensis* Coville in Proc. Wash. Acad. Sci. II. 280 (1900); l. c. III. 311, t. 34 (1901). — Sargent, Silva N. Am. XIV. 65, t. 729 (1902); Man. Trees N. Am. 188, p. 160 (1905). — Ostenfeld in Vidensk.-Selsk. Skrift. 1. Math.-Nat. Kl. 1909, No. 8, 36 (Vasc. Pl. Arct. N. Am. Gjøa Exp.) (1910). — *S. arenaria macrostachys* Richardson in Franklin, Narr. Journ. Polar Sea Bot. App. 753, No. 400 (1823); ed. 2, Bot. App. 37 (1823), non Schleicher. — *S. speciosa* Hooker & Arnott, Bot. Beechey Voy. 130 (1832), non Host in 1828. — Hooker, Fl. Bor.-Am. II. 145 (1839). — Seemann, Bot. Voy. Herald, 40, t. 10 (Fl. West, Eskimaux-Land) (1852-57). — Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 119 (1858); in De Candolle, Prodr. XVI.² 275 (1868), excl. var. *a* etc. — Gray in Proc. U.S. Nat. Mus. VII. 528 (Notes Pl. Stejneger) (1885). — *S. speciosa* var. *Alaxensis* Andersson in De Candolle, l. c. 275 (1868). — ? *S. Barrattiana vestita* Kurtz in Bot. Jahrb. XIX. 406 (1894). — "Although there is no fructification on the specimen of this plant, yet it is altogether so remarkable in appearance, and so unlike any other *Salix* with which we are acquainted, or can find described, that we venture on giving it a name and character." This is a very correct statement of the author, and the species indeed is one of the best marked among Willows. I do not wish to repeat what has been said by Coville who gave a good description of the main characters of this Willow and of its distribution. He cites a good many specimens to which I add the following:

ALASKA. May 7, 1916, *E. P. Walker* (No. 1037a, m.; G.); White Pass, July 23, 1914, *A. Eastwood* (No. 881, st.; A.); Copper River region, along river bank, June 23, 1902, common, *W. L. Poto* (No. 57, fr.; W.; "18 ft. high"); August 17, 1902, same coll. (No. 154, st.; W.; "15-25 ft."). Kodiak Island, Karluk, near river below hatchery, May 25, 1901, *W. T. Horne* (m.; N.; "solitary tree scrubby about 8 feet & seven inch. at the base"); lower course of Karluk River, mostly on little islands in river channel, May 12, 1903, *C. Rutter* (Nos. 66, f., 67 m.; W.; "10 ft. high, coarse branches"); along Sturgeon River near Karluk, May 5 and 8, 1897, same coll. (m., f.; St.; buds collected November 5, 1896; St.); N. E. Harbor Creek, August 3, 1902, same coll. (st.; N.); along river above same creek, June 9, 1901, same coll. (m.; N.); Ditchcreek above dam, May 27, 1901, same coll. (f.; N.; "trees reaching

15 ft. and 5 or 6 in.”). Kotzebue Sound, without exact locality, “July-September, 1826,” *Beechey* [Lay & Collie] (st.; type in K.). Kuskokwim Valley, 1884, *Weinmann* (st.; G.). Vicinity of Port Clarence, tundra at Teller Reindeer Station, July 26, 1901, *F. A. Walpole* (No. 1548, fr.; W.; foliis etiam superne dense sericeo-villosis); on gravelly flats at Mission Creek, July 13, 1901, same coll. (No. 1433, fr.; W.). Arctic regions, without exact locality, Capt. *Parry* (ex Herb. Torrey in G.; a very small sterile fragment with two female fragments of *S. arctica* Pall.).

YUKON TERRITORY. King Point, *A. H. Lindström*, July 4, 1906 (st.; N.). Carcross, July 16, 1914, *A. Eastwood* (No. 687, st.; A.); Lake Lindeman, head of Yukon River, June 12, 1883, *F. Schwatka* (No. 15, fr. juv.; G.); Ingersoll Islands, moist sloughs and river bottoms, May 28, 1899, *M. W. Gorman* (No. 985, f.; N., O.; W.); Lake Bennett, lake shore and upland, June 6, 1899, *I. B. Tarleton* (No. 12, ex parte f.; N.; “up to 12 feet high, 4 in. diam.”).

NORTHWESTERN TERRITORIES. Mackenzie River, north of Arctic Circle, 1898, *J. McConnell* (f.; C.); Fort Franklin, Mackenzie River, *Richardson* (No. 653, f.; G.; same as No. 81, Hb. H.B. & T.; K.); Great Slave Lake, Caribou Island, July 2, 1907, *Seton & Preble* (No. 65, fr.; O.); Upper Liard River, Lat. 60° 62', June 27, 1887, *Dawson* (No. 28b., fr.; C.).

BRITISH COLUMBIA. Bennett, July 17, 1914, *A. Eastwood* (No. 726, st.; A.).

Richardson who first referred to this plant applied a name of *Schleicher* to it, saying: “400. *S. arenaria*, macrostachys: *Schleicher*, *S. limosa*: *Wahl. Lapp.* p. 265? (B.)” In Herb. N. (Herb. Barratt) there are male and female fragments of *S. alaxensis* with the label: “This specimen is identical with 413 *Richd.* app. 37, the *Salix arenaria macrostachys!* — *S. speciosa* *Hooker.*”

Coville states that the stout twigs are either smooth or densely hairy, and sometimes they have a decidedly blue color from the presence of a conspicuous bloom. This last form has been collected by Miss *A. Eastwood* in many numbers, especially at Dawson. In a field note this well known collector says: “At Dawson no specimens have tomentose twigs and all have young twigs covered with a bluish bloom. Some plants have red stems, others yellow. Those with red stems have red pistils if female and red anthers when young if male. The two may be side by side so it does not seem due to soil.” “This is the only species in the Yukon that becomes a tree but it is frequently shrubby. One grove of slender trees is near the brewery at Klondike City, across the Yukon, some about fifty feet high but none more than six inches in diameter. The tree has a smooth greenish bark on the trunk. I saw no trees over a foot in diameter. It is first in bloom and the flowering trees swarm with various lepidoptera, diptera and hymenoptera. I had no facilities for either collecting or preserving, so can't find out the species. The woolly stemmed ones were found only at greater elevation than Dawson. It is most beautiful in flower. The leaves seem to be much eaten by insects and the female catkins on some bushes were full of small smooth caterpillars which hatched out while specimens were drying.”

This glabrescent form with pruinose twigs is rather conspicuous and worthy of being made a distinct variety. There is already a name for it, because *Rydberg* has described a *S. longistylis* which unfortunately he did not compare with *S. alaxensis* and which according to *Coville* “is clearly

identical with *alaxensis*." The type of *longistylis* was collected by Williams at the "mouth of Klondike," and after having seen it I am convinced that *S. longistylis* represents this pruinose form. Therefore I propose the following variety:

8b. *S. alaxensis* var. *longistylis*, var. nov. — *S. longistylis* Rydberg in Bull. N. York Bot. Gard. II. 163 (1901), non *S. longistyla* Gandoger, Fl. Eur. XXI. 96 (1890). — A typo nonnisi differre videtur ramulis novellis laxius vel sparse villosis annotinis glabris flavo-brunneis et (ut etiam biennes) saepissime satis pruinosis. — To this variety which clearly is connected with the type by many intermediate forms the following specimens should be referred which partly had been referred to typical *S. alaxensis* by Coville.

ALASKA. Glacier to White Pass R.R. Skagway, June 9, 1900, *F. A. Walpole* (Nos. 1071, f.; 1077, f. fr.; W.); Muir Glacier, June 9, 1899, *Trelease & Saunders* (No. 3344, fr. im.; 3347 f.; A., M.); June 11, 1899, same coll. (No. 3345, f.; M.); June 12, 1899, same coll. (No. 3348, fr. im.; M.). Yakutat Bay, Hidden Glacier Inlet, June 20, 1899, same coll. (No. 3349, f.; M.); Prince William Sound, Fort Wells, June 26, 1899, same coll. (No. 3372, fr. im.; M.); Kodiak Island, near Kodiak Village, July 2, 1899, same coll. (No. 3351, st.; M.); Kodiak, July 25, 1904, *O. A. Piper* (st.; W.); Alaska Peninsula, Kukak Bay, July 5, 1899, *Trelease & Saunders* (No. 3350, st.; A., M.); Lake Iliamna region, on open slopes along Iliamna Bay, June 22, 1902, *M. W. Gorman* (No. 142, fr.; W.); Anvik, Yukon River, April, without year, *J. W. Chapman* (No. 41a or d, f.; G.). Bergman region, Koyukuk River, Arctic Circle, 1901, *F. C. Shrader* (f.; W.). Valley of Kobuk River, 3 miles below Walker Lake, August 10, 1901, *W. C. Mendenhall* (st.; W.); "quite common, 6-12 feet high"; about 45 miles below Walker Lake, August 17, 1901, same coll. (st., W.; tall slender Willow, very common along river, from 12 to 25 feet high). Rampart, June 16, 1901, *I. Jones* (No. 19, fr.; W.); July 20, 1901, same coll. (No. 1; W.; 20-25 ft., "very few branches and those near the top of the tree"), same place, July 10, 1903, *A. Hollick* (fr.; N.). Dall River, 65 miles above mouth, 1901, *C. W. Mendenhall* (fr.; W.); Coldfoot, July 16, 1904, *O. A. Piper* (st.; W.); Fort Yukon, July, 1900, *C. C. George-son* (No. 18, f.; W.); Port Wells, June 26, 1899, *W. H. Brewer & Coe* (No. 136, fr. jub.; W.).

YUKON TERRITORY. Ingersoll Islands, moist sloughs and river bottoms, May 28, 1899, *M. W. Gorman* (W. 986, m.; N.). Islands in Klondike River at Dawson, July 15, 1902, *J. Macoun* (No. 54395, O., st.; G.); Dawson, April 26, 1914, *A. Eastwood* (No. 12, m. juv.; A.); May 9, 1914, same coll. (No. 111, m. fr. juv.; A.); May, 1914, same coll. (No. 75, f.; A.; 75a, st.; 76, f.; A.); June 11, 1914, same coll. (No. 179, fr. submat.; A.); June 30, 1914, same coll. (No. 464, st.; A.; foliis satis anguste lanceolatis acuminatis); banks of Klondike River, May 6, 1914, same coll. (Nos. 22, 24, m.; A., M.; Nos. 23, 25, 26, f.; A.); May 9, 1914, same coll. (No. 39, m.; A.); May 18, 1914, same coll. (No. 74, f.; A.); June 11, 1914, same coll. (No. 185, st.; A.); June 13, 1914, same coll. (No. 215, m.; A.); June 17, 1914, same coll. (Nos. 288, 288a, st.; A., M.); June 23, 1914, same coll. (No. 340, st.; A.); Cemetery Hill, May 6, 1914, same coll. (No. 143, fr. im.; A.); Bonanza Creek, May 9, 1914, same coll. (No. 38, f.; A., M.); Ogilvie, July 8, 1914, same coll. (No. 542, st. A.; foliis lanceolatis ad 10:2.5 cm. magnis); Coffee Creek, July 9, 1914, same coll. (No. 551, st. A.); Hard Luck Slough, June 10, 1914, same coll. (No. 559, st.; A., M.; foliis latis ad 12:6 cm. magnis); White Horse, July 12, 1914, same coll. (No. 618, st.; A.); Llewellyn Glacier, July 15, 1914, same coll. (No. 666, st. A.).

In the synonymy of the species I have mentioned with a query var.

vestita Kurtz of which I have not seen the type. The author of l. c. says nothing but the following: "330. *S. Barrattiana* Hook. var. *vestita* Kurtz; ramis junioribus dense albo-tomentosis, bracteis gemmarum valde pruinosis, Amenta omnia androgyna." The type was collected by A. & A. Krause, on May 26, 1881, in southeastern Alaska, "oberes Dejäththal" under No. 24.

b. SECT. CANDIDAE SCHNEIDER

This section probably consists of a single species the true affinity of which is by no means clear as I have already said on p. 211. The second Willow added by me only provisionally is too little known to understand its real relationship.

Sect. *Candidae* Schneider, Ill. Handb. Laubh. i. 46 (1904). — Sect. *Cinereae* Barratt apud Hooker, Fl. Bor.-Am. ii. 144 (1839), ex parte, — Sect. *Arcticae* v. *Subarcticae* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 119 (1858), ex parte. — Ball apud Coulter & Nelson, New Man. Rocky Mts. Bot. 135 (1909), ex parte. — Sect. *Niveae* s. *Glaucæ* Andersson in De Candolle, Prodr. xvi.² 275 (1868), ex parte. — Sect. *Incanæ* Koehne, Deutsche Dendr. 94 (1893), ex parte, non Andersson. — Sect. *Argentea* Rydberg, Fl. Rocky Mts. 189 (1917), ex parte.

1. *S. candida* Flüge apud Willdenow, Sp. Pl. iv. 708 (1805). — Pursh, Fl. Am. Sept. ii. 608 (1814). — Poiret in Lamarck, Encycl. Suppl. iv. 66 (1817). — Hooker, Fl. Bor.-Am. ii. 144 (1838). — Barratt, Salic. Am. no. 1, adnot. (1840); apud Torrey, Fl. N.Y. ii. 204 (1843), et t. 117 sub nomine *incana*. — Forbes, Salict. Wob. 181, t. 91 (1829). — Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 120 (1858); in Trans. Am. Acad. iv. 60 (Sal. Bor.-Am. 14) (1858); in Walpers, Bot. Ann. v. 748 (1858). — Carey apud Gray, Man. 425 (1848); ed. 2, 413 (1858); ed. 3, 413 (1862); ed. 4, 413 (1863). — Andersson in De Candolle, Prodr. xvi.² 277 (1868). — Bebb apud Patterson, Cat. Phen. Pl. Ill. 39 (1876); apud Coulter & Watson Gray, Man. ed. 6, 484 (1890). — MacMillan in Rep. Surv. Minn. Bot. ser. i, 182 (Metasp. Minn. Vall.) (1892). — Kellerman & Werner, in Rep. Geol. Surv. Ohio, vii. pt. 2, 190 (1893). — Koehne, Deutsche Dendr. 94 (1893). — Coulter in Ann. Rep. Dep. Geol. Ind. xxiv. 704 (Cat. Pl. Ind.) (1899). — Britton & Brown, Ill. Fl. i. 501, fig. 1193 (1896); ed. 2, 598 fig. 1167 (1913). — Britton, Man. 318 (1901). — Schneider, Ill. Handb. Laubh. i. 47, fig. 12 n., 20 l-m. (1904). — Robinson & Fernald, Gray's New Man. 327, fig. 665 (1909). — *S. incana* Michaux, Fl. Bor.-Am. ii. 225 (1803), non Schrank (1789). — *S. Mühlenbergiana* Willdenow, Sp. iv. 692 (1805), pro parte, quoad *S. incana* Mchx. — ? *S. candida* β *rugosa* Richardson in Franklin, Narr. Jour. Pol. Sea, Bot. App. 753 (1823); reprint, p. 25; ed. 2, 765 (1823); reprint, p. 37. — *S. candida* α , *tomentosa* Andersson in De Candolle, Prodr. xvi.² 278 (1868). — ? *S. tristis minor* Andersson in Svensk. Vet.-Akad. Handl. vi. 113 (Monog. Salic.) (1867). — ? *S. tristis* β *nivea* Andersson in De Candolle, Prodr. xvi.² 237 (1868). — *S. candidula* Nieuwland in Am. Midl. Nat. iii. 225 (1914).

This well known species has been described by Flüge apud Willdenow without indicating the native country or the name of a collector. Nevertheless the description is quite sufficient. Michaux described it first as *S. incana* from Canada "juxta lacum S. Joannis" but he used a name already applied years before to a European species to which the name *S. Elaeagnos* Scopoli is referred by Koehne and other authors. Koehne placed *S. candida* in the same group with *S. incana* but the latter has more or less united filaments which are pubescent, yellowish bracts with short hairs, and glabrous ovaries while in *S. candida* the filaments are free and glabrous, the bracts brownish or bicolor with long hairs, and the ovaries are densely tomentose. There are other differences too between the two species which can by no means be regarded as even distantly related to each other. The true affinity of *S. candida* is very doubtful. It has been placed with many different species as may be seen by the synonymy of the section as quoted above. I am, however, not convinced that any of the authors have put it in its right place, therefore I hold to my view that *S. candida* represents a section of its own. Its main character is the distinct opace tomentum which may be called pseudofarinaceous or floccose. This character combined with the habit, the more or less linear shape of the rugulose leaves, the brownish bracts, the young purplish anthers, and the mostly purpurascens or reddish styles and stigmas makes *S. candida* one of the most peculiar of Willows. From the species of Sect. *Glaucæ* it chiefly differs in the absence of a second gland in the male flowers.

All the characters of *S. candida* are very constant, only the shape of the leaves varies to a certain degree in the more northern specimens. Andersson distinguished a var. *tomentosa* which is nothing but the type and a var. *denudata*. The identity of this is rather difficult to determine because Andersson did not cite a type nor a locality. He only said: "foliis supra glabrescentibus subaequalibus subtus tomento rariori vel obsoleto fere virescentibus vel etiam glaucescentibus." It is possible that Andersson had before him one of the frequent hybrids of *S. candida*. I adopt, however, the view taken by Fernald who gives the name var. *denudata* to all those forms with glabrescent or almost glabrous mature leaves which in pubescence or in floral characters cannot be separated from typical *S. candida*. There are some forms of the Gaspé Peninsula with long fruiting aments which probably represent another variety not identical with var. *denudata*.

Richardson's *S. candida* β *rugosa*, the type of which came from the Northwest Territories is an uncertain form. His statement "foliis . . . exstipulatis" points to a species different from *S. candida*. I have not yet had an opportunity to see the type specimen. Andersson's form of *S. tristis* mentioned in the synonymy is likewise very doubtful, and may represent a hybrid with *S. candida*.

The Hoary Willow is a species usually found in cold bogs and Tamarack swamps, where it may be recognized at once by its stiff habit and by its

foliage. I have seen specimens of typical *S. candida* from the following states and counties or localities.

UNITED STATES. New Jersey (Morris County); Pennsylvania (nothing seen but recorded from Luzerne and Pike Counties); New York (Tompkins, Madison, Oneida, Herkimer, Wayne, Erie, and St. Lawrence Counties); Connecticut (Litchfield County); Massachusetts (Essex and Berkshire Counties); Vermont (Rutland and Caledonia Counties); Maine (apparently wanting; it is mentioned in the Portland Cat. No. 933, but what I have seen in Herb. G. is *S. pellita*); Ohio (Erie County; according to Kellerman & Werner central and northern Ohio); Indiana (Lagrange, Noble, Steuben and Lake Counties); Michigan (Keweenaw, Calhoun, Ingham, Mackinac and Emmet Counties); Wisconsin (Door, Racine and Dane Counties); Minnesota (Hennepin County); Illinois (Peoria, Winnebago, McHenry and Cook Counties); Iowa (Cerro, Gordo and Winnebago Counties) North Dakota (Benson County); Colorado (locality uncertain, leg. *Hall & Harbour*, 1862, Rocky Mts. Lat. 39° 41', No. 173, st.; G.; in C. sheet 6275); Wyoming (Albany County, Centennial, A. Nelson, Nos. 1755 and 8684; the first is an offshoot, the last a fruiting specimen); Montana (Flathead County; Columbia Falls, Rost Lake, Big Fork, Swan Lake; Teton County; near Cutbank Creek).

CANADA. British Columbia (? Caribou District, Telegraph Trail, Lat. 54, June 8, 1858, *J. Macoun*, No. 1640 ex parte, m., f.; G.); Alberta (Rocky Mts. District: Vicinity of Banff, swamp near Vermilion Lake, and Kananaskis, along the Bow River); Northwest Territories (Great Slave Lake, low island about 3 miles west of Rocher River, August 19, 1914, *F. Harper*, fr.; O.); Saskatchewan (Cumberland House, *Richardson* 1825, st.; N.); Manitoba (Winnipeg Valley, *Bourgeau*, Lake Winnipeg, *Richardson*, and Hudson Bay at Churchill, *J. M. Macoun*); Ontario (Thunder Bay and Lambton Districts); Quebec (Saguenay nearest to Labrador, Mingan Islands, Anticosti, and Gaspé, Bonaventure, Matane, Two Mountains Districts and Temiscaming); New Foundland (Bay of Islands, St. Paul Bay, Ingornachois Bay); Labrador (Forteau, Blanc Sablon); New Brunswick (Gloucester County, Magdalen Islands).

To var. *denudata* Andersson I refer the following specimens:

NEWFOUNDLAND. Ingornachois Bay, wet runs and boggy spots in limestone barrens, near sea-level, August 4, 1910, *Fernald & Wiegand* (No. 3184, st.; G.); Silurian Coastal Region north of St. Paul's Bay, Cow Head, conglomerate limestone and calcareous sandstone cliffs and ledges, July 12, 1910, *Fernald & Wiegand* (No. 3183, fr.; G.).

QUEBEC. Mouth of Grand River, Gaspé County, June 30, 1904, *M. L. Fernald* (m., fr.; G.; the size of the fruiting aments is very variable; they measure from 3.5:1.3 up to 8.5:1.5 cm.; the old leaves are shown in the following specimens; in some specimens even the young leaves are very glabrous); same place, open bogs, August 11-15, 1904, *Collins, Fernald & Peace* (No. 4897, st.; G.; "with the type"); Tourelle, mouth of River St. Anne des Mouts, in springy bogs, August 19-21, 1905, *Collins & Fernald* (st.; G.).

ONTARIO. Along railway east of Carp, Carleton County, May 17, 1913, *J. M. Macoun & M. O. Malte* (No. 87768, O., f.).

WISCONSIN. Sheboygan County: Elkhart Lake, June 29, 1879, *J. H. Suetle*, (st.; G.). Milwaukee County: Milwaukee, wet meadows, May, 1841, *I. A. Lapham* (f., st.; G.).

NEW YORK. Tompkins County: Ithaca, Fleming Meadow, April 30, May 17, September, 1895, *Rowlee & Wiegand* (Nos. 33, f., st.; G., St.).

NEW JERSEY. Morris County: Budd Lake, swamps, local, May 13, 1906, *K. K. Mackenzie* (No. 1966, f.; M.; amentis crassis laxifloris).

c. *SALIX WOLFII* BEBB AND ITS SYSTEMATIC POSITION

When Bebb described this interesting species he said of its possible affinity: "Resembles the foregoing [*S. Novae-Angliae*, Anders., var. *pseudocordata* And.] in habit and in the form of the leaves and aments, but distinguished by the perfectly smooth, reddish capsules, the black, scantily villous scales, and the leaves colored alike on both sides; aments somewhat as in *S. Novae-Angliae*, var. *pseudo-myrsinites* And., but that has beaked capsules and glabrous, crenate leaves, which are membranous in texture and prominently reticulate-veined." The forms to which Bebb alludes belong to sect. *Cordatae*, but *S. Wolfii* cannot be united with this section on account of the presence of a dorsal gland in the male flowers, the sessile or subsessile ovaries and capsules, and other minor characters which distinguish it widely from all the species of the *Cordatae*-group. There are, however, two Mexican species, *S. Hartwegii* Benth and *S. mexicana* v. Seemen with which I have dealt in Bot. Gaz. LXV. 28 (1918), which have such dorsal glands, and in the structure of the female flowers much resemble the species of the *Cordatae*. To this group *S. Hartwegii* is usually referred, but I am of the opinion that the two Mexican Willows represent a distinct section which may be regarded as somewhat intermediate between the *Cordatae* and the group to which *S. Wolfii* belongs. This is, of course, no definite statement, because we are still far from having more than a rather vague idea of the true relationship of a good many of the American Willows. I think it best not to unite species of apparently no close affinity in the same group but to propose some new sections for those forms which show good characters of their own. *S. Wolfii* is a species which I cannot refer to any group of species of America or of the Old World. I do not, however, at present propose a new section for it, I only wish to signify its peculiar position. Ball referred it to his section *Commutatae* in 1909, but as I have already explained on p. 148 under sect. *Adenophyllae* I do not think that it can be placed with the species of that group on account of the dorsal gland in the male flowers.

S. Wolfii Bebb apud Rothrock in Wheeler, Rep. U.S. Geogr. Surv. West 100. Merid. VI. Bot. 241 (1878). — Rydberg in Bull. N.Y. Bot. Gard. I. 276 (1899); Fl. Rocky Mts. (1917). — Ball apud Coulter & Nelson, New Man. Rocky Mts. Bot. 134 (1909). — The type was collected by Wolf & Rothrock, No. 280, in South Park, Colorado. I have seen all the specimens cited by Bebb, and I give the following description because Bebb's diagnosis is rather short and needs some additions. Frutex parvus erectus, fide Tidestrom ad 1 m. altus, breviter et dense plus minusve divaricato-ramosus ramis vix ad 6 mm. crassis; ramuli novelli subdense tenuiter breviterque sericeo-villosuli, hornotini flavescentes vel in sicco saepe nigrescentes, annotini paullo laxius villosuli (rarius glabrati), flavo-brunnei vel brunnescentes, circiter 1-1.5 cm. crassi, biennes vetustioresque brunnei vel fere atro-brunnei, saepe subnitidi, plerique glabri vel subglabri, demum epidermide flavescente solubili sordide fusciscentes. Gemmae bene

evolutae ovoidae, obtusiusculae, circ. 5 mm. longae, ut ramuli hornotini pilosae et coloratae. Folia adulta firma sed tenuia, minora inferiora plusminusve oblanceolata vel spathulata, saepissime apice obtusa vel fere rotundata, circ. 8:3 ad 20:6-7 mm. magna, normalia superiora oblanceolata, elliptico-lanceolata vel saepissime rhomboideo-oblanceolata, basi subito sensimve cuneata, apice acuta vel breviter acuminata, 2.5:0.6 ad 3.8: (vel ad 4:1.3) cm. magna, omnia integerrima, rarius infima tenuiter denticulata, superne initio plusminusve dense adpresse breviter argenteo-sericea, submicantia, adulta glabriora sed saepissime tantum infima minima satis glabrata, cano-viridia, costa nervisque lateralibus utrinque 4-5(-6) angulo valde acuto a costa abeuntibus et marginem subparallelibus ad apicem currentibus vix vel paullo visibilibus, epidermide ut subtus stomatifera; subtus plusminusve ut superne pilosa, colorata et nervata, magis glabrescentia, costa leviter prominente; petioli (1-)2-5(-6) mm. longi, superne sulcati et villosuli, subtus glabri vel subpilosi; stipulae nullae vel minimae, ovato-rotundae, tenuiter glanduloso-fimbriatae, vix ultra 1 mm. longae. Amenta plusminusve coetanea, parva, elliptica, densiflora, pedunculis 1-4 mm. longis foliola parva lanceolata vix ultra 1:0.4 cm. magna superne fere glabra subtus plusminusve sericea gerentibus suffulta; mascula circiter 5-12 (-18):5-8 mm. magna, pedunculo excluso; bracteae obovato-oblongae, apice rotundatae, atrofuscae, tenuiter sericeo-villosae (pilis quam bracteae circiter $\frac{1}{2}$ vel $\frac{1}{3}$ brevioribus), vix ultra 2 mm. longae; stamina 2, filamentis tenuibus liberis glabris bracteam demum $2\frac{1}{2}$ -plo superantibus, antheris minimis subglobosis flavis; glandulae 2, ventralis ovato-rectangularis truncata quam bractea $\frac{1}{3}$ ad $\frac{1}{2}$ -plo brevior, dorsalis saepissime minor et filiformis, saepe minima; amenta feminea sub anthesi circiter ad 1:0.6 mm., fructifera ad 2.5:1 mm. pedunculo excluso magna, densa; bracteae ut in floribus masculis; ovaria anguste ovoideo-conica, glabra, rariter basi id est pedicello brevissimo sparse pilosa, subsessilia; glandula 1, ventralis, ut in masculis, vel angustior; styli breves sed distincti, 0.5-1 mm. longi, apice interdum subbifidi, stigmatibus minimis bifidis divaricatis ad 3-plo longiores; fructus maturi rufescentes circiter 4.5-5 (-5.5) mm. longi, e basi ovoideo-rhomboidali conico-subrostrati pedicello brevissimo glandulam 2 3-plo brevior excludo.

The following specimens of typical *S. Wolfi* have been examined.

COLORADO. Dolores County: Rico, 3000-3250 m., July 1, 1909, coll.? (No. 2340, Pl. of Colo.; fr.: N.). ? Pitkin County: Elk Mountains, Mt. Baldy, about 3900 m., July 11, 1891, *E. C. Smith* (m., f.; M.); Lake County: Leadville: bank of stream, 3300 m., June 25, 1916, *F. W. Clockey* (No. 2669, fr.: C.); Tennessee Pass, 3500 m., June 24, 1893, *De Alton Saunders* (m., d.; N.). Park County: Mosquito Pass, 3500 m., September 4, 1898, *J. G. Jack* (st.: A.); South Park, 1873, *J. Wolf* (m., f.; N., W.); same locality, June, 1873, *J. Wolf* & *J. T. Rothrock* (No. 820, m., f.; type in C. [sheet 305647] co-type in G.; No. 828, m., f.; G.; same in W. sub No. 372 mixed with *S. monticola*). ? Jefferson County: South Platte (or on Platte River in Park County), June, 1873, *Wolf* & *Rothrock* (No. 824, m., f.; C., G.; No. 827, m., f.; G.). Gilpin County: Eldorado to Baltimore, about 2800 to 3200 m., June 20, July 10, 1903, *F. Tweedy* (No. 5604, fr. im.: N.). Larimer County: Camp Creek, swampy land, July, 1903, *L. N. Goodding* (No. 1463, f. adult.; Cor., G.

M., N., W.; ovarii ex parte pilosis ad var. *idahoensem* spectans); Berthoud Pass, west slope, July 29-30, 1918, *D. M. Andrews* (No. 28, st.; A.; ut praecedens). Jackson County: on Grizzly Creek, alt. 2800 m., July 24, 1896, *C. F. Baker* (Rowlee Nos. 11, 12, and 13; st.; M., N.); ? same County, North Park, May 31, 1898, *G. E. Osterhout* (No. 1585, m., f.; N.) ? La Plata County: Vicinity of Mt. Carbon, along creek, alt. 900 m., July 15, 1910, *J. Tidestrom* (No. 3670, fr.; W.; "shrub 1 m. high; fructibus glabris, foliis ut in var. *idahoensi*"); Mt. Carbon, June, 1909, *N. L. T. Nelson* (No. 55, fr.; N.); Eagle County: Wolcott, *A. Eastwood* (m., C. sheet 457948). Routt County: Flat Top Mts., June, 1891, *A. Eastwood* (No. 19, m., f.; C.). ? County: without exact locality and date, *Hall & Harbour* (f.; sheet 367360 in C.)

WYOMING. Albany County: Medicine Bow Mts., Nash's Fork, July 28, 1900, *A. Nelson* (No. 7780, f.; Cor. G., N., W.); Wood's Creek, August 11, 1896, same coll. (No. 2079, st.; Cor.). Fremont County: Wind River, 1873, *C. C. Parry* (No. 263, m., f.; C., G.). Sheridan County: Bighorn Mts., Headwaters of Tongue River, July, 1898, *F. Tweedy* (No. 88, fr. juv.; N.); same place, about 3050 m., July 13, 1900, *J. G. Jack* (fr.; A.); Piney and Beaver Creeks, alt. 1000 m., July 22, 31, 1900, *C. C. Curtis* (fr.; N.). Lincoln County: Teton Forest Reserve, Buffalo Fork, about 3200 m., August, 1897, *F. Tweedy* (No. 297, fr.; N.); Jackson's Hole, common on low grounds near Gros Ventre River, July 15, 1901, *Merrill & Wilcox* (No. 941, fr. submat.; C., G., M., N., W.). Yellowstone Park: Swan Lake Flat, July 9, 1902, *E. A. Mearns* (No. 1666, f.; N.; in W. ad var. *idahoensem* vergens); same locality, June 9, July 9, 1902, *E. C. Smith* (m., f.; fr.; C.); without exact locality, July 13, 1902, *Mearns* (No. 1833, fr.; W.); Mammoth Hot Springs, abundant in extended patches on low flats, July 3, 1899, *A. & E. Nelson* (No. 5655, f.; G., M.; in W. determined var. *idahoensis* by Ball); Norris Geyser Basin, September 7, 1904, *A. Rehder* (st.; A.); same place and date, *J. G. Jack* (st.; A.).

There has been described by Ball a *S. Wolfii* var. *idahoensis* in Bot. Gaz. XL. 378 (1905); apud Coulter & Nelson, New Man. Rocky Mts. Bot. 134 (1909), which Rydberg (Fl. Rocky Mts. 197 [1917]) made a species *S. idahoensis*. It has been named *S. glauca* var. *villosa* by various authors dealing with the flora of the Rocky Mountains, and I have found it in different herbaria under the name *S. Cusickii* Rowlee which so far as I know has never been published. Ball said about var. *idahoensis*: "The relationships of this little willow are all with *S. Wolfii* Bebb, from the typical form of which it differs mainly in the silky-pubescent capsule and the rather more silky leaves. The different specimens show considerable variation in the amount of pubescence on the capsules, in general, the specimens from the northwestern localities, show the denser pubescence, both on leaves and capsules. In some cases they tend toward a glabrate condition in age. In *S. Wolfii* the capsules are glabrous even when young. This variety is found from the Yellowstone Park northwestward across Montana and Idaho to eastern Oregon. The species is found from central Colorado to Montana and Idaho."

After having examined the material cited below, I may state that var. *idahoensis* seems to differ from typical *S. Wolfii* chiefly by the following characters: gemmae magis conicae, ad 9 mm. longae, atrobrunneae; folia infima minima saepius subtiliter glanduloso-denticulata, majora superiora lanceolata, oblanceolata vel elliptico-lanceolata, apice obtusa ad rotunda, basi saepissime sensim acute, 2.5:0.6 ad 5(-6):1.5(-2) cm. magna, utrinque,

saltem initio, dense adpresse argenteo-sericea, dein plusminusve cinereo-viridia, paullo vel distinctius glabriora, petioli ad 7-10 mm. longi; stipulae in ramulis vegetioribus ad 5 mm. longae, semi-ovato-lanceolatae, acutae, dense glanduloso-(subfimbriato-)denticulatae; amenta (mascula nondum visa) feminea ad 3:1.2 cm. magna pedunculo brevi folia ad 3 satis normalia gerente excluso; ovaria plusminusve dense sericeo-villosula vel satis glabrescentia, sessilia vel subsessilia; styli 1-1.25 mm. longi, bracteae interdum plusminusve flavo-brunneae (an formae hybridae?) fructus 4-5 mm. longi.

After all var. *idahoensis* hardly represents more than a vigorous variety of *S. Wolfii* with pubescent capsules. Tidestrom's No. 3670 has glabrous fruits, but leaves like var. *idahoensis*, for which it is taken by Ball. On the other hand in *S. Wolfii* the ovaries are not always entirely glabrous as I said in the description given above. There may be forms of hybrid origin, and some forms of the *Cordatae* which hitherto have been referred to *S. pseudomyrsinites* or *S. pseudocordata* by Ball and Rydberg are often very similar to var. *idahoensis* at least when without fruit and in leaf only.

The following specimens seem to belong to this variety:

IDAHO. Elmore County: Trinity Lake region, wet meadows, August 27, 1910, J. F. Macbride (No. 638, fr.; G.; "low clumps"). Blain County: Forks of Wood River, alt. 1800 m., July 25, 1895, L. F. Henderson (No. 3399, type; W.). Fremont County: Upper Teton Canyon, 1872, J. M. Coulter (st.; W.; forma incerta) fr.

WYOMING. Teton Forest Reserve, Sheep Mt., August, 1879, F. Tweedy (No. 293, f., fr.; N.). Without locality, along mountain brook, near camp 11, August 19, 1893, J. N. Rose (No. 404, ex parte; f.; W.; mixed with fruiting specimen representing probably a hybrid of this variety). Yellowstone Park: Head of Swan Lake Valley, July 9, 1888, F. H. Knowlton (fr.; C., W.); borders of ponds, July 6, 1894, J. H. Burglehaus (No. 12, fr., C.); without locality, Sylvan Lake, 1911, C. A. Reynolds (st.; C.); September 5, 1904, J. G. Jack (st.; A.); Indian Creek, June, 1881, F. Tweedy (No. 481, f.; W.); about 2300 m., common, July, 1896, C. S. Sargent (fr. im.; A.); Lincoln Gulch, August 12, 1796, A. Nelson (2596a; st.; A.); August 16, 1903, E. A. Mearns (No. 3364, fr.; W.); East de Lacy's Creek, 2500 m., August 10, 1897, Rydberg & Bessey (Nos. 3916, st. 3961a st.; N., forma porro observanda); Lewis River, common, August 9, 1899, A. & E. Nelson (No. 6387, fr.; G., N.; "in clumps, 0.9 to 2.1 m., high"); Red Mts., Yellowstone Lake, 1872, J. M. Coulter (Hayden Survey, fr., W.).

MONTANA. Gallatin County: lower basin of the Gallatin, marshy places, 2150 m., July 7, 1898, J. W. Blankinship (fr.; Cor.; shrub); Bald Mt., July 21, 1880, S. Watson (No. 372 b.; f., m.; G.; forma satis incerta) floribus masculis una tantum glandula instructis.

OREGON. Wallowa County: bank of Wallowa River, mouth of Hurricane Creek, June 11, 1900, W. C. Cusick (No. 2400, f.; C. G., Jepson, N. M., W.; distributed as *S. Cusickii* Rowlee); near Lostine, June 18, 1907, F. V. Coville (No. 2433, fr. W.; "in a wet gravelly bottom growing with *Betula glandulosa*").

VIENNA, January, 1920.

THE CANYON FLORA OF THE EDWARDS PLATEAU OF TEXAS

ERNEST J. PALMER

ANY ONE who has traveled by daylight over the Southern Pacific railway from San Antonio towards El Paso can scarcely have failed to notice the bold line of hills and cliffs rising abruptly from the plain and visible on the northern sky-line for nearly one hundred miles, and to have contrasted it with the comparatively level country through which he was passing and which extends as far as can be seen to the southward. This escarpment is part of a long line of faulting traceable from the vicinity of the Red River in northern Texas to near the mouth of the Pecos; along this line in remote geological times a great fracture of the earth's crust occurred which threw down the region to the south some hundreds of feet below its former level and allowed the sea again to invade it.

The Rio Grande Plain, thus set off from the highlands, has a slightly undulating surface diversified here and there by low, rocky hills and ridges and traversed by numerous shallow, gravel-covered stream beds which, except for infrequent water holes, are dry through the greater part of the year. A thin growth of stunted Mesquite, Chaparral, Opuntias and other semi-desert shrubs covers much of the area, amongst which after the infrequent rains a growth of short grass and herbage springs up and affords a precarious pasturage to the herds of cattle that have succeeded the buffalo, deer and antelope that formerly roamed over it.

Above the escarpment is the Edwards Plateau, extending west to the Pecos River and indefinitely northward until merged into the Staked Plains. The plateau is underlaid by nearly horizontal beds of limestone aggregating many hundreds of feet in thickness, the different layers varying greatly in hardness, texture and purity. The old Cretaceous seas in which these strata were deposited must have fairly teemed with animal life, as is evidenced by the beautifully preserved sea urchins, oyster shells and other fossils found in countless numbers in some of the beds. The erosion of ages working upon these more or less solvent limestones has carved out a topography for the region that is varied and striking and in places picturesque and fantastic.

The average elevation of most of the plateau ranges from about one thousand feet on the south and east to three thousand or more in the interior and northwestern portion. The rainfall is rather scant, the annual average diminishing from twenty-five or thirty inches on the eastern side to less than twenty on the western. A considerable proportion of it, however, is absorbed by the porous limestones that underlie much of the area. Through this "honeycomb rock" the water percolates until it strikes an impermeable layer over which it flows until it finds escape in some of the innumerable fissures or canyons that dissect the marginal rim of the highlands. Most of the precipitation occurs in the autumn and winter months, and the rains are often of a torrential nature, so that sometimes from a

fourth to a third of the total for the year may fall in less than twenty-four hours. This circumstance, together with the wide diurnal and seasonal variations in temperature, has had a marked effect upon both the topography and the vegetation. Under these conditions erosion is, of course, going on quite rapidly: and a very thin mantle of residual soil covers most of the table-land, while upon the slopes and narrower ridges the naked rock is everywhere exposed.

In their lower courses some of the larger streams traverse broad valleys bounded by lines of hills and cliffs. The valleys, which are sometimes several miles in width, are locally called canyons and the highlands separating them are known as divides. Through these wide canyons the streams meander and below the level of the old flood planes they have in many cases carved secondary canyons with low rocky terraces or bluffs which in places serve to confine their waters even in times of greatest flood. Some of the old canyons are quite out of proportion to the present volume of the streams and appear to have been the work of an earlier period when they carried a much larger volume of water. The streams confined to their recent channels rarely approach the outer barriers of the old valley, so that high perpendicular bluffs contiguous to such barriers are unusual along their lower courses.

The settlements and roads follow the canyons and in traveling up them a broken sky-line of peaks, domes and flat-topped hills is in sight on either hand. Gradually these converge as you ascend until by their near approach they form a narrow gorge or true canyon, dividing frequently into many branches. Scaling the walls of these canyons you emerge upon the rocky table-land of the divide, dissected into innumerable sharp ridges, knolls and mesa-like hills, their summits mostly conforming to a general level determined by an unusually hard, thick stratum or cap-rock. Where the cap-rock has been eroded away locally and softer strata exposed gentle slopes are formed. On such hills is often found a stunted growth of Texas Red Oak and a Juniper with large copper-colored fruit (*Juniperus Pinchotii*).

Viewed as a whole the Edwards Plateau may be described as a sparsely timbered region. Although, except in the protection of the upper canyons and along the margins of the larger streams, very little of the growth would be designated as forest according to usual standards, the number of woody species is quite large and many of them become arborescent under favorable conditions. The contrast of the treeless, grassy plains to the north makes this diversified ligneous flora appear more remarkable.

Up the wide canyons of the lower river courses the Chaparral and Mesquite flora of the Rio Grande Plain has pushed, occupying most of the open ground. Closely investing the streams, especially along the rocky terraces and about the larger water holes, there is usually a narrow fringe of trees. Pecan, Live Oak, Hackberry (*Celtis laevigata* var. *texana*) and the Cedar Elm (*Ulmus crassifolia*) are common here. Close along the margins of the streams a variety of the Black Willow (*Salix nigra* var. *Lindheimeri*) and the Small-fruited Walnut (*Juglans rupestris*) are frequently found. But

most remarkable of all, and indeed one of the last trees one might expect to find in such a region, is the Bald Cypress (*Taxodium distichum*), which often grows abundantly and of large size about the deeper water holes.

This tree, which is most at home in the deep swamps of Mississippi and Louisiana, a region of very abundant rainfall, has here adapted itself in a remarkable manner to the peculiar conditions of a semi-arid country. Here too, although there are no swamps, it actually grows with its feet in the water: for it is never found more than a few yards back from the margin of the pools, and while on the upper side it is firmly anchored to the solid, often rocky, bank, a precaution made necessary by the occasional destructive freshets, on the other side its roots are thrust deep into the permanent pool of life-giving water. Here it has no use for the peculiar aerial root cones or knees, that are so conspicuous and characteristic a feature of its growth in the swamps, and it has entirely discarded them. The general habit of the tree is stockier, the branches larger and more wide-spreading and the crown consequently lower and broader than further east. The base, while usually well buttressed and hollow near the ground, has never the exaggerated proportions commonly seen in swamps. Cypress occurs along the Medina, Sabinal, Frio, Nueces and Devils Rivers and a number of smaller streams, from the heads of the canyons to the point where they leave the plateau. After they descend into the Rio Grande Plain most of the streams cease to flow perennially. Their waters sink beneath the gravel, except for short distances or in occasional pools, and Cypress is not found in that region.

The high bluffs that wall in the wide canyons afford considerable protection from the dry winds and scorching sun and along their bases and ledges there is usually a deeper accumulation of soil and a certain conservation of moisture. Consequently there is a more vigorous and varied growth of trees and shrubs here than in the open valley or on the rocky table-land above. One of the interesting trees of such situations is Lacey's Oak (*Quercus Laceyi*), a species of White Oak that appears to be limited to the canyons of the Edwards Plateau. It is a small sized tree, rarely more than thirty or forty feet high, with a trunk seldom a foot thick; the bark on old specimens is deeply fissured; the trunks often crooked and not infrequently several spring from a common base. It can be recognized at some distance by the peculiar bluish or smoky hue of the foliage, unlike that of any other Oak. The Mexican Buckeye (*Ungnadia speciosa*), Western Red-bud and the Texan Arbutus, the Madrona of the Mexicans, are likely to be found here with many other interesting species. Much of the high rocky table-land of the divides is covered by a more or less dense growth of scrub. The Shin Oak (*Quercus annulata*) is in some sections the most common species over thousands of acres. A stunted form of the Live Oak often grows with it. The Mountain Cedar (*Juniperus mexicana*), the Mexican Persimmon, and the Small-leaved Adelia (*Forestiera pubescens*) are quite abundant. Yuccas, various species of Cactus and the low thorny Cat's Claws or Acacias mingle with them and predominate over the more exposed portions.

Having thus hastily glanced at the physiography of the plateau and the

general character of its vegetation let us return to the upper canyons of the perennial streams where most peculiar conditions exist and many surprising and perplexing plants are found. Here the scenery is often most picturesque: The high limestone cliffs in places rise as sheer walls but oftener as a series of terraces, green with shrubs and herbage where there is seeping water; promontories and peaks are carved into most fantastic shapes by ages of erosion, and great castle-like masses detached perhaps centuries ago from the face of the cliff stand out amongst the smaller rubble on the floor of the canyon. Xerophytic ferns, Columbines, Scarlet Sage, shrubby Eupatoriums, Buddleas or the yellow-flowered Laphamia grow abundantly from clefts in the rocks, sometimes where scarcely a trace of soil or foothold is apparent. Along some of the ledges water is constantly seeping and strong springs gush out here and there, constantly augmenting the stream which dashes and foams below over its rocky bed. At frequent intervals it descends over outstanding ledges, forming small cascades, and often below them broadens out into deep, limpid pools, favorite haunts of the black bass and where the wild deer are still sometimes mirrored as they come down to drink. Farther down, the stream may disappear entirely under the loose gravel and rubble only to emerge again as a lower ledge comes to the surface. Under overhanging ledges, kept wet by seepage water, the Venus' Hair Fern (*Adiantum Capillus-Veneris*) grows luxuriantly and the Sword Fern (*Dryopteris normalis*) is found along the rocky margins of the pools.

Many of the woody plants common over the more open parts of the plateau here attain their maximum development and become truly arborescent. Such species as the Mountain Cedar, Hackberry, Cedar Elm, Pecan, Lacey's Oak, Slim Oak, Soapberry and Mexican Mulberry form a large proportion of the forest growth. But in a few favored spots, where water is abundant and the canyon well protected by high bluffs from the parching winds and direct sunlight during the hottest part of the day, small colonies of plants are found of species identical with or closely allied to those of the Atlantic or Gulf coastal plain forest and quite foreign to the general flora of this region. Besides the Cypress, which we found lower down in the open canyons, such trees as Slippery Elm, Bur Oak, Chestnut Oak, Wild Cherry, Sugar Maple and three or four forms of Linden attain a considerable size; while amongst smaller growth there are Yellow and Red-flowered Buckeye, Deciduous Holly, French Mulberry (*Calycarpum americanum*), Indian Cherry (*Rhamnus caroliniana*), Spice-bush and several species of red Haws. Herbaceous species associated with them include the Rattlesnake Fern (*Botrychium virginianum*), Coral-root Orchid, Virginian Snake-root and two or three kinds of Violet. Where the stream approaches the high bluffs with north or east exposure and with only room for a narrow strip of talus and rich soil between them, ideal conditions for these peculiar colonies are found. Some of the rarer species are limited to such situations, and while others mentioned above are by no means rare nearly all are confined to the protected canyons.

These colonies can in no sense be considered as extensions of the Atlantic forest belt: for besides being so restricted in habitat their species nowhere form more than a small per cent of the forest growth even in the canyons where they are found. With the exception of the Cypress, Pecan and Wild Cherry none of them grow even in the wide lower canyons; and they are separated from their kind or their nearest allies by more than three degrees of longitude, the intervening country between the Edwards Plateau and the lower Brazos River being a dry, open country where they have been unable to survive.

The interesting question then naturally arises: how did they reach these remote stations and what does their presence here signify? The answer is probably to be found in the later geological history of western Texas, to the record of which they may add valuable corroborative testimony.

That the seeds of these species have been transported either by wind or water from the nearest stations where they are at present found in eastern Texas is out of the question; for not only is the distance much too great but both the prevailing air currents and drainage are in other directions. Nor could they have been carried to these remote canyons by migratory birds or other animals; for there is no migration in this direction and the fauna of the Edwards Plateau is distinct in almost all of its species from that of the humid portion of eastern Texas. Moreover, the seeds of some of the plants found here are not of a kind that could be distributed in this way.

After a careful survey not only of the canyons and the plateau country but also of the southwestern portion of the great Atlantic forest belt and of the intermediate region where that rich and varied forest dwindles away and its species one by one succumb to cumulative adverse ecological conditions, but one reasonable hypothesis suggests itself.

Towards the close of the Tertiary period or early in the Pleistocene great mountain-making movements occurred in the continental interior, resulting in the elevation of the Trans-Pecos region of Texas, the obliteration of the vast inland seas previously occupying portions of the plains country and the diversion of drainage systems over wide areas. As a result of these disturbances a cycle of changes was inaugurated that must have profoundly affected the climate and physiography of the region, and these reacting in turn upon the fauna and flora, like ripples raised by a stone thrown into the water, diminishing in force but widening in circumference, have been active until very recent times, if indeed their influence has yet entirely subsided.

That the Edwards Plateau existed as an outstanding physiographic region before the beginning of this cycle is evidenced by the fact that the great deposits of gravel brought down from the foothills of the Rocky Mountains by the swollen rivers of the Lafayette stage, sweeping across where now is the canyon of the Pecos River, passed to the north and south of it, some of the streams reaching the Gulf of Mexico far to the east.

The vast forest of the Gulf coastal plain, stretching at the present time from the Atlantic seaboard to eastern Texas, has beyond doubt occupied the region, or such parts of it as were above sea-level, from remote geological

times, probably having had an uninterrupted development from forests of similar floristic character in the early Tertiary period.

A great amount of evidence supports this belief; but it may be sufficient here to mention that fossil floras as early as the Lignitic stage of the Eocene, found in some parts of the region, furnish records of a forest even then composed of genera mainly identical with and of many species similar to those of the present. Comprising such familiar trees as Cypress, Willows, Hickories, Oaks, Elms and Magnolias conditions under which this early forest flourished must have been in many respects similar to those that obtain there today.

Strong internal evidence of its antiquity is also furnished by the fully developed state of the forest of the coastal plain, the variety and highly specialized character of its components, the large percentage of endemic species amongst them and the complete manner in which it has occupied the region and each species its particular station. Changes in the composition of the flora through the elimination of species and the development or introduction of new ones have, of course, being going on through all this vast time; and while in the main preserving its continuity the boundaries of the forest have been constantly shifting: advancing upon one front over new-made lands or in response to some favorable modification in geography or climate; in another quarter, perhaps, steadily retreating for centuries before adversely changing conditions or by the quick destruction of large sections by some sudden vicissitude of nature.

It is probable that gradual changes on a large scale in the boundaries of the great southern forest are going on at present in several areas. An examination of its depleted ranks and the shattered front it presents along the line where it disappears in eastern Texas and of the conditions that confront it there indicate that it has for a long time been losing ground in that direction. The fact that extreme eastern Texas is a region of high humidity, receiving an annual rainfall of from fifty to sixty inches, while on the western boundary of the state the precipitation is scarcely more than ten inches, sufficiently accounts for the disappearance westward one by one of the moisture-loving forest species. But there is reason to believe that conditions have not always been thus and that at no very distant period as measured by geology, though immensely remote by historic standards, the great forest extended unbrokenly along the western portion of the Gulf coast, up the Rio Grande valley and across the Edwards Plateau, perhaps almost to the base of the Rocky Mountains. Climatic changes resulting from the last mountain-making movements and elevation of land in that region marked the western portion of this forest for destruction and gradually pushed it back to its present limits, allowing the semi-desert flora of the Southwest and of northern Mexico to invade and establish itself over most of the area. Here and there throughout the region vestiges of the old flora may still be found clinging to small areas where more favorable soil or moisture conditions have enabled them to survive. Amongst many examples of this class are the groves of Hickory, Post Oak and Black Jack occupying areas of

deep sands with dense subsoils in Wilson, Atascosa and Gillespie counties; the Cottonwoods (*Populus balsamifera*) along the Llano and other open rivers of the Edwards Plateau and a low Palmetto in Kendall County northwest of San Antonio. A few hardy species, such as the Live Oak, Texas Oak, Hackberry, Southern Elm and White Ash (*Fraxinus texana*) were sufficiently adaptable or have undergone such modification in character that they have been able to survive, generally in a much reduced and stunted form, even in more open situations. But the most conclusive and striking evidence is afforded by those peculiar vestigial colonies of unmistakably Carolinian species, although most of them have been considerably modified by long isolation, found in the upper canyons of the Edwards Plateau. There as the forest retreated before the increasing aridity of the region, they took refuge, and by reason of the protection afforded by the cliffs and the perennial water supply, which not only furnishes moisture for their roots but through its rapid evaporation keeps the air somewhat humid, they have been able to survive and stand as living witnesses to the mutations of time upon the flora of the region.

WEBB, CITY MISSOURI, February, 1920.

CAMPHOR

CINNAMOMUM CAMPHORA NEES & EBERMAIER

E. H. WILSON

In the Occident camphor obtained from *Cinnamomum Camphora* Nees & Eberm. is the best known commercial product of Formosa and for this reason it is thought that information obtained during my recent visit to that island, where the industry is a Government monopoly, may be of interest. The tree grows in the warm-temperate and sub-tropical rain-forest zone of eastern Asia from south-central Japan to just within the borders of Tonking, yet for this variety of natural camphor the world is almost entirely dependent upon Formosa. In this island the tree is not to be found on the alluvial plains but in the submontane region from little above sea-level to 1400 m., being at its best between 500 and 1000 m. Within this altitudinal zone the Camphor-tree is found all over the island, but to-day apparently is most plentiful in the northeastern parts. It is never found in pure stands but always as an isolated tree scattered through the evergreen forests. These are mainly composed of other Lauraceae, evergreen Fagaceae and Tree Figs with a rich undergrowth of miscellaneous shrubs, Tree Ferns and coarse herbs; stout lianas abound and the tree-trunks and main branches are clothed with epiphytes, chiefly Ferns and Orchids. The country is steep and the Camphor-trees are tall but not really large, indeed, I saw none that merit special mention on account of size or approach that of many planted specimens in Japan. The finest I saw were on the east coast in Karenko and Giran prefectures. In Taihoku and in Nanto prefectures nearly all the accessible Camphor-trees have been felled.

In Japan the Camphor-tree is wild in southern Hondo, Shikoku and Kyu-

shu and as a planted tree is found as far north as Tokyo. It is a feature of the courtyards of temples dedicated to Hachiman, God of War. Many of these trees are of venerable age and of enormous size, in fact the Camphor-tree exceeds in bulk of trunk all other broad-leaf trees that grow in Japan. On these planted trees burls develop on the trunk which with age becomes very gnarled and quite different in appearance to that of trees found in the forests. At the Hachiman shrine at Kamo in Satsuma province, Kyushu, there is a Camphor-tree 100 ft. tall and 75 ft. in girth of trunk at 5 ft. from the ground. It is claimed that this is the largest Camphor-tree in Japan. In the Shiroyama Park, Kagoshima, there are many tall and handsome specimens of this tree, but the finest I have seen are in the grounds of Osuwa Temple in Nagasaki which are lofty and magnificent trees with clean trunks and wide-spreading, rounded crowns. But in general the Camphor-tree in Japan is more remarkable for the size of its bole and spread of crown than for its height. On the Korean island of Quelpaert the Camphor-tree is indigenous but is rare and of no great size. In the eastern provinces of China from Shanghai south to the Tonking border the Camphor-tree grows wild and in some places is said to be common. In Japan and in Quelpaert the Camphor-tree does not ascend more than 500 m. above sea-level and is associated with other evergreen trees chiefly Fagaceae and Lauraceae. In China very little is known about its altitudinal distribution except that in the central parts of the Yangtze Valley where it reaches its western limits it is more or less confined to river-level. The trees planted as far north as Tokyo are often subjected in winter to a few degrees of frost and to snowstorms which often brown the leaves but the trees quickly recover.

Small quantities of camphor are obtained in south Japan, in Fokien and Kwangtung provinces of China but the real industry is confined to Formosa. Apparently the climatic conditions there are more favorable to the secretion of the necessary hydro-carbons than elsewhere. It is a curious fact that not every Camphor-tree yields camphor in appreciable quantities, neither is every part of the tree equally rich. Often it happens that in two trees growing side by side one may be rich in camphor and the other almost devoid of it. Sometimes it happens that one side of the tree may be richer than the other. Why these marked variations in quantity should be there is no telling but the fact remains. Some day it may afford the plant hybridist opportunity to breed a race of Camphor-trees all equally rich in camphor. Chinese do most of the work of camphor distilling in the forests of Formosa, and they are expert in telling by means of smell and taste which trees are profitable to work and which are not. The bole of the tree is usually richest and frequently the thick, buttress roots rank next. The work of felling the tree is sometimes done in piecemeal fashion. The wood is reduced to thin chips by means of an adze or gouge-chisel and is then ready for camphor distillation. From the crude stills in the forest the camphor and camphor oil is taken to the factory of the Monopoly Bureau in Taihoku and refined.

To appreciate the difficulties of the camphor industry in Formosa it should be remembered that the mountains of Formosa are inhabited by savage tribes addicted to head-hunting. In late years the Japanese have succeeded in bringing many of these tribes under control; causing them to abandon their murderous practice. But the early story of camphor collecting is one of aggression on the part of the Chinese and retaliations by the savages with treachery and much bloodshed on both sides. Since the Japanese occupation it has been also a fruitful source of border warfare. At one time the whole area where the Camphor-tree grows was savage territory but little by little the Chinese with their camphor still, and latterly the Japanese, have penetrated and forced the savages farther and farther into the recesses of the higher mountains. The Chinese commenced the quest and the Japanese continue to systematically carry it forward. Nevertheless it will be many years yet before the whole Camphor-belt of the island becomes properly controlled. However, the tree is becoming rare, which should occasion no surprise when it is remembered that its destruction has been in progress since the sixteenth century and with increasing rapidity. Admitting that there are districts in which the Camphor-tree grows yet to be exploited it needs no prophet to foretell a shortage in the near future. The Japanese Government has realized the fact and commenced planting in the northern parts of Formosa on quite a large scale. I saw these plantations and they are thriving but there will be lean years before they are available as a source of supply.

The plantations are all pure which is contrary in method to what obtains in a state of nature, but in all the plantations I saw the young trees were growing well under those conditions. One point, however, must not be lost sight of. Fuel is necessary in camphor distilling and at present in Formosa is supplied by the companion trees of other kinds. In the plantations no such provision has been made so the fuel will have to be brought from a distance and the cost of camphor production will be increased.

There is another fact worthy of record which may have great or may have no effect on the yield from plantation camphor. In Formosa the wild Camphor-trees are tall and gathering the fruit has been found to be exceedingly difficult and costly. The Camphor Monopoly Bureau, therefore, has purchased and continues to purchase its stocks of Camphor-tree seeds in Japan where in temple grounds the gathering of the seed is a simple matter. So the situation is that plantation Camphor in Formosa, and for that matter everywhere else in the world, is the product of the Japanese Camphor-tree. Whether trees of this origin will produce camphor in quantity and quality comparable with that of the Formosan trees has yet to be proved.

The camphor industry of Formosa was established as a Government Monopoly in 1899 and the average annual production for the first decade, reckoning the Japanese kin as $1\frac{1}{3}$ lb. avoirdupois, was camphor 4,375,886 lbs., camphor oil 3,757,269 lbs. In the previous decade (i.e. 1889-98) the average annual production of camphor was 4,219,199 lbs.; figures for camphor oil are not available. In the years 1895 and 1896 the produc-

tion of camphor was 6,877,297 lbs. and 6,935,285 lbs. respectively. In the fiscal year 1917 (the last return I have seen) the production of camphor is given as 7,371,574 lbs. and camphor oil as 6,727,512 lbs. These figures show that the industry has remained about stationary but the tendency now is toward a decline which must increase until plantation camphor becomes available. The quantity of camphor sold in the fiscal year 1917 is given as 9,308,960 lbs. valued at \$3,466,150 gold; of camphor oil as 2,531,819 lbs. valued at \$244,961 gold.

THE AMERICAN AND ASIATIC SPECIES OF SASSAFRAS

ALFRED REHDER

THE genus *Sassafras* stood for a long time as an example of a very distinct monotypic genus peculiar to the flora of eastern North America, until comparatively recently, in 1907, a Chinese species, *Sassafras tzumu*, was added to it by Hemsley. This Chinese species, though it is so similar in its general appearance, in its inflorescence and fruit that without close examination it is difficult to distinguish from the American *S. officinale*, differs in its floral structure in several important particulars, and for this reason was made by H. Lecomte the type of a distinct genus under the name *Pseudosassafras*. The chief differences are the hermaphrodite or apparently hermaphrodite flowers, the presence of a fourth staminal whorl consisting of three staminodes and the pubescence on the inside of the base of the perianth. Now a third closely related species appeared when Mr. Wilson, while arranging his extensive collection of the plants he brought back from Formosa, drew my attention to a plant described by Hayata as *Lindera randaiensis*, which looked almost exactly like the Chinese *Sassafras tzumu*. On closer examination this similarity extended even to the more minute structure of the flower except that the anthers had only 2 locules as correctly described by Hayata for his *Lindera randaiensis*, instead of 4, as a true *Sassafras* should have. The number of locules has been considered by most botanists who have dealt with Lauraceae a very important character, particularly by Pax who bases the main division of the whole family on this character; Bentham & Hooker, Lecomte and others lay much stress on this character, which, however, seems to lead to an artificial classification. Species with 2-loculed anthers may occur in genera with normally 4-loculed anthers, as in *Persea cuneata* Meissner; and in *Persea* § *Heterandra* the anthers of the third series of stamens have two locules, instead of the normal four of the first two series; the same is the case in *Phoebe* § *Heteranthera*. Also the reduction of hermaphrodite flowers to dioecious flowers does not necessitate generic separation, as we have both kinds of flowers in genera like *Ocotea*, *Aydendron*, *Cinnamomum* and others, nor does the absence or abortion of a staminodial whorl necessitate generic separation, as the presence or absence of staminodes varies in many genera. Instead of using the structure of the anthers whether introrse or extrorse, 4-celled or 2-celled, as the chief

character for the principal groups of the family, we seem to arrive at a more natural arrangement if we consider with Mez (Laurac. Amer. Monog. in Jahrb. Bot. Gart. Mus. Berlin, v. [1889]) the nature of the inflorescence as one of the most important characters. According to his arrangement *Sassafras* belongs to the tribe Litseae which is nearly the same as Litsaeaceae of Bentham & Hooker except that Mez refers *Sassafridium* which has a paniculate inflorescence to Ocotea of the tribe Perseae. From all the genera of the tribe Litseae the genus *Sassafras* is easily separated by its racemes of slender-pedicelled flowers, in the axils of the basal scales of the terminal branch-bud, while in the other genera the flowers are arranged in lateral umbels or heads sometimes reduced to one flower, subtended by an involucre of 4-6 bracts, or as in *Actinodaphne* in lateral subsessile fascicles. The genus most closely related to *Sassafras* is apparently *Benzoin* to which the Formosan *Sassafras* with 2-loculed anthers forms a transition. Very close to *Benzoin* is *Litsea* which differs from it in no other character than in the 4-loculed anthers and should be united with it, if the number of locules is not considered a sufficient generic character. These three genera are the only Lauraceae with all (in *Sassafras*) or part of the species deciduous.

All three species of *Sassafras* agree perfectly in their vegetative characters, in habit, in bark, in their winter-buds, in the deciduous leaves with a more or less pronounced tendency toward lobing, in the inflorescence and in the fruit, and the differences in the structure of the flowers are only such as can be explained by suppression or abortion. The phylogenetic type of the genus is apparently *S. tzumu* which has a typical Lauraceous flower; from this type the Formosan species deviated by the suppression of the two upper smaller locules of the anther, and *S. officinale* by the abortion of the staminodes and by a more advanced state of dioecism already indicated in *S. tzumu*. As the admission of the two Asiatic species to the genus necessitate some change in its characters a revised generic description may be given here.

Sassafras Nees & Ebermaier, Handb. Med.-Pharm. Bot. II. 411 (1831).—*Pseudosassafras* Lecomte, Notul. Syst. II. 268 (1912).

Flores dioeci vel androdioeci floribus masculis ovario fere normali instructis, laxe et breviter racemosi, racemis pedunculatis, involuero proprio fere omnino destitutis, e gemmis terminalibus simul cum innovatione orientibus; perianthii tubus fere subnullus; segmenta 6, subaequalia, debilia, lanceolata; stamina 9, ordinis tertii basi utrinque glandula stipitata aucta; staminodia 3 vel in specie dioeca nulla; speciei dioecae flores masculi ovario omnino destituti et feminei tantum staminodiis 6 instructi; filamenta angusta; antherae introrsae, 4- vel 2-locellatae; ovarium ovoideum, stylo longiuseculo; bacca perianthii tubo aucto carnosio breviter cupulato margine truncato vel sinuato insidens. — Arbores cortice crasso suberoso profunde fissio cinnamomeo: gemmae ovoideae squamis pluribus imbricatis rotundatis vel late ovatis: folia alterna, decidua, penninervia vel 3-lobata et 3-nervia: flores praecoces, flavescentes: racemi fructiferi ad basin ramulorum; bacca subglobosa vel breviter ellipsoidea, nigro-coerulea, basi

cupula aurantiaco vel rubro circumdata; pedicelli supra medium inerasati.

Flores dioeci, intus glabri, masculi staminodiis et ovario destituti, feminei staminodiis 6 instructi; antherae 4-locellatae; folia saepe trilobata . . . 1. *S. officinale*.

Flores androdioeci, intus basi pilosi, masculi ovario fere normali, omnes staminibus 9 et staminodiis 3 instructi.

Antherae 4-locellatae; folia saepe trilobata 2. *S. tzumu*.

Antherae 2-locellatae; folia rarissime trilobata 3. *S. randaiense*.

1. *Sassafras officinale* Nees & Ebermaier. — For synonyms and literature see Sargent, *Sylva N. Am.* vii. 17 (1895). For nomenclatorial discussion see Blake in *Rhodora*, xx. 98 (1918).

EASTERN NORTH AMERICA.

2. *Sassafras tzumu* Hemsley in *Kew Bull. Misc. Inform.* 1907, 55; in *Hooker's Icon.* xxix. t. 2833 (1907). — Henry in *Elwes & Henry, Trees Gr. Brit. Irel.* iii. 515 (1908). — Rehder in *Bailey, Stand. Cycl. Hort.* vi. 3082 (1917). — *Pseudosassafras Tzumu* Lecomte, *Notul. Syst.* ii. 269 (1912); *Nouv. Arch. Mus. Paris, sér. 5*, v. 108 (1913).

CHINA. Western Hupeh and Kiangsi (see Sargent, *Pl. Wilson*, ii. 74, for enumeration of specimens). Chekiang: Ningpo, 1908, *D. Macgregor*; Shi-bun-shan, June 26, 1915, *F. N. Meyer* (No. 1456); Mokan-shan, August 5, 1915, *F. N. Meyer* (No. 1617). Hunan: "ad minas Hsikwangshan prope urbem Hsinhwa," alt. 500-800 m., May 14, 1918, *H. Handel-Mazzetti*. Kweichow: "in jugo inter vic. Lopusse et Wendnen, prope opp. Duyün," alt. 900 m., July 11, 1917, *H. Handel-Mazzetti*. Eastern Szechuan: without locality, *P. Farges* ex Lecomte.

In addition to the characters mentioned above *S. tzumu* differs from *S. officinale* in the stouter and darker colored branchlets, the larger winter-buds, the larger leaves glaucous beneath, the lobes more acuminate, in the smaller flowers with shorter sepals and stamens and in the somewhat smaller nearly globose fruit. The staminate flowers can be distinguished from the fertile hermaphrodite flowers only by the slightly smaller and often somewhat deformed ovary which, however, may be sometimes fertile, as the staminate trees, according to Mr. Wilson's observation in China, usually produce occasional fruits. The tree, though apparently hermaphrodite, is functionally dioecious, a behavior which I have called elsewhere (*Rhodora*, vi. 18) pseudomonoclinism.

3. *Sassafras randaiense*, comb. nov. — *Lindera randaiensis* Hayata in *Jour. Coll. Sci. Tokyo*, xxx. art. 1, 257 (*Mat. Fl. Formosa*) (1911); *Icon. Pl. Formos*, v. 179, fig. 62b (1915). — Kanehira, *Trees Formosa*, 438 (1917).

FORMOSA. Arisan, prov. Kagi, alt. 2300-2500 m., October 30, 1918, *E. H. Wilson* (No. 10800; tree to 26 m. tall, 3 m. girth); east of Arisan, alt. 2200 m., October 30, 1918, *E. H. Wilson* (No. 10800a).

This species is very similar to *S. tzumu*, but differs in its 2-loculed anthers, a character which I have found constant in a considerable number of flowers examined. Other slighter differences will be found in the slightly more elongated and pointed winter-buds and in the longer and comparatively narrower leaves of firmer texture. Judging by the copious material col-

lected by Mr. Wilson from several large trees, among which I find only a single leaf with one lateral lobe, the leaves of older trees are almost invariably entire, but they are partly three-lobed on his specimens of young plants. The only fruit collected is smaller than that of the Chinese species and measures 6 mm. in diameter.

The Formosan species occurs only in scattered individuals on the mountains Arisan and Randaian and possibly elsewhere on the island, while each of the other two species has a much wider distribution and is much more common within its range. All the species, however, are only relics as compared with the range of the genus during the Tertiary period, when it was distributed apparently all over the northern hemisphere.

NOTES ON NORTH AMERICAN TREES. VI ¹

C. S. SARGENT

Hamamelis

THE different species of *Hamamelis* cannot be distinguished by good morphological characters, the structure of the flowers, fruits and seeds being the same in them all, and in view of the superficial botanical surveys on which the earlier publications on the plants of the southern states were based it is not surprising that all the Witch Hazels in North America have usually been referred to a single species, *Hamamelis virginiana* L. Walter, however, in 1788 mentioned without descriptions three species, *dioica*, *monoica* and *androgyna*, and in 1814 Pursh described his *H. macrophylla* based on a specimen collected by Lyon on river banks in the western part of Georgia and chiefly distinguished by the tubercles on the lower surface of the leaves. After Nuttall in 1818 and Elliott in 1821 no American author has considered Pursh's plant which has been referred without comment to *H. virginiana*. In 1911 I described as *H. vernalis* a small winter-flowering shrub spreading into thickets by stolons and common on the gravelly banks of streams in southern Missouri and now known to extend through Arkansas into eastern Oklahoma and distinguished from *H. virginiana* by the red color of the inner surface of the calyx-lobes and by the shape of the leaves which are often round at apex, more symmetrical at base, less coarsely lobulate and pale and often glaucous below. At one time I believed that the Witch Hazel of Louisiana could be referred to this species, but the leaves of all the specimens of *Hamamelis* which I have seen from the Gulf States are covered with tubercles. These are the enlarged bases of the short stellate hairs which cover the young leaves and are more prominent on the lower than on the upper surface. Such tubercles are not common in *Hamamelis*, and have not been found on the leaves of any other species except occasionally on one of the Japanese species. These tubercles, the smaller flowers which open from December to February with a calyx only 5 mm. across the flattened lobes and pale yellow sometimes streaked with red, petals only 8 mm.

¹ For part. V, see p. 61.

long and less than 1 mm. wide, and the shape of the leaves which are often rounded at apex and more symmetrical at base seem to distinguish sufficiently the southern plant from *H. virginiana*. From *H. vernalis* it differs in the yellow color of the inner surface of the calyx, and in the tubercles on the leaves which are green and not pale or glaucous below, and I am inclined to consider the plant of the Gulf States a species and to take up for it Pursh's name although it is an unfortunate one for the leaves are usually smaller than those of *H. virginiana* and they are rarely if ever "suborbicular."

Hamamelis macrophylla Pursh, Fl. Am. Sept. 1, 116, 1814. — Elliott, Sketch, 1, 220 (1821). — *Hamamelis virginiana* β . *macrophylla* Nuttall, Gen. 1, 107, 1818. — *Hamamelis virginiana* of many authors, not L.

Leaves oblong-obovate or occasionally broad-elliptic, rounded, acute or rarely acuminate at apex, cuneate, rounded or cordate at the narrow slightly unsymmetrical base, crenately lobulate above the middle with small rounded lobes, covered when they unfold with short stellate hairs more abundant on the lower than on the upper surface, at maturity dark green above, lighter green below, and roughened by the persistent tubercle-like bases of the stellate hairs, 8–13 cm. long, and 5–8 cm. wide, with a slender midrib and five or six pairs of primary veins; petioles slender, pubescent, 1.5–2 cm. in length. Flowers opening in December, January and February; calyx yellow often slightly streaked with red on the inner surface. Fruit ripening in the autumn, about 1.2 cm. long; seeds acute, dark chestnut-brown or nearly black.

A tree often 10–15 m. high, producing stoloniferous shoots round the tall trunk up to 15 cm. in diameter, spreading branches, and branchlets rusty tomentose during their first year, becoming glabrous or nearly glabrous in their second season.

All the specimens of *Hamamelis* from the Gulf States which I have seen have the tuberculate leaves of *H. macrophylla* which extends northward to the neighborhood of Savannah, Georgia, and to southern Arkansas. The following specimens are in the herbarium of the Arboretum and in the Gray Herbarium (H. G.):

GEORGIA. Chatham County, near Savannah, C. E. A. Hale, July, 1911, January and February, 1912; Lowndes County, near Valdosta, J. K. Small, June 6–12, 1895.

FLORIDA. Duval County, Jacksonville, T. G. Harbison, December 3, 1917, Clay County, John Donnell Smith, March 27, 1886 (No. 26) (H. G.); Columbia County, Lake City, F. E. Straub, December, 1814 (No. 34) (H. G.); Gadsden County, River Junction, G. V. Nash, August 10, 1895 (No. 2385).

ALABAMA. Mobile County, Mobile, Gates, Fletcher and Jewett, April, 1839 (No. 82) (H. G.); Dallas County, banks of the Alabama River near Berlin, R. S. Cocks, December, 1919.

MISSISSIPPI. Wayne County, Waynesboro, C. L. Pollard, August, 1896 (No. 1238) (H. G.); Jackson County, Ocean Springs, J. Skehan, September 15, 1895; Harrison County, Biloxi, S. M. Tracey, January 8, 1894 (No. 2842); Hinds County, near Jackson, T. G. Harbison, May 15 and 20, 1915; Adams County, near Natchez, C. C. Compton, December, 1919.

LOUISIANA. New Orleans, Thomas Drummond, 1832 (No. 137) (H. G.); St. Tammany Parish, Covington, C. S. Sargent, April 1, 1900, R. S. Cocks, April 14 and 20,

1910; West Feliciana Parish, near Bayou Sara, *C. S. Sargent*, April 12, 1916; Catahoula Parish, Urania, *E. J. Palmer*, May 12, 1915 (No. 7586); Lincoln Parish, Ruston, *R. S. Cocks*, July, 1909 and February 4, 1911; Richland Parish, Alto, *R. S. Cocks*, April 18, 1910; Winn Parish, Winnfield, *C. S. Sargent*, April 6 and November 9, 1913; St. Landry Parish, 10 miles west of Opelousas, *C. S. Sargent*, April 4, 1913; Natchitoches Parish, Natchitoches and Chopin, *E. J. Palmer*, April 16 and March 22, 1915 (Nos. 7246 and 7065); Calcasieu Parish, Lake Charles, *C. S. Sargent*, March 25, 1911, *R. S. Cocks*, March 27, 1911.

TEXAS. Jefferson County, Beaumont, *E. J. Palmer*, September 12, 1917 (No. 12728); Fletcher, Hardin County, *E. J. Palmer*, April 25, 1917 (No. 9558).

ARKANSAS. Hempstead County, McNab, *E. J. Palmer*, October 19, 1915 (No. 8972); Saline County, Benton, *E. J. Palmer*, September 2, 1915 (No. 8441).

The most southern stations from which I have seen *Hamamelis virginiana* are in the neighborhood of Stone Mountain, DeKalb County, near Reynolds, Taylor County, and banks of the Savannah River near Augusta, Richmond County, Georgia, and McNab, Hempstead County, southern Arkansas.

Crataegus

CRUS-GALLI

Crataegus montivaga, n. sp.

Leaves obovate to oval, rhombic or suborbicular, rounded, acute or acuminate or abruptly short-pointed at apex, concave-cuneate at base, sharply serrate to below the middle with straight acuminate glandular teeth, dark green, lustrous and scabrate above, pale yellow-green below, 2.5-3 cm. long, 1.8-2.5 cm. wide, with a thin midrib and prominent primary veins; petioles slender, wing-margined at apex, villose early in the spring, becoming glabrous, about 6 mm. in length. Flowers opening late in April 1.2 cm. in diameter, on villose pedicels 6-12 mm. long, in compact mostly 7-10-flowered villose corymbs, their bracts and bractlets linear-obovate, glandular-serrate; calyx-tube broadly obconic, glabrous or with occasional hairs near the base, the lobes gradually narrowed from a wide base, glandular-serrate, sometimes lacinate near the acuminate apex, glabrous on the outer surface, villose on the inner surface; stamens 10-15, usually 10; anthers pink; styles 2 or 3. Fruit ripening late in September or early in October, on erect nearly glabrous or villose pedicels, short-oblong to ellipsoidal, orange-red, about 8 mm. long, the calyx much enlarged; flesh thin, dry and mealy, yellow-green; nutlets 2 or 3, rounded at apex, ridged on the back with a low broad rounded ridge, about 6 mm. long.

A bushy tree rarely more than 4 or 5 m. high, with a short trunk 25-30 cm. in diameter, erect and spreading branches, and slender nearly straight branchlets orange-brown and covered with long scattered pale hairs when they first appear, dull red-brown and glabrous at the end of their first season and gray the following year.

WESTERN TEXAS. Rocky banks of streams: Kendall County, near Boerne, May 15, 1910, *B. Mackensen*, June 21 and September 30, 1913, *G. A. Schattenberg*, April 27, 1914, *G. D. Gray*, May 19, 1916, *E. J. Palmer* (rocky banks of Spring Creek, No. 9820), September 27, 1916, *E. J. Palmer* (No. 108828, type), April 6, 1917, *E. J.*

Palmer (Rocky banks of Cibolo Creek, No. 11476), April 7, 1917 (No. 11487), Lindendale, May 25, 1916, *E. J. Palmer* (along rocky banks of streams, No. 9899); Comal County, Fischer's Store, June 6, 1917 (limestone hills, No. 12197); Bandera County, June 18, 1916, *E. J. Palmer* (rocky banks of Seco Creek, No. 10245); northern Edwards County, October 10, 1916, *E. J. Palmer* (No. 10976); Callahan County, *E. J. Palmer*, May 30, 1918 (sandy uplands, No. 13806); Brown County, Brownwood, October 23, 1916, *E. J. Palmer* (No. 11109); Jeff Davis County, Spraul Ranch near Fort Davis, August 25, 1913, *D. M. Andrews*.

Common on the rocky banks of streams on the Edwards Plateau; and interesting as the extreme southwestern representative of the *Crus-galli* Group, and its only species in western Texas.

***Crataegus Cocksii*, n. sp.**

Leaves oblong-obovate, acute or rounded at apex, gradually narrowed and cuneate at base, finely serrate above the middle with straight acuminate teeth, glabrous, dark green and lustrous above, dull and paler below, 2.2–3 cm. long, 5–10 mm. wide, with a slender midrib, and slender primary veins mostly within the parenchyma; petioles slender, about 4 mm. in length; leaves at the ends of vigorous shoots broad-obovate, rounded or abruptly short-pointed at apex, thicker, more coarsely serrate, often 4 cm. long and 2.5 cm. wide. Flowers opening early in April, 1.5–1.8 cm. in diameter, on slender pedicels, in compact few-flowered glabrous corymbs; calyx-tube broadly obconic, glabrous, the lobes oblong-ovate, gradually narrowed and acuminate, entire, sparingly villose on the inner surface; stamens 20, small, pale rose color; styles 2 or 3, surrounded at base by clusters of white hairs. Fruit ripening in October, on slender pedicels about 6 mm. long, in few-fruited clusters, short-oblong to slightly obovoid, crimson, lustrous, 8–12 mm. long, with spreading calyx-lobes mostly deciduous from the ripe fruit; flesh yellow, dry and mealy; nutlets 2 or 3, ovoid, acute at apex, rounded at base, prominently ridged on the back, about 6 mm. long.

A slender tree 7 or 8 m. high, with a tall stem 10–15 cm. in diameter, with dark red-brown bark covered with small closely appressed scales, slender pendulous smooth branches and slender bright red-brown glabrous branchlets becoming gray in their second year, and armed with slender dark chestnut-brown lustrous spines 3–4 cm. in length.

LOUISIANA: Winn Parish, low rich woods at the marble quarry near Winnfield, *R. S. Cocks* and *C. S. Sargent*, April 6 and October 9, 1913.

I am glad to associate with this handsome tree, which differs from other Cock-Spur Thorns in its head of gracefully drooping branches, the name of Reginald Woodhouse Somers Cocks, professor of botany in Tulane University, tireless explorer of the flora of Louisiana.

AESTIVALES

This is one of the most distinct of the groups into which the species of *Crataegus* can be divided. The species all have large flowers in few-flowered simple corymbs, which open with or before the leaves unfold from February to April; the stamens are normally 20, but flowers with 15 or 25 stamens occasionally occur; the styles vary from 3–5. The fruit ripens in spring or

summer and is scarlet, lustrous and short-oblong to subglobose, with thick yellow succulent subacid flesh; the nutlets vary from 3-5 and are small, rounded or slightly ridged and grooved on the back, with a broad prominent hypostyle extending to below the middle of the nutlet. The fruit is largely gathered for jellies and preserves. The species, which are small trees or shrubs, grow in shallow depressions filled with water during most of the year ("pond-holes"), on the wet borders of streams and swamps, and in low wet woods.

The name *aestivalis* in connection with a *Crataegus* was first used by Walter in 1788 who published in his *Flora Caroliniana* "*Mespilus aestivalis spinosa, foliis angulatis serratis, floribus corymbosis, baccis magnis rubris.*" A specimen of this plant unfortunately is not found in Walter's herbarium preserved in the British Museum, and it is impossible to do more than guess at the identity of his plant. Pursh referred it as a synonym to *Crataegus coccinea* L.: Nuttall did not mention it: Elliott doubtfully referred it to *C. elliptica* Pursh, and Elliott's *C. lucida*, which he seems to have considered a *Crus-galli* species, is also probably Walter's plant. The name *Crataegus aestivalis* was first used by Torrey & Gray, in 1840, but their description is of a plant of southwestern Georgia and western Florida which is not known in the coast region of South Carolina or Georgia, where there is a species of this group which might have been known to Walter as it now grows near Yemassee, South Carolina, and near Valdosta and Meldrim, Georgia, all within the region probably well known to Walter. Walter's description as far as it goes describes this coast plant for the leaves at the ends of vigorous branches are "angulatis serratis" and the fruit is large and red; and it is therefore probably safe to use *aestivalis* as the specific name for the Atlantic-coast May Haw. If Walter's name is not used Elliott's *C. lucida*, if it were not a synonym, might perhaps be used for this tree, for there is no other *Crataegus* with "corymbis simplicibus, paucifloris" now growing where he found his *C. lucida*, "on the margin of the Ogeechee River just where the tides cease to flow." Meldrim is now at this point and May Haws are abundant there. Whether the *C. lucida* of Elliott is our plant or not Elliott certainly knew the May Haw which he believed was probably the *Mespilus aestivalis* Walt., for his description of it under *C. elliptica* Pursh leaves no doubt on this point. I did not know the Atlantic coast species until 1916 when Mr. Harbison obtained abundant material, and in 1906 I described under the name of *C. maloides* a May Haw from the east coast of Florida which varies so little from the Georgia plant that it may be considered a variety; and this is true of two other May Haws also from Volusia County, Florida, *C. cerasoides* and *C. luculenta* which I described in 1913.

The species of this Group may be arranged as follows:

Leaves glabrous with the exception of the small tufts of axillary hairs on their lower surface.

Leaves oblong-obovate, 3-5 cm. long; flowers in 2- or 3-flowered corymbs; stamens 15-20; anthers pale pink; a tree with nearly straight sparingly armed branchlets.

C. aestivalis.

- Leaves broad-obovate, 1-2 cm. long; flowers usually solitary; stamens 20; anthers dark rose color; a shrub rarely 2 m. high, with conspicuously zigzag branchlets covered with spines *C. monantha*.
- Leaves hoary tomentose below early in the season, becoming villose with rufous hairs most abundant on the midrib and veins; stamens 20; anthers deep rose color.
- Leaves oblong-obovate, acute or broad and rounded at apex, often slightly lobed above the middle, lustrous above; pedicels villose-pubescent *C. rufula*.
- Leaves elliptic to oblong-cuneiform, narrowed at apex, dull above; pedicels glabrous *C. opaca*.

Crataegus aestivalis Sargent (not Torrey & Gray). — *Mespilus aestivalis* Walter, Fl. Car. 148, 1788. — ? *Crataegus lucida* Elliott, Sketch, I. 548 (1821).

Leaves oblong-obovate, rounded or acute at apex, cuneate at base, coarsely serrate above the middle with glandular teeth, furnished below with small tufts of axillary hairs, otherwise glabrous, dark green and lustrous above, yellow-green below, 3-5 cm. long, 1-2 cm. wide, short-petiole, at the ends of vigorous shoots often laterally lobed. Flowers 2 cm. in diameter, in 2- or 3-flowered corymbs; calyx-tube narrowly obconic, glabrous, the lobes short, acute, glabrous, eglandular; stamens 15-20; anthers pink or pale rose color; styles usually 3. Fruit on a short erect pedicel, usually solitary, short-oblong, 8-10 mm. long, the calyx persistent with erect lobes.

A tree 7 or 8 m. high, with a tall stem 15-20 cm. in diameter, covered with pale flaky bark, erect or slightly spreading branches, and slender branchlets chestnut-brown and lustrous in their first year, becoming dull gray-brown the following year, and armed with stout spines 1.5-3 cm. in length.

GEORGIA: Effingham County, banks of the Ogeechee River near Meldrim, *T. G. Harbison*, April 12 and May 27, 1916; Lowndes County, near Vidalia, *M. A. Huger*, March, 1914.

SOUTH CAROLINA: Hampton County, swamps on the Combahee River, near Yemassee, *T. G. Harbison*, March 15, 1916; Aiken County, near Aiken, *H. W. Ravenel*, March 18, 1880.

NORTH CAROLINA: Craven County, near New Bern, *T. G. Harbison*, April 20, 1919.

Crataegus aestivalis var. *maloides*, n. var. — *Crataegus maloides* Sargent, Trees and Shrubs, I. 9, t. 5 (1902).

Differing from the type in the hairs on the upper side of the midrib of the leaves, in the shape of the leaves on the end of vigorous shoots, sometimes broad-obovate, rounded and often 3-lobed at apex, in the longer acuminate calyx-lobes villose on the inner surface, and in the dark rose-colored anthers.

FLORIDA: wet prairies, near Seville, Volusia County, *A. H. Curtiss*, March, June and July, 1900 (No. 6679.)

Crataegus aestivalis var. *cerasoides*, n. var. — *Crataegus cerasoides* Sargent, Trees and Shrubs, II. 237 (1913).

Differing from the type in the short white hairs on the upper surface of the young leaves, the longer acuminate calyx-lobes slightly villose on the inner surface, and often minutely serrate near the middle, the dark rose-

colored anthers and in the larger fruit on drooping pedicels, ripening in July and August.

A shrub with numerous stems often 10 m. high, forming a round-topped head 10–12 m. in diameter.

FLORIDA: Volusia County, low wet often inundated prairies; Leon County, Bradfordville; Hamilton County, Jasper; Gadsden County, Quincy.

Crataegus aestivalis var. *cerasoides* f. *luculenta*, n. forma. — *Crataegus luculenta* Sargent, *Trees and Shrubs*, 1. 11, t. 6 (1902).

Differing from the var. *cerasoides* in the more broadly obovate leaves, in the more numerous hairs on their upper surface while young, the rather smaller flowers, the smaller and less juicy fruit, ripening at the end of June or early in July, and in its often arborescent habit.

FLORIDA: Volusia County, "Haw Creek."

Crataegus rufula, nov. nom. — *Crataegus aestivalis* Torrey & Gray, N. Am. Fl. 1. 468, in part (1840), not *Mespilus aestivalis* Walter.

Leaves oblong-obovate, acute or rounded at apex, gradually narrowed, cuneate and entire at base, finely crenately glandular-serrate, and often slightly lobed with short rounded lobes above the middle; covered above with soft pale hairs and whitish tomentose below when they unfold, and at maturity thick, dark green, lustrous and glabrous or slightly pubescent along the midrib on the upper surface, rufous pubescent especially on the midrib and veins on the lower surface, 2–3.7 cm. long and 1.8–3 cm. wide, rarely not more than 2.5 cm. long and 1.2 cm. wide; petioles slender, villose-pubescent with rufous hairs, occasionally glandular, 6–8 mm. in length; leaves at the ends of vigorous shoots oblong-obovate, rounded and short-pointed to elliptic and acuminate, laterally lobed or deeply 3-lobed at apex and often 6 cm. long and 3.8 cm. wide. Flowers appearing from the 10th to the end of March, 1.8–2.5 cm. in diameter, in mostly 3–5-flowered clusters, on villose pubescent pedicels about 8 mm. in length; calyx-tube broadly obconic, glabrous or villose-pubescent sometimes in the same cluster, the lobes gradually narrowed from a wide base, acuminate, entire or slightly glandular-serrate nearly to apex, glabrous or slightly pubescent on the outer surface; stamens 20; anthers dark rose color; styles 3–5, surrounded at base by a ring of white tomentum. Fruit ripening the end of May, often solitary on glabrous erect pedicels 6–12 mm. long, subglobose, scarlet, lustrous, about 1.2 cm. in diameter, with yellow juicy subacid flesh, the calyx persistent, with erect lobes; nutlets rounded and only slightly grooved on the back, about 6 mm. long.

A tree sometimes 10 m. high, with a tall trunk 20–25 cm. in diameter, covered with rough deeply furrowed dark bark, paler and less deeply furrowed on smaller and younger stems, stout, ascending and spreading branches forming a broad round-topped head, and slender slightly zigzag branchlets covered when they first appear with pale tomentum, glabrous or rusty tomentose until the early summer, becoming chestnut-brown, lustrous and glabrous before autumn, and dull gray in their second year, and unarmed or armed with slender or stout straight spines 1.2–3.8 cm. in length.

NORTH CAROLINA. Wayne County, near Goldsboro, *T. G. Harbison*, April 10 and May 25, 1919.

GEORGIA. Dougherty County, near Albany, *T. G. Harbison*, April 16, 1917; DeCATUR County, Douglas Pond, near Bainbridge, *G. R. Shaw*, March 15, 1907, *T. G. Harbison*, May 29, 1909, May 8, 1919.

FLORIDA. Jackson County, Cottondale, *T. G. Harbison*, March 9, May 28, 1916, March 18, 19, 20, 1917, Round Lake, *T. G. Harbison*, March 8, 9, 18, May 25, 27, 1917; Gadsden County, Quincy, *R. M. Harper*, March 15, 1910, *T. G. Harbison*, March 10, 1916.

ALABAMA. Houston County, near Dothan, *T. G. Harbison*, March 17, May 23, 1917.

SILVICOLAE

Crataegus drymopila, nov. nom. — *Crataegus silvicola* Beadle in Bot. Gaz., XVIII. 414 (1899), not Gandoger.

In 1871 Gandoger published with a complete technical description in the Bull. Soc. Bot. France, XVIII. 448, a *Crataegus silvicola*, a native of France, and this name is not therefore available for the species from our southern states.

MOLLES

Crataegus meridionalis, n. sp.

Leaves elliptic to ovate or slightly obovate, acuminate, cuneate at the entire base, and coarsely often doubly serrate above with broad straight glandular teeth, coated below with hoary tomentum and covered above with short white hairs when they unfold, more than half grown when the flowers open from the first to the middle of April, and at maturity thin, yellow-green and scabrate on the upper surface, paler and villose-pubescent on the lower surface, especially on the slender midrib and primary veins, 7-8 cm. long, and 4-5 cm. wide; petioles slender, slightly wing-margined at apex, densely villose-pubescent with white hairs early in the season, becoming glabrous or nearly glabrous, 1.5-2 cm. in length; leaves on the end of vigorous shoots broad-ovate to broad-elliptic, more coarsely serrate, occasionally slightly divided into short broad lateral lobes, often 8-9 cm. long and 6-7 cm. wide, with a stout midrib, and petioles broadly wing-margined at apex and 1-1.5 cm. in length. Flowers 1.5-2 cm. in diameter, on stout pedicels thickly covered like the narrow obconic calyx-tube with matted silvery white hairs, in broad compact many-flowered villose corymbs, with conspicuous glandular-serrate villose bracts and bractlets mostly persistent until after the flowers open; calyx-lobes narrow, acuminate, laciniately glandular-serrate, slightly villose-pubescent when the buds open; stamens 20; anthers white; styles 3-5, surrounded at base by a broad ring of white tomentum. Fruit ripening from the middle to the end of September, on elongated slender puberulous pedicels, in few-fruited drooping red-stemmed clusters, short-oblong to subglobose, rounded at the ends, scarlet, 1-1.2 cm. in diameter, the calyx persistent, much enlarged, with erect or spreading conspicuous lobes; flesh thin, dry and mealy; nutlets 3-5, rounded at base, acute at apex, ridged on the back with a high rounded ridge, 7-8 cm. long.

A tree often 7-8 m. high, with a trunk 15-20 cm. in diameter, covered with dark bark slightly divided by shallow fissures into broad thin plates, spreading ashy gray branches forming a round-topped head, and slender zigzag branchlets, covered when they first appear with long white hairs, soon glabrous, orange-brown or reddish brown during their first season and dull gray the following year, and armed with numerous straight slender purple spines 2-6 cm. in length.

ALABAMA: Hale County, near Gallion, *T. G. Harbison*, April 17 and September 21, 1915 (type).

MISSISSIPPI: Oktibbeha County, Starkville, *T. G. Harbison*, April 7, 1913; Noxubee County, Brookville, *T. G. Harbison*, May 3, 1915.

***Crataegus noelensis*, n. sp.**

Leaves ovate to oval, acute, acuminate or rarely rounded at apex, acutely or broadly cuneate at base, and coarsely doubly serrate with straight teeth, covered above with short white hairs and densely villose-pubescent below when they unfold, more than half grown when the flowers open at the end of April, and at maturity dark yellow-green, smooth and glabrous on the upper surface, villose-pubescent on the lower surface, 5-8 cm. long, and 3-6 cm. wide, with a prominent midrib and thin conspicuous primary veins; petioles slender, slightly wing-margined at apex, hoary tomentose early in the season, becoming glabrous, 1-3 cm. in length; leaves at the end of vigorous shoots broadly ovate, acuminate, rounded or cuneate at the broad base, more coarsely serrate, usually laterally lobed with short broad acuminate lobes, and often 9 cm. long and 7-8 cm. wide. Flowers 2 cm. to nearly 2.5 cm. in diameter, on short pedicels densely covered like the narrow obconic calyx-tube and the compact 5-10-flowered corymb with long matted white hairs; calyx-lobes slender, long-acuminate, minutely glandular-serrate, slightly villose; stamens 5-10, usually 10; anthers rose color; styles 3-5, surrounded at base by a broad ring of pale tomentum. Fruit ripening in September, on slender drooping pubescent pedicels, subglobose, orange-red, about 1 cm. in diameter, the calyx prominent with a short tube and spreading closely appressed lobes; flesh thin, soft and yellow; nutlets 3-5, rounded at base, narrowed and rounded at apex, slightly grooved on the back, 5-6 cm. long.

A tree 6-7 m. high, with a trunk sometimes 15 cm. in diameter, spreading branches forming a broad flat or round-topped head, and stout zigzag branchlets coated when they first appear with matted white hairs, reddish brown, pubescent or puberulous during their first season and gray the following year, and armed with few or many slender straight purple lustrous spines 2-7 cm. in length, sometimes persistent and compound on old trunks.

MISSOURI: McDonald County, near Noel, *B. F. Bush*, August 8, October 12, 1908 (No. 6), April 24, 1909 (Nos. 5488, 5509), April 21, 22, 1915 (Nos. 7474, 7485, 7486, 7487), May 10, 1915 (No. 7528); *E. J. Palmer*, September 3, 1913 (No. 4097, type), April 30, 1914 (No. 5433).

COCCINEAE

Crataegus Holmesiana var. *tardipes*, n. var. — *Crataegus tardipes* Sargent in Ontario Nat. Sci. Bull. No. 4, 51 (1908).

The late ripening fruit first called my attention to this tree and led me to describe it as a species. This character, however, has little morphological value. It differs, too, from *C. Holmesiana* Ashe in its darker green leaves rougher on the upper surface, larger flowers on often villose pedicels, and in the shorter pedicels of the more constantly obovoid fruit. In size, habit, and in the bark of the trunk and branchlets this tree does not differ from *C. Holmesiana* with which it grows in Ontario, the Province of Quebec and in central and western New York, and can best perhaps be considered a variety of that species.

Crataegus pedicellata var. *gloriosa*, n. var. — *Crataegus gloriosa* Sargent in Rep. N.Y. State Mus. 122, 79 (1908).

The rather larger flowers with pink, not deep rose-colored anthers, the somewhat larger more lustrous fruit usually mamillate at base, and ripening a few days earlier, the convex leaves and the somewhat paler bark of the trunk, led me at one time to consider this tree specifically distinct from *C. pedicellata* Sargent. Having seen more of the trees growing near Rochester, New York, which is the only place where *C. gloriosa* has been found, I now believe that it is best considered a variety of *C. pedicellata* which is common in the same region.

NEW SPECIES, VARIETIES AND COMBINATIONS FROM THE HERBARIUM AND THE COLLECTIONS OF THE ARNOLD ARBORETUM¹

ALFRED REHDER

SAXIFRAGACEAE (*continued*)

Ribes L.

Ribes vulgare Lam. f. *variegatum*, comb. nov. — *Ribes rubrum* 3. *variegatum* Weston, Bot. Univ. i. 244 (1770). — *Ribes rubrum* var. Schmidt, Oester. Baumz. ii. 44, t. 93 (leaf) (1794). — *R. rubrum* 6, *foliis luteo-variegatis* Du Hamel apud Loudon, Arb. Brit. ii. 977 (1838). — *R. rubrum* 3, *foliis aureo-marginatis* Hort. apud Kirchner in Petzold & Kirchner, Arb. Musc. 414 (1864). — *R. rubrum aureo-marginatum* hort. apud Schelle in Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 143 (1903).

Of the common currant Miller in his *Catalogus plantarum*, pp. 64, 65 (1730) enumerates 3 different variegated forms: 1. *Ribes; vulgare, foliis ex luteo variegatis* — 2. *Ribes; vulgare, foliis ex albo variegatis*. — 3. *Ribes; fructu albo, foliis ex albo variegatis*. The leaf figured by Schmidt is

¹ Continued from p. 210.

broadly and irregularly margined with yellowish white and represents probably the most common form. Weston does not mention the color, he simply calls his form "striped-leaved Currant-tree."

R. vulgare f. *striatum*, comb. nov. — *R. rubrum* γ. *baccis variegatis* Wallroth, Sched. Crit. 107 (1822). — *R. rubrum* β. *variegatum* Berlandier in De Candolle, Prodr. III. 481 (1828), non Weston. — *R. rubrum* 1d. *striatum* Kuntze, Taschen-Fl. Leipzig, 236 (1867).

This form has fruits striped red and yellow.

× *Ribes holosericeum* Otto & Dietr. var. *pallidum*, var. nov. — *R. pallidum* Otto & Dietrich in Allgem. Gartenzeit. x. 268 (1842). — Heiland in Bot. Not. 1901, 102. — Janczewski in Bull. Acad. Sci. Cracovie, 1901, 298; l. c. 1904, 24; Mém. Soc. Phys. Hist. Nat. Genève, xxxv. 480, f. 183 (Monog. Gros.) (1907). — *R. ciliatum* Kitaibel apud Kanitz in Linnaea, xxxii. 480 (1863). — *R. Kitaibelii* Doerfler, Herb. Norm. No. 4264 (1902).

According to Janczewski *R. holosericeum* is a hybrid between *R. rubrum* L. and *R. petraeum* Wulf. var. *caucasicum* (= var. *Biebersteinii* Schneid.), while *R. pallidum* is a hybrid between *R. rubrum* and *R. petraeum* var. *bullatum* Jancz. Both hybrids have therefore the same species as parents, and must be classed under one binominal. As *R. holosericeum* precedes the other hybrid in the original publication, it may stand as the main name.

Ribes odoratum Wendl. var. *serotinum*, comb. nov. — *R. flavum* Colla in Mem. Accad. Torino, xxxiii. 114, t. 1b (Hort. Ripul. apx. III.) (1828), non Berlandier. — *R. fragrans* Loddiges, Bot. Cab. xvi. t. 1533 (1829), non Pallas. — *R. aureum* β. *serotinum* Lindley in Trans. Hort. Soc. vii. 242 (1830). — *R. aureum* γ. *sanguineum* Lindley, l. c. — *R. intermedium* Janczewski in Bull. Acad. Sci. Nat. Cracovie, 1910, 86, vix *Chrysobotrya intermedia* Spach. — *R. aureum* var. *intermedium* Janczewski, l. c. 91, fig. 2 (1910). — *R. aureum* *acerifolium* Hort. Spaeth ex Janczewski, l. c., pro syn.

This variety differs chiefly in its spreading, not reflexed or revolute sepals, narrower, less red petals and globular purple-brown fruit. Coville & Britton (in N. Am. Fl. xxii. 204 [1908]) place *Chrysobotrya intermedia* Spach under typical *R. aureum* which seems correct according to the original description and figure, while Janczewski places it under his *R. aureum grandiflorum* which is identical with *R. odoratum* Wendland.

Ribes Ruizii, nom. nov. — *R. glandulosum* Ruiz & Pavon, Fl. Peruv. III. 13, t. 233b (1802), non Grauer, 1784. — Berlandier in Mém. Soc. Phys. Sci. Hist. Nat. Genève, III. pt. 2, 59, t. 2, fig. 20 (1826); in De Candolle Prodr. III. 481 (1828). — Gay, Fl. Chil. III. 33 (1847). — Philippi in Linnaea xxviii. 647 (1856). — Reiche, Fl. Chil. III. 42 (1902). — Janczewski in Mém. Soc. Phys. Hist. Nat. Genève, xxxv. 430, fig. 144 (1907).

CHILE, BOLIVIA, ARGENTINE.

Ruiz & Pavon's name *R. glandulosum* is preoccupied by the valid *R. glandulosum* Graver (1784), the oldest name for the species generally known as *R. prostratum* L'Héritier (1785).

HAMAMELIDACEAE

Parrotiopsis Jacquemontiana, comb. nov. — *Fothergilla involucrata* Falconer in Proc. Linn. Soc. I. 18 (1839), sine descriptione, in Royle, Ill. Bot. Himal. introd. xxv. (1839), sine descriptione. — Niedenzu in Engler & Prantl. Nat. Pflanzenfam. III. 2A, 126 (1891). — *Parrotia Jacquemontiana* Decaisne in Jacquemont, Voy. VI. 73, t. 82 (1844). — Brandis, For. Fl. 216, t. 28 (1874). — Clarke in Hooker f., Fl. Brit. Ind. II. 426 (1879). — Hooker f. in Bot. Mag. CXXII. t. 7501 (1896). — *Parrotiopsis involucrata* Schneider, Ill. Handb. Laubholzk. I. 429, fig. 274h-l, 275b (1905). — Baas Beeking in Mededeel. Landbouwhooges. Wageningen, XIV. 104, t. 3 (1918).

Parrotiopsis first proposed as a subgenus of *Fothergilla* by Niedenzu in 1891 (l. c.) is probably best regarded with Schneider as a distinct genus, as it differs in its floral character as well from *Fothergilla* as from *Parrotia*, though it is apparently nearer to the former from which it differs only in the capitate inflorescence supported at the base by large bracts, in the less numerous stamens with linear not club-shaped filaments, while from *Parrotia* it is distinguished by the upright more numerous stamens with sub-quadrangular yellow anthers opening laterally by two longitudinal valves and by the stellate pubescence. The specific name, however, accepted by Schneider cannot stand, as the name *F. involucrata* is in neither one of the two places cited above accompanied by a description.

Hamamelis vernalis Sargent f. **tomentella**, forma nov.

A typo recedit foliis subtus praesertim ad nervos dense tomentellis vel subtomentosis, pilis fasciculatis e pilis villosis 0.5-1 mm. longis compositis.

OKLAHOMA. Le Flore County: Poteau, July 12, *E. J. Palmer* (No. 8260, type), near Page, September 9, 1913, *G. W. Stevens* (No. 2640).

MISSOURI. Monteer, October 25, 1908, *B. F. Bush* (No. 5344).

The same form has appeared among plants introduced from Swan, Missouri, and is growing now at the Arboretum. Like the type this form varies in the color of the under side of the leaves from green to glaucous.

ROSACEAE

Physocarpus australis, comb. nov. — ? *Spiraea caroliniana* Marshall, Arbust. 146 (1785), nomen. — *Opulaster australis* Rydberg in N. Am. Fl. XXII. 242 (1908).

Virginia to South Carolina.

This species seems to be well distinguished from *P. opulifolius* Maximowicz by the stellate-tomentose receptacle and sepals, by the shorter, abruptly pointed follicles and the smaller and broader leaves.

Physocarpus stellatus, comb. nov. — *Spiraea opulifolia* E. ferruginea Nuttall apud Torrey & Gray, Fl. N. Am. I. 414 (1840). — *Neillia opulifolia* var. *ferruginea* S. Watson, Bibl. Ind. I. 290 (1878). — *Opulaster stellatus* Rydberg in Small, Fl. Southeast. St. 513 (1903); in N. Am. Fl.

xxii. 243 (1908). — *Physocarpus ferrugineus* Daniels in Univ. Missouri Stud. Sci. i. 291 (1907). — *Opulaster alabamensis* Rydberg in N. Am. Fl. xxii. 243 (1908).

Georgia to Florida and Alabama.

This species is well distinguished from *P. opulifolius* by the stellate-pubescent carpels and the stellate pubescence of the young branchlets and of the under side of the leaves, but I am unable to separate from it specifically *Opulaster alabamensis* Rydberg. Specimens of that species from the type locality differ only in the generally narrower and more pointed leaves, those of the shoots often acuminate, those of the flowering branchlets usually acute; the flowers are somewhat larger and the follicles number usually five. On the plants growing in this Arboretum which were raised from seed collected in 1906 at the type station of *O. alabamensis*, the bracts of the inflorescence are leafy, narrowly elliptic to oblong-lanceolate, entire or with few coarse teeth, pubescent and 4–8 mm. long and mostly persistent until autumn, while on wild specimens the bracts are small and caducous.

Neillia longeracemosa Hemsl. var. *lobata*, var. nov.

A typo differt foliis minoribus 2.5–4.5 cm. longis manifeste 3-lobatis et apicem versus inciso-lobulatis et grossius serratis, subtus costa media basin versus pubescente excepta glabris, stipulis saepe pauci-denticulatis.

CHINA. Szechuan austr.: “inter Oti et Jenyan Hsien prope Quentui in dumetis” alt. 2900 m., June 4, 1914, *C. Schneider* (No. 3558).

This form appears at the first glance very distinct from other species of the genus *Neillia* on account of the small deeply lobed leaves, the sinuses of the basal lobes reaching about halfway to the middle, but the flowers agree exactly with those of *N. longeracemosa*, while the leaves and the stipules resemble closely those of *Stephanandra incisa* Zabel.

Neillia sparsiflora, sp. nov.

Frutex ramis gracilibus teretibus pallide rubro-brunneis; ramuli juniores setoso-glandulosi ceterum glabri; gemmae fuscae, glabrae; folia ovata, caudato-acuminata, basi rotundata vel leviter subcordata, argute et partim dupliciter serrata, basi lobis brevibus instructa, sursum lobulata, 4–6.5 cm. longa et 3–4.2 cm. lata, supra laete viridia, glabra, subtus pallidiora et ad costam et venas sparsissime pilosa et stipitato-glandulosa; petioli graciles, 0.8–1.2 cm. longi, sparse stipitato-glandulosi et supra pubescentes; stipulae ovato-lanceolatae, petiolum dimidium vix aequantes, sparse serratae; inflorescentia circiter 4-flora, pedunculo incluso circiter 3.5 cm. longa, rhachi gracili flexuosa, ut pedunculus et pedicelli 3–4 mm. longi setoso-glandulosi; bractae late lanceolatae, margine sparse setoso-glandulosae, pedicellos subaequantur vel paulo longiores; receptaculum campanulatum vel cylindrico-campanulatum, 6–7 mm. longum et 4–5 mm. crassum, extus glabrum, intus circa medium pilis sparsis annulum formantibus instructum; sepala ovata-lanceolata, acuminata, intus dense, extus versus apicem sparse villosula, 4 mm. longa; petala ovalia, 5 mm. longa, apice

eroso-denticulata et sparse ciliolata; stamina 20, longiora petalis circiter triente breviora, antheris ochraceis; ovarium ellipsoideum, supra medium dense villosum; stylus basi villosus, staminibus longioribus paulo brevior; ovula circiter 9: fructus non visus.

Proxima videtur *N. sinensi* Oliver, sed ramulis et petiolis rachique setoso-glandulosis, petiolis longioribus, racemo paucifloro, receptaculo campanulato facile distinguitur.

CHINA. Yunnan: Kou-ty, circa prope Pe-yen-tsin, 1917, *Siméon Ten* (No. 462).

This species differs from all *Neillias* known to me in the setose glandular branchlets, petioles and inflorescence. With *N. sinensis* Oliver and *N. ribesioides* Rehder it agrees in the glabrous receptacle, but both species differ in their many-flowered racemes, cylindric receptacle and in the ovary being pubescent only at the apex; the former species differs further in the short petioles about 5 mm. long, and *N. ribesioides* in the short, ovate, acutish and mucronulate sepals and in the pubescent under side of the leaves.

Spiraea prunifolia Sieb. & Zucc. var. *hupehensis* comb. nov. *S. hypericifolia* var. *hupehensis* Rehder in Sargent, Pl. Wilson. 1. 439 (1913).

A reëxamination of Wilson's No. 1754 and No. 2754 have convinced me that these specimens do not belong to *S. hypericifolia* from which they differ considerably in their short stamens which are only about one third as long as the petals, while in *S. hypericifolia* they are about as long as the petals. Furthermore the leaves are elliptic-oblong and bright green and do not show the tendency toward the obovate shape and the grayish color characteristic of *S. hypericifolia*. From typical *S. prunifolia* the variety differs chiefly in the glabrousness of the leaves and in the serration which is reduced to 1-4 teeth on each side near the apex.

The true *S. hypericifolia* occurs in northern China, being represented in our collection by a specimen collected May, 1910, near Yen-an Fu, Shensi, by Wm. Purdom (No. 346).

Spiraea Martinii Léveillé in Fedde, Rep. Spec. Nov. ix. 321 (1911). — *S. fulvescens* Rehder in Sargent, Pl. Wilson. 1. 439 (1913), non Dippel (1893).

CHINA. Yunnan: Mengtze, barren dry hills, alt. 5000 ft., *A. Henry* (No. 10662); Pe-yen-tsin, in collibus Ta-song-pin, April 4, 1916, *Siméon Ten* (No. 39, frutex 1.5 m. altus); Yunnan-Fu, in vallibus dumosis, alt. 2000 m., April 29, 1916, *O. Schoch* (No. 54).

The study of additional material has convinced me that my *S. fulvescens* is not specifically different from *S. Martinii* Léveillé of which, however, I have not seen the type. This is in so far fortunate, as the name *S. fulvescens* Rehder could not have been retained on account of the older homonym *S. fulvescens* Dippel which is a hybrid of the *Spiraria*-group. *Siméon Ten*'s specimen differs from the original description in the more pubescent leaves and in their grayish green, not glaucous under side, while *Schoch*'s No. 54 differs in the smaller, not 3-lobed leaves and in the less pubescent

branchlets; none of these specimens shows the peculiar fulvescent spurs of Henry's No. 10662.

***Spiraea Schochiana*, sp. nov.**

Frutex ut videtur erectus ramis arcuatis; ramuli juniores dense fulvo-villosi, annotini prominenter striati et angulati; gemmae ovoideae, acutiusculae, perulis imbricatis pubescentibus obtectae: folia elliptica vel obovato-elliptica, acutiuscula vel obtusiuscula et mucronata, basi late cuneata, circiter 1.5 cm. longa, utrinque dentibus 1-5 mucronulatis instructa, supra opace viridia, sparse lanuginosa, subtus tomento lanuginoso-villoso initio fulvescente demum cinerascete et epidermate glaucescente papillosa oblecta, utrinsecus nervis 3-4 instructa; petioli 1-2 mm. longi, dense villosi: flores albi in corymbo composito multifloro convexo denso 2.5-3.5 cm. diam. ramulos plurifolios terminante; pedunculi pedicellique 1-2 mm. longi et receptaculum dense fulvescenti-villoso: sepala triangularia intus extusque villosula; petala suborbicularia, 1.8 mm. lata; stamina 25-30, longiora petalis subaequilonga; discus conspicuus, 10-lobatus: receptaculum intus villosa; carpella apice longe villosa pilis longis partim stylum fere aequantibus, ad ventrem tantum parce pilosa; styli sepalis paulo breviora: carpella matura desiderantur.

CHINA. Yunnan: district of Yunnan Fu, "in silvis versus bor. occ.," alt. 2200 m., March 14, 1916, *O. Schoch* (No. 84).

This species is closely related to *S. Henryi* Hemsley which chiefly differs in the terete branchlets, the less dense pubescence of all parts, the much larger and looser inflorescence, the slenderer pedicels 2-6 mm. long and in the carpels being pubescent on the back. I should have considered this species a variety of *S. Henryi* with a denser pubescence and a smaller, more compact inflorescence, but for its strongly angled shoots, a character of importance in the genus. In its angled branchlets it agrees with *S. canescens* Don, which, however, differs markedly in its winter-buds with only 2 exposed scales, in the smaller, less pubescent, entire or slightly toothed leaves and in the grayish not fulvescent pubescence. In its general appearance the new species has a close resemblance to *S. chinensis* Maximowicz, but the inflorescence of that species is a simple umbel-like raceme.

***Spiraea Teniana*, sp. nov.**

Frutex erectus 1-3-metralis; ramuli hornotini initio minute et laxe puberuli, mox glabri et fusco-rubri, teretes, annotini brunnei; gemmae breves, perulis 2 exterioribus glabris oblectae, interioribus accrescentibus foliaceis margine ciliolata excepta glabris: folia elliptica vel elliptico-ovata, acuta, basi late cuneata, 2-2.8 cm. longa, tertia vel quarta parte inferiore excepta argute subsimpliciter serrata dentibus late ovatis acutis et interdum latere exteriori denticulo unico instructis, supra obscure viridia, glabra, subtus pallida, sed vix glaucescentia, ad costam basin versus sparse accumbenti-pilosa et margine basin versus ciliolata, utrinsecus nervis 4-6 subtus elevatis et venulis leviter elevatis instructa; petioli 1-2 mm. longi, fere glabri: flores hermaphroditi, albi, vix 4 mm. diam. in corymbis com-

positis densis 2-3 cm. diam. et ramulos adscendentes 7-13 cm. longos terminantibus; pedunculi pedicellique et receptaculum accumbenti-pilosula; ramuli 2-3 inferiores bracteam foliaceam supra basin vel circa medium gerentes; sepala triangularia, acutiuscula, mucronulata, 1 mm. longa, glabrescentia; petala suborbicularia, 1.5 mm. longa; stamina valde inaequalia, breviora petala subaequantia, longiora ad 4 mm. longa; discus irregulariter crenulatus; receptaculum intus minute sericeo-pubescent; carpella basitantum et ad ventrem sparse pilosula; styli sepala paulo superantes; follicula matura desiderantur.

CHINA. Yunnan bor.-occ.: circa Pe-yen-tsin, in silvis Tie-so, Jun. 22, 1916, *Siméon Ten* (No. 165).

This species seems most closely related to *S. vacciniifolia* D. Don which differs chiefly in the densely villous inner bud-scales of the winter-buds, in the slenderer petioles, in the entire or crenately serrate leaves and in the larger and looser densely villous inflorescence. It also resembles *S. bella* Sims, but that species is at once distinguished by its dioecious flowers.

Spiraea virginiana Britt. var. *serrulata*, var. nov.

A typo recedit foliis majoribus et latioribus elliptico-oblongis 4-7 cm. longis et 1.5-3 cm. latis plerisque supra medium serrulatis, rarius versus apicem tantum pauci-serrulatis, corymbis 5-13 cm. latis.

NORTH CAROLINA. Macon County: Franklin, on river bank, July 2, 1919, *T. G. Harbison* (No. 208, type; shrub 2 m. tall); banks of Little Tennessee River, same date and same collector (No. 209; a straggling much-branched shrub with flowering wands 1.25 m. long).

This new variety on account of its larger and broader leaves serrulate above the middle and of the large inflorescence looks quite distinct from typical *S. virginiana*, but in all other characters it agrees with the type. A specimen from Buncombe County collected by *T. G. Harbison* on the same date is intermediate between the type and the variety.

Holodiscus franciscanus, comb. nov. — *Sericotheca franciscana* Rydberg in *N. Am. Fl.* xxii. 268 (1908).

This species is certainly very closely related to *H. discolor* Maximowicz and may possibly be a variety of that species, but the firmer texture of the usually narrower leaves, less deeply toothed and more often with simple teeth and the short, triangular-ovate and acute sepals serve to distinguish it from *H. discolor*.

The numerous species described are often difficult to distinguish on account of the occurrence of intermediate forms; of those I have seen I am unable to separate specifically *Sericotheca obovata* Rydberg from *H. glabrescens* (Greene) Heller, and *Sericotheca concolor* Rydberg from *H. microphylla* Rydberg.

Pyracantha discolor, sp. nov.

Frutex 1.5-3 m. altus; ramuli juniores fulvo-tomentosi, annotini et vetustiores glabri et fusco-purpurei-lucidi, interdum in spinas circa 1 cm. longas mutati; folia ovalia vel elliptica vel oblonga, obtusa, rarius acuta vel emar-

ginata, pleraque mucronulata, basi cuneata vel late cuneata, vel interdum fere rotundata, 2–6 cm. longa, integra vel rarius minute crenato-serrulata, supra laete viridia, subtus pallida vel glaucescentia, nervis fere obsoletis, initio praecipue subtus ad costam mediam villosa, mox glabra; petioli 3–8 mm. longi, initio pubescentes, demum glabri vel fere glabri; corymbi multiflori, 3–4 cm. diam.; pedicelli glabri, graciles, 0.3–1 cm. longi; flores albi, circiter 8 mm. diam.; receptaculum glabrum; sepala semiorbicularia vel ovata, apiculata, sparse pubescentia, erecta; petala rotundato-obovata; stamina fere 20, petalis breviora, antheris flavidis; discus lanatus; carpella 5, apice villosa; fructus tantum immaturi visi.

CHINA. Hupeh: Fang Hsien, side of streams, alt. 300 m., June, 1907, *E. H. Wilson* (Arnold Arb. Exp. No. 2986, type); same locality, July, 1910, *E. H. Wilson* (Veitch Exp. No. 349, quoad unum specimen florens, altero spec. florente et spec. fructifero exclusis); north and south of Ichang, alt. 300–1300 m., May 26, 1907, *E. H. Wilson* (Arnold Arb. Exp. No. 662, specimine fruct. excluso). Kwei-chou: "inter oppida Tuyän et Patschai prope vicum Dodjie, in silva xerophila collis," alt. 700 m., Jul. 13, 1917, *H. Handel-Mazzetti*; "prope urbem Kutschou, in silvis frondosis templi Yanggu-miau," alt. 300 m., July 20, 1917, *H. Handel-Mazzetti*; "in silva frondosa collis Nanyo-schan pr. urb. Kweiyang," alt. 1200 m., July 4, 1917, *H. Handel-Mazzetti*.

This new species is well characterized by its glabrous, entire or nearly entire leaves, pale or glaucescent and indistinctly veined beneath. It is most closely related to *P. Gibbsii* A. B. Jackson which differs in its obovate to obovate-oblong or spatulate leaves, gradually narrowed toward the base, coarsely crenate, light green beneath and with distinct secondary veins and in the quite glabrous sepals. In the entire or nearly entire leaves and in their oblong shape it resembles *C. angustifolia* Schneider, but that species differs in the tomentose pubescence of the under side of the much narrower leaves and of the denser and few-flowered inflorescence. The three specimens from Kwei-chou agree with the type specimens in the size and shape of the leaves, while Wilson's Nos. 349 and 662 have smaller leaves, not more than 3 cm. long and occasionally acutish or acute.

Pyracantha Koidzumii, comb. nov. — *Cotoneaster formosana* Hayata in Jour. Coll. Sci. Tokyo, xxx. art. 1, 101 (Mat. Fl. Formos.) (1911); Icon. Pl. Formos. i. 244 (1911). — Kanehira, Trees Formosa, 213, fig. (1917); ed. 2, 213, fig. (1918). — *Cotoneaster Koizumii* Hayata in Jour. Coll. Sci. Tokyo, xxx. art. 1, 101 (Mat. Fl. Formosa) (1911); Icon. Pl. Formos. i. 244 (1911). — Kanehira, Trees Formosa, 213 (1917). — *Cotoneaster Koidzumii* Koidzumi in Jour. Coll. Sci. Tokyo, xxxiv. art. 2, 35 (1913), includ. syn. *C. formosana*. — *Cotoneaster taiioensis* Hayata in Jour. Coll. Sci. Tokyo, xxx. art. 1, 102 (Mat. Fl. Formosa) (1911); Icon. Pl. Formos. 245 (1911). — Koidzumi in Jour. Coll. Sci. Tokyo, xxxiv. art. 2, 36 (1913). — Kanehira, Trees Formosa, 214 (1917). — *Pyracantha formosana* Kanehira, Trees Formosa, ed. 2, 213 (1918), pro synon.

FORMOSA. East Coast: Pinan to Dakusui, between Pinan and Karenko, abundant in stony areas of river mouth, Nov. 18, 1918, *E. H. Wilson* (No. 1128); Pinan and Taito (ex Hayata):

The three species described by Hayata differ only by slight and partly accidental individual differences and Mr. Wilson who has seen the type specimens in Toyko says that they undoubtedly belong to the same species. Kanehira in the second edition of his *Trees of Formosa* (which does not differ from the first except in a few nomenclatorial changes) had inserted after *C. formosana*, acting on the suggestion of Mr. Wilson that the species belongs to *Pyracantha*, in parenthesis the name *Pyracantha formosana*, but as five years earlier Koidzumi had already united *C. formosana* and *C. Koizumii* under the name *C. Koidzumii*, and as his choice cannot be modified according to art. 46 of the International rules, though *C. formosa* has precedence on the page, the specific name "*Koidzumii*" is the correct name if the two species are united. Moreover, *Pyracantha formosana* Kanehira is not a valid publication, being cited only as a synonym.

Crataegomespilus Dardari Simon-Louis var. *Asnieresii*, comb. nov. — *Crataego-Mespilus* "Jules d'Asnières" Simon-Louis apud Jouin in Jardin, 1899, 22. — *Crataegus Oxyacantha* × *Mespilus germanica* 2. *Asnieresii* Koehne in Gartenfl. L. 632 (1901). — *Crataego-Mespilus Dardari crataegoides* Zabel in Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 180 (1903). — *Crataegomespilus Asnieresii* Schneider, Ill. Handb. Laubh. I. 765, fig. 433G-H, 434A-C (1906). — Bean in Kew Bull. Misc. Inform. 1911, 268, fig. 2. — Beck in Reichenbach, Icon. Fl. Germ. xxv. 31, t. 109 (1914?). — Berger in Gartenwelt, xx 481, fig. 1a-d (1916). — *Mespilus germanica* × *monogyna* B. *Asnieresii* Ascherson & Graebner, Syn. Mitteleur. Fl. VI. 2. 46 (1906).

As *C. Asnieresii* Schneider is of the same parentage as *C. Dardari* and even originated on the same tree, it must be treated as a variety of the older *C. Dardari*.

× *Crataegomespilus Gillotii*, comb. nov. — *Crataegus oxyacantho-germanica* Gillot in Bull. Soc. Bot. France, xxii. xiv (1876), excl. synonym.; in Bull. Herb. Boiss. II. apx. iv. 18 (1894), pro parte. — *Crataeo-Mespilus Gillotii* G. Beck in Reichenbach, Icon. Fl. Germ. xxv. 30, t. 107 (1914).

Beck placed this plant, apparently a hybrid between *Mespilus germanica* and *Crataegus monogyna* under *Crataeo-Mespilus*, a name proposed by Camus in 1899 (in Jour. de Bot. xiii. 326) for the hybrid between *Mespilus germanica* and *Crataegus Oxyacantha* first described as *Mespilus grandiflora* Smith, but a year earlier Jouin had proposed (in Compt. Rend. Congr. Hort. Paris, 9) the name *Crataego-Mespilus* for graft hybrids between *Mespilus germanica* and *Crataegus monogyna*. As both generic names are intended for intermediate forms between the same genera, they should be considered synonymous and the oldest name adopted as valid. It seems, however, advisable to keep sexual hybrids and graft hybrids between the same species distinct under different specific names, and to retain in this case for the sexual hybrids between *Crataegus monogyna* and *Mespilus*

germanica the name *C. Gillotii*, while *C. Dardari* is restricted to the graft hybrids between the same species.

Crataegus monogyna f. *biflora*, comb. nov. — *C. Oxyacantha* 7. *biflora* Weston, Bot. Univ. i. 79 (1770). — *Mespilus Oxyacantha praecox* Dumont de Courset, Bot. Cult. ed. 2, v. 453 (1811). — *Crataegus Oxyacantha* 25. *praecox* Hort. apud Loudon, Arb. Brit. ii. 833 (1838). — *C. monogyna* var. *praecox* Henry in Elwes & Henry, Trees Gr. Brit. Irel. vii. 1736 (1913), non Dippel (1892).

Though Weston's description of this form may be considered insufficient, for his designation of the form as "biflora" can mean either two-flowered or twice flowering, the citation of the vernacular name "Glastonbury Thorn" should be sufficient for identification. Moreover, the name "praecox" under *Crataegus monogyna* is preoccupied by *C. monogyna* var. *praecox* Dippel (1892) which is not based on any previously published name and according to the description is entirely different from the Glastonbury Thorn and apparently not a form of *C. monogyna*.

Crataegus pentagyna Waldst. & Kit. var. *Oliveriana*, comb. nov. — *Mespilus Oliveriana* Dumont de Courset, Bot. Cult., ed. 2, v. 454 (1811). — *Crataegus Oliviriana* (sic) Bosc in Nouv. Cours Agric. ed. 2, ii. 222 (1821). — *C. Oliveriana* Bean, Trees & Shrubs Brit. Isl. i. 431 (1914). — *C. Oxyacantha* var. *Oliveriana* Lindley in Bot. Reg. xxiii. t. 1933 (1837). — Loudon, Arb. Brit. ii. 831, fig. 606 (1838).

This is apparently only a variety of the variable *C. pentagyna* Waldstein & Kitaibel and differs from it chiefly in the more pubescent and more finely toothed leaves, in the entire or less toothed stipules and in the smaller fruit. In the first description by Dumont de Courset the leaves are described as somewhat pubescent with the lobes having nearly constantly three teeth at the apex. Bosc himself in 1821 describes the leaves as very pubescent with 5 acute lobes on each side. Though Poiret states that he received his specimens from Bosc himself, his *Mespilus Oliveriana* (Encyl. Méth. iv. 72 [1816]) must be an entirely different plant, for he describes it as "glaberrima, lobis obtusis subintegris"; De Candolle (Prodr. ii. 630 [1825]) follows Poiret's description. Koch (Dendr. i. 156 [1869]) considers it a form of *M. melanocarpa* M. Bieb., while Dippel, Koehne and Schneider consider it a synonym of *C. pentagyna*.

Sorbus Harrowiana, comb. nov. — *Pyrus* (*Sorbus*) *Harrowianus* Balfour f. & W. W. Smith in Not. Bot. Gard. Edinb. x. 61 (1917).

CHINA. Yunnan.

This species is remarkable for its very large leaves; the larger leaflets of the 5-7-foliolate leaves are often more than 20 cm. long.

Sorbus hybrida L. f. *fastigiata*, comb. nov. — *Pyrus pinnatifida fastigiata* Bean in Gard. Chron. ser. 3, xli. 184, fig. 82 (1907).

A form with strictly upright branches forming a fastigiate tree.

(To be continued)

NOTES

The Botanical Magazine. When Sir William Jackson Hooker assumed in 1827 the editorial control of *The Botanical Magazine* he adopted the plan of dedicating the yearly volume to a man or woman distinguished in botany or horticulture, or to one of the great patrons of horticulture. This plan has been followed by succeeding editors up to the present day. In 1850 Sir Joseph Dalton Hooker who had followed his father as editor, dedicated the seventy-sixth volume to Dr. JOHN TORREY of New York, "the distinguished author of *The Flora of North America*," and the next year the seventy-seventh volume was dedicated to ASA GRAY by his "affectionate and faithful friend the author." No other American was honored in this way until 1911, when Sir David Prain dedicated the one hundred and thirty-seventh volume to Professor SARGENT, the Director of the Arboretum, and now the volume for 1919 is dedicated "to ERNEST HENRY WILSON, Assistant Director of the Arnold Arboretum, whose ardour as an explorer and judgment as a collector have added to our gardens many eastern Asiatic plants whose portraits embellish *The Botanical Magazine*." It is interesting that of these four men living in America (Mr. Wilson is a British subject) who have been honored in this way three have been connected with Harvard.

ERRATA

Page 54, line 15 for *Nordmanniana* Hort. read *Nordmanniana speciosa* Hort.

- “ 58, “ 3 and 4 from below strike out: *Arundinaria* . . . 61 (1900).—
- “ 59, “ 22 for Handel-Mazetti read Handel-Mazzetti.
- “ 60, “ 13 and 15 for *Handel-Mazetti* read *Handel-Mazzetti*.
- “ 66, “ 20 for *Taiwania cupressoides* read *Taiwania cryptomerioides*.
- “ 77, “ 7 from below for Tyrull read Tyrrell.
- “ 78, “ 3 for Tyrull read Tyrrell.
- “ 82, “ 16 for 1897 read 1867.
- “ 118, “ 5 add: — *Evodia Nishimurae* Koidzumi in Toyko Bot. Mag. xxxiii. (265) (1919), nomen; 218 (December, 1919).
- “ 118, “ 1 from below, add: — *Zanthoxylon inerme* (Rehd. & Wils.) Koidzumi in Tokyo Bot. Mag. xxxiii. 218 (1919).
- “ 122, “ 5 from below for comb. nov. read Hayata, Icon. Pl. Formos. vi. suppl. 72 (1917).
- “ 123, “ 17 for comb. nov. read Hayata, Icon. Pl. Formos. vi. suppl. 72 (1917).
- “ 126, “ 9 for comb. nov. read Hayata, Icon. Pl. Formos. vi. suppl. 72 (1917).
- “ 129, “ 15 for *omalokos* read *Omalkos*.
- “ 150, “ 4 for *Iliama* read *Iliamna*.
- “ 170, “ 22 for *pyrisolia* read *pyrifolia*.
- “ 170, “ 11 from below for *Tyull* read *Tyrrell*.
- “ 182, “ 20 in col. 2 for *Sideroxylon ? ferrugineum* Hook. & Arn. read *Sideroxylon liukiense* Nakai.

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NOTES ON AMERICAN WILLOWS. IX.

CAMILLO SCHNEIDER

IN this article I shall discuss the species of two sections which were believed to be well known. If we, however, make a close examination of these species we find that our present knowledge of them is still superficial and only an attempt can be made to elucidate the synonymy, variability and the relationship of certain species. Some of these need a much closer study in the field before we can become acquainted with their forms and hybrids. There is also a great difficulty in referring some of these species to distinct sections. It is evident that many of my observations cannot be regarded as final and I desire to induce as many students as possible to take an earnest interest in the study of these difficult forms and to point out the defects in our present knowledge. I am sorry that I had to break off my studies too soon, as with more time I might have reached different conclusions with regard to certain of these species and forms. Nevertheless I hope that my notes contain some valuable hints for other salicologists. As for the preceding notes this study is mainly based on the collections mentioned in notes VII and VIII. I wish again to address my best thanks to all the gentlemen who have helped me.

a. THE SPECIES OF THE SECTION DISCOLORES.

By recent authors the species of this section are mostly referred to the section *Capreae* which comprises some well-known European species. It may be that these American forms can be united with those of the Old World, but the more I become acquainted with American Willows the less I find, at least in most cases, a close relationship even with forms that are widely spread through Europe and Asia. Of course, I do not pretend to know enough of these species to draw final conclusions from the material I have studied. Our knowledge of the Asiatic Willows is, to-day, much too limited. But, in my opinion, we can gain less by uniting groups or species of different geographical distribution and of different morphological aspect than by keeping them apart. It is often difficult to describe the differences, and it is only by good sketches of the characters of the flowers and fruits and of other features that the reasons can be made clear why I prefer to regard many of the American Willows to be not so closely related to Euro-

leaner Asiatic species as one might judge by the conclusions of Andersson and more recent authors.

As may be seen by the synonymy given below Barratt referred *S. discolor* and *S. Scouleriana* to different groups but he, apparently, was not well acquainted with *S. Scouleriana*. On the other hand, he did, in 1840, recognize *S. discolor* as the type of a distinct section, of which the synonymy is as follows:

Sect. *Discolores* Barratt apud Hooker, Fl. Bor.-Am. II. 147 (1839), [*Discolorae*], pro parte, excl. *S. Richardsonii*; Sal. Am. sect. II. (1840). — Sect. *Capreae* Koch, De Salic. Eur. Comm. 31 (1828), quoad *S. prinoides* in nota. — Ball apud Coulter & Nelson, N. Man. Rocky Mts. Bot. 137 (1909). — Sect. *Cinereae* Barratt apud Hooker, Fl. Bor.-Am. II. 144 (1838), pro parte quoad *S. Scouleriana*, non Fries 1828. — Sect. *Cinerascentes* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 120 (1858), pro parte. — Sect. *Cinerascentes* vel *Capreae* Andersson in Svensk. Vet.-Akad. Handl. VI. 82 (Monog. Salic.) (1867); apud De Candolle, Prodr. XVI.² 215 (1868), pro parte, quoad *S. brachystachys* et *S. discolor*. — Sect. *Phylicifoliae* Schneider, Ill. Handb. Laubh. I. 54 (1904), pro parte, quoad *S. discolor*.

To the same group seem to belong the Mexican species *S. paradoxa*, *S. oxylepis* and *S. Rowleei*. Not having seen enough material of these and not yet having been able to reach a final conclusion regarding the differences between certain forms of *S. Scouleriana* and *S. discolor* I do not give now a key for this group. The differences of these two species as pointed out by such an eminent salicologist as Ball (1909) do not always prove right. As a whole it is much easier to distinguish both in the herbaria by their appearance than to describe the characters by which they may be separated.

1. *S. discolor* Muhlenberg in Neue Schrift. Ges. Nat. Fr. Berlin, IV. 234, t. VI, fig. 1 (1803). — Willdenow, Spec. Pl. IV. 665 (1805). — Pursh, Fl. Am. Sept. II. 613 (1804). — Poiret in Lamarck, Enc. Suppl. VI. 57 (1817). — Elliott, Sketch Bot. II. 669 (1824). — Bigelow, Fl. Bost. ed. 2, 364 (1824). — Forbes, Salic. Wob. 279, fig. 147 (1892). — Hooker, Fl. Bor.-Am. II. 147 (1839), excl. var. β —Bebb apud Coulter & Watson, Gray's Man. ed. 6, 482 (1890). — Sargent, Silva, IX. 133, t. 478 (1896). — Schneider, Ill. Handb. Laubh. I. 54, fig. 11 u-u¹, 26 a (1904). — Britton & Brown, Ill. Fl. I. 499, fig. 1187 (1896); ed. 2, I. 599, fig. 1472 (1913). — Robinson & Fernald, Gray's Man. 325, fig. 658 (1908). — Ball apud Coulter & Nelson, N. Man. Rocky Mts. Bot. 137 (1909); in Elys. Mar. III. 32, t. 7, fig. a (1910). — *S. conifera* Wangenheim, Beytr. Forstw. Nordam. Holzart. 123, t. 31, fig. 72 (1787), ex parte. — Willdenow, Berl. Baumz. 347 (1796); ed. 2, 455 (1811), ex parte; Sp. Pl. IV. 705 (1805), ex parte. — Pursh, Fl. Am. Sept. 612 (1814), ex parte; —? *S. sensitiva* Barratt, Sal. Am. no. 8 (1840). — *S. prinoides* Forbes, Salic. Wob. 79, t. 40 (1829). — *S. (phylicifolia*) discolor* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 123 (1858), pro parte. — *S. discolor virescens* Andersson in Svensk. Vet.-Akad. Handl. VI. 85 (1867). — *S. balsamifera intermedia* Barratt nom. nud. in herb. sec. Bebb in Bot. Gaz. IV.

191 (1879). — *S. squamata* Rydberg in Britton, Man. 317 (1901); in Britton & Brown, Ill. Fl. ed. 2, 1. 600 (1913).

The type of the widely spread eastern "Pussy Willow" has been well described by Muhlenberg and Willdenow, and also, in 1867, by Andersson as *S. discolor virescens*. It comprises the forms in which the branchlets are pubescent only when young, and the mature leaves become quite glabrous. The leaves are said to be "ovato-lanceolata utrinque acuta" by the author, or according to Willdenow who prepared the short diagnoses in Muhlenberg's article "oblonga obtusiuscula." The leaf figured on the plate seems to be only a half grown one. The type came from Lancaster, Pa.

This species was apparently first described by Wangenheim as *S. conifera* who probably confused the two species *S. humilis* and *S. discolor*. The pubescence of the leaves points to *S. humilis*, the habit to *S. discolor*. The figure given by Wangenheim is very badly drawn, and the name *conifera* refers to the galls which frequently are found on both species as well as on other Willows. Therefore it seems best to abandon entirely Wangenheim's name unless there can be found a type specimen which clearly proves the identity of his plant.

Michaux' *S. eriocephala* of 1803 the type of which came from Illinois represents the form with more or less persistently tomentose branchlets ("ramulis minutim tomentosus"). I shall say more of it later in dealing with Andersson's forms.

Pursh, in 1814, besides *S. discolor* described a *S. prinoides*. According to his statements it differs in its narrower more acute leaves, longer pedicels and longer styles. It is, however, almost impossible to judge from his description which form he had in mind. In Herb. Kew there is a specimen named *prinoides* by Borrer from Hort. G. Andersson of which a sketch is in Herb. G. It looks to me like typical *S. discolor*.

Barratt's varieties of 1840, *gracilis*, *obovata*, *minima*, and *attenuata*, are nomina nuda. I have only seen the type of f. *obovata*, which is nothing but *S. discolor typica*. The types of the other forms seem to be in Herb. Kew, and there are some sketches of them in Herb. G. Besides *S. discolor* Barratt mentions *S. conformis* Forbes. The native country of this form is not known; it may be a narrow leaved form of *S. discolor* identical with *S. prinoides* Pursh. The plant figured by Forbes (t. 410) as *S. prinoides* is the same form that Rydberg recently has described as *S. squamata*; it is nothing but a late flowering state of typical *S. discolor*, an opinion also held by Britton & Brown in 1913.

Of Barratt's no. "6. *Salix eriocephala* Michaux?" I have seen two specimens which are identical with var. *eriocephala* sensu Fernald (see later). Barratt also described a *S. crassa* of which I have seen the type. It, too, is *eriocephala*, and Carey in 1847 already made *S. crassa* a synonym of *eriocephala*. Barratt's *S. sensitiva* is, in my opinion, typical *S. discolor* or the same form which Pursh calls *S. prinoides*. Carey has put it with a question mark as a synonym of *S. discolor*.

The form which Carey took for *S. eriocephala* is uncertain to me. He said:

"Closely resembles the last [*S. discolor*]; but the aments are more compact and silky, and the scales rounder." He does not mention the pubescence, and cites as synonyms "*S. prinoides* Pursh? *S. crassa*, Barratt."

Andersson (1858) said very little of *S. discolor* making it a quasi form of *S. phylicifolia*. In 1867, he dealt thoroughly with it. His figure 49 on t. 5 represents rather short-petioled leaves loosely pubescent beneath, and a glabrous female flower which rather agrees with that of *S. cordata* but unfortunately a good many of Andersson's figures are very inaccurately drawn. He divides *S. discolor* in the three forms: *rigidior*, *latifolia* and *vinescens*. The last is identical with Muhlenberg's type in Herb. Willdenow, and represents a form with "foliis angustius lanceolatis." Andersson does not mention it again in the Prodrumus (1868). Here he also changed the two other forms of 1867. The name *rigidior* is not used again but is apparently changed to *angustifolia*. This form, however, is, in my opinion, the same as var. *prinoides* of recent authors. The name *rigidior* seems the oldest, therefore this variety has to be called var. *rigidior* (see later).

Andersson's var. *latifolia* (1867) is retained in 1868, but in the Prodrumus he excludes the hairy forms keeping them separate as "*3 hirsuta*" of which the type is said to be in "H. C. Vindob." Unfortunately I have not been able to find it in the Herbarium at Vienna.

In 1867 Andersson also mentions two subspecies: **S. eriocephala* and **S. prinoides*. In 1858 (Öfv. Svensk. Vet.-Akad. Förh. xv. 117) he said of *S. eriocephala*: "E Salicibus americanis haec mihi valde obscura" placing it next to his *irrorata*. He dealt extensively with specimens which he had received as *S. eriocephala*, *prinoides*, and *conifera* but his statements are of little value. In 1867 he made two varieties of his subspec. *eriocephala*: *parvifolia* and *rufescens*. The type of *parvifolia* was collected by Bourgeau "Ad flumen Saskatchewan." Without having seen it, I cannot decide whether this really is a form of *S. discolor* or of *S. Bebbiana*. Andersson himself says: "facie *S. vagantis rostratae*." The var. *rufescens* came from "America occidentalis," and it belongs to *S. Scouleriana*. Andersson adds to his description the following remark: "Haec forma *S. brachystachyae-Scoulerianae* similis est, ab ea attamen amentis multo longioribus magisque laxifloris capsulis demum longius pependentibus differt." See also *S. Scouleriana*. In 1868, Andersson does not mention again these two forms. He makes *S. eriocephala* a var.? *eriocephala* of *S. discolor* and says: "In herbariis variis formas indubie identicas nunc *S. discolor* nunc *S. eriocephala* promiscue signatas vidi, nec e scriptis auctorum differentias ulla; extricare potui, nisi jam allatas, e forma squamarum desumtas sed viles."

The subspecies *S. prinoides* Andersson (1867) is founded on Pursh's *S. prinoides*. Andersson says: De hac species iterum incertus sum; e descriptione a praecedentibus et omnibus *S. cinerascens* differret "stylus elongato" et forsitan melius *S. phylicifoliae* affinis censeretur; specimina tamen quae plurima vidi, etiam in eo *S. discolor* magis revocaberunt, quod stylus ullum subproductum vix observare possem. Pursh ipse de hac dicit "resembles *S. discolor*." Nuttall eam cum *S. discolor* cum ? con-

jungit, ut etiam Asa Gray alique." In the Prodrômus, Andersson treats *S. prinoides* in the same manner as *S. eriocephala*, that is as a var. ? *prinoides* of *S. discolor*, and remarks: "Obit praecipue memorabilis utpote quae, regiones magis septentrionales Americae orientalis praecipue inhabitans, forma capsularum ad *S. humilem* transitum quadammodo efficit."

So far as I am acquainted with *S. discolor* there seem to occur at least two rather distinct varieties: one with "ramulis folisque ab initio glabris vel tantum novellis pubescentia grisea fulvaeque plusminusve densa cito evanescente obtectis"; the second with "ramulis novellis dense tomentosis etiam annotinis floriferisque plusminusve (partim) tomentosis, foliis (saltem subtus) plusminusve griseo-fulvoque pilosis sed adultis saepe omnino glabrescentibus." The first one in my opinion, is typical *S. discolor*. There may be a forma glaberrima of it to which certain forms from the northeast ought to be referred. To the typical variety apparently belongs as a form with narrower leaves and with a somewhat longer style *S. prinoides* sensu stricto. The correct name for it, as already stated, seems to be *S. discolor* f. *rigidior* Andersson in Svensk. Vet.-Akad. Handl. vi. 84 (1867) (*S. prinoides* Pursh, Fl. Am. Sept. II. 613 (1814). — Bebb apud Watson & Coulter, Gray Man. ed. 6, 482 (1890). — Ball in Bot. Gaz. LX. 398 (1915) et auct. al. ex parte. — ? *S. conformis* Forbes, Salicet. Wob. 47, t. 24 (1829). — Barratt, Sal. Am. no. 5 (1840). — *S. discolor* ** *S. prinoides* Andersson in Svensk. Vet.-Akad. Handl. vi. 86 (1867). — *S. discolor* 2° *angustifolia* Andersson in De Candolle, Prodr. xvi. 2 225 (1868). — *S. discolor* γ ? *prinoides* Andersson, l.c. 225, an tantum pro parte? — *S. discolor* var. *prinoides* auct. al. pro parte maxima. — *S. homonyma* Gandoger in Flora LXV. 228 (1882).

The second variety with tomentose branchlets is the same as *S. eriocephala* Mich. and as var. *eriocephala* of most authors. The oldest name that has to be used seems to be *latifolia* of Andersson, therefore the synonymy may be indicated as follows: *S. discolor* var. *latifolia* Andersson in Svensk. Vet.-Akad. Handl. vi. 84 (1867) — *S. eriocephala* Mich. Fl. Bor.-Am. II. 225 (1803). — Carey apud Gray, Man. 426 (1848); ed. 2, 414 (1856); ed. 3, 414 (1862); ed. 4, 414 (1863). — Britton, Man 317 (1901.) — *S. discolor* * *S. eriocephala* Andersson in Svensk. Vet.-Akad. Handl. vi. 85 (1867), excl. var. — *S. discolor* 1° *latifolia* Andersson in De Candolle, Prodr. xvi. 2 225 (1868). — *S. discolor* β ? *eriocephala* Andersson, l.c. 225. — *S. discolor* var. *eriocephala* Bebb apud Watson & Coulter, Gray's Man. ed. 6, 482 (1890) et auct. al. pro parte maxima. — *S. eriocephala amplifolia* Rydberg apud Britton, Man. 317 (1901).

There is a very obscure form mentioned by Andersson as *S. commixta* Andersson in Svensk. Vet.-Akad. Handl. vi. 84 (1867) in textu et apud De Candolle, xvi. 2 225 (1868) in textu, nomen nudum. In the last place Andersson says: formae quam *S. commixtam* appellavimus eximie similis, sed capsulae longius pedicellatae et stylus nullus!" Probably a hybrid.

Gandoger, Fl. Europ. XXI. 167 (1890), has made the following subspecies of *S. discolor*: *S. canadensis* (Type: lg. Fowler, Bass River, Canada), *S. imponens* (type: lg. Babcock, Riverside, Ill.), *S. Michauxiana* (type: lg.

Congdon, Warwick, R.I.), *S. stenocarpa* (type: lg. Pierron, Westmoreland, Pa.), and *S. stephanostigma* (type: lg. Congdon, Warwick, R.I.); their identity is uncertain to me not having seen the types.

S. discolor, including its main varieties, is widely distributed from New Foundland (where the glabrous form mentioned above occurs), Nova Scotia (Colchester, Haunts and Yarmouth Counties), Prince Edward Island (Prince and Summerside Counties), New Brunswick (Charlotte, Sunbury, Westmoreland, Kent and Restigouche Counties), Maine (Penobscot, Washington, Cumberland and York Counties), New Hampshire (Grafton and Cheshire Counties), Vermont (Caledonia, Addis, Rutland and Lamoille Counties), Massachusetts (Worcester, Berkshire, Hampshire, Essex, Middlesex, Suffolk, Norfolk, Bristol and Barnstable Counties), Connecticut (Fairfield and New London Counties), Rhode Island, New Jersey (Sussex, Passaic, Morris, Middlesex Essex and Bergen Counties), Pennsylvania (Lancaster and Berks Counties), Kentucky (locality uncertain, forma ad var. *latifolium* vergens, ex Herb. Chapman in M.), Ohio (Cuyahoga and Richland Counties), Indiana (Wells, Randolph, Shelby, Marion, Knox, White, Newton and Lake Counties), Illinois (Coos, Stark, Henderson, Lake and Winnebago Counties), Michigan (Wayne, Marquette, St. Claire and Houghton Counties, Isle Royale), Minnesota (Minneapolis County), Wisconsin (near Madison), Iowa (ex Ball in Proc. Iowa Acad. Sci. vii. 148 [1900]: Dickinson, Emmet, Cerro Gordo, Fayette, Delaware, Story, Clinton, Johnson, Scott and Henry Counties), Northeastern Missouri (Clark County), S. Dakota (Black Hills, see Ball in Bot. Gaz. lx. 398 [1915], partly doubtful to me), N. Dakota (Benson and Cumberland Counties), Saskatchewan (Qu'appelle, Quill Plain, Saskatoon and Cumberland Districts, and on Assiniboine River), E. Ontario (Carleton and Glengerry Districts), Manitoba (Lake Winnipeg), Quebec (? Pontiac, Algonquin, Ottawa, La Prairie, Stanstead, Chateaugay, Megantic, Rimouski and Gaspé Districts, Mingan Islands and Magdalen Islands).

2. *S. Scouleriana* Barratt apud Hooker, Fl. Bor.-Am. ii. 145 (1839), excl. foliis. — Howell, Fl. N. W. Coast, 619 (1902). — Piper in Contrib. U.S. Nat. Herb. xi. 214 (Fl. Wash.) (1906). — Ball apud Coulter & Nelson, N. Man. Rocky Mts. Bot. 138 (1909). — Rydberg, Fl. Rocky Mts. 195 (1917). — *S. Hookeriana* Nuttall, Sylva N. Am. i. 64 (1843), pro parte, non Barratt. — *S. flavescens* Nuttall l. c. 65, non Host, 1828. — Bebb in Bot. Gaz. vii. 129 (1882). — Macoun, Cat. Can. Pl. ii. 448 (1886); iv. 357 (1888). — *S. stagnalis* Nuttall, Sylva N. Am. i. 66 (1843). — *S. brachystachys* * *S. Scouleriana* Andersson in Svensk. Vet.-Akad. Handl. vi. 83, t. 5, fig. 48 [mala] (1867), excl. var. *crassijulis*. — ? *S. discolor* * *S. eriocephala rufescens* Andersson, l. c. 85 (1867). — *S. Nuttallii* Sargent in Gard. and For. viii. 463 (1895), excl. var. — *S. Scouleriana* var. *flavescens* Henry, Fl. S. Brit. Columb. 98 (1915).

The type of *S. Scouleriana* has been collected by Dr. Scouler "on the Columbia." According to Piper (Fl. Wash. 13) Scouler's "collections were

confined to the single season of 1825. During April and May he collected with Douglas mainly at the mouth of the Columbia and at Fort Vancouver." The type, of which I saw fragments and a photograph from Herb. Kew, has almost ripe fruits and young leaves. It probably has been collected in the beginning of May. Barratt also cites specimens of Tolmie from Vancouver. There is one from Barratt's herbarium in Herb. G. It consists of a fragment of a branchlet with female flowers and very young leaves, and of a male fragment which belongs to *S. sitchensis*. In the original diagnosis of *S. Scouleriana* the leaves, too, have been described but apparently there is no sterile type or co-type with mature leaves in existence, and Andersson states (1858): "in herbario Hookerii vidi specimina duo florentia ad *S. brachystachyam* Benth. absque ullo dubio pertinentia, et specimen *S. sitchensis* Sans." In 1867 he says, that these three specimens are "in una eademque charta agglutinata." The photograph before me only shows a specimen collected by Scouler which I regard as the type. The description of the leaves in Hooker's Flora certainly fits those of *S. sitchensis*; Barratt, therefore, must have had a specimen of this species with mature leaves which has been lost. Piper remarks that "Barratt's original types seem to be lost."

Andersson, in 1858, rejected the name *S. Scouleriana* because it is founded on two different species. There is however no reason to suppress the name, as the female specimen represents a good species. There is a possibility, already mentioned by Piper, that Scouler only collected a fruiting specimen, and that the mixture with *sitchensis* is due to Tolmie's plant of which I have spoken. Barratt and Hooker do not describe male flowers, and probably they have not seen Tolmie's male specimen or recognized that it belongs to a different species.

S. Scouleriana sensu stricto was described again by Nuttall in 1843 as *S. flarescens* and *S. stagnalis*. Of *S. flarescens* there is a co-type in Herb. G. consisting of one fragment with fruits and another with mature leaves. The first bears the label "*Salix* * *flarescens*. R. Mts. by streams." The young leaves partly show a thick flavescent opaque tomentose pubescence on the lower surface but appear to become later rather glabrous. They are oboval but the apex is wanting. The small leaflets of the fruiting ament are almost glabrous above and flavescent-silky beneath. The other fragment with mature leaves which are almost glabrous and brownish beneath might be taken for a co-type of Nuttall's second species, *S. stagnalis*. The oboval leaves measure up to 4:2 cm. The twigs of the season are finely pilose, the one year old branchlets glabrous and purplish. The type of *flarescens* came from the Rocky Mountains while that of *stagnalis* was collected on "the banks of the Oregon" Columbia. There is another specimen in Herb. G. collected by Nuttall "Columbia-woods," and named "*Salix cinerea* * *lagopus*." The name *cinerea* has been crossed out later, and above it is written *Hookeriana* Barratt. This seems to be *S. Hookeriana* Nuttall (Sylva, p. 64) sensu stricto. The specimen has folia utraque acuta, ad 10:7 cm. magna. The pubescence is the same as in the hairy form mentioned below, the aments are in bad condition.

The name *S. stagnalis*, so far as I know, has later been mentioned only by Bebb (1879) with a ? as a synonym of *S. flarescens*; it is not to be found in Andersson's or Ball's writings or in the Floras of Howell or Rydberg. Nuttall describes the leaves as "oblongo-lanceolatis, obtusis integerrimis basi cuneatis," and "scattered beneath with a minute brown pubescence, which communicates a somewhat rusty appearance to the leaves; they are about $1\frac{1}{2}$ inches long and $\frac{1}{2}$ to $\frac{3}{4}$ of an inch wide, and in the bud covered with long silky hairs."

In 1857, Bentham's *S. brachystachys* was published from *prope* Monterey in California, and a little later (1858) Andersson described his *S. capreoides* as well as Bentham's species. Bentham's type is Hartweg's No. 1957 of which I have seen a photograph and a fragment from Herb. Kew, and a co-type in Herb. G. Andersson's species is based on Coulter's No. 656 (he quotes the number in 1867) to which he adds in 1858, "et Oregon (Herb. Hook.)" without indicating the collector. This specimen may be identical with Cooper's male piece from Astoria which I have seen in Herb. G. Andersson has written on this sheet "*S. (brachystachys) capreaeformis*." The specimen belongs to the pubescent form mentioned later. In 1867 and 1868 Andersson does not again mention this specimen.

In my opinion, the types of *S. brachystachys* and *S. capreoides* belong to the same form. Bebb, in 1879, quotes both names as synonyms but he says (1882) that both have to be regarded as "striking modifications" of the variety (of *S. flarescens*) which he calls *Scouleriana*.

Andersson's treatment of these intricate forms has to be studied very carefully to understand the confusion which resulted from it. He ignored Nuttall's names *S. flarescens* and *S. stagnalis*, and he, too, rejected *S. Scouleriana* as a specific name. In his monograph (1867) he gave the following arrangement of forms under *S. brachystachys* to the type of which he referred specimens of Hartweg, Coulter and Scouler: subspec. * *S. Scouleriana* with the forms — *tenuijulis* And. (syn. *S. Scouleriana* Barr.) and — *crassijulis* And. (syn. *S. capreoides* And.) In 1868, Andersson repeats this but changes the subspec. *Scouleriana* to var. β *Scouleriana* with 1° *tenuijulis* and 2° *crassijulis*. His f. *tenuijulis* is nothing but typical *S. Scouleriana* because he quotes as types the specimens of Scouler and Tolmie. In 1868 he adds a specimen collected by Wrangel in California which I did not see, and which seems to belong to what I take for typical *flarescens*. Andersson's var. *crassijulis* is identical with his *S. capreoides*, and therefore with *S. brachystachys* sensu stricto.

In 1879¹ Bebb commenced his investigation of *S. Scouleriana*, rejecting this name and taking up *S. flarescens* Nutt. When he, in 1882, again dealt with the species of California he proposed to keep the name *S. flarescens* for the mountain form (Rockies, Sierra Nevada, mountains of Oregon and Washington), and proposed that the form of the coast, "should be arranged as a variety of that species for which the old name *Scouleriana* might well

¹ The reprint of Bebb's treatment of the Willows of Watson's Fl. Cal. appeared in 1879, though the second volume of Watson's work was not published until 1880.

be retained, and under which *S. brachystachys* Benth. and *S. capreoides*, And., would be placed as striking modifications." He does not say how to distinguish the last two forms but he states that they "exhibit an intricate diversity of forms which defy the drawing of any line between them." In 1895, Bebb decided not to use the name *Scouleriana* at all, and said "we, therefore, fall back upon *S. capreoides*, Anders., as next in point of date." Strange to say he did not apply the older name *S. brachystachys* which he himself had cited in 1879 as a synonym. By this Bebb almost more than Andersson added to the confusion in the nomenclature of the group of difficult forms which are now referred to *S. Scouleriana*. In 1895, Sargent stated that the name *S. flarescens* Nutt. could not be used on account of the older *S. flarescens* Host (of 1828), and he proposed the name *S. Nuttallii* overlooking entirely *S. stagnalis* Nuttall, and not considering *S. brachystachys* Bentham, while he transferred var. *capreoides* to *S. Nuttallii*. In his *Silva* (1896) Sargent kept *S. Nuttallii* with var. *capreoides* and var. *brachystachys* which he said was the "most abundant Willow in western Washington and Oregon." In doing so he used the name *brachystachys* for what for the most part is typical *Scouleriana* which is pictured on his plate 483.

Ball in dealing with our species in 1899, kept the name *S. flarescens*, and rejected *Scouleriana*. Besides the typical *flarescens* of the mountains he distinguished like Bebb the form of the coast as var. *capreoides* sensu Bebb. Coville in 1901 used the name *Nuttallii* "until a critical revision of these willows has been made." Howell (1902) and Piper (1906) took up the name *Scouleriana* again, and Ball followed them in 1909 and 1913. The last valuable remarks on this species were made by J. K. Henry (1915) whose treatment I shall discuss later.

From what I have already explained we may draw the conclusion that the oldest name is *S. Scouleriana*, and that if we reject it on account of its being a mixture of two species, *S. stagnalis* Nutt. would be the next oldest name to adopt. There is however no valid reason to abandon Barratt's name. Regarding the nomenclature of the varieties we have to adopt principles in accordance with the international rules.

The type of *S. Scouleriana* came from the northern coast (Vancouver), and that of *S. brachystachys* and *S. capreoides* from the Californian coast. If we separate, as Bebb and Ball (in 1899) did the mountain form (which is *S. flarescens* sensu stricto), this ought to be called *S. Scouleriana flarescens* because all the other varieties hitherto made including var. *tenuijulis* and var. *crassijulis* And. refer to the coast form. Unfortunately, Henry, in 1915, made the combination *S. Scouleriana flarescens* for a form which is "common on V.I."; therefore, his name does not apply to the mountain form.

S. Scouleriana has a wide range extending from the Yukon Territory through British Columbia and southern Alaska (to Cook Inlet), to the Black Hills in South Dakota, Colorado, New Mexico, and Arizona, and along the coast to southern California. It is easy to understand that within this range the species must show remarkable degrees of variation. Geographically these

forms are, however, not clearly separated. The variability seems to be the same in different localities, and Ball rightly states (1915) that it is "an immensely variable species especially as to foliage." J. K. Henry, having in mind in 1915 only the variations of typical *S. Scouleriana* in southern British Columbia, likewise asserts that the species is "very variable, presenting many ill defined forms." Apparently he made careful observations of these forms in the field, and besides the type he distinguished a var. *flavescens* (Nutt.). According to him the type is a small leaved form (folia 2.5-5 cm. longa) while his var. *flavescens* represents large leaved forms (folia 5-10 cm. longa). Of the last he says: "These are two recognizable forms of this var. (a) leaves prevailing obovate and obtuse, 4-6 cm. broad, common on V.I. (b) Leaves prevailing oblanceolate and acute; but the two intergrade." In 1899 Ball as already stated was inclined to separate the coast form from that of the mountains, the last being identical with the typical *S. flavescens*; in 1909, however, he only says: "Forms with short stout aments may be referred to var. *crassijulis* Anders." but he does not mention other forms.

It is extremely difficult to analyze correctly the different forms of such a variable species. It would be an easy task to describe as many varieties as have for instance been made of the European *S. nigricans*, but nothing could be gained by doing this. We need many more careful observations in the field, and much more material collected from the same individual at different seasons of the year from every part of its habitat. We are far from having a good idea of the variability of the individual plant and of its adaptability to certain ecological and climatic conditions. The differences in the flowers (size of the aments, glabrousness or pubescence of the filaments, size and color of the anthers, length of the stigmas and of the style, length of the pedicel, etc.) do not seem to afford very reliable characters on which to base varieties or even forms. The pubescence of the twigs and leaves which often looks so distinct, at least in the herbarium, is changeable in the same plant according to the season or locality; and I am far from being able to decide the taxonomic value of these variations.

It is not less difficult to apply certain names to certain forms. As may be seen by what has been said and by the synonymy given above, a good many combinations have already been made. Several of them apply to identical forms. The oldest varietal name var. *tenuijulis* Anders. is synonymous with typical *S. Scouleriana*, while var. *crassijulis* Anders. can only be used for the form which is identical with the typical *S. capreoides* which moreover is nothing but *S. brachystachys* Benth.

I have already mentioned that the name var. *flavescens* has been applied by Henry in 1915 to a form which apparently is not the *S. flavescens* of Nuttall, but probably typical *S. Scouleriana* or at least a form of it. Nuttall's *flavescens* may be a form of the mountains which, at present, I cannot clearly distinguish from the northern coastal form. Nuttall's *S. stagnalis* from the Columbia in Oregon seems to agree with typical *S. Scouleriana*, Henry's small-leaved form. Here the leaves are indeed, as Nuttall says, "scattered

beneath with a minute brown pubescence" while of *S. flavesceus* Nuttall states: "For a good while the leaves still remain downy, particularly on the under surface, which is tinged also with pale yellow." After all, however, I cannot find that both kinds of pubescence indicate two really different forms because in several specimens before me the older (lower) leaves agree with the description of *S. stagnalis*, while the younger (upper) leaves have the pubescence of *S. flavesceus*.

Among the specimens from the Yukon Territory there are some with very tomentose branchlets of the preceding year of which the (not yet quite mature) leaves bear a thick soft pubescence on the lower surface. On other specimens the pubescence of the branchlets seem to disappear, and the leaves soon become glabrescent while, too, there are forms with quite glabrous branchlets of the previous year and with quickly glabrescent leaves which finally show only a thin pubescence of minute gray and brownish hairs on the lower surface.

The extremes of those forms are indeed very unlike each other, but there are apparently many intermediates between them. Henry expressly states that the leaves "in moist situations often remain tomentose beneath, in drier becoming silky and finely brown beneath." Piper, already in 1906, emphasized the fact that *S. Scouleriana* is "an exceedingly variable species as to foliage and habit, but in the floral characters apparently not capable of being divided."

The main variation in the female flowers is in the length of the style which mostly is somewhat hairy, and in the length of the stigmas which varies from 1 to 2 mm. We do not yet know whether these variations correspond with others in the leaves or in other parts of the plant. Sometimes the pedicel is as long as the bract, but there is no other indication of an influence of *S. Bebbiana*. The male flowers seem normally to have glabrous filaments or rarely a few hairs at their base. Whether forms with filaments hairy up to half of their length (which seems to be often the case with late flowers) can be separated I have not been able to make out. Of the color of the anthers Miss Eastwood says in a field note of the Yukon forms: "Some bushes have yellow anthers and some have red. The former have yellow catkins before the anthers open and the latter red. The same difference in color holds in the pistils." I have never seen purple anthers in the forms of other regions except in one specimen (L. E. Smith, no. 574) from Sisson, California.

At present I do not retain more than two varieties of *S. Scouleriana*. One is the type (*S. brachystachys Scouleriana tenuijulis* Andersson) apparently figured by Sargent (Silva, t. 482) which according to the type specimen is characterized as follows: ramulis floriferis dense villosulo-tomentosis, foliis juvenilibus distincte ferrugineo-pilosis, amentis femineis submaturis circ. $3\frac{1}{2}$ cm. longis, circ. 12 mm. crassis, ovariis stylo circ. 0.5 mm. longo plusminusve distincto, stigmatibus siccis circ. 1 mm. longis, pedicellis glandulam 2-plo superantibus, circ. 1.5 mm. longis, fructibus maturis circ. 6-7 mm. longis. As to the leaves I can only say that while they seem to become very

glabrous when mature they still show a minute brown pubescence on the lower surface. The branchlets are more or less slender, brown-red, and those of the preceding year may be rather glabrous or show only remnants of pubescence. The male flowers apparently have glabrous filaments like those of specimens collected by Spreadborough at Departure Bay, V.I.

Of this typical variety forms with very small oblanceolate leaves and others with very short and small aments are frequently found. Besides these there is the form called var. *flavescens* by Henry which is as I have already explained probably not Nuttall's *flavescens*. I have named it in different herbaria var. *poikila*¹ but I am not sure whether it really is more than an ecological form. It is characterized by foliis superioribus saepissime ultra 6 ad 10-12 cm. longis, oblongioribus saepe utrinque acutis, subtus magis tomentosis vel griseo-pilosis, amentis satis crassioribus longioribusque, stigmatibus plusminusve distincte sessilibus 1.5-2 mm. longis. Such forms I have seen from Washington, British Columbia, and the Yukon Territory. There are somewhat similar specimens before me from Utah (Ogden Canyon). Very often offshoots of the typical form show the same characters of the leaves.

A more distinct variety seems to be

S. Scouleriana var. *crassijulis*, comb. nov. — *S. brachystachys* Benth., Pl. Hartweg, 336 (1857). — (*S. Caprea* *) *Capreoides* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 120 (1858); in Proc. Am. Acad. iv. 60 (Sal. Bor.-Am. 14) (1858); in Walpers, Ann. Bot. v. 748 (1858), pro specie. — *S. brachystachys* * *S. Scouleriana crassijulis* Andersson in Svensk. Vet.-Akad. Handl. vi. 83 (Monog. Salic.) (1867). — *S. brachystachys* ♂ *Scouleriana* ♀ *crassijulis* Andersson apud De Candolle, Prodr. xvi.² 225 (1868). — *S. flavescens* var. *capreoides* Bebb in Gard. & Forest, viii. 373 (1895). — *S. Nuttallii* var. *capreoides* Sargent in Gard. & Forest, viii. 463 (1895). — *S. Nuttallii* var. *brachystachys* Sargent, Silva, ix. 142, t. 483 (1896). — *S. Scouleriana* var. *brachystachya* (!) Jones, Willow Fam. 15 (1908). — It may be briefly characterized as follows: frutex vel arbor ramis satis brevibus divaricatis tortuosis, etiam ramulis vetustioribus plusminusve tomentellis; ramuli hornotini annotinique satis tomentosi; folia satis parva, obovata, vix ultra 6:3 cm. magna, subtus plusminusve dense pubescentia (saltem juniora, adultiora satis rufescenti-pilosa); amenta fructifera ad 4:1.7 cm. magna, styli subnulli stigmatibus circ. 1.5 mm. longis ultra 4-plo breviores; filamenta glabra vel basi sparse pilosa; fructus fere 8 mm. longi pedicello ad 2 mm. longo excluso.

This variety seems to be restricted to California (Santa Cruz, Monterey, and probably San Bernardino County) but some forms from Oregon (for instance Sheldon's no. 11627-8, Portland) look very similar. There may be intermediates between var. *typica* and var. *crassijulis* and the forms of the Rocky Mountains from British Columbia to New Mexico and of the Sierra Nevada which represent the typical *S. flavescens*. In 1899 Ball distinguished the typical *S. flavescens* from var. *capreoides* Bebb which is our

¹ Derived from *ποικίλος*, intricate, changeable.

var. *crassijulis*, and the typical *S. Scouleriana*, but later he apparently changed his mind.

I do not wish by any means to make a definite statement as to the possibility of circumscribing with sufficient accuracy the varieties mentioned. The purpose of my lengthy explanations is only to show how little we really know and how difficult it is to come to a proper understanding of a species like *S. Scouleriana*. I have seen material from the following states and counties: Alaska (Cook Inlet, Admiralty, Skagway and Guard Island); Yukon Territory (Dawson to Lake Bennett); British Columbia (Vancouver Island, New Westminster, Yale, Kootenay and Cassiar Districts); Alberta (Rocky Mountain District); Saskatchewan (Cypress Hills); Washington (San Juan Islands, King, Pierce, Klickitat, Douglas, Wallawalla, Adams, Columbia, Kittitas, Whitman, Spokane, Whatcom and Chelan Counties); Oregon (Clatsop, Multnomah, Morrow, Marion, Polk, Klamath, Coos, ? Jackson and Josephine Counties); California (Humboldt, Siskiyou, Nevada, Plums, Placer, Amador, Madera, Monterey, Santa Clara, Marin, Santa Cruz, Alameda, ? Mendocino, Fresno, San Bernardino and Inyo Counties); Montana (Missoula, Deer, Lodge and Gallatine Counties); Wyoming (Yellowstone Park, Fremont, Sweetwater, Sheridan, Crook and Albany Counties); South Dakota (Lawrence County); Nevada (Ormsby and ? Washoe Counties); Colorado (Laramie, Boulder, Clear Creek, Teller, Ouray, Costilla, Montrose and La Plata Counties); New Mexico (Otero, Sierra, Union and Santa Fé Counties), and Arizona (Coconino and Pima Counties).

3. *S. paradoxa* Kunth in Humboldt & Bonpland, Nov. Gen. Pl. II. 20 (1817). — This Mexican species has been dealt with in my first article in Bot. Gaz. LXV. 35 (1918). It needs further observation.

4. *S. oxylepis* Schneider, Bot. Gaz. LXV. 34 (1918). — *S. latifolia* Martens & Galeotti in Bull. Acad. Brux. x. pt. 1, 344 (1843), non Forbes (1829). — This is another little known Mexican species.

5. *S. Rowleei* Schneider in Bot. Gaz. LXV. 31 (1918). — *S. cana* Rowlee l. c. XXVII. 137 (1899), pro parte, non Martens & Galeotti. — This is a third Mexican species of close relationship to the other two, and like these very badly known. Those three species apparently belong to the same group as *S. discolor* and are rather closely related to *S. Scouleriana*. Not having seen enough material I at present refrain from explaining the differences between the Mexican and northern species.

b. THE SPECIES OF THE SECTION GRISEAE.

This section was established by Borrer who referred to it as the only species *S. petiolaris* Smith. Barratt enlarged it to contain, in addition to *S. petiolaris*, "*S. rosmarinifolia* L." which is *S. sericea* Marshall; *S. coactilis* Fernald is closely related to the last. The two other species added here: *S. humilis* and *S. tristis* were placed by Barratt (1840) in his section *Cinereae* which name he used in 1838 (apud Hooker) for species like *S. candida*, *S. Drummondiana* and others which I have dealt with before. The name,

however, had been applied by Borrer in 1830 to a group of European Willows which to-day is known as sect. *Capreae*.

I do not wish to say that the group of *S. petiolaris* and *S. sericea* and that of *S. humilis* are so closely connected that they have to be united in one section but there is a great similarity in the floral characters of both.

Possibly even *S. Lemmonii* might be placed in this section, but it seems in some respect to have a closer relationship with the species of section *Fulrae* of which I shall speak in my next note. The synonymy of section *Griseae* is as follows:

Sect. *Griseae* Borrer apud Hooker, Brit. Fl. 419 (1830). — Barratt apud Hooker, Fl. Bor.-Am. II. 148 (1839); Sal. Am. (1840) sect. 3. — Sect. *Cinereae* Barratt, l. c. sect. 1, non Borrer 1830, nec Barratt 1838. — Sect. *Argenteae* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 126 (1858), pro parte, non Koch. — Sect. *Argenteae* s. *Repentes* Andersson in De Candolle, Prodr. XVI.² 233 (1868), pro parte. — Sect. *Repentes* Zabel apud Beissner, Schelle et Zabel, Handb. Laubholz-Ben. 31 (1903). — Sect. *Argenteae*, subsect. *Repentes* Schneider, Ill. Handb. Laubh. I. 64 (1904), pro parte.

In a key I shall show later the differences between the groups and also between the species.

1. *S. sericea* Marshall, Arbust. Am. 140 (1785); Cat. Arb. Arbriss. 223 (1788). — Muhlenberg in Neue Schr. Ges. Nat. Fr. Berlin, IV. 240, t. VI. fig. 8 (1803). — Carey apud Gray, Man. 426 (1848). — Andersson in Proc. Am. Acad. IV. 66 (Sal. Bor.-Am. 21) (1858). — Bebb apud Watson & Coulter, Gray Man. ed. 6, 483 (1890). — Macoun, Cat. Am. Pl. 455 (1886). — Britton & Brown, Ill. Fl. I. 499, fig. 1188 (1896); ed. 2, 598, fig. 1469 (1913). — Ball in Proc. Iowa Acad. Sci. VII. 149, t. 12, fig. 10 (1900); in Elys. Mar. III. 30, t. VI. fig. b. (1910). — Schneider, Ill. Handb. Laubh. I. 64, fig. 15 g, 21 m-m' (1904). — Britton, Man. 318 (1905). — Porter, Fl. Penn. 101 (1903). — Griggs in Proc. Ohio Acad. Sci. IV. 302, t. 11 (1905). — Robinson & Fernald, Gray's Man. ed. 7, 326, fig. 662 (1909). — Von Seemen apud Ascherson & Graebener, Syn. Mitteleur. Fl. IV. 130 (1909). — Schaffner in Bull. Ohio Biol. Surv. I. 199 (Cat. Ohio Vasc. Pl.) (1914). — *S. grisea* Willdenow, Sp. Pl. IV. 699 (1805). — Pursh, Fl. Am. Sept. II. 616 (1814). — Poiret in Lamarck, Enc. Suppl. VI. 64 (1817). — Barratt, Sal. Am. no. 10 (1840). — Koch, De Sal. Eur. Comm. 21 (1828), excl. var. — Loudon, Arb. Brit. III. 1533 (1838). — Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 126 (1858). — *S. argentea* Dumont de Courset, Bot. Cult. ed. 2, VI. 395 (1811), doubtful. — ? *S. rosmarinifolia* Pursh, Fl. Am. Sept. II. 612 (1814), non Linneaus. — Elliott, Sketch Bot. II. 668 (1824). — *S. pennsylvanica* Forbes, Salic. Wob. 189, t. 95 (1829). — *S. petiolaris* var. *grisea* Torrey, Fl. N. York II. 207 (1843). — *S. petiolaris* * *S. sericea* Andersson in Svensk. Vet.-Akad. Handl. VI. 110, t. VI. fig. 61 ** (Monog. Salic.) (1867). — *S. petiolaris* €, *sericea* Andersson apud de Candolle, Prodr. XVI.² 235 (1868.)

This species was described in 1785 by Marshall in a short but sufficient manner. The type probably came from Chester County, Pennsylvania.

In 1803, Muhlenberg gave a more detailed description adopting Marshall's name. Willdenow in 1805 changed the name to *S. grisea*, and retained *S. sericea* of Villars (1789), which represents a European form very closely related to *S. glauca* Linnaeus. Pursh (1814) kept Willdenow's name, but he also has a *S. rosmarinifolia* which has nothing to do with Willdenow's plant whom he quotes as author. It is, in my opinion, a form of *S. sericea*, growing "in wet meadows and mountain swamps: Pennsylvania to Carolina."

A rather obscure Willow which may belong to *S. sericea* is *S. argentea* of Dumont de Courset (1811) which is said to be a North American plant, and of which the author gives the following account: "Arbrisseau de 2 à 3 pieds; les branches et les rameaux bruns, courts et fermes. Feuilles ovales-lanceolées, soyeuses et argentées des deux côtés, plus grandes que celles des espèces précédentes [*incubacea*, *fusca*, *rosmarinifolia*]. Lieu. L'Amérique sept. Cette espèce ne me paroît être qu'une variété de la 19 [*lanata*] ou de la 20 [*lapponum*]."

Forbes (1829) does not mention *S. grisea*, and the plant he figures as *S. sericea* apparently is a form very similar to Villars' species. He, however, has a *S. pennsylvanica* which probably is nothing but *S. sericea*. This was also the opinion of Borrer, as quoted by Loudon (1838) under *S. grisea*. Barratt also used this name in 1840, and he, too, cites Forbes' species as a synonym. Carey (1848) took up Marshall's name which has been accepted by all later botanists.

Torrey (1843) made *S. sericea* a variety of *S. petiolaris* under the name var. *grisea*. Andersson (1858) used probably by mistake the name *S. grisea* and quoted Marshall as the author and Gray's Manual. In Sal. Bor.-Am. Gray corrected this mistake. In 1867, Andersson made *S. sericea* a kind of subspecies of *S. petiolaris* and expressed himself as follows in regard to its relationship: "Est forma sat singularis e nostratibus *S. viminali* et *S. fragili* subsimilis, ex americanis *S. petiolaris* maxime affinis." In 1868 he changed the subspecies to a variety of *S. petiolaris*.

S. sericea is certainly closely related to *S. petiolaris* but it is not difficult to separate the two species, as already stated by Griggs (1905). The closest relationship with *S. sericea* is found in *S. coactilis* which, however, so far as I can judge by the material before me, differs in the coarser teeth of its leaves, the somewhat larger fruits and in the glabrous pedicel. See also my remarks under this species and under *S. petiolaris*.

I have seen material of *S. sericea* from the following states: New Brunswick; Maine (Aroostook County); Vermont (Caledonia and Lamoille Counties); Massachusetts (widely spread); New York (frequent); Pennsylvania (Chester, Bedford and York Counties); Connecticut, Rhode Island, New Jersey, Maryland, District of Columbia, northern Virginia, West Virginia (Randolph and Pocahontas Counties); North Carolina (Polk, Macon, Mitchell, Orange and Durham Counties); South Carolina (Oconee County); Kentucky (near Louisville); Ohio (according to Schaffner "general"); Indiana (Randolph, Hancock, Floyd, Grant, Jackson, Hamilton, Lagrange, Knox and

Davies Counties); Illinois (little material seen); Missouri (St. Louis, Cape Girardeau, Iron and Wayne Counties); Iowa (eastern part); Michigan (neighborhood Flint County).

2. *S. coactilis* Fernald in *Rhodora*, viii. 21 (1906).—This species has been well described by Fernald, and is as yet only known from Penobscot County in central Maine. I cannot add anything of value to Fernald's statements except that according to my observations the pedicel is only twice (not about five times) as long as the gland as is also the case in typical *S. sericea*. Fernald says that "the shrub of central Maine is in the shape of its capsule and its distinct style as closely related to the arctic-alpine *Salix argyrocarpa* Anders. as to *S. sericea*." Unfortunately the male plant of *S. coactilis* is still unknown; it would be of great interest to ascertain whether the flowers have one gland as in *S. sericea* or two as in *S. argyrocarpa*. After all it seems to me much more closely related to *S. sericea* than to the latter species.

3. *S. petiolaris* Smith in *Trans. Linn. Soc. Lond.* vi. 122 (1802); *Engl. Bot.* xvi. t. 1147 (1803); *Fl. Brit.* iii. 1048 (1804); *Engl. Fl.* iv. 181 (1828). — Willdenow, *Spec.* iv. 665 (1805). — Pursh, *Fl. Am. Sept.* ii. 616 (1814). — Poiret in Lamarek, *Enc. Suppl.* vi. 57 (1817). — Forbes, *Salic. Wob.* 45, t. 23 (1829). — Hooker, *Brit. Fl. ed. 3*, i. 423 (1835). — Loudon, *Arb. Brit.* iii. 1533 (1838). — Carey apud Gray, *Man.* 483 (1843). — Andersson in *Öfv. Svensk. Vet.-Akad. Förh.* xv. 126 (1858); in *Svensk. Vet.-Akad. Handl.* vi. 108 (Monog. *Salic.*) (1867), excl. var. pro parte; in De Candolle, *Prodr.* xvi.² 234 (1868), excl. var. pro parte. — Macoun, *Cat. Can. Pl.* iii. 453 (1886) pro parte. — Britton & Brown, *Ill. Fl.* i. 500 fig. 1189 (1896); ed. 2, i. 599, fig. 1470 (1913). — Britton, *Man.* 318 (1901). — Schneider, *Ill. Handb. Laubh.* i. 64, fig. 19 c, 20 t-t' (1904). — Robinson & Fernald, *Gray's Man. ed. 7*, 326 fig. 662 (1908). — *S. grisea* β *subglabrata* Koch, *De Salic. Comm.* 21 (1828). — *S. petiolaris* l. *rigida* f. *longifolia* Andersson in *Svensk. Vet.-Akad. Handl.* vi. 109 (1867); in De Candolle, *Prodr.* xvi.² 234 (1868). — *S. petiolaris* β *rigida* 3 *brevifolia* Andersson, l. c. 234 (1868).

This species was described in 1802 by the well-known English salicologist J. E. Smith who published a good picture of it in 1803. At first he said "this species has not been found wild in Norfolk, but was sent to Mr. Crowe by Mr. Dickson along with the last, as of British growth," while in 1803 he states: "for this new species of *Salix* we are obliged to Mr. Dickson who found it in some part of Great Britain, the exact place is not remembered, and sent it in a growing state to Mr. Crowe. We only know the female which is a small spreading tree." Pursh (1814) declared that "it has been by mistake adopted as a native of Great Britain." Smith however in 1828 thought it possible that it might grow in Europe, and that the statements that it had been found in Scotland "are not likely to be erroneous." Hooker mentions the species in 1835 but says, "I have never seen native specimens." Loudon who in 1838 quotes these different opinions says: "Mr. Borrer had formerly both sexes growing at Henfield having received the male from Mr.

G. Anderson." How this plant came to England has never been exactly explained. It is not mentioned in later books on the English flora.

Koch (1828) made *S. petiolaris* a var. β *subglabrata* of *S. grisea* using *grisea* for *S. sericea*. Andersson (1858) mentioned it only briefly, while in 1867 he distinguished the varieties *rigida* and *subsericea*. The last is now generally regarded as a hybrid between *S. petiolaris* and *S. sericea*. Of the first Andersson described two forms: *f. latifolia* and *f. longifolia* but he does not cite any specimens. His diagnosis of *f. latifolia* runs: "foliis 2-3 poll. longis, basi latiori subrotundatis, infra medium $\frac{3}{4}$ -1 poll. latis, subito cuspidatis, argute serratis, rigidissimis, subtus valde intense glaucis. Haec forma non raro modificationibus *S. lucidae* aut *S. discoloris* similis est ob folia basi sat lata et subito acuminata, rigida et sublucida; sed facile distinguitur amentis longe alienis." I have not seen a specimen really agreeing with this description, to which Andersson in 1868 adds that the leaves are "aut valde intense glaucis aut pure et lucide viridibus." He probably confused different plants. Andersson's *f. longifolia* is nothing but the typical *S. petiolaris*, and he himself says in 1868 "haec fere typica." In 1867, his variety consists of forms with leaves lustrous silky beneath "ut *S. discolor*," and others with glabrous leaves. In the Prodrômus he adds a *f. brevifolia* with shorter leaves (1-2 inches long, instead of 3-4 inches as in *f. longifolia*) which are hardly $\frac{1}{2}$ inch wide. I do not think this is a form of any taxonomic value.

In 1858 Andersson described a *S. gracilis*, from specimens collected by Drummond and Richardson in Saskatchewan to which he cites as a synonym *S. rosmarinifolia* Hooker (1839). The type of this willow is Richardson's specimen from Cumberland House (Hooker says only Saskatchewan). There is a co-type of it in Herb. Barratt. Andersson also named Richardson's no. 387 (Herb. K.) *S. gracilis* which is called by Richardson *S. purpurea*. Hooker, too, cites *S. purpurea* from "Cumberland House Fort, Dr. Richardson." Besides this Andersson himself named *S. gracilis* a species of Drummond's from Saskatchewan in Herb. K. All these specimens agree well with each other. From typical *S. petiolaris* they chiefly differ in their more linear leaves (according to Andersson "latitudine fere decies longioribus") and in their longer pedicels (about 4 mm. long instead of 3 mm.); the whole aspect of the plant therefore is a little different. In 1858, Andersson speaks of *S. gracilis* as "quasi hybridae *S. vagante* [*S. Bebbiana*] et *S. myrtilloide* [*S. pedicellaris*]," while in 1867, regarding *S. gracilis* as a kind of subspecies of *S. petiolaris* he more correctly remarks: "Habitu a *S. petiolaris* majori et typica valde recedit sed modificationibus permultis cum ea intime connexa est. Indumentum foliorum idem, ut etiam capsularum, sed forma in hac angustior magisque elongata. Ramis in forma arbusculae humilis erectis, foliis angustis et amentis primum subglobosis habitum *S. rosmarinifoliae* nostrae prae se fert, sed ab ea luculenter differt capsulis longissime pedicellatis."

Andersson, in 1858, also made a var. *rosmarinoides* of *S. gracilis* which differs only in its "foliis apicem versus serrulatis in *gracilis* integerrimis marginibus acutiusculis, subrevolutis." This sentence apparently should

run: foliis acutiusculis . . . margine subrevolutis. The type of it came from "Durham County." To this statement Gray (Sal. Bor.-Am. p. 22) has added "New Jersey." So far as I know there are two counties of this name in North America, one in Ontario, the other in North Carolina. In New Jersey there is only a village named Durham. Andersson's form probably came from Ontario, certainly not from North Carolina. He says of it: "Varietas, ut etiam nostra, *S. gracilis* '*S. rosmarinifolia* Barratt' inscripta, multo magis ad *S. rosmarinifoliam* veram accedit. Ostant autem capsulae longissime pedicellatae." Of this form I have had a fragment before me, and on the photograph of the type of *S. gracilis* there can be seen part of the type of var. *rosmarinoides*. I cannot distinguish it from typical *gracilis* which has entire or more or less serrate leaves. In 1867 Andersson does not even mention var. *rosmarinoides* or the specimen from Durham County. He refers to *S. gracilis* a specimen from "ad Milwaukee (Lapham)," and this fact proves that he also referred to his *gracilis* specimens of a more southern origin.

In 1868 Andersson somewhat changed his opinion by describing besides var. *gracilis* a var. *angustifolia* without mentioning var. *rosmarinoides*. The type of var. *angustifolia* is "*S. rosmarinifolia* Barratt (Hb. Hook.) et Hook. Fl. Boreal-amer. 2. p. 148 pp." It is characterized by "foliis anguste lanceolatis fere linearibus margine tenuiter serrulatis v. subintegris" and he says of it: "Haec quae regiones magis septentrionales praecipue incolit, nostrae *S. rosmarinifoliae* sat similis, sed differt foliis subserratis, capsulis longius pedicellatis et habitu! Ad sequentem transitum evidentissimum effecit et ab ea difficillime distinguenda; e contrario in formas minus latifolias et rigidas *S. petiolaris* sensim confluit." The "following" variety is var. *gracilis* which, indeed, can be distinguished only "difficillime" or better not at all from var. *angustifolia*. This last form certainly is identical with var. *rosmarinoides* of 1858, and this is another instance of Andersson's changing of names without even quoting again his former denominations. Now, if we take *gracilis* for a variety of *S. petiolaris* we must use the name *rosmarinoides* for it. Barratt, to be sure, had already made a *S. petiolaris* var. β *angustata* in 1840 (Sal. Am. sub no. 9), and he says of the typical *petiolaris* "there are several varieties of it; some with narrower leaves," but he had in mind only forms of Pennsylvania and New York. Therefore, this var. *angustata* refers to narrow leaved forms of the type which have longer fruiting aments with more crowded fruits with pedicels up to 3 mm. in length. Such forms have been distributed by Bebb in his Herb. Salic. under nos. 28 and 29; they seem to unite the type with var. *rosmarinoides*. Of this variety the type shows a few stomata in the upper epidermis of the leaves, something which I have not observed in other specimens.

In the forms of typical var. *rosmarinoides* the under surface of the leaves is always glabrous or almost so (with exception perhaps of the very youngest leaves) while the upper surface is more or less hairy. There occurs, however, in Maine and Quebec a form of which the young leaves (at least partly)

bear a rather conspicuous pubescence of silvery or fuscous silky hairs on their lower surface. The mature leaves of this form seem to become glabrous (at least partly) like those of var. *rosmarinoides*, and I doubt whether it can be kept as a separate variety under any name but var. *rosmarinoides*. It is the same form which is called *S. petiolaris* var. *angustifolia* by Fernald & Wiegand (in *Rhodora* XII. 137 [1910]).

Andersson, in 1868, distinguished two forms of var. *gracilis*: 1° *sericocarpa*, capsulis anguste conicis $2\frac{1}{2}$ lin. longis tenuiter sericeis, and 2° *lejocarpa*, capsulis basi crassioribus glaberrimis viridi-testaceis. He does not cite any specimen, and I have not yet seen a specimen with entirely glabrous fruits. These are often, as Andersson in 1867 states in regard to *gracilis*, only "parcissime pubescentibus," but the pedicel always is minutely pubescent. Therefore I cannot say whether there is a real f. *lejocarpa* or not.

The synonymy of var. *rosmarinoides* and its taxonomic characters are as follows:

S. petiolaris var. *rosmarinoides*, comb. nov. — *S. purpurea* Richardson apud Franklin, Narr. Jour. Polar Sea, 752 (Bot. App. VII. 24, no. 387) (1833), fide specimen originale, non Linnaeus. — Hooker, Fl. Bor.-Am. II. 148 (1839). — *S. rosmarinifolia* Hooker, l. c., non Linnaeus. — *S. gracilis* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 127 (1858). — Rydberg, Fl. Rocky Mts. 195 (1917). — *S. petiolaris* * *rosmarinoides* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 127 (1858). — *S. petiolaris* * *S. gracilis* Andersson in Svensk. Vet.-Akad. Handl. VI. 109 (Monog. Salic.) (1867). — *S. petiolaris* γ *angustifolia* Andersson in De Candolle, Prodr. XVI.² 234 (1868), pro parte. — Fernald & Wiegand in *Rhodora*, XII. 137 (1910). — *S. petiolaris* δ *gracilis* Andersson in De Candolle, l. c. 235 (1868), excl. prob. f. *lejocarpa*. — Macoun, Cat. Can. Pl. III. 453 (1886). — *S. petiolaris* Rydberg, Fl. Rocky Mts. 195 (1917), pro parte minima. — A typo praecipue differt: foliis angustioribus, plusminusve lineari-lanceolatis vel linearibus, saepe subacuminatis, basi acutioribus, integerrimis vel plerisque tantum partim (saltem ad apicem) minute denticulatis, saepissime 3: 0.5 ad 6: 0.7–0.8 cm., in ramulis vegetioribus ad 7.5: 1–1.3 cm. magnis, subtus initio satis fulvo-sericeis, demum glabris glaucis vel in forma sericeo-pilosa utrinque plusminusve sericeis (pilis argenteis saepe cum fulvis mixtis); amentis fructiferis subbrevioribus, crassioribus et minus laxifloris, vix ultra 3: 1.8–2 cm. magnis, fructibus 7–9 mm. longis, pedicello 3–4 mm. longo excluso.

Of typical *S. petiolaris* I have seen specimens from the following states: New Brunswick (St. Stephen), Massachusetts, New York, New Jersey, Pennsylvania, Ohio, Indiana, Michigan, Minnesota, Ontario, Manitoba (West Selkirk, Lake Winnipeg), and Saskatchewan (Cumberland House).

To var. *rosmarinoides* I refer specimens from Alberta, Saskatchewan, Ontario, Quebec and Maine. Some forms from Maine need further observation. There is also a specimen from British Columbia (Cache Creek May 23, 1875, J. Macoun, no. 24,700, O.; f.) which I am not able to determine at present.

4. *S. humilis* Marshall, Arbust. Am. 140 (1785); Cat. Arb. Arbriss. 223 (1788). — Carey apud Gray, Man. 425 (1848). — Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 126 (1858); in Svensk. Vet.-Akad. Handl. vi. 110 t. vi. fig. 62 (Monog. Salic.) (1867), excl. var. pro parte et sub-spec. *Hartwegii*; in De Candolle, Prodr. xvi.² 235 (1868), excl. form. pro parte et var. *Hartwegii*. — Bebb apud Watson & Coulter, Gray's Man. ed. 6, 483 (1890). — Ball in Proc. Iowa Acad. Sci. vii. 148, t. 11, fig. 7 (1900); in Elys. Marian. iii. 35, t. 7, fig. c (1910). — Britton & Brown, Ill. Fl. i. 498, fig. 1185 (1896); ed. 2, i. 600, fig. 1473 (1913). — Britton, Man. 317 (1901). — Robinson & Fernald, Gray's Man. ed. 7, 326, fig. 660 (1908), excl. var. — *S. conifera* Wangenheim, Beytr. Forstw. Nordam. Holzart. 123, t. 31, fig. 72 (1787), pro parte; Willdenow, Spec. Pl. iv. 705 (1805) pro parte; Berlin. Baumzucht, ed. 2, 455 (1811) pro parte. — Muhlenberg in Neue Schr. Ges. Nat. Freunde Berlin, iv. 240 (1803). — Elliott, Sketch Bot. ii. 669 (1824). — Pursh, Fl. Am. Sept. ii. 612 (1814), pro parte. — ? *Salix* spec. Schoepf, Mat. Med. Am. 147 (1787). — ? *S. flava* Gmelin, Syst. Nat. (Linn. ed. 13) ii. 74 (1791). — *S. occidentalis* Walter, Fl. Carol. 243 (1788). — *S. tristis* Muhlenberg in Neue Schr. l. c. 241 (1803), pro parte et quoad t. vi. fig. 9, non Aiton. — *S. Mühlenbergiana* Willdenow, Sp. Pl. iv. 693 (1805), pro parte minima. — *S. Mühlenbergiana* Pursh, Fl. Am. Sept. ii. 609 (1814), excl. synonym. ex parte. — Elliott, Sketch Bot. ii. 667 (1824) excl. syn. Walter. — Forbes, Salict. Wob. 278 (1829), an excl. fig. 145?. — Torrey, Fl. N.Y. ii. 205 (1843). — Barratt, Sal. Am. no. 1 (1840), prob. excl. var. pro parte. — *S. humilis longifolia* Andersson in Svensk. Vet.-Akad. Handl. vi. 111 (1867), excl. formis pro parte; in De Candolle, Prodr. xvi.² 236 (1868), excl. formis pro parte. — *S. humilis angustifolia* Andersson in Svensk. l. c. (1867) excl. formis; in De Candolle, l. c. (1868), excl. formis. — ? *S. tristis glabrata* Andersson in Svensk. l. c. 113 (1868); in De Candolle, l. c. 237 (1868).

This species was described by Marshall as follows: "This seldom rises above three or four feet, with greenish, somewhat downy stalks. The leaves are larger than the other kinds [*nigra*, *sericea*] entire, oblong, somewhat oval, and glaucous or whitish underneath. There are some varieties of larger growth, belonging either to this or the last mentioned kind" [*sericea*]. There is no doubt that this description can only be applied to what we now call *S. humilis*. Two years later Wangenheim published his *S. conifera* restricted to *S. discolor* by Willdenow in 1796. Wangenheim's figure, as I explained already under *S. discolor*, is very inaccurately drawn, and his diagnosis partly fits *S. discolor* (12 to 15 feet high), partly *S. humilis* (foliis ovato-lanceolatis acutis . . . subtus tomentosis), as also does his remark "sie haben kurze Blattstiele." He speaks of 2 to 7 stamens which must be an erroneous statement. So far as I can judge by his description he had before him either *S. discolor* var. *latifolia* (see p. 4) or *S. humilis*. Without having seen a type (for instance the specimen from which the figure was drawn) I cannot decide what Wangenheim really had in mind. I believe, however, he mixed the two forms just mentioned. Willdenow's description of 1796 in my opinion, applies to *S. discolor*. Later, in 1805 and 1811, Willdenow added

S. longirostris Michaux as a synonym to his *conifera*, but Michaux's species is *S. tristis*.

In 1787, Schoepf mentions a *Salix* spec. which has been named by Gmelin (1791) *S. flava*. This plant may be identical with *S. humilis*, but I am not able to decide which Willow Schoepf meant in speaking of "foliis . . . tenuissime serratis." This sentence has been omitted by Gmelin. Walter, in 1788, proposed a *S. occidentalis* with "foliis integris subtus tomentosis." This is apparently nothing but *S. humilis* because he also describes *S. tristis* as *S. alpina*. Muhlenberg (and Willdenow) in 1803, has besides *S. tristis* a *S. conifera* which according to Willdenow is the same as his *conifera* of 1796 and that of Wangenheim. Muhlenberg's diagnosis, however, fits *S. humilis* best; and he also proposed at the same time *S. discolor* as a new species. The fig. 9 on Muhlenberg's t. vi. which he refers to *S. tristis* probably belongs to his *S. conifera* (= *S. humilis*). Possibly part of Muhlenberg's *S. tristis* really applies to *S. humilis*, because he speaks of "caule pedali-quadrupedi," and says of it "an satis distincta a *Conifera*."

Willdenow, in 1805, suspected that Muhlenberg's *S. tristis* was not the true *tristis* of Aiton, and he proposed for it the name *S. Mühlenbergiana*, referring to it also *S. incana* Michaux as a synonym. This last species, however, is *S. candida* Fluegge. I think that *S. tristis* Muhlenberg for the most part represents the true *tristis*, and only pro parte minima is to be referred to *S. humilis*. Pursh's *S. Mühlenbergiana* is the same as *S. humilis* except the synonyms *S. alpina* Walter and *S. tristis* Muhlenberg, pro parte. Pursh also has a *S. recurvata* which commonly (see Barratt, Andersson, Ball and others) is regarded as a (at least doubtful) form of *S. humilis*. Pursh says "S. foliis obovata-lanceolatis acutis integerrimis margine glandulosis glabris subtus glaucis, junioribus sericeis, stipulis nullis, amentis praecocibus recurvatis, squamis apice nigris, pilis longitudine germinis, germinibus ovatis, brevi-pedicellatis sericeis, stylo brevissimo, stigmatibus bifidis." "In shady woods in the mountains of New Jersey and Pennsylvania." "A low shrub; branches brown, smooth; buds yellow." I hesitate to identify it with *S. humilis*. On the other hand, Pursh's *S. fuscata* (Fl. Am. Sept. 612 [1814]) might be connected with *S. humilis*, Barratt (1840 under no. 12) has a Willow named *S. fuscata* which "grows in pools and swamps and on wet banks. It furnishes excellent twigs suitable for fine basket work. . . ." He puts it in his section *Griseae*; and Torrey in 1843 (Fl. N.Y. II. 207) in describing *S. petiolaris sericea* says: "I suspect that *S. fuscata* Pursh must be united with "*S. grisea* and *S. sericea*." Pursh however lays stress upon the "dark brown or black tomentum" which covers the branches of the preceding year, and the fact that the young leaves are pubescent and the old ones obovate-lanceolate and I suspect that it may have a closer relationship with *S. humilis* than with *S. sericea* or *S. petiolaris*, of which it has been made a synonym by Andersson (1867).

Barratt (1840) discusses *S. Mühlenbergiana* at considerable length, and uses that name for *S. conifera* Muhlenberg (not as Willdenow did for *S. tristis* Muhlenberg). Muhlenberg's *S. conifera*, as already explained, is *S.*

humilis. Barratt¹ asserted that Willdenow mixed different species, and he too stated, that *S. Mühlenbergiana* Forbes (1829) "is *S. tristis* Aiton." Forbes just copies Pursh's description, and the leaf represented in his fig. 145 may be taken for a small one of *S. humilis* or a large one of *S. tristis*.

Barratt's varieties of *S. Mühlenbergiana* are nomina nuda. They cannot be determined without type specimens. Torrey (1843) also used the name *Mühlenbergiana*, and it was Carey who in 1848 reestablished Marshall's name *S. humilis*. He cites, in the synonymy, *S. Mühlenbergiana* Barratt and *S. conifera* Muhlenberg. Andersson's (1858) followed Carey in keeping the oldest name. In his monograph (1867) he proposed three varieties each comprising two forms. He held the same view in the *Prodromus* (1868). The first variety is var. *grandifolia* to which he cites *S. conifera* Muhlenberg as a synonym. It is said to be characterized by: "foliis obovato-oblongis, 3-4 poll. longis supra medium plusquam 1½ poll. latis, supra nitidis, subtus intense glaucis saepius demum glabratis." Of this variety he distinguishes f. *obtusata* (in 1868 f. *obtusifolia*) with "foliis apice subrotundato oblongo-obovatis, subtus non raro dense albo-tomentosis" while in 1868 he says "foliis . . . subtus aut denudatis glaucescentibus aut tenuiter albo-tomentosis." Besides this there is a f. *acuminata* (1867 and 1868) with "foliis apice productiori breve acuminatis, tenuioribus, subtus tomento evanido glabratis, glaucescentibus." He adds, in 1868, "*S. prinoidi* subsimilis, sed differt foliis tenuibus amentis brevibus, capsulis brevius pedicellatis." After all, Andersson's var. *grandifolia* seems to be no true *S. humilis* but a rather uncertain form of possibly hybrid origin.

Of his var. *longifolia* (1867 and 1868) Andersson states himself: "haec forma est typica." He proposes three forms of it: the first f. *rigidiuscula* is (1867) said to be "*S. discolori* quoad folia subsimilis," while in 1868 he says: "ad *S. tristem* appropinquans." The leaves are described as "supra opacis sed glabris, subtus intense tomentosis." Generally the leaves of *S. humilis* are also pubescent on the upper side, at least on the midrib. Robinson & Fernald (Gray's Man. ed. 7, 326) use the name *rigidiuscula* for forms with leaves which are "very rugose and glabrescent beneath. (O. to Ga. and Kan. — Shrub or small tree)." It is more than doubtful to me whether this last form is the same as Andersson's f. *rigidiuscula*. I have not been able to get a good idea of the forms to which Robinson & Fernald refer.

Andersson's second form of var. *longifolia* is f. *glauca* with "foliis acuminato-cuspidatis, supra nitide viridibus, subtus intense glaucis denudatis." In 1867, Andersson adds: "Formis augustifoliis *S. lucidae* haud absimilis," a sentence omitted in 1868. I have not seen a form to which this description would fit. The third form is f. *tenuis* "foliis tenuibus subpellucidis et ideo rufescentibus, subtus vix tomentosis opacis." Here, too, Andersson does not cite a specimen or a locality. The description points to a typical form with young leaves.

¹ He too considers *S. villosa* Forbes, Salict. Wob. 183, t. 92 (1829) as the same as *S. tristis* Aiton. Forbes, however, says that the leaves are "covered with small shining hairs" beneath, and he gives no clue to its origin. The flowers are wanting, and after all it is a very uncertain species.

The third variety is var. *angustifolia* with "foliis 1-2 poll. longis vix $\frac{1}{4}$ poll. latoribus, supra opaco-cinerascentibus subtus pallidis tomentosis nec denudatis," while in 1868 the sentence runs "foliis 1-2 poll. longis vix $\frac{1}{2}$ poll. latis subtus glaucescentibus vel tenuiter tomentosis." In 1868 he puts under this variety f. "*recurvata* (Psh): capsulis recurvatis," and f. "*opaca*: capsulis brevissime vel vix pedicellatis (Wright, Coll. Nov. Mexic. n. 1878)." In 1868 he says: "Huc forsan etiam pertinent: *S. recurvata* Pursh . . . et forma *opaca* . . ." Of *S. recurvata* Pursh I have already spoken. Wright's no. 1878 is a form with glabrous (not only glabrescent) capsules which does not belong to *S. humilis* at all.

S. Hartwegii Benthams which is regarded by Andersson as a subspecies (1867) or doubtfully as a variety (1863) of *S. humilis* has nothing whatever to do with this species. See my note in Bot. Gaz. LXV. 28 (1918).

To *S. humilis* seems to belong also Andersson's *S. tristis glabra* (1867 and 1868) of which he himself says: "Ad *S. humilem* aperte accedens." I have not seen a type. It is extremely difficult to distinguish well marked varieties of *S. humilis* until full series of the variations of the different regions and localities have been collected. The first question that arises is: can *S. tristis* be regarded as a good species, or only as a variety of *S. humilis*, as asserted by Griggs (see later under *S. tristis*). Almost all authors agree that *S. tristis* is, as Ball (1910) says, "very similar to *S. humilis* but smaller in every way." It differs from *humilis* chiefly in its thinner branches, shorter petioles (hardly more than 3 mm. long), smaller leaves (scarcely up to 5 cm. long and 1-1.3 cm. wide), the absence of stipules, present and linear only on vigorous shoots and in its smaller aments. Probably it is nothing but an ecological subspecies.

I am not able to discuss certain forms of *S. humilis* from the northeast which partly resembles *S. discolor*. There are others, too, in the middle west that need careful observation in the field. I have seen material of *S. humilis* sensu lato from the following states and counties: Vermont (Caledonia County), Massachusetts (Middlesex, Hampshire, Essex and Suffolk Counties), Connecticut (Fairfield County), New York (Tompkins, Warren, Wayne Counties and Long Island), Rhode Island (Providence County), New Jersey (Bergen and Ocean Counties), Maryland (Montgomery County), District of Columbia, Virginia (Bedford County), North Carolina (Buncombe County), West Virginia (Randolph County), Georgia (Sumter County, uncertain form), Florida (Leon County), Pennsylvania (Chester and York Counties), Kentucky (Jefferson County), Mississippi (Alcorn County) Arkansas (Polk and Clay Counties), Texas (Pottawatomie and Atchinson Counties), Nebraska (Nuckolls, Cass, Howard, Thomas, Holt and Brown Counties), Iowa (Lyon, Cerro Gordo, Floyd, Humboldt, Delaware, Story, Decatur and Poweshiek Counties), Missouri (St. Louis, Pike, Wayne, Howell, Carter, Newton, Jasper, Scott, Webster, Shannon, Jepson, Macon, Putnam and Clark Counties), North Dakota (Richland County), Minnesota (Ramsay County), Wisconsin (Sauk County), Michigan (Ingham, Wayne and St. Claire Counties), Ohio (Franklin and Scioto Counties), Illinois (St.

Claire, Richland, Clinton, Cook and Mason Counties), Indiana (Clay, St. Joseph, Lagrange, Allen, Winnebago, Steuben and Crawford Counties), Ontario (Essex District).

5. *S. tristis* Aiton, Hort. Kew. III. 393 (1789). — Muhlenberg in Neue Schr. Ges. Nat. Fr. Berlin, IV. 241 (1803) excl. t. VI. fig. 9. — Willdenow, Spec. Pl. IV. 693 (1805). — Dumont de Courset, Bot. Cult. ed. 2, VI. 396 (1811). — Pursh, Fl. Am. Sept. II. 609 (1814). — Elliott, Sketch Bot. II. 668 (1824). — Forbes, Salict. Wob. 279 (1829), prob. excl. fig. 150. — Barratt, Sal. Am. no. 2 (1840). — Torrey, Fl. N.Y. 205, t. 118 (1843). — Carey apud Gray, Man. 425 (1847). — Andersson in Öfv. Svensk. Vet.-Akad. Förh. XV. 126 (1858); in Svensk. Vet.-Akad. Handl. VI. 112, t. VI. fig. 63 (Monog. Salic.) (1867), excl. var.; in De Candolle, Prodr. XVI.² 236 (1868), excl. var. — Macoun, Cat. Can. Pl. III. 455 (1886). — Ball in Proc. Iowa Acad. Sci. VII. 149 (1900); in Elys. Marian. III. 35, t. 9, fig. a (1910). — Britton & Prown, Ill. Fl. 1. 499, fig. 1186 (1896); ed. 2, I. 600, fig. 1474 (1913). — Schneider, Ill. Handb. Laubh. I. 64, fig. 11 x-y, 12 u (1904). — Robinson & Fernald, Gray's Man. ed. 7, 326, fig. 661 (1908). — *S. alpina* Walter, Fl. Carol. 243 (1788), non Scopoli (1772). — Blake in Rhodora, XIII. 136 (1915). — *S. longirostris* Michaux, Fl. Bor.-Am. II. 226 (1803). — Bigelow, Fl. Bost. ed. 3, 391 (1840). — *S. Mühlenbergiana* Willdenow, Spec. Pl. IV. 692 (1805), pro parte et excl. syn. *S. incana* Michaux. — *S. Mühlenbergiana* Pursh, Fl. Am. Sept. II. 609 (1814), pro parte. — Elliott, Sketch Bot. II. 667 (1824), pro parte. — *S. conifera* Willdenow, Spec. Pl. IV. 705 (1805) et Berlin. Baumzucht, ed. 2, 455 (1811) pro parte, quoad syn. *S. longirostris*, non Wangerheim. — Pursh, Fl. Am. Sept. II. 609 (1814), pro parte, quoad syn. *S. longirostris*. — Elliott, Sketch Bot. II. 669 (1824), pro parte, quoad syn. *S. longirostris*. — *S. tristis* var. β *monadelphia* Barratt, Sal. Am. no. 2 (1840). — *S. tristis microphylla* Andersson in Öfv. Svensk. Vet.-Akad. Förh. XV. 126 (1858). — ? *S. tristis longiflora* Andersson in Svensk. Vet.-Akad. Handl. VI. 113 (1867). — *S. humilis* var. *tristis* Griggs in Proc. Ohio Acad. Sci., IV. 301, t. x, partim (1905).

Walter (1788) was the first to describe this species as *S. alpina* but this name had been used before by Scopoli for a European Willow.¹ Aiton's original diagnosis is: "*S. exstipulacea*, foliis lineari-lanceolatis petiolatis rugosis subtus tomentosis. Nat. of Pennsylvania. Mr. William Young. Introd. 1765." The type therefore of *tristis* came from Pennsylvania. Muhlenberg (1803) gave a rather good description of it but the leaf which he figured looks more like one of *S. humilis* than of *S. tristis*. As I have already explained he probably had *S. humilis* partly in mind, and I have also referred under *S. humilis* to Willdenow's treatment of *S. tristis*. Michaux's *S. longirostris* is probably *S. tristis* because he says "*foliis subsessilibus longiuscule lanceolatis*" Forbes (1829) describes the true *S. tristis* but the

¹ Scopoli's *S. alpina* is a rather uncertain form. It has been referred with a query to *S. arbuscula* Linnaeus by A. & E. G. Camus, Class. Saules d'Europe, I. 124 (1904), while v. Seemen in Ascherson & Grabener, Syn. Mitteleur. Fl. IV. 164 (1908) partly refers it to *S. repens* var. *Jacquiniana* Koch.

leaf represented by him in his fig. 150 is finely glandular-serrate. Barratt mentions a forma *monstrosa* with partly united filaments which he calls var. *monadelphica* of which I have seen the type. Torrey (1843) gives a good description and figure of typical *S. tristis* under the correct name. Anderson (1858) cites Gray's manual, and has a var. *microphylla* which is nothing but the type. In 1867 he does not mention this variety, but he has three other forms: *glabrata*, *minor* and *longiflora*. The first seems to belong to *S. humilis*; the second which he called *nivea* in 1868, I take to be *S. candida*, while the third is probably typical *S. tristis*.

As I have already pointed out under *S. humilis* it is doubtful if *S. tristis* can be kept as a distinct species or considered a variety of *S. humilis*. Griggs who holds the latter view makes the following statement: "A depauperate form of *S. humilis* with which it is connected by many intermediates. It may be described as smaller and hairier throughout. It is quite low (to 6 dm.) with smaller leaves (to 5 cm. long) more strongly gray tomentose, and catkins sometimes scarcely 5 mm. long. This can hardly be regarded as a distinct species. There is not a single constant character by which the two differ and what differences there are, are such as would be likely to be caused by differences in environment. Such forms should be considered as varieties rather than as species."

I have seen specimens of *S. tristis* from the following states and Counties: Massachusetts (Middlesex, Hampshire, Norfolk, Essex, Worcester, Plymouth, Bristol and Barnstable Counties), Rhode Island, Connecticut (New London and Middlesex Counties), New Jersey (Gloucester, Cumberland, Camden, Middlesex and Salem Counties), New York (Suffolk, Queens, Nassau and King's Counties), Delaware (New Castle County), Pennsylvania (Chester, Lancaster and Luzerne Counties), Virginia (Fairfax County), District of Columbia, North Carolina (Rowan and Macon Counties), Kentucky (Webster and Edmonson Counties), Tennessee (Robertson and Coffee Counties), Florida (Leon County), Indiana (Vermilion, Cass and White Counties), Illinois (Winnebago and Hancock Counties), Wisconsin (Sauk County), Missouri (St. Louis, Phelps, Jasper and Atchison Counties), Nebraska (Brown and Custer Counties), Mississippi (Kemper County; an *humilis*?), Iowa (Hamilton, Boone, Harrison, Johnson, Floyd and Story Counties).

VIENNA, April, 1920.

A PHYTOGEOGRAPHICAL SKETCH OF THE LIGNEOUS FLORA OF FORMOSA

E. H. WILSON

THE island of Formosa is off the east coast of China and is situated between 21° 45' N. latitude and between 119° 18' and 122° 6' E. longitude. It is oblong in shape and about 244 miles long and in the widest part is 75.6 miles broad; at the extreme south its breadth is only 7.3 miles while in the extreme

north it is 12.2 miles broad. The circumference of the island is about 708 miles, and the total area is about 13,908 square miles, being about the same size as Kyushu, the southern island of Japan. Formosa is very mountainous, with a central axis stretching from north to south and situated well toward the east side. The central range is composed of palaeozoic rocks, chiefly clay slates and its average height is about 3000 m. Several peaks are over 3600 m. and the highest, Mt. Morrison, situated on the Tropic of Cancer, is 3985 m. high. The north is largely volcanic while the extreme south is of coral formation. The east coast is for the most part bold, rugged, and without safe anchorage. From Pinan to Karenko stretches a coastal range, largely volcanic, and not more than 1200 m. high. Between this coastal range and, the foothills of the main axis is a narrow valley which constitutes the only agricultural area of this region. West of Karenko and stretching southward to Pinan is an outcropping of limestone of no great thickness. From Karenko northward, hard, crystalline schistose rocks prevail and these form the famous seacliffs of northeast Formosa. These cliffs seen from the sea appear to be vertical walls of rock fully 2600 m. tall.

The west coast is separated from China by the Formosa Channel, which is nowhere more than 100 fathoms deep. The short rivers that flow from the mountains bring down annually enormous quantities of detritus, spreading it out over the alluvial plains which are constantly increasing in size. Many of the foothills abutting on the plain are worn into terraced flats with vertical faces. About 80 miles south of Taihoku an east and west range of hills extends to the sea and exercises a strong influence on the climate. Owing to the influence of the Japan current which flows up the east coast the mean temperature is higher and the rainfall more copious than in the corresponding latitudes on the continent. The rainfall varies considerably in different parts of the island. At Keelung in the north it averages about 130 inches, while at Taihoku, only 17.8 miles south and one hour's journey by train, it is about 76 inches. At Takao in the south it is about 70 inches, and at Koshun about 84 inches. Thanks to the range of hills which bisect the island the wet and dry seasons of the northern and southern parts of Formosa alternate.

The rich plains on the west coast support a large agricultural population. Rice, of which two crops are harvested each year, is the staple, while in recent years sugar-cane has been grown in enormous quantities. The alluvial areas have nearly all been brought under cultivation. In the north the foothills are also largely given over to agriculture, and the Camphor-tree in great quantities has been planted. In the central parts of the island are several upland valleys, really old lake beds, and these too are under crops. Of the many lakes which at one time existed in this region only one, Lake Candidius, remains. In the north and centre the Tea-plant is grown in quantity and the "Oolong Teas" of Formosa are famous. In places Citronella-grass is cultivated for its oil, while Bananas, Betle-nut Palm and the Longan-tree are features round homesteads at low altitudes. Where

not cleared for cultivation, the foothills are covered with a dense jungle-growth of coarse grasses, Bamboos, miscellaneous shrubs and trees of no great value. At one time the Camphor-tree was prominent on these foothills, but it has long since been destroyed for the sake of its camphor.

The higher mountains are densely clothed with magnificent evergreen forests. The upper slopes of some of these mountains like Mt. Sylvia, are, however, treeless. Others, like Mt. Morrison, the highest of all, is tree-covered to within a few hundred feet of its summit which carries snow for fully six months of the year. Into these wild, densely forested mountain-fastnesses the head-hunting aboriginals have been forced by agricultural Chinese who occupy all the valleys. Over 7000 square miles of the island is recognised as savage territory. Some of the tribes have been brought under control, but the majority of them live in a state of war against Japanese authority and against their neighbors. A well-organized system of military police is maintained with a chain of block-houses, and all trade with the savages is done in barter and through the police stations. Fenced guard-lines of wire charged with heavy voltage of electricity are used to segregate the unfriendly tribes.

On the west coast, a railway runs from Keelung in the north to Takao in the south and on the east coast there is about 50 miles of railway from Karenko south. There are several short lateral railways and an extensive system of push-trolley lines built for the purpose of bringing down the products of the foothills and the interior valleys to the railways; there is also a railway constructed specially for the purpose of bringing down the timber felled on Ari-san to the town of Kagi. These railway and trolley lines afford ready facilities as far as they go, but really only very limited distances can be covered by their aid. Owing to the fact that so much of interior Formosa is in the hands of head-hunting Savages travel off the main routes, except by special permission of the Japanese government, is not allowed. The only roads into the mountains are those which have been made for police purposes and these are well guarded. The Government was very gracious toward me on the occasion of my two visits to Formosa. It placed every convenience at my disposal and did its utmost to further the objects I had in view, and, thanks to this invaluable assistance, I was able during the six months I was there to see much of the island. I traveled all round it using the railways on the west coast and staying off at convenient places. From the terminus beyond Ako I went on foot to Koshun over the coral formations in the south. From Taihanroku, the port of Koshun, I went by ship to Pinan; from Pinan by push-trolley I traversed the interior valley already mentioned until the railway-head about 50 miles below Karenko was reached. From Karenko I journeyed on foot over the famous sea-cliffs of northeast Formosa to the little port of So-ō, near Giran. I had previously traveled overland from Taihoku to Giran and returned by way of Keelung. I visited Mt. Taihei situated in the northeastern part of the island and famous for its wonderful Chamaecyparis-forests. In the centre of the island I visited Mt. Kiraishiu which is

beyond Horisha and 3353 m. high. I paid two visits to Ari-san and from there journeyed over the mountains eastward and ascended to the summit of Mt. Morrison. Several other districts were visited including the mountains of Shinchiku prefecture and the volcanic area of Mt. Daiton northwest of Taihoku. It is thus apparent that I had ample opportunities for seeing and gathering information about the flora of the island. Furthermore, to my great good fortune Mr. R. Kanehira, Director of the Government Experimental Station of Forestry, and his assistant, S. Sasaki, were my companions on many trips including that to the summit of Mt. Morrison. On other excursions Y. Shimada accompanied me. These gentlemen have a very intimate knowledge of the flora which they freely imparted, and but for their help and tuition I should have been lost among the wealth of species and forms. It is with great pleasure that I recall the delightful days we spent together and the earnestness with which they labored to make my journeys pleasant and profitable. To them and to the Government of Formosa my best thanks are now offered for the help they gave which contributed so largely toward the success of the Arnold Arboretum Expedition.

On the mountains of Formosa are the finest forests of eastern Asia and the largest (*Chamaecyparis formosensis* Matsum.) and the tallest (*Taiwania cryptomerioides* Hay.) coniferous trees known outside of California. From sea-level upward the dominant forest-features are Tree Figs, Lauraceae, evergreen Fagaceae and Conifers. No Cycad is indigenous and of the three genera of Taxaceae found in Formosa only Podocarpus is common. Pinaceae is represented by 11 genera and on the higher mountains its members form extensive forests both mixed with broad-leaf trees and pure. Considering the warm climate, the Palm family is poorly represented by five genera and of these only *Phoenix Hanceana* Naudin, *Didymosperma Engleri* Warb. and *Calamus Margaritae* Hance are common. The Calamus is one of the principal lianas of the forest and yields slender rattans of excellent quality. The broad-leaf trees are mostly evergreen and dominate from sea-level up to altitudes of 2000 m. Deciduous-leaved trees are comparatively rare though in certain districts *Liquidambar formosana* Hance is common, and in open alluvial areas and mountain valleys like those beyond Horisha and elsewhere in Nanto prefecture forms pure woods. More plentiful is *Alnus formosana* Mak., perhaps the most common deciduous-leaved tree on the island. It is found from sea-level to 2500 m. altitude and is the first tree to spring up on bare slopes and after landslides. On its roots a nitrifying mycorrhiza is found as on other species of *Alnus*. The usefulness of this tree as a fertilizing agent is well-known to the Savages who plant it in their exhausted Millett fields for the purpose of restoring fertility, and after a few years cut it down and plant Millett again.

Such northern genera as *Fagus*, *Ulmus*, *Carpinus*, *Malus* and *Alnus* reach the southern limits of their range in Formosa, and deciduous-leaved Oaks are represented by one species (*Q. variabilis* Bl.) only, and this, though it occasionally forms pure woods as beyond Horisha and Musha, does not grow to a large size. The presence of an endemic species of Beech

(*Fagus Hayatae* Palib.) is very remarkable; the species is well-characterized by its very small fruit on a short peduncle and also by its small leaves. Its distribution is very local and unfortunately I did not see this tree. An endemic species of Walnut grows high up on the mountains west of Karenko, and round Ari-san and elsewhere a species of Sassafras, making the third known species of the genus. Several species of Willow are indigenous in Formosa, but no Poplar, Birch nor Chestnut have yet been discovered, neither has any species of Magnolia though representatives of the related genera *Michelia* and *Illicium* are common forest trees.

In general the climate of Formosa is warm-temperate; at sea-level many sub-tropical species are found and high up on the mountains grow many cool-temperate plants. There is the usual coastal fringe of species widespread within the sub-tropical regions, and, in the extreme south especially, quite a number of Philippine species occur. Among trees two such typical Japanese genera as *Chamaecyparis* and *Trochodendron* are important and prominent forest-features. Nevertheless, among the woody plants Chinese forms abundantly predominate and, as will be demonstrated later, the real affinity of the Formosan flora is with that of central and western China.

Before proceeding with an account of my own observations it may be well to record the present state of our knowledge of the flora as told in books.

Prior to the ceding of Formosa to Japan by China in 1895 our only knowledge of its flora was from small collections made chiefly by various officers of the British Consular Service and of the Chinese Imperial Maritime Customs Service. The first plants were collected round Tamsui by R. Fortune in April 1854, and in 1858 Charles Wilford collected at various places on the north coast. These pioneers were followed by R. Oldham, R. Swinhoe, W. Hancock, G. M. Playfair, T. Watters, C. Ford, Steere, Warburg and others who made small collections near the coast. In 1893 and 1894 A. Henry collected round Takao and through a lighthouse-keeper, named Schmüser, secured a number of plants from savage territory round the South Cape (Garambi). In 1896 Henry published in the *Transactions of the Asiatic Society of Japan* (xxiv. Suppl.) with descriptive notes a "List of Plants from Formosa." This list includes 1429 plants of which 1283 are flowering plants, 131 Ferns and 15 Fern-allies. In the *Kew Bulletin of Miscellaneous Information* for March, 1896, there is published an account of the flora of Formosa by A. Henry, taken from the Foreign Office Report on Formosa prepared by Mr. Perkins of the British Consular Service stationed at Anping (F. O. Commercial No. 1, 1896). These two accounts of Henry's represent the state of our knowledge of the flora of Formosa up to the acquisition of the island by Japan in 1895. In 1904 the Government of Formosa decided to carry out a botanical survey of the whole island the results to be published over a period of fifteen years under the title of *Icones Plantarum Formosanarum*. This survey and the publication of results is still in progress. In the *Actes du III^e Congrès International de Botanique, Bruxelles, 1910*, there is published a very interesting account of

the flora of Formosa by Dr. B. Hayata. He gives a general history of botanical study in the island, enumerates the collectors, tabulates the principal types found growing in different altitudinal zones, and gives illustrations from a number of excellent photographs. He states that at that time the total number of flowering plants and vascular cryptogams known was 2417 species belonging to 764 genera. In Volume VII of the *Icones Plantarum Formosandarum* issued on March 25, 1918, the figures had risen to 3359 species and 57 varieties belonging to 1173 genera and 169 families. Quite a large portion of the island is still unexplored and the collections made by the lamented Père U. Faurie and by W. R. Price have not yet been wholly determined. So notwithstanding the great progress made since the Japanese undertook a botanical survey of the island it cannot be said that the flora is exhaustively known. Furthermore, before any accurate idea of its richness in endemic forms is possible it will be necessary to compare them with those of central and western China. Taken on the whole and as far as our knowledge goes Formosa is remarkably poor in endemic genera, but very rich in species of woody plants, especially of trees, and the mountain flora is largely composed of endemic plants.

The coastal flora is not particularly interesting consisting as it does largely of plants widespread in warm-temperate and sub-tropical regions. On the west coast a broad alluvial plain extends from the foothills to the sea which is ever receding. Agriculture claims nearly the whole of the plain and I have never visited a less interesting region. In the north volcanic mountains that have been largely deforested abut on the sea. In the gullies and ravines grow various trees but the slopes and mountain-tops are mostly clad with a tangle of miscellaneous shrubs and coarse grasses. South of Taihoku, the capital city, are low hills similar to those of the volcanic area. In both regions *Pinus Massoniana* Lamb. is common but since this Pine has been much planted by the Chinese it is not possible to distinguish with certainty spontaneous trees. In fact I am by no means convinced that it is really indigenous in Formosa. The Pride of India (*Melia Azedarach* L.) and an *Acacia* (*A. confusa* Merrill) are also abundant as planted trees, and the latter appears to be indigenous in the extreme south. Other trees of the coastal hills are *Quercus glauca* Thunb., *Meliosma rhoifolia* Maxim., *Celtis sinensis* Pers., *Machilus Thunbergii* S. & Z., *Bombax malabaricum* DC., and various Tree Figs like *Ficus Wightiana* Benth., *F. retusa* L., *F. Harlandii* Benth. and *F. nervosa* Heyne. On the volcanic Daiton range grows a variety of shrubs including *Rhododendron Oldhamii* Maxim., *Pieris ovalifolia* D. Don, several species of *Elaeagnus*, a large-leaved Box which may be *Buxus liukiensis* Mak., *Rosa laevigata* Michx., several *Viburnums*, a *Mahonia*, and *Euscaphis japonica* Dipp.

In the south round Takao the formation is all coral limestone. On the strand which encloses a lagoon at Takao grow such Mangrove-like trees as *Kandelia Rheedii* Wight, *Rhizophora mucronata* Lam. and *Bruguiera gymnosperma* Lam. and associated with them are *Aricennia officinalis* L. and *Lumnitzera racemosa* Willd. A similar collection of Mangrove-like trees

is said to occur near Keelung in the north but I did not see it. On Ape's Hill, Takao, the dwarf, endemic *Phoenix Hanceana* Naudin is abundant and so too is *Pittosporum formosanum* Hay., *Scolopia crenata* Clos and *Croton Cumingii* Muell. Arg. Such littoral woody plants as *Pandanus tectorius* Soland., *Scaevola Koenigii* Vahl, *Excoecaria Agallocha* L., *Hibiscus tiliaceus* L., *Pongamia glabra* Vent., *Caesalpinia bonducella* Bl., *Clerodendron inerme* Gaertn., *Ipomoea biloba* Forsk. and *Canavalia obtusifolia* DC. are abundant and widely distributed. In the south, especially from Anping to Rokko, *Myoporum bontioides* A. Gray is common; *Freyinetia formosana* Hemsl. is confined to the region round Keelung in the north; *Tournefortia argentea* L. is local, but *T. sarmentosa* Lam. is plentiful and widespread. A feature of the coral-cliffs round Takao is the curious *Euphorbia tirucalli* L. with cylindric, whip-like branchlets. This succulent Tree Euphorbia is considered to be a native of Africa, but it must have been introduced into Formosa from China by early settlers. The seacoast between Boryo and Koshun for many miles is covered with an almost pure growth of *Vitex Negundo* L., and near tide mark *V. orata* Thunb. abounds. In the same district *Hibiscus mutabilis* L., *Kleinohoria hospita* L., *Cerbera odollam* Gaertn., *Acacia Farnesiana* Willd., *Rauwolfia chinensis* Hemsl. and *Atalantia buxifolia* Oliv. are features, and *Indigofera anil* L., *Abutilon indicum* L., *Urena lobata* L., *Sida rhombifolia* L., *Uraria crinita* Desv. and *Abrus precatorius* L. are wayside weeds. The low hills are clothed with *Acacia confusa* Merrill and on the rocks *Phoenix Hanceana* Naudin grows in abundance but nowhere more so than at Taibanroku, a little seaport village near Garambi, the South Cape of foreign maps. The Cape itself is a bold headland of coral-rock, and inland from it rise curious pillars and fortress-like masses of coral for the most part clothed with a jungle-growth. This region is hot and wind-swept and the vegetation more tropical in character than elsewhere in Formosa. In sheltered gullies I saw the gutta-yielding *Palaequium formosanum* Hay. and the interesting *Diospyros Kusanoi* Hay. and *D. utilis* Hemsl.; the latter has a large, apple-like, flattened fruit covered with short hairs. The stinging *Laportea pterostigma* Wedd. is common and so too are *Sapindus mukorossi* Gaertn., *Gleditsia formosana* Hay., *Cudrania javanensis* Trécul, *Melastoma candidum* D. Don and *Heptapleurum octophyllum* Benth. and many species of Tree Figs, Ilex, Evonymus and Capparis. The region is very rich and I made a good haul of specimens during my brief visit. At Pinan on the east coast I saw little of interest except the Macartney Rose (*R. bracteata* Wendl.) which does not grow on the west coast though it is common in the adjacent coast provinces of eastern China; it may be only an escape in Formosa. Near Pinan and also near Giran in the north grows *Koelreuteria formosana* Hay., which seems to be always a small tree. The flora of the inland valley through which the road to Karenko leads is like that of the foothills and the lower mountains and is both rich and varied. In places *Pinus taiwanensis* Hay. reaches the valleys, and in the rock-strewn beds of shallow rivers and summer-torrents *Pyracantha Koidzumii* Rehd. with its masses of scarlet

fruits arrests attention in autumn and winter. Bushes of *Elaeagnus* in several species are plentiful and here and there grows *Caryopteris incanus* Miq. On the impressive and lofty sea-cliffs north of Karenko the mountain flora descends well toward the sea and there is no well-marked littoral vegetation. The flora of these cliffs is little known and many of the species are peculiar. On them I gathered a new *Rose*, a new *Distylium* and several other interesting plants. At Gukutsu, where a strong-flowing river has burst through to the sea, *Juniperus formosana* Hay. descends to sea-level rocks, and on the faces of vertical cliffs *Hibiscus syriacus* L. with lovely lavender-colored flowers is plentiful. In the descent from the cliffs to the little port of So-ō I gathered the interesting *Abelia ionandra* Hay.; also a *Ficus* with deeply lobed leaves and a species of *Caryopteris*, both new, and each only a few inches high. It took me five days to make this pioneer trip over the sea cliffs of northeast Formosa. The road is exceedingly difficult, not to say dangerous and the weather was far from favorable, but a rich harvest of specimens of interesting plants well repaid me for the fatigue and hardships. From the sea only can a proper estimate of the height and grandeur of these cliffs be obtained, but only by struggling over them can the forest-wealth which clothes all but the most vertical walls be realized. Nearly all the trees are evergreen; *Fagaceae* and *Lauraceae* predominate and their canopy of green almost shuts out the heavens. Camphor-trees are plentiful, *Calamus Margaritae* Hance, *Mucuna ferruginea* Matsum., *Bauhinia Championii* Benth. and other lianas cling about the tallest trees and with rope-like stems bind them together. The forest-floor is choked with a dense growth of Ferns in great variety including *Alsophila* and other tree species. *Alocasia macrorrhiza* Schott with huge dark green leaves is plentiful; various *Araliaceae* are common and among them the Rice Paper-plant (*Tetrapanax papyrifera* K. Koch) with huge panicles of snow-white flowers conspicuous in the dim subdued light of the forest-depth. Everything is dank and luxuriant, and the tense silence is broken only by the dull roar of the waves of the Pacific Ocean dashing themselves against the cliffs some two or three or more thousand feet below. Occasionally a bird flits across the path or a monkey is seen in the tree tops, but these are rare events. The armed Japanese police and the Savages who carried our baggage were all silent as we trudged slowly through the wondrous primeval forests which clothe the upper parts of the world-famous sea-cliffs of northeast Formosa.

The character of the vegetation on the foothills varies according to their nearness or otherwise to districts long settled by Chinese. When near such settlements they have been deforested and are now clothed with coarse grasses, miscellaneous shrubs and trees none of much interest or value. The Camphor-tree and its relatives with other broad-leaf evergreen trees have disappeared from low altitudes except where the Savage has held the utilitarian Chinese in check. Where the unmolested forest remains it is similar in character from near sea-level up to 1800 metres. It is everywhere a rain-forest, and nearly all the woody plants are evergreen. At the

lower levels *Dendrocalamus latifolius* Munro, *Bambusa stenostachya* Hack., *B. Oldhamii* Munro, *B. dolichoclada* Hay. and other species with various Tree Figs are prominent. Above 1000 m. Lauraceae and Fagaceae are the dominant types but *Schima Noronhae* Reinw., *Echinocarpus dasycarpus* Benth., *Elaeocarpus japonicus* S. & Z., *E. decipiens* Hemsl., *Crataeva religiosa* Forst. and other interesting trees are plentiful. All are lofty with clean boles, many of them buttressed at the base. Araliaceae of which *Aralia hypoleuca* Presl, *Fatsia polycarpa* Hay, *Oreopanax formosana* Hay., *Heptapleurum arboricolum* Hay., *H. racemosum* Bedd. and *H. octophyllum* Benth. are noteworthy, and with *Ardisia Sieboldii* Miq. and *Rapanea neriifolia* Mez and various species of *Symplocos*, *Eurya*, *Thea* and *Osmanthus* are the most common of the small trees forming the undergrowth. A Banana (*Musa formosana* Hay.) and *Alocasia macrorrhiza* Schott are abundant and impart a tropical appearance to the forest flora. The interesting *Helicia formosana* Hemsl., *Turpinia arguta* Seem., *T. nepalensis* Wall. and various Tree Ferns are common and so is *Debregeasia edulis* Wedd., a species of *Stachyurus*, and the dwarf Palm, *Didymosperma Engleri* Warb. The steeper the mountains the denser the forest on the floor of which Ferns in great variety luxuriate. Lianas such as *Calamus Margaritae* Hance, *Mucuna ferruginea* Matsum., *Ecdysanthera rosca* Hook. & Arn., *E. utilis* Hay. climb to the tops of the tallest trees, and such root-climbers as *Hydrangea integra* Hay. and *Pileostegia ureolata* Hay. and climbing Figs like *F. pumila* L., *F. foveolata* Wall. and *F. aukeotsang* Hay. clothe their trunks and main branches. Such epiphytic Orchids as *Dendrobium*, *Bulbophyllum*, *Cirrhopetalum*, *Cymbidium*, in many species abound, and in the south grows the lovely *Phalaenopsis Aphrodite* Reich. In more open and drier forests the few deciduous trees mentioned early in this article are to be found. The Alder is the most plentiful and in open places forms pure woods. An Elm (*Ulmus Uyematsui* Hay.) is plentiful above altitudes of 1000 m. in mixed forests and grows to a large size. Several species of Maple grow in this forest zone but are small trees, and this also applies to the species of *Carpinus*. At quite low altitudes *Bischofia javanica* Bl. is common and has a short very thick trunk and massive branches forming a wide-spreading crown. The Liquidambar is also common and so too are an Ash (*Fraxinus formosana* Hay.), *Trema orientalis* Bl., *Rhus javanica* L. and *Prunus punctata* Hook. f. In rather open country round Musha, in central Formosa, a Cherry (*Prunus subhirtella* var. *ascendens* Wils.) is quite a feature in early March, and associated with it grows *Prunus mume* S. & Z. the favorite "Plum-blossom" of the Chinese and Japanese. In the dense forests on steep slopes near Musha the lovely *Prunus campanulata* Maxim. is common and when in flower its red blossoms are seen to great advantage against the dark foil of surrounding evergreen trees. Other handsome flowering trees of this zone are the red-flowered *Illicium arborescens* Hay. and the white-flowered *Michelia compressa* Maxim. both of them with fragrant flowers. Several species of *Styrax* all small trees or large bushes, including *S. formosanum* Matsum., *S. Matsumurae* Perk., *S. suberifolium*

Hook. & Arn. and *S. Hayataianum* Perk. are prominent, and so too is the interesting *Alniphyllum pterospermum* Matsum., a slender tree with bark flaking off and leaving brown scars, and highly tinted autumn foliage. The very distinct *Malus formosana* Kawak. & Koidz., several species of *Eriobotrya* and two of *Paulownia* are also found in this forest zone. Among the Lauraceae the Camphor-tree on account of its economic importance demands first-mention though large trees are rarely seen except in the regions remote from Chinese and Japanese habitations. I saw more trees on the west coast than elsewhere. Several other species of *Cinnamomum* are common, including *C. Kanahirai* Hay., all of great size, but none yield camphor. The genus *Machilus* is very rich in species, one of the handsomest of which, but with bad-smelling flowers, is *M. Kusanoi* Hay. Another genus represented by two species is *Cryptocarya* and these and *Beilschmiedia erythrophloia* Hay. are very common trees. Fagaceae are very rich in species of *Castanopsis*, *Lithocarpus* and *Quercus* many of which have remarkable fruits. Of the first of these genera such species as *C. Junghuhnii* Hay., *C. taiwaniana* Hay. and *C. formosana* Hay. are very lofty trees. Less tall but very interesting is *C. Kawakamii* Hay. with large, Castanea-like fruit and shaggy bark flaking off in thick plates. The *Lithocarpus* are on the whole smaller trees but such as *L. Kawakamii* Hay. with exceptionally large, strongly veined, leathery leaves and *L. castanopsisifolia* Hay. with a large, thick-shelled nut almost completely enclosed in the tuberculate cupule are remarkable species. The loftiest species is *L. amygdalifolia* Hay. which usually has a strongly buttressed hole clean of branches for sixty or more feet. The curious *L. Konishii* Hay. with its flattened inch-broad nuts and shallow cupule is usually a large bush and at best is never more than a slender tree less than thirty feet tall. This and other species are a special feature of the forest round Lake Candidius. Of Oaks *Quercus pseudomyrsinaefolia* Hay. and *Q. gilva* Bl. produce the best timber, but are perhaps less common than other species such as *Q. pachyloma* Seem., *Q. glauca* Thunb., *Q. tomentosicupula* Hay. and *Q. longinux* Hay. The forests of this lower mountain-zone are seen to good advantage in the ascent to Ari-san and in the neighborhood of Keitao, they are, however, finer on Mt. Taihei in Giran prefecture, on the sea-cliffs of northeast Formosa, in Karenko prefecture, and beyond Urai which is only a few miles west of Taihoku, the capital city. Except on the steeper mountains and where hard rock prevails they are unfortunately being destroyed by axe and fire to make way for Sugar and Camphor plantations.

Near Lake Candidius and the town of Horisha *Podocarpus Nakaii* Hay., a species very near *P. macrophyllus* D. Don is common but is a tree of small size. In Giran and Karenko prefectures, *P. nagi* Zoll. & Moritzi is fairly plentiful though I did not see a good tree. But, strictly speaking, Taxaceae are nowhere really well represented. Conifers are rare on the lower mountains. Near Urai the interesting *Libocedrus macrolepis* Benth. & Hook. grows on cliffs and steep, rocky slopes scattered among the broad-leaf evergreens, but unable to withstand the competition is fast disappearing. It is

not a tall tree, but has a short thick trunk and massive branches and is never upright in habit, but inclines usually at an acute angle. Its timber is very valuable and the Chinese from early times have sought it out for making coffins. Another disappearing type is *Keteleeria Davidiana* Beissn. which is known from the forests near Herinbi, a day's journey west of Taihoku, and also from the south of the island. It is now a rare tree, and old stumps I saw testify to the large dimensions it once attained; of living trees I saw none in Formosa comparable in size with those I am familiar with in Hupeh and Szech'uan provinces of China. In Nanto and Pinan prefectures *Pinus taiwanensis* Hay. and *P. morrisonicola* Hay. both descend to this zone, but they really belong to higher altitudes. The first delights in open grassy country where it often forms small woods, but *P. morrisonicola* Hay. is confined to rocks and cliffs where it is not crowded by broad-leaved neighbors. The only other Conifer that rightly belongs to this zone is *Pseudotsuga Wilsoniana* Hay. of which I saw only one tree. I was told of its growing in Karenko prefecture but where I saw it was on the border of Shinchiku and Toyen prefectures on the edge of hostile Savage territory. The tree I saw and gathered cones from was a shapely specimen of no great size. This species is probably identical with *P. sinensis* Dode which grows in Kweichou and Yunnan provinces of southwest China.

Rich as is the vegetation on the lower mountains the forests of Formosa reach their highest perfection between altitudes of 1800 and 3000 m. In this belt mixed with broad-leaf, mostly evergreen, trees Conifers prevail. At the lower level Conifers are rare but higher; they almost entirely supersede the broad-leaf trees. The two *Chamaecyparis* (*C. formosensis* Matsum. and *C. obtusa* var. *formosana* Hay.), *Taiwania cryptomerioides* Hay., *Cunninghamia Konishii* Hay. are confined to these forests, and *Pinus taiwanensis* Hay. *P. morrisonicola* Hay. and *Juniperus formosana* Hay. though found at lower levels are most abundant here, and so is *P. Armandi* Franch. although this ascends to nearly 3800 m. The Spruce (*Picea morrisonicola* Hay.) and the Hemlock (*T. chinensis* Pritz.) are common in the upper limits of these forests. The loftiest tree is the *Taiwania* which rears its small mop-like crown well above all its neighbors. The average height of this tree is from 150 to 180 ft., but specimens exceeding 200 ft. are known. The trunk is sometimes as much as 30 ft. in girth, quite straight and bare of branches for one hundred to one hundred fifty feet. It is a strikingly distinct tree, singularly like an old *Cryptomeria* and both trees suggest gigantic Lycopods. In the dense forests the crown is small, dome-shaped or flattened, the branches few and short and one wonders how so little leafage can support so large a tree. When the top is broken by storms, the lateral branches assume an erect position. In the more open forest the branches are massive, wide-spreading and the crown oval or flattened, and on small trees the branchlets are often pendent. The *Taiwania* sheds its small inner branches as do *Cryptomeria*, *Cunninghamia* and *Sequoia*.

The Big Tree of Formosa is *Chamaecyparis formosensis* Matsum. found

throughout this forest-zone but most plentiful between altitudes of 2000 and 2500 m. Its maximum height is about 180 ft. and the girth of the largest tree known is 64 ft. The average height is from 120 to 150 ft. and the girth from 30 to 40 ft. One old felled specimen showed two thousand seven hundred annual rings, so if this be any guide the age of the trees must be from two thousand five hundred to three thousand years, and very few trees of a younger generation are to be found. The trunks of many of the trees are hollow, some mere shells, but very few dead trees occur either standing or on the ground. Some fifty feet or so above the base the trunks divide into from three to several erect stems. The lateral branches are slender, short and spreading, the crown thin and tapering, and much of the foliage is usually brownish. These old trees are far from handsome but the bulk of their enormous trunks is most impressive. The *Cunninghamia* like the *Taiwania* is a rare tree only found here and there in the forest. It is nearly as tall as the *Taiwania* but more slender and is neither impressive nor handsome. At one time these three old types probably formed pure forests, the *Chamaecyparis* at a later date than the others, but unable to withstand the competition of aggressive broad-leaf trees ascending from below, they have lost supremacy. Neither beneath their own shade nor in the dense forests are seedlings or young plants of these trees to be found, but in glades, where landslides have taken place, and on Ari-san, where clearings have been made to accommodate a railroad, young seedling plants of the *Chamaecyparis* in particular are quite common.

Much more handsome is *Chamaecyparis obtusa* var. *formosana* Hay. with its shapely, oval, bright green crown and straight trunk. Its height is about the same as that of the Big Tree, but in girth it is seldom more than thirty feet and usually less. The trunk is solid, of even thickness for a considerable height, and the timber more valuable than that of any other soft-wood tree found in eastern Asia. This tree reaches its maximum development between 2500 and 2800 m. in the Ari-san region, and on Mt. Taihei in Giran prefecture there are wonderful forests of it between altitudes of 2000 and 2500 m. At one time *Pinus morrisonicola* Hay. doubtless formed extensive forests on the more steep and rocky mountains, but to-day it is found scattered or in small groves among mixed trees. It is nowhere abundant, but on Matsu-yama near Ari-san grow the largest trees that I have seen. Between Horisha and Musha it is not uncommon, but the trees are small. It appears to favor cliffs and mountain peaks where it has opportunity to overtop its neighbors. *Pinus Armandi* Franch. is sometimes found on cliffs and among mixed trees, but it is seen to best advantage in open grassy country. West of Ari-san on grass-clad slopes and between Musha and Noko this tree is abundant and attains a far greater size than it does in central and western China. Trees from one hundred to one hundred and twenty feet high and twenty feet in girth of trunk are common. The other Pine (*P. taiwanensis* Hay.) forms pure woods in open country and is rarely found elsewhere. The Juniper prefers rocky places, and may be either a prostrate bush or a shapely little tree with hanging branchlets, and from

20 to 30 ft. tall. Among broad-leaf trees *Trochodendron aralioides* S. & Z. is peculiar to this belt and round Ari-san is particularly abundant growing with the *Taiwania* and the two species of *Chamaecyparis*. It is a much branched, wide-spreading tree with a short trunk often 20 ft. in girth and from 60 to 80 ft. in height. This tree has a very wide distribution northward through Liukiu, Yaku-shima, Kyushu and Hondo to the Nikko region, and the finest trees that I have seen grow in the *Cryptomeria*-forests on Yaku-shima.

The various *Fagaceae* of the lower mountains are also present and dominant among them is *Quercus Morii* Hay. and *Lithocarpus ternaticupula* Hay. The *Lithocarpus* is a small tree, but the *Quercus* is one of the largest and noblest of Formosan Oaks. It grows a hundred or more feet tall and has a broad-topped crown and a very thick trunk clothed with gray bark which flakes off in thick plates. This species worthily commemorates one of the pioneer Japanese explorers and botanical collectors in Formosa. *Lauraceae* decrease rapidly in numbers above 2500 m. altitude, but on the upper parts of Ari-san grow scattered trees of *Sassafras randaiense* Rehd., a recently recognized third member of this interesting genus. Among smaller trees *Adinandra lasiostyla* Hay., several species of *Symplocos* including *S. erio-botryaefolia* Hay. with lamellate pith, *Gilibertia pellucidopunctata* Hay. with polymorphous leaves, *Otherodendron illiciifolium* Hay., *Photinia serulata* Lindl., and various species of *Thea*, *Ilex* and *Osmanthus* are noteworthy. Of large shrubs or small trees with conspicuous flowers mention may be made of *Hydrangea Kawakamii* Hay. with huge deciduous leaves and broad flat corymbs of pink and blue flowers, *Viburnum melanophyllum* Hay. which is related to the Japanese *V. furcatum* Bl., *Photinia niitakayamensis* Hay., which is really a *Stranvaesia*, and has white flowers in corymbs and scarlet fruit, *Prinsepia scandens* Hay., which is not scandent, and has white, fragrant flowers and arching, green branchlets, *Mahonia lomariifolia* Takeda, *Berberis Kawakamii* Hay., *Rhododendron Morii* Hay., *R. Tanakai* Hay., *R. formosanum* Hemsl. and others. Rubi in many species abound, and in open, grass-clad regions beyond Ari-san *Rhododendron rubropilosum* Hay. is common and so too is the lovely *Pieris taiwanensis* Hay. Among the climbers the evergreen *Hydrangea integra* Hay. and *H. integrifolia* Hay., with *Schizophragma integrifolium* var. *Fauriei* Hay., *Rhus orientale* Schneid., *Eronimus Spraguei* Hay., *Kadsura japonica* S. & Z., *Actinidia chinensis* Planch. and other species, *Hedera himalaica* Tobl., *Clematis Morii* Hay. and others, and species of *Smilax* and *Ficus* demand notice. The forest-bed in all but the most intensely shaded places is choked with *Arundinaria niitakayamensis* Hay. and *A. oiwakensis* Hay. These graceful Bamboos with their feathery culms grow from 6 to 10 ft. tall, and form impenetrable jungles and ultimately crowd out all other undergrowth. Epiphytic plants are plentiful including such shrubs as *Rhododendron Kawakamii* Hay., *Vaccinium emarginatum* Hay., *V. caudatifolium* Hay., *Gaultheria Cumingiana* Vidal, *Pachycentria formosana* Hay. and the pinnate-leaved *Pentapanax castanopsicola* Hay. Different species of *Loranthus* are common

and on *Alnus formosana* Mak. a Mistletoe is a bad pest. Most of the broad-leaf trees have buttressed boles and their average height is from 80 to 120 ft. with a girth of from 9 to 15 ft. Rich in variety is the vegetation of these forests and most impressive are the trees in lofty stature, size and grandeur.

Above 3000 m. broad-leaf trees play a minor part in the composition of the forests. Shrubs, more especially those belonging to northern genera, increase in number and the variety is considerable, but Conifers everywhere predominate. West of Ari-san toward Mt. Morrison up to 3300 m. altitude a Spruce (*Picea morrisonicola* Hay.) and a Hemlock (*Tsuga chinensis* Pritz.) with *Pinus taiwanensis* Hay. and *P. Armandi* Franch. are almost the only large trees. They grow first with broad-leaf trees and higher up on the mountains form pure stands or forests of themselves. At their highest level they are associated with *Abies Kawakamii* Hay. which between 3500 and 3800 m. forms extensive pure forests except for occasional trees of *Juniperus squamata* Lamb. West of Musha on Noko-san and Kiraishiu the Conifer-zone is between 2500 to 3300 m. The Pines have been sufficiently mentioned but the others deserve a word or two. The *Tsuga* is found at altitudes of from 2500 to 3300 m. and in rocky places often forms extensive and semi-pure woods. At its best it is the most picturesquely beautiful of all Formosan Conifers. Trees 30 ft. in girth of trunk with thick, wide-spreading branches forming massive tabuliform crowns and from 80 to 120 ft. tall are common. The bark is nearly white on the outer surface, red-brown within, papery and scaling. Nowhere in my travels have I seen such magnificent *Tsuga*-trees as those which grow round Noko beyond Musha in the western limits of the Nanto prefecture.

The *Picea* I saw only west of Ari-san. It is a lofty tree, in sheltered places fully 150 ft. tall, but usually is less than 100 ft. high and in girth of trunk from 10 to 20 ft. The leaves are dark green and slender and the aspect of the tree decidedly sombre. The bark is gray and separates in round thin scales. The *Abies* is a handsome species with very resinous violet-purple cones, and nearly white bark, scaly and fissured into irregular, oblong plates. It grows from 50 to 120 ft. tall and from 6 to 15 ft. in girth of trunk. On windswept slopes above Noko and at its altitudinal limits on Mt. Morrison it is reduced to a bush from 5 to 8 ft. high. The tree is pyramidal in habit with horizontally disposed branches, and its blunt leaves are dark green above and silvery below. The dwarf Bamboos already mentioned form the principal undergrowth up to about 3500 m. and above this *Rhododendron Morii* Hay. and *R. pseudochrysanthum* Hay. predominate. Occasional bushes of *Ribes formosanum* Hay., *Berberis morrisonicola* Hay., *B. breviseptala* Hay., *B. mingtsensis* Hay., *Lonicera oiwakensis* Hay., *Rosa morrisonensis* Hay., *R. transmorrisonensis* Hay. and other shrubs with *Rubus randaiensis* Hay. and other species occur, and *Sorbus randaiensis* Hay. is a small and fairly common tree. On bare rocks and heath-like pastures *Gaultheria borneensis* Stapf, *Vaccinium Merrillianum* Hay., *Rubus calycinoides* Hay. and *Cotoneaster morrisonensis* Hay. form extensive mats. The *Cotoneaster* has small, shining, evergreen leaves, conspicuous white

flowers and bright scarlet fruits, and is very closely related to *C. Dammeri* Schneid. of central and western China. On the divide beyond Noko I gathered a species with deciduous leaves and red fruits very similar to *C. horizontalis* Deene. abundant in the above mentioned regions in China.

The tops of all the higher peaks of the central range are bare of trees and clothed with grass, various herbs and low shrubs. On Mt. Morrison the tree limit is at about 3800 m. Above this for some 150 m. *Juniperus squamata* Lamb. forms a low impenetrable jungle. In the *Abies*-forests this Juniper is often a handsome tree, sometimes as much as 50 ft. tall and 8 ft. in girth of trunk, with a shapely, nearly oval crown and between this and a low mat closely hugging the ground there is every intermediate condition. On exposed rocks low trees or large bushes of this Juniper with broad irregular crowns and gnarled branches clothed with pendent masses of a silvery gray Lichen (*Usnea longissima* Ach.) are exceedingly picturesque. On Kiraishiu this Juniper covers extensive areas with a dense, low growth.

The crumbling summit of Mt. Morrison, 3985 m. above the sea, is reached by a dangerous path, but the climb is not difficult above the trees. It is bare save for a few herbs, among which an Edelweiss is prominent, occasional low bushes of *Rhododendron pseudochrysanthum* Hay., the tiny *Gaultheria borneensis* Stapf with snow-white bells, prostrate mats of the Juniper and a *Salix*. I reached the summit when a slight but bitterly cold sleet storm was in progress and after sojourning beneath the over-hanging lee of some cliffs two thousand feet below for three days. From the summit a wonderful view embracing the Pacific Ocean on the east, the Formosan Channel on the west and much of the island to the north and south is to be had in clear weather. When on the summit I could not see more than fifty feet in any direction and the strong gale and sleet storm made almost inaudible the banzai cheers with which my Japanese companions and police announced our conquest of the highest mountain in the Japanese Empire and the loftiest peak between the Californian Sierra Nevada and the snow-clad peaks of the Chino-Thibetan borderland.

Hayata in his paper already referred to gives percentage tables which show that the flora of Formosa is specifically as closely related to that of Japan as to that of China. To this I cannot agree. His premises, owing to inadequate comparative knowledge of the Chinese flora due to lack of material and opportunity, are at fault. That Formosa is a continental island is generally accepted. It was probably separated from the mainland of China in Tertiary times, and the dividing channel to-day is nowhere more than 100 fathoms deep. A very natural conclusion would be that the flora is most closely related to that of the east coast provinces of China from the mouth of the Yangtze River southward. And it is really surprising that this is not so. The real affinity, however, is with that of central and southwestern China — that is with that of the provinces of Hupeh, Kweichou, Szech'uan and Yunnan.

I have not had the time necessary to compare material in general gath-

ered in the two widely separated regions. I am positive, however, that in the evergreen Fagaceae and Lauraceae many trees will be found conspecific. A concrete example of this relationship is *Pittosporum daphniphylloides* Hay. which grows on Ari-san and elsewhere in Formosa and on Mt. Omei and in neighboring mountains in western Szech'uan. Some of the Rubi in the two regions are identical and like the *Pittosporum* are absent from eastern China. Some types, *Rhododendron Mariesii* Hemsl. & Wils. for example, which have their western limits in Hupeh and southeastern Szech'uan are found also in the eastern provinces of China and in Formosa. Among the more unstable modern genera the species are numerous, local in distribution and of minor importance in phytogeographical research. For such work old types are more instructive and as their species are usually limited in number they are more easily dealt with. The absence in Formosa of such types as Nyssaceae, Eucommiaceae, Cercidiphyllum, Euptelea, Magnolia and Hamamelis is puzzling since they are a feature in central and western China. But without magnifying unduly the anomalies we may obtain a better perspective of the problem of phytogeographical relationship if we consider a group like the Conifers and Taxads of Formosa and compare them with their relatives in Japan, eastern China and western China. Of the four species of *Pinus* in Formosa, one Hard Pine (*P. taiwanensis* Hay.) is endemic, and is essentially a mountain species though on the east coast it descends to below an altitude of 300 m. The other *P. Massoniana* Lamb. is confined to low altitude on the northwest and west-northwest parts, and in China is found from sea-level to 1300 m. altitude in all but the colder regions. The White Pine (*P. morrisonicola* Hay.) is endemic, and the Nut Pine (*P. Armandi* Franch.) though abundant in the central and western regions is absent in eastern China but reappears on Yaku-shima, Tanegashima and the southern tip of Kyushu in Japan. The *Abies* of Formosa (*A. Kawakamii* Hay.) is endemic but is closely related to *Abies Faxoniana* Rehd. & Wils. of northwest Szech'uan. The *Picea* (*P. morrisonicola* Hay.) is endemic but its nearest relative is *P. Watsoniana* Masters of western China. The *Tsuga* of Formosa (*T. morrisonicola* Hay.) is identical with *T. chinensis* Pritzl abundant in central and western China but absent from eastern China. The *Pseudotsuga* (*P. Wilsoniana* Hay.), is conspecific with *P. sinensis* Dode of Kweichow and Yunnan. The *Keteleeria* is *K. Davidiana* Beissn. so abundant in central and western China up to 1600 m. altitude. This is instructive since in eastern China grows *K. Fortunei* Mayr, a very distinct species. The *Cunninghamia* of Formosa (*C. Konishii* Hay.) is endemic and the other species of the genus (*C. lanceolata* Hook.) is confined to China. The *Taiwania* first discovered in Formosa is now known to grow wild in the extreme northwest border of Yunnan. The related *Cryptomeria* is purely Japanese being unknown as a wild tree in China and Formosa. *Chamaecyparis*, unknown in the continental areas of the Old World is represented by the gigantic *C. formosensis* Matsum. and another which is apparently identical with the Japanese *C. obtusa* S. & Z. The *Libocedrus* (*L. macrolepis* Benth. & Hook. f.) is confined in Formosa to the

northwest and reappears again in Yunnan. This is curious since its close relative *Fokienia* of eastern China and western Tonking is unknown in Formosa and central and western China. The two *Junipers* of Formosa, *J. formosana* Hay. and *J. squamata* Lamb., abound in central and western China and the last-named in its dwarf form is found as far west on the Himalayas as Sikkim.

Turning to the *Taxads*, no *Torreya* has yet been found in Formosa, the *Cephalotaxus* is rare and apparently an endemic species, but the Yew, also rare, is identical with *Taxus chinensis* Rehd. of central and western China. The species of *Podocarpus* need a thorough investigation. One is certainly *P. nagi* Zoll. & Moritz indigenous also on the Liukiu Islands and in south Japan, another is very similar if not identical with *P. macrophyllus* D. Don, also indigenous in Liukiu and south Japan. It is possible that of the other recorded species one may be endemic or they may be the same as the above. But the curious thing is that none of them are known to grow wild in China. To sum up, *Podocarpus* and *Chamaecyparis* show an affinity with the flora of Japan, while the other *Taxads* and the *Conifers* and many broad-leaf trees show the connection with that of central and western China. Broadly speaking no real line can be drawn between the temperate floras of Japan, Liukiu, Formosa, China and the Himalayas. The generic types are largely common to the whole vast territory though in number they are richer and more concentrated in central and western China. Narrowed down to species and related species the regions mentioned constitute distinct geographical entities. From this viewpoint the flora of Formosa has closer relationship with that of central and western China than with that of Japan, Liukiu or the fairly adjacent coastal provinces of China.

Thanks to the enlightened policy of the Japanese Government in promoting a botanical survey of Formosa and to the assiduous labors of Dr. B. Hayata much progress toward a knowledge of the rich and varied flora of that island has been made. But we know so little about the flora of China and the regions west to Sikkim that it will be long before exact knowledge of the affinities and geographical distribution of species will be possible. A century hence some botanist may critically analyze and compare the floras of the region I have sketched. Formosa is indeed the "Pearl of the Orient" and her crowning glory are the magnificent forests of ever-green *Lauraceae* and *Fagaceae*, the gigantic *Chamaecyparis* and the lofty *Taiwanias* which clothe her steep and rugged mountains. Preserved from the utilitarian Chinese by the head-hunting custom of the aboriginal population, it is sincerely to be hoped that these forests may not be destroyed by the progressive Japanese.

NEW SPECIES, VARIETIES AND COMBINATIONS FROM THE HERBARIUM AND THE COLLECTIONS OF THE ARNOLD ARBORETUM ¹

ALFRED REHDER

ROSACEAE (*continued*)

Sorbus L.

× *Sorbus arnoldiana*, hybr. nov. (= *S. Aucuparia* × *discolor*)

Arbor pyramidalis ramis suberectis vel erecto-patentibus; ramuli juniores fere glabri vel sparsissime villosi; gemmae fusco-purpureae, margine perularum dense et longe ciliato et apice barbato exceptis glabrae vel sparse longe pilosae. Folia 6-7-juga; foliola anguste oblonga, acuta, basi oblique late cuneata vel fere rotundata, 3-5 cm. longa et 0.8-1.4 cm. lata, basis quarta parte inferiore plerumque excepta argute serrata vel interdum ad medium, rarius ultra integra, supra glabra, laete viridia, subtus initio sparse, ad costam densius villosa, maturitate glabra vel secus costam sparse villosa, glaucescentia; petioli 1.5-2.5, rarius 3 cm. longi, ut rhachis purpurascens et initio sparse villosi, mox glabri; stipulae 5-8 mm. longae, digitato-incisae, pleraeque persistentes. Corymbi circiter 10 cm. diam., satis densi, rhachi et ramulis sparse villosi; flores 8-10 mm. diam.; petala ovalia vel late ovata, 3.5-4 mm. longa; stamina petalis subaequilongae; styli 3-4. Fructus subglobosi vel subpyriformes, 7-9 mm. diam., rosei; rhachis et ramuli inflorescentiae glabri et purpurascens.

Cultivated at the Arnold Arboretum (raised from seed of *S. discolor* Maxim. in 1907); specimens collected May 16 and September 26, 1918, *A. Rehder* (type).

This new hybrid was raised at the Arnold Arboretum in 1907 from seed collected from a tree of *S. discolor* Maxim. (*S. pekinensis* Koehne) received in 1902 from the nursery of C. Gebbers, Wiesenburg, Germany. It differs from *S. discolor* in the pubescence of the under side of the young leaflets, the smaller stipules, the shorter petioles, the denser villose inflorescence and in the pink fruits; from *S. Aucuparia* which is apparently the other parent it may be distinguished by the narrower leaflets, the larger, deeply incised and partly persistent stipules, the glabrous or glabrescent winter-buds and by the pink fruit. As it grows in the Arboretum it is a handsome pyramidal tree of vigorous growth now 6 or 7 m. tall and attractive in spring with its numerous dense clusters of white flowers, and in autumn remarkable for the light pink color of its fruits.

Aronia Pers.

Aronia arbutifolia Ell. f. *leiocalyx*, forma nov.

A typo recedit calyce pedicelloque glabris vel fere glabris. — Folia obovata vel obovato-oblonga, subito acuminata, 4-6.5 cm. longa et 1.7-3.8

¹ Continued from vol. I, p. 263.

cm. lata; inflorescentia in parte inferiore satis plus minusve tomentosa, sursum glabrescens.

MASSACHUSETTS: Cedar Pond near Lynn, May 29 and October, 1886, *J. H. Sears* (type); same locality, October 16, 1890 and May 19, 1891, *C. E. Faxon*; Wyoma Lake, near Lynn, May 23, 1903, *A. Rehder*.

The glabrousness of the calyx and the upper part of the inflorescence suggests *A. melanocarpa*, but the leaves are pubescent beneath and the fruit is bright red and ripens in October. Specimens with similar pubescence I have seen from Maine, Virginia and South Carolina, but in the absence of fruits it is impossible to say if they belong here or to *A. floribunda*. This new variety is apparently not identical with *A. arbutifolia* b. *glabra* Elliott (Sketch Bot. i. 557 [1821]) which is described as having a glabrous calyx and the leaves a little hairy beneath while young, and glabrous at maturity, while in our form the leaves are tomentose beneath as in the type.¹

Aronia arbutifolia var. *pumila*, comb. nov. — *Mespilus pumila* Schmidt, Oester. Baumz. ii. 39, t. 88 (1794). — Krauss, Abbeild. Boom. Heest. 2 pp., t. (Class xii, Ord. iv.) (1802). — *Pyrus depressa* Lindley in Trans. Hort. Soc. vii. 230 (1827). — *Aronia depressa* Spach, Hist. Vég. ii. 90 (1834). — *Pyrus arbutifolia* 4. *pumila* Loudon, Arb. Brit. ii. 926, fig. 647, 648 (1838). — *Sorbus depressa* Heynhold, Nomencl. Bot. 772 (1840). — Hedlund in Svensk. Vetensk.-Akad. Handl. xxxv. No. 1, 116 (Monog. Sorbus) (1901). — *Sorbus arbutifolia* var. *depressa* Schneider, Ill. Handb. Laubholz. i. 698 (1906). — *Aronia arbutifolia* var. *depressa* Schneider in Fedde, Rep. Sp. Nov. iii. 150 (1906).

This is a dwarf form with creeping and rooting stems, small leaves and dark red fruits. I have little doubt that Lindley's *Pyrus depressa* is the same. Its dark purple fruits are described as downy, as are those of *Mespilus pumila*, which excludes *A. floribunda* with glabrous lustrous fruit. Specimens from Newfoundland agree in habit with the plant figured by Schmidt, but the color of the mature fruit of the Newfoundland plant is not known.

Aronia arbutifolia f. *macrophylla*, comb. nov. — *Pyrus arbutifolia* var. *macrophylla* Hooker in Comp. Bot. Mag. i. 25 [1835], nomen.

A typo recedit foliis majoribus usque ad 8 vel 9 cm. longis et interdum habitu arborescente.

LOUISIANA. Orleans Par'sh: New Orleans, 1833, *T. Drummond* (type, photograph seen); St. Tammany Parish: Covington, *T. Drummond* (photograph seen); Folsom, April 20, 1920, *R. S. Cocks* (Nos. 3332, 3333).

ARKANSAS. Hot Springs County: Malvern, June 23, 1915, *E. J. Palmer* (No. 8108).

TEXAS. San Augustine County: San Augustine, September 19, 1918, *E. J. Palmer* (No. 14460); Bland Lake, margin of sandy bog, April 2, 1918, *E. J. Palmer* (No. 13264).

¹ There was no specimen of this variety to be found in the Elliott herbarium preserved in the Charleston Museum, Charleston, S. C., but in the local herbarium I noticed a specimen from the Chicora woods, collected March 28, 1913, which answered Elliott's description and was stated to have "red berries."

This form differs from the type in the larger leaves which are up to 8 cm. long and 3.5 cm. wide in Drummond's specimen of which we received excellent photographs through the kindness of Dr. Prain; in Cock's No. 3333 they attain 9 cm. in length and 4 cm. in width. Palmer's Texas specimens came according to his notes from slender trees from 5 to 7 m. tall. The form with large leaves described as *A. arbutifolia* var. *Baenitziana* Schneider probably belongs to *A. floribunda*, as its fruit is fully ripe in August.

Sorbus arbutifolia var. *xanthocarpa* Hedlund (*Mespilus xanthocarpa* Loddiges¹) and *S. arbutifolia* var. *leucocarpa* Hedlund (*Pyrus arbutifolia* γ *alba* Willdenow) are unknown to me, and there is no reliable record in literature of forms with yellow or white fruit. Forms with large fruits have been named *A. arbutifolia* f. *macrocarpa* Zabel (in Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 192 [1903], nomen).

Aronia floribunda Spach. Hist. Vég. II. 89 (1834). — *Pyrus floribunda* Lindley in Bot. Reg. XII. t. 1006 (1826); Trans. Hort. Soc. VII. 229 (1827?)² — ? *Pyrus melanocarpa* β *subpubescens* Lindley, l. c. (1827?). — *Sorbus floribunda* Heynhold, Nomencl. Bot. 773 (1840). — ? *Sorbus melanocarpa* β *subpubescens* Heynhold, l. c. (1840). — ? *Aronia nigra* b. *pubescens* Dippel, Handb. Laubholzk. III. 386 (1893), pro parte. — *Pyrus arbutifolia* var. *melanocarpa* f. *pubescens* Rand & Redfield, Fl. Mt. Desert, 98 (1894). — *Aronia atropurpurea* Britton, Man. 517 (1901). — Britton & Brown, Ill. Fl. ed. 2, II. 291, fig. 2327 (1913). — Nash in Addisonia III. 1, t. 81 (1918). — *Sorbus arbutifolia* var. *atropurpurea* Schneider, Ill. Handb. Laubholzk. I. 698 (1906). — *Aronia arbutifolia* var. *atropurpurea* Schneider in Fedde, Rep. Sp. Nov. III. 150 (1906). — *Pyrus arbutifolia* var. *atropurpurea* Robinson in Rhodora, x. 33 (1908). — *Adenorhachis atropurpurea* Nieuwland in Am. Midl. Nat. IV. 94 (1915). — *Pyrus atropurpurea* Bailey in Rhodora, XVIII. 154 (1916). — *Pyrus melanocarpa* var. *atropurpurea* Farwell in Rep. Mich. Acad. Sci. XIX. 258 (1917).

This species is intermediate in its characters between *A. arbutifolia* and *A. melanocarpa* Elliott, resembling in its pubescence the first species and in its fruit the second. Therefore *A. floribunda* has been considered by some botanists, first apparently by Koehne (Deutsch. Dendr. 254 [1893]), a hybrid between these two species, but its wide distribution from Newfoundland or Nova Scotia to Florida and west to Michigan and Indiana and its occurrence in regions where only one or neither of the parents grow, is not in favor of this theory, though possibly hybrid forms occasionally occur which it seems impossible to distinguish from this species.

¹ Upon *Mespilus xanthocarpa* Loddiges, the fruit of which was unknown to him, Lindley based his *Pyrus melanocarpa* β *subpubescens* which probably belongs to the following species.

² As the date of Lindley's publication usually the date of the title page, 1830, is cited, but the volume was published in parts and Lindley's article must have appeared between 1826 and 1829, as he does not cite it in 1826, while in 1828 he quotes it under plate 1154 of the Botanical Register.

Photinia Lindl.

Photinia villosa DC. var. **coreana**, comb. nov. — *Pourthiaea coreana* Decaisne in Nouv. Arch. Mus. Paris, x. 148 (1874). — *Pirus mokpoensis* Léveillé in Fedde, Rep. Nov. Spec. x. 200 (1909). — *Pourthiaea villosa* var. **coreana** Nakai in Tokyo Bot. Mag. xxx. 25 (1916).

This variety differs from the type chiefly in the thinner, long-acuminate leaves and usually attenuate at the base, in the somewhat longer (3–6 mm. long) petioles and in the slenderer pedicels and branches of the inflorescence which is villous or sometimes only slightly so. It occurs in Korea and Japan.

Amelanchier Med.

× **Amelanchier grandiflora**, hybr. nov. (= *A. canadensis* × *laevis* Wiegand in herb.) — *A.?* *Botryapium lancifolia* Simon-Louis apud Zabel, Syst. Verz. Muenden, 19 (1878), nomen. — *A. canadensis grandiflora* Zabel in Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 191 (1903), nomen. — *A. lancifolia* hort. gall. ex Zabel, l. c. (1903), pro synonym.

Arbor vel frutex ramis patentibus gracilibus; ramuli juniores initio floccoso-villosi, mox glabri, annotini purpureo-fusci. Folia ovata vel oblongo-ovata, breviter acuminata, basi subcordata, 4–10 cm. longa et 2.5–4 cm. lata, subaequaliter argute serrata, initio glauco-purpurea et supra laxa, subtus satis dense tomento sericeo-floccoso cito evanescente oblecta, maturitate glabra, supra opace viridia, subtus glauca, utrinsecus nervis 7–12 conspicuis; petioli 1.2–2 cm. longi, initio sericeo-villosi, mox glabri. Racemi plerique pendentes, flexuosi, 5–10 cm. longi, 8–10-flori, laxissime sericeo-villosi, purpurascens; pedicelli inferiores 1.5–2.2 cm. longi, apicem versus decipientes; calyx extus glaber vel fere glaber, purpurascens; sepala triangulari-vel ovato-lanceolata, acuminata, 4–5 mm. longa, sub anthesi initio erecti, mox reflexi; petala oblongo-oblancoolata, 1.3–1.6 cm. longa et 5–6 mm. lata; ovarium apice glabrum; hypanthium late campanulatum. Fructus atropurpurei, leviter glaucescentes, 7–8 mm. diam., succulenti, dulces, sepalis reflexis, pedicellis inferioribus 1.7–2.5 cm. longis.

Cultivated specimens: Bot. Gard. Muenden, April 23 and July 3, 1893, *A. Rehder* (type); Arnold Arboretum under No. 4406 (received from Muenden in 1892). May 11, 1900, May 3, 1902, June 22, 1903, May 11 and July 6, 1912, May 14 and July 5, 1919; Arb. Spaeth, Berlin, May 8, 1909, *H. Jensen* (as *A. canadensis*).

The following spontaneous specimens in the herbaria of the Arnold Arboretum and of the New England Botanical Club and in the Gray Herbarium have been referred to this hybrid by Dr. K. M. Wiegand:

ONTARIO. Kingston, May 15, 1902, *J. Fowler*.

VERMONT. Windham County: Westminster, April 30, May 15, 1903, and (North) Westminster, Rod. Smith's pasture, May 3 and 10, 1903, *W. H. Blanchard* (distributed as *A. intermedia*). Rutland County: Noyes swamp, Pittsford, May 6, 1899, *W. W. Eggleston* (No. 1183); Rutland, July 7, 1899, *G. H. Ross* (Eggleston, No. 1118).

NEW HAMPSHIRE. Sullivan County: Summer's Falls, Plainfield, July 27, 1909, *W. W. Eggleston* (No. 1958).

CONNECTICUT. Hartford County: May 7 and June 16, 1901, May 8, June 13 and September 1, 1901, May 8 and June 9, 1901, *C. H. Bissell*; Glastonbury, May 14, 1913, *C. A. Weatherby* (No. 2863a); Tariffville, May 17, 1903, *E. J. Winslow & A. F. Hill*. New Haven County: banks of Mad River, May 1, 1913, *A. E. Blewitt* (No. 1800).

RHODE ISLAND. Providence County: Lime Rock, June 4, 1913, *C. F. Batchelder*; Lincoln, July 13, *M. L. Fernald*.

NEW YORK. Monroe County: Seneca Park, Rochester, May 4, 5, 18, June 21, July 6, 1905, *B. H. Slavin* (Nos. 1, 3, 8, 16). Chemung County: Latter Brook, May 13, 1898, *T. F. Lucy* (No. 5). Tompkins County: Fall Creek, Ithaca, 1885, *W. R. Dudley* (No. 54).

PENNSYLVANIA. Erie County: Presque Isle, May 8-9, 1906, *O. E. Jennings*. Lancaster County: mouth of Tucqan, April 29, 1893, *A. A. Heller & E. G. Halbach* (No. 1365).

VIRGINIA. Smyth County: Stalie's Knob, East Marion, May 18-19, 1892, *J. K. Small*; south fork of Holston River, east of Add Wolf, August 8, 1892, *J. K. Small*. Alexandria County: south of Alexandria, April 28, 1901, *G. S. Miller*.

NORTH CAROLINA. Rowan County: April 24, 1916, *T. G. Harrison* (No. 3).

GEORGIA. Richmond County: Augusta, May 22, April 6, 1900, *A. Cuthbert* (No. 2).

INDIANA. Warren County: two miles north of Attica, April 21, May 15, 1917, *C. C. Deam* (No. 22524). Ripley County: seven miles south-east of Versailles, June 18, 1915, *C. C. Deam* (No. 16116). Wells County: one mile below Vera Cruz, May 8, 1915, *Mrs. C. C. Deam* (No. 15582).

ILLINOIS. Jackson County: Grand Tower, May 3, 1902, *H. A. Gleason* (No. 2404); Tower Rock, May 7, 1902, *H. A. Gleason* (No. 2405).

MISSOURI. Marion County: Hannibal, August 28, 1911, *J. Davis* (Nos. 704, 713).

MICHIGAN. Marquette County: Turin, May 18, 1901, *B. Barlow*. Arenac County: Au Gres, June 21, 1912, *C. K. Dodge* (No. 4); Wayne County: Detroit, May 12, 1856 (*Herb. W. Boott*).

The specimens cited above are all intermediate in their characters between *A. canadensis* and *A. laevis* and there can be little doubt that they represent hybrid forms between these two species. The hybrid, as represented by the plants in the Arnold Arboretum differs from *A. canadensis* in the larger flowers, the longer and slenderer less pubescent racemes, in the purplish young leaves covered with a less dense, more floccose tomentum which soon disappears entirely; from *A. laevis* it differs in the tomentose young leaves, the slightly villose racemes with more numerous flowers on shorter pedicels and in the larger, more succulent fruit. Among the many *Amelanchier* grown at the Arboretum it is easily the most handsome and always attracts attention by the abundance of its large flowers set off effectively by the purplish foliage; it forms a large tree-like shrub with wide-spreading slender branches. As I saw it in 1893 in the Botanic Garden of the Forest Academy at Muenden it formed a well-shaped small or medium-sized tree with spreading branches; it had been received from the nursery of Simon-Louis near Metz as *A. lancifolia*, a name which apparently was never published.

Amelanchier grandiflora f. *rubescens*, f. nov.

A typo recedit floribus in alabastro intense purpureo-roseis. sub anthesi leviter roseo suffusus.

Cultivated in the Durand-Eastman Park, Rochester, New York; specimens collected: May 16, 1920, *B. H. Slavin & J. Dunbar*.

This handsome form agrees in its characters with the type except that the flowers are purple-pink in bud and suffused with pink when open. It is a seedling from a tree of typical *A. canadensis* growing in Seneca Park, Rochester, and represented in our herbarium by specimen collected by B. H. Slavin and marked No. 10. The seedling described above, however, shows unmistakably the influence of *A. laevis* which is growing at the same locality.

Malus L.

In the following conspectus of the genus *Malus* thirty-two species are recognized, including *Eriolobus* which had been considered by some botanists a distinct genus. These thirty-two species fall easily into several distinct and apparently natural groups which call for a systematic arrangement under sections and subsections to bring out their relationship. The first division of the genus into sections was proposed in 1893 by Koehne, who divided it into the sections *Calycomeles* and *Gymnomeles* according to the behavior of the calyx whether persistent or deciduous. Ten years later Zabel considering the vernation of the leaves the most important character proposed the section *Eumalus* with involute and never lobed leaves and the section *Sorbomalus* with conduplicate and more or less lobed leaves. In 1906 Schneider added two new sections, *Eriolobus* corresponding to the genus of that name, and *Docyniopsis* containing *M. Tschonoskii* which I had referred in 1903 to the genus *Eriolobus* chiefly on account of the presence of copious grit-cells in the fruit; this character, however, I do not now consider important enough for generic distinction and I am following Schneider in referring *Eriolobus* to *Malus*.

SECT. I. EUMALUS Zabel in Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 185 (1903), nomen. — Schneider, Ill. Handb. Laubholz. 1. 714 (1906). — Leaves involute in bud, never lobed; fruit without grit-cells.

Subsect. 1. PUMILAE, subsect. nov. — *M.* sect. *Calycomeles* Koehne, Deutsch. Dendr. 257 (1893), pro parte. — Calyx persistent: styles 5; fruit about 2 cm. thick or larger.

1. *M. pumila* Mill. — 2. *M. sylvestris* Mill. — 3. *M. prunifolia* Borkh. — 4. *M. spectabilis* Borkh. — The species of this subsection are closely related. — Europe, western to eastern Asia.

Subsect. 2. BACCATAE, subsect. nov. — *M.* sect. *Gymnomeles* Koehne, Deutsch. Dendr. 257 (1893), pro parte. — Calyx deciduous: styles 3–5; fruit small, not exceeding 1.5 cm.

5. *M. sikkimensis* Koehne. — 6. *M. baccata* Borkh. — 7. *M. theifera* Rehd. — 8. *M. Halliana* Koehne. — The species of this subsection are closely related except *M. sikkimensis* which seems to have some relation to *M. Prattii* and *M. yunnanensis*. — Eastern Asia, Himalayas.

SECT. II. SORBOMALUS Zabel in Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 721 (1906), nomen. — Schneider, Ill. Handb. Laubholz.

1. 721 (1906). — *M. sect. Gymnomeles* Koehne, Deutsch. Dendr. 257 (1893), pro parte. — Leaves conduplicate in bud, usually more or less lobed: calyx deciduous or sometimes persistent: styles 3-5: locules of ovary not extending with their apex to the base of style and core of fruit not protracted into a free pointed apex; fruit without or with few grit-cells.

Subsect. 3. *SIEBOLDIANAE*, subsect. nov. — Calyx caducous, leaving a large shallow scar: styles 3-5, villous at base: leaves of flowering branchlets not lobed; those of shoots partly 3-5-lobed, rarely not lobed: fruit subglobose, without grit-cells, small.

9. *M. floribunda* Sieb. — 10. *M. zumi* Rehd. — 11. *M. Sieboldii* Rehd. — 12. *M. Sargentii* Rehd. — The species of this group are all closely related. — Japan and Korea.

Subsect. 4. *KANSUENSES*, subsect. nov. — Calyx usually tardily deciduous, leaving a small deeply impressed scar, sometimes partly or wholly persistent: styles 3-5, glabrous: all leaves more or less lobed except in *M. fusca*: fruit ellipsoidal, without or with few grit-cells.

13. *M. fusca* Schneid. — 14. *M. transitoria* Schneid. — 15. *M. kansuensis* Schneid.¹ — 16. *M. Komarovii* Rehd. — 17. *M. honanensis* Rehd. — The first two species of this group form a transition to the preceding subsection on account of the absence of grit-cells in the fruit and of dots on the fruit and the first also in its only partly three-lobed leaves. The following two species have their fruits dotted and with a few grit-cells; of the last species which forms by the shape of its leaves a transition to the subsect. *Yunnanenses* the fruit is not yet known. — Western North America, eastern Asia.

Subsect. 5. *FLORENTINAE*, subsect. nov. — Calyx deciduous: leaving a small deeply impressed scar: styles 5, villous at base: all leaves lobed with several lobes on each side: fruit broadly ellipsoidal, without grit-cells.

18. *M. florentina* Schneid. — Italy.

Subsect. 6. *YUNNANENSES*, subsect. nov. — Calyx persistent: styles 5, glabrous or nearly so: leaves slightly lobed with several lobes on each side or not lobed: fruit subglobose, about 1 cm. across, dotted, with grit-cells.

19. *M. Prattii* Schneid. — 20. *M. yunnanensis* Schneid. — The first species seems to have some relation to the subsect. *Kansuenses*, while *M. yunnanensis* has leaves similar to those of *M. Tschonoskii*. — Western China.

SECT. III. *CHLOROMELES*, sect. nov. — *Chloromeles* Decaisne in Fl. des serres, XXIII. 156 (1881). — *M. sect. Calycomeles* Koehne, Deutsch. Dendr. 257 (1893), pro parte. — *M. subsect. Coronariae* Rehder in Sargent, Trees & Shrubs, II. 142 (1911). — Leaves conduplicate in bud, at least the leaves of shoots lobed, rarely without lobes: calyx persistent: styles 5, villous at base; anthers red or reddish; locules of ovary extending with their apex above base of style and core of fruit with free pointed apex: fr. subglobose or depressed, 2-5 cm. across, green or yellowish green, not dotted, without grit-cells.

¹ The styles of this species are glabrous in our specimens, not pilose as described by Batalin.

21. *M. platycarpa* Rehd. — 22. *M. coronaria* Mill. — 23. *M. glaucescens* Rehd. — 24. *M. glabrata* Rehd. — 25. *M. bracteata* Rehd. — 26. *M. lancifolia* Rehd. — 27. *Malus angustifolia* Mill. — 28. *M. ioensis* Britt. — This is a very distinct and at the same time homogeneous group; its species are so closely related that some authors have considered them as all belonging to one species. The type of the section is *Malus angustifolia*, the species upon which Decaisne based the genus *Chloromeles*. — Eastern North America.

SECT. IV. *ERIOLOBUS* Schneider in Fedde, Rep. Sp. Nov. III. 179 (1906). — *Pyrus* sect. *Eriolobus* Seringe in De Candolle, Prodr. II. 636 (1825). — *Eriolobus* Roemer, Syn. Monog. III. 216 (1847). — *Cormus* sect. *Eriolobus* Decaisne in Nouv. Arch. Mus. Paris, x. 157 (Mém. Fam. Pomac.) (1874). — *Eriolobus* sect. *Eucriolobus* Schneider, Ill. Handb. Laubholz. I. 725 (1906), pro parte. — Leaves conduplicate in bud, all deeply lobed, calyx persistent, with reflexed lobes; styles 5, villous at base; stamens 20–30; locules of ovary extending with their apex into base of style and core of fruit pointed and free at apex; fruit ellipsoidal, with grit-cells.

29. *M. trilobata* Schneid. A very distinct species which has no close relation to any other species. — Western Asia.

SECT. V. *DOCYNIOPSIS* Schneider in Fedde, Rep. Sp. Nov. III. 179 (1906). — *Eriolobus* Rehder in Sargent, Trees & Shrubs, I. 74 (1903), pro parte. — Leaves conduplicate in bud, not or very slightly lobed; inflorescence 2–5-flowered; calyx persistent, with upright lobes; stamens 30–50; styles 5, villous at base; locules of ovary extending into base of style and core of fruit pointed and free at apex; fruit 2–4 cm. across, dotted, with grit-cells.

30. *M. Tschonoskii* Schneid. — 31. *M. formosana* Kawak. & Koidz. — 32. *M. laosensis* A. Cheval. (*Pyrus laosensis* Cardot). — This group shows a close affinity to *Docynia* and particularly *M. formosana* much resembles in the structure of its flower that genus, but has only two ovules in each cell. *Malus docynioides* placed by Schneider in this section belongs to *Docynia*. — Eastern Asia.

Malus baccata Borkhausen f. *gracilis*, forma nov.

A typo recedit habitu humiliore, ramis patentibus ramulis gracilibus pendentibus, foliis ab initio glabris, ovato-oblongis vel oblongo-ellipticis, 5–8 cm. longis et 2–4 cm. latis, basi late cuneatis, crenato-serrulatis, petiolis 1.5–3.5 cm. longis, floribus minoribus, circiter 3 cm. diam., stylis saepe 4, fructibus 0.8–1 cm. longis, late obovoideis vel subglobosis, rubris.

Cultivated in the Arnold Arboretum; plants received from the Veitchian Nurseries in 1913 as *Pyrus* sp. Purdom no. 327; type specimens collected May 14 and October 21, 1919, preserved in the herbarium of the Arboretum.

This form belongs to the typical variety of *Malus baccata* (var. *sibirica* Schneid.), but differs from the commonly cultivated form chiefly in the graceful pendent habit, the comparatively narrower obtusely serrulate leaves with slenderer petioles, in the smaller flower with often only 4 styles and in the small fruits. The white flowers are not fragrant.

The exact native habitat of this form is not known with certainty. Purdom sent under No. 329 flowering specimens of *M. baccata* collected at Yen-an Fu, Shensi, and it is probable that No. 327 under which the plants were received from Veitch is a mistake for 329, as the number 327 is represented by a *Caragana* in his collection. None of his flowering specimens, however, agrees with our plant and no fruiting herbarium specimens of *M. baccata* have been collected by Purdom.

***Malus floribunda* Siebold var. *brevipes*, var. nov.**

A typo praecipue recedit foliis minoribus, floribus minoribus, albidis, circiter 2.5 cm. diam., pedicellis brevibus 0.8–1.5 cm. longis ut calyx glabris, petalis late ovalibus 1–1.2 cm. longis; stylis 3–4 quarta parte tantum connatis ima basi glabris et tantum versus apicem partis connatae sparse vel densius pilosis, fructibus subglobosis circiter 1 cm. diam. pedicello erecto vel suberecto 0.6–1.5 cm. longo suffultis.

Cultivated at the Arnold Arboretum under No. 1850 for many years, originally received as *Pyrus Sieboldii* probably from St. Petersburg; type specimens collected May 19 and October, 1898, preserved in the herbarium of the Arboretum.

This is a very peculiar form which in its leaf-characters agrees with *M. floribunda*, but the flowers are much smaller, only slightly pink, rather short-stalked and the style is more deeply divided and less densely pubescent. The shrub looks particularly distinct in autumn with its more or less upright fruit on rather stout pedicels rarely more than 1 cm. in length. It is not without hesitation that I refer this plant as a variety to *M. floribunda*, but it shows no characters which point to hybrid influence of any other species, and from *M. Sieboldii* it differs in the leaves which never show the slightest tendency toward lobing. It may be nearer to the wild form, *M. floribunda* var. *spontanea* Koidzumi which according to a specimen before me has smaller lighter colored flowers and smaller leaves than the cultivated typical form.

***Malus kansuensis* Schneider f. *calva*, forma nov.**

A typo recedit pedicellis calycibusque extus et foliis subtus ab initio glabris, ramulis et petiolis basin versus sparse pilosis mox glabris.

CHINA. Hupeh: Fang Hsien, alt. 2300 m., May 28 and September, 1907, *E. H. Wilson* (No. 264, flowers [type] and fruit); without exact locality, *A. Henry* (No. 6754), Shensi: Tai-pei-shan, 1910, *W. Purdom* (No. 1118). Western Szechuan: woodlands around Tachien-lu, 2600–3300 m., June, 1908, *E. H. Wilson* (No. 2996); without precise locality, alt. 3000 m., May, 1904, *E. H. Wilson* (Veitch Exped. No. 3495).

This new form is easily distinguished from the type by the absence of pubescence from the inflorescence and the leaves. The original description of Batalin is chiefly based on Potanin's specimens of which he describes the flowers with pubescent pedicels and calyx; in the description of the leaves as "glabra vel subtus in nervis puberula" he apparently includes fruiting specimens of Henry's No. 6754 which belongs to *f. calva*. Batalin's description of the flowers fits exactly Wilson's specimens from Pan-lan-shan under No. 2995 except that he describes the styles as pilose, while

I found them glabrous; in these specimens the young leaves are densely villose on the whole under side and the same pubescence is present in Purdom's specimens from western Kansu, which are in young fruit; the pubescence never disappears entirely and in Wilson's fruiting specimens under 4115 from Pan-lan-shan and Tachien-lu the mature leaves show more or less pubescence beneath, at least on the midrib and the veins.

Malus Komarovii, comb. nov. — *Crataegus tenuifolia* Komarov in Act. Hort. Petrop. xvii. 435 (1901); xxii. 470, t. 10 (Fl. Manchur.) (1904), non Britton. — Nakai in Jour. Coll. Sci. Tokyo, xxvi. art. 1, 180 (Fl. Kor. i) (1909); Chôsenshokubutsu, i. 292, fig. 346 (1914). — Schneider, Ill. Handb. Laubholz. i. 771 (1906). — *Crataegus Komarovii* Sargent, Pl. Wilson. i. 183 (1912). — Schneider, Ill. Handb. Laubholz. ii. 1005 (1912). — Nakai, Fl. Sylv. Kor. vi. 62, t. 29¹ (1916).

NORTHERN KOREA: "in jugi Koreani, in silvis mixtis primævis," June 20 (old style), 1897, *V. Komarov* (No. 862); Tumen-Yalu divide, prov. Kankyo, August 30, 1917, *E. H. Wilson* (No. 9058; bush 1.5 m.); above Kanin between Keizanchin and Choshin, prov. Kankyo, September 11, 1917, *E. H. Wilson* (No. 9143; bush 1-3 m.; fruit reddish); about middle of Mt. Laoling, prov. Kankyo, alt. 1300 m., September 17, 1917, *E. H. Wilson* (No. 9177; bush 1-2 m.; fruit reddish); "secus torrentes montis Sodenrei," July 10, 1914, *T. Nakai* (No. 1573).

Malus Komarovii is closely related to *M. kansuensis* and similar to its form *calva*, but is easily distinguished by the short pedicels of the fruit which are only 1-1.5 cm. long (2-3.5 in *M. kansuensis*), by the cordate or subcordate base of the more deeply lobed leaves, the sinus of the lower lobes reaching often more than halfway to the middle, and by the oblong-ovate gradually acuminate spreading or often slightly recurved lower lobes provided usually with a small basal lobe, while in *M. kansuensis* the lower lobes are triangular-ovate and abruptly short-acuminate without basal lobes. The resemblance of the leaves to those of certain *Crataegus* has led Komarov in the absence of mature fruit to place this plant in the genus *Crataegus*, but even before examining the structure of the ovary the racemose inflorescence shows at a glance that it is not a *Crataegus*.

As the first specific name given to this plant is a still-born name, the later valid specific name has to be used for the new combination under *Malus*.

Malus honanensis, sp. nov.

Frutex (verisimiliter); ramuli satis graciles, initio laxe floccoso-tomentosi, cito glabri, rubro-brunnei, nitiduli; gemmae juveniles (medio Junio) perulis paucis rubro-brunneis extus glabris margine villosis. Folia late ovata, rarissime oblongo-ovata, vel orbiculari-ovata, acuta, basi truncata vel rotundata, interdum subcordata, 4-7 cm. longa et 3.5-6.5 cm. lata, utrinque lobis 2-5 apicem versus decrescentibus brevibus late ovatis acutis vel obtusiusculis instructa, toto margine subsimpliciter argute serrulata vel interdum crenato-serrulata, initio utrinque laxe villosa-tomentosa, supra

¹ Nakai figures the fruit erroneously with a persistent calyx, but the calyx is finally deciduous, though it remains on the immature fruit a long time together with the remnants of the stamens and the styles.

mox glabra, subtus tarde glabrescentia, reticulo venularum impresso satis conspicuo, nervis utrinsecus circiter 5 rectis sub angulo circiter 45° divergentibus; petioli graciles, 1.5–2 cm. longi, initio villosio-tomentosi, tarde glabrescentes; stipulae lineari-lanceolatae vel subulatae, caducae. Flores (deflorati tantum visi) 5–8 in racemo umbelliformi; pedicelli post anthesin glabri, graciles, 1.5–3 cm. longi, cicatricibus bracteolarum notati; sepala deltoideo-ovata, acutiuscula, 2 mm. longa, extus glabra, intus dense villosa, post anthesin reflexa, verosimiliter demum decidua; petala orbiculari-ovata (unum tantum visum), 7–8 mm. longa, basi subcordata, unguiculo brevi, utrinque glabra; stamina circiter 20, 4–5 mm. longa; discus cupularis, glaber; styli 3, infra medium connati, toti glabri, stamina paulo superantes. Fructus desideratur.

CHINA. Honan: Sung Hsien, Shi-tze-miao, May 26, 1919, *Joseph Hers* (No. 489, type; No. 573); Teng Feng Hsien, Yu-tai-shan, alt. 800 m., April 23 and June, 1919, *Joseph Hers* (No. 222, 222bis, sterile); Hwei Hsien, Shang-hsi-kiang, June 17, 1919, *Joseph Hers* (No. 725).

This is a very distinct species related to *M. kansuensis* with which it agrees in the structure of the flowers, particularly in the 3 glabrous styles and the triangular-ovate sepals, but the leaves are very different from those of *M. kansuensis* which are usually three-lobed or occasionally five-lobed, and resemble those of *M. yunnanensis* Schneid. The plant might be described as having the leaves of *M. yunnanensis*, but smaller and comparatively broader and acute, not acuminate, and the flowers of *M. kansuensis*. As the mature fruit is not yet known, it remains doubtful whether the calyx is deciduous or persistent.

Mr. Hers notes three different vernacular names for this plant; for no. 222: "ta-yeh-mao-cha" (large hairy leafy Crataegus); for 573: "sung-lo-cha" (meaning doubtful, sung-lo being the classical name of an undetermined vine, or as Bretschneider has it, a mistletoe); for nos. 489 and 725: "mu-hu-li" (fox pear).

***Malus coronaria* var. *dasycalyx*, var. nov.**

A typo recedit calyce villosa, foliis subtus pallidioribus, eis turionum maturis interdum ad costam et venas leviter pubescentibus.

OHIO. Lucas County: Maumee River bank, Walbridge Park, Toledo, May 21 and September 28, 1914, September 29, 1915, *R. E. Horsey* (No. 253, type; near Ottawa Park, Toledo, May 24, 1915, September 29, 1914, *R. E. Horsey* (No. 308); May 22 and September 29, 1914, same place and collector (No. 259). Lorain County: Oberlin, October 4, 1915, *R. E. Horsey & Green* (No. 496). Harden County: Mt. Victory, May 16 and September 24, 1915, *R. E. Horsey* (No. 349). Franklin County: Columbus, May 17, 1914 and September 24, 1913, *R. E. Horsey* (No. 115). Clark County: Springfield, May 13, 1915, *R. E. Horsey* (No. 337).

INDIANA. Porter County: sand dunes 5 miles north of Chesterton, August, 1915, *C. C. Deam* (No. 18066). Noble County: 2 miles northwest of Wold Lake, May 14, 1919, *C. C. Deam* (No. 27458). Allen County: Godfrey Reserve, 3 miles south of Fort Wagner, May 14, 1919, *C. C. Deam* (No. 27479). Wells County: east of Bluffton, May 19, 1916, *C. C. Deam* (No. 19754); southeast of Bluffton, May 18, 1919, *C. D. Deam* (No. 27487). Whitley County: Loon Lake, May 14, 1919, *C. C. Deam* (No. 27474). Warren County: 2 miles south of Rainsville, May 10,

1919, *C. C. Deam* (No. 27356). Randolph County: 5 miles south of Winchester, May 18, 1919, *C. C. Deam* (No. 27498). Wayne County: Elliott Mill bog, 4 miles southeast of Richmond, May 18, 1919, *C. C. Deam* (No. 27499).

SOUTHERN ONTARIO: woods, Niagara, May 31, 1901, *J. Macoun* (Herb. Surv. Geol. Canada, No. 34405); Amherstburg, June 10, 1882, *J. Macoun* (Fl. Can. No. 81); Fort St. Detroit, May 23, 1869 (Herb. Wm. Boott); all three in Herb. Gray.

This variety seems to be restricted to the southwestern part of the Great Lakes region, its range extending from southern Ontario to central Ohio and to middle and northwestern Indiana and probably to northeastern Illinois.

The flowering specimens show some resemblance to *M. glaucescens* Rehder which is an Alleghanian species ranging from northwestern New York to northern Alabama, but they differ in the more or less villous calyx while the pedicels are glabrate and in the narrower and longer leaves less deeply lobed and less glaucescent; the adult leaves of vigorous shoots differ still more being less deeply lobed, green or only slightly glaucescent beneath and particularly toward the end of the shoots pubescent on the midrib beneath and borne on short, pubescent petioles; such leaves occur in *M. coronaria* but not in *M. glaucescens*.

***Malus coronaria* var. *dasycalyx* f. *Charlottae*, forma nov.**

A typo varietatis recedit floribus semiplenis majoribus.

Hort. E. P. DeWolf, Waukegan, Illinois, June 1, 1919, and June 20, 1920, *E. P. DeWolf*.

This handsome double-flowered form was discovered about eighteen years ago by Mrs. Charlotte M. DeWolf, near Waukegan. It is the second double-flowered form known of American Crab Apples. From the well known Bechtel Crab, *M. ioensis plena*, it is easily distinguished by the characters in which *M. coronaria* var. *dasycalyx* differs from *M. ioensis*.

Malus coronaria Charlottae is apparently fully as handsome as the Bechtel Crab and will probably become like that form a favorite ornamental tree.

***Malus angustifolia* Mill. f. *pendula*, forma nov.**

A typo recedit ramulis gracilibus pendulis.

FLORIDA. Gadsden County: River Junction, June 25, 1914, *T. G. Harbison* (No. 129).

According to Mr. Harbison this form is very conspicuous among other Crab Apples on account of its peculiar weeping habit. It should be introduced into cultivation, as it will prove probably a valuable ornamental tree.

Malus bracteata Rehder in Sargent, Trees & Shrubs II. 230 (1913); in Mitteil. Deutsch. Dendr. Ges. XXIII. 261 (1914). — *Pyrus bracteata* Bailey in Rhodora, XVIII. 155 (1916); Stand. Cycl. Hort. v. 2878 (1916). — *Malus redolens* Ashe in Bull. Charleston Mus. XII. 39 (1916).

Malus bracteata originally described from a tree in southeastern Missouri has according to recent extensive collections a much wider range which extends from North Carolina to northwestern Florida and west to southeastern Missouri and central Alabama. The chief characters of *M. bracteata* are

the obtuse or acute, serrate or serrulate never lobed leaves of the flowering branchlets and the slightly lobed rather broad leaves of the vigorous shoots, pubescent beneath at least on the veins. The mature leaves of the shoots resemble those of *M. ioensis* var. *Palmeri*, but that species differs in its tomentose calyx. From *M. lancifolia* which some forms of *M. bracteata* resemble it differs in the broader and thicker strongly veined and pubescent leaves of the shoots, which are in *M. lancifolia* thin and glabrous at maturity and those of the flowering branchlets acute or acuminate at the apex. It is perhaps most closely related to *M. angustifolia* from which it differs chiefly in the broader and larger serrulate or serrate, not crenate leaves usually rounded at base and of thinner texture and not turning brown in drying, like those of *M. angustifolia*. The persistent bractlets which form a conspicuous feature of the Missouri specimens are smaller and early deciduous in most other specimens.

Malus ioensis f. *plena*, comb. nov. — *Pyrus angustifolia* fl. *pleno* in Gard. Chron. ser. 3, XIII. 43, fig. 8 (1893). — *Pyrus coronaria* fl. *pleno*, l. c. xxv. 39, fig. 145 (1899). — *M. angustifolia plena* Hartwig in Mitteil. Deutsch. Dendr. Ges. xvi. 268 (1907). — *M. angustifolia* fl. *pleno* Morel in Rev. Hort. 1910, 60, tab. — Burvenich in Rev. Hort. Belg. xxxviii. 185, tab. (1912). — *M. coronaria* var. *plena* Schneider in Silva-Tarouca, Uns. Freil.-Laubg. 264 (1913). — *Pyrus coronaria* f. *plena* Voss in Putlitz & Meyer, Landlex. iv. 68 (1913). — *Pyrus coronaria ioensis* fl. *pleno* Kache in Gartenw. xviii. 477, fig. (1914). — *Pyrus ioensis flore pleno* Bean, Trees Shrubs Brit. Isls. II. 286 (1914). — *Pyrus angustifolia Bechtelii* Greening Nursery Co., Descript. Book, 31, fig. (191?).

This double-flowered form of *M. ioensis*, generally known as "Bechtel's Crab" was found near Staunton, Illinois, and was introduced into cultivation by E. A. Bechtel of Staunton about 1888 from a tree found wild northeast of Staunton and known to old settlers for about 40 years (see Garden Mag. xvii. 318 [1913]). Flowering specimens were sent to the Arboretum in 1892 by Mr. Bechtel under the name *Pyrus angustifolia* fl. *pleno*.

HYBRIDS

× *Malus robusta*, nomen nov. = *M. baccata* × *prunifolia* Koehne, Deutsch. Dendr. 260 (1893). — ? *Pyrus baccata* var. *cerasifera* Regel in Gartenfl. xi. 202, t. 364, figs. 1, 6 (var. *cerasiformis* in tab.) (1862). — *Pyrus cerasifera* Wenzig in Linnaea, xxxviii. 45 (1874), non Tausch. — *Pyrus cerasifera* var. *hyemalis* Wenzig, l. c. — *M. microcarpa turbinata* Carrière, Étud. Gén. Pomm. Microcarp. 71 (1883). — *M. microcarpa cerasiformis* Carrière, l. c. 72 (1883). — *M. microcarpa robusta* Carrière, l. c. 76 (1883). — *M. microcarpa jucunda* Carrière, l. c. 81 (1883). — *M. microcarpa macrantha* Carrière, l. c. 94 (1883). — *M. microcarpa kermesina* Carrière, l. c. 87, fig. 15 (1883); in Rev. Hort. 1885, 112, fig. 21. — *Malus cerasifera* Zabel in Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 187 (1903), non Spach. — *Malus cerasifera coccinea* hort. apud Zabel, l. c. — *M. cerasifera*

coccinea macrocarpa hort. apud Zabel, l. c. — *M. cerasifera hiemalis* hort. apud Zabel, l. c. — *M. cerasifera jenensis* hort. apud Zabel, l. c. 188 (1903). — *M. cerasifera odorata* hort. apud Zabel, l. c. — *M. odorata* Hort. Gall. ex Zabel, l. c. (1903), pro synon.

This hybrid has been called by many recent authors *Malus* or *Pyrus cerasifera*, but *M. cerasifera* Spach as well as *Pyrus cerasifera* Tausch are synonyms of *M. baccata* var. *mandshurica* and not applicable to this hybrid. The numerous forms of this hybrid are also often found in gardens referred to *M. baccata* Borkh. or *M. prunifolia* Borkh. under various varietal names. Of the different specific names attributed by various authors to this hybrid or quoted as synonyms none seems to be applicable to it. *Malus sibirica* Borkh. is according to the author's description either a form of *M. pumila* Mill. or *M. astrachanica* Dum.-Cours. *Pyrus microcarpa* Wendl. (not *P. microcarpa* Spreng.) of which I have not been able to find the place of publication is cited by Roemer (Syn. Monog. III. 214 (1847)) as a synonym of *M. baccata*, while *M. microcarpa* Carr. is a collective name for all Apples with smaller fruit than those of the common cultivated Apple; it seems to have been first applied to *M. microcarpa fastigiata* (in Rev. Hort. 1879, 215) which is apparently a form of *M. pumila*. *Pyrus rubicunda* Hoffmanns. (*M. rubicunda* Roem.) is probably a form of *M. prunifolia* or of *M. sylvestris*. *Pyrus ceratocarpa* Wender. has been taken for a form of *M. prunifolia* (*M. prunifolia* ζ *ceratocarpa* Roem.) and *P. sphaerocarpa* Wender. is probably *M. baccata* var. *mandshurica* Schneid. to which variety also *P. suaveolens* Wender. may possibly be referable.

To this hybrid belong many of the forms cultivated under the name "Siberian Crabs" and the "Red Siberian" (colored plate in Beach, Apples of New York, II. 264, tab.) may serve as a representative of this group. One of the oldest forms is probably "Biggs' Everlasting Crab" mentioned by Loudon who states that it was raised in the Cambridge Botanic Garden by Mr. Biggs from seed received in 1814 from Siberia.

× *Malus robusta* var. *persicifolia*, var. nov.

A formis aliis recedit praecipue foliis oblongo-lanceolatis, 5–7.5 cm. longis et 1.5–2.5 cm. latis. — Arbor parva ramis suberectis satis robustis, folia acuminata, basi cuneata, argute serrulata, ab initio fere glabra, maturitate subchartacea; petioli 1–1.5 cm. longi; flores albi, in alabastro leviter carneo suffusi, 2.5 cm. diam.; pedicelli 2–2.5 cm. longi, ut calyx glabri: fructus subglobosus, circiter 1.5 cm. diam., plerique calyce deciduo interdum parvo persistente coronati, flavi, colore rubro suffusi.

Cultivated at the Arnold Arboretum; received from the Veitchian Nurseries in 1913 as *Pyrus* sp. Purdom (No. 179); type specimens collected May 8 and August 26, 1918, preserved in the herbarium of the Arboretum.

This is a very distinct looking Apple with rather stout branches fairly closely set with narrow peach-like leaves; but presenting no striking ornamental qualities.

× *Malus adstringens* Zabel = *M. baccata* × *dasyphylla* Zabel in Beiss-

ner, Schelle & Zabel, Handb. Laubholz-Ben. 187 (1903) (= *M. baccata* × *M. pumila*). — ? *M. transcendens* [Hort. apud Nash] in Jour. New York Bot. Gard. XIX. 195 (1918), nomen.

Zabel's name though published without description may be considered sufficiently fixed by the indication of the parentage and seems to be the oldest name for the hybrids between *Malus baccata* and *M. pumila*. *Malus adstringens* is similar to *M. robusta* and not always easily distinguished from it, particularly as ternary hybrids like *M. (baccata* × *prunifolia*) × *pumila* probably occur, but the generally more pubescent leaves, the shorter stalks of the flowers and fruits, the larger, often depressed fruits with more impressed calyx will distinguish this group of hybrids which is also included under the general term "Siberian Crabs." Forms like "Hyslop" (see Beach, Apples of New York, II. 257, tab.), "Transcendent" (Beach, l. c. 266, tab.) and "Martha" (Beach, l. c. 259, tab.) may serve as types of this group of hybrids which is from an economic point of view more important than the forms of *M. robusta*.

× *Malus sublobata*, comb. nov. (= *M. prunifolia rinki* × *Sieboldii*). — *Pirus Ringo sublobata* Zabel, Syst. Verz. Muenden, 18 (1878), nomen. — *P. Ringo trilobata* Zabel, l. c. (1878). — *Malus Ringo a. sublobata* Dippel, Handb. Laubholzk. III. 400 (1893). — *M. Ringo* × *Toringo sublobata* Zabel in Beissner, Shelle & Zabel, Handb. Laubholzk. 188 (1903). — *M. Ringo* × *Toringo trilobata* Zabel, l. c. 189 (1903).

Arbor coma pyramidalis ramis suberectis vel adscendentibus, vel coma rotundata ramis patentibus; ramuli satis robusti, juniores tomentosi, demum glabrescentes, fusco-purpurei; gemmae perulis tomentosis partim glabrescentibus. Folia vernatione partim conduplicata, partim involuta, ea ramulorum brevium anguste elliptica vel elliptico-oblonga, 3.5–8 cm. longa et 2–3.8 cm. lata, breviter acuminata, basi cuneata, argute simpliciter serrata, rarissime lobis brevibus 1–2 instructa, initio utrinque villosito-tomentosi, supra mox glabra, subtus tomento persistenti tenui vestita; petioli 1–4 cm. longi, graciles, pubescentes; folia turionum late ovata ad oblongo-ovata, ad 8 cm. longa et ad 7 cm. lata, basi rotundata vel late cuneata, superiora plura vel pauca utrinque, vel uno latere tantum, infra medium lobo brevi acuto instructa, maturitate chartacea; petioli plerique 1.5–2 cm. longi. Flores 3–6, albo-rosei, 3.5–4 cm. diam.; pedicelli 1.5–2.5 cm. longi, ut calyx albo-villosi; lobj calycis anguste triangulari-lanceolati, circiter 7 mm. longi; petala ovalia, circiter 2 cm. longa, basi rotundata; styli 5 vel 4, raro 3, circiter 1 cm. longi, staminibus paulo longiores. Fructus subglobosus, 1.5–2 cm. diam., interdum leviter costatus, flavus, calyce persistente basi in tubum brevem connato coronatus vel interdum calyce deciduo.

Cultivated at the Arnold Arboretum under No. 3833–1, of unknown origin; type specimens collected May 25, 1916, and September 23, 1918, preserved in the herbarium of the Arboretum.

This is a very handsome tree of pyramidal habit, or in one form with a round head, conspicuous in autumn by its numerous yellow fruits. It has

the general appearance of a vigorous form of *M. robusta*, but the veneration of the leaves which at least on the upper part of vigorous shoots are distinctly lobed and the number of styles which varies to 4 and even to 3 show the influence of *M. Sieboldii*. Of the origin of our plants nothing certain is known; the form with the round head probably came up in a lot of mixed *Malus* seeds brought in 1892 by Professor Sargent from Japan. As it appears from the synonyms enumerated above, forms of similar origin had been cultivated by Zabel in the arboretum at Muenden, Germany, before 1878, but a plant received as *M. Ringo sublobata* from Spaeth's nursery near Berlin, Germany, in 1900, proved to be a form of *M. robusta*.

× *Malus Arnoldiana* Sargent in Arnold Arb. Bull. no. xxii. 2 (1912), nomen. — Dunbar in Garden Mag. xxx. 22. fig. (1919) (= *M. baccata* × *floribunda*.) — *M. floribunda* var. *Arnoldiana* Rehder in Moeller's Deutsch. Gärt. Zeit. xxiv. 27, 2 figs. (1909). — *Pyrus pulcherrima* var. *Arnoldiana* Bailey in Rhodora, xviii. 155 (1916); Stand. Cycl. Hort. v. 2875 (1916). — *Malus pulcherrima* var. *Arnoldiana* [Nash] in Jour. New York Bot. Gard. xix. 194 (1918).

When I described this handsome flowering Crab in 1909 as a variety of *M. floribunda*, I believed that *M. floribunda* was probably a hybrid of *M. baccata* and *M. Sieboldii*, but I now consider *M. floribunda* to constitute a species, being led to this change of opinion partly on account of the discovery of a similar wild form described as *M. floribunda* var. *spontanea* Koidz., and partly on account of the fact that the hybrid theory does not satisfactorily explain the characters of *M. floribunda*.

Malus purpurea, comb. nov. (= *M. atrosanguinea* × *M. pumila* var. *Niedzwetzkyana*). — *M. floribunda purpurea* Barbier & Cie. in Rev. Hort. 1910, 539. — *Pyrus Malus floribunda purpurea* R. C. Notcutt in Gard. LXXXVIII, 220 (1914). — *Pyrus floribunda* × *P. Niedzwetzkyana* in Gard. Chron. ser. 3, LXII. 221, fig. 84 (1917). — This hybrid was offered to the trade in 1910 by Barbier & Cie. of Orléans, France, and was stated to be a hybrid between *M. floribunda atropurpurea* and *M. Niedzwetzkyana*, which seems to be correct judging from the characters of the plant. This makes it a ternary hybrid, as *M. atrosanguinea* is supposed to be a cross between *M. Halliana* and *M. Sieboldii*. From *M. pumila* var. *Niedzwetzkyana* it differs chiefly in the occasionally lobed, smaller and lustrous leaves, in the longer-pedicled flowers with oblong petals and partly 4 styles and in the smaller fruit with sometimes deciduous calyx; from *M. atrosanguinea* it differs in the purplish young leaves, the purplish wood, in the larger and darker colored flowers and in the much larger fruit with usually persistent calyx.

Besides this hybrid two other hybrids of *M. pumila* var. *Niedzwetzkyana* have been briefly described by Professor N. S. Hansen in a leaflet published by the Department of Horticulture of the South Dakota State College of Agriculture and Mechanic Arts, entitled Northern Novelties for 1920. One of these hybrids is called "Hopa Red-flower Crab" and *M. baccata* is stated to be the male parent; it will, therefore, have to be classified as a variety

of *M. adstringens*. The other hybrid is called "Red Tip Crab" and is a hybrid with a wild Crab from Elk River, Minnesota, as the female parent. As *M. ioensis* is the wild species of that region, this hybrid would be a variety of *M. Soulardii*.

Docynia Deene.

Docynia docynioides, comb. nov. — *Docynia Delarayi* Rehder in Sargent, Pl. Wilson, II. 296 (1915), pro parte, non Schneider. — *Malus docynioides* Schneider in Bot. Gaz. LXIII. 400 (1917).

CHINA. Southern Szechuan: "inter Kua-pie et Ta-tiao-ko," alt. 2700 m., May 23, 1914, *C. Schneider* (No. 1349, type); Chin-chi Hsien, mountain-side alt. 1300 m., August, 1908, *E. H. Wilson* (Arnold Arb. Exped. No. 2998); same locality, July, 1903, *E. H. Wilson* (Veitch Exped. No. 3493). Yunnan: Mengtsze, mountains west, alt. 1800–2000 m. *A. Henry* (Nos. 10036, 10036a).

In examining Schneider's type of *Malus docynioides* I find that there are 3–5 ovules in each cell and that it should, therefore, be transferred to *Docynia*, though the resulting combination is rather unfortunate. This new *Docynia* is so closely related to *D. Delarayi* that some botanists may possibly not consider it specifically distinct, as the two types, though looking very distinct, are apparently connected by intermediate forms. *Docynia docynioides*, however, may be readily separated from typical *D. Delarayi* by the absence of the dense white tomentum of the under side of the leaves, by the thinner, not persistent leaves often, particularly toward the apex, serrate or serrulate, by the smaller number of stamens, and apparently also by the smaller number of ovules, for Cardot (in Rev. Hort. 1918, 131) states that in Franchet's type the number of ovules in each locule is 8–10, not 4 as described by Franchet, and Cardot for this reason transfers the species to *Cydonia* (in which he includes *Chaenomeles*) as *C. Delarayi*, but even if the number of ovules should be ten, this would not be a sufficient reason to transfer the species to *Cydonia* or *Chaenomeles*, as it agrees in all other characters, particularly in the structure of the flowers, with the other species of *Docynia*. The number of ovules, too, in *Cydonia* and *Chaenomeles* is more than ten.

Chaenomeles Lindl.

× *Chaenomeles superba*, hybr. nov. (= *C. japonica* × *lagenaria*). — *Cydonia Maulei* var. *superba* Frahm in Gartenw. II. 214 (1898). — Rehder in Bailey, Cycl. Am. Hort. I. 427 (1900). — *Chaenomeles Maulei superba* Leichtlin apud Zabel in Beissner, Schelle & Zabel, Handb. Laubholz.-Ben. 128 (1903). — Rehder in Bailey, Stand. Cycl. Hort. II. 728 (1914). — *Cydonia Maulei* var. *atrosanguinea* Froebel apud Olbrich in Gartenw. IV. 270 (1900).

This handsome garden form is apparently a hybrid between *C. japonica* and *C. lagenaria*, as already suggested by Zabel (l. c., see above). It differs from *C. japonica* chiefly in the larger, but narrower, acute, more sharply serrate, darker green leaves and in the larger flowers of deep blood-red color, and from *C. lagenaria* in the pubescent young branchlets slightly verruculose the second year, in the smaller, generally obovate-oblong less finely

and closely serrate leaves and in the more upright and compact habit. There are several distinct forms in cultivation.

C. superba f. *alba*, comb. nov. — *Cydonia Maulei* var. *alba* Froebel apud Olbrich in Gartenw. iv. 270 (1900). — *Chaenomeles Maulei alba* Froebel apud Zabel in Beissner, Schelle & Zabel, Handb. Laubholz.-Ben. 182 (1903). — A form with white flowers.

C. superba f. *rosea*, comb. nov. — *Cydonia Maulei* var. *grandiflora rosea* Froebel apud Olbrich, l. c. — *Chaenomeles Maulei grandiflora rosea* Froebel apud Zabel, l. c. — A form with light rose-colored flowers.

C. superba f. *perfecta*, comb. nov. — *Cydonia Maulei grandiflora perfecta* Froebel apud Olbrich, l. c. — *Chaenomeles Maulei grandiflora perfecta* Froebel apud Zabel, l. c. — A form with larger and broader leaves and with scarlet flowers with sometimes 6-8 petals.

In the genus *Chaenomeles* I am not able to distinguish more than three well marked species: *C. sinensis* Koehne belonging to the section *Pseudocydonia* Schneider later considered a distinct genus by its author, and *C. japonica* Lindley and *C. lagenaria* of the section *Euchaenomeles*; the former Japanese and the latter Chinese. The following recently proposed species based on cultivated plants are apparently all forms of *C. lagenaria*: *C. angustifolia* Koidzumi in Jour. Coll. Sci. Tokyo, xxiv. art. 2, 97 (1913); *C. eugenioides* Koidzumi in Tokyo Bot. Mag. xxix. 160 (1915); *C. trichogyna* Nakai in Tokyo Bot. Mag. xxx. 23 (1916); Fl. Sylv. Kor. vi. 42, t. 15 (1916); *C. cardinalis* (Carr.) Nakai in Tokyo Bot. Mag. xxxii. 145 (1918) and *C. eburnea* (Carr.) Nakai, l. c. They may be distinct enough to be ranked as varieties or forms, but as I have seen neither specimens nor plants of any of them I am not able to make a definite statement regarding their systematic standing.

Pyrus L.

Pyrus ussuriensis Maxim. var. *hondoensis*, var. nov. — *Pyrus ferruginea* Koidzumi in Tokyo Bot. Mag. xxix. 158 (1915), non Hooker f. — *P. rufoferruginea* Koidzumi, l. c. 311 (1915). — *P. aromatica* Kikuchi & Nakai in Tokyo Bot. Mag. xxxiii. 33 (1918). — *P. hondoensis* Kikuchi & Nakai l. c. 34 (1918).

HONDO. Mountainous parts near Tonomachi, Kamiheigun, Iwate pref., May 20, 1918, *K. Yamagishi*; same locality, same date, *K. Kikuchi*; mt. near Aidomura, Iwakigun, Fukushima pref., August 22, 1918, *S. Akiyama*; Ajara Mt. near Kuratatemura, Minamitsugarugun, Aomori pref., August 30, 1918, *A. Kikuchi*; about three miles from Yamagatamura, Minamitsugarugun, Aomori pref., August 22, 1914, *A. Kikuchi*; Fujisan, above Subashiri, alt. 1167 m., June 1918, *E. H. Wilson* (No. 10375; tree 5 m.); Soihimura, Chiisagatagun, Naganoken, May 23, 1918, *A. Kikuchi*; Kogoyama, prov. Kai, and Yamanaka, prov. Kai, *T. Komiyama*.

This variety differs from the type chiefly in the more elongate, ovate to ovate-oblong leaves with closer and finer, more appressed and less aristate serration, in the longer pedicels of flowers and fruits and in the often present brown floccose tomentum of the young branchlets and leaves and

of the inflorescence. The tomentose form described as *P. subferruginea* which scarcely differs from *P. aromatica*, may possibly be kept as a distinct form of the var. *hondoensis*, while the type of the variety represents the glabrescent or glabrous form. In Korea and particularly in southern Korea a form with longer pedicels occurs, but the shape and serration of the leaves is that of typical *P. ussuriensis*.

Pyrus ussuriensis var. *ovoidea*, var. nov. — *P. ovoidea* Rehder in Proc. Am. Acad. L. 228 (1915); in Moeller's Deutsch. Gaertn.-Zeit. xxxi. 102, fig. 2 (1916). — Nakai, Fl. Sylv. Kor. vi. 48, t. 17 (1916). — Bailey, Stand. Cycl. Hort. v. 2869, fig. 3278 (1916).

The addition of the var. *hondoensis* to *P. ussuriensis* has lessened the differences between *P. ovoidea* and *P. ussuriensis* and there remains now only the shape of the fruit which can hardly be considered a specific character in *Pyrus*. It therefore seems necessary to reduce *P. ovoidea* to a variety of *P. ussuriensis*.

To *P. ussuriensis* as synonyms or varieties belong probably the following recently published species based mostly on cultivated plants: *P. acidula* Nakai in Tokyo Bot. Mag. xxx. 27 (1916); Fl. Sylv. Kor. vi. 49, t. 18 (1916). — *P. Maximowicziana* Nakai, l. c. 50, t. 20 (1916). — *P. macrostipes* Nakai, l. c. 28 (1916); l. c. 52, t. 22 (1916). — *P. vilis* Nakai, l. c. 28 (1916); l. c. 51, t. 21 (1916). — *P. crassipes* Kikuchi & Nakai in Tokyo Bot. Mag. xxxii. 35 (1918). — *P. obovoidea* Koidzumi in Tokyo Bot. Mag. xxxiii. 123 (1919). — *P. insueta* Koidzumi, l. c. 123 (1919). — *P. tremulans* Koidzumi, l. c. 126 (1919). — *P. insulsa* Koidzumi, l. c. 127 (1919). — *P. iwatensis*, Koidzumi, l. c. 127 (1919). — *P. nambuana* Koidzumi, l. c. 128 (1919). — *P. jucunda* Koidzumi, l. c. 128 (1919).

Pyrus serrulata Rehder in Proc. Am. Acad. L. 234 (1915); in Sargent, Pl. Wilson. ii. 263 (1915); in Moeller's Deutsch. Gaertn.-Zeit. xxxi. 111, fig. 7 (1916). — Bailey, Stand. Cycl. Hort. v. 2870 (1916).

From the specimens collected by Wilson in China this species was described as having 3-4 styles and a deciduous calyx, but plants raised at the Arboretum from seed collected at the same time in China produced flowers with usually 4, very often 5, but very rarely 3 styles and with partly persistent and partly deciduous calyx; between the number of styles or locules and the behavior of the calyx there seemed to be a slight correlation in so far as a larger percentage of the fruits with deciduous calyx had five locules. The few fruits, too, of a specimen collected by Professor L. H. Bailey at Kuling, Kiangsi, in 1917, which otherwise looks like *P. serrulata*, shows five styles and persistent calyx. Whether the variation in the number of styles and in the behavior of the calyx indicates hybrid origin of *P. serrulata* or simply a tendency of the species to vary, I am not yet prepared to say. In species with normally deciduous calyx it occurs sometimes, as I have observed in *P. betulifolia*, *P. Calleryana* var. *Fauriei* and in *P. pashia*, that the calyx wholly or partly persists, but in this case the fruits often do not seem to be quite normal and sometimes are seedless.

***Pyrus Calleryana* Decne. f. *graciliflora*, forma nov.**

A typo recedit ramulis apicem versus tomento canescenti denso ad secundum annum persistente vestitis, basin versus glabris, floribus minoribus circiter 2 cm. diam., staminibus dimidia petala superantibus, antheris roseis. — Arbor: folia ab initio glabra margine tantum villosa: inflorescentia glaberrima, 7–10-flora, laxa; pedicelli 1.5–2.5 cm. longi; styli fere semper 2.

Cultivated at the Arnold Arboretum; raised from seed collected by Mr. E. H. Wilson, at Patung Hsien, Hupeh, in 1907; type specimens collected May 6, 1919, preserved in the herbarium of the Arboretum.

This form looks at flowering time quite distinct from the plants we consider typical *P. Calleryana* on account of its looser and slenderer inflorescence and the smaller flowers with pink, not purple anthers.

***Pyrus Calleryana* f. *tomentella*, forma nov.**

A typo recedit ramulis junioribus dense albo-tomentosis, annotinis glabrescentibus vel glabris, foliis initio tomento floccoso obtectis mox glabris costa media utrinque villosa excepta, saepe, praesertim eis turionum, argutius serrulatis nec crenato-serrulatis, inflorescentiis, pedicellis calycibusque albo-villosis.

Cultivated at the Arnold Arboretum; raised from seed collected by Mr. E. H. Wilson in Hupeh in 1907; type specimens collected May 10 and September 22, 1918, preserved in the herbarium of the Arboretum.

This form is readily distinguished from the type by the dense white tomentum of the young growth and of the inflorescence, which on the branchlets often persists until the following year.

Pyrus Calleryana var. *Fauriei*, Nakai mscr. in. sched. Herb. Imp. Univ. Tokyo ex Nakai in Toyko Bot. Mag. xxx. 30 (1916), pro synon. — *P. Fauriei* Schneider, Ill. Handb. Laubholz. i. 666, fig. 363d' (1906); in Fedde, Rep. Sp. Nov. iii. 121 (1906). — Rehder in Proc. Am. Acad. L. 238 (in nota) (1915). — Nakai in Coll. Sci. Tokyo, xxvi. art. 1, 182 (Fl. Kor. i.) (1909); Fl. Sylv. Kor. vi. 54, t. 24 (1916).

KOREA. Prov. Keiki: mountain slopes near Keijyo (Seoul), September 23, 1918, *E. H. Wilson* (No. 10743; shrub 1–2 m.; fruit russet spotted); Seoul, May 1901, *U. Faurie* (No. 78, type, ex Schneider); "Syon Ouen, circa sepulchrum," May 30, 1906, *U. Faurie* (No. 310); Kazan near Suigen, May 24, 1917, *E. H. Wilson* (No. 8480; tree 8 m.); same locality, September 2, 1917, *S. Tokuda*.

Judging from the specimens before me *P. Fauriei* is only a variety of *P. Calleryana*, smaller in all its parts than the type; the leaves are sometimes broadly cuneate at base and rather thin.

Pyrus Kawakamii Hayata in Jour. Coll. Sci. Tokyo, xxx. art. 1, 99 (1911); Icon. Pl. Formos. i. 243 (1911). — *P. Koehnei* Koidzumi in Jour. Coll. Sci. Tokyo, xxxiv. art. 2, 57 (1913), pro parte. — Rehder in Proc. Am. Acad. L. 238 (1915), quoad plantam Formos., non Schneider.

FORMOSA. Kyoshiro, prov. Nanto, road-side, alt. 667m., February 11, 1918, *E. H. Wilson* (No. 9835; bush 4 m.); same locality, thickets, November 4, 1918, *E. H. Wilson* (No. 10876; tree to 10 m.); in garden of Chinese at Sozon, prov. Taikoku, October 11, 1918, *E. H. Wilson* (No. 10785; tree 5 m.).

This species had been referred as a synonym to *P. Koehnei* by Koidzumi

and I followed him having seen at that time no specimens of either species. Now I have before me flowering and fruiting material of the Formosan plant and find that the flowers are quite different from those of *P. Kochnei*; the calyx-lobes are short, ovate and obtuse or obtusish, the number of styles is 3 in the several flowers examined and the peculiar construction of the disk in *P. Kochnei* as figured by Schneider is not present. The species is much nearer to *P. Calleryana* and may be only a variety of it; it differs chiefly in the ovate, obtuse or obtusish, not deltoid and acute calyx-lobes, in the broadly elliptic to elliptic-oblong, more coriaceous leaves usually cuneate not rounded at base and more deeply and sharply crenate-serrulate, though similar leaves may be found on specimens of *P. Calleryana* from Kwangtung. The young leaves, the pedicels and the outside of the calyx are quite glabrous.

× *Pyrus congesta*, hybr. nov. (= *P. betulifolia* × *elaeagrifolia*).

Arbor ramis patentibus ramulis subpendentibus junioribus cinereotomentosis tomento ad secundum et partim ad tertium annum persistente. Folia ovata vel elliptico-ovata ad elliptico-lanceolata, acuminata vel minora acuta, basi rotundata vel cuneata, 3-6 cm. longa, ea turionum semper anguste elliptica ad elliptico-lanceolata, basi cuneata et ad 7 cm. longa, basi excepta argute serrulata, initio utrinque, supra laxius tomentosa, demum supra costa media villosa excepta glabra, intense viridia, lucida, subtus pallidiora tomento tenui obtecta, nervis utrinque elevatis conspicuis sub angulo circiter 45° divergentibus; petioli 0.5-2.5 cm. longi, graciles, tomentosi. Flores 6-9 in umbella satis densa 3-5 cm. diam., albi, 2-2.5 cm. diam.; pedicelli 0.5-2 cm. longi, ut calyx villosotoomentosi; calycis lobi triangulari-ovata, obtusiuscula, 1.5-2 mm. longa, reflexa, utrinque villosa, dimidium tubum aequantes; petala ovalia, 0.8-1.2 cm. longa; stamina 25-30, petala dimidia aequantia; styli 3-4, rarissime 5, basi sparse pilosi vel fere glabri, staminibus breviores. Fructus subglobosi, 3-9 in umbella congesta, 1-1.5 cm. diam., brunnei, punctulati, pedicellis robustis 0.5-1.5 cm. longis suffulti, calyce persistenti lobis reflexis coronati; semina 6 mm. longa, obovoidea.

Cultivated at the Arnold Arboretum, of unknown origin, probably from seed collected in the Arboretum; type specimens collected May 13, 1909, and September 30, 1913, are preserved in the herbarium of the Arboretum.

This hybrid resembles most *P. betulifolia* Bunge from which it chiefly differs in the finely serrulate narrower leaves, those of the shoots mostly elliptic-lanceolate and cuneate at the base, tomentose on both sides when unfolding and with permanent tomentum beneath, in the larger short-stalked flowers with 3-4 or rarely 5 styles and in the larger fruit with persistent calyx. The other parent is apparently *P. elaeagrifolia* of which there was a tree near the *P. betulifolia* from which the seed was probably taken. From that species it is easily distinguished by the broader serrulate leaves, the 3-4 styles, only very rarely 5, and the smaller fruit in dense clusters of from three to nine.

(To be continued)

NOTES

Strutt's Sylva Italica. The Arboretum has lately obtained a copy of the *Sylva Italica*; or Portraits of Forest Trees in Italy, distinguished by their Antiquity, Magnificence or Historical interest, drawn from nature and etched by Jacob George Strutt, and published by Dickinson & Son, 114 New Bond Street, London, and by the author, 52 Via Babuino, Rome. Like the *Sylva Britannica* by the same author it is a folio, and it consists only of part 1 containing the descriptions and portraits of four trees. The *Sylva Italica* appears to be a rare book. It is not mentioned in the *Bradley Bibliography*; it is not in the catalogue of the British Museum (Natural History), the catalogue of the library of the Royal Gardens at Kew or in that of the Department of Agriculture of the United States.

Plate 1 represents Tasso's Oak standing in the garden of the Convent of Sant' Onofrio in Rome founded in 1491. Although the author does not mention the fact, this tree is *Quercus Ilex*. It was still standing in 1906, but a photograph in the Arboretum collection taken in that year shows that it had lost many branches in the great storm of September 20, 1842, and was apparently in poor health.

No. 2. Cypresses in the garden of the Villa d'Este at Tivoli. These are *Cupressus sempervirens* var. *fastigiata* and, according to Strutt, "the largest of these trees measures sixteen feet eight inches in circumference at five feet from the ground and is about one hundred and ten feet in height."

No. 3. The Colonna Pine in the garden of the Colonna Palace in Rome and planted by the Colonna Family in 1332 "as a lasting memorial of their vengeance, by the death of Cola di Rienzi, for the slaughter of three of their kinsmen at the gate of San Lorenzo, during the contest that existed between the Tribune and the haughty nobles of Rome." Strutt's portrait represents a magnificent specimen of *Pinus pinea*. He gives the height as about one hundred and twenty feet and the circumference of the trunk at five feet from the ground as twenty-one feet four inches.

No. 4. Michael Angelo's Cypresses. "These magnificent trees," we are told, stand "in the large court of the Carthusian Convent of Santa Maria degli Angeli, which together with the noble church adjoining were constructed by Michael Angelo on the site of the ruins of the Baths of Diocletian." These trees (*Cupressus sempervirens* var. *fastigiata*) are said to have been planted by Michael Angelo and to have been originally four in number. Three of the original trees appear in Strutt's engraving; the fourth, which he says had been destroyed by lightning, had been replaced by a young Cypress of the same variety. Strutt gives the circumference of the largest of these trees at five feet from the ground as thirteen feet eight inches and the height of the tallest ninety-five feet.

Famous Trees of Korea. The Arboretum has recently received from the Right Reverend Mark Napier Trollope, Episcopal Bishop of Korea, an

interesting record of Korean trees famous for their size, age or historical associations, published by the Government General of Chosen. The work is in Japanese and its value in the Arboretum library is increased by the following description which the Bishop has appended to the volume.

"This book was published by the Government General of Chosen in April 1919, and consists of 197 pages, of which 181 are occupied with particulars of the famous trees, followed by an appendix of miscellaneous notes occupying 16 pages. The whole is preceded by twelve pages of illustrations, a page of introduction and four pages of Index or 'Contents.' The trees depicted in the twelve illustrations are —

1. Keyaki (*Zelkova*).
- 2, 3. Ichō (*Ginkgo*).
- 4, 5. Akamatsu (*Red Pine*).
6. Enjū (*Sophora japonica*).
7. Haru nire (*Elm*).
- 8, 9, 10. Byakushin (*Chinese Juniper*).
11. Shiromatsu (*White Pine*).
12. Kaya (*Yew*).

"It is difficult to see in some of the above cases why they should have been specially selected for illustration in preference to other and finer specimens.

"The information throughout is given in Japanese exclusively, except that (a not always happy) attempt is made in most cases to supply the Korean vernacular name of the tree in question in Korean script. The height measurements purport to be given in ken, a Japanese measure amounting to about 6 feet. But in some cases it is plain that the number of feet has been given instead of the number of ken. For example a Chinese Juniper (No. 14 in § 13) on p. 155 is given as being 25 ken (about 150 feet) tall, whereas it certainly does not exceed 25 or 30 feet.

"The trees, of which particulars are given in the main part of the book (pp. 1-181) are 3188 in number, arranged according to species in 64 sections.

"The information with regard to each tree is given in nine columns, of which the first (at top of page) gives the number of the tree or the list, the second and third give the precise locality, the fourth gives the ownership, the fifth gives the girth of the trunk (in feet) at 5 feet from the ground, the sixth gives the height of the tree, the seventh gives its age, the eighth gives the tree's character or title to special care or notice, the ninth adds notes as to the historical associations of the tree or its connection with local superstitions, traditions or religious observances."

This volume makes an important supplement to the volume published in 1913 on the Old and Famous Trees in Japan by Suroku Honda, the distinguished and best known Japanese landscape gardener, professor in the Imperial University of Tokyo.

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NOTES ON AMERICAN WILLOWS. X¹

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BEFORE I can prepare a key and an enumeration of all the American Willows I have to discuss several more species. Most of them may be referred to the sections *Fulvae* and *Roseae*. Much doubt, however, exists as to the systematic position and the real relationship of some species.

There is yet another group I have not dealt with, namely, the section *Cordatae*, but as I have repeatedly stated, I have not studied this group sufficiently because Mr. C. N. Ball is already writing a monograph on it.²

To-day I can only refer to what I said in the introduction to my last note on the incompleteness of our present knowledge of most of the species and varieties, and on the collections on which I have mainly based my studies. All I can do here is to try to stimulate the interest in the study of Willows. Investigations like those of Griggs³ on the species of Ohio would greatly help us, especially if careful attention is paid to the existing literature on this subject. A critical review of the treatment of the genus given in such books as Britton & Brown's *Illustrated Flora*, Britton's *Manual*, Gray's *New Manual*, Rydberg's *Flora of the Rocky Mountains*, Jepson's *Flora of California*, Howell's *Flora of the Northwest Coast* and others would be of great value but it cannot be done successfully until we are able to interpret more correctly certain species, their relationship and variability.

a. THE SPECIES OF SECTION FULVAE.

This section was proposed by Barratt in 1840 for *S. rostrata* Richardson. He gave a good description of its main characters, and said that it is "nearer allied to some of the European, than any of the American Willows, known to me." Andersson, in 1858 and later, placed the species of this section in his section *Cinerascentes* vel *Capreae*, and I too, in 1904, referred

¹ Our attention has been drawn by Professor J. C. Nelson to an error on p. 162 of vol. I of this Journal in regard to Coville & Applegate's No. 551 of *Salix commutata* which is enumerated under the state of Washington, but should be referred to Oregon, the locality being near the line between Lane County and Crook County or probably, after the subdivision of this county, Deschutes County; the date should read August 17, not 7. Ed.

² Mr. Ball's study of the section *Cordatae* is expected to appear in the next issue of this Journal. Ed.

³ Griggs, R. F. The Willows of Ohio. (Proc. Ohio State Acad. Sci. vi. pt. 6, pp. 60. 1905.)

S. Bebbiana to the *Capreae*. Both sections, however, are quite distinct, and Ball, in 1909, made a new section *Rostratae* for *S. Bebbiana* and *S. Geyeriana*, apparently overlooking Barratt's name *Fulvae*.

From those of section *Discolores* (see my note ix) the species of the *Fulvae* chiefly differ in their yellowish or light brown scales with a short thin pubescence, their more slender and lax aments, their comparatively longer pedicels and shorter stigmas. They show a closer relationship to the species of section *Griseae* also treated in my last note. Species like *S. humilis* and *S. tristis* with their rostrate capsules are, perhaps, better placed in a separate section because they differ as much from the true *Griseae* (*S. sericea* and *S. petiolaris*) as from the *Fulvae*, the species of which also have rostrate fruits. The taxonomic value of certain characters in a genus like *Salix* can be interpreted very differently, and I shall later explain how much at variance the opinions of our best salicologists really are.

The synonymy of section *Fulvae* is as follows:

Sect. *Fulvae* Barratt, Sal. Am. sect. vii (1840). — Sect. *Cinereae* Borrer apud Hooker, Fl. Bor.-Am. ii. 144 (1838), pro parte, quoad *S. rostratam*. — Sect. *Cinerascentes* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 122 (1858), pro parte. — Sect. *Cinerascentes* vel *Capreae* Andersson in Svensk. Vet.-Akad. Handl. vi. 57 (Monog. Salic.) (1867), pro parte; in De Candolle, Prodr. xvi.² 215 (1868), pro parte. — Sect. *Capreae* Schneider, Ill. Handb. Laubholz. i. 61 (1904), pro parte, non Koch. — Sect. *Rostratae* Ball apud Coulter & Nelson, New Man. Rocky Mts. Bot. 138 (1909).

1. *S. Bebbiana* Sargent in Garden & Forest, viii. 463 (1895); Silva, ix. 131, t. 477 (1896). — Schneider, Ill. Handb. Laubholz. i. 61, fig. 11 w-w², 12 s (1904). — Britton & Brown, Ill. Fl. ed. 2, i. 599, fig. 1471 (1913). — *S. rostrata* Richardson, Bot. App. in Franklin, Narr. Jour. Polar Sea, 753 (1823); reprint, 25; ed. 2, 765 (1823); reprint, 37; non Thuillier (1799). — Hooker, Fl. Bor.-Am. ii. 147 (1839). — Barratt, Sal. Am. No. 25 (1840). — Torrey, Fl. N.Y. ii. 211 (1843). — Carey apud Gray, Man. ed. 1, 428 (1848). — Bebb apud Gray, Man. ed. 6, 482 (1890). — *S. fusca* Hooker, Fl. Bor.-Am. ii. 151 (1839), sec. specim. orig., non Linnaeus — *S. ragans* l. *cinerascens* b. *occidentalis* Andersson in Öfv. Vet.-Akad. Förh. xv. 122 (1858), quoad pl. americ. — *S. ragans* l. *S. rostrata* Andersson in Svensk. Vet.-Akad. Handl. vi. 87 (Monog. Salic.) (1867), quoad var. *obovata*, exclud. formis. — *S. ragans occidentalis* Andersson, l. c., pro syn. subspec. *rostratae*. — *S. livida occidentalis* Gray, Man. ed. 5, 464 (1867). — *S. ragans* β *rostrata* 3. *obovata* Andersson apud De Candolle, Prodr. xvi.² 227 (1868). — *S. depressa* c. *rostrata* Seemen in Ascherson & Graebner, Syn. Mitteleur. Fl. iv. 119 (1909).

This species was first described by Richardson (1823) as *S. rostrata*. The type came from the "wooded country from lat. 54° to 64° north." In the herbarium of the New York Botanical Garden there is Richardson's specimen from Fort Franklin (65°) which agrees with the author's description.

The same form is in Herb. Ottawa under No. 24749 (fruiting branchlets) bearing the label "*Salix Scouleriana* Fl. Bor. Am. Dr. Richardson." Bebb, in 1891, made the note to it: "ticket evidently misplaced." If it is, however, a specimen of Richardson's (ex Herb. Mus. Brit.) the name only may be a lapsus calami. On the same sheet there is also a sterile branchlet which is not described by Richardson. In his description everything fits the specimen in Herb. N. Here we find on the same sheet a female specimen collected by Richardson on July 20, 1827 "N.Y. House." According to Franklin (Narr. second Exp. Polar Sea, 315 [1828]) Richardson on July 8, 1827, was at Fort Alexander, Manitoba, whence he went to Montreal. Where he was on the 20th of July is not stated, and I have been unable to find out where "N.Y. House" is. The specimen is identical with that from Fort Franklin.

There is, however, in Herb. Ottawa another specimen collected by Richardson and labeled "*S. rostrata* Richards. Franklin Expedition, between Forts Simpson and Chepewyan" (Chapewyan on Franklin's map). This specimen has narrow elliptic-lanceolate leaves which soon become almost glabrous beneath, and glabrous branchlets. Richardson's statements "*folia sesquipollicaria, exstipulata, pube sericea caduca ? vestita subtus grisea sub-glauc*" might refer to this glabrescent form. But if we take this specimen for the type, *S. rostrata* sensu stricto would be the same as our present var. *perrostrata*, and we should be obliged to take up the name var. *obovata* of Andersson for the eastern form which we at present regard as the type.

As I have not seen the material of the Hookerian Herbarium I use the name *Bebbiana* (*rostrata*) for the pubescent form which, however, is closely connected with var. *perrostrata* by numerous intermediate forms. Richardson's glabrescent specimen has rather thin, acute leaves which measure up to 4:1.2 cm. They are partly distinctly glaucescent beneath, the pubescence being very thin. The fruiting aments are old, the fruits measure about 8 mm., the pedicels about 4 mm. in length, and their pubescence is very thin.

Hooker, Barratt, Torrey and Carey used the name *S. rostrata* Richardson. When Andersson first dealt with the American Willows he named this species *S. vagans cinerascens occidentalis*. He cites Richardson, Gray and Hooker but he does not mention any specimens, and he also refers to it some Siberian forms. The quotation "*S. depressa cinerascens* Trautv." has been omitted in Sal. Bor. Am. 61. All the other forms of *S. vagans* given by Andersson in 1858 are of European origin. In 1867, he has a *S. vagans* l. *S. rostrata* with the synonym *S. rostrata* Richardson and *S. vagans occidentalis* Andersson. This sub-species *rostrata* includes only American forms, and Andersson enumerates the following five varieties of it: *latifolia*, *lanata*, *obovata* (with forms *subambigua* and *subrepens*), *lanceolata* and *glabrescens*. To his second subspecies *cinerascens* Andersson, in 1867, does not refer American forms, but under his third subspecies, *S. livida*, we find a var. *americana* which is said to be connected by inter-

mediates with var. *glabrescens* of the subspecies *rostrata*. In 1868 Andersson reduced his subspecies to varieties, and we find under var. β *rostrata* only four forms: 1 *latifolia*, 2 *lanata*, 3 *obovata* (without any subform), and 4 *latifolia*; var. *glabrescens* of 1867 has been omitted.

Gray in 1867 used the name *S. livida occidentalis* for *S. rostrata*. Bebb, however, took up this name again in 1885 (in Coulter's Manual). Sargent, in 1895, changed the name *S. rostrata* to *S. Bebbiana* on account of the older *S. rostrata* Thuillier (Fl. Envir. Paris ed. 2, 517 [1797]). This new name has been accepted by several later authors. Robinson and Fernald (1909) keep Richardson's name, regarding *S. rostrata* Thuillier as a strict synonym. This name, however, is not an unconditional synonym (as for instance the name *S. longifolia* Lamarck, see Bot. Gaz. LXVII. 340). A. & E.-G. Camus (Class. Saul. d'Europe i. 163 [1904]) mention *S. rostrata* Thuillier in the synonymy of *S. repens* Linnaeus but again as a synonym of their var. *A vulgaris* subvar. *microphylla*. Von Seemen (in Ascherson & Graebener, Syn. Mitteleurop. Fl. iv. 127 [1909]) refers Thuillier's name as a synonym to his *S. repens* B. *rosmarinifolia* thus regarding it as identical with a form different from that of Camus. It is, therefore, possible that Thuillier's name may be used again as a specific name, and as the case stands it seems not advisable to apply the name *S. rostrata* to an American species.

With regard to the variability of *S. Bebbiana* it ought to be said that the floral characters as a whole seem to be very constant. The length of the style varies to a certain degree but we should need the investigation of a very large series of well-developed female specimens to decide whether the forms with a more conspicuous style (almost equaling the length of the stigmas) can be regarded as distinct. Fernald's var. *projecta*, a still very little known variety, seems to be the only one of which the flowers differ somewhat from those of the type, but here, too, the differences are not very important. On the other hand the variability of the leaves is much greater but it is extremely difficult to limit varieties. Andersson, apparently, did not see copious material, and he was inclined to lay too much stress upon certain variations which look very distinct as long as intermediate forms are not seen. As I have already mentioned Andersson first considered *S. Bebbiana* as var. *occidentalis* of his *S. vagans* L. *cinerascens*. Later also he kept it as a variety of *S. vagans*.¹ I do not wish to-day to discuss the question whether the American *S. Bebbiana* is so closely related to any of the European-Asiatic forms which have been united under the name *livida*, *depressa* or *Starkeana* that it, too, must be regarded as a variety or a subspecies of it. I think it best to keep the American forms as a separate species.

As already explained, Andersson, in 1867 and 1868, established quite a number of forms of his subspecies or var. *rostrata*. It is strange that he also has besides *rostrata* which only consists of American forms another

¹ This *S. vagans* is the same as *S. livida* of Camus and *S. depressa* of Von Seemen. As I have tried to show the oldest name for this species is *S. Starkeana* Willdenow, see Sargent, Pl. Wils. III. 151 (1916).

American form under his subspecies or var. *livida* of which he, in 1867, says: "Ad formas denudatas *S. rostratae* attamen modificationes permultae adsunt transitoriae." This is his var. or f. *americana* of which the type was collected by Bourgeau "ad fluv. Saskatchewan." The var. *americana*, in 1868, is said to be characterized by "foliis magnis 2-3 poll. longis late lanceolatis v. subovali-obovatis grosse undulato-crenatis, primo tenuibus subtus partim glaucescentibus, demum rigidiusculis utrinque viridibus, nervis pallidioribus et prominenti-reticulatis pulchre percursis." He adds: "E regione ad fl. Saskatchewan plura specimina a Bourgeau lecta vidi." Among Bourgeau's specimens which I have seen none fitted this description. The statement that the leaves later become "utrinque viridibus" is rather strange. It is probable after all that var. *americana* does not belong to *S. Bebbiana*, and it is impossible to ascertain the identity of this variety without seeing the type.

"In *S. lividam americanam* aperte abiens" is Andersson's var. *glabrescens* of *rostrata*, the type of which, too, was found by Bourgeau on the Saskatchewan. From var. *americana* it "vix nisi foliis minutissime pubescentibus et forsan etiam majoribus differt." In 1868 this var. *glabrescens* is not mentioned by Andersson even as a synonym. One might be inclined to apply this name to what we now call var. *perrostrata* if there was not the statement that the leaves are rather larger than those of var. *americana*. Forms with such large leaves apparently do not belong to *S. Bebbiana* but to *S. discolor* or *S. balsamifera*. Only by a type specimen can the identity of the large-leaved form be established.

There remain to be discussed four more of Andersson's varieties of 1867. Of these var. *obovata*, according to the author is "forma typica, ubique in America septentrionali frequens." He distinguished two forms of it: f. *subambigua* and f. *subrepens*. The first is characterized by "foliis ovali-obovatis, rigidissimis, margine remote serrulatis, subtus lucide tomentellis." It was collected by Lyall "in Sumass-prairie." The second differs by "foliis lingulato-lanceolatis basi longe attenuatis, breve acuminatis, 1½ poll. longis, supra medium vix ½ poll. latis, subtus saepissime tomentosis." Bourgeau found it in the Rocky Mountains. In 1868, both forms are mentioned again but without names, and Andersson here states "Ambae in Rocky mountains (Bourgeau)." I have not yet seen a specimen of Lyall's from Sumass Prairie or of Bourgeau's from the Rocky Mountains which agree with these descriptions, and I must regard at present the two forms as uncertain, while I take var. *obovata* for a synonym of typical *Bebbiana*.

A narrow leafed form of the type seems to be Andersson's var. *lanceolata* of which in 1867 he says: "foliis elongatis supra medium parum dilatatis, fere 2 pollices longis vix ¾ poll. latis, utrinque pilis adpressis incano-hirtis; amentis magis densifloris." He himself adds "foliis tantum angustioribus a praecedente [var. *obovata*] recedunt." The diagnosis of 1868 is somewhat different, and it is impossible to decide the identity and the taxonomic value of this variety without the type.

Among Lyall's specimens from the "Lower Frazer River" in the Kew

Herbarium is one which Andersson himself named "*Salix vagans cinerascens latifolia*." In 1867 and 1868 he, however, states that the type of *S. vagans cinerascens rostrata latifolia* was collected by Lyall "in ins. Vancouver." The description runs: "foliis $2\frac{1}{2}$ -3 poll. longis, supra medium 1-1 $\frac{1}{2}$ poll. latis, longius acuminatis, tenuibus, subintegris, subtus molliter tomentosis; stipulis parvis acutissimis." I have not yet seen a specimen of *S. Bebbiana* from Vancouver Island, and Henry (Fl. South. Brit. Col. 98 [1915]) says of *S. Bebbiana*: "common east of the Cascades. Kamloops; Armstrong; Crows Nest Pass." It apparently does not grow on Vancouver Island. Therefore the type of Andersson's var. *latifolia* may belong to *S. Scouleriana*.

Of Lyall's specimens from the lower Frazer River before me none agrees with Andersson's var. or f. *lanata* which he, in 1867, characterizes as follows: "foliis ex ovato-subcordata basi ovali-oblongis, crassioribus, 1 $\frac{1}{2}$ poll. longis, integris, breve acuminatis, utrinque cinereo-sublanatis; capsulis magnis a basi latissima ovatis; ramis nudiusculis, junioribus fusco-tomentosis." In 1868 Andersson only says: "fol. ovato-subcordatis crassiusculis utrinque dense tomentosis." *S. Bebbiana* rarely has leaves with an ovate-subcordate base, and I have never seen young branches with a fuscous pubescence. On the other hand it seems hardly probable that Andersson misinterpreted this plant because he had seen the fruits. Otherwise one might believe that var. *lanata* should be referred to *S. Scouleriana* or some other species. After all Andersson's varieties and forms mostly are very uncertain. None of them can be regarded as really identical with one of the varieties discussed later.

As far as I can judge by the material I have seen there are two main variations: the typical *S. Bebbiana* (*S. rostrata* Richardson sensu stricto) which is found in the north and east, and a western-southwestern variety agreeing with Rydberg's *S. perrostrata*, and chiefly differing from the type by its smaller, smoother leaves glabrescent below. In his original description of *S. perrostrata* Rydberg does not state the differences between it and *S. Bebbiana*. In 1906 (and 1917) Rydberg says of *S. perrostrata*: mature leaves "thin, glabrous, faintly nerved," and of *S. Bebbiana*: "mature leaves firm, pubescent or tomentose beneath, more strongly nerved." These statements do not prove correct. The texture and nervation are often much alike in both varieties, and only by the glabrousness and by the general impression of the plant is it possible to decide whether it should be referred to the type or to var. *perrostrata*.

The type of *S. perrostrata* came from the Black Hills in South Dakota where it had been collected by Rydberg (No. 1018) near Hermosa in 1892. Rydberg also referred to it a specimen collected by R. S. Williams at Dawson, Yukon Territory. Coville (1901) said: "While his bibliographical references indicate that the species is a segregate of *bebbiana*, the author gives no comparison of distinguishing characters. I am unable to find in his description anything to distinguish our Alaskan specimens from what I take to be typical *bebbiana*, whatever may prove to be the relation of

that species to the Black Hills willow." I have seen a great number of specimens from the Yukon Territory collected by Miss Eastwood which partly can be regarded as var. *perrostrata*, and partly can hardly be distinguished from typical *S. Bebbiana*. Some are very glabrous. I have not yet seen the Alaskan material mentioned by Coville. What I call var. *perrostrata* seems to be the form prevailing from western Nebraska and western South Dakota through Colorado, northern New Mexico, eastern Arizona, Utah, northeastern Nevada and northeastern Oregon; this form apparently is becoming more similar to or is connected with the typical form by many intermediate forms in Idaho, Washington, British Columbia, Alberta, eastern Alaska (Cook Inlet, according to Coville), the Yukon Territory and the western parts of the Northwestern Territories. The typical *S. Bebbiana* seems to be predominant from Fort Franklin in the Northwest Territories to the James Bay and to Newfoundland, its range extending to the south to New Jersey, Pennsylvania, northern Ohio, northern Indiana, northern Illinois and Iowa. Very often it is almost impossible to decide in the herbarium whether a specimen belongs to var. *perrostrata* or to the type. Only a thorough study of copious material collected in those regions where both forms meet can prove whether var. *perrostrata* is a variety of real taxonomic value. Fernald (1914) sees in it the common Rocky Mountain representative of the species, and says that the leaves are less rugose or almost plane and glabrate in age, and the branchlets glabrate or quickly glabrescent. Its synonymy is as follows:

1b. *S. Bebbiana*, var. *perrostrata*, comb. nov. — *S. Bebbiana* Rydberg in Contrib. U. S. Nat. Herb. III. 523 (1896), pro parte maxima, non Sargent. — Coville in Proc. Wash. Acad. Sci. III. 306, fig. 17 (1901), pro parte maxima. — Ball apud Coulter & Nelson, New Man. Rocky Mts. Bot. 138 (1909) pro parte maxima. — *S. perrostrata* Rydberg in Bull. N.Y. Bot. Gard. II. 163 (1901); in Britton, Man. 317 (1901); Fl. Rocky Mts. 195 (1917). — Britton & Brown, Ill. Fl. ed. 2, I. 599 (1913). — *S. rostrata* var. *perrostrata* Fernald in *Rhodora*, XVI. 177 (1914). — A typo praecipue recedit foliis maturis etiam superioribus subtus fere vel omnino glabrescentibus laevioribus plerisque minoribus saepe tenuioribus, ramulis saepissime magis glabrescentibus.

In Colorado and New Mexico certain forms seem to occur of which the branchlets are somewhat pruinose. I enumerate the following specimens which need further observation.

COLORADO. Teller County: Colorado Springs, Pikes Peak, September 10, 1905, *Glatfelter* (st.: M.). El Paso County: Manitou, about 3300 m., September 9, 1905, same collector (fr. mat., st.; M.; fructibus adultis glabris sed normalibus¹); Ute Pass, above Manitou Springs, along Fountain Creek, September 1, 1881, *G. Engelmann* (st., M.; forma incerta satis pubescens).

NEW MEXICO. Santa Fé County: Santa Fé Canyon, 9 miles east of Santa Fé, May 14, 1897, *A. A. & E. G. Heller*. (No. 3524, f.; M.); Santa Fé Creek above

¹ A form with entirely glabrous ovaries and pedicels has been collected by Macoun, Cabin Creek, Jasper Park, Alberta (No. 95792, O).

Santa Fé, September 18, 1916, *A. Rehder* (Nos. 604, 609, st.; A.; "shrub 10 feet"); same place, September 4, 1894, *C. S. Sargent* (st., A.; "tree 20 × 1 ft., pendulous branches, rough trunk, deeply furrowed dark brown bark").

With regard to the eastern forms proposed by Fernald of which I have seen the types the following may be said. The first variety is var. *luxurians* (in *Rhodora*, ix. 223 [1907]) which "is clearly an extreme variation of the common *S. rostrata*." It chiefly differs from it by its longer capsules (9 to 12 mm. long) and longer pedicels (5 to 8.5 mm. long). So far it has been only seen "on banks of the St. Lawrence from Rimouski Co. to Gaspé Co." in Quebec. It should be looked for in other localities of the type, and it apparently is nothing but a forma *luxurians*.

Fernald's next variety, var. *capreifolia* (in *Rhodora*, xvi. 177 [1914]) "presents the most extreme development of pubescence in the species . . . while var. *perrostrata* shows the opposite tendency." According to the material before me var. *capreifolia* is closely connected with the type by frequent intermediate forms. Fernald thinks that it "may prove to be the same as *S. vagans* L. *rostrata* forma *latifolia* Andersson" of which I have already spoken. This is, however, in my opinion an uncertain form, and may even belong to another species. To var. *capreifolia* Fernald refers specimens from Newfoundland, eastern Quebec and Nova Scotia, and it apparently has a wider distribution.

Fernald states "in typical *S. rostrata* Richardson (*S. Bebbiana* Sargent) the new branchlets are pubescent at tip, but the pubescence is early deciduous." In the specimen of Richardson which I regard as the co-type (see p. 66) the branchlets of the season are distinctly pubescent, and only somewhat glabrescent toward the base, but even the branchlets of the preceding year are at least partly pubescent. Very rarely these branchlets are glabrous or almost so. The pubescence of the leaves, too, of typical *rostrata* is hardly very different from that of var. *capreifolia* of which the lower leaves also are partly glabrescent. A closer study of the western form may, however, lead to the hypothesis that there are glabrescent and pubescent forms of the type as well as of var. *perrostrata*.

The most striking of Fernald's forms is var. *projecta* (in *Rhodora*, xvi. 178 [1914]) which so far is very incompletely known. It has only been found in Newfoundland, Wild Cove, south of Bay of Islands, June 11, 1896, by A. C. Waghorne (fr.; G.). According to Fernald it differs from all varieties of *S. Bebbiana* "in the slender elongate ament, the long scales, the short capsules and pedicels shorter than the scales." Unfortunately there are neither mature leaves nor well-ripened capsules. The male plant, too, is unknown. Fernald says: "when better known this may prove to be a distinct species."

2. *S. Geyeriana* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 122 (1858), quoad specim. fem.; in Proc. Am. Acad. iv. 63 (Sal. Bor.-Am. 17) (1858); in Walpers, Ann. Bot. v. 750 (1858); in Svensk. Vet.-Akad. Handl. vi. 86 (Monog. Salic.) (1867), excl. t. 5, fig. 50; in De Candolle, Prodr. xvi. 2 226 (1868). — Rydberg in Mem. N.Y. Bot. Gard. i. 114 (Cat. Fl.

Mont.) (1900); Fl. Colo. 95 (1906); Fl. Rocky Mts. 195 (1917). — Howell, Fl. N.W. Am. 619 (1902). — Piper in Contrib. U.S. Nat. Herb. xi. 215 (Fl. Wash.) (1906). — Ball apud Coulter & Nelson, New Man. Rocky Mts. Bot. 138 (1909); apud Piper & Beattie, Fl. N.W. Coast, 117 (1915); in Bot. Gaz. LX. 399 (1915). — Henry, Fl. S. Brit. Col. 98 (1915). — *S. macrocarpa* Nuttall, N. Am. Sylva, I. 67 (1843), pro parte, non Trautvetter. — Bebb in Bot. Gaz. x. 221 (1885). — Macoun, Cat. Can. Pl. II. 360 (1890). — Ball in Trans. Acad. Sci. St. Louis, IX. 80 (1899).

This Willow was first described as *S. macrocarpa* by Nuttall from specimens collected in Oregon. He does not quote a locality but only says "forming clumps in wet places." According to a co-type in the Gray Herbarium Nuttall had before him a form of var. *meleina*, but in his description he states that "the branches are smooth and brownish black, sometimes glaucous or whitish." Nuttall's name cannot be used because it is preoccupied by Trautvetter.

As Bebb already explained in 1885 Andersson entirely mistook Nuttall's species. He "transferred Nuttall's name to a single specimen collected by Burke 'ad Hudson Bay,' which Nuttall never saw, and described a new species of his own, *S. Geyeriana*, which . . . coincides absolutely with *S. macrocarpa*, Nutt." Andersson's *macrocarpa* is a species with "capsulis breve pedicellatis, conicis, glaberrimis, stylo mediocri, stigmatibus integris; foliis exstipulatis lanceolatis, integris, subtus pallidioribus, utrinque glaberrimis." It is entirely different from Nuttall's Willow which the author regarded as closely related to the Pond Willow (*S. sericea*). Andersson (1858) apparently had no knowledge of Nuttall's description, but he had an opportunity to examine those of Nuttall's specimens which are preserved in the Hookerian Herbarium. When he described his *S. Geyeriana* he based it on Geyer's No. 286 of which the exact locality is unknown. Andersson says "Missouri and Oregon, Rocky mountains." I have seen a photograph of this number and fragments of the female specimen, and also a male ament. The female plant only is *S. Geyeriana*, while the male ament belongs to *S. Bebbiana*. This has already been elucidated by Bebb, and he is right in the statement that Andersson's description is almost wholly drawn from the female plant. The male specimen is only mentioned in the following sentence (1858): "Amenta mascula etiam breviora et crassiora stamina magis aureo-fulvis quam in *S. vaganti* [*S. Bebbiana*]." In 1868, too, Andersson says: "*S. vaganti-rostratae* valde similis" but to Bebb this comparison seems "unintelligible" because "the affinity of the plant in question — as Nuttall had the sagacity to see — is really with *S. sericea*." I do not quite agree with Bebb because the shape of the capsules is very different in both species. Of *S. sericea* the mature fruits are short and blunt scarcely longer than 5 mm. with a pedicel 1.5 (–1.7) mm. long, while in *S. Geyeriana* the ovoid-rostrate capsules measure almost (5–)6–7 mm. in length excluding the 2–3 mm. long pedicel. Their shape is much more like that of the fruits of *S. Bebbiana*.

According to the female plant of Geyer's No. 286 the typical *S. Geyer-*

iana is the form with pruinose branchlets of which those of the year bear a fine silky tomentum. The statement of Andersson that the pedicel is six times longer than the gland is not correct as it is only 2 to $2\frac{1}{2}$ times longer. The stigmas are not sessile but they show a short style which often is bifid at the top, but hardly longer than the two-cleft stigmas. The statement "foliis molliter tomentosis" seems to indicate that Andersson probably had before him other specimens of *S. Bebbiana* than the male of which I have seen a photograph. In 1867 he speaks of the male aments as "sessilia, ebracteata" while in 1868 he says "vix bracteata." The type of *S. Geyeriana* before me clearly shows a short but distinct peduncle with a few small leaflets at least under the upper aments. The leaf represented in fig. 50 on plate 5 of Andersson's monograph certainly belongs to *S. Bebbiana*, the drawing of the female flower, too, agrees much better with this species. The statement of Geyer that the plant is "10-15 feet high" also refers to *S. Bebbiana* a species which as a whole is so easily distinguishable from *S. Geyeriana*.

There are two forms which can be separated from the type. One has been described by Bebb as var. *argentea* (of *S. macrocarpa*) for the type of which has to be taken a specimen of Lemmon's from Sierra County, California, of which I have seen co-types in Herb. G. and M. In Bebb's Herbarium is a male specimen collected by Lemmon at Sierra Valley without date and number but I have found no real type. This var. *argentea* is probably nothing but a very silky form of the type and its synonymy is as follows:

2b. *S. Geyeriana* var. *argentea*, comb. nov. — *S. Geyeriana* Bebb apud Watson, Bot. Cal. II. 87 (1879), non Andersson. — Rydberg, Fl. Colo. 95 (1906), ex parte. — *S. macrocarpa*, var. *argentea* Bebb in Bot. Gaz. x. 223 (1885); apud Coville in Contrib. U.S. Nat. Herb. iv. 199 (1893). — Ball in Trans. Acad. Sci. St. Louis, ix. 80 (1899). — *S. leucosericea* Bebb & Nelson apud Nelson in Bull. Wyom. Exp. Stat. No. 28, 179 (First Rep. Fl. Wyom.) (1896), nom. nud.¹ — A typo praecipue recedit pubescentia ramulorum foliorumque novellorum densiore et omnino argentea vel tantum pilis paucissimis ferrugineis intermixta.

Of this variety I have seen specimens from the following states and counties: southern Idaho (Owyhee, Bear Lake and Blaine Counties), eastern Oregon (Union, Crook and Harney Counties), Wyoming (Fremont, Sweetwater, Albany, Sheridan and Bighorn Counties), Colorado (Laramie, Lake and San Miguel Counties), Nevada (Elko County), California (Plumas, Sierra, Nevada, Placer, Eldorado, Mono, Tuolumne, Tulare, and Fresno Counties).

Another form of apparently greater taxonomic value is var. *meleina* described by Henry (Fl. S. Brit. Col. 98 [1915]) as follows: "var. *meleina*:

¹ Nelson, l. c., says: "In communicating this name to me Mr. Bebb made the following comment: 'It will shortly appear as above in a government report. This is the Rocky Mountain or Plateau member group which has for its eastern or Atlantic Coast representatives, *S. sericea* and *S. petiolaris*, and for the Pacific Coast *S. macrocarpa*.'"

Taller, 1-7 m. high; twigs black or green and black, without bluish bloom, the older branches often banded with gray and black; leaves oblong, soon glabrous above, very glaucous beneath, the hairs on the lower surface becoming more or less brown. The coast form; Shawnigan; Victoria; New Westminster." As I already stated it is partly the typical *S. macrocarpa* of Nuttall. The leaves sometimes are somewhat denticulate, the lower surface often becomes almost glabrous and their texture is firmer than of those of the type. The branchlets of the year are not unfrequently rather orange-colored (see for example Suskendorf's specimens from Falcon Valley, September 7, 1896). Of var. *meleina* I have seen specimens from British Columbia (Vancouver Island and New Westminster District), Washington (Stevens, King, Mason, Thurston, Pierce, West Klickitat and probably Clarke Counties where Nuttall seems to have collected the type of *S. macrocarpa* on the banks of the Columbia), Montana (Flathead and Missoula Counties) and northwestern Oregon (Columbia and Marion Counties).

The typical *S. Geyeriana* is known to me from the following states and counties: northwestern Idaho (Shoshone and Latah Counties), Montana (Deer Lodge, Gallatin and Madison Counties), Oregon (Grant, Jackson, Crook, Wallowa, and Klamath Counties), Wyoming (Yellowstone Park, Albany and Sheridan Counties), eastern Nebraska (Scotts Bluff County), Colorado (Jackson, Larimer Lake, Gunnison, Mineral, and Grant Counties) and Utah (Sevier County; a specimen of H.D. Langille, from Uinta Mountains, 1902, [No. 125, m., f.; A.; "5-7 feet high"] is uncertain, the leaves show stomata in their upper epidermis), Arizona (Coconino and Apache Counties).

3. *S. Lemmonii* Bebb apud Watson, Bot. Cal. II. 88 (1879); in Bot. Gaz. XVI. 106 (1891) — Jepson, Fl. Cal. 343 (1909), pro parte. — Rydberg, Fl. Rocky Mts. 196 (1917), pro parte. — When Bebb described this species he proposed three varieties basing his descriptions mainly on specimens collected by J. G. Lemmon in Sierra County, California. The first is var. *melanolepis* characterized by pitch-black and slightly or not at all hairy scales. Bebb cites no type but there is one in his herbarium in the Field Museum (No. 7794) consisting of male and female specimens. Here, too, are type specimens of the second var. *macrostachya*, and the third var. *sphaerostachya*, and two sheets which represent the typical form. All these specimens came from Sierra Valley in Sierra County, except those of var. *sphaerostachya* which are only marked "Sierra Nevada."

The type of *S. Lemmonii* (No. 7800 in Herb. Bebb) has unripe fruits and young leaves, and well agrees with that of var. *melanolepis*. The differences mentioned above are of no importance, because we can observe a change in the pubescence of the bracts not only in the aments of the same twig but even in the bracts of the same ament. Only in the male syntype of var. *melanolepis* (sheet 7799 in C.) the glabrousness of the bracts is a little more conspicuous. The size of the aments and the more or less ful-

vous pubescence of the young leaves are the same in both types. The young twigs are thin, slender, mostly covered with a grayish and rusty pubescence but soon becoming glabrous.

Bebb's var. *macrostachya* has female aments which measure up to 6.5 cm. in length but their peduncles are hardly different (Bebb says "more leafy"). The style is 1 mm. long; the fruits are not yet quite mature and scarcely more "tapering to a produced style" than those of the other forms. The male aments are hardly a little larger (to 3.5 : 1.3 cm.), and scarcely more silky than those of the type. In his main description Bebb says: "scales . . . black, thinly pilose." The pedicels always are only 2 to 3 times and not "4-6" times longer than the nectary. The var. *sphaerostachya* certainly is nothing but "a depauperate or subalpine form" as Bebb himself indicated. The type in Bebb's herbarium bears the No. 6752, and it is identical with a cotype in the Gray herbarium. The reddish brown or orange-colored branchlets show faint traces of a glaucous bloom thus pointing to var. *Austinae* (see later).

Bebb likened his species to *S. macrocarpa* (= *S. Geyeriana*) which "differs especially in its smaller pale acute scales, glabrate capsules, and nearly sessile stigmas." *S. Geyeriana melaina* has a rather distinct style (up to 0.5 mm. long), and there seems to be no difference as to the pubescence of the capsules. In this form of *S. Geyeriana* the glaucous bloom of the twigs is also wanting.

The leaves of *S. Lemmonii* are not only "paler or scarcely glaucous beneath" (Bebb) but the mature ones are distinctly glaucescent and by no means "green, nearly alike on both sides," as Jepson says. See Lemmon's specimen with mature leaves which Bebb makes the type in his herbarium (No. 6753 Bebb). *S. Lemmonii* apparently has been misunderstood by recent authors, and the diagnosis of Bebb is rather insufficient. Therefore I think it best to give the following more complete description and an enumeration of the specimens which I have seen. Frutex erectus ut videtur divaricato-ramosus, 1-3, raro ad 5 m. altus. Ramuli novelli tenuiter sericeo pilosiusculi (pilis argenteis ferrugineisque mixtis), hornotini glabri vel fere glabri, interdum parce pruinosi (confer specimina a cl. Ware in Mono Pass lecta), annotini biennesque brunnescentes, purpurascetes (vel interdum fere atropurpurei), glabri, nitiduli (in *S. Geyeriana* opaci), demum cinereo-nigrescentes; gemmae ut videtur ovoideo-oblongae vel ovoideae, obtusiusculae, ut ramuli coloratae, demum glabrae, divaricatae, floriferae quam foliiferae crassiores. Folia membranacea, sed adulta satis firma, anguste lanceolata, oblanceolata, anguste elliptico-lanceolata, basi acuta vel subobtusa, apice acuta ad subacuminata, interdum subapiculata, infima pleraque obtusiora, margine integra vel (saltem ad medium) parce distanter brevi-denticulata, infima saepe oblongo-spathulata interdum densius obscure glanduloso-denticulata, 1 : 0.3 ad 2.5 : 0.6 cm., superiora perfecte evoluta 3 : 0.8 ad 5.5 : 1 vel 7-9 : 1-1.5-1.8 cm. magna; superne novella plus minusve adpresse sericea vel sericeo-villosula, pilis griseis et ferrugineis mixtis, deinde saepissime cito glabrescentia et adulta glabra

vel pilis paucis difficile recognoscendis praedita, ut videtur vivide et intense viridia, in epidermide stomatibus plus minusve numerosis instructa, laevia vel costa nervisque laevissime prominulis; subtus initio ut superne pilosa, demum etiam, saepe citius, glabrescentia et adulta distincte glaucescentia, pleraque tenuissime adpresse breviter sericea glabrave, costa flavescens elevata, nervis lateralibus utrinque 6-10 (-12) vix prominulis; petioli tenues, pilosuli (saltem superne in sulco), 2-7 mm. vel interdum fere ad 16 mm. longi; stipulae minimae vel parvae, lanceolatae vel semi-ovato-lanceolatae, plusminusve acutae, glanduloso-denticulatae (partim lobulato-dentatae), ut folia pilosae, petiolis pleraeque 2-3-plo breviores, deciduae vel nullae, raro in surculis ad 8 mm. longae. Amenta coetanea, pedunculo brevi bracteato vel distincte foliolato suffulta, rhachi villosula; mascula densiflora, ellipsoideo-cylindrica vel cylindrica, 1:0.7 ad 3:1.2 (rare ad 3.5:1.4) cm. magna pedunculo brevissimo vel vix ultra 5 mm. longo foliolis lanceolatis acutis plus minusve integris superne fere glabris subtus adpresse et satis longe sericeis (pilis ferrugineis argenteisque mixtis) vix ultra 12:4 mm. magnis praedito excluso; bractae obovatae vel obovato-oblongae, apice rotundatae vel obtusiusculae, laxae longe sericeae, pilis summis quam bractea saepissime subbrevioribus, rarius apice plusminusve glabrescentes; stamina 2, filamentis liberis (interdum paullo vel ad $\frac{1}{3}$ coalitis), fere ad medium pilosis bracteam demum 2-3-plo superantibus, antheris aureis parvis crasse ellipsoideis; glandula 1, ovoideo-rectangularis, truncata, bractea duplo vel subduplo brevior; amenta feminea sub anthesi 1-2.5:0.8-1 cm. magna, pedunculo ut in masculis vel ad 6-12 mm. longo et distinctius foliolato (foliolis saepe deciduis), fructifera 2:1.5 ad 3.5-4:1.8 (rarius ad 6:2) cm. magna; bractae ut in masculis vel interdum apice acutiusculae, initio pedicellum paullo vel interdum fere subduplo superantes, demum eum aequantes vel rarius eo $\frac{1}{4}$ breviores; ovaria anguste ellipsoideo-conica, breviter sericeo-tomentosa vel laxius plusminusve adpresse sericeo-villosula; styli breves, saepissime 0.5-1 mm. longi, integri vel apice breviter bifidi; stigmata breviter oblonga, bifida, stylo circiter duplo, rarius paullo tantum breviora; pedicelli distincti, tenues, 1.5-2 vel in fructibus interdum ad 2.5 mm. longi, ut ovaria pilosi vel (in typo) partim vel fere omnino glabri; glandula 1, ventralis, ut in masculis vel paullo angustior, in ovaris pedicello 2-2 $\frac{1}{2}$ -plo, in fructibus interdum ad 3-plo (sed non 4-6-plo ut ab auctore indicatum) brevior. Fructus perfecte maturi ellipsoideo-vel ovoideo-rostrati, pedicello excluso 6-8 mm. longi, ut ovaria vel paullo laxius pilosi.

SPECIMENS EXAMINED: CALIFORNIA. Lassen County: Hot Springs Valley, near Lassen Peak, circ. 2000 m., June 6, 1910, *W. L. Jepson* (No. 4081, fr.; Jeps.; a small-leaved form resembling var. *meleina*). Plumas County: without exact locality, May 1877, *R. M. Austin* (f.; G.; the male specimen is *S. lasiolepis*); June 1878, same coll. (m., f.; G.); May 1879, same coll. (f.; G.; forma incerta ovaris partim pedicellis totis glabris, foliis superne parce stomatiferis); Warner Valley, about 1700 m., June 5, 1910, *W. L. Jepson* (No. 4066, st.; Jeps.; forma porro observanda foliis parvis superne sparse stomatiferis); Portola, May 25, 1918, *A. Eastwood* (No. 7004, f., 7005, m.; A.). Sierra County: Sierra Valley, without date, *J. G. Lem-*

mon (st., old fruits; sheet 6753 in C.), same coll. (f., type of var. *melanolepis*, sheet 7794 in C.; m., sheet 7799); same coll. (fr. juv., type of *S. Lemmonii*, sheet 7800 in C.); same coll. (f.; type of var. *macrostachya*, sheet 6754 in C.; m.; sheet 7795); same coll. (f., fr.; sheets 7798, 7796 in C.); Sierra Nevada, same coll. (f. m.; type of var. *sphaerostachya*; sheet 6752 in C.); west side of Webber Lake, near shore, June 21, 1900, *W. R. Dudley* (No. 5415, m.; St.); shore of Webber Lake, the common Willow, August 29, 1894, *Dudley* (st.; St.). Nevada County: Ice Lake near Soda Springs, on Pacif. Railr., about 2800 m., October 11, 1880, *G. Engelmann* (st.; M.); Truckee, May 1892, *C. F. Sonne* (No. 40, f.; C.); flat land on Yuba River, opposite Cascade, June 15, 1900, *W. R. Dudley* (No. 5151, a. m.; St.); valley near Lake Mary, near Summit, same date and coll. (Nos. 5104, m., 5111, f., 5115, m., 5115^a, f., 5116, f., 5116^a, m., 5117, f., 5120, m., 5122, f., 5128, fr.; St.); along South Yuba River, same date and coll. (Nos. 5139, fr., 5139^a, m.; St.); near hotel at Summit, same date and coll. (Nos. 5103, m., 5130, fr.; St.); grade east of hotel at Summit, same date and coll. (Nos. 5092, 5098, f.; St.); road between Summit and Cisco, same date and coll. (Nos. 5141, f., 5142, fr., 5143, fr., 5144, m., fr., 5145, f., 5146, m.; St.); Donner Lake, 500 yards below upper dam, June 14, 1900, same coll. (No. 5019, fr.; St.); Webber Lake and Serraville Trail, June 21, 1900, same coll. (No. 5475, f.; St.) Glenbrook near Truckee, June 28, 1900, same coll. (Nos. 5775 m., 5777, 5778, 5780, fr.; St.); Tahoe City, on meadow, most common willow, June 29, 1900, same coll. (Nos. 5796, 5799, 5800, fr.; St.); Independence Lake, meadow east of outlet and below bridge, June 19, 1900, same coll. (No. 5278, m.; St.). Placer County: Summit, about 2700 m., July 16, 1909, *A. A. Heller* (No. 9842, f.; G; sub nomine *curtiflora* distributa); low grassy places along Yuba River below Cisco, about 1800 m., June 17, 1917, same coll. (Nos. 12688, 12721, f.; St., C.); Lake Tahoe Region, Deer Park, June 15-19, 1912, *A. Eastwood* (Nos. 364, m., 432, f.; A.); road above Donner Lake, June 14, 1900, *W. R. Dudley* (No. 5081^a, f.; St.); between Donner Lake and Summit on "loop grade," same date and coll. (Nos. 5065, 5065^a, fr., 5066, 5067, f., 5069, m., 5070^a, f., 5077, 5078, fr.; St.); by Lake shore near Maddenie Cr. above McKinney's Cr., June 1900, same coll. (No. 5533, st.; St.). Eldorado County: Tallac (?) House to Desolation Valley, June 1900, same coll. (fr.; St.); near Tallac (?) House, June 28, 1900, same coll. (No. 5666, fr.; St.); near Camp Agassiz, June 17, 1900, same coll. (No. 5665, fr.; St.); Glenn Alpine, June 1900, same coll. (No. 5661, fr.; St.). Alpine County: near Highland Lake, about 2700 m., July 24, 1911, *L. R. Abrams* (Nos. 4748, f., m.; 4751, f.; G., St.); Iceberg (?) Meadow, Clock's fork, about 2200 m., July 22, 1911, same coll. (No. 4745, fr.; St.). Amador County: Silver Lake, about 2700 m., July 1892, *G. Hansen* (No. 199, fr.; M., St.). Mariposa County: Yosemite Valley, May and June 1900, *F. T. Bioletti* (f., m.; A.); vicinity of Lake Tenaya, about 2700 m., June 1902, *Hall & Babcock* (No. 3524, m., fr.; Jeps., St.); Lake Merced, about 2400 m., July 9, 1909, *W. L. Jepson* (No. 3194, fr.; Jeps.); Glacier Point, Turn Pike, May 26, 1888, *J. W. Congdon* (No. 123, f.; St.). Mono County: Mono Pass, Bloody Canyon, about 2800 m., July 23, 1907, *R. A. Ware* (fr.; G.; folia maxima ad 6.5:1.1 cm. magna, ramuli partim parce pruinosi). Tuolumne County: Tuolumne River Meadow, 2 mi. below Soda Springs, about 2750 m., July 18, 1909, *W. L. Jepson* (No. 3357, st.; Jeps.); Kennedy's Lake, about 2700 m., August 12, 1915, *A. L. Grant* (No. 246, fr.; A.). Fresno County: Horse Corral Meadow, region of King's River, August 11, 1900, *W. R. Dudley* (Nos. 3174, fr., 3177, st.; St.); King's River Canyon, same date and coll. (No. 3214, fr.; St.); Upper King's River, Rowell Meadow woods, June 21, 1900, same coll. (fr.; St.). Tulare County: Sequoia National Park, Marble Fork, about 2500 m., July 15, 1902, *G. B. Grant* (No. 1514, fr.; St.); [Milky Meadow to Three Rivers], Whitney (now Volcano) Creek, about 2800 m., July 23-31, 1900, *W. L. Jepson* (No. 954, st.; Jeps.); region of Sequoia National Forest, Vicinity of Homer's Nose, Cahoon Meadow, about 3000 m., July 13, 1897, *W. R. Dudley* (No. 1846, fr.; St.); region of Little Kern River, Barut (?) Corral Meadow, August 10, 1897, same coll. (No.

1979, fr.; St.); Vicinity of Mount Whitney, August 8, 1897, same coll. (No. 2501, st.; St.)

NEVADA. Ormsby County: Snow Valley, 2460–2615 m., June 24, 1902, *C. F. Baker* (No. 1162, f., m.; A., Cal., G., N.). Washoe County: Divide, south of Slide Mountain, in granite, about 2500 m., *A. A. Heller* (No. 10928, fr.; A., C., G., M.); ridge above Bowers, about 2200 m., same date and coll. (No. 10937, fr.; St.); about Marlette Lake, 2460 m., July 10, 1902, *C. F. Baker* (No. 1294, fr.; Cal.).

According to Jepson *S. Lemmonii* is also known from the Wasatch Mountains in Utah, but I have not seen any material from that region. Rydberg states that the species occurs as far east as Idaho. What I have seen from Idaho bearing the name *S. Lemmonii* did not at all belong to this species. This is the case, too, with Cusick's No. 1835 from eastern Oregon which (at least partly) seems to consist of male and female specimens of different species. His No. 1836 mostly represents the following variety.

S. Lemmonii, var. *Austinae*, var. nov. — *S. Austinae* Bebb apud Watson, Bot. Cal. II. 88 (1879); in Bot. Gaz. XVI. 106 (1891). — Bebb described *S. Austinae* from specimens collected by Mrs. R. M. Austin at Indian Valley, Plumas County, California. In Bebb's herbarium I have found only one specimen by this collector under *S. Austinae* (sheet 3388). Bebb did not put a name on it but he made sketches of the male and female flowers on the sheet. It is identical with other sheets in Herb. C. (Herb. Patterson) and in Herb. C. U. In 1891 Bebb stated that "the leaves described belong to *S. Lemmonii*, and in some (though not all) of the specimens male aments of *S. lasiolepis* were intermixed." But "there yet remain the fertile aments not identifiable with any willow of the Pacific Coast region as at present understood." If we take sheet 3388 in C. which well fits Bebb's description for the type it can be said that the leaves are not distinguishable from those of *S. Lemmonii*. The male and female aments, however, may well belong to one species, and the male aments are not identical with those of *S. lasiolepis*. Bebb does not describe the male flowers, but his sketch on the sheet shows glabrous filaments. A close investigation of the flowers revealed to me the fact that the filaments are hairy for about a fifth of their length and are often slightly connected at the base. The flowering branchlets are glabrous, orange-colored, and slightly shining. Those of the male specimen are hardly pruinose while the glaucous bloom is rather conspicuous on the branchlets of the female specimen which are of the same color. This glaucous bloom seems to be the main character to distinguish var. *Austinae* from *S. Lemmonii*. It is also to be seen on the specimens collected by Cusick in eastern Oregon (No. 1306 and 1836) which are named *S. Lemmonii*, and on a piece without number in Bebb's herbarium (sheet 7760 in C.). Pruinose twigs I also observed in Grant's No. 290 from Tuolumne County, the leaves of this specimen having stomata in their upper epidermis. After all I suppose that *S. Austinae* can best be considered a variety of *S. Lemmonii* but certainly a thorough study of more copious material is needed than I have been able to investigate. From the specimens enumerated below I have drawn the following diagnosis. Frutex vel arbor parva;

ramuli initio laxè tenuiter pilosuli pilis griseis et paucis fulvis mixtis, hornotini autumnò glabri, flavo-brunnei vel ut annotini floriferi magis rubescentes vel purpurascens, nitiduli, saepe leviter pruinosi; gemmae (in No. 1836 Cusickii) ovoideo-oblongae, acutae, petiolis plusminusve aequilongae. Folia textura coloreque ut in *S. Lemmonii*, initio fusco-pilosi pilis griseis intermixtis (in costa etc.), pubescentia, deinde quamvis ut in *S. Scouleriana*, anguste lanceolata vel lanceolata, basi acuta vel saepissime satis obtusa, apice acuta vel breviter acuminata (minimis lineari-oblongatis obtusioribus exclusis), 3.5:0.8 ad 6.5:1.1 vel ad 9:2 vel 8:2.1 cm. magna, margine obscure subserrata vel satis distanter serrata, superne subtusque ut in *Lemmonii*, subtus distincte albescens vel glaucescens, pruinosa, costa elevata flava nervisque lateralibus flavis graciliter prominulis et satis indistincte reticulata; petioli stipulaeque ut in *Lemmonii*. Amenta praecocia vel subcoetanea, cylindrica, densiflora, pedicello brevi foliola minima 2-3 lineari-lanceolata superne glabra subtus sericea decidua gerente 1-5 mm. longo suffulta; mascula vix ultra 2.8:1.2 cm. magna; bractae atrofuscae, obovato-oblongae, utrinque sericeae, obtusae; stamina 2, filamentis basi parce pilosis, interdum paullo coalitis, bracteam duplo superantibus, antheris ellipsoideis flavis; glandula 1, oblongo-rectangularis, truncata, bractea subtriplo brevior; amenta feminea sub anthesi 2 2.8:1 cm. magna; bractae ut in floribus masculis; flores ut in *Lemmonii*; styli vix ultra 0.5 mm. longi; pedicelli vix ultra duplo longiores quam glandula; stigmata stylo subaequilonga, breviter oblonga, divaricata; glandula ut in masculis. Fructus maturi mihi tantum ignoti.

SPECIMENS EXAMINED: CALIFORNIA. Plumas County: Indian Valley, without date, *Mrs. Austin* (m., f., st.; type in C., sheet No. 3388; the same is sheet 361195 in C. U., 204066 Herb. Patterson in C. and sheet 346815 Herb. Schuette in C.; on sheet 204065 Herb. Patterson in C. is a label of Bebb's with the note: "I suppose we call this all *S. Austinae* — but I begin to fear that the dividing line between *Austinae* and *Lemmonii* is hazy to say the least"). Sierra County: Sierra Valley, without date, *Lemmon* (m., f.; sheet 7792 Herb. Bebb in C.; apparently nothing but typical *Lemmonii*; the same is sheet 7793).

OREGON. Union County: without date, *Cusick* (m., f.; sheet 7760 in C.; named by Bebb "*S. Lemmonii*, mixed with flowers of *S. flavescens*." The male branchlets are distinctly pruinose; the sterile specimen has lanceolate obovate acute leaves with a more or less conspicuous crenate dentation, a glabrous under surface, and distinct stipules). County?: Mountains of Eastern Oregon; banks of streams, about 1350 m., *Cusick* (No. 1306, fr., st.; sheet 7759 in C.; leaves and branchlets as in the foregoing specimen); a slender shrub of streambanks, April 19, May 9, September, 1898, same coll. (No. 1836, f.; sheet 109712 in C.; named *S. Lemmonii* but looking much like *S. Geyeriana*, leaves without stomata in their upper surface); apparently same region, same date and coll. (No. 1835, f., m. st.; sheet 109711 in C.; the large leaves partly become greenish beneath, the bloom of the twigs is hardly recognizable; in different herbaria are somewhat different specimens under this number.)

Bebb (1891) said, that Cusick found the species in eastern Oregon but unfortunately he did not quote Cusick's numbers. In Bebb's herbarium I have found the three sheets of Cusick's just mentioned. To the sheet 7759 are added two letters of Cusick's, in one of them (dated October 10, 1887) he states that his numbers 1510 and 1610 represent *S. Lemmonii*. I did

not, however, detect specimens bearing these numbers in Bebb's herbarium. Cusick also says in the letter the following as to the differences between *macrocarpa* (*Geyeriana*) and *Lemmonii*: "*S. Lemmonii* is a much larger shrub, sometimes a tree 8 or 10 inches in diameter; seldom or never upright, divaricately branching; growing in widely spreading clumps and commonly on the bank of rocky swift running streamlets. The *macrocarpa* form is smaller, slender and virgate; the tops gradually dissolving into small branchlets, one plant one inch in diameter is large and will be 6 to 8 feet high; it is found more commonly along sluggish or marshy streams. I saw it in great abundance on Stein's Mountains in Malheur Co. in the summer of '86." Possibly Cusick's *Lemmonii* is identical with var. *Austinae*. Another sheet of Cusick's (No. 7758) I take for *S. Scouleriana*. It consists of a sterile specimen with old leaves measuring up to 9-11:4-3 cm. and bearing beneath the typical short brownish pubescence of *Scouleriana*.

b. THE SPECIES OF SECTION ROSEAE

This section was proposed by Andersson in 1867 for the species *S. proluxa* Andersson, *S. myrtilloides* Linnaeus and *S. fuscescens* Andersson to which he added a number of European hybrids. The type species is *S. myrtilloides* because he named the section "Stirps X. Salices roseae v. *S. myrtilloides*," and later, in 1868, "§ 10. Roseae s. Myrtilloides." Andersson's first species *S. proluxa* is a very little known Willow. The true *S. myrtilloides* is not found in the New World where it is represented by *S. pedicellaris* Pursh treated by Andersson as a subspecies or as a variety of *S. myrtilloides*. *S. fuscescens*, too, needs further study, and this section as a whole is a group of rather doubtful taxonomic value. The best I can do at present is to discuss briefly these American species, and to advise other students who have a good opportunity to collect better material and to study the plants in the field. The synonymy of the group is as follows:

Sect. *Roseae* (sive *Myrtilloides*) Andersson in Svensk. Vet.-Akad. Handl. vi. 94 (Monog. Salic.) (1867); in De Candolle, Prodr. xvi.² 229 (1868). — Sect. *Arbusculae* Barratt apud Hooker, Fl. Bor.-Am. ii. 150 (1839), pro parte, quoad *S. pedicellaris*. — Sect. *Virentes* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 123 (1858), pro parte quoad *S. myrtilloides*. — Sect. *Myrtilloides* Zabel apud Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 30 (1903). — Sect. *Argenteae*, subsect. *Myrtilloides* Schneider, Ill. Handb. Laubh. i. 63 (1904).

1. *S. pedicellaris* Pursh, Fl. Am. Sept. ii. 611 (1814). — Poirlet in Lamarck, Encycl. Suppl. vi. 62 (1817). — Torrey, Fl. N.Y. ii. 213, t. 120 (1843). — Hooker, Fl. Bor.-Am. ii. 150 (1839), quoad descr. sed probabiliter exclud. specim. — Carey apud Gray, Man. 429 (1848). — Britton & Brown, Ill. Fl. ed. 2, i. 602 fig. 1479 (913). — Griggs in Proc. Ohio Acad. Sci. iv. 313, t. 16 (1905) ex parte. — Robinson & Fernald, Gray, Man. ed. 7, 324, fig. 655 (1908). — Fernald in Rhodora, xi. 157 (1909). — *S. myrtilloides* Tuckerman in Am. Jour. Sci. xlv. 34 (1843), non Linnaeus. — An-

dersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 125 (1858). — Gray, Man. ed. 5, 465 (1867). — Bebb apud Gray, Man. ed. 6, 485 (1889). — Britton Man. 316 (1901). — Britton & Brown, Ill. Fl. i. 505, fig. 1204 (1896). — Piper in Contrib. U.S. Nat. Herb. vi. 214 (1906). — Ball in Proc. Iowa Acad. Sci. vii. 153, t. 12, fig. 14 (1900). — *S. myrtilloides* [subspec.] *S. pedicellaris* Andersson in Svensk. Vet.-Akad. Handl. 96 (1867). — *S. myrtilloides* var. β *pedicellaris* Andersson in De Candolle, Prodr. xvi.² 230 (1868).

The history, geographical distribution and variability of this "attractive bog willow" was fully given by Fernald in 1909. I do not wish to repeat what this excellent observer has said, and only the following statements from my own observations may be added. The shape of the leaves of the European *S. myrtilloides* is not always different from that of the American species. I have repeatedly observed in American specimens (see for instance Sandberg's No. 521) round-ovate or ovate-oblong leaves which are broadest near the base and rounded or subcordate at base but as a whole the differences indicated by Fernald hold true. I do not, however, agree with his interpretation of the type. Pursh indeed says: "foliis . . . utrinque concoloribus" but his plant was collected in April, and he apparently had not seen mature leaves. I have seen all the specimens referred to the type by Fernald but all of them have leaves with at least a partly more or less glaucescent undersurface. I am not convinced that the plant of Pursh of which no type specimen is in existence has to be regarded as different from the widely distributed form which Fernald has named var. *hypoglauca* (in Rhodora, xi. 161 [1909]). Pursh's plant came from the Catskill Mountains in New York, a region from which I have not seen any material of *S. pedicellaris*.

Fernald's var. *tenuescens* (l. c. 162) seems to me hardly more than a form with narrower leaves. There are some specimens from Illinois (Palmer, No. 15561, in A.) and from Indiana (Deam, No. 20118^a, in A.) which need further observation.

2. *S. proluxa* Andersson in Svensk. Vet.-Akad. Handl. vi. 94 (1867); in De Candolle, Prodr. xvi.² 229 (1868). — Macoun, Cat. Can. Pl. i. 452 (1886). — Ball apud Piper & Beattie, Fl. N. W. Coast, 115 (1915). — Of this "forma elegantissima habitu omnino singulari" I have seen a photograph and fragments of the type which was collected by Lyall "ad Lower Frazer-River, 49 l.b." in 1859. Unfortunately I have misplaced part of my notes and sketches on it. According to Ball (1915) it chiefly differs from *S. pedicellaris* by longer pedicels, and thinner leaves with a coarser reticulation. It is said by Macoun (1886) to be "not uncommon around Victoria, Vancouver Island, also in the Valley of Thompson River, at Spence's Bridge, B.C." I asked Professor J. K. Henry, the well-known author of the Flora of Southern British Columbia for his opinion on this species, and he wrote to me in a letter of September 7, 1919, as follows: "As to *Salix proluxa* Andersson: I have never seen an authentic or typical specimen of this

plant. The Victoria collectors cannot find it. My own feeling was that it is not distinct from the very common *S. Mackenziana* the leaves of which are sometimes green beneath when the fruit is mature. Willow leaves, on this coast at least, mature very slowly and it is often midsummer before they assume the final shape and character. It does not seem to me that the analysis of Piper & Beattie in their Flora of the North West Coast is very satisfying as far as these two species are concerned. *Salix Mackenziana* about Victoria, B.C., is often a low shrub, while the scales are not black even when dry. The stipules, too, vary. Possibly, however, the specimens I enclose from New Westminster (from a shrub . . . on the moist bank of the Frazer River) you may consider *S. proluxa*."

I am not able to give a final judgment on these specimens. The type of *S. proluxa* is not sufficient to decide the question whether it is a good species or not. It does not possess well-matured fruits and leaves. Henry may be right that the plant which is considered to be *S. proluxa* by Ball does not represent a distinct species. On the other hand, *S. proluxa* may belong to those good species which have a very limited distribution, and are still in need of a better understanding. Not being well enough acquainted with some western forms of the *Cordatae* group I leave it to Ball and other salicologists to demonstrate the true taxonomic value of Andersson's species.

3. *S. fuscescens* Andersson in Svensk. Vet.-Akad. Handl. vi. 97 (1867); in De Candolle, Prodr. xvi.² 230 (1868), excl. var. — Coville in Proc. Wash. Acad. Sci. III. 329, fig. 25 (1901). — *S. myrtilloides* f. 1 et 2 Chamisso in Linnaea, vi. 539 (1831). — *S. rhamnifolia* Hooker & Arnott, Bot. Voy. Beechey, 117, t. 26 (1832), excl. citat., non Pallas. — *S. phlebophylla* Rydberg in Bull. N.Y. Bot. Gard. I. 274 (1895), ex parte, quoad pl. Cape Blossom, non Andersson. — This species has been founded upon Hooker's *S. rhamnifolia* from "Awatschka Bay, in lat. 53°," Kamtschatka, the type of which was collected by Beechey & Mertens and is still unknown to me. In 1858, Andersson mentioned *S. rhamnifolia* Hooker but then he evidently was not quite sure whether this was identical with the plant Pallas and Ledebour took for this species. He also cited Chamisso's *S. myrsinites* (in Linnaea vi. 540) "ad sinum S:eti Laurentii" of which I have not seen the type, and also Chamisso's forms 1 and 2 of *S. myrtilloides* which, too, I have had no opportunity to compare. No. 1 came "e sinu Eschscholtzii" in Alaska, while No. 2 was collected "in paludibus prope Tigil Kamtschatcae occidentalis." In 1867 Andersson proposed the name *S. fuscescens* for what Hooker has called and figured as *S. rhamnifolia*. Andersson's fig. 54 quoted by him in 1868 is not given in his monograph.

Judging by the description and figure given by Hooker and by Andersson's own diagnosis I believe that the specimens regarded by Coville and myself as *S. fuscescens* really represent this species. I have not seen it from America except from Alaska and not eastward of the 150°. The following specimens which I have seen are not mentioned by Coville.

ALASKA. Kuskokwim Valley, 1884, *Weinmann* (f., fr.; G.); between Tyonok, on Cook Inlet, and Rampart City, Yukon River, Camp 7, Beluga Valley, about 330 m., June 10, 1902, *A. H. Brooks & L. M. Prindle* (fr. im.; W.); Yukon Delta, July 14, 1889, *J. C. Russell* (fr.; W.); St. Lawrence Island, July 13, 1899, *B. E. Fernow* (f.; Cor.); Lake Iliamna Region, Iliamna Bay, in sphagnum marsh, June 22, 1902, *M. W. Gorman* (No. 41, fr.; W.; "prostrate and creeping"); Valley of Kobuk River, at Kobuk portage between Alatna and Walker Lake, July 3, 1901, *W. C. Mendenhall* (fr.; W.; "small and creeping, from 3 to 10 in. high. Common in low places"); Seward Peninsula, Nome, 1914, *G. A. Hill* (No. 84, f.; W.); tundra behind Nome, "on moss hummocks plentiful," June 17, 1903, *F. L. Hess* (f., m.; St.; "in spreading communities"); Vicinity of Port Clarence, near entrance to lagoon, below mouth of Kuzitvin River August 2, 1901, *F. A. Walpole* (No. 1674, fr.; W.); Port Clarence, July 12, 1899, *B. E. Fernow* (f.; Cor.); Norton Sound, St. Michael, July 10, 1889, *J. C. Russell* (f.; W.); Cape Blossom, 1884, ? *S. B. McLenyan & St. Corvin* (fr.; G.; Rydberg 1899 as *S. phlebophylla*).

NORTHEASTERN ASIA. Arakam (Tchetchene) Island, 1853/6, *C. Wright* (fr.; G.; mixed with an *arctica* form).

In 1907 Fernald stated that *S. fuscescens* "hitherto known only from northern and western Alaska and the adjacent coast of Siberia, is abundant in bogs on the serpentine tableland of Mt. Albert" on the Gaspé Peninsula. According to my own observations the eastern specimens all belong to var. *hebecarpa* described by Fernald, and it may even be that this variety can be raised to the rank of a species. It chiefly differs from typical *S. fuscescens* by foliis saepissime apice paullo acutiusculis vel distincte acutis, capsulis pedicello brevi ut videtur fere semper piloso vix ultra 1.5 mm. longo excluso vix ultra 6-7 mm. longis brevius rostratis basi crassioribus, saepissime plusminusve vel omnino (praesertim basi) pilosis et distinctius glaucescentibus. What Fernald regards as typical *fuscescens* is in my opinion, only a glabrescent form of var. *hebecarpa* of which the pedicels never become wholly glabrous, and are always comparatively shorter and thicker than those of true *fuscescens*.

There is a female specimen collected by Trelease & Saunders under No. 3443 mixed with *S. ovalifolia* which Coville refers to *S. fuscescens*. It has, indeed, flowers very similar to those of this species but the ovaries are hairy and borne on shorter and thicker pedicels. It looks to me like a hybrid, and I do not think that it is a hairy form of *S. fuscescens* identical with the eastern var. *hebecarpa*.

There remain to discuss several species which I at present am unable to refer to one of the sections with which I have dealt.

The first is

S. arbusculoides Andersson in Svensk. Vet.-Akad. Handl. vi. 147 t. 8. fig. 81 (1867), excl. var. *glabra*. — Bebb in Bot. Gaz. xv. 54 (1890). — Macoun, Cat. Can. Pl. II. 358 (1890). — Coville in Proc. Wash. Ac. Sci. III. 323, fig. 21 (1901). — Rydberg, Fl. Rocky Mts. 196 (1917). — *S. arbuscula* Andersson in Öfv. Svensk. Vet.-Acad. Förh. xv. 130 (1858), excl. var. *labradorica*, non Linnaeus. — *S. humillima* Andersson in De Candolle, Prodr. xvi.² 248 (1868), excl. var. *glabra*. — Macoun, Cat. Can. Pl. I. 449 (1886). —

This Willow was first mentioned by Hooker (1839) as *S. acutifolia* Willdenow. Hooker gave a short description from specimens collected by Drummond and Richardson "Saskatchewan to Fort Franklin on the Mackenzie River," and said: "Mr. Borrer considers this to be the same as true *acutifolia* of Willdenow, from the Caspian Sea." This was, of course, a mistake, and our Willow has nothing whatever in common with Willdenow's well-known species. Hooker himself apparently regarded Borrer's determination as doubtful because he expressly stated that the twigs are not pruinose in the dried specimens. In the Herbarium of the New York Botanical Garden I have found a specimen of Richardson's from the Mackenzie River under "No. 65 Hb. H.B. & T.," and another specimen labeled "*Salix acutifolia* Fl. Bor. Am." of which the later indeed represents the typical *S. arbusculoides*. In 1858, Andersson mentioned *S. acutifolia* Willdenow saying nothing but "Ramum foliatum tantum in herb. vidi." He never quoted Hooker's plant. According to Bebb he passed the specimens of Drummond and Richardson in the Hookerian herbarium as *S. petiolaris*. He referred, in 1858, the plants on which he later based his *S. arbusculoides* to *S. arbuscula* Linnaeus, and at this time he proposed a *S. arbuscula* *labradorica*, a name later omitted by him. He did not cite a type for it, and only stated "Labrador." In describing his *S. arbusculoides* he gave as type specimen "Prince Albert's Sound (Mietscherling)," and he added "Raë River (Dr. Raë)," and "et in Labrador." (In 1858 he wrote "Miertsching" and "Roe.") Later in the Prodrum Andersson proposed a new name, and said of *arbusculoides* "nomine incaute graeco-latino delendo." Here he cited Labrador with a ?. In 1867 as well as in 1868 Andersson has two varieties: var. *puberula* and var. *glabra*.

Bebb, in 1890, has already discussed this species, and stated that "Prof. Macoun who examined Andersson's types for me in the Kew Herbarium, says, that the specimens of Mieschring and Dr. Raë are all on one sheet with no means of telling to which, respectively, the labels belong; that they comprise apparently two or more species and are very imperfect, a few bearing young catkins." I have had no opportunity to compare these specimens but have examined copious material of this species from which I am able to draw the diagnosis given below.

It has been described, too, by von Seemen (1895) as *S. saskatchewaniana* who based his species on Hooker's *S. acutifolia* of which I have seen the type. Von Seemen does not refer to *S. arbusculoides* or *S. humillima*, and probably did not know Bebb's note. According to a fragment of Von Seemen's type his species is nothing but Andersson's var. *glabra*, and certainly not a form of specific rank. Of the typical *S. arbusculoides* the following description may be given to enable a better understanding of this little known species.

Frutex in regione arctica humilis sed apud Dawson fide cl. Eastwood interdum arbuscula ad 3-6 m. alta ramis rubescentibus nitidis erectis vel interdum pendentibus; ramuli ab initio glaberrimi vel novelli minute puberuli et cito glabrescentes, hornotini olivacei vel ut annotini atrofusci vel casteani, nitiduli, dein atro-purpurascens; gemmae floriferae (Eastwood

No. 16) conicae, subrostratae, apice subrecurve, ad 8 mm. longae, fuscae, nitidulae, glabrae, foliiferae ut videtur magis ovoideo-oblongae, breviores. Folia adulta chartacea, minora lineari-lanceolata, majora anguste lanceolata, rarius anguste elliptico-lanceolata, 1.5:0.4 ad 8:1.3 vel in ramulis vegetioribus ad 9:1.8 (vel in No. 467 Eastwoodiae ad 12:2.8 vel 14:2.3) cm. magna, utrinque acuta vel apice sensim breviter acuminata, subintegra, vel plus minusve dense breviter glanduloso-serrata, dentibus 1-20 pro 1 cm., superne ut videtur saepissime ab initio glaberrima vel novella pilis sparsis brevibus adpressis praedita, intense vivide viridia, nitidula, laevia, costa flavescenti nervisque lateralibus planis vel parce prominulis et laxe graciliter reticulata, in epidermide haud stomatifera vel stomatibus plusminusve numerosis (saepe tantum ad costam) praedita, subtus discoloria, glaucescentia vel fere albescentia, initio (infimis exceptis glabris) dense adpresse sericea pilis argenteis saepe cum fulvis mixtis, vel tantum parce pilosa et demum plusminusve vel omnino glabrescentia, adulta interdum parce fulvo-sericea, costa flavescenti prominula nervis lateralibus utrinque ad 14 tenuiter prominulis parallelibus angulo acuto circ. 40-45° a costa abeuntibus, vix vel tenuissime reticulata; petioli superne sulcati et (saltem initio) minute puberuli, (2-) 4-8 (-11) mm. longi; stipulae nullae vel distinctae, lineari-lanceolatae, glanduloso-serratae, vix ultra 5 mm. longae, in surculis interdum latiores brevioresque. Amenta praecocia vel subcoetanea, anguste cylindrica, subsessilia, mascula (1-) 1.5-4:1 cm. magna, elongata, saepe subcurvata vel flexuosa, basi pedunculo 1 ad vix 5 mm. longo foliolis minimis linearibus normalibus vel squamiformibus 2-3 instructo; bracteae oblongae vel subobovato-oblongae, apice obtusae vel subrefusae (sed in eodem amento etiam subaeutae) vel angustiores et acutiores, semper fusciscentes vel atrobrunnescentes, sparse et satis breviter vel ad apicem densius longe sericeae; stamina 2, filamentis glabris liberis vel imo basi brevissime coalitis, demum bracteam duplo superantibus, antheris parvis subglobosis vix 1 mm. longis in vivo ut videtur purpurascens: glandula 1, ovoideo-conica vel ovoideo-rectangularis, apice late truncata, saepe leviter emarginata, 2 2½-plo longius quam lata; amenta feminea sub anthesi pedunculo brevi excluso 1.5-3.5:0.5-0.6 cm., fructifera 2:1 ad 6:1.2 cm. magna, pedunculo circ. 3-8 mm. longo ut in masculis foliolato suffulta; bracteae ut in masculis, fere semper obtusae, forma pubescentiaque variables; ovaria ellipsoideo-conica, dense breviter sericeo-tomentosa; styli 0.2-0.8, rarius ad 1 mm. longi, saepissime subbifidi, stigmatibus parvis brevibus bifidis divaricatis iis aequilongis (vel initio sublongioribus); glandula ut in masculis, interdum vix longior quam lata sed saepissime 2-3-plo altior; fructus maturi tenuius quam ovaria tomentosi, e basi ellipsoideò vel ovoideo plusminusve rostrati, 5-7.5 mm. longi, pedicello 0.5-1.25 mm. longo excluso.

SPECIMENS EXAMINED: NORTHWEST TERRITORIES. Fort McPherson, July 11, 1904, E. A. Preble (Nos. 350, 351, fr.; W.); Fort Norman, Mackenzie, June 12, 1904, same coll. (No. 322, f.; W.); half way between Fort Rae, Great Slave Lake, and MacTavish Bay, Great Bear Lake, Lake St. Croix, August 10, 1903, same coll. (No. 247, st.; W.; forma ad var. *glabram* referenda); Great Slave Lake, Loon

Island, fifty miles north of Fort Resolution, July 10, 1901, *E. A. & A. E. Preble* (Nos. 133, 134, f.; W.); Slave River, about 45 mi. from mouth, August 29, 1914, *F. Harper* (No. 99027, st.; O.); Fort Resolution, July 14, 1901, *E. A. & A. E. Preble* (No. 151, st.; W.); June 21, 1903, *E. A. Preble* (No. 201, f.; W.); Nahami Mts., June 6, 1904, same coll. (No. 317, f.; W.); Churchill, Hudson Bay, August 2, 1910, *J. M. Macoun* (No. 79152, fr.; O.)

YUKON TERRITORY. Vicinity of Dawson, island near footbridge, July 13, 1899, *R. S. Williams* (fr.; N.); same vicinity, April 26, 1914, *A. Eastwood* (No. 16, winter-buds; A.); June 29, 1914, same coll. (No. 31, st.; A.; ad var. *glabram* spec-tans); May 21, 1914, same coll. (No. 56, partim, f.; A.; ut *praeedens*); May 14, 1914, same coll. (Nos. 56, partim, f., 57, m.; A.); May 15, 1914, same coll. (Nos. 64, m., 65, f.; A.); May 21, 1914, same coll. (Nos. 85, f., 87, m.; A.); May 23, 1914, same coll. (Nos. 98, m., 99, f., 100, m.; A.); May 26, 1914, same coll. (No. 106, f.; A.); June 2 and 3, 1914, same coll. (Nos. 129, m., 130, f.; A.); July 13, 1914, same coll. (No. 217, fr. submat.; A.; var. *glabra*); July 14 and 15, 1914, same coll. (Nos. 229, 239, 240, fr.; A.); June 19, 1914, same coll. (Nos. 301, st.; var. *glabra*; 302, fr.; A.); West Dawson, July 16, 1902, *J. Macoun* (No. 54402, st.; O.: "a small straight tree"); trail to Moosehide, July 1, 1914, *A. Eastwood* (No. 467, st. surc.; A.); islands in Klondike River, July 15, 1902, *J. Macoun* (No. 54401, fr.; O., partim var. *glabra*); Colorado Pup, July 29, 1902, same coll. (No. 54400, st.; O.); Ogilvie, July 8, 1914, *A. Eastwood* (No. 540, st.; A., var. *glabra*); Hard Luck Slough, July 10, 1914, same coll. (No. 565, fr.; A.); Cormacks, July 1, 1914, same coll. (No. 584, st.; A.); Carcross, Lake Bennett, July 16, 1914, same coll. (No. 725, st.; A.); Ingersoll Islands, moist sloughs and river bottoms, May 28, 1899, *M. W. Gorman* (m., f.; N.; "this willow is much eaten by Moose").

ALASKA. White Pass, July 23, 1914, *A. Eastwood* (No. 860, fr.; A.; an uncertain form of which the young leaves are rather tomentose along the under side of the midrib); Fort Gibbon on Yukon River, August 1, 1905, *C. N. H. Heideman* (No. 83, st.; W.; forma incerta; surculi foliis elliptico-lanceolatis membranaceis ad 10:2.2 cm. magnis breviter acuminatis subtus glaucis tenuiter brevissime adpresse sericeis stipulis linearibus).

ALBERTA. Jasper Park, near Jasper, July 22, 1917, *J. M. Macoun* (No. 95376, st.; A., O.); Athabasca River, July 23, 1918, same coll. (No. 95373, fr.; A., O.), same River, near bridge, east end, mixed alluvial soil and gravel, June 20, 1918, same coll. (Nos. 95750, m., 95751, fr. submat.; 95769, f.; 95770, m., f.; A., O.)

The localities of Drummond's specimens are uncertain. They are preserved in Herb. N. under "No. 61, Hb. H.B. & T.," fr., "marshes near Rocky Mts.," "No. 62, Hb. H.B. & T." f., and "No. 63, Hb. H. B. & T." st. No. 62 is Drummond's No. 663.

As a variety may be kept

S. arbusculoides var. *glabra* Andersson in Svensk. Vet.-Akad. Handl. VI. 148 (Monog. Salic.) (1867). — *S. acutifolia* Hooker, Fl. Bor.-Am. II. 150 (1839), non Willdenow. — *S. humillima* var. *glabra* Andersson in De Candolle, Prodr. XVI.² 248 (1868). — *S. saskatchavana* von Seemen in Bot. Jahrb. XXI. Beibl. 52, 7 (1895). — *S. saskatchewana* Rydberg, Fl. Rocky Mts. 198 (1917). — This is probably nothing but a glabrescent form and needs further observation. I refer to it the specimens mentioned as var. *glabra* in the enumeration above, and Richardson's plant from Fort Franklin preserved under "No. 65 Hb. H.B. & T." in Herb. N.

As to the true relationship of *S. arbusculoides* I do not wish to make a definite statement. Sometimes the leaves have rather numerous stomata

in their upper epidermis but not unfrequently I could not detect any trace of them. The length of the style and of the pedicel varies to a certain degree, and the shape of the gland is not always alike. These variations need further study. As to the Yukon plant at Dawson Miss Eastwood in a field note makes the following statement: "In habit it is variable but is generally tall and erect with dark red glossy stems. Some bushes have pendent branches, and some have almost fastigate branches. It often becomes 10-20 feet high, and forms a great deal of the Willow growth along sloughs. It is common along the fence near the barracks, and in the slough on Fifth Street where the bridge crosses. It is one of the features of the vegetation in the town."

The second species of doubtful affinity is

S. argyrocarpa Andersson in Svensk. Vet.-Acad. Handl. vi. 107, t. 6, fig. 60 (Monog. Sal.) (1867); in De Candolle, Prodr. xvi.² 233 (1868). — Bebb in Bull. Torr. Bot. Club, xvi. 211 (White Mt. Will. III) (1889); apud Watson & Coulter, Gray Man. ed. 6, 483 (1890). — Britton & Brown, Ill. Fl. I. 500, fig. 1190 (1896); ed. 2, I. 603 fig. 1484 (1913). — Britton, Man. 318 (1901). — Robinson & Fernald, Gray's Man. ed. 7, 327, fig. 664 (1908). — Von Seemen in Ascherson & Graebner, Syn. Mitteleur. Fl. iv. 92 (1909). — *S. repens*? Bigelow, Fl. Bost. ed. 3, 392 (1840), non Linnaeus. — Carey apud Gray, Man. 430 (1848). — Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 126 (1858). — *S. fusca* Oakes in Mag. Hort. Bot. Harvey, vii. 184 (Not. Rar. Pl. New Engl. 7) (1841), non Linnaeus. — *S. ambigua* Tuckerman in Am. Jour. Sci. xlv. 35 (1843), non Ehrhart. — *S. labradorica* Schw. in Herb. ex Bebb in Bull. I. c. 211 (1889), nom. nudum. — *S. argyrocarpa sericea* Andersson in Svensk. Vet.-Akad. Handl. vi. 107 (Monog. Sal.) (1867); in De Candolle, Prodr. xvi.² 234 (1868). — *S. depressa* Barratt in Herb., nom. nudum, non Fries.

Bebb (1889) has dealt with this Willow quite extensively. The synonymy given above furthermore shows how this species has been treated by previous authors. I am not sure whether Pursh's *S. repens* (Fl. Am. Sept. 610 [1814]) really is the same as our species. He had a Willow in mind that came from "Nova Scotia and New Foundland," and was "a very small creeping species." I have not yet seen specimens that agree with Pursh's description which apparently is partly taken from Willdenow. Pursh says that the ovaries are pubescent but the capsules glabrous. Von Seemen seems to have been the first who observed the presence of two glands in the male flowers, and he therefore placed this species with *S. glauca*. In my opinion it cannot be referred to sect. *Glaucæ*, and may represent the type of a special group.

Besides var. *sericea* which is nothing but the type Andersson in 1867 described as var. "*glabrior*: foliis magis aequalibus, supra nitide, subtus opacoviridibus denudatis" which name he (1868) changed into var. *denudata* where he says: "foliis utrinque glabris, subtus opacæ viridibus, iis *S. pedi-*

cellaris subsimilibus." Not citing a type specimen it is almost impossible to tell what Willow Andersson may have had before him.

I have been able to examine specimens from the White Mountains in New Hampshire, from Table-top Mountain in Gaspé Peninsula and from various localities in southern Labrador.

When I dealt with the species of section *Glaucæ* in my 2nd and 3d notes (see Bot. Gaz. LXVII. 58 [1919]) I omitted a curious species described by Rowlee as *S. Maccalliana* of which he said that it is "obviously related to *Salix glaucops* Anders., but differs in having glabrous serrate leaves. Its leaves and buds suggest *S. lucida*." After having examined probably all the material preserved in American herbaria up to 1919 I suppose that *S. Maccalliana* indeed can be regarded as a member of this group because the flowers show a strange similarity to those of *S. glauca* var. *glabrescens*. The male flowers have a dorsal gland, and the pubescence of the straw-colored or light brown bracts is short. The leaves, however, present a wholly different aspect, and somewhat resemble those of forms which Ball names *S. pseudomyrsinites*, a species of the *Cordatæ* group. I will give the following precise description and enumerate the specimens.

S. Maccalliana Rowlee in Bull. Torr. Bot. Club xxxiv. 158 (1907). — Henry, Fl. S. Brit. Col. 97 (1915). — Rydberg, Fl. Rocky Mts. 198 (1917). — Frutex 1–2 m. altus, ut videtur erectus, strictus, ramosus; ramuli novelli sparse pubescentes, cito glabri, ? balsamei, hornotini olivacei vel purpurascens, saepe ut annotini biennesque castanei, nitiduli, vetustiores ignoti; gemmae bene evolutae nondum visae. Folia matura crasse chartacea, inferiora minora pedunculorumque anguste vel lineari-lanceolata vel oblanceolata, gradatim in superiora majora anguste elliptico-lanceolata vel anguste elliptico-oblonga abeuntia, basi acuta vel obtusa, apice subacuta vel subacuminata, 1.5 : 0.5 ad 6.5 : 1.6 vel in surculis ad 8(–9) : 2.5 cm. magna, margine incrassato distincte glanduloso-crenato-dentata dentibus circ. 2–4 pro 5 mm., superne novella pilis griseis fulvisque saepe satis difficile recognoscendis obsita, in costa saepe densius pilosa, demum subito satis vel omnino glabrescentia, intense viridia (in vivo nitidula?), costa nervisque lateralibus flavescentibus plusminusve planis et subtiliter reticulata, in epidermide stomatibus satis magnis ellipticis subnumerosis instructa, sub initio ut superne pilosis et demum glabra, viridescencia, vix vel paullo pallidiora, ? subnitidula, costa elevata nervisque lateralibus utrinque circ. 8–14 prominulis et etiam tenuiter reticulata; petioli 2–8 mm. longi, flavo-brunnei, superne sulcati et pilosuli; stipulae etiam in surculis non visae. Amenta coetanea, pedunculata, rhachi villosa, mascula ovoideo-cylindrica, pedunculo brevi (vix ultra 8 mm. longo) foliola 3–4 normalia ad 2 : 0.6 cm. magna gerente excluso 1.5–2 : 1.2 cm. magna, densiflora; bracteae anguste obovato-oblongae, apice rotundae, flavescentes, breviter pilosae, sed versus apicem plusminusve glabrescentes, venosae; stamina 2, filamentis liberis, circ. $\frac{1}{2}$ pilosis bracteam demum duplo longioribus, antheris flavis ellipsoideis

circ. 1.5 mm. longis; glandulae 2, ventralis ovoideo-conica vel saepe bipartita, bractea subtriplo brevior, dorsalis minima interdum plusminusve 3-partita; amenta feminea sub anthesi nondum visa, adultiora circ. 3.5-4: 2 cm. magna (pedunculo ad 1-2 cm. longo 3-4-foliolato excluso), basi plusminusve laxiflora, fructifera ad 5:1.6 cm. magna; bractae ut in masculis, saepe omnino breviter pilosae; ovaria anguste ovoideo-oblonga, dense breviter argenteo-sericeo-tomentosa; styli distincti, 0.8-1.3 mm. longi, apice saepissime bifidi, stigmatibus oblongis divaricatis bifidis stylo paullo ad duplo brevioribus; pedicelli initio glandulam duplo dein ad triplo superantis, in fructu circ. 2 mm. longi; glandula 1, late ovoideo-rectangularis, saepissime bipartita. Fructus maturi e basi ovoideo-rhombica rostrati, 8-10 mm. pedicello excluso longi, ut ovaria tomentosi.

SPECIMENS EXAMINED: ALBERTA. Edge of Bow River, near Cave and Basin, about 1500 m., July 10, 1899, *W. C. McCalla* (No. 2252^a, partim, f.; N.); vicinity of Banff, on water's edge along road to Sun Dance Canyon, about 1500 m., July 10, 1890, same coll. (No. 2252^a, partim; Cor.; "about 1 m. high"); low ground along road to Devil's Head Lake, about 1500 m., June 19, August 11, 1899, same coll. (No. 2252, type, m., st.; Cor. "1.5 m. high"); Banff, August 13, 1908, *Olson* (f.; G.); Morley, foothills of Rocky Mts., damp places, June 17, 1885, *J. Macoun* (No. 24506; O.; olim No. 17, C.); Banff, Cave Avenue, July 4, 1891, same coll. (No. 24517, fr.; O.; olim nos. 28 and 33 in C.); marshy flat near the Bow River, July 15, 1891, same coll. (No. 28, fr., C.; "bush 1.2 m. high"); Spray River, June 30, 1891, same coll. (No. 33, fr.; C.; "low spreading bush on the borders of the same marsh").

BRITISH COLUMBIA. Yale District, Armstrong in the Okanagan Valley, 1912, *E. Wilson* (No. 2, f., m., fr.; Cor.; in O. sub No. 87817); Kootenay District, Cranbrook, June 22, 1914, *J. K. Henry* (fr.; Cal.; "clumps 1.2 to 1.8 m. high").

SASKATCHEWAN. Prince Albert, Camp, thickets by railway, July 6, 1876, *J. Macoun* (No. 13675, st.; Cor., O.); west of Eagle Creek, Bare Hill, in a bog, July 31, 1906, *J. Macoun & W. Herriot* (No. 70260, st., O., G.).

MANITOBA. In thickets east of Brandon, June 6, 1896, *J. Macoun* (No. 13666, fr. im.; C., Cor., O.).

ONTARIO. Thunder Bay District, Lake Superior, north shore, by C.P.R.R. in SW. between Port Arthur and Fort Williams, July 23, 1883, *W. R. Dudley* (f.; C.).

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THE LIGNEOUS FLORA OF THE STAKED PLAINS OF TEXAS

ERNEST J. PALMER

THE traveler who has passed over the high, wind-swept, grassy plains of the Texas Panhandle and viewed the country only from the speeding train might perhaps imagine that an article on the trees and shrubs of the region could be as brief and trite as the celebrated treatise on the Snakes of Ireland; but a closer inspection will reveal the fact that even if Nature has essayed a sinister imitation of St. Patrick's rôle upon the ligneous flora here it has been carried out but indifferently, and that although largely confined to certain limited areas woody plants are by no means rare and the total number of species is not inconsiderable. Moreover, instead of showing any tendency

to abandon the country, both in area occupied and in number of forms, there appears to be a steady if slow increase in progress at the present time.

The southern portion of the Great Plains, occupying western Texas, rises gradually or by a series of step-like plateaus from the lower Rio Grande valley, with a maximum elevation of only a few hundred feet above sea-level, to the high plains of the Panhandle, parts of which exceed four thousand feet in altitude. The first of these, if we exclude the Rio Grande Plain, which properly belongs to the Gulf Coastal Plain, is the Edwards Plateau, set off from the lowlands by the bold Balconies Escarpment; the second is the Staked Plains, lying to the northwest of the rocky plateau and rising gradually from it. The boundary between these two regions must, therefore, be somewhat arbitrarily drawn, but in general it may be regarded as following the line of contact between the limestones of the Comanchean Series and the overlying Tertiary or Quaternary deposits, principally of gravels, sands and other unconsolidated materials, that constitute the surface formations of most of the Staked Plains area. This line runs in a southwesterly direction from near the town of Big Spring, in Howard County, to the valley of the Pecos River, in Crane County, which it follows thence at an angle of about forty-five degrees northwestward into New Mexico. On the eastern side the plateau rises abruptly from the lower bordering plain by a high escarpment or line of cliffs, the crown of which is formed by a hard, thick stratum, usually of the recent, non-marine limestone or "caliche." The more resistant nature of this upper layer is responsible for the bold character of the cliffs, and it is locally known as the "cap-rock" or "rim-rock." The escarpment is also well defined on the north, where it forms a wall of the deep valley of the Canadian River, which separates the Staked Plains from the next successive, higher stage, the Panhandle High Plains. On the west it is bounded by the valley of the upper Pecos River, in New Mexico. The margins of the plateau are in places deeply incised by the canyons of streams which have their sources in the highlands. The most important of these are on the eastern side the various branches of the Colorado, Brazos and Red Rivers, and on the west those of the Pecos. It is in these canyons and along the ravines and broken ground bordering them that most of the ligneous plants are found, and many of them are confined to such protected situations or to the marginal escarpment of the plateau.

Viewed as a whole the Staked Plains is a high, mesa-like tableland, with a remarkably level surface over its interior, and nearly destitute of running streams. The rainfall is sparse, the annual average ranging from fifteen to twenty-five inches, and its elevation and exposed position in the vast plains stretching unbrokenly from the Arctic Ocean to the Gulf of Mexico, gives it a somewhat rigorous climate, marked by great extremes of temperature, both seasonable and diurnal. Dry winds of high velocity prevail during the greater part of the year, and under their influence the potential evaporation is much greater than the total average rainfall. In addition to the normal severity and wide variations of the climate its effect upon life

conditions is augmented by the frequent tornados, blizzards and long periods of drouth to which the region is subject.

The broad plains forming the summit of the plateau present for many miles an almost featureless surface. The streams, so-called, are merely wide, shallow stretches of gravel and sand, devoid of running water or even pools except for short periods after the infrequent rains. Their courses are generally comparatively straight, with very slight fall and practically without banks.

Ascending from the lower level over the steep grades or precipitous passes of the escarpment the appropriate significance of the colloquialism, "on the plains," is apparent. Far as the eye can see extend the unbroken, grassy stretches of level surface, conveying an impression of boundless space comparable only to the great sandy deserts or to the ocean. The only natural features that vary the landscape are here and there broad, shallow depressions or sinks, defined by the deeper green of their more luxurious herbage, and perhaps the far-flung glistening ribbon of one of the waterless streams in the distance. In the refracted light of the dazzling summer sun may be seen the inverted images of cattle, buildings, fences and trees along the horizon on either hand, mirrored in the phantom lakes of the mirage. Scarcely more marked or impressive in the magnificent distances than the few and slight inequalities of nature are the tangible evidences of civilization: the ranch houses and stock sheds with the ever-present windmills, many miles apart; fences and roads no less remote, and the grazing herds of cattle that have come with the plainsmen and cowboys as successors to the once numberless buffalo and the nomadic Indians, that not many years ago held undisputed sway over these broad prairies. The traveler is sometimes startled into a realization of how very recent is the period of this great cultural transition by coming upon the whitened skulls of the bison, still occasionally to be seen about salt licks or along the streams, or by turning up the flint or obsidian arrow-heads of the primitive hunters.

Underground solution of salt, magnesia and other mineral matter has resulted in the formation of the numerous shallow depressions that are in many places so conspicuous a feature of the plains topography. These are sometimes many acres in extent but seldom more than a metre or so below the general level at their greatest depth, and as the sides slope gently towards the centre they appear to be even shallower. Following the heavier rains many of these sinks become shallow lakes, but this condition generally continues for only a short time. Practically all of the water disappears in a few days or weeks at most by evaporation, very little of it sinking to any great depth into the ground. After the water is gone a rank growth of coarse grasses and rushes springs up, and as the herbage on the level plain becomes dry and brown the contrast in color is quite striking.

The flora of the open plains is essentially grassy; species of *Bouteloua*, *Andropogon* and *Festuca* being very abundant. Many annual and perennial species of flowering plants are found but most of them are conspicuous only for a short time after the rainy season. Low mat-like forms are common,

with wide-spreading branches close to the ground the better to resist the constant buffeting of the dry winds. Owing to the generally light rainfall and rapid evaporation the subsoil contains little moisture and this condition, together with the great depth of ground water, offers little incentive to deep-rooted plants, those having wide-spreading, shallow root systems being the prevailing types. Ligneous plants are almost entirely absent. Occasional stunted bushes of Mesquite and the low Cat's Claw (*Mimosa borealis*) or the shrubby Senecio may sometimes be found along the slight depressions of stream beds and ravines.

The Mesquite (*Prosopis glandulosa*), which is the most frequent woody species, is here strictly shrubby, seldom attaining a height of more than one or two metres. This plant, which makes a small tree under favorable conditions, with a maximum height of twelve or fifteen metres and a trunk diameter of four or five decimetres, is everywhere in this region the most hardy pioneer of advancing forestation. It has extended its range from its original home, probably south of the Rio Grande, until it now occupies all of the lowlands of the Rio Grande plain, the lower open canyons of the Edwards Plateau and those of the Staked Plains, encircling these tablelands and extending westward through the canyons and river valleys of New Mexico and Arizona and northward into western Oklahoma. Scattered specimens are found as far north as southwestern Kansas and eastward in Texas to the boundary of Louisiana. As the most abundant and widely distributed ligneous plant over hundreds of square miles it is familiar to all travelers in the Southwest, and numerous accounts of it appear in the literature, both scientific and general, dealing with that part of the country. Over a large part of western Texas it is the only species that attains the size of a tree and it is therefore of the greatest value to the ranchers and settlers in the construction of fences as well as for fuel and other purposes. The wood is of rapid growth and rather durable; the beans and foliage are eagerly eaten by stock and furnish a valuable addition to the forage at times when grass and other herbage is dried up. Although the thin foliage affords but indifferent protection from the scorching summer sun, as the only refuge, often, in a dry, hot land its shade is most grateful both to man and beast. The testimony of travelers and early settlers in western Texas agrees that Mesquite was absent or rare not many decades ago in much of the region where it is now so abundant. While evidence of this sort must always be received with caution there can be little doubt that it has advanced widely to the northward and eastward in recent years and that the forward movement is still going on with undiminished rapidity. One of the stories told of its introduction into Texas is as follows:

At an early day in the history of the territory when the Franciscan padres were establishing missions in the San Antonio country and zealously striving, under the banner of the cross, to bestow the blessings of the true faith upon the benighted natives, while Spanish adventurers from Mexico were seeking no less assiduously, by argument of the sword, to separate them from their more material possessions and to locate the fabulous

mines and rich cities of the interior, rumors of which had reached them from earlier explorers and from native traditions, the burrows, which were the pack animals of their caravans, were fed largely upon the beans of the Mesquite, and in this way the tree was first established in the country. My informant assured me that their route from the Rio Grande, up through the Spanish Pass northwest of San Antonio, towards San Saba and the interior, could formerly be traced by the growth of Mesquite along it, and that subsequently it had spread over the country in all directions from this nucleus. I cannot vouch for the authenticity of this account, but certainly the trail of the old Spaniards pointed out through the region is near the centre of distribution of the Mesquite in Texas and it does not seem impossible that it may have been, at least in part, introduced in this way. In recent years its dissemination over wide areas has been accomplished largely by the domestic animals that feed upon it. It is claimed that in the arid regions the seeds will germinate only after having passed through the stomachs of animals. Certain it is that the undigested seeds are often distributed and the plant established in this way.

Along the southern border of the Staked Plains there is a gradual transition from the flora, as from the topography, of the Edwards Plateau and a number of the more hardy woody species of the latter region persist for some distance into the plains. Some of the trees and shrubs find their northern limit about the buttes and ridges of Comanchean limestone that appear at intervals through the more recent residual deposits, but others reappear in the canyons or persist about the marginal rim of the elevated plains. Amongst those of the former class appear to be the Riverside Walnut, Western Red-bud, Live Oak, Mexican Buckeye and deciduous Coral Bean (*Prosopis affinis*); more persistent are the Shin Oak, the Red-fruited Juniper, Hackberry, Argireta (*Mahonia trifoliata*), Gum-elastic (*Bumelia texana*) and wild China (*Sapindus Drummondii*). In flats and depressions shrubby species from the Rio Grande Plain and the more arid regions to the southwest appear. Typical of these are the Creosote Bush (*Larrea tridentata*), the slender Cactus (*Opuntia leptocaulis*), *Rhus microphylla* and *Koeberlinea spinosa*.

The marginal escarpment of the plateau with its high, perpendicular cliffs, frequently overhanging ledges of cap-rock and deep indenting coves and ravines, affords protection to many plants that are unable to maintain themselves in more open situations; but as most of the ligneous species found here are also common to the canyons, some of which have worked far back into the interior, they will be mentioned in that connection.

The streams which traverse the upper plains, with their very slight fall and shallow channels, serve to carry off the surplus water after heavy rains. However, owing to the flatness of the country, the generally dry atmosphere and almost constant winds, the amount of water that reaches them is very small in proportion to the area, most of it remaining on the surface and disappearing in a short time through evaporation. Under these conditions there is little erosion through the action of the streams in this part of their

courses; but as they approach the marginal rim the grade becomes suddenly accelerated; cascades or rapids are formed as they plunge over the precipitous cap-rock or rush down the steep slopes of the escarpment. While the streams in this stage are intermittent and their work continues for only a short time after rainy periods they are at such times very active and the nature of the deposits they encounter is generally quite favorable for rapid excavation. After the hard stratum of cap-rock has been broken down, which is accomplished rapidly along the overhanging ledges, the soft under-lying strata are easily removed. When the level of ground water is reached, which in the high plains is often several hundred feet below the surface, springs begin to issue along the canyon walls and the streams become perennial.

The small streams forming the headwaters of Red River have worked out deep channels for many miles back into the interior of the plateau. The Paloduro Canyon in Randall and Armstrong Counties, the largest of these, is one of the most remarkable erosion features of the plains and of the entire Southwest. Beginning as several narrow, shallow ravines near Canyon City it rapidly deepens and widens until in some places its floor is from 800 to 1000 feet below the level of the plains and more than ten miles in width. This enormous amount of excavation has been accomplished by a small stream in comparatively recent geological times and the work of deepening and widening it is going on with undiminished force and rapidity at present. During the summer of 1918 several days were spent by me in exploring this canyon and in studying and making collections of the plants found in it and upon the surrounding plains. As the ecological conditions and flora are quite characteristic of this interesting phase of the Staked Plains the following notes on the trees and shrubs found in this canyon may be regarded as of general application.

Approaching the canyon in its deeper sections across the plains is an interesting experience. Before you lies the seemingly endless prairie, almost as level as a billiard table; in the distance, perhaps, you see a ranch house with its outbuildings and windmills; not a ripple marks the surface of the plain and there is no apparent obstacle to prevent you continuing in a direct course to the settlement. Suddenly you come upon a shallow ravine eating its way into the plain; some low Juniper or Mountain Mahogany bushes appear along an eroded slope for a few yards and then all at once you stand upon the brink of a precipice and at your feet lies a chasm some miles in width and several hundred feet deep. On the opposite side you make out the horizontal line of the plain which continues thence as if unconscious of the interruption. Far down below, the course of a tiny stream meandering through the broad valley is marked by a fringe of trees. The canyon walls are nowhere perpendicular for their entire height, as in some of the western canyons carved through harder strata, but fall away by a series of terraces, slopes and ledges, sometimes with outstanding pinnacles and masses carved into irregular and fantastic forms. There are numerous short but deep side canyons and ravines, which in many places afford the only avenues of descent into the main canyon.

Near the summit of the canyon walls there is a stratum of soft but comparatively durable limestone several feet in thickness, locally known as the "upper cap-rock." Above it there is sometimes a slope of gravel or calcareous sand a few feet in thickness; below there is another slope of only partially consolidated calcareous material, sometimes as much as fifty feet in thickness, resting upon a thick bed of sandstone of Triassic age. This latter formation, called the "lower cap-rock," varies greatly in character. In places it is from 50 to 120 feet in thickness and ranges from a sandy shale to a coarse grained sandstone or conglomerate. Below it are the "red beds" of the Permian, consisting of soft, friable sandstones, clay and gypsum. The brick-red color of these deposits, due to the iron oxide which they contain, is imparted to the waters of the stream and gives name and character to the Red River. These soft Permian strata yield readily to erosion and every rain carries away great quantities of material broken down by each rill and temporary torrent. Sections of the cap-rock are constantly being undermined through removal of the softer underlying deposits and huge masses of it frequently piled up at the base of the cliff or in the narrow side canyons. Balancing and "toadstool" rocks are frequent where detached masses of the sandstone surmount columns of the softer material. In such places the scenery of the canyon has quite the aspect of the "bad lands" of the Northwest, and amongst the innumerable hillocks and defiles of the more rugged parts it is hard to realize that one is in the midst of the plains and not in a mountainous country.

Below the level of the plains four principal zones of plant life may be recognized in the canyon. These are the calcareous beds above and below the upper cap-rock, including that stratum, the sandstone section of the lower cap-rock and the broken belt of the Permian deposits below it, the open, comparatively level floor of the main canyon, and the immediate borders of the river and perennial, spring-fed streams. For convenience these may be designated the Upper Cap-rock, Lower Cap-rock and Talus, Canyon-floor and River-bank zones.

The following woody plants were collected in Paloduro Canyon at several points in Randall and Armstrong Counties, Texas, but principally at the J. B. Gamble ranch south of Claude in the latter County, and the brief notes are based on observations made during a rather hasty visit:

Juniperus monosperma (Engelm.) Sarg.

This species, locally called White Cedar, is one of the most conspicuous if not the most abundant of the woody plants. It occurs from the Upper Cap-rock zone, where it is usually low and shrubby, through the Lower Cap-rock-talus zone into the deep protected side canyons. In the last named situations and below high protecting bluffs it sometimes becomes a tree 20 metres or more high and with a trunk diameter of 5 or 6 decimetres.

Juniperus Pinchotii Sudw.

The species was originally described from this locality and I am applying the name to the tree or shrub called Red Cedar in the canyons, with erect rigid branches and large copper-colored fruit. It is commonly not more

than a tall shrub, often sending up a number of stems from burned-off stumps. In more protected situations it becomes arborescent, the largest specimens observed being about 12 or 15 metres in height and 4 or 5 decimetres in trunk diameter. It is rather abundant in the same zones as the last species.

Ephedra Torreyana Wats.

This interesting shrub is usually found near the summit of the canyon walls in the Upper Cap-rock zone. Its naked, Equisetum-like stems are much branched and present a very curious appearance. It was also found near Channing, in Hartley County.

Populus texana Sarg.

One of the commonest and largest tree along the margins of the river, in the deep side canyons and under the protection of cliffs is the Cottonwood, which has recently been described by Professor Sargent under this name. While not attaining the large size of some of the other Cottonwoods, specimens 20 metres high and 75 or 80 centimetres in trunk diameter are frequent. The trunks are often bent and branched from near the ground. This species was observed in Nolan, Garza, Randall, Armstrong and Hemphill Counties, and doubtless occurs elsewhere in canyons of the Staked Plains and along the northern border of the Edwards Plateau and probably extends into southwestern Oklahoma.

Salix amygdaloides Anders.

A common Willow in the River-bank zone, both in the canyons and in more open situations wherever there are running streams or pools. A tree sometimes 10 or 12 metres high.

Salix exigua var. *stenophylla* (Rydb.) Schneid.

A shrub or slender tree found rarely in the River-bank zone and watered side canyons. Much more abundant along pool and stream margins in more open situations on the plains.

Quercus Mohriana Rydb.

Very abundant along the Upper and Lower Cap-rock-talus zones. Usually a shrub from one to three metres high, but in the protection of cliffs and in deep side canyons sometimes becomes a tree seven or eight metres high, with thick, rough, pale bark and a low conical crown. The leaves are quite variable in size and shape.

Celtis laevigata var. *texana* Sarg.

A small tree common in the Canyon-floor and River-bank zones, and less abundant in the higher zones of the canyon walls.

Mahonia trifoliata Moric.

This curious and rather pretty shrub of the arid Southwest, called Argireta by the Mexicans, is occasionally found in the Lower Cap-rock-talus zone.

Morus microphylla Buckl.

The Mexican Mulberry, a typical tree of the Edwards Plateau, appears to be rather rare except along the southern border in the Staked Plains. In the canyon a few specimens were seen in the Lower Cap-rock-talus zone.

Prunus angustifolia Marsh.

Found occasionally in small thickets in the Canyon-floor and River-bank zones.

Prunus virginiana var. *demissa* (Nutt.) Torr.

Growing in deep watered side canyons and under the protection of bluffs near water.

Cercocarpus argenteus Rydl.

A common and typical shrub of the Upper Cap-rock zone. Seldom more than two or three metres high.

Prosopis glandulosa Torr.

The Mesquite is one of the commonest ligneous plants in the canyon. It is most abundant in the Canyon-floor zone, where it becomes a tree, sometimes ten metres or more in height, but it is also found along the margins of the river and along the sides of the canyon to the upper plains. In the last-named situation it is struggling to maintain and extend a precarious foothold on the open, wind-swept surface, but it seldom becomes more than a shrub two or three metres in height.

Mimosa borealis Gray.

The low, thorny Cat's Claw grows in similar situations to the Mesquite but is perhaps commonest in the broken, rocky ground below the lower cap-rock.

Dalea formosa Gray.

This diminutive shrub is rather common in rocky ground of the Lower Cap-rock zone and is less frequent in the zones above and below.

Gleditsia triacanthos L.

There is a small grove of Honey Locust trees in the Club House grounds near Canyon City and it is said to occur sparingly elsewhere in the upper part of the canyon. The trees seen are of small size for the species, averaging, perhaps, eight or ten metres in height. It appears to be absent lower down in the canyon.

Amorpha fruticosa L.

Rather frequent in the River-bank zone and in low places of the Canyon-floor zone.

Amorpha canescens Pursh.

Collected along the banks of a small ravine above the upper cap-rock. Apparently not common.

Glossopetalon spinescens Gray.

This is one of the most interesting shrubs found in the canyon from the standpoint of plant distribution. On the Edwards Plateau I observed it only along the western and southern borders in Uvalde County and in the Devils River region, where it seems to have come in from the Trans-Pecos country. In the Paloduro Canyon it grows on calcareous banks of the Upper Cap-rock zone. It was seen near Canyon City, in Randall County, and south of Claude, in Armstrong County.

Ribes aureum Pursh.

In deep canyons and along protecting cliffs in the Upper and Lower Cap-

rock-talus zones. Found in Noran, Irion, Garza, Randall, Potter and Armstrong Counties, also in Woodward County, Oklahoma.

Ptelea trifoliata var. *mollis* Torr. & Gray.

Not uncommon on dry rocky banks and in open situations throughout the canyon.

Rhus trilobata Nutt.

Abundant on rocky banks in the Lower Cap-rock-talus zone and less frequent in the zones above and below it.

Rhus microphylla Engelm.

A common shrub in the open Canyon-floor zone and not uncommon in the Lower Cap-rock zone.

Rhus Toxicodendron L.

Grows as a low shrub, usually less than a metre high, in the protection of bluffs. Most abundant in the Upper Cap-rock zone. The scandent form was not observed anywhere in the Staked Plains.

Opuntia leptocaulis DC.

Common in the Canyon-floor zone and extending into the zone above.

Atriplex canescens (Pursh) James.

A common shrub in the Canyon floor and Lower Cap-rock zones.

Zizyphus obtusifolius Gray.

One of the commonest shrubs in the Canyon-floor zone and extending into the zone above.

Sapindus Drummondii Hook. & Arn.

The Soapberry, usually called Wild China or Wild Chinaberry in Texas, is a common tree in the canyon, generally growing in the open ground of the Canyon-floor zone or on the river banks. It sometimes extends to the foot of the lower cap-rock.

Forestiera neo-mexicana Gray.

A common shrub on rocky banks from the Lower Cap-rock to the River-bank zone.

Forestiera pubescens Nutt.

In similar situations to the last but less common.

Lycium Berlandieri Dunal.

In the open ground of the Canyon-floor zone and extending into the zone above.

Lonicera albiflora Torr. & Gray.

Not very common on steep banks of side canyons and along the upper cap-rock.

Cephalanthus occidentalis L.

Frequent along river banks and in depressions of Canyon-floor zone.

Baccharis halimifolia L.

Not very common in the River-bank zone and along margins of spring branches in side canyons.

Baccharis salicina Torr. & Gray.

Occasional on gypseous banks below the lower cap-rock.

Baccharis Wrightii Gray.

A low shrub in open situations in the canyon and on the upper plains.

Bigelovia pulchella Gray.

On rocky banks of Upper and Lower Cap-rock zones.

Bigelovia graveolens (Nutt.) Gray.

A diffuse shrub, one to one and a half metres high, with densely canescent foliage and stems. Grows on calcareous or gypseous banks of Upper and Lower Cap-rock zones.

Brickellia Wrightii Gray.

On dry banks in Upper and Lower Cap-rock zones.

Artemisia filifolia Torr.

Often common in sandy open situations on the upper plains, and sometimes found in the canyon from the Upper Cap-rock zone to the canyon floor.

Clematis Simsii Sweet.

Found in deep-watered side canyons. Not common.

Celastrus scandens L.

The Bittersweet vine was noted in only one locality, in a protected situation at the head of a deep side canyon.

Vitis Longii Prince.

Commonly grows as a low shrub a metre or so high in the protection of low bluffs in the Upper Cap-rock zone. In the deeper side canyons and along bluffs of the Lower Cap-rock talus zone it sometimes becomes a vine several metres high. This species is also very abundant, in the shrubby form, in the deep sands bordering the Canadian River, farther north.

Vitis rupestris Scheele.

Low bushy plants, which from the leaf form appeared to belong to this species, were found at one point in the talus below the lower cap-rock. As there was no fruit it may possibly be only a form of the last-named species.

From the foregoing list it will be seen that the assemblage of woody plants in the canyons is a rather heterogeneous and remarkable one. It must be remembered, too, that even here the trees and shrubs constitute only a small proportion of the entire flora. While it is not within the province of this article to enter into a detailed description of the non-ligneous plants it may be noted that they appear to have been drawn from no less varied sources and an investigation of them may contribute largely to an understanding of the origin of the trees and shrubs with which they are associated. In the protection of high bluffs and at the heads of deep canyon branches, where perennial springs afford a considerable supply of water, the herbaceous growth becomes in places quite luxuriant. Dripping banks are clothed with the Venus' Hair fern (*Adiantum Capillus-Veneris*); there are mossy ledges and boggy beds of Equisetums, rushes and the tall plummy grass, *Phragmites communis*, and many other surprises in moisture-loving plants are encountered. Their presence in these canyons in the midst of the grassy plains, associated with a comparatively rich ligneous flora, and so far removed in many cases from the main body of their kind and kindred,

suggests many interesting questions. In seeking the answers the origin of the plains topography and especially that of the canyons must be taken into account no less than the present ecological conditions and the possible agencies of transportation that have coöperated in developing the flora and giving it its present composition.

All of the phenomena observable in the canyons serve to impress the observer with a realization of how rapidly the work of excavation is going on and how comparatively modern their entire history may be. The remarkable facility with which some of the small streams have been able to cut deeply for many miles back into the plains plateau is attributable not only to the generally soft character of the deposits encountered but also probably to a recent uplift of the region, after the streams had defined their present courses, thus increasing the gradient and augmenting their erosive activities as they approached the escarpment.

It was the writer's good fortune in one respect, although not conducive to comfort or successful plant collecting at the time, to be in the Paloduro Canyon during a very heavy rainfall. Through the greater part of a day and night the rain came down in torrents, and when it slackened on the following morning the little stream across which I had waded several times on stepping-stones, scarcely wetting my boots, had become a roaring torrent more than a hundred yards across in places; fences and water-gates had been carried away and many of the Cottonwood, Mesquite and other trees along the river margins had been uprooted and borne down stream through the undermining of the banks, which were still crumbling at a rapid rate. On every hand could be heard the crashing and booming of falling earth and rock. When it became possible to approach the walls of the canyon and enter the deep side galleries the destructive effects of the elemental warfare were everywhere apparent. Great sections of the cap-rock ledges had been undermined and had tumbled down into the stream or were piled up at the base of the cliffs and slides of rock and earth on a large scale were going on in the saturated and fragile beds for some time after the storm.

The new sections of unoccupied land thus constantly being exposed invite the settlement of such plant pioneers as can gain a foothold. The competition between these first settlers is usually very slight but not all of them that have the hardihood to attempt colonization on these often dry and sterile lands succeed or prosper. Many tragedies ensue, too, from the unstable nature of the rapidly changing surface; but gradually those species, amongst the plants available or such as fortuitously enter the area, which are best adapted to all of the conditions encountered establish themselves and become dominant.

In general the protection afforded in the canyons from the almost constant force of the dry winds of summer and the cold blasts of winter that prevail upon the open plains, together with the more abundant water supply and the diversity of surface and soil are favorable to the development of a rich and varied flora and make possible there the growth of many plants that cannot survive beyond their limits in the Staked Plains region. There

are no permanent human settlements in the Paloduro Canyon and probably no consecutive weather records have been kept, but I was assured that the average winter temperature is several degrees warmer than that of the open plains. Cattle are wintered in the canyons without feeding or artificial shelter and without losses such as occur in the open country above. Based upon a study of the wild life, principally the fauna, the United States Biological Survey has designated the canyons as extensions of the Lower Austral, while the surrounding plains area belongs to the Upper Austral zone.

The plants peculiar to the canyons appear to be emigrants from various sources. Most of them have doubtless advanced gradually or been transported directly over wide intervening distances by various agencies from the Edwards Plateau region to the south; some appear to have come in by way of the upper Pecos valley from extreme southwestern Texas, amongst them such woody forms as *Glossopetalon*, *Ephedra*, *Lycium* and various Composites; others have evidently worked their way along the margin of the plateau and thence up the canyons as they have excavated their way back into the interior; of this class probably are the Junipers, Hackberry, Shin Oak and Soapberry or Wild China; still others, like the Willows and Cottonwoods, may have been introduced from the northwest through the Canadian River valley. The Honey Locust, Bittersweet vine and some of the herbaceous species present special problems of peculiar interest as to their origin and method of introduction. In the case of *Gleditsia triacanthos* the rather heavy seeds must have been transported from sections far to the east or southeast, the lower Brazos valley or the valley of Red River in eastern Texas and Oklahoma being the nearest sections where it occurs, so far as I am aware.

One of the best internal evidences of a newly established or changing flora is the lack of completeness and general balance in its composition and organization as compared with that of the zone it occupies and similar adjacent regions from which its plant population must have been drawn. In a plant society long established this adjustment has been brought about by ages of keen competition and elimination, compelling each surviving member to make the most of every opening and every available space; while in a newly invaded region not only is there evidence of the somewhat confused mingling of the old and new elements but the recent emigrants are arranged in a more or less haphazard way and are apparently seeking their true position or experimenting on the possibility of finding a permanent place in the flora. This partial lack of symmetry and order in the plant society may, if the geological history and physiographic development of the region as well as of the ever changing boundaries of the flora are not kept clearly in mind, be as little explicable under the modern theory of plant succession as under the old discarded idea of special creation, by which each species was supposed to have been placed for definite useful purposes in the particular environment for which it was best fitted: for plants perfectly adapted to a region that has undergone profound climatic or physiographic changes do

not spring up spontaneously; they must find means and await opportunities for entering the new territory, and these may be long delayed, thus allowing less suitable species to occupy it temporarily in the absence of competition.

Considering the geographical position and ecological conditions of the canyons certain woody plants are as conspicuous for their absence as others are surprising by their presence. Possibly a more extensive and thorough exploration than I was able to make might discover some of the plants mentioned below, but in a careful though brief examination of some of the most typical and heavily wooded portions of the Paloduro Canyon I found no trace of them. Conditions in the River-bank zone of the canyon appear to be ideal for the growth of the Mexican or Riverside Walnut (*Juglans rupestris*), which is such a common and characteristic tree along all the streams of the Edwards Plateau, and which approaches the Staked Plains at least as near as Sweetwater, Texas, and extends northward into the Wichita Mountains of Oklahoma; but it does not appear to have as yet found means of entering the canyon. The Pecan, too, should thrive and easily maintain itself along the river banks were it once introduced, and it would have no very wide distance to bridge from the upper Pease River, in Hardiman County, Texas, where it was observed growing spontaneously. It is also surprising that only one species of Oak has found its way into the canyons, since several shrubby and arborescent forms occur not far to the south and east. The American Elm and Red Mulberry might both be expected in the River-bank zone, but neither of them were seen, although the former at least is growing in the valley of the Canadian River on the northern border and along the upper Colorado not far to the southeast. No species of Red Haws, Roses, Blackberries, Viburnums, Dogwood, Ash nor many other plants that might naturally be expected were seen.

The entire absence of many plant families and the poor representation of others which are largely developed in the surrounding country and some of which seem well adapted to conditions here, together with the miscellaneous character of the plants that have become established are all strongly suggestive of the extremely new and incomplete status of the flora. There are, too, so far as known, no endemic species and a general absence of well-marked varieties such as would naturally have been developed had many of the species been long isolated under the peculiar conditions obtaining in the canyons from the parent stock and normal habitat.

All this is in striking contrast to the peculiar canyon flora of the Edwards Plateau, where more or less modified representatives of a typical eastern flora occupy certain restricted areas. If the former may be compared to remnants of aboriginal tribes surviving in isolated fastnesses amidst an alien and conquering race, the assemblage of plants in the Paloduro and other canyons of the Staked Plains may better be likened to the heterogeneous society in process of formation and adjustment drawn from many sources to a newly opened land. Here, in fact, are found many of the phenomena of a flora in the making, and one that has not yet reached a state of even approximate equilibrium or attained a well-balanced and permanent form.

In speaking of the very recent history and development of these canyons and their flora it is not, of course, intended to imply that they are to be considered in terms of a few years or even centuries. Some of the *Juniper* trees in the Paloduro Canyon are probably not less than one to two hundred years old, and we have no reason to assume that in them we are looking upon the original patriarchs of their race; but in comparison with some of the adjacent physiographic regions and as measured by the standards of geologic time and biologic evolution both appear extremely modern. Some of the plants, on the other hand, may have appeared only in the last few years and other emigrants may be expected from time to time, some of which will be only transient while others will establish themselves and become in time conspicuous and important additions to the flora.

Probably the two principal agents in introducing new plants into the canyons are at present, as they have been in the past, wind and migratory birds. The large proportion of southwestern species and the absence or comparative paucity of those from the contiguous regions to the east and northeast is doubtless due to the circumstance that during the season when seeds of most plants ripen and can be transported and successfully sown the direction of both of these agencies is from the south or southwest northward. Some of the lighter seeds, with special provisions for transportation through the air, may be carried almost incredible distances by such strong and persistent winds as prevail upon the plains. As there are few inequalities on the surface to arrest their progress, they would in many cases find lodgment only, at least in situations where there would be any chance for them to germinate and survive, when swept into the canyons that lie across their northward course.

Many birds breed in the canyons and others in their passage northward, doubtless, stop for a time in its protection. It is to be regretted that no definite data can be given either as to the meteorology or ornithology of the canyons to determine their relative and absolute importance as agencies in plant introduction. Their investigation, however, would prove a most interesting and fruitful field for a local observer with the taste and opportunity for pursuing it. Amongst the birds noted in the Paloduro Canyon, which are persistent seed eaters and probable agents in plant introduction are the Western Mockingbird, Texas Quail, Texas Jay and species of Woodpecker, *Vireo* and *Oreole*. Other birds seen were the Canyon Wren, Horned Lark, Poor Will, Cliff Swallow and Western Chipping Sparrow, and I was reliably informed that both the Mexican and Bald Eagle are found.

An analysis of the list of forty-five woody species given for the Paloduro Canyon reveals the fact that no less than twenty-three, or more than half, produce fruit attractive to ordinary seed-eating birds; while the seeds of the Shin Oak and most of the Legumes might have been transported by larger birds or mammals. Fifteen, including the Willows, Cottonwood, Wafer Ash, Button Bush, Virgin's Bower and the Composites are more or less perfectly adapted to wind transportation. In view of the inference that birds have probably been one of the chief agencies in bringing new plants

into the canyons it may at first seem the more surprising that no representatives of the large Red Haw group and some of the other *Rosaceae*, whose fruit is so attractive and which are commonly transported through their migrations over wide areas, should have found their way here. The explanation is no doubt found in the fact that species of these groups are rare or absent from most of the Edwards Plateau region and from that to the southwest.

WEBB CITY, MISSOURI, April, 1920

A NEW SPECIES OF PISTACIA NATIVE TO SOUTHWESTERN TEXAS, *P. TEXANA*

WALTER T. SWINGLE

IN 1859 John Torrey¹ reported *Pistacia mexicana* HBK. as occurring in Texas in "Rocky ravines near the mouth of the Pecos, western Texas, October (fruit); Bigelow. A small tree."

In 1891 John Coulter² included the species *Pistacia mexicana* HBK. in his Botany of Western Texas, with a very brief description, ending with the following statement: "A small Mexican tree, with an edible nut,³ said to occur near the mouth of the Pecos."

In 1897 Asa Gray⁴ described fruiting material in some detail in his Synoptical Flora and, although he had not seen the flowers, transferred the species to the genus *Rhus* as the sole species of a new section, *Pistacioides*. The name *Rhus mexicana* Gray, is cited as having been published "in Patterson, check-list, 1892, 21," but this check-list (Patterson's Numbered Check-list of North American Plants, North of Mexico, p. 21. [Oquakwa, 1892]) gives merely a *nomen nudum*, "RHUS . . . 1690 Mexicana Gray." with no citations of the previously published *Pistacia mexicana* HBK.

In 1905 Vernon Bailey,⁵ in his Biological Survey of Texas, assigns the plant to *Schmaltzia* (a segregate of *Rhus*, based on *Rhus aromatica*, Ait.) as *Schmaltzia mexicana*, citing *Rhus mexicana* and *Pistacia mexicana* as synonyms, and notes its relationship to the *Pistacia vera* from which the pistache nut of commerce is obtained. He goes on to say, "In places in the canyons of the Rio Grande this large shrub grows in profusion, suggesting that the real *pistachio* also might succeed here."

Aside from occasional citations of the scanty information given in these

¹ Torrey, John. Botany of the Boundary, in Emory, William H., Report on the United States and Mexican Boundary Survey (34th Cong. 1st Sess. Senate Ex. Doc. No. 108). II. pt. 1, p. 44 (Washington, 1859).

² Coulter, John M. Botany of Western Texas, in Contributions from the U.S. National Herbarium, Washington, D.C. II. 67 (June 27, 1891).

³ This is an error, as the seeds are too small to be classed as edible.

⁴ Gray, Asa. Synoptical Flora of North America, I. 386, also p. 381 (Part 1, fasc. 2, June 10, 1897).

⁵ Bailey, Vernon. Biological Survey of Texas, in North American Fauna (U.S. Dept. Agriculture). No. 25, p. 30. (Washington, 1905.)

sources practically nothing else has been published regarding this Texas plant which has always been assumed to be *Pistacia mexicana* HBK.

In 1902 I began a study of the genus *Pistacia* in order to ascertain the botanical relationships of *Pistacia vera* L., the cultivated Pistache nut, which I was endeavoring to introduce into culture on a commercial scale in California, Arizona and other Southwestern States. I soon satisfied myself from a study of the material preserved in the principal old-world and American herbaria that *Pistacia mexicana* HBK. was very different from any old-world species, but in the absence of flowers it was difficult to come to any decision as to the true relationship.

In March, 1907, through the courtesy of Mr. C. S. Scofield, his assistant, Mr. F. D. Headley, the superintendent of the San Antonio Experiment Farm, was sent to the mouth of the Pecos River in Valverde County, Texas, to secure flowering specimens of this plant. Mr. Headley secured some good specimens of both sexes, with photographs. A study of this material showed at once that it could not belong to a species of *Rhus* as supposed by Gray, but was very near *Pistacia*.

In March, 1911, Prof. S. C. Mason, aided by Mr. Stephen H. Hastings and Mr. R. E. Blair, collected additional and much better material and photographs in the same general region near the junction of the Pecos River with the Rio Grande. This additional material, together with Professor Mason's ample notes made on this and on two previous trips in March and April, 1910, permitted me to get a very good understanding of the Texas species.

The *Pistacia mexicana* HBK. was based on fruiting specimens collected at Chilpancingo in the State of Guerrero about 750 miles south of Valverde County, Texas. In the principal American herbaria there is fairly abundant material from the States of Puebla and Oaxaca which adjoin Guerrero, and even from the type locality, Chilpancingo, Guerrero (U.S. Nat. Herb. No. 399406, E. W. Nelson No. 7065, "Side of Sierra Madre, above Chilpancingo," May 25, 1903, fruiting branch) and some from Jalisco and Chiapas, all of which doubtless belongs to *Pistacia mexicana* HBK. A single fruiting specimen in the National Herbarium at Washington, D.C. (No. 867188), collected by Mr. O. F. Cook (No. 60, June 1, 1906) from "rough limestone country between Nenton and Candalaria, Dept. de Huehuetenango in northwestern Guatemala near the Mexican border," may be the same species but looks somewhat different.

In May, 1912, Mr. C. A. Purpus collected abundant material at Tehuacan, Puebla (No. 5848), and sent it to me together with a good photograph showing the habit of the species. He also sent in May, 1912, a quantity of seed, of which a very small percentage (38 out of 1754) germinated, and gave rise to plants (C.P.B. No. 7581) now growing in the greenhouses of the Bureau of Plant Industry at Washington, D.C., and also in the open in California.

On the other hand, there is some good material, mostly of the fruiting specimens only, from the northeastern Mexican States of Coahuila, Nuevo

Leon and Tamaulipas, that seems very like the Texas plant and distinctly different from the true *Pistacia mexicana* HBK. of southern Mexico.

Thanks to this wealth of material of both the southern Mexican and the Texas Pistaches, I am now convinced that the Texas plants constitute a good species, for which I propose the name *Pistacia texana*, n. sp.

***Pistacia texana*, n. sp.**

Pistacia foliis subpersistentibus, foliolis plus minusve curvatis, obtusis, submucronatis, subspathulatis; fructibus maturis profunde rubro-brunneis.

Species affinis *P. mexicanae* sed foliis minoribus, foliolis paucioribus, plus minusve curvatis, plus minusve spathulatis, latioribus obtusioribusque, minus mucronatis; ramulis novellis minus pubescentibus; alabastris bracteisque minoribus et minus pubescentibus; fructibus maturis rubro-brunneis nec atro-purpureis et glaucescentibus; trunco fere e basi ramoso (non trunco simplice).

Leaves persistent or tardily deciduous, odd-pinnate, 5–10 cm. long and 2.5–4.5 cm. broad, usually 6–8 cm. long and 2.5–3.5 cm. broad; petiole 10–15 mm. long, or sometimes 20 mm. on male trees, flattened and very narrowly winged; rachis very narrowly winged, slightly pubescent above; leaflets 4–9, usually 5–8 pairs, often not strictly opposite, thin and netted-veined, 8–25 mm. long and 5–9 mm. broad, usually 12–20 mm. long and 6–8 mm. broad; mature leaflets broadly rounded, more or less spatulate, or more or less mucronate at the tip (half-grown leaflets wine-red, acute-lanceolate, acute at tip) tapering into a deltoid or subcuneiform base; lateral leaflets more or less curved and inequilateral; midrib usually much nearer the side of the leaflet toward the parent twig; and usually more or less curved with the concave side toward the parent twig; leaflets dark green and sparingly pubescent along midrib above, pale green and glabrous below; almost sessile (except the terminal leaflet which is narrowed into a petiolule 4–6 mm. long) margin entire, slightly recurved. Female inflorescences appearing just before or with the new leaves, loosely and simply paniculate, 4–6 or sometimes 7 cm. long, almost glabrous. Female flowers small, usually subtended by a small ciliate margined bract and two similar bractlets, all three usually wine-red at the tips; perianth none; ovary ovate or sub-globose; styles 3, two shorter ones with 2-lobed stigmas, one, the longer, with a 3-lobed stigma. Male inflorescences in compact panicles, 2–4 cm. long, much more crowded than the female panicles; anthers very evident, reddish yellow, sometimes wine-colored as are the tips of the bracts subtending the flowers and branches of the panicles. Fruits lenticular to oval, dark reddish brown and slightly glaucescent when ripe, 5–6 mm. long, 4–5 mm. broad and 2.5–3 mm. thick, usually containing no embryo. Young twigs slender, 1.5–2.5 mm. thick, slightly pubescent, reddish colored when young, grayish brown when one year old from scaling off of the white cuticle; flower-buds small, 1.5–2.5 mm. long, sparingly pubescent.

A small tree or a large shrub, usually branched from the base, 5–10 m. high with a spread of 5–10 or rarely 12 m. Diameter of largest trunks

20–25, rarely 30–35 cm. at 30 cm. from ground. Not uncommon on limestone cliffs, and on soils derived from the weathering of limestone along the Pecos River near its junction with the Rio Grande in southwestern Texas and along the Rio Grande near the mouth of the Pecos on both sides of the river in Texas and in Coahuila, Mexico. It grows densely crowded in the narrow ravines or vegas in the limestone near the mouth of the Pecos River.

The young foliage of this species is wine-red in early spring.

This new species, *Pistacia texana*, differs from *P. mexicana*, HBK. in having smaller leaves with fewer leaflets (4–9, usually 5–8 pairs, instead of 8–18, usually 12–16 pairs), which are more or less spatulate, broader and more obtuse at the tip, not so markedly mucronate and more or less curved. The young twigs are much less pubescent and have smaller and less pubescent flower-buds and bracts than in *P. mexicana*. The mature fruits of *P. texana* are dark reddish brown, slightly glaucescent rather than glaucous and purplish black, as in *P. mexicana*. The trunks of the trees of *P. texana* are much branched near the ground, while *P. mexicana* often (perhaps always) has a single trunk. The smaller branches are rough grayish brown whereas those of *P. mexicana* are smooth and often light brownish gray, almost silvery.

TYPE LOCALITY: Near Hinojose Spring, Rio Grande Valley, near the mouth of the Pecos River, about 20 miles west of Comstock, Valverde County, Texas. The type specimens (type and merotypes¹) were collected by S. C. Mason, March 18, 1911, from a pistillate tree marked III–XVII, M. 26, about two miles above Hinojose Spring. The male syntypes were collected by S. C. Mason, March 18, 1911, from a tree growing on the bank of Hinojose Spring. Both the female type and male syntype are specimens in the National Herbarium and merotypes of both are in the Arnold Arboretum herbarium.

Numerous other collections (all in flower) made near the mouth of the Pecos in Valverde County, Texas, by F. B. Headley in March, 1907; and by Prof. S. C. Mason in March and April, 1910, and again in March, 1911, are all paratypes¹ as are the following specimens: National Herbarium, No. 19714, Mexican Boundary Survey, labeled "*Rhus Scheidiana*," fruiting twigs; Columbia College [Torrey] Herbarium, Mexican Boundary Survey "No. 152, Rocky Ravines near the mouth of the Pecos. Bigelow," fruiting twig; N.Y. Botanical Garden Herbarium, Mexican Boundary Survey No. 152, labeled "*Pistacia mexicana* HBK., *Rhus pterotoides*," fruiting twig; National Herbarium No. 364672, E. N. Plank, "near Shumla, Valverde County, Texas, June 6, 1895," sterile twig; National Herbarium, Vernon Bailey No. 480-g, "Rio Grande near Comstock, July 29, 1902," with nearly ripe fruit; Arnold Arboretum, S. S. Hastings, No. 25, "On banks of Rio Grande near Comstock," April 9, 1910, flowering branches; Arnold Arboretum, E. N. Plank, "Cañons of the Pecos River, Texas," 1899, leaves only; National Herbarium No. 19717, Dr. Edward Palmer, "Coahuila, Mexico, 1880" fruits; Arnold Arboretum, Dr. Edward Palmer, No. 196 (N¹), Saltillo, Coahuila, Mex., July 1–8, 1880, fruiting branch; National Herbarium No. 842129, C. A. Purpus No. 4888, "Sierra de la Paila, Coahuila," Mex., Oct. 1910, fruiting branches; Arnold Arboretum, C. G. Pringle, No. 1930, "Rhus Mexicana, Gray . . . Canyons of the Sierra Madre near Monterey," Nuevo Leon, Mex., June, 1888, fruiting branch; National Herbarium, No. 19716, C. G. Pringle, No. 1930 as above; Arnold Arboretum, "*Pistacia Mexicana* HBK., Monterey [Nuevo Leon, Mex.], Coll. C. S. Sargent," April 6, 1887, two fruiting branches;

¹ Swingle, Walter T., Types of Species in Botanical Taxonomy, in Science n. s. XXXVII, 864–7, (No. 962, June 6, 1913).

National Herbarium No. 332516, *E. W. Nelson*, No. 4445, "Road over mountain between Victoria and Jaumave Valley, altitude 800-2500 ft.," Tamaulipas, Mex., May 31, 1898, two fruiting branches.

The species probably occurs not only along the Rio Grande, but also along its tributary streams, both in Texas and in the Mexican states of Coahuila, Nuevo Leon and Tamaulipas, wherever the soil conditions are suitable.

In March, 1907, Mr. F. B. Headley visited the Rio Grande Valley near the mouth of the Pecos River and sent specimens and photographs, adding the following notes on the species:

"A characteristic of . . . this species is that as fast as the old trunks die out new ones shoot forth from the same base. The majority of the trees observed were staminate. More trees are found growing in rocky than in silt soil. It may be that the pistache is crowded out from those soils and locations where it enters into competition with other trees. It is evidently highly drought-resistant, for it grows out of rocky soils at an altitude of from 200 to 300 feet above the river level. It also grows in moist locations, but most of the trees observed and photographed were growing out of the rock bottom of cañons which are periodically swept by floods. I found many trees having neither staminate nor pistillate blossoms. Goats seem to be fond of the leaves and it is probably for this reason that there are at present no young pistaches in this location."¹

Prof. S. C. Mason's notes on an unusually large tree read as follows:

"Along the pond below the Hinojose spring I located what I believed to be the largest pistache tree yet recorded. . . . This was in a rich . . . alluvium and its roots doubtless penetrate to permanent moisture. The main old trunk is fourteen inches in diameter, besides several large sprouts from the ground seven or eight inches in diameter, others smaller; the entire tree having a spread of thirty-nine feet and a height of about thirty feet."²

On the second trip by Professor Mason, April 7, 1910, this tree was found to be staminate and already out of bloom; but on his third trip, March 17, 1911, this tree was in full bloom and from it the male syntype was collected as well as many additional specimens (merotypes).

The larger trees in the alluvial plain of the Rio Grande near the mouth of the Pecos River are nearly all male. Professor Mason, who visited this region in March, and again in April, 1910, expressly to study this Pistache, reports as follows:

"On Saturday morning . . . I made a tramp alone of twelve or fifteen miles, going to the big bend of the Rio Grande six miles above our camp [near the Big Spring on Hinojose's ranch]. Just below this I discovered two large groves of pistache in the old alluvium at the front of the bluffs facing the river. . . . In all of these groups the pistillate trees were in very small proportion, not over ten per cent. This is a difficult matter to offer an explanation for. Another point may be merely accidental, but without exception the large trees are staminate. In no case did we find an unusually large tree to be pistillate. . . .

The recuperative power of this tree is remarkable. Parts of a stool that are old and dead at the top will send up most vigorous shoots, so that the top is renewed and kept vigorous. The growth is slow, a stem of apparently average growth, $4\frac{1}{2}$ inches in diameter, showing 33 annual rings. This stick shows on a radial measurement, $1\frac{1}{4}$ inches of yellow-brown heart wood to one inch of sap wood. The sap wood is

¹ Frank B. Headley, letter to Walter T. Swingle, dated San Antonio, Texas, April 1, 1907.

² Letter to Walter T. Swingle dated San Antonio, Texas, March 7, 1910.

nearly white with a pale yellowish cast. Both sap and heart wood show small, fine, medullary rays. The wood is rather tough, strong, compact, fine-grained, and weighs approximately 60 pounds to the cubic foot. It shows only a moderate tendency to check in seasoning and little inclination to warp. The wood could only be procured in short and small samples, seldom more than three or four feet long, and from six to eight inches in diameter, but for small articles, as in turnery, and possibly for blocks for wood engraving, it has valuable qualities.

It is a thin-foliaged species, highly intolerant of shade, cleaning up its stem and small branches very rapidly."¹

The true *Pistacia mexicana* is a tree having a single well-marked trunk, not branched at or near the surface of the ground. This is shown clearly by photographs taken near Tehuecan, Puebla, by Dr. J. N. Rose and Mr. C. A. Purpus, and now filed in the National Herbarium, and by a photograph taken in the same region by Dr. D. T. MacDougal, now filed in the herbarium of the New York Botanical Garden. The Texas Pistache, on the contrary, almost never develops a single trunk. Prof. S. C. Mason says of the individuals of this species:

"All show a strong tendency to produce several trunks from the ground or to sprout low down, rather than to form a single stem. In the thickets in the rich soil along the river front (the alluvium of an ancient river flood plain, high above the present) these divergent stems are so highly curved and interlocked as to make the groups almost impenetrable. There is no sign of sprouting from the roots, or what may be termed suckering, nor any indication of surface roots. Deep penetration of the roots seems to be the rule."¹

The smaller branches of *P. mexicana* are smooth and light brownish gray, while *P. texana* has rather rough, dark brownish gray branches, never silvery.

POSSIBLE ECONOMIC USES: At first I feared the American Pistaches were so different from the old-world species that the Pistache-nut tree (*Pistacia vera* L.) could not be grafted on them. However, it has been found by Mr. Eugene May, Jr., that the Pistache-nut tree can be budded readily on *P. mexicana*, and in view of the close affinity of the Texas species it is highly probable that it also can be used as a stock on which to grow the true Pistache-nut.

The Texas Pistache as it grows in the limestone country near the mouth of the Pecos, forms compact, rounded clumps, with dark, evergreen foliage. In early spring the new growth shows a beautiful wine-red color all over the clump. It is a handsome tree, well worthy of trial as an ornamental, especially in warmer parts of the southwestern United States.

BUREAU OF PLANT INDUSTRY
WASHINGTON, D. C.
September 18, 1920

¹ Letter to Walter T. Swingle, from San Antonio, Texas, April 15, 1910.

A NEW SPECIES OF CAMPNOSPERMA FROM PANAMA

PAUL C. STANDLEY¹

COLLECTIONS of plants obtained in Panama in recent years have revealed the occurrence in that region of many genera of plants, especially of trees, which previously were believed to be confined to the forests of Brazil and the adjoining countries. It is now evident that the Panamanian flora is much more closely allied with that of Brazil than has been believed heretofore. Another striking example of this relationship is afforded by the new species of *Campnosperma* here described. This genus, which is a member of the Anacardiaceae, has been known in America from a single species, *Campnosperma gummifera* (Benth.) L. March., a native of the Amazon region of Brazil. The other members of the group are natives of the East Indies.

Campnosperma panamensis Standley, sp. nov.

Ramulis 12 mm. crassis, cortice rugoso obtectis, novellis stellato-puberulis, dense foliatis; foliis breviter petiolatis, oblongo-obovatis, 27 cm. longis, 11.5 cm. latis, apice rotundatis, basi cuneatis, coriaceis, supra glabris, subtus dense stellato-lepidotis, costa supra canaliculata, subtus valde prominente, nervis lateralibus subparallelis, utrinque latere circiter 20, sub margine adscendentibus; paniculis interrupte spiciformibus, longe pedunculatis, 13-18 cm. longis, stellato-puberulis, floribus pedicellis perbrevibus crassis fultis; calycis lobis ovato-rotundatis, 1.5 mm. longis, stellato-puberulis, obtusis; petalis triangulari-ovatis, acutiusculis, costa extus stellato-puberula; staminibus petalis brevioribus, filamentis glabris; disco crasso, 1 mm. alto, 2-2.5 mm. lato; fructu juvenili ovoideo, lepidoto.

Type in the herbarium of the Arnold Arboretum, collected "at the Chiriquito Lagoon on the south side of Panama where it covers an area of about 6 square miles" and received from A. D. Little, Inc., of Cambridge, Massachusetts, in August, 1920.

The specimen was forwarded to the writer by Mr. Alfred Rehder, who had already referred it to the Anacardiaceae.

No specimens of the Brazilian *C. gummifera* have been seen by the writer, but an excellent plate of that species is given by Engler in Martius's *Flora Brasiliensis* (xii.² t. 82 [1876]). The Panamanian plant agrees very well with the plate, except in its longer panicles. Engler, however, describes the leaves, sepals, and fruit as glabrous, and in his later monograph of the Anacardiaceae² he uses the presence or absence of pubescence upon the leaves as a key character, placing *C. gummifera* among the species with glabrous leaves. The only species of *Campnosperma* described as having pubescent leaves is *C. macrophylla* (Blume) Hook. f., an East Indian tree. In that, however, the pubescence is stellate and comparatively coarse, while the pu-

¹ Published by permission of the Secretary of the Smithsonian Institution.

² In De Candolle, *Monog. Phan.* iv. 316-321 (1883).

bescence in *C. panamensis* is essentially lepidote, each trichome having a conspicuous, flat, brown centre. One of the panicles of the type specimen of *C. panamensis* bears two bractlike leaves about 2 cm. long at the apex of the peduncle.

U.S. NATIONAL MUSEUM
WASHINGTON, D.C.
September 21, 1920

NOTES ON NORTH AMERICAN TREES. VII¹

C. S. SARGENT

Prunus

THE last ten years have added little to our knowledge of the Plum-trees of North America, where in the Arkansas, Oklahoma and Texas region they are more numerous in species and probably in individuals than in any other part of the world. It is difficult to obtain good material for a complete study of these trees. They flower early when there is little else in bloom to occupy the collector, who is obliged to make long and expensive journeys to collect the flowers of one genus. In four years out of five the young fruit is destroyed by the severe frosts which in that region usually come later than the flowering of the Plum-trees. When the fruit escapes destruction by frost it is difficult to obtain, for it ripens at the season when heat and insects make plant collecting in the region where plums abound a difficult and disagreeable undertaking. The different specimens are often widely separated, and it is therefore impossible to make the comparative study of the living plants which is necessary in order properly to understand their similarities and differences. That there are natural hybrids between at least some of the shrubby species is probable, but it has not yet been possible with available material to work these out; and there is little prospect that American Plums can be properly understood until all or most of the species can be grown together in one garden until they flower and produce fruit. Such a collection will not be easy to establish and maintain, for some of the most interesting species are not hardy in the north, and, except in the north, it is not probable that such a collection will be attempted. A good beginning of such a collection has been made by the Park Department of the City of Rochester, New York, which has brought from Oklahoma and Texas a large number of living plants of several species, varieties and probable hybrids, and many seedlings have been raised from the fruit which has ripened in Rochester on these plants. There are, too, a number of American Plums in the Arnold Arboretum, although some of the Texas and Oklahoma species which are doing well in Rochester have not proved entirely hardy here.

Prunus americana Marsh. is usually described as spreading by suckers from the roots into large or small thickets. In the north this seems to be

¹ For part VI, see Vol. I, p. 245.

generally true, but in western Florida, in the neighborhood of Selma, Dallas County, Alabama, and of Starkville and Jackson, Mississippi, and near New Orleans, Louisiana, trees which I cannot otherwise distinguish from *Prunus americana* grow with a single stem and show no tendency to produce plants from the roots. When better known it is possible that these trees may prove distinct enough from the northern tree to make it possible to consider them specifically distinct. Unfortunately seedlings of the Florida and Alabama trees raised at the Arboretum have not proved hardy, and it will not be possible to give them here the sustained observations necessary for the proper understanding of any species of Plum-tree. One of the Florida Plum-trees, however, seems distinct enough to be considered a variety, for which I suggest the name of

Prunus americana var. *floridana*, n. var.

Differing from the type in its thinner finely serrate leaves and purple fruit.

Leaves oval to slightly obovate or rarely ovate, usually abruptly short-pointed, acute or acuminate at apex, gradually narrowed and cuneate or rounded at base, and finely often doubly serrate with short apiculate teeth, when they unfold tinged with red and slightly pubescent, and at maturity thin, dull dark green on the upper surface, paler on the lower surface, 6-8 cm. long and 3.5-5 cm. wide, with a slender midrib and primary veins sparingly villose on the lower side; petioles slender, pubescent or puberulous, eglandular, 7-12 mm. in length; stipules linear, puberulous, 6 or 7 mm. long, caducous. Flowers opening from the middle to the end of March, 2 cm. in diameter, on slender glabrous pedicels tinged with red and 1.7-2 cm. in length, in 2- or 3-flowered short-stalked umbels; calyx glabrous, red, the lobes narrow-acuminate, entire or glandular serrate toward the apex and usually ciliate on the margins, puberulous on the outer surface, villose-pubescent on the inner surface; petals oblong-obovate, rounded at apex, contracted below into a narrow claw, 7 or 8 mm. wide; filaments glabrous, longer than the petals; ovary and style glabrous. Fruit short-oblong, rounded at ends, 2.5 cm. long and 2-2.2 cm. in diameter, red becoming purple when fully ripe, with a thin skin, thick sweet flesh and an oblong flattened stone pointed at ends, acutely ridged on the ventral suture, obscurely grooved on the dorsal suture, 1.7-1.8 cm. long, 1.3-1.4 cm. wide, and 7 or 8 mm. thick.

A small tree without suckers from the roots, with pale gray bark and slender glabrous red-brown branchlets.

FLORIDA. Low rich woods in the neighborhood of St. Marks, Wakulia County, common; *T. G. Harbison* (No. 30 = 1427, type), March 30, 1914, September 17, 1919; No. 1207, September 25, 1913.

Prunus mexicana S. Wats. The common "Big-tree" Plum of Texas which I described as *Prunus arkansana* (*Trees and Shrubs*, II. 157, t. 165 [1911]) has been probably correctly referred to Sereno Watson's *P. mexicana* (in *Proc. Am. Acad.* XVII. 352 [1882]), based on a fragmentary speci-

men collected by Dr. Edward Palmer at Lerios, Coahuila. The Big-tree Plum has thick leaves usually broad and rounded at base with more or less prominent reticulate veinlets, villose-pubescent on the midrib and veins below, glabrous pedicels and globose or rarely short-oblong dark red fruit covered with a bluish bloom, the stone nearly round to obovoid, turgid, usually pointed at base and rounded at apex.

Prunus mexicana, which is distributed through Arkansas to southeastern Kansas, eastern Oklahoma, western Louisiana, and eastern and southeastern Texas into northwestern Mexico, and occurs in eastern Louisiana, never produces suckers from the roots, and is a tree up to 14 m. in height with a single trunk often 3 dm. in diameter, covered with dark, nearly black or light gray bark, exfoliating in plate-like scales on young stems and large branches, and becoming rough and furrowed on old trunks. With more knowledge of the Big-tree Plum than I had when I described it in 1911 it seems better to consider varieties of *P. mexicana* the related species which I described at that time as *P. reticulata*, *P. polyandra* and *P. fultonensis*. These three then become:

Prunus mexicana var. *reticulata*, n. var. — *Prunus reticulata* Sargent in *Trees and Shrubs*, II. 151, t. 162 (1911).

Differing from the type in its thicker leaves more often narrowed at base, with more prominent reticulate veinlets, pubescent pedicels, smaller globose fruit ripening late in September or in October, with thin bitter astringent flesh, and dark deeply furrowed bark.

DISTRIBUTION. Uplands and along the margins of river-bottom lands; in the neighborhood of Dallas and of Sherman, Grayson County, northern Texas.

Prunus mexicana var. *polyandra*, n. var. — *Prunus polyandra* Sargent in *Trees and Shrubs*, II. 155, t. 164 (1911).

Differing from the type in the narrower base of the leaves, the more numerous stamens (up to 36), in its earlier ripening fruit with an obovoid compressed stone pointed at apex, and gradually narrowed and acute at base.

DISTRIBUTION. Rich woods, Fulton, Hempstead County, Arkansas.

Prunus mexicana var. *fultonensis*, n. var. — *Prunus fultonensis* Sargent in *Trees and Shrubs*, II. 248 (1913).

Differing from the type in its thinner leaves pubescent below over the whole surface, with more obscure reticulate veinlets, and in its smaller dark bluish purple fruit ripening in June, with thin flesh and a compressed stone pointed at apex and gradually narrowed and acute at base.

DISTRIBUTION. Rich woods near Fulton, Hempstead County, Arkansas.

Prunus virginiana L. Attempts have been made by different authors to separate the Choke Cherry of North America into several species, but a careful examination of the large amount of material preserved in the herbarium of the Arboretum and a study of the trees growing in a considerable part of the region which the Choke Cherry inhabits and in cultivation fails to show characters in the different forms sufficiently stable to justify their

treatment as species. In all the forms the leaves are oval, oblong or obovate, abruptly pointed, sharply sometimes doubly serrate with slender spreading teeth, and green or pale on the lower surface. The flowers and the fruits of all the forms vary considerably in size, and in the west the fruit is often less astringent and is usually darker in color at maturity than in the east. If the different forms are considered varieties they may be arranged as follows:

Prunus virginiana L. Leaves cuneate or rounded or rarely slightly cordate at base, pale or green on the lower surface, glabrous or furnished below with axillary tufts of short hairs, and very rarely villose on the lower side of the midrib. Fruit red at first when fully grown, becoming at maturity bright red, dark crimson or nearly black, more or less astringent at maturity; in one form (var. *leucocarpa* S. Wats.) bright canary yellow.

Usually a small or large shrub; occasionally truly arborescent, especially the yellow-fruited variety, and from six to eight meters high.

The typical *Prunus virginiana* is distributed from Newfoundland to Labrador and the shores of Hudson Bay, and southward to the valley of the Potomac River, to Buncombe and Tridell Counties, North Carolina (*Cerasus virginiana* β *humilior* Michx.), and to northern Kentucky, and westward to Saskatchewan, and in the United States to eastern North Dakota, eastern Nebraska, northeastern Missouri and northeastern Kansas.

Prunus virginiana var. *demissa* Torr. This most distinct of the varieties of the Choke Cherry was discovered by Nuttall in western Oregon and was called by him *Cerasus demissa*. The leaves of this tree, which are usually cordate at the base and covered below with pale pubescence, certainly appear distinct from those of the eastern plant, but trees with leaves cuneate or rounded at base are also common in the Pacific coast region, leaves with a cordate and with a cuneate base often occurring on the same branch, and there is nothing but the pubescence of their lower surface by which this western tree can be distinguished from the eastern tree. *Prunus virginiana* var. *demissa*, which I know in the Pacific States only in western Washington and Oregon, and in Kern and Napa Counties, California, is not confined to the Pacific States if the pubescence on the lower surface of the leaves can be depended on to distinguish it. Fendler's New Mexican specimen (No. 1847 in Herb. Gray) has cordate leaves pubescent below. On a specimen collected by Professor Pammel near Ames, Iowa, in July, 1914, the leaves are cuneate, rounded or slightly cordate at base and pubescent on the lower surface. A specimen (No. 112) collected by V. H. Chase near Wady Petra, Stark County, Illinois, has the broad leaves rounded or subcordate at base of var. *demissa* although only slightly pubescent below; and the leaves of two specimens (Nos. 6643 and 13058) collected by C. C. Deam in LaPorte County, Indiana, are rounded or cuneate at base and slightly pubescent below, and with the Wady Petra specimen seem to connect the trees of the Atlantic and Pacific coast regions. More distinct with its pubescent branchlets is:

Prunus virginiana var. *demissa* f. *pachyrrhachis*, n. comb. — *Prunus demissa* var. *Nuttallii* f. *pachyrrhachis* Koehne in Mitt. Deutsch. Dendr. Gesell. xx. 236 (1911). — *Padus valida* Wooton & Standley in Contrib. U.S. Nat. Herb. xvi. 134 (1913).

Differing from var. *demissa* in the cuneate or rounded base of the leaves villose pubescent below on the midrib and veins, in the stouter pubescent rachis and pedicels, and in the pubescent branchlets usually becoming glabrous at the end of their first season.

Leaves oval or slightly obovate, acute or abruptly short-pointed at apex, rounded at base, finely serrate, thick, dark green and glabrous above, pale and villose below along the midrib and principal veins, 5–7 cm. long and 2.5–3.5 cm. wide; petioles stout, pubescent, glandular at apex, 1–1.5 cm. in length; leaves of a vigorous shoot 10–11 cm. long and 5–6 cm. wide. Flowers not seen. Mature rachis and pedicels stout, densely pubescent. Probably a shrub with usually stout branchlets finely pubescent during their first and second seasons, and stout acute winter-buds 8 mm. or 9 mm. long.

TYPE LOCALITY. Canyons, Kingston, Sierra County, New Mexico, at an altitude of 2200 m., August 24, 1904, *O. B. Metcalfe* (No. 1213 in Herb. Nat. Mus.).

The type of this form is well distinguished by its stout pubescent branchlets, large winter-buds, thick pubescent rachis and pubescent pedicels. Flowers of the type have not been seen, but the fruit and its stone are similar to those of *Prunus virginiana*. The other Choke Cherries from New Mexico, *Padus pumicea*, *P. calophylla* and *P. mescalearia* Wooton & Standley (in Contrib. U.S. Nat. Herb. xvi. 133, 134 [1913]), varying somewhat in the shape of their leaves and in the amount of their pubescence, have branchlets more or less pubescent and afford no characters by which they can be satisfactorily separated. The type specimen of *Padus pumicea* (No. 563903 in Herb. Nat. Mus.) is a sterile branch with slightly pubescent leaves and branchlets. Another specimen (No. 737183 in Herb. Nat. Mus.) referred to this species from the same locality has more pubescent leaves and branchlets and a slender pubescent rachis, and so resembles forma *pachyrrhachis*. The type specimen of *Padus calophylla* (No. 562677 in Herb. Nat. Mus.) has narrow-elliptic pubescent leaves, a slender puberulous rachis and branchlets; another specimen referred to this species (No. 686679 in Herb. Nat. Mus.) has broad-oval leaves glabrous with the exception of small axillary tufts of pale hairs below, and a slender puberulous rachis and branchlets. The type specimen of *Padus mescalearia* (No. 690233 in Herb. Nat. Mus.) has slightly pubescent leaves, a glabrous rachis and puberulous branchlets. Although perhaps most closely related to the form *pachyrrhachis*, the specimens of these three species in their slender branchlets show a transition to *Prunus virginiana* var. *melanocarpa*. Their connection with *P. virginiana* var. *demissa* is shown by a sterile specimen (No. 6042 in Herb. Arnold Arboretum) collected near Valentine, Cherry County, in northern Nebraska by the Reverend John Bates, with broad-oval or obovate leaves pubescent below and distinctly pubescent branchlets, and by a specimen

(in Herb. Arnold Arboretum) collected by C. L. Anderson near Santa Cruz, California, with narrow pubescent leaves, a glabrous rachis and puberulous branchlets, and referred by Koehne to his *P. demissa* var. *Nuttallii* f. *holotricha*.

Prunus virginiana var. *melanocarpa*, nov. comb. — *Cerasus demissa* var. *melanocarpa* A. Nelson in Bot. Gaz. xxxiv. 25 (1902). *Prunus melanocarpa* Rydberg in Bull. Torr. Bot. Club, xxxiii. 143 (1906).

This is the widely distributed Rocky Mountain form of the Choke Cherry, differing from the eastern typical form in its rather thicker leaves and usually darker fruit sometimes black or nearly black at maturity. This is a common usually shrubby plant often only 2° or 3° high, or occasionally a tree, distributed from western North and South Dakota and Nebraska to southern Colorado, New Mexico and southern Arizona to the Pacific coast where it ranges from British Columbia to San Diego County, California. In North Dakota the eastern and western forms "intergrade so completely that there is no way of distinguishing them except in extreme cases. The difference is apparently due to the conditions under which they grow, so that they are to be considered merely as forms of the same species."¹

A form with yellow fruit may be distinguished as forma *xanthocarpa*, n. forma. Near La Veta, Huerfano County, Colorado, C. S. Sargent, August, 1911.

Prunus virens Shreve.

This New Mexican and Arizona Cherry-tree, although very closely related to *Prunus serotina* Ehrhart, may be distinguished from that species by its smaller more finely serrate glabrous usually elliptic or oval to rarely oblong-obovate or ovate leaves acute or rounded, rarely acuminate, at apex and cuneate at base, by its eglandular petioles, by its shorter racemes and smaller flowers. In the typical form the leaves are glabrous, but on some trees the under side of the midrib of the leaves is furnished on the margins below the middle with a thick coat of rusty pubescence showing the connection of these trees with

Prunus virens var. *rufula*, n. var. — *Padus rufula* Wooton & Standley in Contrib. U.S. Nat. Herb. xvi. 132 (1913).

Differing from the type in the rusty brown persistent pubescence on the under side of the midrib of the leaves, the pubescent petioles, the pubescence on the lower part of the rachis, the puberulous ovary, and in the rusty brown pubescence of the young branchlets.

The type of *Padus rufula* (No. 563998 in U.S. Nat. Herb.) collected on the west fork of the Gila River, Arizona, August, 1900, has leaves only 4-4.5 cm. in length and branchlets thickly covered with matted rusty hairs. The specimens in the National Herbarium referred to *Padus rufula* vary in the amount of the pubescence on the branchlets, and those of No. 497841

¹ H. F. Bergman, Fl. North Dakota in Sixth Biennial Rep. North Dakota Soil and Geological Survey, 207 (1912).

collected in flower in 1904 on the Black Range, New Mexico, by O. B. Metcalfe are nearly glabrous.

DISTRIBUTION. With the species on many of the mountain ranges of southern New Mexico and Arizona usually at altitudes between 1800 and 2000 m.

The oldest specimens of this variety which I have seen were collected by J. G. Lemmon on the Chiricahua Mountains, Arizona, May, 1881. "Tree 40° high" (No. 156 in Herb. Gray), by Pringle in "rich cañons" of the Santa Rita Mountains, Arizona, in July, 1881, and by Rusby (No. 2159) on the Mogollon Mountains, New Mexico, in August, 1881.

Aesculus

Aesculus glabra Willd. The leaves of the type of this tree as described by Willdenow (Enum. Pl. 405 [1809]) are "glaberrima." The type was a tree cultivated at Berlin, and wild trees with entirely glabrous leaves occur, but appear to be extremely rare, and are found chiefly in the region east of the Mississippi River. Usually the leaflets are furnished below with conspicuous tufts of axillary hairs, and westward their lower surface is often covered in early spring with loose, floccose hairs which are most abundant on the midrib and veins, and usually disappear before the beginning of the summer. More distinct is a form with leaflets thickly covered below with close, dense pubescence, persistent during this season. What is evidently this form was described as *Aesculus pallida* by Willdenow (l. c. 406) who says of it "Folia subtus pubescentia et ut in *A. Pavia* atque *flava* in axillis venarum fasciculo pilorum instructa, quum praecedentis [*A. glabra*] folia semper glaberrima sint." This form, although it differs from the type only in the pubescence of the leaves and young branchlets, is probably best considered a variety, especially as it is found only in a comparatively restricted area. Treated as such it becomes:

Aesculus glabra var. *pallida* Kirchner in Petzold and Kirchner, Arb. Musc. 166 (1864).

The only specimens of this variety which I have seen are the following:

IOWA. Indianola, Warren County, and Moringona, Boone County, *L. H. Pammel*, August and September, 1912.

MISSOURI. Hannibal, Marion County, *J. Davis* (No. 2136), September, 1913; Galena, Stone County, *E. J. Palmer* (No. 5706) May, 1914; Eagle Rock, Barry County, *E. J. Palmer* (No. 6286) July, 1914.

ARKANSAS. Winslow, Washington County, *E. J. Palmer* (No. 8263) July, 1915.

It is interesting that the variety of *A. glabra* with usually seven leaflets (var. *Buckleyi* Sarg.) from Jackson County, Missouri, the type locality, is pubescent, that a specimen of this variety from eastern Kansas is nearly glabrous and that specimens from Ohio and Mississippi are glabrous.

Aesculus octandra Marsh. As long ago as 1856 Asa Gray in the third edition of his Manual described a var. *purpurascens* of this species. He referred to his variety *Aesculus discolor* of Pursh as a synonym and gave the range from W. Virginia southward and westward. The flowers (both

calyx and corolla) were described as tinged with flesh color or deep purple and the leaflets as commonly downy below. This description was probably based on specimens of *Aesculus discolor* of Pursh, for Gray had no specimen of a red-flowered *Aesculus octandra* in his herbarium. The confusion about a red-flowered Appalachian Buckeye was increased in the second volume of the *Silva of North America* in which I proposed the name *Aesculus octandra* var. *hybrida* for a tree said to be not rare on the Appalachian Mountains. The description, however, was that of *Aesculus discolor*, and *Aesculus hybrida* DC; a hybrid between *Aesculus octandra* and *A. Paria* which appeared in Europe more than a century ago, was thought to be the Appalachian tree. Who started the story that a red-flowered Buckeye grew on the Mountains of Virginia, I do not know. For many years I have been looking for it in the field and in herbaria. I thought I had found it at Mount Vernon among the trees which Washington planted about 1785 and which were believed to have been raised from seeds which he had gathered near the mouth of Cheate River, West Virginia. I am now satisfied that these trees are hybrids between *Aesculus Pavia* or *Aesculus discolor* and some species with petals ciliate on the margins. They could not have come from seeds gathered in West Virginia. *Aesculus discolor* and *A. Pavia* do not, so far as I know, grow in West Virginia and *A. octandra* does not grow in any part of the country near *Aesculus Pavia* or *A. discolor*. *Aesculus discolor* does, however, grow with or near *Aesculus georgiana* in northern Georgia and it is possible that the elder Michaux or John Bartram whom Washington consulted about his trees may have given him nuts brought from South Carolina or Georgia which produced the Mount Vernon trees. This theory is possible, but hardly probable; and the Mount Vernon Buckeyes present a problem which I am unable to solve. That they are hybrids the mixture of hairs and glands on the margin of the petals seems to show.

That the story, whoever may have started it, of a red-flowered form of *Aesculus octandra* on the mountains of West Virginia is true is now shown by specimens in this herbarium collected on May 17, 1919, in the neighborhood of White Sulphur Springs, Greenbrier County, by Mr. John S. Ames, who went specially to West Virginia to look for this tree. He was fortunate in finding several trees with red flowers and others with pink and cream-colored flowers growing with the typical yellow-flowered trees. This red-flowered form of *Aesculus octandra* is without a name, for the var. *purpurascens* Gray is *Aesculus discolor* Pursh by description and synonymy and the var. *hybrida* Sarg. is a confusion of the hybrid *Aesculus hybrida* DC. and *Aesculus discolor* Pursh. and I suggest that it be called

***Aesculus octandra* var. *virginica*, n. var.**

Differing from the type only in the red, pink or cream-colored flowers.

***Aesculus georgiana* Sarg.** The type of this species was found in the neighborhood of Stone Mountain, DeKalb County, Georgia, where it is common as a broad shrub from 1-2 m. high. The flowers which are produced in short, compact clusters, have a red and yellow calyx and red pet-

als ciliate on the margin. This species which is easily distinguished from *Aesculus octandra* by the absence of glandular hairs on the calyx and pedicel is now known to be widely distributed in the Piedmont regions from North Carolina to northern Georgia, and to occur on the banks of the Savannah River near Augusta, Richmond County, Georgia, in northern Alabama (Madison, Etowah and Tuscaloosa Counties) and near Pensacola, Escambia County, Florida. It is sometimes a shrub but often a slender tree from 10 to 15 m. high. The flowers are sometimes red and yellow, often yellow and occasionally bright red. The inflorescence which is short, broad and densely flowered in the type, is sometimes narrow and more elongated with less crowded flowers. The calyx which is normally campanulate varies considerably in shape and is occasionally tubular, the two forms sometimes appearing in the same inflorescence. The var. *pubescens* Sarg. distinguished by the pubescence on the lower surface of the leaves, known first only from the neighborhood of Stone Mountain proves also to be widely distributed and occasionally arborescent in habit. This variety is common in the woods west of Augusta and occurs in Rabun and Floyd Counties, Georgia; in North Carolina it ascends on the Blue Ridge to altitudes of about 1000 meters and ranges northward in the Piedmont region to Orange County; southward it is not rare with the species in northern Alabama. A form with narrow leaflets may be distinguished as

***Aesculus georgiana* var. *lanceolata*, n. var.**

Differing from the type in its narrow-lanceolate or slightly oblanceolate leaflets.

Leaves 5-foliolate with glabrous petioles 9-12 cm. in length; leaflets lanceolate to slightly oblanceolate long-acuminate at apex cuneate at base, finely serrate with incurved gland-tipped teeth, when the flowers open early in May thin, yellow-green above, pale below, glabrous with the exception of occasional hairs on the under side of the slender midrib and of minute axillary tufts, 13-18 cm. long and 3-4 cm. wide, their petiolules 5-8 mm. in length. Flowers bright red, otherwise as in the type, in a narrow panicle 15 cm. in length. Fruit not seen.

A tree 8-10 m. high with a short trunk 15-20 cm. in diameter, erect branches forming a narrow head and slender, glabrous branchlets.

GEORGIA. Rabun County, *T. G. Harbison* (No. 19 type) May 9, 1917.

× *Aesculus* *Bushii* Schneid. (*A. discolor* var. *mollis* Sarg. × *A. glabra* var. *leucodermis* Sarg.)

To this hybrid which was found several years ago near Fulton, Hempstead County, Arkansas, should probably be referred a tree found near Starkville, Oktibbeha County, Mississippi, by *T. G. Harbison* (No. 1055) April 7, 1913. From the type of *A. Bushii* the Mississippi tree differs in its rather more pubescent and less coarsely serrate leaflets, in its longer and narrower inflorescence, and in its narrower red calyx and darker red petals.

Aesculus discolor var. *mollis*, *A. Paria* and the typical form of *A. glabra* are the only Buckeyes which grow in Oktibbeha County. The mixture of

hairs and glands on the margin of the petals indicate the hybrid origin of the Harbison plants and the pubescent under surface of its leaflets point to *A. discolor* var. *mollis* rather than to *A. Pavia* as one of the parents of this hybrid.

× *Aesculus mississippiensis* (*A. glabra* × *A. Pavia*), n. hybr.

Leaves 5-foliolate with petioles slightly pubescent toward the apex on the upper side and 8–10 cm. in length; leaflets elliptic to oblong-obovate, acuminate and often abruptly pointed at apex cuneate or rounded and often unsymmetric at base, finely often doubly serrate with incurved gland-tipped teeth, glabrous with the exception of short hairs scattered on the upper side of the lower part of the midrib and of small tufts of axillary hairs, 9–10 cm. long, 4–5 cm. wide, and sessile or raised on a short pubescent petiolule. Flowers appearing early in April in puberulous panicles 8–10 cm. in length on slender slightly pubescent pedicels, 6–8 mm. long; calyx narrow-campanulate, red, glabrous, the lobes ciliate on the margin; petals dark red or yellow, pubescent furnished on the margin with hairs and glands. Fruit slightly and irregularly tuberculate; seed 2–3 cm. in diameter, dark chestnut-brown with a small hilum.

A tree 6 to 7 m. high with a trunk 16 cm. in diameter and slender glabrous branchlets.

MISSISSIPPI. Low woods; near Brookville, Noxubee County, *T. G. Harbison* (Nos. 1061, type and 1061 A), April 8, and October, 1913.

The mixture of hairs and glands on the margin of the petals of this tree indicate that it is a hybrid of a species of the subsection *Octandrae* with one of the *Eupaviae*. Of the former subsection only *A. glabra* grows in southern Mississippi where both *A. Pavia* and *A. discolor* var. *mollis*, of the *Eupaviae* are common; and the general absence of pubescence from the leaflets of the hybrid point to *A. Pavia* as its other parent. Two specimens collected at Starkville, Oktibbeha County, Mississippi, by *T. G. Harbison* (Nos. 1054 and 1056) April 7, 1913, with rather larger flowers, probably represent the same hybrid.

NEW SPECIES, VARIETIES AND COMBINATIONS FROM THE HERBARIUM AND THE COLLECTIONS OF THE ARNOLD ARBORETUM¹

ALFRED REHDER

ROSACEAE (*continued*)

Prunus L.

× *Prunus arnoldiana*, hybr. nov. (*P. cerasifera* × *triloba*).

Frutex 2-metralis v. ultra, ramosissimus, satis densus, ramis patentibus divaricatis; ramuli annotini glabri, plerumque virides, annotini fusco-rubri; gemmae ovatae, parvae, pleraeque stipulis paucis praeditae. Folia

¹ Continued from p. 62.

elliptica vel ovato-elliptica vel inferiora interdum obovata acuta, basi cuneata, 3-6 cm. longa et 1.7-3 cm. lata, crenato-serrata dentibus late ovatis abrupte acuminulatis, interdum leviter dupliciter serrata, supra sparse adpresse pilosula, subtus sparse, ad nervos densius villosa, utrinsecus nervis 5-8; petioli 0.4-1 cm. longi, sparse villosi, apice plerumque glandulis 1-3 instructi; stipulae subulatae, glanduloso-serrulatae, basi lobulis 1-2 instructae. Flores solitarii, coetanei, albi, in alabastro colore roseo suffusi, fere 2.5 cm. diam.; pedicelli circiter 5 mm. longi, glabri; calyx late campanulatus, extus glaber, intus supra medium villosulus; sepalia ovalia, obtusa, serrulata, extus glabra, intus villosula, sub anthesi reflexa, tubum fere aequantia; petala ovalia, 11-13 mm. longa; stamina circiter 30, petalis breviora; ovarium villosum; stylus staminibus paullo brevior. Fructus subglobosus, ruber, sparsissime villosus; putamen globoso-ovoideum, 12 mm. longum et 11 mm. latum, compressum, carinatum, leviter punctato-rugulosum.

Cultivated at the Arnold Arboretum sub no. 3176-5 (raised from seed of *P. triloba* in 1902); specimen collected May 9, 1914, Aug. 14, 1915 (fruit), May 23, 1917, May 3, 1919, September 11, 1920.

This hybrid originated in 1902 at the Arnold Arboretum from seed of a plant of *P. triloba* derived in the second generation from seed sent by Dr. Bretschneider in 1884 from the mountains near Peking. It differs from *P. triloba* chiefly in the white flowers coming out with the first young leaves, the longer pedicels, the reflexed calyx-lobes pubescent inside, in the stamens exceeding the style, the generally elliptic, less coarsely and scarcely doubly serrate leaves, in the longer petioles, the larger more succulent and less hairy fruit with a more compressed sharply keeled stone, and in the shorter stipules of the winter-buds. From *P. cerasifera* Ehrh. which blossoms at about the same time and is apparently the other parent, it differs in the red-brown color of the one year old branchlets, in the shorter pedicels, the villous ovary, the larger and broader sometimes obovate and more pubescent leaves with coarser more acute teeth and in the slightly hairy fruit with a more globose stone. It is interesting as being a hybrid between species of the subgenera *Amygdalus* and *Prunophora*, and is to my knowledge the first known hybrid between these two subgenera.

Prunus arnoldiana is a handsome freely and early flowering shrub of rather dense habit. From *P. cerasifera* it differs in its more compact shrubby habit and from *P. triloba* in its more numerous white flowers.

Prunus Meyeri, sp. vel hybr. nov. (? *P. Maackii* × *Maximowiczii*.)

Arbor pyramidalis ramis patentibus, ramulis junioribus puberulis, annuinis purpureo-fuscis, ramis vetustioribus aurantiaco-brunneis lucidis laevibus lenticellis magnis horizontalibus notatis, cortice trunci brunneo longitudinaliter fisso; gemmae ovoideo-conicae, brunneae, glabrae, pauci-perulatae. Folia ovata v. elliptico-ovata ad ovato-oblonga, acuminata, basi pleraque¹ rotundata, 4-8 cm. longa et 3-5 cm. lata, eaturionum pleraque oblongo-ovata et ad 14 cm. longa et fere ad 6 m. lata, dupliciter ad subsimpliciter serrata dentibus triangulari-ovatis acutis, supra glabra, laete

viridia, subtus ad costa densius, ad nervos sparsius pilosa, ceterum glabra, sed glandulis fuscis conspersa; petioli pubescentes, 1–1.5 cm. longi. Racemi multiflori, pedunculo bracteis foliaceis instructo incluso 5–6 cm. longi, pubescentes; pedicelli sparse pubescentes, inferiores 0.6–1 cm. longi, apicem versus decrescentes, bracteis dimidium pedicellum plerisque superantibus lanceolatis v. lineari-lanceolatis glanduloso-denticulatis inferioribus saepe latioribus et foliaceis suffulti; calyx extus sparse pilosus, lobis triangularibus sparse glanduloso-denticulatis tubo paullo brevioribus; petala oblongo-obovata, circiter 7 mm. longa; stamina petalis et stylo paullo longiora. Fructus ignoti.

Cultivated at the Arnold Arboretum (raised from seed collected by F. N. Meyer in northern Korea in 1906 and received from the U.S. Department of Agriculture under No. 20084 [F. N. Meyer, No. 352a]); specimens collected, May 18, 1918, and June, and September 14, 1920.

Prunus Meyeri seems in all its characters intermediate between *P. Maackii* Rupr. and *P. Maximowiczii* Rupr. and is probably a hybrid between these species, both of which grow in northern Korea and in the same regions, as specimens collected by Mr. Wilson on the Tumen-Yalu divide on two subsequent days show. From *P. Maackii* the supposed hybrid is easily distinguished by the darker and close, not flaky, bark, by the much coarser and double serration of the leaves with acute, not setosely acuminate teeth, by the longer peduncles furnished with bracts, the much larger bracts at the base of the pedicels and by the shorter style. From *P. Maximowiczii* it differs chiefly in the lustrous orange-brown bark of the branches, in the larger leaves glandular-punctate beneath, in the many-flowered racemes with smaller and narrower bracts, in the smaller flowers and in the less densely pubescent calyx and pedicels. If this *Prunus* really is a hybrid, it is like the preceding a hybrid between species of two different subgenera, for *P. Maximowiczii* belongs according to Koehne to the subsect. *Phyllomahaleb* of the subgen. *Cerasus*, while *P. Maackii* belongs to the Ser. *Maackiopadus* of the subgen. *Padus*, though the two groups may be more closely related in spite of Koehne's classification.

Our tree which is now about 6 meters tall with a trunk 12 cm. in diameter has flowered well for several years, but has so far produced no fruits and in this respect resembles *P. Maackii* which in this Arboretum fruits very sparingly while *P. Maximowiczii* is usually well covered with its purple-black lustrous fruits. Though its flowers are not conspicuous *P. Meyeri* is a desirable ornamental tree on account of its vigorous growth, its dense pyramidal habit and its pleasing bright green foliage. The orange-brown lustrous bark of its limbs and branchlets make it attractive in winter.

Prunus Padus L. var. *laxa*, var. nov.

A typo varietatis recedit ramulis gracilibus laxe pendulis foliis angustioribus plerisque obovato oblongis, axillis nervorum subtus ebarbatis, racemis laxis pendulis, putamine minore laeviore vix foveolato. — Arbor glabra ramis patentibus, ramulis junioribus basi tantum minute puberulis: folia elliptico-obovata v. oblongo-obovata, 5–10 cm. longa et 3–4.5 cm. v.

rarius ad 5 cm. lata, acuminata, basi abrupte contracta et glandulis 2 notata, argute serrulata, ea turionum saepe grossius et obtuse serrata, subtus glaberrima, laete vel pallide viridia; petioli graciles, 1-1.8 cm. longi; racemi laxi, pedunculo folia pauca et parva interdum decidua gerente incluso 10-13 cm. longi; flores 1.4 cm. diam; pedicelli 6-13 mm. longi, graciles; petala orbiculari-ovalia, manifeste eroso-denticulata: fructus parvi, purpureo-nigri; putamen 6 mm. longum, costis elavatis brevibus a carina abeuntibus notatum, in media facie fere laevi vel in No. 20078 totum fere laeve.

Cultivated at the Arnold Arboretum (raised from seed collected by F. N. Meyer in northern Korea in 1906 and received from the U.S. Department of Agriculture under Nos. 20082 and 20078; specimens collected: May 6 and Sept., 1915; May 8 and July 25, 1918 (No. 20082 [F. N. Meyer, No. 350a], type); May 8 and July 25, 1918 (No. 20078 [F. N. Meyer, No. 346a])).

This new variety is nearest to *P. Padus* var. *commutata* Dipp. and is perhaps only a form of it; it differs chiefly in its loose pendulous habit, the rather narrow, generally oblong-obovate, quite glabrous leaves, the elongated lax racemes and the much smoother or nearly smooth stone. I have seen no specimen of *Prunus Padus* neither of the European type nor of any of the Asiatic forms with such a smooth stone, except perhaps Wilson's No. 8946 from North Kankyo, the most northern province of Korea. The two plants representing this variety in this Arboretum differ in the stone which is ribbed toward the margin in No. 20082 and nearly smooth in No. 20078, in the petals which are fringed in No. 20082 and nearly entire in No. 20078, and in habit which is looser and more pendulous in No. 20082. The other pendulous form of *P. Padus*, the European *P. Padus* f. *pendula* Hartwig, may be distinguished chiefly by its stouter branchlets, the broader more closely serrate leaves glaucescent beneath, the larger leaves at the base of the racemes, the obovate petals and by the deeply sculptured stone.

Of the other varieties of *P. Padus* occurring in Korea var. *glauca* Nakai differs in the glaucous and var. *pubescens* Regel in the pubescent underside of the leaves, and var. *seoulensis* Nakai in the longer pedicels up to 2 cm. in length, in the long leafy peduncle and in the longer-acuminate leaves.

Two other varieties of *P. Padus* collected by F. N. Meyer in northern Korea were received from the Department of Agriculture, namely, No. 20077 (F. N. Meyer No. 345a) which is *P. Padus* var. *commutata* Dipp., and No. 20079 (F. N. Meyer No. 347a) which is *P. Padus* var. *pubescens* Regel, a variety new to cultivation, as far as I know.

ARALIACEAE

Acanthopanax ternatus, sp. nov.

Frutex bimetralis vel altior, glaber; rami patenti-erecti, satis tenues, pallide cinerei vel brunneo-cinerei, sparse lenticellati, aculeis paucis 4-6 mm. longis validiusculis basi valde dilatatis rectis vel leviter curvatis saepissime geminis et infrapetiolaribus armati vel saepe inermes; gemmae ovoideae, acutiusculae, 1.5-2 mm. longae, brunneae. Folia decidua, petiolata,

3-foliolata; foliola subsessilia vel fere rhombico-elliptica vel ovato-elliptica, apice brevissime acuminata vel acutiuscula et mucronata, basi cuneata, 2-4 cm. longa et 1-2.5 cm. lata, margine dentibus plerisque grossis 1-7 instructa vel praecipue in ramulis floriferis pleraque integra, crassiuscula, supra rugulosa et saturate viridia, subtus pallide viridia, utrinque lucidula, costa media utrinque leviter elevata, venis venulisque supra impressis subtus vix elevatis sed colore distinctis; petioli 1-2.5 cm. vel rarius 3-4 cm. longi. Umbellae in ramulis elongatis terminales, 4-7, centrali majore, rarius solitariae, multiflorae, pedunculatae pedunculis 1-1.5 cm. longis; pedicelli graciles, 5 mm. longi, fructiferi 1 cm. longi; calycis lobi triangulares, minutissimi; petala ovata, acuta vel acuminulata, 2 mm. longi, intus viridi-albi, extus rubescentes; filamenta 1.75 mm. longi; antherae albae, ovalia, 1 mm. longae; styli duo, sub anthesi erecti, 0.5 mm. longi, distincti, in fructu patentes, leviter curvati, 1.5 mm. longi. Fructus suborbiculatus, valde compressus, 6-7 mm. diam., 3 mm. crassus, nigro-purpureus, dispermus, margine calycis et stylis leviter recurvatis coronatus.

CHINA. Yunnan: mountains near Tsin-kon, on the Mekong River, at high altitude, 1905, *Abbé Monbeig* (seed sent to M. Maurice L. de Vilmorin who sent in 1911 a plant under No. 4280 to the Arnold Arboretum); specimens from this plant collected October 13, 1917, October 14 and 26, 1918 and October 13, 1919 are preserved in the herbarium of the Arnold Arboretum.

This new species seems to be most closely related to *A. trifoliatum* Voss (*A. aculeatum* Witte), which is easily distinguished by the hooked spines, the larger, petioluled, sometimes prickly leaflets, the much longer and slenderer peduncles and pedicels, by the styles being connate to the middle and by the less compressed fruit. It has also some resemblance to *A. spinosum* Miquel, but that species has 5-foliolate leaves and solitary umbels on short lateral spurs.

The plant which was received from M. Maurice de Vilmorin in 1911 has grown into a round-headed bush with upright stems and is now about 2 meters tall. It has proved perfectly hardy at the Arnold Arboretum; the flowers do not open until the beginning of October and the fruits begin to ripen at the end of the same month and are produced only on the central umbel which blooms about two weeks earlier than the lateral umbels. The leaves remain on the branches without change until severe frost sets in in November. The shrub has no special claim to ornamental value except in its dark green, long-persisting leaves which have never suffered from insects or diseases.

CAPRIFOLIACEAE

× *Viburnum Jackii*, hybr. nov. (*V. Lentago* × *prunifolium*).

Frutex altus, ramis gracilibus erecto-patentibus comam rotundam satis densam formantibus; ramuli juniores sparse lepidoto-glandulosi, annotini brunneo-grisei, vetustiores brunnei; gemmae floriferae late ellipsoidales et in rostrum obtusum productae, 0.8-1.2 cm. longae, fuscae, cinereo-lepidotae, foliiferae anguste oblongae, minores. Folia late vel orbiculari-elliptica ad ovata vel elliptica, breviter acuminata, basi late cuneata vel fere rotundata,

4-7 cm. longa et 2.5-5 cm. lata, dense serrulata, supra laete viridia et glabra, subtus sparse fusco-lepidota et pallide viridia, nervis utrinsecus 8-10; petioli 0.8-2 cm. longi, anguste marginati vel ei infra inflorescentiam latius marginati et margine ciliati, initio plana, demum leviter undulata et revoluta. Corymbus 5-9 cm. diam., sessilis vel brevissime pedunculatus; flores 7-8 mm. diam., sessiles vel pedicellati pedicellis 1-3 mm. longis sparse glandulosis ut axes inflorescentiae; stamina corolla longiora. Fructus ellipsoidalis, coeruleo-nigra, pruinosis; putamen compressum, circiter 1 cm. longum et 7 mm. latum.

Cultivated at the Arnold Arboretum, of unknown origin, specimens collected September 24, 1908, June 2, 1909, October 30, 1911, May 28 and September 13, 1912, *J. G. Jack*; September 5, 1918, and June 1, 1920, *A. Rehder*.

This hybrid which was first observed in 1908 in the Arnold Arboretum by Professor *J. G. Jack* in several individuals of unknown origin, is clearly intermediate between *Viburnum Lentago* and *V. prunifolium* and apparently a hybrid between these two species which bloom at about the same time, with *V. prunifolium* in advance by about a week. From *V. Lentago* it differs chiefly in the less long-acuminate leaves, those below the inflorescence often acutish or obtusish, in their finer serration, in the less pale under side with less conspicuous veinlets, in the less broadly margined petioles with the margin not or little wavy and revolute, although sometimes slightly so at maturity, in the shorter winter-buds and in the denser habit. From *V. prunifolium* it differs in the more or less acuminate leaves with the veins more prominent beneath, in the margined petioles, in the usually sessile, slightly lepidote inflorescence, the smaller, less pure white flowers and in the slenderer branches. As it grows in this Arboretum it forms a handsome rather compact round bush 3-4 m. tall with slender spreading branches, quite different from *V. prunifolium* which is more tree-like with stout rigid branches and often spinescent spurs; it is also different from *V. Lentago* which forms a taller arborescent shrub with a looser head of spreading and arching branches.

Lonicera subsessilis, sp. nov. (Sect. *Isika*, subsect. *Rhodanthae*).

Frutex circiter 2-metralis, glaber; ramuli hornotini demum brunnescentes, annotini grisei v. griseo-brunnei; gemmae conice oblongo-ovatae, acutae, flavo-brunneae, 4-5 mm. longae, perulis circiter 12 glanduloso-ciliolatis. Folia ovata v. elliptico-ovata, acuta v. breviter acuminata, inferiora interdum obtusiuscula, basi late cuneata, inferiora truncata v. rotundata, terminalia angustius cuneata et saepe rhombico-ovata, 3-5.5 cm. longa et 1.6-3.2 cm. lata, margine saepe undulata, utrinque distincte nervoso-reticulata, supra laete viridia, subtus paullo pallidiora, nervis utrinsecus 7-9; petioli 2-5 cm. longi. Flores bini in axillis foliorum superiorum brevissime pedunculati v. fere sessiles, pedunculo vix 1 mm. longo; bractae subulatae minutae, bracteolis breviores; bracteolae in cupulam vix vel leviter bilobatum tertiam partem ovarii aequantem sparse glanduloso-ciliatam connatae; ovaria ad medium vel paullo ultra connata; calycis lobi triangulares, breves, sparse glanduloso-ciliolati; corolla ignota. Baccae intense rubrae,

pleraeque fere ad apicem connatae, 6-8 mm. longae, basi cupula ut videtur succulenta et rubra circumdatae; semina pauca in quoque frutu, irregulariter ellipsoidea, compressa, 5-6 mm. longa, flavida, rugulosa, testa minute granulosa.

KOREA. Prov. Kogen: Kongo-san, cliffs, rare, alt. 667 m., July 5, 1918, *E. H. Wilson* (No. 10436, type; bush 4 ft.); common around Makaenan, Kongo-san, Sept. 13, 1918, *E. H. Wilson* (No. 10722; bush 4-6 ft.; fruit scarlet); Bambutsusu, Kongo-san, Oct. 8, 1917, *E. H. Wilson* (No. 9263; bush 4-6 ft.; fruit scarlet); thickets, Choanji, Kongo-san, Oct. 16, 1917, *E. H. Wilson* (No. 9275; bush 5-7 ft.; fruit scarlet).

This new species is most closely related to *L. Maximowiczii* Rupr. which also grows on Kongo-san, but is easily distinguished by the longer, long-acuminate, more or less pubescent leaves, by the slender peduncles, and by bractlets connate into two distinct pairs. In its glabrous reticulately veined leaves *L. subsessilis* resembles the closely related *L. Chamissoi* Bge. which differs, however, in the generally oval and obtusish, usually nearly sessile leaves, in the slender peduncles, the very small bractlets connate into distinct pairs, and in the smaller and more numerous seeds of the fruit.

Young plants of *L. subsessilis* are growing in this Arboretum and from these we shall probably soon be able to supply the description of the flowers which, however, as we know them do not present very marked differences in the species of the subsect. *Rhodanthae*.

***Lonicera demissa*, spec. nov.**

Frutex 1-4-metralis, satis densus, ramis divaricatis patentibus subregulariter bifarie ramulosis; ramuli graciles, tenues, accumbenti-villosi, purpurascens, annotini glabri, cinerei, anguste fistulosi; gemmae ovatae, pallide brunneae, perulis orbiculari-ovatis apice rotundatis basalibus acutis exceptis vel ovatis et acutiusculis, margine ciliato excepto glabris. Folia obovata vel elliptico-obovata, in turionibus saepe elliptica vel anguste elliptica, acuta vel obtusiuscula et mucronulata, basi cuneata, 1.5-3 cm. longa et 0.8-1.8 lata, supra opace viridia et accumbenti-pilosa, subtus pallide viridia, longius et densius accumbenti-pilosa praesertim ad nervos, nervis utrinsecus 3-5; petioli pilosi, 1-2 mm. longi. Flores bini, pedunculati pedunculis 0.6-1.2 cm. longis erectis; bractae subulatae, 4-5 mm. longae, ovario duplo longiores, pilosae; bractae ovalia, dimidium ovarium paulo superantes vel ovarium fere aequantes, longe ciliatae et sparse pilosae; sepala rotundata, breviter, cilata, interdum parcesissime glandulosa; corolla initio albida, mox lutescens, profunde bilabiata, circiter 1 cm. longa; tubus limbo duplo brevior, manifeste gibbosus, intus pilosus; labium anticum lineari-oblongum, reflexum, posticum erectum, apice breviter lobatum lobis ovalibus 2 mm. longis subaequalibus, intus glabrum; stamina labium posticum paulo superantia, filamentis infra medium pilosis, antheris lineari-oblongis; stylus corolla brevior, deflexus, usque ad apicem longe pilosus, stigmatibus capitatis; ovaria distincta, subglobosa, sparse breviter pilosa et sparse glandulosa, 3-loculare loculis biovulatis. Baccae distinctae, globosae, 6-9 mm. diam., intense rubrae, glabrae; semina pauca, ovalia, compressa, minute punctulata, flavo-brunnea.

JAPAN. Suruga prov.: Fuji-san, northern slopes, woods, common, 1000 m. alt. June 1, 1914, *E. H. Wilson* (No. 6908, bush 2-4 m. tall and as much through; flowers yellow). Kai prov.: Yatsugadake, forests, common, alt. 1600-2300 m., September 17, 1914, *E. H. Wilson* (No. 7539; bush 1-2 m., much branched, fruit brilliant scarlet).

This new species is closely related to *L. chrysantha* Turcz. and *L. Morrowii* A. Gray; from both it is distinguished at the first glance by its much smaller leaves, smaller flowers and smaller fruits. The chief characters in which *L. chrysantha* differs are the larger, elongated and pubescent winter-buds, the much larger leaves, the larger flowers, shorter stamens, shorter bractlets, the densely glandular and scarcely pubescent usually ovoid ovary, while *L. Morrowii* differs chiefly in the larger, generally oblong leaves, larger flowers with deeply divided upper lip, shorter stamens with glabrous filaments and in the densely pubescent longer bractlets.

Lonicera demissa was introduced into cultivation by Mr. Wilson who sent seeds in 1914 from Yatsugadake. The plants raised at the Arnold Arboretum have proved perfectly hardy and flowered for the first time in 1919 and more profusely in 1920. Though the shrub has perhaps less claim than most of the related species to ornamental qualities, the dense habit and the bright green foliage are pleasing features and the brilliant scarlet fruits, when produced in abundance, will probably make the shrub attractive in autumn.

MISCELLANEOUS GENERA

Physocarpus intermedius Schneid. f. *parvifolius*, forma nov.

A typo recedit statura humiliore, ramulis congestis adscendentibus, foliis et floribus minoribus. — Frutex humilis, ramis erectis, ramulis congestis suberectis dense foliosis praeditus; folia minora, ovata ad obovata, acuta, basi cuneata v. rarius rotundata, ramulorum floriferorum 0.8-2 cm., turionum ad 4.5 cm. longa, breviter lobulata; flores minores; bracteae persistentes; calyx extus glaber; sepala triangularia, margine et intus villosula; petala elliptica, 3 mm. longa, extus medio rubescentia, in alabastro rosea; stamina petalis paulo longiora, antheris fusco-purpureis; carpella 3, rarius 4, villosa, stylis stamina subaequantibus.

Cultivated at the Arnold Arboretum; specimens seen: Capitol Nurseries, Topeka, Kansas, June 1918, J. H. Skinner & Co. (type); Stark Bro's Nurseries, Louisiana, Missouri, June 10, 1918; Arnold Arboretum, June 19, 1920.

This form is very distinct in its habit and in the smallness of all its parts from *P. intermedius* with which it agrees in the more important morphological characters. As it grows in this Arboretum it forms a low shrub now about one meter tall with many upright stems each with numerous rather short ascending branchlets densely clothed with small, bright green leaves. The small pinkish flowers are borne in dense clusters 1.5-2.5 cm. in diameter.

The dense, regular, and distinctly upright habit, the pleasing bright green color of its small foliage and the pinkish flower clusters make this new variety attractive and valuable as a distinct ornamental shrub.

(To be continued)

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BOTANICAL RECONNAISSANCE OF SOUTHERN ILLINOIS

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MOST of the collecting season of 1919 was spent by the writer in making a botanical reconnaissance of several of the southern counties of Illinois for the Arnold Arboretum. The purpose of this extensive field work was to make as complete a collection as possible of the ligneous plants, noting the conditions under which they grow; and incidentally to observe the physiography of the region, the influence of its various phases upon the flora, and the relation of this to the forests of the Gulf coastal plain on the south and to the prairies to the north of this region. In addition to the collection of the woody plants for the Arnold Arboretum a large series of the herbaceous species was taken for the Missouri Botanical Garden, in the herbarium of which institution a full suite of both is now preserved.

Most of the collecting was done in the two southernmost series of counties, and in those bordering the Ohio River on the east side as far north as the mouth of the Wabash River, or approximately in the region south and east of a line drawn from Cape Girardeau to Grayville. Several excursions were made beyond this area in Illinois and in the adjoining states of Missouri, Kentucky and Indiana, where physiographic conditions are, of course, quite similar.

Field work was carried on from early in April until the end of June, and in fall from the middle of September to the last week in October. The spring and early summer of 1919 was extremely wet in this section; and following a drouth of several weeks in mid-summer there ensued a period of very heavy and almost continuous rain in October. There were very few days free from clouds and rain in May, and twenty-one days show a record of rainfall during some part of the twenty-four hours. After the middle of October the rain fell so continuously that little could be accomplished, and several contemplated trips had to be abandoned. Under these conditions travel, especially in the low and swampy parts of the region, was disagreeable and sometimes impossible; and as no artificial heat was available the greatest difficulty was experienced in drying specimens.

Upwards of fifteen hundred serial collections were made during the season, aggregating about forty-five hundred herbarium specimens. Seeds and nuts of more than one hundred species, chiefly of the trees and shrubs, were taken, and about two hundred and fifty small photographs made, illustrating the topography and vegetation of the region.

The town of Cairo, located at the southernmost point of the state of Illinois, at the juncture of the Ohio and Mississippi Rivers, is a few miles north of the thirty-seventh parallel, or slightly south of the latitude of Richmond, Virginia; but owing to its interior continental position the extremes of temperature and seasonal variation in precipitation are much greater than in the corresponding latitude on the Atlantic sea-board, resulting in conditions much less favorable generally in the central Mississippi Valley for the northward extension of the rich and varied flora of the humid Lower Austral region of the Coastal plain than on the eastern coast.

The topography of southern Illinois is remarkably varied; a number of geological formations appear on the surface, giving rise to a wide range of soils, drainage conditions and relief features, that afford habitat and protection to a diversified flora. In the vicinity of Cairo and for some distance up the Mississippi River, and at intervals along the Ohio and smaller intervening streams, are extensive swamps, lagoons and wide alluvial bottoms, originally subject to annual overflow when the streams were at flood. Leveeing and drainage have made considerable head-way against these conditions; and the woodman's axe and busy saw mills have cleared away most of the splendid forest that formerly covered the entire region; but still many small areas of swamps persist and remnants of timber are preserved in the undrained and less accessible lands.

The chief botanical interest of this region lies in the fact that here the flora of the Gulf Coastal Plain makes a sharp salient to the northward, carrying a number of its species, in spite of the climatic handicap, to some two or three degrees higher latitude than elsewhere in the continental interior, and in some cases even farther than on the temperate Atlantic sea-board. The extreme northern point of this salient extends up the valley of the Wabash River to above the mouth of the White River, that forms the southern boundary of Knox County, Indiana, or in the vicinity of Mt. Carmel on the Illinois side; and is marked by the outposts of such southern woody plants as the small Cane (*Arundinaria macrosperma*), Bald Cypress (*Taxodium distichum*), Overcup Oak (*Quercus lyrata*), Basket Oak (*Q. Prinus*), Sweet Gum (*Liquidambar styraciflua*), Downy Swamp Maple (*Acer rubrum* var. *Drummondii*), One-seeded Honey Locust (*Gleditsia aquatica*), Wisteria, Pumpkin Ash (*Fraxinus profunda*) and several other species. Towards the northern limit most of these plants occur only locally in isolated swamps, but farther south in Illinois they form with other associated species an important part of the forest flora, and a little lower down in the Mississippi Valley the

swamp flora reaches its highest development in southeastern Missouri and northeastern Arkansas.

To anyone familiar with the flora of the Middle States and accustomed to regard Illinois and the adjacent region as well beyond the limits of the South it is something of a revelation to see such trees as Cypress, Pecan, Swamp Hickory (*Carya aquatica*), Water Elm (*Planera aquatica*), Tupelo, Swamp Maple (*Acer rubrum*), Spanish (*Quercus rubra*) and Basket Oak and other southern species growing here in great abundance and to a maximum size.

To the influence of the Mississippi River and its great confluent, the Ohio, which joins it here, is doubtless due the markedly southern character of the flora. While the direct effect of the enormous volume of water carried by these streams upon humidity and temperature, and of the work they are doing and have done in the recent past in creating wide alluvial bottoms and extensive swamps, offers an obvious and sufficient explanation of the fact that so many species can maintain themselves here much beyond the limits of their general northward range, the original conditions and causes that led to their introduction into this salient can only be accounted for by an understanding of the past physiographic history of the region.

Geological evidence has established the fact that until the end of the tertiary period, and probably continuing even somewhat later, a great embayment of the Gulf of Mexico extended northward into this region. At that time the Mississippi River discharged itself into the extended Gulf probably above the present mouth of the Ohio. The presence of this large body of water with its thermal currents pouring in from the tropical seas must have given the region a much warmer and more equable climate than prevails at present. Climatic and physiographic conditions in the lower portion of the Coastal plain were probably quite similar to those obtaining there at the present time; and the forest that came up to the shores of the Gulf Embayment had much in common, both in aspect and floral character, with its modern successor, which there is every reason to believe was directly evolved from it.

Since the last uplift of the Ozark plateau and the obliteration of the Mississippi embayment, the flora of the Coastal plain has been subjected to vast mutations; and both the composition and boundaries of the great forest have changed in many ways. There has doubtless been a gradual retreat of the extremely southern species from the central Mississippi Valley, and an extension of the more hardy species over the Ozark region. The causes of the latter movement are not involved with the present discussion and will be taken up in a later paper.

Obviously the natural tendency of heavy-fruited species, such as the Oaks, Hickorys, Cypress, Tupelo and Sweet Gum, is to extend their range down stream, as their seeds are taken up and transported by floods and deposited in favorable situations when the waters subside; and while such trees as the Willows, Maples, Ashes and others are more or less

aided in their up-stream migration by southerly winds, it is doubtful if any of the more southern forms can make much headway here, with the climatic handicap, in competition with more hardy species. The inference then seems reasonable that the typically southern species found in Southern Illinois and adjacent areas in Missouri, Kentucky and Indiana, have not invaded the region by a northward extension of their range in comparatively recent times, but on the contrary are survivors of a more numerous association that flourished here in the remote past, when climatic conditions were much more temperate and favorable to them. It seems safe also to assume that few, if any, of the extra-limital species are increasing in numbers or are extending their range within the salient at present, but in fact are gradually losing ground through the destruction of their most exposed outposts in seasons of long continued drought or extreme cold—losses which they are unable to make good against the constant pressure of more hardy species. This process is also being greatly facilitated by the inroads of civilization: in the draining of swamps, clearing of forests, and probably also through the introduction of new insect and fungus enemies that help to turn the tide against the archaic species in the unequal combat they are waging in a somewhat too rigorous climate.

In the extreme southern part of Illinois, where the Ohio River joins the Mississippi, and in the big bend of the latter to the west, are extensive tracts of alluvial bottom lands, interspersed with swamps and lakes, the latter evidently remnants of former river channels. Similar areas persist, with a slight interruption in the vicinity of Thebes, along the Mississippi River as far north as Grand Tower, and for some distance up the valleys of Cache River and Big Bay Creek, small tributaries of the Ohio. Lowlands and swamps of considerable extent are also found along the Ohio, north of the Shawnee Hills, from the Saline River to above the mouth of the Wabash. Most of this area is, or was before the days of leveeing and drainage, subject to frequent inundations, and along the lower levels and old channels water accumulated, forming permanent sloughs and swamps.

A magnificent forest of deciduous species originally covered these areas of swamp and lowland: in density of growth and size of individuals it was scarcely surpassed by anything north of the tropics; and it is here that nearly all of the typically southern species are found.

One of the most remarkable and quite the most conspicuous of the southern trees of this region is the Cypress (*Taxodium distichum*). It was formerly very abundant in the deep swamps and in shallow water along the margins of lakes, sloughs and small streams in all of the southern counties; and on the eastern side it extended northward along the flood plain of the Ohio River as far as the mouth of the Wabash. Some of the trees here grew to an enormous size, and with all the characteristics that mark the species in its most favored haunts in the extensive swamps of Mississippi, Louisiana and eastern Texas. Specimens from one hundred

to one hundred and fifty feet high and measuring from four to six feet in diameter above the swelled base were by no means rare. The bases of such trees were buttressed in a most grotesque and astonishing manner, being frequently fifteen or twenty feet in diameter and surrounded for many yards by the curious aerial root cones or "knees." On account of its value for lumber most of the large trees have been cut down, and those that remain have for the most part escaped only because their trunks are hollow, decayed or in some way defective. Specimens of moderate size are still frequent, however, and remain the most striking feature of the swamp-land forest.

Other notable trees of the frequently inundated lowlands and swamps are the Tupelo, Swamp Hickory, Water Elm, Sweet Gum, Swamp Honey Locust, Pumpkin Ash, Green Haw (*Crataegus viridis*), Ironwood (*Carpinus caroliniana*), Southern Hackberry (*Celtis laevigata*), Swamp Maple (*Acer rubrum*), Downy Cottonwood (*Populus heterophylla*), and the Overcup, Bur (*Quercus macrocarpa*), Basket, Willow (*Q. Phellos*), Pin (*Q. palustris*), and Swamp White (*Q. bicolor*) Oaks. Typical shrubs are the Silky Willow (*Salix sericea*), Swamp Dogwood (*Cornus stricta*), Button Bush (*Cephalanthus*), Storax (*Styrax americana*), Itca, Swamp Rose (*Rosa palustris*), Swamp Privet (*Forestiera acuminata*), and Deciduous Holly (*Ilex decidua*). A number of these species, however, extend beyond the limits of the swamps and are associated with many others in the rich and varied forests of the wide valleys.

Since the alluvial flood plains of the great rivers and the peculiar ecological conditions that support this flora are best developed in the region about the town of Cairo, as a plant province of southern Illinois, it may appropriately be called the Cairo Formation. Its relation to the general region occupying the lowlands of the ancient Mississippi Embayment and delta and its limits in Illinois have already been indicated.

Besides the quite characteristic species mentioned above many others common to the surrounding regions grow in the bottom lands and some of them even invade the swamps. Amongst trees and shrubs of this class may be mentioned the Big Sealy-bark Hickory (*Carya luciniosa*), River Birch (*Betula nigra*), Spanish Oak, Bur Oak, Red Mulberry, Pawpaw (*Asimina triloba*), Summer Haw (*Crataegus mollis*), Honey Locust, Silver Maple (*Acer saccharinum*), Box Elder (*Acer Negundo*), Black Gum (*Nyssa*), Green Ash (*Fraxinus pennsylvanica* var. *lanceolata*), False Indigo (*Amorpha fruticosa*), Button Bush, Southern Black Haw (*Viburnum rufidulum*), Rough-leaved Dogwood (*Cornus asperifolia*), and the climbers *Bignonia radicans*, *Vitis rupestris*, *V. cordifolia*, *Parthenocissus quinquefolia hirsuta*, and three or four species of *Smilax*. The woody vines *Vitis palmata*, *Brunnichia cirrhosa* and *Trachelospermum difforme* are restricted to the swamps or their immediate borders; and from the long list of herbaceous plants the following may be taken as characteristic of the Cairo Formation: *Peltandra virginica*, *Iris fulva*, *Ranunculus delphinifolius*, *Radicula aquatica*, *Hottonia inflata*, *Hibiscus incanus*, *Triadenum virginicum*, *T.*

petiolatum, *Decodon verticillatus*, *Asclepias perennis*, *Dianthera orata*, *Spilanthes americana* and *Mikania scandens*.

Bordering the Ohio River and extending almost across the southern extremity of the state except where interrupted by the broad flood plain of the Cache, there is a narrow area, from three to fifteen miles wide, underlaid by deposits of Upper Cretaceous age. These consist largely of unconsolidated materials: clay, gravel, sand and loamy residual soil and alluvium. The surface here is marked by low hills with gentle slopes, dissected here and there by deep ravines or narrow valleys, where grows a luxuriance of ferns and wild flowers under the cover of shrubbery and trees that clothe their steep sides. Where uncleared the area is all well-wooded; the forest with its undergrowth is rich in species and the flora as a whole is strikingly different from that of the bordering lowlands. Amongst the characteristic trees and shrubs are the Scaly-bark Hickory, Small-fruited Hickory (*Carya glabra*), Bitternut (*Juglans cinerea*), Black Walnut (*J. nigra*), Chinquapin Oak (*Quercus Muhlenbergii*), Northern Red Oak (*Q. borealis* var. *maxima*), Black Oak (*Q. velutina*), Schneek's Oak (*Q. Shumardii* var. *Schneckii*), American and Red Elm (*Ulmus americana*, *U. fulva*), Cucumber Tree (*Magnolia acuminata*), Tulip Tree, Sassafras, Spice Bush (*Benzoin aestivale*), Wild Cherry (*Prunus serotina*), Red Bud (*Cercis canadensis*), Sugar Maple (*Acer saccharum* and the variety *Schneckii*), Linden (*Tilia glabra*), Sweet Gum, Black Gum, American Ash, Tear Blanket (*Aralia spinosa*), and Wild Hydrangea.

On the uplands the trees often grow tall and straight and of a good size for the respective species; but the stand is seldom so dense as in the Cairo Formation, and the woods have an open park-like appearance, with little undergrowth and few vines or herbs, except on steep hillsides or in the protection of ravines and valleys.

Just north of the town of Mounds, in Pulaski County, this flora and the topography of the Cretaceous area that supports it is typically developed; and from the mound-like character of the low hills, which have presumably given the name to the town, the term Mounds Formation seems quite appropriate for this floral province. However, while typically developed here, practically the same plant association is widely distributed beyond the Cretaceous area.

Amongst the commonest undershrubs in the Mounds Formation are the Hazel, Spice Bush, Wild Black Raspberry and the smooth and cinerous Hydrangeas (*Hydrangea arborescens* and *H. cinerea*). Characteristic herbaceous species are *Phegopteris hexagonoptera*, *Adiantum pedatum*, *Dryopteris noveboracensis*, *Asplenium filix-femina*, *A. angustifolium*, *Carex Jamesii*, *Trillium grandiflorum*, *Corallorrhiza Wisteriana*, *Actaea rubra*, *Aruncus sylvestris*, *Collinsonia canadensis*, *Eupatorium incarnatum* and *Prenanthes altissimum*.

Several of the above species are found occasionally in the lowlands of the Cairo Formation and the majority of them extend into the higher rocky region to the north, but are comparatively rare or uncommon there, while abundant and typical here.

A low outlying spur of the Ozark uplift crosses the state of Illinois, from the Mississippi to the Ohio River, near its southern extremity. The axis of this ridge passes through the counties of Union, Johnson, Pope and Hardin, and has given rise there to a topography strikingly different from that of the lowlands to the south. Several distinct groups of sedimentary rocks underlie this area. Limestones are most abundant on the western side near the Mississippi River and in Hardin County, bordering the Ohio, while sandstone formations predominate in the central portion and on the northeastern flank. Over much of this area the surface is quite rugged, with rock exposures on the ridges and steep hill-sides, and with bold escarpments and bluffs along the streams. While the surface of the highlands is not extensive enough for the formation of large springs, seepage water and small streamlets issue in many places along the bluffs, giving rise to perennial streams in some cases. Although rainfall is abundant, owing to the narrowness of the watershed and the nearness of the two great rivers, none of the streams originating here attain much size. The Cache River, which joins the Ohio a few miles north of Cairo, is the largest of these, and most of the creeks flowing south from the central sandstone area unite to form it. Towards their sources many of these small streams have cut deeply into the comparatively soft, heavily-bedded Pennsylvanian sandstones, forming narrow gorges with perpendicular or overhanging cliffs, in some cases one hundred to two hundred feet in height. Often deep grottos and rock shelters are found in such places, some of which, where comparatively dry and high enough, were used by the Indians for habitation or refuge, as is shown by the numerous flint chips, fragments of pottery, bones and other debris found near them and by digging in the cave earth of their floors. At other points in the protection of the high cliffs, especially where there is an abundance of moisture and an accumulation of rich soil and humus along the ledges or at the base, a rich flora is established, and some of the trees and herbaceous plants found here are more typical of the Mounds Formation: amongst these are the Butternut, Tulip Tree, Linden, Sugar Maple and Red and Chinquapin Oaks. More common are the Small Scaly-bark (*Carya ovalis*) and Pignut Hickory (*C. glabra*), Black and Schneek's Oak, Black Gum and Red Maple. Along the dry exposed ledges at the top of the bluff there is often a scrubby growth of Red Cedar (*Juniperus virginiana*), Black Jack Oak (*Quercus marilandica*), Tree Huckleberry (*Vaccinium arboreum*), Winged Elm, Low Hackberry (*Celtis pumila georgiana*), and less commonly the June Berry (*Amelanchier canadensis*) and Fragrant Sumac (*Rhus canadensis*). Here, too, are often found such typical barrens plants as *Opuntia humifusa*, *Agave virginica*, *Crotonopsis elliptica*, *Talinum calycinum*, *Hypericum gentianoides* and *Polygonum tenue*.

On the dry uplands Hickories and Oaks constitute a large proportion of the forest. The commonest species are *Carya glabra*, *C. ovalis* and its varieties, *C. alba*, *Quercus velutina*, *Q. alba* and *Q. stellata*. Shingle

Oak (*Quercus imbricaria*), Flowering Dogwood (*Cornus florida*), and White Ash (*Fraxinus americana*) are frequent; and in the more open places several species of Red Haws, Crab Apples and Plums are found, together with Sassafras, Persimmon, Blackberry, Climbing Rose and Summer Grape. Along the rocky margins and beds of some of the streams grow the Silky Willow, Smooth Alder (*Alnus rugosa*), Silky Dogwood (*Cornus amomum*), Winterberry (*Ilex verticillata*), and Shrubby St. John's Wort (*Hypericum prolificum*). The Ohio Buckeye (*Aesculus glabra*) grows abundantly in rich alluvial ground along a branch of the Cache in Johnson County.

On the western side, paralleling the Mississippi River and extending through the northern half of Alexander and across Union County, is a narrow area of Devonian rocks, consisting of compact limestone with considerable interbedded chert. Near Thebes the bold bluffs of this formation approach the river, but further north are separated from it by a wide bottom. The surface of the uplands here is in places strewn with angular fragments of residual chert, and affords conditions more closely resembling typical sections of the Ozarks in Missouri than any other part of southern Illinois. In the vicinity of Alto Pass the country is quite rugged, with Mississippian sandstone exposed in picturesque bluffs and huge residual masses about the village. The altitude at the M. & O. depot is 746 feet, and hills in the vicinity must be considerably higher. A few miles to the southwest is a much broken area, locally known as the "Pine Hills." On the points of some of the highest ridges the Short-leaved Pine (*Pinus echinata*) grows, though in no great abundance. It is evidently an outpost of the large colonies of this species found on similar rocky ridges in sections of the Missouri Ozarks. The surface of the uplands in the Pine hills is thickly covered with chert fragments; Oaks and Hickories are among the commonest trees, such species as *Quercus velutina* and *Q. marilandica*, *Carya alba* and *C. ovalis odorata* predominating. The acid character of the soil and the Ozarkan type of the flora are also emphasized by the presence of such Ericaceous plants as *Rhododendron roseum*, *Vaccinium virgatum tenellum* and *V. arboreum*, the first of which, at least, has been found nowhere else in southern Illinois.

At the other extremity of the Ozark Ridge, bordering the Ohio River, in Pope and Hardin Counties, limestone of the Mississippian series is the prevailing country rock over a considerable area. The surface is quite broken, and sink-holes and caves abound in many places. High picturesque bluffs appear along the Ohio and smaller streams, and outcrops and bare ledges occur on the steep slopes and tops of some of the hills. Fluorspar with ores of lead and zinc is mined from the St. Louis limestone, and is becoming the basis of an important industry. The flora here is not remarkably different from that of the central sandstone portion of the ridge, but in places on the limestone hills stunted Cedar bushes and various species of Red Haws, Plums and other small trees and shrubs form extensive thickets, and the genus *Crataegus* is repre-

sented by more numerous forms than in any other part of southern Illinois.

Farther north along the Ohio River, from the Saline to the mouth of the Wabash and for some distance up the valley of the latter stream, there is much low, level country; the broad alluvial flood plains are frequently inundated; drainage in many sections is poor and swamps and bayous abound. Such conditions obtain over a large part of Gallatin County; and extending more or less continuously to the village of New Haven is a line of sloughs and lakes, evidently marking an old channel of the Wabash River, when that stream joined the Ohio some twelve or fifteen miles south of the present junction point. The flora of this section, like its topography, is generally quite similar to that of the Cairo region, although several of the southern trees and shrubs have disappeared. Cypress, however, persists nearly as far north as the mouth of the Wabash, and is reported to have formerly grown in a swamp, long since drained, near New Haven, at the mouth of the Little Wabash. On the Indiana side it is still growing some distance farther north, and an extensive Cypress swamp is said to have occurred in Knox County until destroyed by drainage.

A short distance back from the Ohio River, near Shawneetown, a range of low hills, underlaid by shales and sandstones of the Pennsylvanian series stand out above the surrounding alluvial plain. The contrast in topography is very striking, although at their highest points the hills are little more than a hundred feet above the valley. The surface is rather undulating than rugged, and in the northern portion, known as the Shawneetown Hills, scarcely any rock outcrops occur. In the Gold Hills to the south, however, there are some low sandstone escarpments and the slopes are generally steeper.

The hills, like the surrounding valley, originally supported a heavy growth of deciduous trees. Much clearing has been done in the more level portions, and most of the merchantable timber has been culled out. A tract of some hundred acres of practically virgin forest in the Shawneetown Hills was cut for lumber during the year 1919. Many saw logs from three to five feet in diameter, of Sweet Gum, White Oak and Tulip Tree (*Liriodendron Tulipifera*) were secured. To the last named species the name of Yellow Poplar has been applied by the lumbermen, and unfortunately widely adopted by the country people.

In composition and general character of growth the flora of the Shawneetown and Gold Hills is quite similar to that of the Cretaceous area farther south, and the relation of the hills to the surrounding lowlands here, although isolated and underlaid by a different geological formation, closely approximates that of the Mounds and Cairo Formations; and the flora of the respective stages may well be classed together. Amongst the commonest forest trees on the uplands here are the Scaly-bark and Pig-nut Hickories, White and Red Oaks, Black Gum, Sweet Gum, Tulip Tree and Sugar Maple. Vines and undershrubs are not abundant in most

situations, but this is partly due to the long-continued pasturing of the fenced woodlands; and on steep hillsides and in other more protected situations such species as *Corylus americana*, *Staphylea trifoliata*, *Viburnum rufidulum*, *Smilax rotundifolia* and *Vitis cordifolia* sometimes form dense thickets, while in more open situations little groups or copses of *Prunus americana*, *Crataegus phaenopyrum* and *Aralia spinosa* occur. The Black Locust appears to be indigenous in the Shawneetown Hills; Linden (*Tilia glabra*) is occasionally found on banks of small streams, and *Rhamnus caroliniana* collected here was seen nowhere else in southern Illinois. Beech is found along steep hillsides and in deep ravines, but is not so common as southward, and the Cucumber Tree was not observed.

LIST OF LIGNEOUS PLANTS COLLECTED IN SOUTHERN ILLINOIS

Pinus echinata Mill. Found only on high cherty hills in Union County. Very local and likely to be exterminated.

Taxodium distichum (L.) Richard. Formerly quite abundant in swamps and sloughs south of the Ozark Ridge, and along the Ohio River to the mouth of the Wabash and beyond. Strictly confined to swamps and lake margins, and its range now very much restricted by drainage and cutting for commercial use. For these reasons it is likely to become comparatively scarce, but hardly extinct in the region for many years. Observed in Alexander, Union, Pulaski, Johnson, Massac, Gallatin and Saline Counties.

Juniperus virginiana L. Rather common but usually of small size throughout the Ozark Ridge region and rarely on low hills of the Mounds Formation. Apparently most abundant in Union, Johnson and Pope Counties, where a considerable quantity is cut for fence posts and occasionally for poles used in construction of local telephone lines.

Arundinaria macrosperma Michx. Common in low open bottoms and along banks of small streams, lakes and borders of swamps throughout the Cairo Formation; more local along rich banks in the Mounds and Ozark Ridge Formations. Most abundant and of the largest size near Cairo, where it sometimes forms small thickets, growing to a height of one to two metres, and with stem diameter rarely up to three or four centimetres. Observed in Alexander, Union, Pulaski, Massac, Johnson, Pope, Hardin, Gallatin, White, Wabash and Richland Counties.

Smilax rotundifolia L. Not uncommon in bottoms and along streams, apparently throughout the region.

Smilax glauca Walt. Rather uncommon and apparently restricted to the lowlands of the Cairo Formation, although likely to be found along streams penetrating the hills. Usually of small size.

Smilax Bona-nox L. Apparently restricted to the Ozark Ridge Formation, where it is a common species in old fields and on eroded hillsides. In such situations it is usually low and trailing and seldom produces fruit. It is occasionally found trailing over low bushes, producing canes several metres long and with abundant fruit.

Smilax hispida Muhl. Rather common in thickets and along small streams, apparently throughout.

Smilax pseudo-china L. Found in the Wabash Valley, where it is a common species in thickets and along fence rows. — A vigorous growing *Smilax* with thorny-hispid canes and broad-oval leaves up to 1.5 or 2 decimetres in diameter was collected, under number 15543, in low overflow bottoms of the Wabash River near New Haven. Dr. Ridgway has apparently found the same thing in Richland County.

Salix nigra Marsh. Common in low bottoms and on alluvial banks of streams and lakes throughout. Most abundant and of the largest size in the Cairo Formation.

Salix amygdaloides Anders. Locally abundant on low alluvial banks of the Mississippi River near East Cape Girardeau, Alexander County, and more rarely southward along the same stream to the vicinity of Cairo. A medium-sized tree, sometimes 10 or 12 metres tall.

Salix longifolia Muhl. Very common in low alluvial bottoms and on sand-bars and low banks of streams in the Cairo Formation; often forming extensive thickets with a very dense cane-like growth along newly-made mud-flats and sand-bars of the Mississippi and Ohio Rivers; less common but not rare along streams and in low ground throughout the region. Usually a shrub from one to three metres tall; rarely a small tree six to ten metres tall, with rough bark and erect branches.

Salix cordata? Muhl. A shrub or small tree, apparently an undetermined variety of this species occurs in the Cairo Formation. (Apparently no collection of this was made in Illinois, but it is represented by number 16369, Poplar Bluff, Mo.)

Salix cordata var. *myricoides* (Muhl.) Carey. A straggling shrub 3 to 5 metres high, with greenish, or on old stems gray, bark, and pubescent branchlets and leaves pubescent below. In open situations, alluvial banks and margins of swamps in the Cairo Formation.

Salix humilis Marsh. Uncommon along open rocky banks in the Ozark region; more abundant northward.

Salix humilis var. *rigiduscula* Anders. A straggling shrub, up to 2 or 3 metres tall, on flat wet prairies in Richland County. Not seen elsewhere.

Salix sericea Marsh. A tall shrub in open swamps of the Cairo Formation, and also collected along rocky (sandstone) beds of streams in Johnson County.

Salix pedicellaris Pursh. A spreading shrub 3 or 4 metres tall, on open banks of railway cut near Norris City, White County. Not seen elsewhere.

Populus heterophylla L. Common in swamps and along low margins of lakes in the Cairo Formation and northward along the Wabash.

Populus balsamifera L. Not uncommon, on alluvial banks of streams and in open bottoms throughout.

Juglans cinerea L. Frequent along bluffs and rich hillsides, especially in the Mounds Formation.

Juglans nigra L. Occasional in rich upland woods throughout, but nowhere very common. Most trees large enough for commercial purposes have been cut, the destruction being especially heavy since the beginning of the great war. It appears to be most abundant in the vicinity of New Haven and Inman, in Gallatin County, and some good-sized trees were seen there.

Carya pecan (Wang.) Aschers. and Graebn. Common in alluvial bottoms of streams from Cairo northward along the Mississippi Rivers and smaller streams to beyond the limits of this exploration. Not found in the Ozark Ridge Formation.

Carya ovata (Mill.) K. Koch. More or less common throughout, except in the low and swampy parts of the Cairo Formation, but frequent in the well-drained bottomlands. Most abundant and of the largest size in the Mounds Formation and along bluffs and in swales of the Ozark region.

Carya ovata var. *Nuttallii* Sarg. A large tree in upland woods of the Ozark region. Observed in Johnson and Gallatin Counties.

Carya ovata var. *pubescens* Sarg. A rather common form on rocky hills near Equality, Gallatin County, and doubtless occurring elsewhere in the Ozark Ridge Formation.

Carya laciniosa (Michx. f.) Loud. Not uncommon throughout, in low alluvial bottoms. Most abundant in the Cairo Formation.

Carya alba (L.) K. Koch. Nowhere very common and apparently absent from the Cairo Formation; most abundant in the Ozark region.

Carya glabra Sweet. Not common, but apparently most frequent in the Ozark Ridge Formation.

Carya glabra var. *megacarpa*? Sarg. Apparently this variety was collected in upland woods in the Shawneetown Hills, Mounds Formation (No. 15268).

Carya ovalis (Wang.) Sarg. Occasionally found in upland woods of the Mounds and Ozark Ridge Formations.

Carya ovalis var. *obcordata* Sarg. Much more abundant than the last, and one of the commonest Hickories in the Mounds and Ozark Ridge Formations. It often attains a large size, up to 30 or 40 metres, and with a straight symmetrical trunk.

Carya ovalis var. *odorata* Sarg. A rather uncommon variety in dry open woods of the Ozark region.

Carya Buckleyi var. *arkansana* Sarg. Not common, and apparently restricted to the rocky upland woods of the Ozark Ridge and northward, near the Mississippi River.

Corylus americana Walt. Very common in open woods of the Mounds Formation; less abundant along small streams and rocky banks in the Ozark region, and rarely growing on low knolls in the Cairo Formation. *Corylus rostrata* Ait. was not collected nor definitely noted in Southern Illinois, but is not rare on knolls in low woods in Southeastern Missouri, and probably occurs in similar situations in the Cairo Formation of Illinois.

Ostrya virginiana (Mill.) K. Koch. Rather abundant on rocky hill-sides in the Mounds Formation, and sometimes found along rocky bluffs and stream banks in the Ozark region; but apparently absent from the Cairo Formation.

Carpinus caroliniana Walt. More or less abundant in low woods and on alluvial banks of streams throughout; most abundant in the Mounds and Cairo Formations.

Betula nigra L. Frequent on alluvial stream banks throughout the region.

Alnus rugosa (DuRoi) Spreng. Seen only in Johnson County, along rocky stream banks.

Fagus grandifolia Ehrh. Rarely found in rich woods, on knolls and slight elevations in the Cairo Formation, and in deep hollows and below high bluffs in the Ozark region. Much commoner in the Mounds Formation where it is a characteristic tree.

Fagus grandifolia var. *caroliniana* (Loud.) Fernald & Rehder. Growing in similar situations as the species, and perhaps more abundant.

Quercus alba L. A common Oak in many places and rather abundant throughout. Most frequent and of the largest size in the Mounds Formation.

Quercus stellata Wang. Common in the rocky upland woods of the Ozark region, and occasionally found throughout, except in the swamps and low bottoms of the Cairo Formation.

Quercus lyrata Walt. An abundant and characteristic species of the low and swampy lands of the Cairo Formation. Noted in Alexander, Union, Pulaski, Massac, Gallatin, Johnson, Jackson, Saline, White, Wabash and Richland Counties.

Quercus macrocarpa Michx. Occasional throughout, but nowhere very common. Most abundant in bottoms of the Cairo Formation, and elsewhere found along alluvial flood plains of most of the streams.

Quercus bicolor Willd. Abundant in low woods throughout. A typical tree of the low lands and semi-swampy areas. More common northward.

Quercus Prinus L. A species of the low woods; most abundant in the Cairo Formation, but less common than *Q. lyrata*. Seen in Alexander, Pulaski, Union, Jackson, Johnson, Massac, Gallatin, White and Wabash Counties, and reported by Dr. Ridgway from Richland County.

Quercus Muhlenbergii Engelm. Most abundant in the limestone areas of Union, Pope and Hardin Counties, but found occasionally along bluffs and banks in the Mounds and Ozark Ridge Formations.

Quercus rubra L. A common Oak of the low but not swampy woods in the Cairo Formation, and perhaps equally common in the Mounds Formation, where it often becomes a very large tree. In the Ozark region it is comparatively rare. This is *Quercus falcata* Michx.

Quercus palustris Moench. A very common species in the lowlands of the Cairo Formation, and abundant throughout along streams.

Quercus Shumardii var. *Schneckii* (Britton) Sarg. A fine large species along bluffs and hillsides. Rather frequent in the Mounds Formation and Ozark region, and occasionally found on the higher ground in the Cairo Formation.

Quercus velutina Lam. A common Oak in the uplands of the Ozark Ridge Formation; less abundant in the Mounds Formation and sparingly found in the Cairo region.

Quercus borealis Michx. f. var. *maxima*. A fine species, and one of the commonest Oaks in the Mounds Formation. In the Ozark region it is confined to the vicinity of rocky bluffs and hillsides.

Quercus marilandica Moench. Confined to the Ozark Ridge region, and there abundant only on dry rocky hillsides and in sandstone barrens.

Quercus Phellos L. The Willow Oak is rare in Illinois, and is found sparingly in low woods in the vicinity of Cairo, and more abundantly, though very local, in Massac County. No large trees were seen about Cairo, but just north of the town of Brookfield some fair-sized specimens occur in the low woods, and near Wickliffe, Kentucky, it is a common tree, growing to a large size.

Quercus imbricaria Michx. Occasional in upland woods throughout. Rare in the dryer situations of the Cairo Formation; infrequent in the Mounds Formation, and somewhat more abundant in the Ozark region and northward.

Quercus bicolor $\times$ *lyrata*. This hybrid was found in low woods near Mound City, Pulaski County, growing with both supposed parent species. The only other white Oaks near were *Q. bicolor* and *Q. Prinus*.

Quercus alba $\times$ *bicolor* = *Q. Jackiana* Schneid. A tree supposed to be this hybrid was found growing along a creek near Pinkneyville, Perry County. It was growing with the supposed parent species and also with *Q. stellata*. There was no fruit on this tree.

Quercus imbricaria $\times$ *rubra*. A tree supposed to be a hybrid between the Shingle Oak and Spanish Oak was found along the road side near Rosiclair, Hardin County. The adjoining field was a cleared upland, and both supposed parent species, as well as *Q. velutina* and *Q. palustris*, were found in the fence-row growth. There was no fruit on this small tree. A larger tree, growing in the edge of a cleared field near the little town of Simpson, Johnson County, appears to be the same hybrid. This latter specimen bore an abundance of fruit. The forest had been cleared from the adjacent fields; but besides the supposed parent species both *Quercus velutina* and *Q. Shumardii* var. *Schneckii* were growing near.

Quercus imbricaria $\times$ *velutina* = *Q. Leana* Nutt. A medium-sized tree, supposed to be a hybrid between these two species, was found along the roadside in cleared uplands near the Post Office of Peters' Creek, Hardin County. Trees of *Q. imbricaria*, *Q. velutina* and *Q. Shumardii* var. *Schneckii* were growing nearby, and *Q. rubra* at no great distance. From the form and color of the leaves this was at first taken to be a cross between the Shingle Oak and Schneck's Oak, but from the character of the acorns,

of which there was a small crop this year, it appears to be the combination given above.

Quercus borealis var. *maxima* $\times$ *imbricaria* = *Q. runcinata* Engelm. A medium-sized tree with abundant fruit was found on the edge of a bit of upland wood near Simpson, Johnson County. Both supposed parent species, as well as *Quercus velutina*, *Q. Shumardii* var. *Schneckii* and *Q. rubra*, were growing nearby.

Quercus imbricaria $\times$ *marilandica* = *Q. tridentata* Engelm. A single tree of this supposed hybrid was seen on the grounds of Dr. Robert Ridgway, at Olney, Richland County, where it was first discovered by him.

Quercus palustris $\times$ *Phellos*. An unmistakable hybrid between these two species is rather frequent in low swampy woods about Cairo and Mound City, where the two parent species grow in close proximity. In that vicinity the hybrid was almost as common as the Willow Oak. This hybrid was also found near Brookport, Massac County, and at Wickliffe, Kentucky. It was not found fruiting at any station.

Quercus phellos $\times$ *velutina*. A small tree, suspected to be this hybrid, was found in low woods, bordering a swampy lake, near Miller City, Alexander County. There was no fruit.

Ulmus americana L. Rather abundant throughout, and found in all sorts of situations except deep swamps.

Ulmus fulva Michx. Apparently absent from the Cairo Formation; most abundant in upland woods of the Mounds Formation and occasionally found along bluffs and steep hillsides in the Ozark region.

Ulmus alata Michx. More or less abundant throughout, but commonest in the Ozark region and northward. A form with branchlets entirely destitute of the characteristic corky wings is frequent.

Celtis occidentalis var. *canina* (Raf.) Sarg. Occasionally found in low but seldom inundated bottoms of the Cairo Formation. Apparently rare or absent from the uplands of the Ozark Ridge, but commoner northward in the Ohio and Wabash valleys.

Celtis occidentalis var. *crassifolia* (Lam.) Gray. About as common as the last, and in similar situations. Most abundant north of the Ozark Ridge.

Celtis laevigata Willd. Abundant in low woods, especially in the Cairo Formation; rare or absent from the Ozark Ridge region.

Celtis pumila var. *georgiana* (Small) Sarg. A shrub or rarely a small tree along rocky banks and bluffs in the Ozark Ridge region. Seen in Johnson, Pope and Hardin Counties, and doubtless occurring throughout the rocky uplands.

Celtis pumila var. *Deamii* Sarg. Of similar habit, and found in like situations as the last.

Morus rubra L. Found sparingly throughout the region; most common in the upper alluvial lands of the Cairo Formation. Much sought for post timber on account of its durability.

Magnolia acuminata L. Rather frequent in the Mounds Formation on hillsides and in ravines. It is also found in canyons and at the base of high bluffs in the Ozark Ridge Formation, where it is comparatively rare. Seen in Alexander, Pulaski, Union and Johnson Counties.

Liriodendron Tulipifera L. A beautiful and abundant forest tree in the Mounds Formation, and found less frequently on hillsides and along bluffs in the Ozark Ridge region. One of the most valuable trees for lumber for which reason most of the larger trees have been cut down, but it is likely to remain a conspicuous feature of the flora in the sections where it grows as long as any part of the forest remains.

Asimina triloba Dunal. A small tree, rarely more than three or four metres tall, in southern Illinois. Commonest in the fertile higher bottoms of the Cairo Formation, but also rather frequent in the Mounds Formation and along rich hillsides in the Ozark region.

Aristolochia tomentosa Sims. Seen only along high banks of the Little Wabash River, near New Haven, north of the county line, in White County.

Brunnichia cirrhosa Gaertn. A typical plant of the Cairo Formation, where it grows along rich river banks and in open lowlands bordering swamps.

Clematis virginiana L. Abundant in open ground and on borders to swamps in the Cairo Formation. Not noted elsewhere, but likely of be found in suitable situations throughout the region.

Clematis Simsii Sweet. Rather frequent in rich open ground and along bluffs throughout the region.

Clematis crispa L. Seen only in rich open lands and wet bottoms of the Cairo Formation, to which it is probably limited, and nowhere very common.

Menispermum canadense L. Occasionally found throughout, on rich banks and along bluffs.

Cocculus carolinus (L.) DC. Growing in low rich woods and on open banks of streams, but not very common.

Calycocarpum Lyoni (Pursh) Nutt. Seen only in rich alluvial bottoms along lakes, near Shawneetown, Gallatin County.

Sassafras officinale Nees & Eberm. More or less common throughout in woods and thickets. Most abundant and of the largest size in the Mounds Formation, where it sometimes becomes a tree 8 or 10 metres tall.

Benzoin aestivale (L.) Nees. Often common in the upper rich bottoms of the Cairo Formation, and almost equally abundant in the Mounds Formation; also sometimes found along streams and on rich hillsides in the Ozark region and northward.

Philadelphus verrucosus Schrad. This was found growing along the rocky talus below high bluffs of the Ohio River, near Goleconda, Pope County.¹

¹ See also p. 153.

Hydrangea arborescens L. A common shrub on steep banks and hillsides in the Mounds Formation, and also along shaded rocky bluffs in the Ozark Ridge Formation. Not seen in the Cairo region.

Hydrangea cinerea Small. Apparently less common than the last, and noted only along rocky bluffs in Pope and Hardin Counties.

Itea virginica L. Strictly local in the deep swamps of the Cairo Formation, where it often grows on rotting logs.

Ribes gracile Michx. Seen only along rich rocky hillsides in the Pine Hills of Union County, where it is not abundant.

Liquidambar styraciflua L. A common forest tree, except in the Ozark region, where it is comparatively scarce and confined to the vicinity of streams and bluffs. In the Cairo Formation it often grows in deep swamps with Tupelo and Cypress, but is more abundant in the rich alluvial bottoms. It also forms an important part of the forest in the Mounds Formation, where it attains a very large size.

Platanus occidentalis L. Rather frequent on banks of streams throughout the region, except in the Cairo Formation, where it is rarely seen.

Malus coronaria (L.) Mill. Frequently found throughout in thickets and open woods of bottoms and hillsides. Some very large specimens were seen on slopes of the "Wild Cat Hills," near Equality, Gallatin County. While no measurements were taken, the largest specimens were estimated at 10 or 12 metres tall, and more than 3 decimetres in diameter of trunk.

Malus ioensis (Wood) Britt. Often found in similar situations as the last; and occurring throughout the region. Rare in the Cairo Formation, and most common northward.

Malus lancifolia Rehd. Medium-sized trees found in low woods near Shawneetown, Gallatin County, and Elizabethtown, Hardin County, appear to belong to this species.

Malus angustifolia Michx. This southern Crab Apple is found in open upland woods and on rocky slopes and river banks in Johnson and Pope Counties. In the dryer situations it is a shrub or small tree, rarely more than 2 or 3 metres tall; in richer soil below the rocky bluffs of the Ohio River near Golconda, arborescent specimens 6 or 8 metres tall were found. The bark of these trees is dark, comparatively smooth, and not shaggy as in the preceding species; and the small ovate pointed leaves are very characteristic. This plant, like a few others, such as *Crataegus phaenopyrum* and *Robinia Pseudoacacia*, seems to have entered the region from the southeast, having by some means crossed the barrier of the broad valley of the Ohio River from the southern Appalachian foothills.

Amelanchier canadensis (L.) Medic. Frequently found along rocky bluffs in the Ozark Ridge region, and more rarely on hillsides in the Mounds Formation.

Rubus occidentalis L. The wild Raspberry is most abundant in the Mounds Formation, and is occasionally found along rich bluffs and hillsides in the Ozark Ridge region.

Rubus alleghaniensis Porter. This appears to be the common high Blackberry of southern Illinois, and is rather common in open ground throughout.

Rubus canadensis L. Found in the Ozark Ridge and Mounds Formations, generally on open rocky hillsides or in well-drained open ground.

Rubus villosus Ait. What appears to be this species is found occasionally in open ground north of the Cairo region.

Rubus rubrisetus Rydb. Often abundant in low open woods and swamps in the Cairo region, to which it seems mainly confined.

A *Rubus* perhaps representing another species is frequent in deep swamps of the Cairo Formation, often growing upon rotten logs with *Itea virginica*, *Rosa palustris* and a few other typical swamp plants. (Number 14949, Olive Branch, represents this form.) In low open ground near Cairo another *Rubus* was seen, which appeared to be distinct from any of those mentioned above. This is a low, mainly prostrate plant, with greenish, angular, rigid canes, and short stout prickles. As it was neither in flower nor fruit when found no specimens were made.

Crataegus crus-galli? L. Apparently this species is found as a small tree near the Ohio River, in Pope, Hardin and Gallatin Counties.

Crataegus Engelmannii Sarg. Common in thickets and open woods, on rocky hillsides and uplands in Pope and Hardin Counties.

Crataegus pratensis Sarg. Small trees doubtfully referred to this species were found in open rocky woods above the Ohio River, near Rosiclair, Hardin County.

Crataegus fecunda? Sarg. A small tree 5 or 6 metres tall, growing in open woods, in the Gold Hills, near Shawneetown, Gallatin County.

Crataegus punctata? Jacq. Trees, sometimes 8 or 9 metres tall, with slender clear trunks and small crowns of horizontal or wide-spreading branches; growing in rich upper bottoms of the Cairo Formation, and along small streams in the Ozark Ridge region.

Crataegus viridis L. This is one of the commonest species in the swamps and low wet woods of the Cairo Formation, and it is not infrequent in low bottom lands of streams throughout.

Crataegus pruinosa? (Wendl.) K. Koch. A small tree, or sometimes shrubby, on the limestone hills of Pope and Hardin Counties, and throughout the Ozark region and northward.

Crataegus mollis (T. & G.) Scheele. Abundant in low alluvial ground and in the upper bottoms of the Cairo Formation, and more or less frequent along streams throughout the region. Sometimes a large tree for the group.

Crataegus coccinioides Ashe. Frequent in open woods and glades throughout the Ozark region and northward.

Crataegus tomentosa? L. Slender trees up to 5 or 6 metres tall, in low open woods. Collected near Carbondale, Jackson County, and doubtless growing elsewhere in the Ozark Ridge region.

Crataegus phaenopyrum Med. Observed in swales and hollows of the Gold Hills, near Shawneetown, Gallatin County, and in open upland woods near Elizabethtown, Hardin County. — Besides the species of *Crataegus* listed above nineteen others were collected in the region, distributed as follows in the different groups: *Crus-galli* 7, *Punctatae* 2, *Virides* 3, *Pruinosae* 1, *Tomentosae* 4, *Molles* 1, and *Intricatae* 1. Doubtless several others occur, especially in the vicinity of the Ohio River, where thorns are very abundant on the limestone hills of Pope and Hardin Counties, and northward.

Prunus serotina Ehrh. More or less frequent throughout, except in the lowlands of the Cairo Formation. Most abundant in the Mounds Formation.

Prunus angustifolia Marsh. Growing in small thickets in various parts of the region, but nowhere common. Observed in Alexander, Johnson, Hardin and Gallatin Counties.

Prunus Munsoniana Wight & Hedrick. One of the commonest wild Plums, and found throughout in open ground and borders of woods.

Prunus hortulana Bailey. Found throughout the region along small streams and in open woods, but nowhere very common.

Prunus americana Marsh. Most abundant in the limestone areas of Pope and Hardin Counties, and frequently found throughout the Ozark region and northward.

Prunus lanata Wats. This Plum is uncommon in the Ozark Ridge and Mounds Formations. It was observed near Shawneetown, Gallatin County, in the Gold Hills, and also near Columbus, Kentucky, where it had the large, rugose leaves of *P. mexicana* Wats. that characterize that species in Gulf Coastal plain region.

Rosa setigera Michx. This form, with glabrous foliage, is much less common than the last, but is occasionally found in low woods and thickets, especially in the southern part of the region.

Rosa setigera var. *tomentosa* Torr. & Gr. Rather common throughout in thickets and open ground, especially in the northern portions. This is the common trailing or climbing Rose of the Mississippi Valley.

Rosa palustris Marsh. Common in swamps of the Cairo Formation, where it often grows on rotting logs. It is also very abundant in swales of flat, poorly drained prairies in Richland County.

Rosa dasistema Raf. Growing with the last in swamps of the Cairo region.

Rosa carolina L. The common low growing Rose, and found throughout except in the lowlands of the Cairo area. This is *Rosa humilis* Marsh.

Rosa rudiuscula Greene. What appears to be this species is occasionally found in open rocky ground in the Ozark Ridge and northward, but it is nowhere very common.

Rosa rubiginosa L. is an occasional escape near towns and dwellings, and is well established and abundant in a section of the Gold Hills, near Shawneetown, Gallatin County.

Gymnocladus dioica (L.) Koch. Found occasionally throughout the region. In the Cairo Formation it occurs rarely on well-drained river banks and in the upper alluvial bottoms; in the Ozark Ridge Formation it is sometimes found along rocky bluffs, but is not common. Most abundant on steep hillsides of the Mounds Formation.

Gleditsia triacanthos L. Rather frequent in moist ground and low woods throughout the region.

Gleditsia aquatica Marsh. Locally abundant in swamps of the Cairo Formation, extending northward in swamps along the Ohio and Wabash Rivers. Near Cairo a form was found having two seeds in each pod. Noted in Alexander, Pulaski and Gallatin Counties, and reported as far north as White County.

Cercis canadensis L. More or less abundant throughout the region. Commonest and of the largest size in the Mounds Formation.

Robinia Pseudoacacia L. Apparently native along the Ohio River, north of the Ozark Ridge, and in the Shawneetown Hills of Gallatin County. Adventive elsewhere, and often common in the Cairo region, along levees and banks of streams.

Amorpha fruticosa L. Common in low and swampy ground throughout the region.

Wistaria macrostachya Nutt. Seen only in the Cairo region, where it grows sparingly in rich open woods and along borders of swamps and streams; but reported from Richland and Wabash Counties by Dr. Ridgeway.

Zanthoxylum americanum Mill. Uncommon in thickets and open hillsides in the Ozark Ridge region and northward.

Ptelea trifoliata L. Seen only along rocky banks of the Ohio River, near Golconda, Pope County.

Rhus glabra L. More or less common throughout, in thickets and open ground.

Rhus copallina L. In similar situations to the last and about as common.

Rhus Toxicodendron L. Rather common in woods and along rocky banks and bluffs in all parts of the region.

Rhus canadensis Marsh. Seen only in the Ozark Ridge region, where it is comparatively rare. Noted in Union and Johnson Counties.

Ilex decidua Walt. In low woods and swamps of the Cairo Formation, where it is rather common and of large size. It also occurs less commonly along streams in the Mounds and Ozark Ridge Formations and northward.

Ilex verticillata (L.) Gray. Apparently rare along rocky streams in the Ozark Ridge. Seen only at two stations in Johnson County.

Eronymus atropurpureus Jacq. Occasionally found in rich woods and along banks and bluffs in all parts of the region.

Eronymus obovatus Nutt. Rather rare, in rich woods bordering swamps in the Cairo and Mounds Formations and north of the Ozark Ridge.

Staphylea trifolia L. Abundant locally on banks in the Mounds Formation and also along moist rocky bluffs in the Ozark region.

Acer saccharum L. In forests of the Mounds Formation this species is in places one of the commonest and largest trees; and in the Ozark Ridge it occurs frequently along rocky bluffs and in rich, well-drained soil along small streams.

Acer saccharum var. *Rugeli* (Pax) Rehd. Occasionally found with the species in the Mounds Formation and northward.

Acer saccharum var. *Schneckii* Rehd. This variety is often the commonest Sugar Maple in the Mounds Formation; and it is also less abundantly in the higher bottoms of the Cairo Formation and in alluvial ground in the Ozark Ridge. It appears to be restricted to the central Mississippi Valley, ranging through western Tennessee and Kentucky, where it is comparatively rare, and through southern Illinois, southeastern Missouri and northeastern Arkansas, reaching its greatest development in southern Illinois.

Acer nigrum Michx. f. Noted only in Johnson County, in rich alluvial land along a small stream, where a number of large-sized trees were growing, associated with *A. saccharum* and its variety *Rugeli*.

Acer saccharinum L. Often abundant in low woods and on alluvial banks of streams. Commonest in the Cairo Formation.

Acer rubrum L. Occurs more or less commonly throughout the region. In the Cairo Formation trees of this species often attain a large size in the swamps and low woods; it is also frequent along streams in the Mounds Formation. In the Ozark Ridge a form sometimes is found growing on dry rocky bluffs and hillsides, of quite different habit and appearance. This form, which is common on the rocky bluffs and hillsides of the Ozark plateau in Missouri and Arkansas, is often shrubby, with pale mottled smooth bark and nearly glabrous foliage.

Acer rubrum var. *tridens* Wood. In the Ozark Ridge region and northward this is a rather common form, and in places even more abundant than the typical form of the species.

Acer rubrum var. *Drummondii* (H. & A.) Sarg. Common in swamps of the Cairo Formation, and extending up the Wabash Valley at least as far as Richland and Wabash Counties.

Acer Negundo L. Found throughout the region in low woods and along streams. Most abundant in the Cairo Formation.

Aesculus glabra Willd. Seen only in low rich bottoms of the upper Cache River, near Tunnel Hill and Vienna, Johnson County, where it becomes a tree with a maximum height of 10 or 12 metres.

Aesculus octandra Marsh. A few small shrubby specimens were found on a rocky hillside above the Ohio River, near Golconda, Pope County.

Rhamnus caroliniana Walt. Seen only along low rocky bluffs, in the Gold Hills, near Shawneetown, Gallatin County.

Ceanothus americanus L. Observed only in the Ozark Ridge region, in dry rocky open woods.

Tilia glabra Vent. Uncommon, but in places not rare in the Mounds Formation, where it grows on banks of streams and steep hillsides. In the Ozark Ridge it is rarely found along the bases of high rocky bluffs. Seen in Alexander, Union, Pulaski, Johnson, Pope, Hardin, Gallatin and White Counties.

Tilia heterophylla var. *Michauxii* (Nutt.) Sarg. Rather rare on hillsides and along streams in the Mounds Formation, and below high rocky bluffs in the Ozark Ridge region. Observed in Pulaski, Pope and Hardin Counties.

Tilia floridana Small. One tree referred to this species was found growing on a hillside above the Wabash River, near Grayville, White County. It was also collected on low hills bordering the Ohio River, near Wickliffe, Kentucky, across from Cairo; and it may be looked for elsewhere in the Mounds Formation.

Ascyrum hypericoides L. Found only in dry rocky woods in the Ozark region.

Hypericum prolificum L. Locally common along the rocky beds and banks of streams in the Ozark Ridge and northward.

Parthenocissus quinquefolia (L.) Planch. Observed only along rocky bluffs and stream banks in the Ozark Ridge region.

Parthenocissus quinquefolia var. *hirsuta* (Donn) Planch. Much more abundant and widely distributed than the last. Found more or less commonly throughout, in woods and along rocky bluffs.

Ampelopsis cordata Michx. Found occasionally throughout the region, in low alluvial ground and on open banks of streams; nowhere very abundant.

Vitis aestivalis Michx. Frequent in dry open rocky woods in the Ozark Ridge and northward.

Vitis cinerea Engelm. Common in open ground and on alluvial banks of streams throughout the region.

Vitis cordifolia Michx. A common grape in woods and open ground throughout the region.

Vitis vulpina L. Locally common on low alluvial banks of streams in the Cairo Formation.

Vitis palmata Vahl. A typical species of the Cairo Formation, where it grows in swamps and along low margins of streams and lakes.

Aralia spinosa L. A typical species of the Mounds Formation, growing in openings in the woods and along rich banks. It is very abundant in the low hills about Shawneetown, Gallatin County.

Cornus florida L. Found more or less commonly throughout the region; most abundant in dry rocky open woods of the Ozark Ridge Formation.

Cornus rugosa Lam. Locally common along rocky bluffs of the Ohio River and in adjacent rocky woods, in Pope and Hardin Counties.

Cornus amomum Mill. Uncommon along small streams and in low open ground throughout the region.

Cornus asperifolia Michx. Found more or less abundantly in all parts of the region. Perhaps commonest in open woods of the Mounds Formation.

Cornus stricta Lam. A common species in swamps and low wet woods of the Cairo Formation; and also very abundant along small sluggish streams, on poorly drained prairies in Richland County.

Cornus racemosa Lam. Growing with the last in swamps and low woods of the Cairo Formation, but less common.

Nyssa sylvatica Marsh. A rather common forest tree throughout. In the Cairo Formation it grows in the low wet bottoms and sometimes in swamps, as well as in the better drained lands. It is commonest and of the largest size in the Mounds Formation, and is also found in the more fertile lands of the Ozark region.

Nyssa aquatica L. This is one of the typical trees of the Cairo Formation, and is found only in the deeper permanent swamps, where it is often associated with the Cypress; however, it does not extend so far north as the latter, not being found north of the Ozark Ridge in Illinois. It was observed in Alexander, Pulaski, Massac, Johnson and Pope Counties.

Vaccinium arboreum Marsh. Found only in the Ozark Ridge region, where it grows along the edges of bluffs or in dry rocky woods. Seen in Union, Johnson, Pope and Hardin Counties.

Vaccinium arboreum var. *glaucescens* Sarg. Growing with the preceding species along the margins of rocky bluffs in Johnson and Pope Counties, but less abundant than the last.

Vaccinium virgatum var. *tenellum* (Ait.) Gray. Restricted to a few localities in the Ozark Ridge region. Observed only in Union and Johnson Counties, but reported by country people in Hardin County, where it probably grows.

Rhododendron roseum Rehd. Seen only in the Pine Hills locality of Union County, where it grows abundantly along rocky bluffs and steep cherty hillsides.

Trachelospermum difforme (Walt.) Gray. A typical plant of the Cairo Formation, where it grows sparingly on open river banks and margins of swamps.

Bumelia lycioides (L.) Pers. Grows sparingly on knolls in low woods of the Cairo Formation, and along rocky bluffs and hillsides in the limestone section of the eastern Ozark Ridge. Seen in Pulaski, Pope and Hardin Counties.

Diospyros virginiana L. More or less abundant throughout the region, usually growing on open uplands or margins of woods.

Styrax americana Lam. Strictly local in deep swamps of the Cairo Formation. Observed in Alexander, Pulaski, Massac and Johnson Counties.

Fraxinus americana L. Found throughout the region; usually growing in upland forests, but sometimes in low ground.

Fraxinus profunda Bush. A common and characteristic tree in the swamps of the Cairo Formation, and extending up the Wabash Valley at least as far north as Richland and Wabash Counties.

Fraxinus biltmoreana Beadle. Grows along bluffs and steep hillsides in the Mounds and Ozark Ridge Formations; nowhere common.

Fraxinus pennsylvanica Marsh. Not uncommon throughout the region, in low woods and along streams.

Fraxinus pennsylvanica var. *lanceolata* (Borkh.) Sarg. Rather common throughout the region in low and swampy woods and on borders of streams.

Forestiera acuminata Poir. Often abundant in swamps and low woods of the Cairo Formation, and extending north into the Wabash Valley.

Catalpa speciosa Warder. Formerly rather abundant in the Ohio and Wabash valleys. Much sought for post timber, and becoming scarce. Noted in White and Richland Counties.

Bignonia radicans L. Occasional on open banks and along railway grades in all parts of the region.

Anisostichus capreolata (L.) Bur. Found only in the lowlands of the Cairo Formation, where it grows sparingly in woods and along open banks of streams.

Cephalanthus occidentalis L. In swamps and along margins of lakes and streams throughout the region. Most common in the deep swamps of the Cairo Formation, where it is often the commonest shrub.

Symphoricarpos orbiculatus Moench. Found in all parts of the region, but nowhere very common.

Viburnum dentatum L. Scarcely enters the region covered by this report, but a few specimens were seen in Richland County, where it had previously been collected by Dr. Ridgway.

Viburnum prunifolium L. Occasionally found along small streams in the Ozark Ridge region and northward in the Wabash valley.

Viburnum rufidulum Raf. Found in open woods on the higher bottoms of the Cairo Formation and on uplands of the Mounds Formation. Very abundant in rich wooded bottoms of the Mississippi River, near East Cape Girardeau, Alexander County. Not seen in the Ozark Ridge region, but reappearing in the low hills near Shawneetown, Gallatin County.

Sambucus canadensis L. Often abundant in low woods and open ground throughout the region.

Phoradendron flavescens (Pursh) Nutt. Confined to the lowlands of the Cairo Formation and low bottoms along the larger streams northward. *Ulmus alata* and *U. americana* are nearly always the host plants upon which it grows here, but in a few cases it was seen on *Gleditsia triacanthos* and *Nyssa sylvatica*.

In addition to the species listed above a few other adventive or escaped woody plants were seen growing in different parts of the region. Amongst these were *Paulownia tomentosa* (Thunb.) Steud., abundant

along rocky bluffs of the Ohio River, near Golconda, Pope County; *Ailanthus altissima* (Mill.) Swingle, not uncommonly associated with the last; *Rosa gallica* L., along open banks in White County; and in the Ozark Ridge region seedlings of the domestic Apple are frequent, and escapes of the Pear and Cherry were noted.

WEBB CITY, MISSOURI, December, 1920.

PHILADELPHUS VERRUCOSUS SCHRADER SPONTANEOUS IN ILLINOIS

ALFRED REHDER

IN June, 1919, Mr. E. J. Palmer collected a *Philadelphus* on the rocky bluffs of the Ohio River near Golconda, Illinois. When I saw these specimens I was at first inclined to think that they represent an escaped garden plant, as they did not agree with any of the now recognized native species. After Mr. Palmer had collected additional material in October, 1920, I examined the specimens again more closely and came to the conclusion that they are identical with *Philadelphus verrucosus* Schrader described in 1828 and credited to North America. I am unable to find any difference between the material from Illinois and the descriptions of Schrader and of subsequent authors and the plant now in cultivation as *P. verrucosus* Schrad. (*P. pubescens* Koehne, not Loisel.). Schrader's original description was based apparently on cultivated specimens, for in *Reliquiae Schraderianae* (*Linnaea*, xii. 393) "*Ph. grandiflorus* Loddig. Cat. non Willd." is given as synonym. This together with the fact that no spontaneous specimens were known have led many botanists to assume that *P. verrucosus* is a garden form or possibly a hybrid between *P. pubescens* Loisel. and *P. coronarius* L. or a related species, though Koehne always maintained that it was a native American species. The question became still more complicated by the identification of *P. verrucosus* with *P. pubescens* of Loiseleur, which seems to have been first made by Koehne. Schrader himself quotes *P. pubescens* Loiseleur (*Herb. Gén. Amat.* iv. t. 268 [1820]) as a synonym of his *P. latifolius*, but Koehne chiefly on the strength of the brown color of the one-year-old branchlets as shown in the colored plate considers it identical with Schrader's *P. verrucosus* which being the later name is made by him a synonym of *P. pubescens*. In its general appearance, however, the plant figured by Loiseleur, with its large flowers of a creamy white color and its very large leaves looks much more like *P. latifolius* and as Loiseleur himself describes the branches as "grisâtres" I consider the brown color of the branchlets a mistake of the artist who painted the plate; this view is strengthened by the fact that in the re-issue of this plate by Drapiez (*Herb. Amat. Fleurs*, vii. t. 501 (1834)) the one-year-old branch is painted dark gray and the young branchlet brown, as it often is the case in *P. latifolius*.

This points to the possibility that differently colored plates of the original issue exist and that Drapiez's plant was copied from one which had gray branches. I therefore consider *P. pubescens* Loisel. the oldest name for *P. latifolius* Schrad., particularly as the identity of these names is acknowledged by Schrader himself, and keep *P. verrucosus* as the name for the plant described below.

Since all the descriptions published so far are based on cultivated plants and are comparatively short, I give below a full description of this species based on Mr. Palmer's specimens:

Philadelphus verrucosus Schrader apud De Candolle, Prodr. III. 205 (1828), excl. synonym.; in Linnaea, XII. 392 (1838), excl. var. β . — K. Koch, Dendr. I. 342 (1869), pro synonym. — Rehder in Bailey, Cycl. Am. Hort. III. 1299 (1901). — A. H. Moore in Bailey, Stand. Cycl. Hort. v. 2581 (1916). — *Philadelphus grandiflorus* γ *floribunda* Torrey & Gray, Fl. N. Am. I. 595 (1840), quoad synonym. *P. verrucosus*. — *P. latifolius* b. *pubescens* Dippel, Handb. Laubholz. III. 339 (1893) pro parte. — *P. latifolius* a. *verrucosus* Dippel, l. c. 340 (1893), quoad synonym. — *Philadelphus pubescens* Koehne, Deutsch. Dendr. 181 (1893; in Gartenfl. XLV. 542 (1896), not Loiseleur. — Schneider, Ill. Handb. Laubholz. I. 369, fig. 235 f-m, 236 l-m, 237 i-l (1904). — Rydberg in N. Am. Fl. XXII. 174 (1905).

Upright shrub to 3 m. tall, with upright or somewhat recurved branches; young branchlets glabrous or sometimes very sparingly pilose, yellowish or reddish yellow at first, becoming red-brown at the end of the season, red-brown or grayish brown with close bark the second year, the bark tardily exfoliating the third year. Winter-buds minute, enclosed in the base of the petiole. Leaves of the flowering branchlets elliptic-ovate or elliptic to ovate-lanceolate, acute or acuminate, broadly cuneate or sometimes nearly rounded at the base, 4-7 cm. long, sparingly denticulate to entire or nearly so, bright green and glabrous above, lighter green and strigose pubescent beneath on the whole under surface or rather densely villose-strigose, the leaves of the shoots ovate or elliptic-ovate, 5-11 cm. long and 3-7 cm. broad, rounded at base, with 5-7 coarse triangular teeth on each side, 3-nerved, with the pair of prominent veins some distance above the base; petioles 2-5 mm. long, on the leaves of the shoots up to 7 mm. long, slightly hairy or nearly glabrous. Flowers white, about 2.5-3 cm. across, in 5-7-flowered racemes on short lateral shoots with usually two pairs of leaves below the racemes and the lowest or the two lower pairs of flowers in the axils of foliage leaves; internodes of the raceme 1-2.5 cm.; pedicels 3-5 mm. long, strigose-pubescent; calyx-lobes ovate-oblong, short-acuminate, 6-7 mm. long, inside villose near margin and apex, rather densely strigose-pubescent outside like the turbinate calyx-tube; petals oval, about 1.2 cm. long and 7-8 mm. wide; stamens 40-45, unequal, the longest about one-third shorter than the petals; anthers ovate, 1.5 mm. long, cordate at base, pointed at apex; style glabrous, about as long as stamens, divided at the apex $\frac{1}{4}$ or $\frac{1}{3}$ of its length; stigmas narrower than the anthers; ovary partly superior.

Capsule about 1 cm. long, with the margin of the calyx-tube somewhat above the middle.

ILLINOIS. Pope County: rocky bluffs of the Ohio River, near Golconda, June 7, 1919, *E. J. Palmer* (No. 1538); same locality, high rocky (sandstone and limestone) bluffs, October 28, 1920, *E. J. Palmer* (No. 19581).¹

CULTIVATED SPECIMENS. Bot. Gard. Berlin, July 2, 1887, and May 6, 1888, July 4 and August 20, 1892, *E. Koehne* (Nos. 3509, 3512, 9580, 9934). Bot. Gard. Goettingen, July 1 and 4, 1890, July 11, 1892, and September 28, 1893, *A. Rehder*. Goepferthain near Breslau, June 19 and August 21, 1905, June 11 and July 8, 1907, *C. Baenitz* (Herb. Dendrol.). Bot. Gard. Cambridge, Mass., June 25, 1898, *A. Rehder*.

The species appears to be most closely related to *P. pubescens* Loisel. (*P. latifolius* Schrad.) which differs chiefly in the gray color of its one-year-old branches and in the larger flowers and larger leaves. The description by Schrader of the pedicels, calyx and of the midrib and veins on the under side of the leaves as covered with "verruccis piligeris" is apparently exaggerated as far as it concerns the little warts, for K. Koch (*Dendr.* i. 342) says that he did not see such warts on Schrader's original specimens; neither are they mentioned by Koehne, who also had seen Schrader's types. Sometimes one finds, on some specimens more, on some less, particularly on the midrib of the leaves and on the petioles minute excrescences of the epidermis at the base of the hairs, but they are not at all prominent; the wartlets of the branchlets mentioned by Schrader (*Linnaea*, xii. 393) may be seen sparingly on a shoot of Palmer's No. 19581. *Philadelphus verrucosus* is probably not restricted to this one locality and will be found in Kentucky and possibly in Tennessee. It is apparently of rare and local occurrence like some other species of the genus, as for instance *P. laxus* Schrad., the habitat of which was considered uncertain for a long time, but which is, as I have pointed out recently,¹ a native of Tennessee and Georgia.

I may add here that the combination *P. verrucosus* var. *nivalis* I made on p. 199 of vol. I of this Journal, on the assumption that *P. verrucosus*

¹ In a recent letter Mr. Palmer states: "With reference to the *Philadelphus* from Southern Illinois, it had every appearance of being a native shrub long established in the place where I found it, although it is, of course, impossible to say just how these isolated things originated or that the seed may not have been transported in this case long ago by wind or animal agency from cultivated stock. However, there is nothing to suggest this in the surroundings or appearance of this *Philadelphus*. It is growing along the slope and rocky talus of a very high bluff, with east or northeast exposure close to the Ohio River. It is three or four miles from the town of Golconda and some distance from any dwelling or settlement, and the immediate surroundings are so rocky that no garden or habitation would have been possible close by. Indeed before the railroad, which has lately been cut along the base of the bluff, was constructed it would have been almost inaccessible. I made a thorough exploration in October and found a number (perhaps not less than ten or a dozen) clumps of the shrub growing along the steep rocky slope below the main bluff and some thirty or forty feet above the river. The bluff consists of alternating beds of limestone and sandstone of the Mississippian Series, and is well wooded with a variety of trees and shrubs and tangled vines. The tallest specimens of the *Philadelphus* were, I judge, 2½ to 3 metres tall, with many canes and upright or somewhat recurved slender branches. In its surroundings and habit it looks as much at home, and as certainly a native shrub, as any I ever saw, and with all due caution I would not hesitate to class it as such."

¹ Vol. I. 198 (1920) of this Journal.

is of hybrid origin, should be referred as a synonym to *P. nivalis* Jacques, which I take to represent a hybrid between *P. pubescens* and *P. coronarius* and which then would be the valid binomial for this hybrid.

AZALEA OR LOISELEURIA

ALFRED REHDER

EVEN if Azalea in the sense of Desvaux and modern authors is not considered a distinct genus, the correct application of the generic name Azalea of Linnaeus is a question to be decided, if the name of a subgenus or section of Rhododendron is to be based upon it. It was therefore necessary for me, when preparing an account of the American species of Rhododendron with deciduous leaves, to arrive at a definite conclusion as to the species which should be considered the type of the genus Azalea. If we follow up the history of the genus we find no change of the Linnaean conception of 1753 of Azalea until 1796, when Salisbury recognized the close affinity of most of the Linnaean species of Azalea with Rhododendron, restricted the genus Azalea to *A. procumbens* and referred the other species as far as he had to deal with them, including Rhodora¹ to the genus Rhododendron, thus using the genus Rhododendron in the same conception as proposed later apparently independently by D. Don and accepted by Torrey, G. Don, Maximowicz and others. In 1813, however, Desvaux had made another attempt to split up the genus Azalea by removing *A. procumbens* and making it the type of his new genus Loiseleuria. In doing this he paid no attention to Linnaeus' original description of the genus (Gen., 53 (1737), ed. 5, 75 (1754)) which applies exactly to *A. procumbens* except the description of the capsule, which Linnaeus apparently had not seen, as he did not describe or figure it in his Flora Lapponica, where he gives a description and figure of *A. procumbens* and also of *A. lapponica*. He took the description of the capsule probably from the figure of Tournefort's Chamaerhododendron (Inst. t. 373), which is cited as a synonym of Azalea in the first edition of Genera plantarum, but omitted in the second and which reappears in the fifth edition as a synonym of Rhododendron. He apparently had found when working out the species for his Species plantarum that *Rhododendron ferrugineum* had 10 stamens and not 5, as seems to be the case in Tournefort's figure. As the genus originally was based on *A. procumbens* and *A. lapponica* which were at that time the only species Linnaeus was well acquainted with, it is clear that one of them must be the type of the genus, and as the generic description in Genera plantarum fits *A. procumbens*, but not *A. lapponica*, the former must be considered the type of Azalea. The fruit was first correctly described and figured with three cells by Gaertner in 1788, but the erroneous impression that the fruit was

¹ This genus had been united already five years before with Rhododendron by F. S. Gmelin in the thirteenth edition of the Systema naturae (II. pt. 1, 694).

5-celled prevailed long after Gaertner and even G. Don in 1834 described the capsule as 5-celled.

If the result arrived at by the method of types is not considered binding by those who follow the International Rules, as the Rules do not clearly formulate or recognize this method, the fact that Salisbury retained *Azalea* for *A. procumbens* would leave no choice for those who conceive the genus *Rhododendron* in the wider sense of Salisbury and Don, as it certainly could not be considered correct if Salisbury had dropped *Azalea* entirely and coined a new generic name for *A. procumbens*. On the other hand Desvaux's action must be considered correct by those followers of the International Rules who keep *Azalea* distinct from *Rhododendron*, as in dividing the genus he left the larger number of species with *Azalea* and gave a new name to the smaller group, which agrees with article 45 of the Rules. In this case the generic name for *A. procumbens* would vary with the limitation of the genus *Rhododendron*, which shows that the method of types is more conducive to stability in nomenclature than the purely artificial division according to numbers.¹

The following citation of literature and synonyms for *Azalea* L. sensu Salisbury and *Azalea* L. sensu Desvaux show that the former application of the name was accepted by most of the earlier authors; it was probably chiefly the influence of De Candolle which induced the acceptance of Desvaux's name.

***Azalea* L. sensu Salisbury**

Azalea Linnaeus, *Gen.* 35 (1737); *Spec.* 150 (1753), quoad spec. typicam No. 6; *Gen.* 75 (1754). — Gaertner, *Fruct. L.* 301, t. 63, fig. 1 (1788), quoad spec. depictam. — Salisbury, *Prodr.* 286 (1796). — D. Don in *Edinb. Phil. Jour.* vi. 48 (1822). — Torrey, *Fl. N. Y.* 232 (1824). — Reichenbach apud Moessler, *Handb. Gewächsk.* i. 308 (1827); *Fl. Germ. Exc.* i. 417 (1830). — Sweet, *Hort. Brit.* ed. 2, 344 (1830). — G. Don, *Gen. Syst.* iii. 850 (1834). — Koch, *Syn. Fl. Germ.* 477 (1837). — Endlicher, *Gen.* 758 (1839). — Wood, *Classb. Bot.* 374 (1845). — Lindley, *Veg. Kingdom*, 455 (1846).

Loiseleuria Desvaux in *Jour. Bot. Appl.* i. 35 (1813). — Roemer & Schultes, *Syst.* iv. 353 (1819). — De Candolle, *Prodr.* vii. 714 (1839). — Spach, *Hist. Vég.* ix. 444 (1840). — Bentham & Hooker, *Gen.* ii. 595 (1876). — Gray, *Syn. Fl. N. Am.* ii. pt. i, 44 (1878). — Drude in Engler & Prantl, *Nat. Pflanzenfam.* iv. 1, 39 (1889). — Robinson & Fernald, *Gray's New Man.* 632 (1908). — Small in *N. Am. Fl.* xxix. 40 (1914).

Chamaecistus S. F. Gray, *Nat. Arr. Pl.* ii. 401 (1821).² — Kuntze, *Rev. Gen.* ii. 388 (1891). — Britton & Brown, *Ill. Fl.* ii. 563 (1897); ed. 2, ii. 683 (1913); *Man.* 700 (1901).

¹ See also my remarks on p. 45 of vol. I.

² *Chamaecistus* Oeder, *Icon. Fl. Dan.* i. 4 and 9 (1761) can hardly be considered a properly published generic name, as the nomenclature of the earlier part of the work is preliminary; there is no generic description and only the different names for early plants are cited in chronological order—in this case *Chamaecistus* of Clusius happens to be the first name. The insertion therefore of *Loiseleuria* in the list of *Nomina conservanda* was unnecessary, but this cannot change the fact that it is now a *nomen conservandum*.

Azalea L. sensu Desvaux

Azalea Linnaeus, *Spec.* 150 (1753), quoad species 1-4. — Desvaux in *Jour. Bot. Appl.* i. 35 (1813). — Roemer & Schultes, *Syst.* iv. 374 (1819), spec. 12 et 13 exclud. — De Candolle, *Prodr.* vii. 715 (1839). — Gray, *Man.* 268 (1848). — K. Koch, *Dendr.* ii. 1, 171 (1872). — Britton and Brown, *Ill. Fl.* ii. 559 (1897). — Rehder in Bailey, *Cycl. Am. Hort.* i. 119 (1900). — Britton, *Man.* 698 (1901). — Small in *N. Am. Fl.* xxix. 41 (1914).

Tsutsusi Adanson, *Fam. Pl.* ii. 164 (1763).

Anthodendron Reichenbach in Moessler, *Handb. Gewächsk.* i. 244, 308 (1827); *Fl. Germ. Exc.* 416 (1831).

Though *Azalea* must be considered the oldest name for the genus as shown by the synonymy and the remarks above, the name *Loiseleuria* should be retained by those who follow the International Rules of Botanical Nomenclature, as it is one of the *Nomina conservanda*. If, however, a name is considered a *nomen conservandum* in regard to the *nomen rejiciendum* which in this case is *Chamaecistus* Oeder, one may maintain that *Loiseleuria* has preference only as far as it concerns *Chamaecistus* and that the introduction of an entirely new question of priority alters the case which should then be decided according to the law of priority and without regard to the list of *nomina conservanda*. This opinion is held by some botanists who are conscientious followers of the International Rules and for an exposé of the reasons for this viewpoint I refer to the remarks on the nomenclature of *Wikstroemia* Schrad. by S. F. Blake in the Contributions from the Gray Herbarium LIII. 36. It seems, however, to me that it is more advisable to consider the *nomina conservanda*, according to art. 20 of the Rules, names "which must be retained in all cases," or "en tous cas," as the original French text says, which seems to express it even more strongly, as does also the Latin title of the list which reads "*Indices nominum genericorum utique conservandorum.*"

By those who consider the genus corresponding to *Azalea* of Desvaux a distinct genus including *Rhodora*, the latter name would be the correct name of the whole genus, and *Tsutsusi* Adanson with *Azalea indica* as type, if *Rhodora* is excluded, or *Anthodendron* Reichenbach with *A. ponticum* as type if *Rhodora* as well as *Azalea indica* are excluded. Britton and Small cite *A. indica* as type species of *Azalea*, but according to Canon 15, b. and d. of the Philadelphia Code, the choice should be between *A. lapponica* and *A. procumbens* rather than a species which was unknown to Linnaeus except from literature.

The conclusion to be deduced from the preceding remarks may be summed up as follows:

Azalea Linnaeus is based chiefly on *A. procumbens* which must be considered the type of the genus.

According to the International Rules, *Loiseleuria* which also is based on *A. procumbens* is a *nomen conservandum* and therefore the name to

be adopted for *A. procumbens*; *Azalea* Linnaeus thus becomes a synonym of *Loiseleuria*.

According to the Philadelphia Code *Azalea* Linnaeus must be considered the valid name for the genus now generally called *Loiseleuria* and the name *Azalea* in the conception of Britton and Small must be replaced by *Tsutsusi* Adanson.

The subgeneric or sectional name *Azalea* of Planchon under the genus *Rhododendron* is based on species of *Azalea* L. sensu Desvaux, which I do not consider a valid name in this conception, and it is, moreover, antedated by G. Don's and Endlicher's sectional and subgeneric names *Pentanthera* and *Anthodendron*; therefore *Azalea* should not be used as a sectional or subgeneric name under *Rhododendron*.

THE "INDIAN AZALEAS" AT MAGNOLIA GARDENS

E. H. WILSON

THE Magnolia Gardens near Charleston, South Carolina, are among the remarkable gardens of the South and are specially famous for their Azaleas. On April 16th my colleague, Alfred Rehder, visited these gardens and made herbarium specimens of all the varieties then in flower. The collection is of great interest as it represents very completely the "Indian Azaleas" known to the gardens of the 40's and 50's of last century. From most modern gardens these varieties have been lost though nearly all are represented in that at Holm Lea, Brookline, Mass. Miss Marie C. Hastie, granddaughter of the founder of Magnolia Gardens, obligingly informs us that the first planting of Azaleas was made by her grandfather about 1850. The importation came by way of Philadelphia and included plants of *Azalea indica* sent for the special purpose of trying them in South Carolina. Later, plants were secured from the Bercksmanns' Nursery, Augusta, Georgia. Many of the original plants are still growing in Magnolia Gardens, and by successful layering quantities have been obtained and the collection largely increased. The older plants are now much crowded and the largest measure from 16 to 18 feet in height and from 14 to 16 feet through. The largest plants are *R. phoeniceum* G. Don and its forms which are richly represented. Apart from the typical species there is the form *semiduplex* Wils. with double flowers; also one with white flowers which I have not seen before. Other forms are *f. splendens* Wils. (*R. phoeniceum* var. *splendens* D. Don), *f. Smithii* Wils. (*R. pulchrum* Sweet), which were raised in England and introduced into America in 1835 and 1836 and var. *calycinum* Wils. (*A. indica calycina* Lindl.) with very large, rich magenta-colored flowers which was introduced from China into England by R. Fortune about 1850. Of the true *R. indicum* Sweet (*Azalea indica* L.) several color forms are growing at Magnolia including the famous *f. variegatum* DC. which was introduced into England from China in 1833 to Knight's Nursery and into Boston,

Mass., in 1838. For many years this was not only a favorite exhibition plant but was also the parent of many "Indian Azaleas" like "Iveryana" and "Gledstanesii." Van Houtte's *Azalea indica punctulata* and *A. indica punctulata variegata*, which are figured in *Flore des Serres* xvi. tt. 1618-1621 (1865) and are possible hybrids between *R. indicum* Sweet and *R. Simsii* Planchon, are still in the Magnolia Gardens. So, too, is "Azalea Decora" which is probably of the same parentage and has rich red-colored flowers. This Azalea was introduced into Boston, Mass., by Marshall P. Wilder in 1848, and its descendants are still in the Holm Lea collection. The well-known *Azalea indica alba* or *A. ledifolia* (*R. mucronatum* G. Don) and its colored form (var. *ripense* Wils.) are of course represented at Magnolia by many fine bushes. This Azalea was introduced into Boston some time before 1838 and is quite hardy in gardens along the Hudson River, New York, and on Long Island where some very fine specimens are known. The largest and oldest specimen I know of, however, is in the garden of Mr. Henry F. Dupont, Winterthur, Delaware; this is 6 ft. 9 inches tall and 12 ft. 2 inches through the crown and has been in possession of the Dupont family since between 1835 and 1840.

NOTES FROM AUSTRALASIA. No. I

E. H. WILSON

AUSTRALIA is a new world to one familiar only with the flora of the northern Hemisphere. Everything is different, all the species, excepting certain aliens and naturalized weeds, most of the genera and many of the families. The remarkable Grass-tree (*Kingia*) and the Blackboy (*Xanthorrhoea*) of western Australia, probably of an earlier flora than any other living trees, seem out of place in the absence of pachydermatous animals, and wandering among them one half expects to meet an elephant, hippopotamus or rhinoceros whilst the presence of the extinct gigantic Saurians of the Jurassic Age would be in full keeping with these strange and ancient types of vegetation. Thanks to facilities freely placed at the disposal of the Arnold Arboretum's Expedition by the Government of Western Australia and to the admirable arrangements made by the Conservator of Forests, Mr. C. E. Lane-Poole, I traversed some 2000 miles in the southern part of Western Australia. Alone I should have been completely lost among the extraordinarily varied and anomalous vegetation but the Conservator himself was my guide through all the important forest areas and through the sand plains and savannah regions I had the companionship of the Government Botanist, Mr. D. A. Herbert. Thanks to the invaluable aid of these two men I was able to familiarize myself with all the more important trees and many of the larger shrubs of the regions traversed, and to appreciate in a small degree the enormous wealth of species. Truly the southern part of the vast country designated Western Australia is a veritable botanical garden

crammed with an astonishing variety of plants bearing a wealth of curious flowers of intense and vivid colours. Herbs are comparatively few in number though large areas are covered with the Swan River Daisy (*Brachycome iberidifolia* Benth.), Pink and Yellow Everlastings, (*Helipterum roseum* Benth. and *Waitzia aurea* Steetz), blue Dampieras, Stylidium with flowers of every hue and tall growing Droseras of gigantic size when compared with their lowly relatives of the northern Hemisphere, whilst the curious Kangaroo-paws (*Anigozanthus* spp.) with orange, yellow, green and black flowers constantly call forth admiration. The shrubs and sub-shrubs when not in flower bear a strong resemblance to one another for most of them have narrow or spiny leaves, yet in blossom scarcely two companion bushes are alike. There are Grevilleas, Hakeas, Isopogons and others belonging to the family of Proteaceae, Callistemons, Beaufortias, Melaleucas, Boronias, all with gorgeous flowers, Acacias in great variety and innumerable others, but I must not omit Leschenaultia with flowers as blue as the heavens above. All the large trees are species of Eucalyptus and the smaller trees except a few peculiar to the coastal regions belong to the genera Casuarina, Agonis, Melaleuca, Banksia, Dryandra, Hakea, Callitris, Fusanus and Santalum — the last two are parasitic. Of climbing plants there are only three or four — Clematis, Kennedya and Hardenbergia being the chief — and all are slender vines. Most of the forests are open and park-like and except in the Karri forests of the southwest there is no thick or tall undergrowth, indeed, savannah-woodland well describes a large area of the forested land.

I did not visit the region north of Perth which is said to be unforested until the almost inaccessible northwest is reached, so what is here written has reference only to the country east and south of Fremantle. Proceeding from that seaport inland first comes a coastal area of sand-plain and low limestone hills on which and nestling on the banks of the Swan River Perth, the capital city, is situated. This coastal area abuts on the Darling fault, a low, well-defined range stretching from a point some 50 miles north of Perth some 200 miles southward and nowhere more than 800 ft. high. This range is of granite and gneiss and for the most part capped with ironstone laterite on which the Jarrah (*Eucalyptus marginata* Smith) luxuriates. The eastern flank of the Darling fault merges into an undulating plateau, granitic in character intercepted by belts of siliceous sands, which reaches its greatest elevation (1240 ft.) on the gold-fields of Kalgoorlie, some 375 miles east from Perth. East from Kalgoorlie for 167 miles this granitic plateau descends until it dips below a limestone plain, well-named the Nullarbor Plain, which stretches eastward for 450 miles and though more or less well-clothed with shrubs (chiefly Acacias and Saltbush) is absolutely devoid of trees. In the southwest corner of Western Australia the country is broken in character, with more streams and a heavier rainfall, and there grow the tallest and finest trees. From the coast to the western edge of the Nullarbor Plain trees are plentiful and form forests even where the rainfall does not aver-

age more than five to eight inches annually. Truly the Eucalypts are extraordinary in many ways. They have highly specialized flowers which in many species are very large and of brilliant colors, they furnish most valuable hardwoods and grow to a lofty size in regions where one would suppose no tree could possibly exist. Take the Salmon Gum (*E. salmonophloia* F. v. Muell.). On the Goldfields area where the rainfall varies from 5 to 10 inches this tree grows a hundred feet tall with a clean, polished trunk full ten feet in girth. With numerous other species of rather less size it is the dominant tree in rather open forests which cover many hundreds of square miles and furnishes timber, the second strongest in Australia, and invaluable for mining purposes. Indeed but for this tree and the Gimlet (*E. salubris* F. v. Muell) it is questionable if the goldfields of Western Australia, which have to date yielded upwards of four hundred million dollars worth of gold, could have been developed. Another anomalous thing about this tree is that, like all other Eucalypts of Western Australia, it is surface-rooting! A degree or two of frost is not unknown in the region where it grows and I am told that it is flourishing in parts of South Africa. I cannot help thinking that this tree would be a good subject to plant for forestry purposes in the hot, arid parts of Lower California, Texas, New Mexico and of Arizona. Of course the Salmon Gum like all other plant of this Hemisphere are useless in the Arnold Arboretum but they would be of immense value to California. We of the north know little about the Eucalytus and to us the Blue Gum (*E. globulus* Labill.) and one or two others do duty for the whole genus. We know that they are mighty trees which furnish valuable timber but I doubt if many of us realize the ornamental character and great beauty of the flowers of a number of the species. The scarlet-flowered *E. ficifolia* F. v. Muell., which is found wild only on a very limited area near the sea in the southwest of Western Australia, must rank among the most beautiful of trees. It is of small size, quick-growing, has large leaves and terminal masses of flowers from pale orange to crimson in color. The red-flowered *E. torquata* Luehm. is another small tree and this has axillary clusters of flowers which vary in color from white to scarlet. About *E. macrocarpa* Hook. I may add here that the flowers are often 7 inches across!

The wood of the Jarrah (*E. marginata* Smith) is well-known through its use as street-paving blocks and for railway ties. Useful as it is for these purposes it is altogether wrong that so valuable a wood should be so basely employed. The proper use of Jarrah-wood is for making furniture. The tallest and most beautiful of the Western Australian species is the Karri (*E. diversicolor* F. v. Muell.). Trees little short of 300 feet tall with a trunk clean of branches for fully 150 feet are common. Considering the height of this tree the trunk is comparatively slender, seldom exceeding 30 feet but it tapers very gradually. The bark is white and marbled and the trunks suggest columns of some mighty cathedral. Ranking second in height is the Red Tingle (*E. Jacksonii*), another handsome

tree confined to a limited area near the sea in the southwest and only rather recently recognized. The Tuart (*E. gomphocephala* D. C.) grows only on the coastal limestone and a number of others are more or less confined to special soils. A very good account of the Eucalypts of Western Australia is given by Lane-Poole in his "Statement prepared for the British Empire Forestry Conference" (1920).

Of the lesser trees of Western Australia the Peppermint (*Agonis flexuosa* Lindl.) grows to the largest size and in one district forms pure undergrowth in prime Tuart forest. The Peppermint has a dark, fibrous and fissured bark and slender willow-like branches with axillary white flowers. Another species (*A. juniperina* Schauer) furnishes valuable timber but is a smaller and less handsome tree. The Casuarinas, of which there are a number of species, are common trees of no great size found on the sand-plains and in the Eucalyptus-forests. In the swamps and along the sides of streams several species of *Melaleuca* grow and since they have a white thin bark which peels off readily are known as Paper-bark trees. Most striking are the *Banksias* with their terminal erect, cone-like inflorescence. The most common species are *Banksia grandis* Willd. and *B. littoralis* R. Br., both with yellow flowers, but more valuable is *B. verticillata* R. Br. with exquisitely figured wood. These *Banksias* ought to be cultivated in California. Common on the Wheat-belt is *Acacia acuminata* Benth., a small tree with a neat rounded or oval crown of slender branches and wood of exactly the odour of Raspberry Jam.

The Blackboys (*Xanthorrhoea Preissii* Endl. and *X. reflexa*) and the Grass-tree (*Kingia australis* R. Br.) are extraordinarily abundant on the coastal plains and in the open forests from Perth southward. The first-named have a solitary erect rod-like inflorescence sometimes six feet, whereas in the Grass-tree the inflorescence is a small, drumstick-like affair arranged several together in the form of a necklet. Very widely spread in Western Australia is the Sandal-wood (*Santalum cygnorum* Miq.). This is a small, rather ugly, parasitic tree with fragrant wood in great demand in China to burn as incense. There are many other trees worthy of note but I conclude with the mention of another parasite, *Nuytsia floribunda* R. Br., the so-called Christmas-tree of Western Australia. This remarkable tree belongs to the Loranthaceae and possesses a whole catalogue of peculiarities. It grows from 25 to 40 feet tall with a trunk from 5 to 8 feet in girth and an irregular crown of green branches and branchlets. The wood is very brittle and when not in flower it is an ugly tree. It is common on the sand-plains round Perth and elsewhere and toward the end of November and in December every branch terminates in a large panicle of rich orange-colored flowers. When I left Perth a week ago many of these trees were in full flower and wonderfully beautiful.

NOTES ON NORTH AMERICAN TREES. VIII¹

C. S. SARGENT

***Robinia Pseudoacacia* L. in Illinois and Indiana.**

Illinois is one of the states in which the Black Locust has usually been considered to have been naturalized and not indigenous. The elder Michaux, however, included it in the list of plants which he collected "au long du Mississippi" on October 9, 1795 (see *Journal of André Michaux*, 1787-96, p. 124). On the previous day Michaux had arrived "au Fort Cheroquis autrement nommé par les Américains Fort Massac." This was on the Ohio River in Massac County, Illinois, in what is now a State Park and the nearest point to Fort Massac on the Mississippi River is in what is now Alexander County, Illinois, a considerable distance to have been covered at that time in one day. In commenting on Michaux's discovery of the *Robinia* in southern Illinois Dr. Robert Ridgway, the distinguished ornithologist, who for many years has studied the trees of southern Illinois, writes, — "Now at the time of Michaux's visit it is impossible that any tree could have been established there through naturalization. There were no white inhabitants in the country except a few French (mostly hunters and traders) at Kaskaskia and at a very few other places, and these came from the north where *Robinia* does not grow. The Black Locust is common in the hilly district (Ozark Uplift) of the southern counties and I have no doubt it is indigenous there. In other parts of southern Illinois, however, it is unquestionably an introduced and naturalized species, having been planted by the early settlers from Kentucky, Ohio, etc., about their homes. Even now it is rarely if ever seen in the woods except in the Ozark region where it grows intermingled with other forest trees."

It is probable, too, that the Black Locust was indigenous in southwestern Indiana as it was included in the list of "vegetables growing indigenously near the Wabash, between Vincennes and Fort Harrison," seen by David Thomas in 1816 and printed on pp. 222-24 of his *Travels through the Western Country in the summer of 1816*.

Robinia neomexicana A. Gray. Gray based his description of this plant on a specimen collected in May, 1851, on "dry hills on the Membrès" by Dr. George Thurber. The leaflets are oblong-elliptic and acute, and are finely pubescent below. The petiole and rachis of the leaves are pubescent and partially covered with slender minutely glandular hairs which are more abundant on the calyx of the flower. The fruit has not been collected apparently at the type station, but a cluster of pods collected by H. H. Rusby in 1881 at Mangos Springs in the same locality shows that it is slightly stellate-pubescent and entirely destitute of the stout glandular-hispid hairs which have been ascribed to it and

¹ For part VII see p. 112.

which are found in the Colorado Robinia. A specimen collected by Miss Eastwood on May 11, 1919, at Fort Bayard in New Mexico near the type station, has the elliptic acute leaflets of the specimen collected by Dr. Thurber, but the short hairs which are mixed through the inflorescence are nearly destitute of glands. On a specimen of a vigorous shoot collected by A. Rehder (No. 446) in Fresnal Canyon, Sacramento Mountains, New Mexico, on August 26, 1916, the leaflets vary from broad-ovate to oval and are rounded, occasionally acute and distinctly apiculate at apex. In its pubescence this specimen is similar to that of another specimen (No. 389) collected by Rehder a few days earlier at Cloudcroft on the Sacramento Mountains which has the elliptic leaves of the type. Rehder's No. 446, which is probably only an abnormal vigorous shoot of *R. neomexicana*, agrees in the shape of the leaflets and in their pubescence with the description of *R. Rusbyi* Wootton & Standley (Contrib. U. S. Nat. Herb. xvi. 140 [1913]). Judging by the material I have seen, *R. neomexicana* is a rare and local plant confined to Grant and probably Socorro Counties in southwestern New Mexico; it appears to be always a shrub in habit.

The plant which has for many years been considered to be *Robinia neomexicana* A. Gray (see Sargent's Silva N. Am. iii. 43, t. xiv.) differs from the type in the shape of its leaflets which vary from oval with a rounded apex to oblong-ovate with an acute apex and occasionally to elliptic. It differs also in the stout glandular hairs which cover the inflorescence, the young branches and the fruit. Some of the specimens of this form look very distinct from the type of *R. neomexicana*, but specimens like the one collected in May, 1890, by M. E. Jones on the Pinal Mountains, Arizona, with oval leaflets rounded at apex and with the inflorescence and young branchlets nearly destitute of glandular hairs connect the extreme forms, and it does not seem possible to distinguish specifically the two Robinias of the southwestern United States. If this view is accepted the glandular plant becomes *Robinia neomexicana* var. *luxuriana* (Dieck in Gard. Chron. ser. 3, xii. 669 [1892]). This form, which is occasionally a tree from 20-25 feet in height, is widely distributed from the valley of the Cuchura River from Walsenburg to above La Veta, Huerfano County, and of the Purgatory River near Trinidad, Las Animas County, southern Colorado, through New Mexico to the mountain ranges of southern Arizona and northward to southwestern Utah (near Kanab, Kane County, and in Mt. Zion Cañon of the west fork of the Rio Virgen). Mr. D. M. Andrews informs me that it has escaped from cultivation and become naturalized near Colorado towns in the eastern foothill region as far north as Denver. This variety was introduced by the Arboretum into the gardens of the eastern United States and Europe in 1882 from Colorado, and is probably the only form which has been cultivated as *Robinia neomexicana*, the plant described by Gray is still unknown in gardens.

Byrsonima lucida De Candolle, Prodr. i. 530 (1824). — *Malpighia lucida* Miller, Dict. ed. 8, No. 9 (1768). — Swartz, Prodr. 74 (1788). — *Malpighia cuneata* Turczaninow in Bull. Soc. Nat. Mosc. xxxi. pt. i. 390 (1858). — *Byrsonima cuneata* P. Wilson in Bull. N. Y. Bot. Gard. viii. 394 (1917). — Britton & Millspaugh, Bahama Fl. 205 (1920).

The recent change in the name of this plant appears to be due to the fact that a curious error made by Miller had been overlooked. The technical description of his *Malpighia* (*lucida*) No. 9 clearly refers to our Florida plant, but in his notes on the different species Miller transposed his Nos. 8 and 9, describing under his "eighth sort" No. 9, *Malpighia lucida*, and under his "ninth sort," No. 8, *Malpighia illicifolia*. As the species is based on the technical description and not on the notes there seems to be no reason for changing *Byrsonima lucida* DC. to *Byrsonima cuneata* P. Wilson.

Cyrilla racemiflora var. *parvifolia*, n. var. — *Cyrilla parvifolia* Shuttl. apud Small in Bull. Torrey Bot. Club, xxiii. 101 (1896).

This shrub from the west Florida coast differs from *C. racemiflora* L. in its smaller size, smaller leaves and shorter racemes, and affords no morphological characters by which it can be distinguished specifically from that species. The fruit which has been described as globose is ovoid on the specimens which I have seen.

Acer glabrum f. *trisectum*, n. nom. — *Acer glabrum* var. *tripartitum* Pax in Engler Bot. Jahrb. vii. 218 (1886), not *Acer tripartitum* Nuttall in Torrey & Gray, Fl. N. Am. i. 247 (1838); and N. Am. Sylva, ii. 85 (1846).

This new name is suggested for the form of *Acer glabrum* Torrey with 3-parted or 3-foliolate leaves, as the name *tripartitum* which has been used for this form of *Acer glabrum* belongs to a little alpine species which Nuttall found in "the Rocky Mountain Range in about latitude 40 within the line of Upper California." This species differs from *Acer glabrum* in the small 3-lobed leaves which are not more than 2.5–3 cm. in diameter and which so far as I have seen them are never 3-foliolate, in the smaller flowers, fruit with the wing not more than 1 cm. long, and in the pale gray not red-brown young branchlets.

The specimens in this herbarium are from the Big Horn Mountains of Wyoming and from those of Utah and Nevada.

Acer nigrum var. *Palmeri*, nov. var.

Differing from the type in the 3-lobed leaves with broad long-acuminate nearly entire terminal lobes and in their rounded or slightly cordate base.

ILLINOIS. Johnson County, Tunnel Hill in a single grove, E. J. Palmer (No. 15177), May 17, 1919, (No. 16678 and No. 16679 type), October 4, 1919.

INDIANA. Lawrence County, C. C. Deam (No. 17299), July 13, 1915. Putnam County, C. C. Deam (No. 17574), July 18, 1915. Shelby County, C. C. Deam (No. 30258), September 27, 1919.

MISSOURI. Jackson County, Atherton, B. F. Bush (No. 1764), August, 1 1902. Clark County, Wayland, B. F. Bush (No. 625), August 21, 1911. Dunklin County, Campbell, C. S. Sargent, October 3, 1910.

Vaccinium arborescens var. *glaucescens*, n. var. — *Batodendron glaucescens* Greene in Pittonia, III. 326 (1898).

Differing from the type in its glaucescent leaves, in its usually larger leaf-like bracts of the inflorescence, and in its often globose-campanulate corolla.

The leaves are distinctly and constantly glaucescent, but on many plants with such leaves the inflorescence bracts are not larger than those on *V. arborescens* Marsh. and flowers with the open oblong corolla of *V. arborescens* occur. There is no difference in the habit, bark and buds of the two forms which often grow within a few feet of each other. The type of *Batodendron glaucescens* was collected by B. F. Bush on May 18, 1895, at Sapulpa, Creek County, Oklahoma (No. 1273). The leaves, petioles and young branchlets are pubescent, and the under side of the midrib of the leaves is covered with villose hairs; on other specimens with glaucescent leaves the pubescence is confined to the under side of the midrib of the leaves, and others are quite glabrous. I have seen specimens of the glaucescent leafed variety from:

ILLINOIS. Johnson County, Tunnel Hill, B. F. Bush (No. 6903), October 8, 1912; E. J. Palmer (No. 15191), May 7, 1919. Pope County, Golconda, E. J. Palmer (No. 15439), June 7, 1919.

KENTUCKY. Ohio County, Echols, E. J. Palmer (No. 17775), June 2, 1920. Logan County, Russelville, E. J. Palmer (No. 17761), June 5, 1920.

MISSOURI. Iron County, Ironton, E. J. Palmer (No. 18100), June 27, 1920. Dunklin County: Campbell, C. S. Sargent, October 3, 1910; Malden, B. F. Bush (No. 6392), October 8, 1910. Shannon County, Monteer, B. F. Bush (No. 3590), October 8, 1905. McDonald County, Noel, B. F. Bush (No. 5040), August 9, 1908, (No. 5739), May 26, 1908; E. J. Palmer (No. 5501), May 5, 1914.

ARKANSAS. Arkansas County, Arkansas Post, J. D. Kellogg, September 25, 1909. Hempstead County, Fulton, B. F. Bush (No. 215), May 12, 1900, (No. 2380), April 17, 1905, (No. 3799), November 6, 1905, (No. 5540), April 29, 1909, (No. 5664), May 20, 1909, (No. 5957), October 5, 1909; E. J. Palmer (No. 5843), October 15, 1915.

OKLAHOMA. Creek County, Sapulpa, B. F. Bush (No. 470), July 30, 1894 (No. 1273), May 18, 1895 (type).

LOUISIANA. Caddo Parish, Shreveport, R. S. Cocks, April 1, 1910.

TEXAS. Walker County, Huntsville, E. J. Palmer (No. 13372), April 18, 1918. Harrison County, Marshall, E. J. Palmer (No. 5294), April 18, 1914. Cherokee County, Larissa, B. F. Bush (No. 5545), April 30, 1909, (No. 5975), October 7, 1909. Milan County, Milan, E. J. Palmer (No. 11666), April 24, 1917.

Bumelia lanuginosa Pers.

The type of this species was collected in Georgia by Michaux. On all the specimens from Georgia which I have seen the pubescence on the lower surface of the leaves, especially on the midrib, on the flower-buds and their pedicels, is rusty brown, in fact all the specimens from the Atlantic and east Gulf states have this pubescence with the exception of one from North Carolina in young leaf on which the pubescence is white. It seems therefore safe to assume that the pubescence on the

typical *Bumelia lanuginosa* is rusty brown. In the coast region of eastern Texas and as far west as the region of San Antonio the lower surface of the leaves, the flower-buds, pedicels and young branchlets are covered with snow-white pubescence. This gives the tree such a different appearance from the common form that it can perhaps be well distinguished as

***Bumelia lanuginosa* var. *albicans*, n. var.**

Differing from the type in its snow-white pubescence.

NORTH CAROLINA. New Hanover County, Wilmington, *T. G. Harbison*, April, 1919.

TEXAS. Harris County, near Houston, *E. J. Palmer* (No. 11456), April 2, 1917. Fort Bend County, Richmond, *E. J. Palmer* (No. 4943), March 14, 1914. Brazos County: Bryan, *E. J. Palmer* (No. 11730), April 30, 1917; near Neleva, *E. J. Palmer* (No. 13446), April 24, 1918. Wharton County, Wharton, *E. J. Palmer*, March 10, 1914. Brazoria County, Columbia, *B. F. Bush* (Nos. 877, 909, 1427, 1524), 1900, 1901. *E. J. Palmer* (No. 5050), March 30, 1914; Velasco, *E. J. Palmer* (No. 13131), March 21, 1918; Brazoria, *E. J. Palmer* (No. 6741), October 6, 1911. Matagorda County, on Peyton's Creek, *E. J. Palmer* (No. 9734), May 12, 1916. Victoria County, bottoms, Guadalupe River, near Victoria, *C. S. Sargent* (type), April 9, 1915; *E. J. Palmer* (No. 9104), March 7, 1916. Lampasas County, Lampasas, *C. S. Sargent*, March 21, 1911. Travis County, near Austin, *C. S. Sargent*, March 29, 1885. Wilson County, Sutherland Springs, *B. Mackensen*, October, 1910; *C. S. Sargent*, April 8, 1915; *E. J. Palmer* (No. 9209), March 17, 1916; Bexar County: near San Antonio, *B. F. Bush* (No. 802), September 16, 1901. *B. Mackensen*, December, 1909; 25 miles south of San Antonio on road to Corpus Christi, *S. B. Buckley*.

MEXICO. Nuevo Leon, near Monterey, *C. S. Sargent*, April 6, 1887. more distinct is.

***Bumelia lanuginosa* var. *anomala*, n. var.**

Differing from the type in its more silky silvery white pubescence occasionally slightly tinged with brown on the lower surface of the leaves, oval to broad-elliptic on vigorous shoots, in the close scanty pubescence on the pale brown pedicels and calyx, and in its white glabrous branchlets. The fruit has not been collected.

FLORIDA. Hancock County, Gainesville, *T. G. Harbison* (No. 47, type), June 17, 1917, (No. 64), July 25, 1918. Alachua County, *T. G. Harbison* (No. 97), July 20, 1919. Orange County, Orlando, *T. G. Harbison* (No. 51), November 11, 1917.

A specimen collected by *T. G. Harbison* (No. 61) at Gainesville, July 25, 1918, with pale brown less silky pubescence on the lower surface of the leaves, slightly villose petioles, less pubescent calyx and pedicels than those of the type, and pale not white glabrous branchlets, seems intermediate between the type and the var. *anomala* which appears so distinct that were it not for this specimen it might be considered a new species. Nos. 47 and 64 from Gainesville and No. 51 from Orlando are described by Mr. Harbison as small trees.

***Diospyros virginiana* var. *platycarpa*, n. var.**

Differing from the type in its larger depressed globose yellow earlier ripening fruit, usually broad-ovate leaves rounded or cordate at base

and more or less densely pubescent below, especially on the midrib and petioles, and in the villose pubescence of the branchlets often persistent for two or three years.

The fruit of this variety, which is sometimes 4.5-7.5 cm. wide and 2.5 cm. high is distinct in its yellow skin and in the flesh which becomes succulent and edible without the action of frost. In what may be considered the type of the variety from Cotter, Dexter County, Arkansas (Palmer, No. 5968), the leaves are oblong-ovate, abruptly pointed and acuminate at apex, rounded or slightly cordate at base, covered above with short caducous white hairs, and villose-pubescent on the midrib and veins on the otherwise nearly glabrous lower surface, 7-10 cm. long and 5-6 cm. wide, those on vigorous shoots up to 15 cm. in length and 8 cm. in width; petioles stout, densely villose-pubescent, 1.5-2 cm. long; fruit depressed-globose, 4-7.5 cm. broad and 2.5 cm. high, with a yellow skin and sweet succulent flesh; seeds more conspicuously rounded on the dorsal side, much flattened, dark chestnut-brown, very lustrous, only slightly rugose, 1.5 cm. long and 1.2 cm. wide, branchlets densely pubescent when they first appear, becoming glabrate.

About this variety Mr. E. J. Palmer writes: "I have been much interested in the variations of the Persimmon in foliage and fruit, and extreme forms certainly look very distinct. The country people generally throughout the western Ozark region recognize two fruit forms and insist that they are very different from each other. While there is a wide variation in fruit as to size, shape and time of ripening throughout its range, the extreme form, with very large much flattened fruit, ripening from the middle of September to early October and with flesh very soft and succulent, seems to be commonest if not limited to the western slopes of the Ozarks and the adjacent prairie region in southwest Missouri, northwest Arkansas, southeast Kansas and northeast Oklahoma, at least I do not remember having seen it beyond this region. I have seen fruit of this fully three inches in transverse diameter and much flattened at both poles. The fruit is often so soft that in falling to the ground it is crushed or completely squashed when fully ripe. This large fruit is usually associated with large more or less pubescent leaves often cordate at base and turning bright yellow in early autumn. The largest fruit that I have ever seen was on a tree at Cotter, Arkansas, of which I think I sent you fruit in 1914. This was fully as large as some of the cultivated Japanese varieties. My observation on the large-fruited form is that it is usually a small tree seldom more than 4-8 m. tall and never attaining the size of trunk and height of the small-fruited variety. The fruit of the latter is seldom edible until after frost, and in some extreme forms scarcely becomes so at any time. While there is much variation and possibly a complete gradation between the two forms, the latter often has fruit of an oblong shape or longer than wide. The skin is tougher and the flesh more fibrous, and the fruit often candies on the tree, sometimes remaining on all winter."

From Missouri I have seen specimens with villose-pubescent branchlets and large leaves rounded or cordate or elliptic and cuneate at base, from Westport, Jackson County, and Hannibal, Marion County; it is a common form near Allenton, St. Louis County, and is abundant in the southern counties; in Arkansas it extends as far south as the valley of the Red River (Fulton, Hempstead County); it grows near Yazoo City, Yazoo County, and at Rockport, Copley County, Mississippi, and appears to be the prevailing form in western Louisiana, where it grows on hillsides and in deep swamps covered with water during several months of every year; and it has been noticed in swamps in the neighborhood of New Orleans. This form apparently does not extend into Texas. Specimens with villose-pubescent branchlets have been collected in Florida at Palatka, Haines City, and at Sebring by T. G. Harbison, and near Hastings by A. Rehder. I have only seen fully grown specimens of the large flat early ripening fruit from Allenton, Missouri, Cotter, Arkansas, and from a tree cultivated by Palmer at Webb City, Missouri, and am therefore unable to say if the trees with villose-pubescent branchlets and usually broad-ovate more or less pubescent leaves usually rounded or cordate at base habitually or usually produce fruit of this character, and further observations on the fruit of *Diospyros virginiana*, especially in the region west of the Mississippi River, are needed. With the exception of the specimens from Mississippi, New Orleans and Florida to which I have referred, a specimen of a young, vigorous, villose-pubescent branch with large leaves rounded at base and pubescent on the midrib below and on the petiole collected by C. E. Faxon at Virginia Beach, Virginia, and a specimen collected near New Haven, Connecticut, the northern station east of the Mississippi River which I have seen have glabrous branchlets and leaves, and fruit which is depressed-globose to obovoid-oblong, usually not more than 2.5-3 cm. in diameter and, except perhaps in the extreme south, hard and astringent until after the action of frost. The seeds of the eastern tree so far as I have been able to examine them are only slightly unsymmetric, light chestnut brown and conspicuously rugose. A black-fruited form of the var. *platycarpa* may be distinguished as

***Diospyros virginiana* var. *platycarpa*, f. *atra*, n. f.**

I have seen only the fruit of this tree, which was collected several years ago three miles southwest of Norman, Cleveland County, central Oklahoma, by Mr. Joseph Thornburn, of Oklahoma City. The fruit is rounded above, about 3.1 cm. broad and nearly 2.5 cm. high; the seeds in size, shape, dark color and lustre and in their only slightly rugose testa resemble those of the fruit of var. *platycarpa* from Cotter, Arkansas. Until more is known of this tree it seems best to consider it a form of that variety, although in shape the fruit is more like that of one of the common forms of *Diospyros virginiana*. Less distinct is

Diospyros virginiana var. *Mosieri*, n. var. — *Diospyros Mosieri* Small in Jour. N. Y. Bot. Gard. xxii. 33 (1921).

Differing from the type in the somewhat thicker dark chestnut brown lustrous and only slightly rugose seeds, smaller staminate flowers not more than 6 or 7 mm. in length, and smoother bark.

A tree or arborescent shrub up to 8 m. high, with a trunk 20–25 cm. in diameter, covered with light gray slightly fissured bark.

FLORIDA. Dade County, near the Humbugus Prairie, west of Little River, *A. Rehder* (No. 729), April 23, 1920; Arch Creek, *A. Rehder* (No. 733), April 24, 1920; on Long Key in the Everglades, *E. A. Bessey* (No. 60), May, 1908.

The seeds which have been chiefly used to distinguish the *Diospyros* of southern Florida, although rather smaller, in shape, color, lustre and in their slight reticulation, resemble the seeds of the var. *platycarpa* to which, by its seeds at least, it is closely related, although the fruit in size and shape and the glabrous branchlets belong with the typical *Diospyros* of the eastern states.

Halesia monticola, n. sp. — *Halesia carolina* var. *monticola* Rehder in Mitt. Deutsche Dendr. Ges. xxii. 260 (1913).

From *Halesia carolina* the Mountain *Halesia* differs in its larger flowers and fruit, in habit and bark. *Halesia carolina* is an arborescent shrub with spreading stems, or a small tree rarely more than 8 or 9 m. high, with a short trunk rarely more than 30 cm. in diameter covered with close bark separating on the surface into small closely appressed scales; it is an inhabitant of the foothills of the southern mountains and grows down nearly to sea-level. *Halesia monticola* does not grow below altitudes of about 1000 m. on the high Carolina mountains where it is an important timber tree 25–30 m. high, with a trunk often 1 m. in diameter and free of branches for 18 or 20 m. and covered with bark which separates freely into large loose plate-like scales. It reproduces itself from seed, and seedling plants grow habitually with a single stem; and although the leaves of the lowland and the mountain trees show little difference in shape, size and pubescence, it seems desirable to consider this a distinct species. The fact that the two trees were considered identical until a few years ago accounts for the fact that the mountain tree was not cultivated until the end of the last century, although the seeds of *Halesia carolina* were sent to England as early as 1756.

The credit of the introduction of *Halesia monticola* belongs to Mr. Harlan P. Kelsey, of Salem, Massachusetts, by whom it was sent about twenty-four years ago to the parks of Rochester, New York, whence it came to the Arboretum in 1907. In cultivation *H. monticola* proves to be a valuable ornamental tree; it is perfectly hardy, grows rapidly, and begins to flower when less than 4 m. tall, and is better suited for northern gardens than the other species of the genus.

Halesia monticola var. *vestita*, n. var.

Differing from the type in the pubescent under surface of the leaves sometimes rounded at base, in the somewhat wider mouth of the corolla and smaller fruit 2.5–4 cm. long.

The unfolding leaves are pubescent above and, like the young branchlets, thickly covered below with snow-white tomentum, and the mature leaves are glabrous on the upper surface and covered below with short soft pubescence, ovate to obovate or obovate-elliptic, abruptly pointed and acuminate at apex, and cuneate or rounded at base.

The first specimens of this variety came to the Arboretum from the parks at Rochester, New York, in 1917. Plants had been obtained at Rochester in 1915 as two-year-old seedlings from the nurseries of Thomas Meehan & Son, of Germantown, Pennsylvania. These plants are growing on a slope facing the northwest in Durand-Eastman Park fully exposed to the cold winter gales blowing across Lake Erie. The plants have proved perfectly hardy there and, like *H. monticola*, have grown up with a single trunk. A specimen of what appears to be this variety, judging by the shape and pubescence of the mature leaves and the size of the fruit, was collected on the bank of a stream west of Marion, McDowell County, North Carolina, by T. G. Harbison, August 16, 1918; and it is apparently this variety which grows in low sandy woods at Heber Springs, Carroll County, Arkansas, E. J. Palmer (No. 6978), October 31, 1914.

***Halesia monticola* var. *vestita* f. *rosea*, n. f.**

Differing from the type in the pink or pale rose-colored flowers.

Durand-Eastman Park, Rochester, New York, Dunbar and Horsey, No. 3, June 2, 1920. This is one of the Meehan seedlings.

***Halesia parviflora* Michx.**

In the *Silva* of North America this plant was considered a shrub and was not described or figured. More is now known about it and it should find a place among the trees of North America. The fruit was correctly described by Michaux and Chapman, but Gray in his *Synoptical Flora* described it as 2-winged. Gray's description of the fruit was made from specimens which had been grown in the Meehan Nurseries in Germantown, Pennsylvania. These are 4-winged, but in pressing them for the herbarium the alternate wings were brought so close together that the fruit appeared 2-winged. This mistake was copied by Small in his *Flora of the Southeastern States* and has increased the difficulty of obtaining information in regard to the habit and distribution of Michaux's plant. In the herbarium of the Arboretum there are photographs of Michaux's two specimens collected near Matanzas. After these the oldest specimen I have seen was collected by W. M. Canby in March, 1869, at Hibernia, Florida; in March, 1884, flowers were collected for John Donnell Smith from a tree on the border of a swamp of the St. John's River, half a mile north of Magnolia, Florida, and in March two years later he collected flowers from the same tree; in 1895 it was collected in fruit by G. V. Nash (No. 2373) at River Junction, Florida; and two years later in the same region by collectors of the Biltmore Herbarium (No. 520b). The other material which I have seen has been collected for the Arbore-

tum by T. G. Harbison from 1913-1920. A short description as of *H. parviflora* is appended.

Leaves oblong-ovate to slightly obovate or elliptic, abruptly long-pointed or acuminate at apex, narrow and cuneate or rounded at base, finely serrate with minute gland-tipped teeth, densely covered with hoary tomentum when they unfold, becoming glabrous or nearly glabrous, 7 or 8 cm. long and 2.5-3 cm. wide, and on vigorous leading shoots up to 16 cm. long and 6 cm. wide; petioles hoary tomentose when they first appear, becoming glabrous, 6-10 mm. in length. Flowers at the end of March or early in April, 8-12 mm. long, on pedicels more or less densely villose-pubescent with white hairs, becoming nearly glabrous, 8-10 mm. in length; calyx densely hoary-tomentose or rarely villose-pubescent; corolla 9-12 mm. in diameter. Fruit ripening in August and September, clavate, gradually narrowed into the long-stipitate base, 2-3.5 cm. long, 4-winged, the wings of equal width, or occasionally with the alternate wings narrower than the others.

A slender tree 8-10 mm. high, with a trunk 20-25 cm. in diameter, covered with dark brown nearly black thick bark divided by deep longitudinal furrows into narrow rounded rough ridges, small light brown slightly ridged branches and slender branchlets hoary-tomentose; when they first appear, becoming pubescent or nearly glabrous by the end of their first season; or a shrub sometimes only a few feet high.

FLORIDA. St. John's County, Matanzas, A. Michaux. Clay County: Hibernia, W. M. Canby, March, 1867; wood ravines head of Pellicaris Creek, Miller Lewis, June and September, 1884; John Donnell Smith, borders of swamp on St. John's River, half a mile north from Magnolia, March 2, 1886; Magnolia Springs, T. G. Harbison (No. 5), 1913, April 8, 1920. Gadsden County, near Chattahoochee, C. V. Nash (No. 2373), August 10 and 11, 1895; Biltmore Herb. (No. 520b), March 12, 1897; T. G. Harbison, March 26 and September 21, 1914. Jackson County, T. G. Harbison, September 18, 1916; Mariana, March 21, 1917. Lafayette County, Old Town, T. G. Harbison, September 13, 1918, March 30 and 31, 1920.

ALABAMA. Lee County, Auburn, T. G. Harbison, April, 1912.

MISSISSIPPI. Jones County, Laurel, T. G. Harbison, March 26, 1917.

OKLAHOMA. Le Flore County, edge of thicket in Creek Valley, near Page, O. W. Blakley (No. 3441 in Herb. Bot. Gard. Mo.), April 15, 1915.

A specimen collected by T. G. Harbison in April, 1914, in South Carolina opposite the city of Augusta, Georgia, and a specimen collected by him from a shrub growing by the side of the road leading from Augusta to the "Old Ferry" are perhaps of this species. The flowers are only 1 cm. long, and the pedicels are villose, but the calyx is nearly glabrous. Fruit of these plants has not been collected.

Fraxinus caroliniana var. *Rehderiana*, n. var.—*Fraxinus Rehderiana* Lingselsheim in Engler, *Pflanzenr.* iv.-243, 42 (1920).

Differing from the type in the pubescent lower surface of the leaves and in the dense pubescence of the branchlets.

Lingselsheim suggests that *F. Rehderiana* may be a hybrid between *F. caroliniana* and *F. pennsylvanica* but there is no appearance of the latter

in the leaves or fruit of his type specimen collected in southeastern Virginia, a region where *F. pennsylvanica* does not occur. Other specimens of *F. caroliniana* with pubescent leaflets and branchlets in the herbarium of the Arboretum were collected beyond the region inhabited by *F. pennsylvanica* and are referred to this variety.

VIRGINIA. Isle of Wight County, banks of Blackwater River near Zuni, A. Rehder (type), August 19, 1905.

FLORIDA. Taylor County, swamp near the coast, T. G. Harbison, September 8, 1918.

LOUISIANA. Tangipahoa Parish; Ponchatoula, C. S. Sargent, March 29, 1917, near Hammond, C. S. Sargent, March 30, 1917.

NEW SPECIES, VARIETIES AND COMBINATIONS FROM THE HERBARIUM AND THE COLLECTIONS OF THE ARNOLD ARBORETUM¹

ALFRED REHDER

VITACEAE

Ampelopsis Michx.

Ampelopsis brevipedunculata Koehne, Deutsch. Dendr. 400 (1893).—*Cissus* (*Ampelopsis*) *brevipedunculata* Maximowicz in Mém. Acad. Sci. Div. Sav. St. Pétersbourg, ix. 68 (Prim. Fl. Amur.) (1859).—*Cissus humulifolia* β. *brevipedunculata* Regel in Mém. Acad. Sci. St. Pétersbourg, sér. 7, iv. No. 4, p. 35 (Tent. Fl. Ussur) (1861).—*Vitis heterophylla* α. *cordata* Regel in Gartenfl. xxii. 197 (1873), excl. planta americana.—*A. heterophylla* var. β. *amurensis* Planchon in De Candolle, Monog. Phan. v. 456 (1887).—Rehder in Bailey, Stand. Cycl. Hort. i. 278, fig. 191 (1914).—*A. heterophylla* var. γ. *Lavallei* Planchon, l. c. (1887).—*Vitis brevipedunculata* Dippel, Handb. Laubholz. ii. 564, fig. 267 (1892).—*Vitis amurensis* hort. ex Dippel, l. c. (1892), pro synon., non Rupr.

The plant originally described by Thunberg as *Vitis heterophylla* belongs to the genus *Ampelopsis* and is generally known as *A. heterophylla* Sieb. & Zucc., but unfortunately this name cannot be retained, on account of the older *A. heterophylla* Blume (Bijdr. 194 [1825]) which is under the genus *Ampelopsis* the valid name of the plant named by Planchon *Landukia Landuk* (*Cissus Landuk* Hassk., *Vitis Landuk* Miq.) and by Gagnepain *Parthenocissus Landuk*,² but for which the correct combination under

¹ Continued from p. 128.

² As Gagnepain has shown (in Bull. Soc. Hist. Nat. Autun, xxiv. 10 [1911]), the genus *Landukia* cannot be generically separated from *Parthenocissus* and he, therefore, unites the two genera choosing the name *Parthenocissus* for the group. Though *Landukia* has page priority over *Parthenocissus*, it should not be used as the name for the group, as the International Rules of Botanical Nomenclature do not recognize page priority, but rule, according to article 46, that an author who unites two or more genera of the same date may choose, and that his choice cannot be modified by subsequent authors. Moreover, *Parthenocissus* is a nomen conservandum and should be retained "en tous cas."

Parthenocissus is *P. heterophylla* (Bl.) Merrill. The next oldest name available to take the place of *A. heterophylla* Sieb. & Zucc. is apparently *Cissus brevipedunculata* Maxim. of 1859, which, though representing a different form, is undoubtedly conspecific with *Vitis heterophylla* of Thunberg. *Ampelopsis brevipedunculata* in its wider conception is a very variable species and the following varieties and forms may be distinguished. The type occurs in Manchuria, northern China and in Japan.

Ampelopsis brevipedunculata var. *Maximowiczii*, Rehder in Bailey, Gent. Herb. I. 36 (1920) — *Vitis heterophylla* Thunberg, Fl. Jap. 103 (1784.) — *A. heterophylla* Siebold & Zuccarini in Abh. Akad. Muench. iv. 197 (Fam. Nat. Fl. Jap. i. 89) (1846), pro parte, excl. var. α^1 , non Blume. — *A. humulifolia* Bge. β . *heterophylla* K. Koch, Hort. Dendr. 48 (1853). — *Cissus bryoniaefolia* Regel in Mém. Acad. Sci. St. Pétersbourg, sér. 7, iv. No. 4, p. 35, t. 3, fig. 3 (Tent. Fl. Ussur.) (1861), non Bunge. — *A. Regeliana* Carrière in Rev. Hort. 1866, 440. — *Vitis heterophylla* var. *humulifolia* Hooker in Bot. Mag. xciii. t. 5682 (1867), excl. synonym. Bungei. — *Vitis heterophylla* β . *Maximowiczii* Regel in Gartenfl. xxii. 197, t. 765, fig. 2 (1873). — *Vitis humulifolia* f. *glabra* O. Debeaux in Act. Linn. Soc. Bordeaux, xxxi. 132 (Fl. Tché-fou 37) (1876). — *A. heterophylla* var. *Bungei* subvar. α^{bis} *Sieboldii* Planchon in De Candolle Monog. Phan. v. 456 (1887).² — *A. heterophylla* *Maximowiczii* Schelle in Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 333 (1903). — *A. heterophylla* *Regeliana* hort. apud Schelle, l. c. (1903). — *A. aconitifolia* Hort. ex Nicholson, Kew Handlist Arb. i. 77 (1894), pro synonym. — *A. heterophylla* var. *humulifolia* Merrill in Philipp. Jour. Sci. xi. Bot. 129 (1916), excl. synonym. Bungei et Planchonii.³

This is the *Vitis heterophylla* of Thunberg for which the oldest available varietal name seems to be *Vitis heterophylla* var. *Maximowiczii* Regel. The earlier *A. humulifolia* β . *heterophylla* K. Koch cannot be used, as it is not a valid name being formed against the rules of nomenclature by making the older *V. heterophylla* a variety of the later *A. humulifolia*. Also *Vitis heterophylla* var. *humulifolia* Hooker is not available, as this combination is based on *A. humulifolia* Bunge which is different from the plant described and figured by Hooker.

The variety differs from the type chiefly in the more deeply divided and more glabrous leaves and stems. It is common in Japan and Korea and probably extends into Manchuria and to eastern China and the Philippines.

¹ Var. α = *A. humilifolia* Bunge, which has often been confused with *Vitis heterophylla* Thunberg, is a very distinct species (see my note in Mitt. Deutsch. Dendr. Ges. xxi. 187 [1912]), apparently restricted to northern China. To this species probably belongs *Cissus Davidiana* Carrière in Rev. Hort. 1868, 29, fig. 2 (*Vitis Davidiana* Nicholson, Dict. Gard. iv. 187, fig. 203 [1889]), but not *Ampelopsis Davidiana* Mottet which is *Vitis Piasezkii* Maxim., nor *Spinovitis Davidii* Carrière which is *Vitis Davidii* Föëx (*V. armata* Diels & Gilg.).

² Var. α *Bungei* (excl. var. α^{bis} and α^{ter}) = *A. humulifolia* Bunge (see preceding footnote).

³ Lavallée, Arb. Segrez. 36 (1877) quotes *Cissus acutiloba*, *C. pinnata* and *C. major* Carr. as synonyms of *A. heterophylla* Sieb. & Zucc., but these names are apparently inaccurate citations of *Cissus Davidiana acutiloba*, *C. Davidiana pinnata* and *C. Davidiana major* Carrière in Rev. Hort. 1868, 39; they may belong, at least partly, to the true *A. humulifolia* Bunge.

Ampelopsis brevipedunculata var. *Maximowiczii* f. *citruloides*, comb. nov. — *A. citrulloides* Lebas in Rev. Hort. 1875, 179. — *Vitis citrulloides* hort. nonn. ex Dippel, Handb. Laubholzk. II. 565 (1892), pro synonym. *V. heterophyllae*. — *Vitis* & *Ampelopsis citrullifolia* hort. ex Dippel, l. c. (1892), pro synonym. — *A. heterophylla citrulloides* hort. apud Schelle in Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 333 (1903). — Rehder in Bailey, Stand. Cycl. Hort. I. 278 (1914), pro var. — *Vitis heterophylla* var. *citrulloides* hort. ex Schneider, Handb. Laubholzk. II. 320 (1909), pro synonym.

This form differs chiefly in the more deeply 5-lobed leaves with the middle lobe and sometimes the lateral lobes sinuately lobed or toothed with large sinuses and much constricted near the base and middle. It is occasionally met with in cultivation. The only spontaneous specimen I have seen is Wilson's No. 7795 from Japan, collected on Shikoku, Tosa prov., Nishirokawa, up to 1000 m. alt., common, Nov. 20, 1914.

Ampelopsis brevipedunculata var. *Maximowiczii* f. *elegans*, comb. nov. — *Vitis elegans* K. Koch in Ind. Sem. Hort. Berol. 1855, app. 16. — Talon in Hort. Franç. 1866, 103, t. 4. — Witte, Flora, 293, t. 74 (1868). — *Cissus elegans* Hort. ex Jaeger, Ziergeh. 567 (1865), pro synonym. — *Vitis heterophylla* γ. *elegans* Regel in Gartenfl. XXII. 197 (1873). — *Cissus elegans* Carrière in Rev. Hort. 1876, 419. — *Vitis elegantissima* hort. ex Jaeger & Beissner, Ziergeh. ed. 2, 417 (1884), pro synonym. — *A. heterophylla* f. *elegans* Voss in Vilmorin Blumengaert. I. 183 (1894). — Rehder in Bailey, Cycl. Am. Hort. I. 59 (1900), pro var. — *Vitis Sieboldii* hort. nonn. ex Dippel, Handb. Laubholzk. II. 567 (1892), pro synonym. — *Vitis heterophylla* var. *variegata* Nicholson in Kew Hand-list Arb. I. 77 (1894). — *A. tricolor* hort. ex Rehder in Bailey, Cycl. Am. Hort. I. 59 1900, (pro synonym). — *Vitis heterophylla* var. *tricolor* (hort.) ex Nicholson in Kew Handlist Arb. ed. 2, 117 (1902), pro synonym. — *A. heterophylla tricolor* hort. apud Schelle in Beissner, Schelle & Zabel, Handb. Laubholzk. 333 (1903).

This form is nearest to *A. brevipedunculata citrulloides*, but the leaves are variegated with white and greenish white and more or less tinged pink while young.

Ampelopsis brevipedunculata var. *vestita*, comb. nov. — *A. heterophylla* var. *cinerea* Gagnepain in Sargent, Pl. Wilson, I. 101 (1911), tantum quoad no. 2720. — *A. heterophylla* var. *vestita* Rehder in Sargent, Pl. Wilson, I. 579 (1913).

Besides Wilson's 2720 which has the leaves densely soft-pubescent above and tomentose beneath, I refer to this variety the following specimens which are less pubescent, but have the upper surface more or less short-pubescent (glabrous in all other forms of *A. brevipedunculata*) and the lower surface pilose.

Hupei: A. Henry (No. 7519), E. H. Wilson (Veitch Exped. No. 2703). Chekiang: Ningpo, 1908, D. Macgregor. Kwangtung: Lin Distr., October 2, 1918, C. O. Levine (No. 3188).

Ampelopsis brevipedunculata var. *kulingensis* Rehder in Bailey, *Gent. Herb.* i. 36 (1920).

CHINA. Kiangsi.

This variety resembles somewhat typical *A. brevipedunculata*, but is easily distinguished by its glabrousness and by the leaves being truncate or subcordate at the base, remotely and sinuately denticulate and 3-lobed near the apex with long-acuminate lobes.

Ampelopsis brevipedunculata var. *Hancei*, comb. nov. — *Vitis sinica* Miquel in Jour. Bot. Néerl. i. 125 (1861). — *A. heterophylla* var. *δ. Hancei* Planchon in De Candolle, *Monog. Phan.* v. 457 (1887). — *A. heterophylla* var. *sinica* Merrill in Philipp. Jour. Sci. xi. Bot. 128 (1916).

This variety differs from the type chiefly in the smaller leaves of firmer texture, slightly reticulate beneath, coarsely crenate-serrate, without or with three short lobes, and like the branchlets usually glabrous or sometimes with a short minute pubescence on the veins beneath and on the young branchlets and petioles. It is known from the Chinese provinces Kwangtung and Fokien, from Formosa and the Philippine Islands. There are also specimens before me from the Liukiu Islands which are probably best referred to this variety, though part of the leaves resemble var. *Maximowiczii* and part var. *kulingensis*.

Columella Lour.

It has been recently shown by Merrill (in Philipp. Jour. Sci. xi. Bot. 131 [1916]) that *Columella* Loureiro is the oldest name for *Cayratia* Jussieu. Though he voices the hope that a future Botanical Congress will include *Cayratia* under the nomina conservanda, to avoid the renaming of *Columellia* Ruiz & Pavon and of the family of *Columelliaceae*, he adopts the name, makes a number of new combinations and describes some new species. As we do not know when another Botanical Congress will take place and as it is doubtful what action it will take in regard to cases like this, it seems best to be governed by the present rules and accept *Columella* Loureiro. We may even retain *Columellia* Ruiz & Pavon, as it differs in spelling, though only slightly. Whether we accept *Cayratia* or *Columella*, new combinations cannot be avoided, as Gagnepain has described a number of new species under *Cayratia*, while Merrill and Elmer have done the same under *Columella*. At present I am concerned only with the following species which is well represented in our herbarium and which has been introduced into cultivation by E. H. Wilson in 1907.

Columella oligocarpa, comb. nov. — *Vitis oligocarpa* Léveillé & Vaniot in Bull. Soc. Agric. Sci. Sarthe, LX. 41 (1905); in Fedde, *Rep. Spec. Nov.* ii. 159 (1906). — *Cayratia oligocarpa* Gagnepain in Lecomte, *Not. Syst.* i. 348, 359 (1910); in Sargent, *Pl. Wilson.* i. 99 (1911). — *Cissus oligocarpa* Bailey, *Stand. Cycl. Hort.* ii. 775 (1914).

CENTRAL CHINA.

MISCELLANEOUS GENERA

× *Juglans Bixbyi*, nom. nov. = *J. cinerea* × *Sieboldiana* Bixby in Am. Nut Jour. x. 76, fig. 5, nos. 2 and 3, fig. 7 (1919).

In the autumn of 1918 Mr. Willard G. Bixby sent to the Arnold Arboretum some walnuts with corresponding specimens of leaves gathered near Bristol, Indiana, in the Walnut-grove of Mr. Alva Y. Catheart. These specimens came from trees raised about 16 or 17 years ago from nuts of the Japanese Walnut trees on Mr. Catheart's place, and grown from nuts imported from Japan. The nuts, however, borne by these seedlings proved to be different from those of the parent tree and were mostly rough-shelled, resembling more or less those of the Butternut. There can be hardly any doubt, as pointed out and proved by Mr. Bixby in his detailed and well illustrated article cited above, that these trees are hybrids between the Japanese Walnut and the native Butternut which grows wild near Bristol.

Considering the great variability of these seedlings, it does not seem feasible to draw up a general description of the hybrid. I refer to the excellent illustrations given by Mr. Bixby and may state that from *J. Sieboldiana* they differ in the more or less rough-shelled nut, the more viscid-pubescent husk, while from *J. cinerea* they differ in the less deeply and sharply ridged and sculptured nut. The leaves are sometimes more like those of *J. Sieboldiana* as in No. 5 (in fig. 7 cited above), or more like *J. cinerea* as in No. 2, which is intermediate in fruit and may be considered the type of this hybrid. The leaves of the two species are so similar and show considerable variation within each species, that it is hardly possible to distinguish the hybrid forms from their parent species by the leaves alone.

I take pleasure in associating with this interesting hybrid which may be the starting point of a race of improved varieties, the name of Mr. Willard G. Bixby, who has done and is doing so much successful work for the development of the American nut-growing industry.

× *Juglans Bixbyi* var. *lancastriensis*, var. nov. = *J. cinerea* × *Sieboldiana* var. *cordiformis*. — *J. cordiformis* × *cinerea* Bixby in Am. Nut Jour. x. 82, fig. 6, 11 (1918).

In general appearance the nuts of this hybrid are similar to the rougher forms of the preceding hybrid, but they show the influence of *J. Sieboldiana* var. *cordiformis* Makino (*J. cordiformis* Maxim.) in the somewhat compressed nut with a strongly elongated slender point. Mr. Bixby has kindly sent us nuts of this form from a tree in the orchard of Mr. J. F. Jones, in Lancaster, Pennsylvania, which was raised from the seed of the "Hollinger Heartnut," a typical *J. Sieboldiana* var. *cordiformis*. The ridges of the nut of this hybrid are almost as prominent and sharp as those of the Butternut, but the shape of the nut is different.

On page 82 or 83 of Mr. Bixby's article, cited above, there occurs a misleading statement probably due to some omission in copying the

original manuscript, which calls for a correction. "*Juglans Hindsii* $\times$ *nigra*, Royal Walnut" does not occur in Massachusetts; it is like the Paradox Walnut a cross of Burbank's and originated in California. The Massachusetts trees mentioned belong to *J. cinerea* $\times$ *regia* = *J. quadrangulata* Rehd. (*J. intermedia quadrangulata* Carr.). To the hybrids enumerated by Mr. Bixby may be added *J. nigra* $\times$ *regia* = *J. intermedia* Carr. which was first observed in Europe and to which probably the "James River Hybrid" belongs.

***Rubus Henryi* Hemsl. & Kuntze var. *bambusarum*, var. n. — *R. bambusarum* Focke in Hooker, Icon. Pl. xx. in nota ad tab. 1952 (1891); in Bibl. Bot. xxxii. 44 (1910).**

CHINA. Hupeh.

This variety differs from the type in the 3-foliate, not 3-5-parted, leaves and in the densely villose calyx neither bristly nor glandular. Though I have no doubt that *R. Henryi* and *R. bambusarum* are conspecific, I prefer to keep the latter form distinct at least as a variety, as there are hardly any transitions between the two. In *Plantae Wilsonianae* (i. 49 [1911]) where Focke refers *R. bambusarum* as a synonym to *R. Henryi*, he states that ternate and simply trifid leaves occur on the same branch, but as the specimens (Wilson No. 48) show the trifid or simple lanceolate leaves occur only just below the inflorescence; and it is the case in almost all compound-leaved *Rubus*, that the leaves below the inflorescence are apt to be simple. Otherwise the specimens before me show either the simple trifid leaves of *R. Henryi* as in Wilson's No. 76 and in his No. 996 of the Veitch Expedition and or the ternate leaves of the var. *bambusarum* as in Wilson's No. 48 and in his No. 786 of the Veitch Expedition. The same is true of the cultivated plants of both forms.

***Xylosma congestum* Merr. var. *pubescens*, comb. nov. — *X. racemosum* var. *pubescens* Rehder & Wilson in Sargent, Pl. Wilson. i. 283 (1912).**

As shown by Merrill (in Philipp. Jour. Sci. xv. 247 [1919]) the plant now generally known as *X. racemosum* Miquel was first described by Loureiro as *Croton congestum* (Fl. Cochinch. 582 [1790]) which made necessary the new specific combination *X. congestum* Merrill, and this in turn involves the new varietal combination proposed above.

***Cornus florida* L. f. *xanthocarpa*, forma nov.**

A typo recedit fructu luteo.

Hort. Miss L. C. Wilcox, Saluda, North Carolina, October 21, 1919, *Miss L. C. Wilcox* (Herb. Arnold Arboretum).

A yellow-fruited *Cornus florida* has also been found near Oyster Bay, Long Island, by Hicks & Co. of Westbury.

$\times$ ***Symphoricarpus Chenaultii*, hybr. nov. (= *S. microphyllus* $\times$ *orbiculatus*).**

Frutex ramosus gracilis, metralis vel ultra, ramis erectis saepissime subregulariter decussatim ramulosis ramulis patentibus apicem versus floriferis; ramuli juniores puberuli. Folia elliptica v. late elliptica, utrinque acuta v. basi subrotundata, apice mucronata, 1-2 cm. longa et 0.6-1.7 cm. lata, supra coerulesco-viridia, glabra, subtus glauca, villosula, nervis utrinsecus 3-5 elevatis; petioli puberuli, 1-2 mm. longi. Flores sessiles, in fasciculis vel spicis axillaribus et terminalibus ad 1 cm. longis, pedunculis 2-6 mm. longis puberulis suffultis; calycis lobi triangulari-ovati, ciliolati; corolla breviter tubulosa, 6 mm. longa, roseo-alba, glabra, lobis erectis late ovalibus 2 mm. longis, tubo ventre leviter inflato 4 mm. longo intus supra medium piloso; stamina lobos paullulo superantia, filamentis glabris 1.5 mm. longis, antheris lineari-oblongis 1 mm. longis; stylus medium corollam aequans, longe pilosus. Baccae subglobosae, calyce coronatae, 4-7 mm. longae, rubrae, minute pallide punctulatae, facie inferiore pleraeque albescences, rubro-punctulatae; semina elliptica, 3.5 mm. longa, albida.

Cultivated at the Arnold Arboretum under No. 7255 (plants received from Léon Chenault & Cie. at Orléans, France, in 1912, as *S. parviflorus conglomeratus*); specimens collected: August 16 and November 12 and 20, 1915; August 1, 1916.

This plant is probably a hybrid between *S. orbiculatus* Moench and *S. microphyllus* H.B.K. In its habit and in the smallness of the leaves it is very similar to the latter species, but differs in the more pubescent underside of the leaves, in the always clustered or spicate flowers, in the shorter and broader corolla-tube only twice as long as the lobes, in the pilose and shorter style and in the red or partly red color of the fruit. From *S. orbiculatus* it is easily distinguished by the generally smaller leaves, the tubular not broadly campanulate corolla with the nectary glands extending all round below the middle, and by the lighter colored partly whitish fruit. The color of the fruit is rather peculiar; it is usually bright purplish red on the upper exposed side with numerous minute light dots and toward the lower side the color passes gradually into pinkish white sprinkled with purplish dots. In this peculiarity of coloring the fruit resembles that of *Lonicera Vilmorinii* Rehd., a hybrid between the red-fruited *L. deflexicalyx* Batal. and the white-fruited *L. quinquelocularis* Hardw.

Symphoricarpos Chenaultii is a handsome shrub of regular habit with bright green leaves smaller than in any other species of the genus hardy in this Arboretum. Though neither in bloom nor in fruit conspicuous, it will be valued as an ornamental shrub on account of its dense rather low habit and the neat bright green foliage.

(To be continued)

BIBLIOGRAPHICAL NOTES

ETHELYN M. TUCKER

It is intended to publish in this Journal from time to time bibliographical notes on books and serial publications relating to systematic botany, which being undated or having inexact dates are a source of difficulty and error, particularly when questions of priority of publication are involved.

Any corrections or additions to this list will be gratefully received, and if important will be published. It is hoped that with such notes much information known at present in but few libraries will be made available to a larger number of botanical workers.

Nouveau Duhamel. In the preface to Duhamel's "Traité des arbres et arbustes qui se cultivent en France en pleine terre, 1755," he expresses the hope that the work which he has commenced may be continued on broader lines. After nearly half a century this work was undertaken in the form of a "Nouveau Duhamel" issued in 80 parts, from 1801 to 1819 and completed in seven folio volumes.

As the original issue appears to be very rare and the work to be represented in many libraries by a re-issue published about 1852, with partly differing title-pages and without dates, the following citations from an original copy in the library of the Massachusetts Horticultural Society are interesting and may prove useful.

The titles of the several volumes read as follows:

Vol. i. "Traité des arbres et arbustes que l'on cultive en France en pleine terre. Par Duhamel. Seconde édition considérablement augmentée. Paris. Chez Didot, ainé; Michel; Lamy."

This volume has a half-title, an engraved title-page, and a dedication to Madame Bonaparte.

Vol. ii. "Traité des arbres et arbustes que l'on cultive en France en pleine terre. Par Duhamel. Nouvelle édition, augmentée de plus de moitié pour le nombre des espèces. Avec des figures d'après les dessins de P. J. Redouté. Dedié à sa majesté L'Impératrice Reine. Paris. 1804."

Vol. iii. "Traité des arbres et arbustes que l'on cultive en France en pleine terre. Par Duhamel. Nouvelle édition, augmentée de plus de moitié pour le nombre des espèces. Avec des figures d'après les dessins de P. J. Redouté. Dedié à sa majesté l'Impératrice Reine. Paris. 1806."

Vol. iv. "Traité des arbres et arbustes que l'on cultive en France en pleine terre. Par Duhamel. Nouvelle édition, augmentée de plus de moitié pour le nombre des espèces. Avec des figures d'après les dessins de P. J. Redouté. Dedié à sa majesté l'Impératrice Reine. Paris. 1809."

Vol. v. "Nouveau Duhamel; ou, Traité des arbres et arbustes que l'on cultive en France. Rédigé par J. L. A. Loiseleur-Deslongchamps.

Avec de figures d'après les dessins de MM. P. J. Redouté et P. Bessa. Dedié à sa majesté l'Impératrice Joséphine. Paris. 1812."

Vol. vi. "Nouveau Duhamel; ou, Traité des arbres et arbustes que l'on cultive en France. Rédigé par J. L. A. Loiseleur-Deslongchamps. Avec de figures d'après les dessins de MM. P. J. Redouté et P. Bessa. Paris. 1815."

Vol. vii. "Nouveau Duhamel; ou, Traité des arbres et arbustes que l'on cultive en France. Rédigé par J. L. A. Loiseleur-Deslongchamps; et Étienne Michel, éditeur. Paris. 1819."

At the end of vol. iv is an alphabetical list of the articles in vols. i iv, with the name of the author of each article, and followed by a note signed by Étienne Michel, which announces that beginning with vol. v, M. Loiseleur-Deslongchamps will become the sole editor. At the end of vol. v, an "avis" states that the "Nouveau Duhamel" while taking its name and some of its material from Duhamel's "Traité" is neither a re-impression nor a new edition of it, but an entirely new work. "Tous les articles, même ceux que Duhamel avait le mieux travaillés tant sur les Arbres forestiers et d'ornement, que sur les Arbres fruitiers, ont été refaits en entier et considérablement augmentée."

A collation of the volumes is as follows:

Vol. i	[1801]	pp. 264, iv.
" ii	1804	" 244, v.
" iii	1806	" 234, iv.
" iv	1809	" 240, 4
" v	1812	" 330, 4
" vi	1815	" 266, 6
" vii	1819	" 252, 7

The copy of "Nouveau Duhamel" in the Arnold Arboretum library is evidently the re-issue of about 1852 and differs from the original only in the title-pages, which are all alike, with the exception of the volume numbers, are undated, and read: "Traité des arbres et arbustes que l'on cultive en pleine terre en Europe, et particulièrement en France. Ed. augmentée de plus de moitié pour le nombre des espèces distribuée d'après un ordre plus méthodique suivant l'état actuel de la botanique et de l'agriculture. Rédigé par MM. Veillard, Jaume Saint-Hilaire, Mirbel, Poiret, et continué par M. Loiseleur-Deslongchamps. Ouvrage orné de cinq cents planches d'après les dessins de MM. Redouté et Bessa. Paris, Librairie Encyclopédique de Roret." Vol. i has also the engraved title-page as in the original, the note opposite reading "Explication du frontispice" instead of "Explication de la vignette."

It would be very interesting to learn if in any library a copy of this work with the original covers of the 80 parts exists and if these covers are dated, so that it would be possible to get the exact date of each issue.

Torrey and Gray. Flora of North America.

Issued in parts, from 1838 to 1843, the "Flora of North America, containing abridged descriptions of all the known indigenous and naturalized plants growing north of Mexico, arranged according to the natural system," presents the important question of the exact date of issue of each part. These dates for vol. i are given on the verso of the dedication to Sir W. J. Hooker, but as most copies are bound without original covers it is important to know also the pages comprised in each part. They are, with their dates, as follows:

Vol. i.		
Pt. 1	pp. 1-184	July, 1838
" 2	" 185-360	Oct., 1838
" 3	" 361-544	June, 1840
" 4	" 545-711	June, 1840
Vol. ii.		
Pt. 1	pp. 1-184	May, 1841
" 2	" 185-392	April, 1842
" 3	" 393-504	Feb., 1843

Vol. i has a title-page bearing the dates 1838-1840, and an index. Vol. ii was never completed, ending abruptly with page 504 at the conclusion of "Compositae," and without title-page. In the Arboretum copy there is appended an "Index to vol. ii of Torrey & Gray's Flora of North America," which was compiled by G. C. Woolson and printed some time previous to 1890.

That it was the intention of the authors to publish more is indicated by the last paragraph of the preface in vol. i, "A complete index of the genera and species, and an enumeration of all the works which relate to North American botany, or are cited in this work, will be given with the concluding volume, and likewise, if space permit, some general observations respecting the geographical distribution of North American plants. A connected notice of those plants which are important on account of their active or medicinal properties or economical uses, will also be added."

In *Rhodora* for December, 1906, under the heading, "Two editions of Torrey & Gray's Flora of North America," Mr. H. W. Preston calls attention to the fact that variations in the copies of the "Flora" indicate clearly that portions of vol. i were reprinted, "an examination of the type shows that pages 321 to 360 inclusive were reset in a slightly different font." The copy in the library of the Arnold Arboretum has the reprinted pages substituted, and in a letter from Miss Mary A. Day we find that it differs from the original in the Gray Herbarium in the following respects:

"On page 324, line 34, the original has the name *H[osackia] micranthus*, while the reprint has changed this to *H. micrantha*. On the following

page, 325, line 4, a similar change occurs in *H. prostratus* in the original, and *H. prostrata* in the reprint. On page 355, line 14, the original ends with the word 'stem,' in the reprint with the word 'branched.' Other lines of this page and the following pages indicate that a part of the work was a reset. How much was reprinted, or how much later than the original we do not know. Surely Dr. Gray made some corrections in a reprint, but he never called it a different edition."

JOURNAL

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NOTES ON AMERICAN WILLOWS. XI

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a. SOME REMARKS ON THE SPECIES OF SECTION CORDATAE

IN note x, on p. 65 of vol. II of this Journal I made the statement that I had not thoroughly studied this group because Mr. C. N. Ball was writing a monograph of it. Unfortunately he had not been able to finish his study, and by request of the editor I have prepared a short note based on my own observations on species of this section. It is with great reluctance that I do this. Mr. Ball has already proposed some new species and has used these names in different herbaria without, however, publishing descriptions of them. He has also applied several old names to certain forms and I have seen a good many specimens bearing his own determinations. In May, 1919 he kindly gave me a typewritten list of the species, varieties and synonyms including the species I have referred to sect. *Commutatae* and *Balsamiferae*; *S. Wolfii* was also included in his list. On June 15, 1919, I wrote him a long letter in regard to several names used by him explaining my opinion on some of Andersson's critical forms but I have not received an answer to this letter. At present I have to mention some of his new names, and I wish to state emphatically that I can not do more in this note than to give a few hints as to the species and forms belonging to this group. My study is based on the same material as mentioned on p. 67 of vol. I of this Journal, and I wish to express my best thanks also to Mr. R. V. Bradshaw of Eugene, Ore., for sending me good material of some species including *S. mackenzieana*.

The main difference of the species mentioned can be taken from the key given below, and also from the keys in note XII. As to the synonymy of the section the following is to be said:

Sect. *Cordatae* Barratt apud Hooker, Fl. Bor.-Am. II. 149 (1839). — Ball apud Coulter & Nelson, New Man. Rocky Mts. Bot. 132 (1909). — Sect. *Rigidæ* (sive *Hastatae*) Andersson in Svensk. Vet.-Akad. Handl. VI. 157 (Monog. Salic.) (1867), pro parte; apud De Candolle, Prodr. XVI. 251 (1868), pro parte. — Rydberg, Fl. Rocky Mts. 188 (1917), pro parte. — Sect. *Hastatae* Schneider, Ill. Handb. Laubh. I. 49 (1904), quoad *S. cordatam*.

CLAVIS SPECIERUM

Folia subtus discoloria, distincte pallidiora vel glaucescentia.

Ramuli floriferi pruinosi; pedicelli 0.8-1 (rarius ad 1.5) mm. longi. 54. *S. irrorata*.
 Ramuli nunquam pruinosi.

Ramuli annotini biennesque plusminusve castanei, fuscесcentes, sordide brunnescentes vel subviridescentes vel tomentelli.

.Pedicelli fructuum vix ultra 2(-2.5) mm. longi vel ramuli etiam fructiferi satis tomentosi.

Pubescencia foliorum saltem juvenilium pilis griseis et fulvis mixta; folia lanceolata, oblanceolata ad oblongo-(rarius obovato-) lanceolata, apice obtusa vel breviter acuta, basi cuneata vel sensim attenuata, superne haud stomatifera; amenta plerumque sessilia, dense cylindrica; bractae obovatae, praesertim extus dense breviter sericeo-subcrispo-pilosae. 55. *S. lasioides*.

Pubescencia grisea vel folia diversa.

Ramuli etiam floriferi distincte tomentosi vel pubescentes; folia satis lanceolata vel anguste lanceolata, versus apicem saepissime plusminusve sensim acuminata; amenta fructifera ad 7-10 cm. longa et 2 cm. crassa; fructus 8-10 mm. et pedicelli interdum fere ad 3 mm. longi.

58. *S. missouriensis*.

Ramuli floriferi glabri; fructus vix ultra 6-7 mm. longi vel plantae aliis signis diversae.

Folia superne ut videtur semper stomatifera, margine dentata vel subintegra 56. *S. ligulifolia*.

Folia superne haud stomatifera, margine saepissime serrata vel serrato-dentata 57. *S. cordata*.

Pedicelli fructuum (2.5-3-4 mm. longi) 59. *S. mackenziana*.

Ramuli annotini biennesque plusminusve lutescentes vel flavescentes; pedicelli 1.5-3 mm. longi. 60. *S. lutea*.

Folia utrinque concoloria, etiam subtus viridia vel distincte viridescentia.

Folia apice distincte acuta vel acuminata, dentata, serrata vel subintegra; petioli (4-) 6-14 mm. longi.

Pedicelli 2.5-4 mm. longi; folia etiam matura satis membranacea. 61. *S. monochroma*.

Pedicelli 1-1.75 (rarius ad 2.25) mm. longi; folia matura satis chartacea

63. *S. pseudocordata*.

Folia apice obtusa vel subacuta, crenato-dentata vel crenata; petioli vix ultra 3-4 mm. longi. 62. *S. myrtillofolia*.

ENUMERATIO SPECIERUM

54. *S. irrorata* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 117 (1858); in Proc. Am. Acad. iv. 57 (Sal. Bor.-Am. 11) (1858); in Walpers, Ann. Bot. v. 746 (1858); in De Candolle, Prodr. xvi. 262 (1868). — Behb apud Coulter & Nelson, Man. Rocky Mts. Bot. 336 (1885). — Rydberg, Fl. Colo. 95 (1906); Fl. Rocky Mts. 194 (1917). — Ball apud Coulter & Nelson, New Man. Rocky Mts. Bot. 132 (1909). — Wootton & Standley in Contrib. U. S. Nat. Herb. xix. 159 (Fl. New Mex.) (1915). — This well characterized Willow has been described by Andersson from specimens collected by Fendler (No. 812) in New Mexico, Santa Fé County, Santa Fé Creek, bottom of the creek, exposed to inundations, on January 16, 1847. I have seen the type and several cotypes. In 1858, Andersson stated that this species to the European "*S. daphnoidi* ita est similis, ut nullis notis nisi amentis eximie condensatis et foliis (novellis!) integerrimis utrinque viridibus ab ea distingui possit"; but later, in 1868, he more correctly said "maximam cum *S. daphnoide* habet affinitatem, sed distinguuntur amentis condensatis, gemmis rotundatis, squamis obtusis, capsulis minoribus distincte pedicellatis stylo breviori apiculatis. . . ." After all, *S. daphnoides* belongs to a very different group not represented

in the New World, *S. irrorata* is easily distinguished from all the other Cordatae by the glaucous bloom on its branchlets.

I have seen good material from New Mexico (Rio Arriba, Santa Fé, San Miguel, Lincoln, Otero, Grant, Sierra and Socorro Counties), and Colorado (Conejos, Fremont, El Paso, Denver and Larimer Counties). Ball in 1909, states that it also occurs in southwestern Texas. In Arizona (Navajo, Cochise, Ima and Santa Cruz Counties) and in New Mexico (Socorro County) a form with tomentose twigs occurs which much resembles *S. lasiolepis* to which *S. irrorata*, probably, is most closely related.

55. *S. lasiolepis* Benth. Pl. Hartw. 335 (1857). — Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 118 (1858); in Proc. Am. Acad. iv. 58 (Sal. Bor.-Am. 12) (1858); in De Candolle, Prodr. xvi.² 264 (1868). — Bebb apud Watson, Bot. Calif. ii. 86 (1879). — Britton & Shafer, N. Am. Trees, 198, f. 159 (1908). — Rydberg, Fl. Rocky Mts. 193 (1917). — Schneider in Bot. Gaz. LXV. 31 (1918). — ? *S. humilis* ♂, *angustifolia* f. *opaca* Andersson in De Candolle, Prodr. xvi.² 236 (1868), sec. specim. Wright no. 1878. — This species which according to Jepson is "the most common willow in the foothill country throughout the state" of California has been described from specimens collected by Hartweg in 1848 under no. 1955 (167) "on the banks of the river Salinas and Carmel near Monterey" according to the type in Herb. Kew. It also occurs in Lower California (and possibly in New Mexico) and Oregon. I am, however, not sufficiently acquainted with the species and the following varieties retained by Ball according to its MS.-list. It is probably the most arborescent species of this group reaching a height of more than 10 m.

In 1857,* Torrey, Bot. Pacif. R. R. Exped. iv. 139, described a *S. Bigelowii* from specimens collected by Dr. Bigelow in 1854, on April 8, near San Francisco, of which I have seen the type. This species has been mentioned by Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 118 (1858); in Proc. Am. Acad. iv. 58 (Sal. Bor.-Am. 12) (1858); in Walpers, Ann. Bot. v. 747 (1858) [*S. Bigelowii*] and also in Svensk. Vet.-Akad. Handl. vi. 163, t. 8, fig. 94 (Monog. Salic.) (1867). In the last place he describes two varieties: *latifolia* and *angustifolia* without indicating a type for either form but citing besides Bigelow's specimen one from "Bokara (sec. Herb. Hook.)" a quotation unintelligible to me. In his monograph Andersson has also a *S. Bigelowii* **S. fuscior* which he made *S. Bigelowii* β, *fuscior* in De Candolle, Prodr. xvi.² 255 (1868) "in America septentrionali (Herb. Hook.)." He does not give the exact locality of the name of the collector of his type stating only that there were five different specimens on the same sheet in Hooker's herbarium of which "duo versimiliter ad *S. humilem recurvatam* sunt referenda" while one is "*S. lasiolepidi* exacte simile" and the remaining two seemed to be closely related to *S. Bigelowii*. Without having seen this type of var. *fuscior* I cannot

* The title-page of vol. iv bears the date of 1856 but the preface of Torrey's article is dated Jan. 1857. See also Hooker in Jour. Bot. IX. 377 (1857).

say whether or not it really belongs to *S. lasiolepis* at all. Ball in his MS.-list does not mention this form. Bebb apud Watson, Bot. Calif. II. 86 (1879), proposed *S. lasiolepis* var. *Bigelovii*, and Ball, in his list, keeps this variety quoting as synonyms: *S. franciscana* Von Seemen in Bull. Torr. Bot. Cl. xxx. 634 (1903); *S. Sandbergii* Rydberg, l. c. xxxix. 304 (1912); Fl. Rocky Mts. 192 (1917), and *S. boiseana* Nelson in Bot. Gaz. LIV. 406 (1912). The type of *S. franciscana* came from the Cliff House near San Francisco while the types of the other two species had been collected in Idaho, Valley of Hatwai Creek, April 28, 1892, Sandberg, Mac Dougal and Heller (no. 71, f.; N. Y.), and near Boise, May 29, 1911, Miss June Clarke (no. 48, fr.). This variety also occurs in Nevada (Ormsby County) and in Oregon but I am not well enough acquainted with it to say more about its geographical distribution.

Bebb, in 1879, also proposed a var.(?) *fallax* of *S. lasiolepis* without however mentioning a type. Judging by what I have seen in Bebb's herbarium Torrey's no. 491 (from 1865) seems to represent the type of this obscure form which is not quoted in Ball's list.

In 1903, Von Seemen in Bull. Torr. Bot. Club xxx. 635, described a second species *S. Bakeri*, collected by C. F. Baker, on March 9 and May 10, 1902, on the foothills near Stanford University, Santa Clara County, California (No. 274, f., m.; type in Herb. Berol.). This species is kept by Ball as *S. lasiolepis* var. *Bakeri* Ball, in litt. The ovaries of the type are somewhat tomentose toward the apex. The geographical distribution of this form is unknown to me. Jepson Fl. Calif. 241 (1909), does refer *S. Bakeri* as a synonym to var. *Bigelovii*. Britton & Shafer, N. Am. Trees, 204, fig. 167 (1900), keep *S. Bakeri* a distinct species with capsules "hairy toward the top."

56. *S. ligulifolia* Ball, in litt. — ? *S. cordata* Ball apud Coulter & Nelson, New Man. Rocky Mts. Fl. 132 (1909), pro parte. — This species proposed by Ball and known to me only in a few specimens which I saw with Ball's own determination in Bebb's Herbarium (C.) seems to me most closely related to *S. lutea* which however has longer pedicels. Both species may be widely distributed from New Mexico and California to Colorado, Wyoming and farther north. Partly on Ball's authority I quote the following specimens as belonging to his species of which he, unfortunately, has not yet published a description. The specimens of which the numbers are marked with an * have not been determined by Ball. The leaves are mostly provided with stomata in the epidermis of the upper surface, a fact also observed by me in *S. lutea* and, partly, in *S. mackenziana*, but not in typical *S. cordata*.

NEW MEXICO. Without locality and date, *Greene* (sheet 3908 in Herb. Bebb; m., f., fr.).

COLORADO. Conejos County, Los Pinos, May, 1899, *C. L. Baker* (no. 270, m., f.; C., G.). La Plata County, Durango, June, 1891, *A. Eastwood* (No. 23, f., m.; C.). Routt County, Wilecott, July, 1891, *A. Eastwood* (No. 17, fr.; C.). ? Montezuma County, ? Mancos, June, 1891, same coll. (No.

22, m., fr.; C.). El Paso County, Manitou, May 8, 1878, [M. E. Jones (No. 30,* f.; A.). Jefferson County, Golden City, 1870, E. L. Greene (No. 371,* m. f.; G.; a somewhat doubtful form). ? County, Soda Springs Canyon, May, 1886, W. H. Shockley (No. 363, fr.; C.).

UTAH. Salt Lake County, Red Butte Canyon, May 8, 1909, J. Clemens (f.*; A.); Salt Lake, Cottonwood Creek, June 27, 1918, A. Eastwood (No. 7753,* f., m.; A.); City Creek Canyon, May 11, 1880, M. E. Jones (No. 1702,* f.; A.).

WYOMING. Albany County, Sand Creek, May 30, 1900, A. Nelson (No. 6964,* m; N. Cor.; partly mixed with female *S. monticola*).

NEVADA. Ormsby County, Empire City, May 20, 1882, M. E. Jones (No. 4077,* f.; A.).

57. *S. cordata* Muhlenberg in Neue Schr. Ges. Naturf. Fr. Berlin, iv. 236, t. 6, f. 3 (1803). — Michaux, Fl. Bor.-Am. ii. 225 (1803). — Willdenow, Spec. iv. 666 (1805). — Pursh, Fl. Am. Sept. ii. 615 (1814). — Poiret in Lamarck, Encycl. Méth. Suppl. 69 (1817). — Koch, De Salic. Eur. Comm. 22 (1828). — Forbes, Salict. Wob. 277, f. 142 (1829). — Hooker, Fl. Bor.-Am ii. 149 (1839), excl. var. — Barratt, Salic. Am. no. 26 (1840). — Torrey, Fl. N. Y. ii. 211 (1843). — Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 124 (1858); in Proc. Am. Acad. iv. 64 (Sal. Bor.-Am. 19) (1858); in Walpers, Ann. Bot. v. 751 (1858); in Svensk. Vet.-Akad. Handl. vi. 157, t. 8, f. 91 (Monog. Salic.) (1867), pro parte maxima; apud De Candolle, Prodr. xvi.² 251 (1868), pro parte maxima. — Bebb apud Macoun, Cat. Can. Pl. 496 (1886), pro parte. — Britton & Brown, Ill. Fl. i. 503, f. 1198 (1896); ed. 2, i. 596, f. 0463, f. (0913). — Ball in Proc. Iowa Acad. Sci. vii. 151 (1900); in Elys. Mar. iii. 29, t. 6, f. a (1910). — Britton, Man. 314 (1901). — Schneider, Ill. Handb. Laubh. i. 50, f. 11 r-s, 25 h (1904). — Robinson & Fernald in Gray's New Man. ed. 7, 323, f. 650 (1909). — Von Seemen apud Ascherson & Graebner, Syn. Mittel-eur. Fl. iv. 157 (1911), excl. synonym, pro parte. — *S. rigida* Muhlenberg in Neue Schr. Ges. Naturf. Fr. Berlin, l. c. t. 6, f. 4 (1803), fide Ball. — Willdenow, Spec. iv. 667 (1805). — Pursh, Fl. Am. Sept. ii. 615 (1814). — Forbes, Salict. Wob. 277, f. 141 (1829). — *S. cordata* var. *rigida* Carey apud Gray, Man. Bot. 427 (1848). — Andersson in De Candolle Prodr. xvi.² 252 (1868), pro parte. — *S. myricoides* var. *cordata* Dippel, Handb. Laubh. ii. f. 134 (1892). — *S. acutidens* Rydberg apud Britton, Man. 315 (1901), fide Ball. — This widely spread eastern Willow has been described by Muhlenberg from specimens from Lancaster, Pa. I am not well enough acquainted with its variability and its geographical distribution. Andersson, in 1867, proposed two subspecies *S. rigida* and *S. angustata* which he reduced to varieties in 1868. *S. rigida* Muhlenberg is referred by Ball in his list as a mere synonym to *S. cordata*, and *S. myricoides* Muhlenberg in Neue Schr. Ges. Naturf. Fr. Berlin, iv. 235, t. 6, f. (1803) (*S. cordata* var. *myricoides* Carey apud Gray, Man. 427 (1848). — *S. cordata* α, *rigida* 6° *myricoides* Andersson in De Candolle, Prodr. xvi.² 252 [1868] is perhaps a hybrid with *S. sericea* according to Robinson & Fernald, Gray's New Man. ed. 7, 323 (1908). Ball, in Elys. Mar. iii. 30 (1910), says: "A hybrid with *S. sericea* is occasionally found . . .

Forms of *S. cordata* with twigs pubescent, young leaves thinly silky, and capsules occasionally thinly villose (*S. myricoides* Muhl.) should not be confused with it." But in his MS.-list Ball regards *S. myricoides* as probably *S. cordata* $\times$ *sericea*, and he mentions only one variety of *S. cordata*, namely var. *angustata* Andersson in De Candolle, Prodr. xvi.² 252 (1868). (*S. angustata* Pursh, Fl. Am. Sept. II. 613 [1814;] *S. cordata* 2 *S. angustata* Andersson in Svensk. Vet.-Akad. Handl. VI. 158 [1867], pro parte). Andersson proposed some forms which partly do not belong to *S. cordata* (see *S. lutea* p. 191). *Salix cordata angustata* seems to be a very common variety. A mere form of it apparently is the so-called f. *purpurascens* Hort. (*S. Nicholsonii* f. *purpurascens* Dieck, Neuheiten-Offerte 1889-90, 18 [1889].—Dippel, Handb. Laubh. II. 284 [1892].—*S. cordata* var. *rigida* f. *purpurascens* Schneider, Ill. Handb. I. 50 [1904]) which has been regarded as a hybrid of *S. cordata* with *S. nigra* but it is nothing than typical *cordata* or a form of it. There is, certainly, no hybrid with *S. nigra* in existence.

S. cordata is so far as I know not represented in the west. I do not, however, know the exact eastern limits of its geographical range.

58. *S. missouriensis* Bebb in Garden & Forest, VIII. 373 (1895).—Glatfelter in Trans. Acad. Sci. St. Louis, VII. 137 (1896).—Sargent, Silva, IX. 137, t. 480 (1896); XIV. 104 (1902).—Ball in Proc. Iowa Acad. Sci. VII. 152 (1900).—Britton, Man. ed. 2, 314 (1905).—Robinson & Fernald, Gray's New Man. ed. 7, 323, f. 651 (1908).—Britton & Shafer, N. Am. Trees 197, fig. 158 (1900).—*S. cordata* 1. *S. rigida* d. *vestita* Andersson in Svensk. Vet.-Akad. Handl. VI. 159 (1867).—*S. cordata* $\times$ *rigida* 7° *vestita* Andersson in De Candolle, Prodr. xvi.² 252 (1868).—*S. cordata* Britton & Brown, Ill. Fl. ed. 2, I. 596, f. 1463 (1913), pro parte.—The type of this, as Robinson and Fernald say, "poorly understood tree" has been collected "a Duce Neuwied prope Fort Osage fluv. Missouri." According to Ball (1900) it is distinguished from *S. cordata* by its larger size, densely puberulent twigs, large leaves, and longer, fertile aments, and other more minute differences." See also the characters given in the keys. I have not had the opportunity to make a special study of this species which according to Britton (1908) "is known in the valleys of the Missouri and Mississippi rivers and of tributary streams, from Kentucky, Illinois, and Missouri to Iowa and Nebraska.

59. *S. mackenzieana** Barratt apud Andersson in Ofv. Svensk. Vet.-Akad. Förh. XV. 125 (1858); in Proc. Am. Acad. IV. 65 (Sal. Bor.-Am. 10) (1858); in Svensk. Vet.-Akad. Handl. VI. 160, t. 8, f. 91* (1867); in De Candolle, Prodr. xvi.² 252 (1868).—Britton & Shafer, N. Am. Trees, 197, fig. 157 (1908), pro parte.—Ball apud Coulter & Nelson, New Man. Rocky Mts. Bot. 133 (1909); in Piper & Beattie, Fl. Northwest Coast, 115 (1915).—Henry, Fl. Brit. Col. 9 (1915).—Rydberg, Fl.

* Hooker spells the name *Mackenziana*, and Anderson does the same in 1858 quoting Hooker. Later he writes *Mackenziana*, a spelling adopted by all the later authors. I suppose the first spelling is the correct one.

Rocky Mts. 193 (1917). — *S. cordata* α *Mackenziana* Hooker, Fl. Bor.-Am. II. 149 (1839). — Bebb apud Macoun, Cat. Can. Pl. 497 (1886); in Garden & Forest, VIII. 473 (1895). — Jepson, Fl. Cal. 341 (1909). — This Willow was first mentioned by Hooker, l. c., as follows: "Mackenziana: foliis obovato-lanceolatis—*S. Mackenziana* Barratt, mst." Anderson, in 1858, stated under *S. cordata*: "Sub hac specie duas formas attulit Hooker l. c. 1. *S. balsamiferam* Barratt, et 2) *S. Mackenzianam* Barratt." He added: *S. Mackenziana* mihi hybrida proles ex *S. cordata* et *vagante* [= *S. Bebbiana*] videtur." In 1867 and 1868 he also regarded *S. mackenziana* as such a hybrid. It is, however, a good species, and has nothing in common with *S. Bebbiana* except the very long pedicels. I have seen material from the North West Territories where Richardson collected the type in June 1826 on the Mackenzie River and from Alberta, British Columbia, Idaho (Latah, Custer, Lincoln Counties), Washington (Whitman, Spokane, Adams and Columbia Counties), Montana (Lewis and Clark, Powell, Gallatin, Flathead and Park Counties), Wyoming (Yellowstone Park), Oregon (Washington, Good River, Wasco, Umatilla, Union and Lane Counties) and California (Siskiyou County). Probably the species is much more widely spread but sometimes it is not easy to distinguish young flowering specimens of it from those of *S. lutea* or *S. monochroma*.

Ball apud Piper & Beattie, Fl. Northwest Coast, 116 (1915), describes a var. *macrogamma* with densely pubescent-tomentose branchlets and elongated densely pilose-tomentose buds from Seattle, Portland and Corvallis. This form and the typical *S. Mackenziana* have hitherto been confused with the eastern *S. cordata*.

60. *S. lutea* Nuttall, N. Am. Sylva, I. 63, t. 19, f. dextr. sup. (1843) — Ball apud Coulter & Nelson, New Man Rocky Mts. Bot. 132 (1909). — Rydberg, Fl. Rocky Mts. 193 (1917). — *S. cordata* 2. *S. angustata vitellina* Anderson in Svensk.Vet.-Akad. Handl. VI. 159 (Monog. Salic.) (1867), an excl. f. *crassa*? — *S. cordata* β *angustata* 3 *vitellina* Andersson in De Candolle, Prodr. XVI. 252 (1868). — *S. cordata* var. *Watsoni* Bebb apud Watson, Bot. Calif. II. 86 (1879), fide Ball; Jepson, Fl. Calif. 341 (1909). — *S. cordata* var. *lutea* Bebb in Garden & Forest, VIII. 473 (1895). — *S. flava* Rydberg in Bull. Torr. Bot. Club, XXVIII. 273 (1901). — *S. Ormsbyensis* Von Seemen, l. c. XXX. 635 (1903), fide Ball. — *S. Watsonii* Rydberg, l. c. XXXIII. 137 (1906); Fl. Rocky Mts. 193 (1917). — Nuttall, in his good description, says of this species: "It is . . . remarkable for its smooth light yellow branchlets and pale green, rather small, lucid leaves." Ball, in 1909, states that the pedicels are only up to 2 mm. long but according to my own observations they sometimes attain a length of 3-3.5 mm. Ball adds: "Distinguished only with difficulty from *S. cordata* and may perhaps prove to be only a variety of that species." I am not well enough acquainted with the typical *cordata*, especially its western forms, to say anything about the taxonomic value of *S. lutea*

which seems to be a widely spread species of which I have seen specimens from Alberta, Saskatchewan, Idaho, Montana, North and South Dakota (det. by Ball), Wyoming, Oregon, Utah, Colorado, Nevada and California. Here we find the so called *S. cordata* var. *Watsonii* which occurs according to Jepson on the San Jacinto Mts. and the northern Sierra Nevada.

The type of Andersson's *S. cordata angustata vitellina* had been collected by Bourgeau in Saskatchewan "bords de la rivière à côté des Berges Carlton." I have seen co-types of it in Herb. Berol. but I am not acquainted with Andersson's form *S. cordata* 2. *S. angustata vitellina crassa*, mentioned only in 1867, based on another specimen of Bourgeau's from "dans le marais glace près le Fort Carlton."

I suppose Ball will give a good account of this species and its variability. He has already proposed two varieties of it but has not yet published descriptions of them. Therefore I had best refrain from mentioning the type specimen of one of his new varieties which I have seen.

61. *S. monochroma* Ball in litt. — ? *S. rotundifolia* β *orata* Nuttall, N. Am. Sylva, 75 (1843). — *S. cordata* Piper in Contr. U. S. N. at Herb. xi. 214 (F. Wash.) (1906), pro parte — *S. Mackenziana* Britton & Shafer, Trees 196 (1908), pro parte. — *S. pyrifolia* Ball apud Coulter & Nelson, New Man. Rocky Mts. Bot. 133 (1909), non Andersson. — This species is in several respects a counterpart to *S. mackenziana*. Specimens with mature leaves are easily recognized by their greenish under surface. The texture is thin compared with that of the leaves of the following species. In 1909, Ball referred to his *pyrifolia* the variety of Nuttall cited above, but in the MS.-list Ball marks this name with a ?. According to Nuttall it had been collected "by the late Dr. Gairdener, on the hills of the Wahlamet." I have not seen the type specimen but from the description I judge it should be regarded as the same as *S. monochroma*.

The typical *S. rotundifolia* Nuttall has been considered by Ball (1909) a synonym of what he then called *S. pyrifolia obscura*. From Nuttall's description I am inclined to take his *rotundifolia* for a form of *S. myrtilifolia*. Of Andersson's *S. pyrifolia obscura* I have already spoken in my note VII. on p. 169 in vol. 1 of this Journal. Since that was published I have seen a sterile fragment of the type in Herb. Berol. (ex Herb. Mus. Bot. Stockholm). It consists of a piece of a branchlet with mature leaves which are not quite concolor beneath, the upper ones being of a rather lanceolate-elliptic shape, broadly cuneate at base, acute at apex, somewhat coarsely crenulate-dentate, and measure up to 7.5 cm. in length and 2.4-3 cm. in width. They are glabrous on both sides except a sparse minute pubescence on the midrib above and in the groove of the petioles which are about 15 mm. long. The stipules are semicordate-lanceolate and glandular-serrate to dentate and 5 mm. long. According to Andersson the capsules have shorter pedicels than those of *S. pyrifolia*. I am at present unable to decide the question whether or not this var. *obscura* Andersson is a form of *S. monochroma*; but I am inclined to believe it may belong to

S. lutea. Ball, in his MS.-list, is inclined to refer this form to a new species of his of which I have not yet seen a specimen.

Of *S. monochroma* I have been able to examine specimens from British Columbia (Revelstoke), Washington (Whitman, Columbia Counties), Idaho (Nez Percés, Latah, Bannock Counties), Montana (Chouteau, Gallatin, Lewis and Clark, Teton Counties), Wyoming (Yellowstone Park), and Oregon (Crook, Umatilla, Union, Wallowa Counties). It is probably a widely distributed species on the mountains of these states and until now mostly mistaken for *S. cordata* or the so called *S. pseudomyrsinites* of authors.

62. *S. myrtillofolia* Andersson in Ofv. Svensk. Vet.-Akad. Förh. xv. 132 (1858); in Proc. Am. Acad. iv. 74 (Sal. Bor.-Am. 28) (1858); in Walpers, Ann. Bot. v. 756 (1858). — Bebb in Bot. Gaz. xv. 54 (1890). — Coville in Proc. Wash. Acad. Sci. iii. f. 22 (1901). — Fernald in Rhodora, xvi. 170 (1914). — Rydberg, Fl. Rocky Mts. 194 (1917). — *S. myrsinites* Hooker, Fl. Bor.-Am. ii. 151 (1839), an pro parte? — *S. pseudomyrsinites* Andersson in Ofv. Svensk. Vet. Akad. Förh. xv. 129 (1858); in Proc. Am. Acad. iv. 25 (Sal. Bor.-Am. 10) (1858); in Walpers, Ann. Bot. v. 754 (1858), an tantum ex parte? — *S. myrsinites* 2. *S. curtiflora* Andersson in Ofv. Svensk. Vet.-Akad. Förh. xv. 130 (1858); in Proc. Am. Acad. iv. 71 (1858); in Walpers, Ann. Bot. v. 756 (1858), an tantum ex parte? — *S. Novae Angliae* 1. *S. pseudo-myrsinites* Andersson in Svensk. Vet.-Akad. Handl. vi. 160 (1867) ex parte. — *S. Novae Angliae* 2. *S. pseudocordata* Andersson, l. c. 161 (1867), pro parte maxima — *S. Novae Angliae* 3. *S. myrtillofolia* Andersson, l. c. 162 (1867). — *S. Novae Angliae* 4. *S. pseudomyrsinites* Andersson in De Candolle, Prodr. xvi.² 253 (1868), pro parte. — *S. Novae Angliae* 7. *myrtillofolia* Andersson, l. c. (1868). — ? *S. myrtillofolia curtiflora* Rose in Contrib. U. S. Nat. Herb. iii. 573 (1896). — I fully agree with Bebb and Fernald that *S. myrtillofolia* is the correct name to be applied to the forms of the British American and the Rocky Mountain Willows passing as *S. novae angliae* or *S. pseudomyrsinites*. In 1858 Andersson described two American subspecies of *S. myrsinites* as *S. pseudomyrsinites* and *S. curtiflora*, and besides these two to which he gave binomial names, although they were not intended by Andersson to be regarded as species but as subspecies (later changed into varieties), he proposed *S. myrtillofolia* as a good species. In his Monograph in 1867 (not 1865 as quoted by Fernald in 1914), Andersson "in his mature judgment" (as Fernald said) considered these three shrubs as belonging to one North American species," for which he unfortunately proposed a new name: *S. Novae Angliae*, and (in 1868 as varieties) he proposed "tres formas habitu inter se haud parum diversas sed modificationibus numerosis indubie connexas," using the names *S. pseudo-myrsinites*, *S. pseudocordata* (instead of the older *S. curtiflora* of 1858) and *S. myrtillofolia*. In 1868 (not 1864 as quoted by Fernald) in De Candolle, Prodr. xvi.² fasc. II, Andersson went even a step farther in reducing the three subspecies to varieties, and keeping the names used in 1867.

The type of *S. myrtillifolia* of which I have before me a photograph and fragments ex Herb. Kew was collected by Drummond "June 22nd, low situations, Rocky Mountains east side." Of Andersson's subspecies *S. pseudomyrsinites* (1858) the type was found by Douglas "on the grandrapid of Saskatchewan." It is probably preserved in the Hookerian Herbarium, but I have only seen a co-type in Herb. Gray. This specimen is cited by Andersson, in 1867 and 1868, as the type of his forma *lingulata* of the subspecies or variety *pseudomyrsinites*, and Ball in Herb. W. and in his MS.-list regards this form as *S. myrtillifolia* var. *lingulata* (see below.).

Andersson, however, in 1858, under *S. pseudomyrsinites* mentioned another specimen from the Rocky Mountains which is probably the same as the type of what he (in 1867 and 1868) called var. *cordata* of the subspecies or variety *pseudo-myrsinites*. This variety *cordata* has been in the first place described from sterile specimens ("Folia attamen tantum vidi") collected by Drummond which also should be looked for at Kew, but Andersson had before him also a piece of Bourgeau's.* Unfortunately he does not quote the localities where these specimens came from, and I have only seen the material quoted in the footnote which could be regarded as the type of this var. *cordata*. Ball is now using this name for a variety of what he (in Herb. C. and his MS.-list) calls *S. pseudocordata* (see below).

Andersson proposed still another form, *aequalis*, of his subspecies or variety *S. pseudomyrsinites*. In 1867 he quotes as type a specimen collected by Bourgeau "in campement forêt brûlé Rocky Mountains 15 Aug. 1858." I have not seen this type or any other specimen truly representing the form Andersson had in mind. In 1909, Ball described a *S. pseudomyrsinites* var. *equalis* (!), and in Herb. W. and his MS.-list he changes this name to *S. pseudocordata aequalis*. Ball's variety seems to me to present a good species but I doubt whether it is really the same as Andersson's form.

Andersson's second subspecies *S. curtiflora* (1858) is founded on a specimen collected by Richardson at Fort Franklin on the Mackenzie River. There are two specimens of Richardson's in Herb. N. Y. of which the one numbered "no. 69 Hb. H. B. & T." (m., f., fr.) may be identical with the real type (probably preserved in Herb. Kew), but it does not exactly fit Andersson's description made in 1858 in which he states that the pedicels are three times longer than the bracts and four times longer than the gland; some flowers however agree rather well with these indications, and I am unable to distinguish this no. 69 or the second specimen ex Herb. Barratt (N. Y.) "Fort Franklin, low depressed shrub 12 or 14

* This may have been the same of which there is a fragment bearing an old fruiting ament in Herb. Berol. ex Herb. Stockholm, coll. by Bourgeau in 1858 (Palliser's Exped.) in the Rocky Mts. and named by Andersson "*Salix (cordata) pseudomyrsinites*". It agrees with the description of var. *cordata* but the branchlets are pubescent and the leaves hardly more than half an inch wide.

inches long" (m., f.) from typical *S. myrtillofolia*, and Ball, too, in his MS.-list refers *curtiflora* as a synonym to this species.

In 1867 and 1868, Andersson, as already mentioned, changed the name *curtiflora* to *pseudocordata* referring to it also specimens of Bourgeau's ("ad fl. Saskatchewan, prope Fort Pitt"), of which there are male and female fragments in Herb. Berol., and Burke's ("Jaspers house") which I have not yet seen. The specimen from near Fort Pitt represents nothing but typical *S. myrtillofolia*. Besides it he adds "in Rocky Mountains (Drummond)." This last specimen is in the Gray Herbarium and represents No. 659 of Drummond's. According to the label it came with No. 665 which I have seen in Herb. N. Y. Those two numbers consist of male and female pieces with young flowers and leaves, and there is hardly a good character to separate them from *S. myrtillofolia* except that the bracts (at least of the male flowers) are mostly "crispo-albo-villosae" in No. 665 while they are almost glabrous in No. 659, and agree in every respect with those of typical *S. myrtillofolia*. Of course the size and shape of the leaves cannot even be guessed.

There is good reason to doubt whether Andersson's subspecies or variety *pseudocordata* has anything to do with *S. pseudocordata* of Ball in his MS.-list. Rydberg, Fl. Rocky Mts. 194 (1917) has used the names *S. curtiflora* (with the synonym *pseudocordata*) and *S. pseudomyrsinites* apparently for forms different from those which Andersson had before him. I can only hope that Ball will be able to elucidate these critical forms which have been named and renamed by Andersson, as Fernald, said, but also by later authors "in a perplexing fashion."

Fernald, in *Rhodora* xvi. 172 (1914), proposed a *S. myrtillofolia* var. *brachypoda* from Newfoundland, and Ball, as already mentioned, keeps a *S. myrtillofolia* var. *lingulata* in Herb. W. and his MS.-lists (*S. myrsinites* 1. *pseudomyrsinites* Andersson in 1858, see synonymy given above; *S. Novae Angliae* 1. *S. pseudo-myrsinites* b *lingulata* Andersson in 1867; *S. Novae Angliae* α, *pseudo-myrsinites*, 2° *lingulata* Andersson in 1868). I have seen specimens determined by Ball from the Northwest Territories (Fort Providence, Fort Resolution and Hudson Bay) and Saskatchewan, without exact locality, collected by Bourgeau in 1859. The var. *lingulata* does not seem to represent anything but a vigorous form of the type.

Of this I have been able to examine specimens from Alaska (Copper River Region, Yukon Valley), the Yukon Territory (Dawson, Lake Bennett), the Northwest Territories (Fort Franklin, Yahami Mts., Tazin River, Fort Providence, Hudson Bay, Churchill) Alberta, Saskatchewan, Ontario (Lake of Woods), Quebec and Labrador; it probably also occurs in the northern parts of the Rocky Mountains in the United States, where it seems to be replaced by the following species.

63. *S. pseudocordata* Rydberg, Fl. Col. 94 (1906). — ? *S. Novae Angliae* 1. *S. pseudo-myrsinites* Andersson in Svensk. Vet.-Akad. Handl. vi. 161 (Monog. Salic.) (1867), quoad var. a. *cordatam* pro parte et var. c.

aequalem. — *S. Novae Angliae* 2. *S. pseudo-cordata* Andersson, l. c., pro parte. — ? *S. Novae Angliae* α, *pseudo-myrsinites* Andersson in De Candelolle, Prodr. XXI. 253 (1868), quoad 1° *cordatam* pro parte et 3° *aequalem*. — *S. Novae Angliae* β, *pseudo-cordata* Andersson, l. c., pro parte. — *S. cordata* Piper in Contrib. U. S. Nat. Herb. XI. 214 (Fl. Wash.) (1906), pro parte. — *S. pseudomyrsinites* Ball apud Coulter & Nelson, New Man. Rocky Mts. Bot. 133 (1909), incl. var. *equali* Ball. — Rydberg, Fl. Rocky Mts. 194 (1917), pro parte. — *S. curtiflora* Rydberg, l. c. 194 (1917), an tantum pro parte? — As I have already pointed out, I have not been able to compare the specimens which ought to be regarded as the types of Andersson's var. *cordata* (see, however, my footnote on p. 194), var. *aequalis* and his subspecies or variety *pseudocordata*. In 1909, Ball used the name *pseudomyrsinites* "Andersson" for the forms I am inclined to refer to the present species. Andersson did not publish such a species but only a subspecies which he later (1867) reduced to a variety. As explained above Andersson's first subspecies *S. pseudomyrsinites* (1858) is nothing but a form of *S. myrtillofolia* (var. *lingulata* [And.] Ball). Strictly speaking Andersson's subspecies *S. pseudocordata* (1867) is the same as his subspecies *S. curtiflora* (1858) which, as already stated, must be regarded as a synonym of *S. myrtillofolia*. Rydberg did not publish the name *S. pseudocordata* with a new description; he only said: "13. *Salix pseudo-cordata* Andersson (*S. Novae-Angliae pseudocordata* Andersson)." Therefore, in my opinion, the name *S. pseudocordata* Rydberg can hardly stand. I think that the so called *S. pseudomyrsinites* and *pseudocordata* or *curtiflora* of Rydberg and Ball should receive a new name. Ball in 1909 had a *S. pseudomyrsinites* var. *equalis* (having in mind Andersson's var. *aequalis* cited above) and referred it in his MS.-list to *pseudocordata*, of which he also proposes a var. *cordata* which in his opinion is the same as Andersson's var. *cordata* mentioned above. Not having seen Andersson's types I do not know whether Ball is right in regarding them as identical with the forms mentioned below. Without a careful study of the type specimens it seems to me impossible to understand the real meaning of Andersson's descriptions. I sincerely hope that Mr. Ball's investigations will throw much light on these obscure forms. He certainly will give us a good description of this species and its variability.

The following specimens I am inclined to refer to it, partly on the authority of Ball himself. See also the details given in the keys. The forms with pilose pedicels need special observation, and they sometimes remind one of *S. monticola*, having, however, concolor leaves. There may be hybrids among them.

BRITISH COLUMBIA. Kicking Horse Pass, June 21, 1887, *J. Macoun* (No. 35, l. m.; C.). Kananaskis, thickets in the foothills, June 22, 1885, same collector (No. 14, fr.; C.).

ALBERTA. Rocky Mountain Park District, Banff, by the Bow River, June 26, 1891, *J. Macoun* (No. 36, fr.; C.); Banff, August 9, 1904, *J. G. Jack* (fr.; A.; forma incerta). Crows Nest Pass, The Gap, August 4, 1897, *J. Macoun* (No. 94438 and 94439, st., O.).

WASHINGTON. Whitman County, Pullman, *C. V. Piper* (No. 1173, in part, st.; W.; 3598, f.; W.). Kittitas County, Wenatchee Mt., head of Cook Creek, Sept. 3-4, 1901, *F. V. Coville* (Nos. 1175, 1176, st.; W.).

WYOMING. ? Fremont County, Boulder Creek, August 26, 1894, *A. Nelson* (No. 1122, st.; G.); bank of Little Sandy River near Leekie (?), June 28, 1901, *Merrill & Wilcox* (No. 592, m.; N.). Albany County, Woods Creek, along creeks, July 3, 1903, *L. N. Goodding* (No. 1432, f.; M.); forma porro observanda; Centennial, August 7, 1902, *A. Nelson* (No. 8823, fr.; Cor.). ? Sheridan County, Bighorn Mts., Big Goose Creek, July 15-24, 1893, *F. Tweedy* (No. 62, fr.; W.); same mountains, August, 1899, same coll. (No. 2437, fr.; N.; pedicellis pilosis). Yellowstone Park, Golden Gate, June 28, 1899, *A. & Nelson* (Mo. 5549, fr.; G., N.); Obsidian Creek, July 23, 1899, *A. Nelson*, (No. 6070, fr.; pedicellis pilosis; Cor.). Uinta County, Evanston, June 9, 1898, same coll. (No. 4533, m., f.; Cor.); Kemmerer, June 13, 1900, same coll. (No. 7178, fr.; A.; pedicellis parce pilosis). ? County, Green River, May 30, 1897, same coll. (No. 3036, fr. tantum; M.).

IDAHO. Custer County, Mackay (Bear Canyon), July 31, 1911, *Nelson & Macbride* (No. 1551, fr.; G.; pedicellis pilosis).

MONTANA. Park County: without exact locality, 1901, *E. W. Scheuner* (No. 74, m.; N.). Powell County, Deer Lodge Valley, *Blankinship* (No. 790; W.). Beaverhead County, Lima, June 29, 1895, *C. L. Shearer* (No. 3422; W.). Flathead County, Columbia Falls, June 5, 1893, *R. S. W. Williams* (No. 971; W.).

UTAH. ? Summit County, Uinta Mts., Dryer Mine, July 2, 1902, *L. N. Goodding* (No. 1227, fr.; A., G., W.; pedicellis pilosis). Salt Lake County, Salt Lake City, Kimballs, June 3, 1908, *Mrs. J. Clemens* (fr.; St.). Big Cottonwood Canyon, below Silver Lake, *Rydberg & Carlton* (No. 6612, f.; G., N.).

NEVADA. Burnt Timber Mts., Pole Creek, July 15, 1912, *Nelson & Macbride* (No. 2065, fr.; M.).

OREGON. Deschutes (or Crook?) County, swamps wells north slope of Paulina Mts., in water 1 m. in depth, alt. 1690 m., July 13, 1894, *J. B. Leiberger* (No. 422, m. f.; No. 952; A., C.; pedicellis pilosis, distributa sub nomine "*S. Leibergeri* Bebb"); same Mts., in water at shore of West Lake, 2100 m., July 29, 1894, same coll. (No. 579, f.; C.; pedicellis pilosis); Deschutes River, at saw mill, 1½ mi. above Bend, August 8, 1913, *C. R. Ball* (Nos. 1901-1804, f., st.; W.). Crook County, on Little Deschutes River, about 1 mi. north of Pengra, August 14, 1897, *F. C. Coville & E. J. Applegate* (No. 537, st.; W.).

ARIZONA. ? County, White Mountains, Cienegas, head of Little Colorado River, July 10, 1912, *L. N. Goodding* (No. 1153, fr., m.; N.; somewhat doubtful).

b. SOME REMARKS ON THE GEOGRAPHICAL DISTRIBUTION OF THE AMERICAN WILLOWS

Before I conclude my notes on American Willows I wish to say a few words in regard to the geographical distribution of the different sections and species. I suppose it will be of some use to students of the genus and of the flora of a certain state or region in general to give an enumeration of all the species according to their occurrence in the different states based on the material I have been able to examine. Of some states I have seen very little material, and, therefore, my indications are far from exhaustive. I wish to draw the attention of students to the flora of those states or regions where I can give but an incomplete account of the Willows which may occur in them.

Among the twenty-three sections enumerated by me in a later note there are several groups peculiar to America and not represented in the Old World; namely, Sect. *Nigrae*, *Bonplandianae* and *Longifoliae*. Of the *Nigrae* the typical *S. Humboldtiana* is restricted to South America, probably ranging as far south as the Straits of Magellan, while its northern representative, *S. nigra*, reaches the 50th degree N. Lat. in Ontario. No other section covers such a wide area, as it is also found from the Atlantic to the Pacific coast in California.

The species of the *Longifoliae*, too, are widely spread from Guatemala (*S. taxifolia microphylla*) to the vicinity of Dawson in the Yukon Valley, Yukon Territory (*S. longifolia pedicellata*), and in the States from coast to coast.

The *Bonplandianae* inhabit a more restricted area from Guatemala (*S. Bonplandianae* forma) to northern California (*S. laevigata*) or even southern Oregon in the west, and Illinois to the District Columbia (*S. longipes Wardii*) in the east.

Other sections indigenous to Central and North America and apparently of no distinct relationship to forms of the Old World are: *Mexicanae* (three species) in Mexico; *Wolffianae* (one species) in Idaho, Wyoming, Montana, Oregon and Colorado.

The *Candidae* with *S. candida* (and possibly *S. cryptodonta*) are also a section the true affinity of which is by no means clear. It is a Willow of the northern United States from New Jersey to Montana, and of Canada from Labrador to Alberta and probably to British Columbia and the Great Slave Lake in the Northwest Territories.

The *Fulvae*, too, with *S. Bebbiana*, *Geyeriana* and *Lemmonii* are a distinctly American group of which *S. Bebbiana* is a widely spread member from New Mexico to the Yukon Territory, and from Newfoundland and New Jersey to northeastern Nevada and Washington.

Very limited is the range of the strange *Brewerianae* (California), and of the *Sitchenses* (Pacific coast from California to Southern Alaska).

Other sections, like the *Cordatae*, *Adenophyllae*, *Balsamiferae*, *Discolores* and *Griseae*, including only American forms, nevertheless show a more or less distinct affinity to Asiatic and European species, while the sections *Reticulatae*, *Ovalifoliae*, *Glaucæ*, *Phylicifoliae*, *Chrysanthæae* and *Roseae* combine species of the Old and New World.

On the following pages I give an alphabetic enumeration of the species met with in the different states of the United States and of Canada as well as in Mexico and South America. Those species indigenous to or hitherto known only from one state or district are marked with an asterisk. A question-mark signifies that the occurrence of the species or form in the region is still doubtful or that it is not yet clearly identified.

UNITED STATES

ALABAMA: *S. nigra*, longipes var. *Wardii*.

ALASKA: *S. alaxensis* and var. *longistylis*, * *amplifolia*, *arbusculoides*, *arctica* and var. *obcordata*, *Barclayi* and var. *hebecarpa*, *Bebbiana* var. *perrostrata*, * *Chamissonis*, *commutata*, *fuscescens*, * *glacialis*, *glauca* var. *acutifolia*, * *lingulata*, *myrtillifolia*, *niphoelada*, *ovalifolia* and vars. * *camdensis* and * *subarctica*, *phlebophylla*, * *polaris* (typica?) *pulehra* and var. *yukonensis*, *reticulata*, * *rotundifolia* and f. * *pilosiuscula*, *Richardsonii*, *Scouleriana*, *sitchensis*, * *stolonifera* and f. * *subpilosa*, * *venusta* (doubtful), and * *Walpolei*.

ARIZONA: *S. Bebbiana* var. *perrostrata*, *Bonplandiana* var. *Toumeyii*, *exigua* var. *stenophylla*, *Geyeriana*, ? *irrorata*, *laevigata*, *monticola*, *pseudocordata*, *Scouleriana*.

ARKANSAS: *S. cordata*, *humilis*, *longifolia*, longipes var. *Wardii*, *nigra* and var. *altissima*.

CALIFORNIA: *S.* * *Breweri*, *cascadensis*, ? *commutata*, * *Coulteri*, * *delnortensis*, *Eastwoodiae* and var. * *callicoma*, *exigua* forma, *Geyeriana* var. *argentea*, *Goodingii*, *Jepsonii*, *laevigata*, *lasiandra* and vars. *lancifolia* and *caudata*, *lasiolepis* and vars. *Bigelovii* and *Bakeri*, *Lemmonii* and var. *Austinae*, *lutea*, *mackenziana*, *melanopsis* and var. *Bolanderiana*, *orestera*, *planifolia* var. *monica*, * *Parishiana*, *petrophila* and var. *caespitosa*, *Scouleriana* and var. * *crassijulis*, *sessilifolia* vars. *Hindsiana* and * *leucodendroides*, *subcoerulea*.

COLORADO: *S. amygdaloides* f. *pilosiuscula*, *Bebbiana* var. *perrostrata*, *brachycarpa*, *candida*, *exigua* vars. *luteosericea* and *stenophylla*, *Geyeriana* and var. *argentea*, *lasiandra* and var. *caudata*, *irrorata*, *ligulifolia*, *lutea*, *monticola*, *nivalis* and var. *saximontana*, *petrophila*, *planifolia* var. *monica*, *pseudolapponum*, *Scouleriana*, *subcoerulea*, *Wolfii*.

CONNECTICUT: *S. Bebbiana*, *candida*, *discolor*, *cordata*, *humilis*, *longifolia*, *nigra*, *sericea*, *tristis*.

DELAWARE: *S. cordata*, *discolor*, *humilis*, *longifolia*, *lucida*, *nigra*, *tristis*.

DISTRICT COLUMBIA: *S. cordata*, *humilis*, *longifolia*, longipes var. *Wardii*, *nigra*, *sericea*, *tristis*.

FLORIDA: *S. Harbisonii*, *humilis*, longipes, ? *nigra*, *tristis*.

GEORGIA: *S. Harbisonii*, *humilis*, longipes, *nigra*.

IDAHO: *S. amygdaloides* f. *pilosiuscula*, *argophylla*, *Bebbiana* var. *perrostrata*, *bella*, *brachycarpa*, *commutata* var. *puberula*, *exigua* and vars. *nevadensis* and *tenerrima*, *Geyeriana* and var. *argentea*, *lasiolepis* var. *Bigelovii*, *mackenziana*, *melanopsis*, *monochroma*, *pseudocordata*, *Scouleriana*, *sitchensis*, *subcoerulea*, *Wolfii* var. *idahoensis*.

ILLINOIS: *S. adenophylla*, *amygdaloides*, *Bebbiana*, *candida*, *cordata*, *discolor*, *glaucophylloides* var. *glaucophylla*, *humilis*, longipes var. *Wardii*, *lucida*, *missouriensis*, *sericea*, *tristis*.

INDIANA: *S. amygdaloides*, *Bebbiana*, *candida*, *cordata*, *discolor*,

glaucoephylloides var. glaucophylla, humilis, longifolia, lucida, nigra, pedicellaris, petiolaris, sericea, tristis.

IOWA: *S. amygdaloides*, *Bebbiana*, *candida*, *cordata*, *discolor*, *humilis*, *longifolia*, *lucida*, *missouriensis*, *nigra*, *pedicellaris*, *petiolaris*, *sericea*, *tristis*.

KANSAS: *S. cordata*, *amygdaloides*, *longifolia*, *longipes* var. *Wardii*, *nigra*.

KENTUCKY: *S. cordata*, *discolor*, *humilis*, *longipes* var. *Wardii*, *missouriensis*, *nigra*, *sericea*, *tristis*.

LOUISIANA: *S. longifolia*, ? *longipes* var. *venulosa*, *nigra* var. *altissima*.

MAINE: *S. Bebbiana*, *candida*, **coactilis*, *cordata*, *discolor*, *glaucophylloides*, *herbacea*, *longifolia* var. *Wheeleri*, *lucida*, *nigra*, *pellita*, *petiolaris* var. *rosmarinoides*, *planifolia*, *sericea*, *Uva-ursi*.

MARYLAND: *S. cordata*, *humilis*, *longifolia*, *longipes* var. *Wardii*, *nigra*, *sericea*, ? *tristis*.

MASSACHUSETTS: *S. amygdaloides*, *Bebbiana*, *candida*, *cordata*, *discolor*, *humilis*, *longifolia*, *lucida*, *nigra*, *pedicellaris*, *petiolaris*, *sericea*, *serissima*, *tristis*.

MICHIGAN: *S. adenophylla*, *amygdaloides*, *Bebbiana*, *candida*, *cordata*, *discolor*, *glaucophylloides* var. *glaucophylla*, *humilis*, *longifolia* vars. *pedicellata* and *Wheeleri*, *nigra*, *pellita*, *pedicellaris*, *petiolaris*, *sericea*, *serissima*.

MINNESOTA: *S. amygdaloides*, *Bebbiana*, *candida*, *cordata*, *discolor*, *humilis*, *longifolia* var. *pedicellata*, *nigra*, ? *pedicellaris*, *petiolaris*, *pyrifolia*.

MISSISSIPPI: *S. cordata*, *humilis*, *longifolia*, *longipes* var. *Wardii*, *missouriensis*, *nigra*, *tristis*.

MISSOURI: *S. amygdaloides*, *cordata*, *discolor*, *humilis*, *longifolia*, *longipes* var. *Wardii*, *missouriensis*, *nigra*, *sericea*, *tristis*.

MONTANA: *S. amygdaloides*, *Barclayi* and var. *conjuncta*, *Barrattiana* var. *Tweedyi*, *bella*, *brachycarpa*, *candida*, *commutata*, ? *Drummondiana*, *exigua* and var. *tenerrima*, *Geyeriana* and var. *meleina*, *lasiandra* var. *caudata*, *lutea*, *mackenzieana*, *melanopsis*, *monochroma*, *monticola*, *nivalis* and var. *saximontana*, *petrophila*, *planifolia* var. *monica*, *pseudocordata*, *pseudolapponum*, *Scouleriana*, *sitchensis*, *subcoerulea*, *vestita* var. *erecta*, *Wolffi* var. *idahoensis*.

NEBRASKA: *S. amygdaloides*, *Bebbiana* var. *perrostrata*, *cordata*, *exigua* var. *luteosericea*, *Geyeriana*, *humilis*, *longifolia*, *missouriensis*, *nigra*, *tristis*.

NEVADA: *S. amygdaloides* f. *pilosiuscula*, *Bebbiana* var. *perrostrata*, ? *commutata*, *Eastwoodiae* and var. *callicoma*, *exigua* and var. *nevadensis*, *Goodingii*, *laevigata*, *lasiandra* and var. *caudata*, *lasiolepis* var. *Bigelovii*, *Lemmonii*, *ligulifolia*, *lutea*, *nivalis* var. *saximontana*, *orestera*, *petrophila* and var. *caespitosa*, *pseudocordata*, *Scouleriana*, *subcoerulea*.

NEW HAMPSHIRE: *S. argyrocarpa*, *Bebbiana*, *cordata*, *discolor*, *herbacea*, *longifolia*, *lucida*, *nigra*, *planifolia*, *pyrifolia*, ? *serissima*, *Uva-ursi*,

NEW JERSEY: *S. Bebbiana*, *candida*, *cordata*, *discolor*, *humilis*, *longifolia*, *lucida*, *nigra*, *petiolaris*, *sericea*, *serissima*, *tristis*.

NEW MEXICO: *S. amygdaloides* var. *Wrightii*, *Bebbiana* var. *perrostrata*, ? *cordata*, *exigua* var. *stenophylla*, *Gooddingii*, *irrorata*, *lasiandra* and var. *caudata*, *ligulifolia*, *monticola*, *nivalis* var. *saximontana*, *planifolia* var. *monica*, *petrophila*, ? *pseudolapponum*, *Scouleriana*, *subcoerulea*.

NEW YORK: *S. amygdaloides*, *Bebbiana*, *candida*, *cordata*, *discolor*, *humilis*, *longifolia*, *lucida*, *nigra*, *pedicellaris*, *petiolaris*, *pyrifolia*, *sericea*, *serissima*, *tristis*, *Uva-ursi*.

NORTH CAROLINA: *S. cordata*, *Harbisonii*, *humilis*, *longipes*, *nigra*, *sericea*, *tristis*.

NORTH DAKOTA: *S. ? Bebbiana*, *candida*, ? *cordata*, *humilis*, *longifolia*, *lucida*, *lutea*.

OHIO: *S. adenophylla*, *amygdaloides*, *Bebbiana*, *candida*, *cordata*, *discolor*, *glaucophylloides* var. *glaucophylla*, *humilis*, *longifolia*, *lucida*, *nigra*, *petiolaris*, *sericea*, *serissima*.

OKLAHOMA: *S. amygdaloides*, *exigua* var. *stenophylla*, *longipes* var. *Wardii*, *nigra*.

OREGON: *S. amygdaloides* f. *pilosiuscula*, *argophylla*, *Barclayi* var. *conjuncta*, *Bebbiana* var. *perrostrata*, *brachycarpa*, *commutata* and vars., ? *Eastwoodiae*, *exigua*, *fluvialis*, *Geyeriana* and vars., *Hookeriana* and var. *tomentosa*, *lasiandra* and vars., *lasiolepis* var. *Bigelovii*, *Lemmonii* var. *Austinae*, *lutea*, *mackenzicana*, *melanopsis*, *monochroma*, *nivalis* var. *saximontana*, *petrophila*, *Piperi*, *pseudocordata*, *Scouleriana*, *sessilifolia* and var. *Hindsiana*, *sitchensis*, *subcoerulea*, *vestita* var. *erecta*, *Wolfii* var. *idahoensis*.

PENNSYLVANIA: *S. adenophylla*, *Bebbiana*, *candida*, *cordata*, *discolor*, *humilis*, *longifolia*, *lucida*, *nigra*, *petiolaris*, *sericea*, *tristis*.

RHODE ISLAND: *S. Bebbiana*, *cordata*, *discolor*, *humilis*, *longifolia*, *nigra*, *sericea*, *tristis*.

SOUTH CAROLINA: *S. ? cordata*, *Harbisonii*, ? *humilis*, *longipes*, *nigra*, *sericea*.

SOUTH DAKOTA: *S. amygdaloides*, *Bebbiana* var. *perrostrata*, *cordata*, *discolor*, *exigua* var. *luteosericea*, *lasiandra* var. *caudata*, *longifolia*, *lucida*, *lutea*, *nigra*, *Scouleriana*.

TENNESSEE: *S. cordata*, *nigra*, *longipes* var. *Wardii*, *tristis*.

TEXAS: *S. amygdaloides* and var. *Wrightii*, ? *cordata*, *exigua* var. *stenophylla*, *Gooddingii*, *humilis*, ? *irrorata*, *longifolia* var. *angustissima*, *longipes* var. *venulosa*, *nigra* and vars. *altissima* and *Lindheimeri*.

UTAH: *S. amygdaloides* f. *pilosiuscula*, *Bebbiana* var. *perrostrata*, *brachycarpa*, *exigua* vars. *nevadensis* and ? *tenerima*, *Geyeriana*, *lasiandra* var. *caudata*, *ligulifolia*, *lutea*, *monticola*, *nivalis* var. *saximontana*, *petrophila*, *planifolia*, *pseudocordata*, ? *pseudolapponum*, *Scouleriana*.

VERMONT: *S. amygdaloides*, *Bebbiana*, *candida*, *cordata*, *discolor*,

humilis, *longifolia*, *lucida*, *nigra*, *pellita*, *planifolia*, *pyrifolia*, *sericea*, ? *serissima*, *Uva-ursi*.

VIRGINIA: *S.* ? *cordata*, *Harbisonii*, *humilis*, *longipes* and var. *Wardii*, *nigra*, *sericea*, *tristis*.

WASHINGTON: *S.* *amygdaloides* f. *pilosiuscula*, *argophylla*, *Barclayi* and var. *conjuncta*, *Bebbiana* var. *perrostrata*, *bella*, *cascadensis*, *commutata* with its three varieties, *exigua*, *Geyeriana* var. *meleina*, *Hookeriana*, *lasiandra* and vars. *caudata* and *lancifolia*, *mackenzieana*, *melanopsis*, *monochroma*, *nivalis* and var. *saximontana*, *pedicellaris*, *pennata*, *pseudocordata*, *Scouleriana*, *sessilifolia*, *sitchensis*, *subcoerulea*.

WEST VIRGINIA: *S.* ? *cordata*, *humilis*, *nigra*, *sericea*.

WISCONSIN: *S.* *adenophylla*, *amygdaloides*, *Bebbiana*, *candida*, *cordata*, *discolor*, *glaucohyllodes* var. *glaucohylla*, *humilis*, *longifolia* vars. *pedicellata* and *Wheeleri*, *pedicellaris*, *nigra*, ? *petiolaris*, *serissima*, *tristis*.

WYOMING: *S.* ? *Barclayi*, *Barrattiana* var. *Tweedyi*, *brachycarpa*, *candida*, *cascadensis*, * *Dodgeana*, *exigua* and vars. *stenophylla* and *tenerrima*, *Geyeriana* and var. *argentea*, *lasiandra* var. *caudata*, *ligulifolia*, *mackenzieana*, *monochroma*, *monticola*, *nivalis* var. *saximontana*, *petrophila*, *planifolia monica*, *pseudocordata*, *pseudolapponum*, *Scouleriana*, *subcoerulea*, *Wolfii* and var. *idahoensis*.

CANADA

ALBERTA: *S.* *anglorum* var. *araioclada*, *arbusculoides*, *Barclayi*, *Barrattiana*, *Bebbiana*, *bella*, *brachycarpa* and var. *glabellcarpa*, *candida*, *commutata*, *Drummondiana*, *exigua*, *glauca* vars. *acutifolia* and *glabrescens*, *lasiandra* and var. *caudata*, *longifolia* var. *pedicellata*, *lutea*, *Maccalliana*, *mackenzieana*, *melanopsis*, *myrtillifolia*, *nivalis* and var. *saximontana*, *petiolaris* var. *rosmarinoides*, *planifolia* var. *monica*, *petrophila*, *pseudocordata*, *pseudolapponum*, *Scouleriana*, *vestita* var. *erecta*.

BRITISH COLUMBIA: *S.* *alaxensis*, *anglorum* var. *araioclada*, *arctica* and var. *subcordata*, *argophylla*, *Barclayi* and var. *conjuncta*, *Barrattiana*, *Bebbiana* var. *perrostrata*, *candida*, *commutata*, ? *Drummondiana*, *exigua*, *Geyeriana* var. *meleina*, *glauca* vars. *acutifolia* and *glabrescens*, *Hookeriana*, *lasiandra* and vars., *Maccalliana*, *mackenzieana*, *melanopsis*, *monochroma*, *nivalis* and var. *saximontana*, ? *petiolaris* var. *rosmarinoides*, *petrophila*, ? *prolixa*, *pseudocordata*, ? *pyrifolia*, *pulchra*, *Richardsonii*, *Scouleriana*, *sessilifolia*, *sitchensis*, *vestita* var. *erecta*, and spec. coll. *Eastwood*.

LABRADOR: *S.* *adenophylla*, *anglorum*, *arctophila*, *argyrocarpa*, *calicicola*, *candida*, ? *cordata*, *cordifolia* and vars. *atra*, *hypoprionota* and *Macounii*, *herbacea*, *laurentiana*, *myrtillifolia*, *pellita*, *planifolia*, *pyrifolia*, *vestita*, *Uva-ursi*.

MANITOBA: *S.* *adenophylla*, *amygdaloides*, *Bebbiana*, *brachycarpa*, *calicicola*, *candida*, ? *cordata*, *discolor*, *longifolia* var. *pedicellata*, *lucida*,

Maccalliana, petiolaris var. rosmarinoides, ? planifolia, pyrifolia, serissima.

NEW BRUNSWICK: *S. Bebbiana*, candida, cordata, discolor, lucida, nigra, pellita, petiolaris, pyrifolia, sericea.

NEWFOUNDLAND: *S. anglorum* var. *kophophylla*, *Bebbiana* and var. * *projecta*, *calicicola*, candida, ? cordata, cordifolia and var. *Macounii*, discolor, glaucophylloides, * *leiolepis*, lucida, myrtillifolia var. *brachypoda*, pellita, pyrifolia, reticulata, *Uva-ursi*, vestita.

NOVA SCOTIA: *S. Bebbiana*, ? cordata, discolor, lucida, pyrifolia.

NORTHWEST TERRITORIES: *S. adenophylla*, *alaxensis*, *anglorum*, arbusculoides, *arctophila*, *Bebbiana* and var. *perrostrata*, *brachycarpa*, candida, *chlorolepis*, cordifolia, * *desertorum*, * *fullertonensis*, glauca var. *acutifolia*, herbacea, * *hudsonensis*, longifolia var. *pedicellata*, *mackenziana*, myrtillifolia, *nipoclada*, ? planifolia, pyrifolia, reticulata, *Richardsonii*, *Uva-ursi*, vestita.

ONTARIO: *S. adenophylla*, *amygdaloides*, *Bebbiana*, *calicicola*, cordata, discolor, humilis, glaucophylloides var. *glaucophylla*, humilis, *Maccalliana*, myrtillifolia, nigra, pellita, petiolaris and var. *rosmarinoides* pyrifolia, serissima.

QUEBEC: *S. adenophylla*, *amygdaloides*, *anglorum* vars. * *antiplasta*, *araioclada* and *kophophylla*, *arctophila*, *argyrocampa*, *Bebbiana*, *calicicola*, candida and var. *denudata*, *chlorolepis* and var. * *antimima*, cordata, cordifolia and vars., discolor, *fuscescens* var. *hebecarpa*, glaucophylloides, herbacea, * *laurentiana*, longifolia var. *pedicellata*, lucida, myrtillifolia, nigra, * *obtusata*, * *paraleuca*, pellita, petiolaris var. *rosmarinoides*, planifolia, pyrifolia, reticulata, serissima, *Uva-ursi*, vestita.

SASKATCHEWAN: *S. Bebbiana*, *brachycarpa*, candida, ? cordata, discolor, longifolia *pedicellata*, lutea, *Maccalliana*, myrtillifolia, petiolaris, *rosmarinoides*, pyrifolia, *Scouleriana*, serissima.

YUKON TERRITORY: *S. alaxensis* and var. * *longistylis*, arbusculoides, ? *anglorum*, arctica, *Bebbiana* var. *perrostrata*, glauca var. *acutifolia*, *lasiandra* and var. *lanceifolia*, longifolia var. *pedicellata*, myrtillifolia, *pulehra* and var. *yukonensis*, reticulata, *Richardsonii*, *Scouleriana*, and spec. coll. Eastwood.

WESTERN GREENLAND: *S. anamesa*, *anglorum*, *arctophila*, cordifolia, glauca var. *ovalifolia*, herbacea, *Uva-ursi*.

CENTRAL AMERICA

CUBA: *S. longipes*.

GUATEMALA: *S. Bonplandiana* forma, *Humboldtiana* var. *stipulacea*.

MEXICO: *S. amygdaloides* var. *Wrightii*, *Bonplandiana* and vars., * *cana*, * *Endlichii*, *exigua* var. *stenophylla*, *Gooddingii*, * *Hartwegii*, *Humboldtiana* var. *stipulacea*, * *jaliscana*, *lasiolepis*, longifolia var.

angustissima, * mexicana, nigra var. Lindheimeri, * oxylepis, * paradoxa and var. * ajuseana, * Rowleei and var. * cana, * Schaffneri, taxifolia and var. * microphylla.

SOUTH AMERICA: *S. Humboldtiana* and var. * *Martiana*.

DAHLEM-BERLIN, March, 1921.

A LIST OF THE TREES OF LOUISIANA

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THIS catalogue is based upon collections made by the writer during the past fifteen or sixteen years. During that period every portion of the State has been investigated and, with the exception of *Crataegus*, it is believed the list is very nearly a complete one. Specimens of all the trees listed are in the Tulane Herbarium and in that of the Arnold Arboretum. Professor Sargent who has accompanied me on many expeditions in different parts of the State has revised the identifications, and I am deeply indebted to him for his interest and constant assistance. For most trees the time of flowering and of the mature fruit has been given. In the case of flowers this is subject to considerable variation, perhaps as much as three weeks earlier and later in different years. This year, 1921, many trees were flowering in January which normally bloom in February or even in March.

In West Feliciana Parish several trees probably attain their maximum heights as shown by the following measurements carefully made by Mr. Edward Butler of Catalpa in that Parish.

Liriodendron Tulipifera, height 181 feet; girth 16½ feet.

Quercus alba, height 182 feet; girth 14½ feet.

Carya cordiformis, height 171 feet; girth 12½ feet.

Fagus grandifolia var. *caroliniana*, height 125½ feet; girth 12 feet, 10 inches.

Ilex opaca, height 100 feet; girth 5 feet, 8 inches.

Acer saccharum var. *glaucum*, height 92 feet, 8 inches; girth 6 feet.

Magnolia acuminata var. *ludoviciana*, height 91 feet; girth 7 feet, 8 inches.

Magnolia grandiflora, height 147 feet; girth 12 feet.

PINACEAE

Pinus palustris Mill. Pine flats: St. Tammany, Tangipahoa, Beauregard, Calcasieu and Allen Parishes. Pine hills: Washington, Tangipahoa, St. Helena, Beauregard, Winn, Grant, LaSalle and Natchitoches Parishes.

Pinus echinata Mill. Mostly on uplands north of the *Pinus palustris* region, between Ouachita River and the Texas border, and along the Arkansas border.

Pinus caribaea Morelet. Confined to eastern Louisiana. In Washington Parish sometimes forming pure forests. Also in St. Tammany, Tangipahoa and St. Helena Parishes. Usually in poor, undrained soil.

Pinus taeda L. As second growth all over eastern Louisiana except in alluvial or swamp lands. West of the Mississippi River mostly in level woods bordering on grassy marshes. Very common near the Arkansas line. Trees occur in practically every parish in the State except in those which are entirely alluvial.

Pinus glabra Walt. All over eastern Louisiana except in Cypress-swamps, usually mingled with other evergreen and with deciduous-leaved trees. Most abundant in Washington Parish.

Taxodium distichum Rich. Swamps all over the State.

Taxodium distichum var. *imbricarium* Sarg. Not uncommon in vicinity of Pearl River.

Chamaecyparis thyoides B. S. P. According to Dr. Charles Mohr (Plant Life of Alabama, p. 325) this tree occurs in East Louisiana. I have never found it.

Juniperus virginiana L. In dry hilly regions. East and West Feliciana, and East Baton Rouge Parishes. Occasional all over the State; has been very extensively planted for ornament and possibly many of the trees are escapes.

Juniperus lucayana Britt. Occasional over the State. This tree has also been extensively planted and in many places where it occurs is probably naturalized.

LILIACEAE

Yucca aloifolia L. Sandy soil in eastern Louisiana, sometimes nearly 30 feet high, usually about 10 feet.

SALICACEAE

Populus heterophylla L. Swamps over the State. Flowers March 20. Fruit May 1.

Populus balsamifera var. *virginiana* Sarg. Alluvial soil over the State. Flowers March 1-15. Fruit April 15.

Salix nigra Marsh. Wet places over the State. Flowers January 25. Fruit April 15.

Salix nigra var. *altissima* Sarg. Wet places. Richland, West Feliciana.

Salix longifolia Muehl. Borders of rivers over State. Flowers February 15. Fruit April 2.

Salix longipes var. *venulosa* Schneid. Near New Orleans, Drummond, (1832); not seen again.

MYRICACEAE

Myrica cerifera L. All over the State. Occasionally near water courses a tree 40 feet high. More often a shrub. Flowers April 15. Fruit August.

JUGLANDACEAE

Juglans nigra L. Rich alluvial soil over the State. Flowers March 15 to April 15. Fruit October.

Carya pecan Aschers. & Graebn. Rich woods East and West Feliciana Parishes; in Calcasieu Parish and probably elsewhere.

Carya texana Schneid. This rare tree occurs near Lake Charles, near Shreveport and in West Feliciana Parish. Rich alluvial soil. Flowers April 1. Fruit October.

Carya cordiformis K. Koch. Never very common. I have found it in the vicinity of Lake Charles near the Texas border, in West Feliciana Parish, and near Alexandria, Rapides Parish. Flowers March 28. Fruit October.

Carya aquatica Nutt. Swamps and along water courses over the State. Flowers April 3. Fruit October.

Carya myristiciformis Nutt. A very rare tree, local in range. I have seen it only near Natchitoches, Natchitoches Parish, and in Richland Parish. Flowers April 5. Fruit October.

Carya ovata K. Koch. Not a common tree in Louisiana. I have not seen trees of it in East Louisiana. West of the Mississippi River, abundant near Opelousas, St. Landry Parish, and in Richland and Franklin Parishes. Rich, wet woods. Flowers April 1. Fruit October.

Carya laciniosa Schneid. Known only in West Feliciana Parish, where it was first reported eighty years ago by W. B. Carpenter. Flowers April 10. Fruit October.

Carya alba K. Koch. In dry woods over the State. Flowers April 3. Fruit October.

Carya leiodermis Sarg. Widely distributed over the State in wet, flat woods. Specimens have been collected in St. Tammany, Tangipahoa, Natchitoches, Richland, St. Landry and Winn Parishes. Flowers April 1. Fruit October.

Carya leiodermis var. *callicoma* Sarg. Wet woods. Calcasieu and St. Tammany Parishes. Flowers April 3. Fruit October.

Carya pallida Ashe. Only known in the state near Kentwood, Tangipahoa Parish where it is abundant. Flowers April 20. Fruit October.

Carya glabra var. *megacarpa* Sarg. A common tree in upland woods, in East and West Feliciana Parishes; occasionally 140 feet high. Flowers March 28. Fruit October. Has not been found west of the Mississippi River.

Carya Buckleyi var. *arkansana* Sarg. Dry woods. Bossier, Winn, and St. Landry Parishes. Not seen east of the Mississippi River.

BETULACEAE

Carpinus caroliniana Walt. Rich woods over the State. Flowers March 28. Fruit May 1-15.

Ostrya virginiana K. Koch. Rich woods over the State. Flowers

March 28. Fruit May.

Betula nigra L. Sandy banks of rivers over the State. Flowers April 1-15.

FAGACEAE

Fagus grandifolia var. *caroliniana* Fern. & Rehd. Usually on rolling hills over the State. Flowers March 15. Fruit August.

Fagus grandifolia var. *caroliniana* f. *mollis* Fern. & Rehd. West Feliciana Parish. Flowers March 15. Fruit August.

Castanea pumila Mill. Borders of swamps and on rolling hills over the State. Flowers March 15. Fruit August.

Castanea alnifolia var. *floridana* Sarg. Near Covington, St. Tammany Parish. Flowers March 6. Fruit August.

Quercus Shumardii Buckl. Rich alluvial woods over the State. Flowers March 1. Fruit October.

Quercus Shumardii var. *Schneckii* Sarg. With the type.

Quercus velutina Lam. Nowhere very common but widely distributed over the State.

Quercus Catesbaei Michx. Dry sandy soil. St. Tammany and Tangipahoa Parishes.

Quercus rubra L. Dry woods and sandy soil over the State. Flowers February 25. Fruit October.

Quercus rubra var. *triloba* Ashe. Occasional with the type.

Quercus rubra var. *pagodaefolia* Ashe. Rich moist woods and borders of streams. Over the State.

Quercus rubra var. *leucophylla* Ashe. Low wet woods. Very common near Mandeville, St. Tammany Parish.

Quercus marilandica Muenchh. Dry sandy soil over the State. Flowers April 3. Fruit October.

Quercus nigra L. All over the State in both wet and dry soil. Flowers February 15. Fruit October.

Quercus nigra f. *tridentifera* Sarg. Occasional with the type.

Quercus rhombica Sarg. Rich woods and borders of swamps over the State. Flowers February 25. Fruit October.

Quercus Phellos L. Rich woods and borders of streams over the State. Flowers April 3. Fruit October.

Quercus laurifolia Michx. Known in the State only near Bogalusa, Washington Parish, where it is abundant. Flowers April 5. Fruit October.

Quercus cinerea Michx. Dry sandy soil over the State. Flowers April 5. Fruit October.

Quercus Durandii Buckl. In rich woods in the neighborhood of Natchitoches, Natchitoches Parish. Not seen elsewhere.

Quercus macrocarpa Michx. Caldwell Parish. Inserted on authority of Professor George Williamson of the State Normal College, Natchitoches.

Quercus lyrata Walt. In low wet woods over the State. Flowers April 2. Fruit October.

Quercus stellata Wang. In both wet and dry soil over the State, except in Cypress-swamps. Flowers April 3. Fruit October.

Quercus stellata var. *Margaretta* Sarg. Natchitoches and Rapides Parishes.

Quercus stellata var. *Margaretta* f. *stolonifera* Sarg. Seen only in one locality near Bogalusa, Washington Parish.

Quercus stellata var. *araneosa* Sarg. Natchitoches Parish.

Quercus stellata var. *paludosa* Sarg. Rich soil subject to overflow near Washington, St. Landry Parish.

Quercus alba L. Over the State except in swamps. Flowers April 1-15. Fruit October.

Quercus alba var. *latiloba* Sarg. Not uncommon with the type.

Quercus alba var. *repanda* Mich. Known only from one station near Pontchatoula, Tangipahoa Parish.

Quercus Prinus Michx. Swamps and rich flat woods over the State.

Quercus Muehlenbergii Engelm. A somewhat rare tree in Louisiana. In East Louisiana seen only once in West Feliciana Parish. More common in West Louisiana, in Richland, Natchitoches and Franklin Parishes.

× *Quercus ludoriciana* Sarg. (*Q. rubra* var. *pagodaefolia* × *Q. Phellos*). Inundated woods. St. Landry Parish.

× *Quercus Cocksii* Sarg. (*Q. rhombica* × *Q. velutina*). Rapides Parish.

× *Quercus Comptonae* Sarg. (*Q. lyrata* × *Q. virginiana*). Planted for ornament in Louisiana and Mississippi. Trees in New Orleans are said to have been brought from woods in the vicinity of Madisonville, St. Tammany Parish. I have not seen this tree growing wild.

ULMACEAE

Ulmus americana L. Rich woods over the State. Flowers January 5-15. Fruit March 1.

Ulmus alata Mich. Borders of swamps and rich woods over the State. Flowers January 5-15. Fruit March 1.

Ulmus fulva Mich. A rather rare tree along streams and in rich soil over the State. Flowers February 15. Fruit March 8.

Ulmus crassifolia Nutt. A common tree in the northern part of the State; not found east of the Mississippi River. Flowers March 15.

Planera aquatica Gemel. Along water courses over the State. Flowers April 1. Fruit May 1.

Celtis laevigata Willd. Rich soil over the State. Flowers March 5. Fruit August.

MORACEAE

Morus rubra L. Rich soil over the State. Flowers April 1. Fruit June.

Maclura pomifera Schneid. Widely distributed over the State. Prob-

ably an escape from cultivation, except possibly in the extreme north-western part of the State.

MAGNOLIACEAE

Magnolia grandiflora L. Rich soil over the State. Flowers April 10–June 1. Fruit August.

Magnolia virginiana var. *australis* Sarg. Swampy places over the State. Flowers April 5.

Magnolia acuminata var. *ludoviciana* Sarg. Known only in West Feliciana Parish where it is not uncommon. Flowers April 2.

Magnolia Fraseri Walt. Known only in West Feliciana Parish where it is rare. Flowers April 1.

Magnolia macrophylla Michx. St. Tammany Parish, East Louisiana; rare; abundant in Winn Parish, northwest Louisiana. Flowers April 15.

Liriodendron Tulipifera L. Rich soil over the State. Flowers April 10. Fruit October.

ANONACEAE

Asimina triloba Dunal. Rich soil over the State. Most common and attaining its largest size in West Feliciana Parish. Flowers April 4. Fruit August.

LAURACEAE

Persea Borbonia Spreng. Borders of streams and swamps over the State. Flowers April 5. Fruit September.

Persea palustris Sarg. Very abundant in Pine-barren swamps in East Louisiana. Not seen west of the Mississippi River. Flowers April 15.

Sassafras officinale Nees & Ebermaier. In dry sandy soil as a shrub over the State; in rich alluvial soil becoming a large tree 70 feet high; attaining its largest size in Richland and Franklin Parishes. Flowers March 30.

HAMAMELIDACEAE

Liquidambar styraciflua L. In rich soil and borders of swamps over the State. Flowers March 15. Fruit June.

Hamamelis macrophylla Pursh. On rolling hills and borders of streams over the State. Usually a shrub, sometimes a tree up to 40 feet in height. Flowers December 15 to January 10.

PLATANACEAE

Platanus occidentalis L. Common over the State. Flowers April 5. Fruit June.

ROSACEAE

Malus angustifolia Michx. Very abundant in East Louisiana where it occasionally forms extensive thickets in open pine barrens; in West Louisiana only near Winnfield, Winn Parish. Flowers March 1-15. Fruit September.

Malus ioensis var. *Palmeri* Rehd. In wet open woods, Natchitoches and St. Landry Parishes. Flowers April 15. Fruit September.

Malus ioensis var. *crenisserrata* Rehd. Rich woods near Alexandria, Rapides Parish, and near Crowley, Acadia Parish. Flowers April 3-15. Fruit September.

Amelanchier canadensis L. A rather rare tree but widely distributed over the State. Flowers March 2. Fruit May 5.

Crataegus Bushii Sarg. Calcasieu Parish near Lake Charles. Large spreading tree. Flowers April 5. Fruit October 15.

Crataegus Cocksii Sarg. Winn Parish near Winnfield quarries, Natchitoches, Natchitoches Parish. Flowers April 15. Fruit October.

Crataegus edita Sarg. Low wet woods. Near Opelousas, St. Landry Parish, and in Natchitoches Parish. Flowers April 10. Fruit October 5.

Crataegus tersa Beadle. Upland woods near Opelousas, St. Landry Parish and in vicinity of Natchitoches, Natchitoches Parish. Flowers April 10. Fruit October 5.

Crataegus crocina Beadle. Natchitoches, Natchitoches Parish. Flowers April 1-15. Fruit October 1.

Crataegus algens Beadle. Minden, Webster Parish. Flowers April 15.

Crataegus berberifolia T. & G. Wet flat woods near Opelousas, St. Landry Parish, Crowley Acadia Parish. Flowers April 10. Fruit October 5.

Crataegus fera Beadle. Low wet woods near Opelousas, St. Landry Parish; also near Natchitoches, Natchitoches Parish. Flowers April 12. Fruit October 5.

Crataegus edura Beadle. Crowley, Acadia Parish, and Natchitoches, Natchitoches Parish.

Crataegus pyracanthoides Beadle. Low woods, West Lake Charles, Calcasieu Parish. Flowers March 23.

Crataegus opaca Hook. Borders of streams and ponds in Pinebarrens over the State. In St. Tammany Parish sometimes covering many acres with exclusive growth or mixed with *Malus angustifolia* Michx. Flowers February 15. Fruit May.

Crataegus viridis L. This is the largest, the commonest and the most widely distributed species of *Crataegus* in Louisiana; sometimes the only growth for miles along rivers. Occurs in low grounds in all parts of the State. Flowers March 1. Fruit October.

Crataegus velutina Sarg. Natchitoches, Natchitoches Parish. Flowers April 15. Fruit October 8.

Crataegus drymophila Sarg. Rare. A few trees near Mandeville, St. Tammany Parish, in dry pine woods. Flowers March 15. Fruit August.

Crataegus florens Beadle. Abundant in West Feliciana Parish along the roads and on dry rolling hills. Usually shrubby. Flowers March 31. Fruit August.

Crataegus apiifolia Michx. Widely distributed over the State, in wet and dry soil, equally common in East and West Louisiana. Flowers March 15. Fruit October.

Crataegus spathulata Michx. Widely distributed over the State. The last *Crataegus* to bloom in the spring. Occurs in a variety of soils and situations. Flowers April 25. Fruit October.

Crataegus brachyacantha Sarg. & Engelm. Very common in wet Pine-barrens near Covington, St. Tammany Parish; also near Opelousas, St. Landry Parish and in Natchitoches Parish. Usually near water courses. Flowers April 10. Fruit August.

Prunus umbellata Ell. Sandy soil in Pine-barrens. St. Tammany, Tangipahoa and throughout the northern parishes. Flowers March 1. Fruit October.

Prunus umbellata var. *tarda* Wight. Dry woods in vicinity of Natchitoches, Natchitoches Parish. Flowers March 15. Fruit October.

Prunus americana Marsh. Swampy woods in vicinity of New Orleans. Flowers February 25. Fruit October.

Prunus lanata Mack. & Bush. Widely distributed in East and West Louisiana; East and West Feliciana, East Baton Rouge, St. Tammany, Rapides and Natchitoches Parishes.

Prunus mexicana S. Wats. East and West Louisiana. West Feliciana, East Baton Rouge, Rapides, Natchitoches, Richland, and Calcasieu Parishes. Flowers February 25. Fruit September to November.

Prunus Munsoniana Wight & Hedr. Common in the vicinity of Natchitoches, Natchitoches Parish. Flowers March 15. Fruit September.

Prunus angustifolia Marsh. Widely distributed over the State. Perhaps always naturalized. Flowers February 25. Fruit May and June.

Prunus serotina Ehrh. Over the state, nowhere very abundant. Flowers March 15. Fruit August.

Prunus caroliniana Ait. All over the State, but as it has been much planted for ornament it has probably often become naturalized. Undoubtedly native in East and West Feliciana Parishes. Flowers February 15. Fruit August.

LEGUMINOSAE

Cercis canadensis L. Along streams and in rich woods over the State. Flowers March 5. Fruit May.

Gleditsia triacanthos L. Borders of swamps over the State. Flowers March 15. Fruit June.

Gleditsia aquatica Marsh. With the preceding species but not as common. Sometimes forming large thickets in deep water. Flowers March 15. Fruit June.

Sophora affinis T. & G. On high bluffs along the Red River in vicinity of Shreveport, Caddo Parish. Flowers April 15. Fruit June.

Robinia Pseudoacacia L. Now naturalized in all parts of the State. Flowers March 1. Fruit May.

ANACARDIACEAE

Rhus copallina L. Over the whole State; of its largest size in West Feliciana Parish where the trunks are used for fence posts. Flowers April 15. Fruit August.

Rhus glabra L. Over the whole State usually near water courses, often in dry fields; usually a shrub, occasionally a tree 20-30 feet high. Flowers April 10. Fruit August.

Rhus vernix L. Along streams and in wet woods. Not common but widely distributed. Flowers April 15. Fruit August.

CYRILLACEAE

Cyrilla racemiflora L. Wet places and along streams in Pine-woods over the State. Flowers June 1. Fruit July.

Cliftonia monophylla Britt. Along streams in pine woods. Seen only in St. Tammany Parish and near Bogalusa, Washington Parish. Flowers April 15.

AQUIFOLIACEAE

Ilex opaca Ait. Over the whole State. Of its largest size in West Feliciana Parish. Flowers April 15.

Ilex Cassine L. In deep swamps in the vicinity of New Orleans and Avery Island, Iberia Parish. Flowers April 15.

Ilex vomitoria Ait. Over the entire State. In pine barrens sometimes forming extensive thickets. Flowers April 15.

Ilex decidua Walt. Borders of streams and swamps over the State. Flowers April 5.

Ilex lucida T. & G. Usually a shrub. Near Bogalusa, Washington Parish 20-30 feet high and arborescent. Flowers April 15.

ACERACEAE

Acer saccharum var. *glaucum* Sarg. Only in West Feliciana and Natchitoches Parishes; rare.

Acer floridanum Pax. Rare in East Louisiana, and only in West Feliciana Parish; more abundant in Natchitoches and Rapides Parishes. Flowers April 10.

Acer leucoderme Small. In rich moist woods over the State. Flowers April 2.

Acer saccharinum L. Seen only in swampy woods along the Red River near Alexandria, Rapides Parish.

Acer rubrum L. Swamps over the State; less common than its varieties. Flowers January 5. Fruit February.

Acer rubrum var. *Drummondii* Sarg. The common Red Maple in the neighborhood of New Orleans and in East Louisiana. Flowers January 5. Fruit February.

Acer rubrum var. *Drummondii* f. *rotundatum* Sarg. St. Tammany and Natchitoches Parishes, in comparatively dry woods.

Acer rubrum var. *tridens* Wood. The common form in North Louisiana. It occurs in less swampy places than the other varieties. Flowers January 15 to March 15 in different parts of the State.

Acer Negundo L. Borders of swamps and rich woods over the State. Flowers March 15.

Acer Negundo var. *texanum* f. *latifolium* Sarg. Near Natchitoches, Natchitoches Parish, and in vicinity of New Orleans. Flowers March 15.

HIPPOCASTANACEAE

Aesculus Pavia. In East Louisiana. Occasionally a tree 40 feet high, of its largest size near Covington, St. Tammany Parish. Flowers March 15.

Aesculus discolor var. *mollis* Sarg. Sometimes a small tree up to 20 feet. West Feliciana Parish; common in west Louisiana.

SAPINDACEAE

Sapindus Drummondii Hook. & Arn. Rich woods; near Lake Charles, Calcasieu Parish, near Alexandria, Rapides Parish, and near Tangipahoa, Tangipahoa Parish. Flowers April 15.

RHAMNACEAE

Rhamnus caroliniana Walt. Borders of streams, rich woods over the State. Flowers April 20. Fruit September.

TILIACEAE

Tilia nuda Sarg. Rich woods, West Feliciana Parish, and near Lake Charles, Calcasieu Parish. Flowers May 20. Fruit July 15.

Tilia nuda var. *glaucescens* Sarg. Wet places, Lake Charles, Calcasieu Parish, and near Natchitoches, Natchitoches Parish. Flowers May 20. Fruit July.

Tilia floridana Ashe. Widely distributed over the State, usually on rolling hills. West Feliciana, East Feliciana, St. Landry, Caddo, Winn, Natchitoches, and Calcasieu Parishes. Flowers May 15. Fruit June 15.

Tilia floridana var. *oblongifolia* Sarg. On rolling hills West Feliciana Parish Avery Island, Iberia Parish, and Natchitoches Parish. Flowers May 29. Fruit July 28.

Tilia Cocksii Sarg. Rich flat woods in vicinity of Lake Charles, Calcasieu Parish. Flowers May 18. Fruit July 12.

Tilia caroliniana Miller. Widely distributed west of the Mississippi

River, Avery Island, Iberia Parish, Jefferson Davis, St. Landry, Calcasieu and Natchitoches Parishes. Flowers May 15. Fruit July 12.

Tilia caroliniana var. *rhoophila* Sarg. Along the banks of the Calcasieu River near Lake Charles, Calcasieu Parish, and in Jefferson Davis Parish. Flowers May 25. Fruit July 15.

THEACEAE

Gordonia Lasianthus Ellis. According to Britton (North American Trees, p. 705) this tree occurs in Louisiana. I have seen no specimens.

ARALIACEAE

Aralia spinosa L. Borders of swamps and moist woods over the State. Flowers July. Fruit August.

NYSSACEAE

Nyssa sylvatica Marsh. In dry rolling woods, sometimes on the borders of swamps; over the State. Flowers April 15. Fruit September.

Nyssa biflora Walt. Often growing in water, especially ponds in the Pine-barrens; over the State. Flowers April 15.

Nyssa aquatica Marsh. Cypress swamps often growing in water; over the State. Flowers April.

CORNACEAE

Cornus florida L. Over the State except in Cypress-swamps. Flowers February 28 to April 10. Fruit October.

Cornus asperifolia Michx. In rich soil often becoming a tree; sometimes a shrub. Over the whole State. Flowers April 5.

ERICACEAE

Kalmia latifolia L. Seen only in the vicinity of Bogalusa, Washington Parish, where it is very abundant, reaching a height of 40 feet. Flowers April 10.

Oxydendrum arboreum DC. West Feliciana, St. Tammany, Tangipahoa and Baton Rouge Parishes. Flowers May 25. Fruit June 15.

Vaccinium arboreum Marsh. Upland woods and along streams over the State. Flowers April 10. Fruit August–September.

Vaccinium arboreum var. *glaucescens* Sarg. With the type west of the Mississippi River; often a shrub; near Shreveport, Caddo Parish, occasionally a small tree.

EBENACEAE

Diospyros virginiana L. Over the State, in the driest sandy soil and in swamps subject to overflow where sometimes for months the trees stand in water; occasionally forming extensive thickets. There are perhaps two distinct forms. Flowers May 2. Fruit October.

STYRACEAE

Styrax grandiflora Ait. Over the State as a shrub; in West Feliciana Parish a tree 40 feet high; arborescent also near Natchitoches, Natchitoches Parish. Flowers April 10. Fruit July.

Halesia diptera Ellis. Wet woods and borders of swamps over the State. Flowers February 28 to April 10.

SYMPLOCACEAE

Symplocos tinctoria L'Hér. In rolling woods and along streams over the State. Flowers April 3. Fruit June.

OLEACEAE

Fraxinus caroliniana Mill. Along water courses and in swamps over the State. Flowers February 25. Fruit April.

Fraxinus caroliniana var. *Rehderiana* Sarg. Tangipahoa Parish.

Fraxinus americana L. Woods in rich alluvial soil and borders of swamps over the State. Flowers March 15. Fruit May.

Fraxinus pennsylvanica var. *lanceolata* Sarg. Banks of creeks and rivers and alluvial woods over the State. Flowers March 25. Fruit June.

Fraxinus profunda Bush. Widely distributed over the State on the edges of Cypress swamps; very abundant in swamps in the vicinity of New Orleans. Flowers March. Fruit May.

Forestiera acuminata Poir. Widely distributed over the State; usually a shrub; occasionally a tree 30-40 feet high along water courses in East Baton Rouge Parish. Flowers April 3.

Osmanthus americanus Benth. & Hook. Borders of streams and Pine-barren ponds in East Louisiana; common in St. Tammany, Washington and East Baton Rouge Parishes. Flowers March 3.

VERBENACEAE

Avicennia nitida Jacq. Along the seacoast and adjacent islands, forming occasionally dense thickets. Occasionally a tree 30 feet high. Flowers May.

BIGNONIACEAE

Catalpa bignoniodes Walt. Banks of streams, West Feliciana and East Baton Rouge Parishes. Much planted and often naturalized. Flowers April 15.

Catalpa speciosa Engelm. Common over West Louisiana, probably naturalized from cultivation. Flowers April 15.

RUBIACEAE

Cephalanthus occidentalis L. Borders of swamps and along streams over the State. Flowers April-July.

Cephalanthus occidentalis var. *pubescens* Raf. In the vicinity of New

Orleans; near Lake Charles, Calcasieu Parish, and near Natchitoches, Natchitoches Parish.

CAPRIFOLIACEAE

Sambucus canadensis L. Frequently arborescent, with a height of 30 feet and a trunk 2 feet in diameter. Flowers March 28 to April 15.

Sambucus Simpsonii Rehd. A tall shrub or small tree; rich woods near Opelousas. Flowers April 15.

Viburnum rufidulum Raf. On rolling hills over the State. Flowers April 15. Fruit August.

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THE FOREST FLORA OF THE OZARK REGION

ERNEST J. PALMER

A GLANCE at a relief map of North America will serve to show the unique and interesting position occupied by the Ozark uplift with relation to the surrounding regions and the other great physiographic features of the continent. Between the foot hills of the Appalachians on the east and the Rocky Mountains on the west extends a vast almost unbroken plain, its surface conforming generally to the horizontal or gently tilted strata that underlie it, and modified only superficially by the forces of erosion, glaciation and similar agencies. The only place at which these wide spread rocky beds have been extensively disturbed by orogenic forces and thrust up conspicuously above the surrounding areas is in the Ozark region, situated approximately midway between the two great mountain systems and between the Great Lakes and the Gulf of Mexico. It is thus isolated and remote from both coast-line and other mountainous areas, and is completely surrounded by wide, fertile plains, that have for ages been the breeding grounds and battlefields of successive races of plants and animals, many of which, we may safely assume, have from time to time invaded the highlands or been forced to take refuge there from the pressure of aggressive competitors or ruthless enemies: For geological evidence proves that the Ozark region is one of the oldest land areas on the continent; and although portions of it have been subjected to various uplifts and depressions before the beginning of the cycle that gave it its present form, most of it has remained above sea level since very early times.

To the south of it lies the low, humid plain of the Gulf coast, with its rich forests of coniferous and deciduous trees, a region of deep swamps, dense cane brakes and impenetrable tangles of vines and herbage, alternating with low hills, sandy ridges and broad savannas, formerly teeming and still abounding in parts with a profusion of bird, reptile, mammal and lower animal forms; on the east is the broad, fertile valley of the Miss-

issippi, up which the abundant flora and fauna of the southern region have pushed until checked by the pressure of species coming down the great river or its eastern tributaries; northward beyond the valley of the Missouri River lies a diversified region, in which the forest plants of the northeastern states have occupied the valleys of numerous streams dividing the high, rolling prairies; while on the west it merges gradually into the great plains, where forest and hills give place to the vast treeless prairies with their wealth of grasses and flowering plants and their dependent faunas. Thus situated, and since nearly all of the region is more or less densely forested, it is not surprising that the flora of the Ozarks presents many interesting features and evidences of the checkered history through which it has passed.

Two main divisions, rather distinct in structure and aspect from each other, are found in the Ozark region: The northern portion comprises the broad, flat-topped dome of the Ozark plateau, much of the interior of which has a comparatively level, rocky surface, while the marginal slopes and escarpments bordering the valleys of the larger streams have been deeply dissected by long erosion into a topography of extreme ruggedness. The southern portion consists of the Boston Mountains, an area of much greater diversity and characterized by sharply folded strata forming well defined ridges and peaks, in places truly mountainous, although the hills seldom rise more than a few hundred feet above the dividing valleys. Most of the plateau division has an average altitude above sea level of from 300 to 500 meters, while only a few points in the Boston Mountains exceed 600 meters.

The valleys of the Mississippi and Missouri Rivers may roughly be taken as the eastern and northern boundaries of the Ozark region; but some distance below the junction of the two streams the highlands reach the margin of the former and stand out as a line of bold bluffs along its course. Between the towns of Chester and Thebes in Illinois a low, outlying spur crosses the river and extends across the southern point of the state to the Ohio River. The name of Shawnee Hills has been applied to at least the eastern part of this ridge; and in its more rocky portions it has much in common with the topography and flora of the Trans-Mississippi Ozarks. The Boston Mountain division lies mainly between the White and Arkansas Rivers. To the southwest of the Arkansas River valley is a detached area of closely folded beds of shales, slates and sandstones, known as the Ouichita Mountains; so far as the forest flora is concerned it may well be considered as part of the Ozark region. The entire region as thus defined occupies nearly the southern half of Missouri, with a narrow spur crossing southern Illinois, the northwestern portions of Arkansas, comprising about one third of the entire state, and a long triangular strip in eastern Oklahoma, bounded roughly on the west by a line extending from the town of Wagoner to the northeast corner of the state.

The geological formations of the Ozark region are varied and represent a wide range in time, but consist principally of the older Paleozoic sedimentaries. The oldest rocks are the Archaean granites and porphyries of the Iron Mountain area in southeastern Missouri; surrounding these and forming the surface strata over the greater part of the Ozark plateau are the magnesian limestones, cherts and sandstones of the Cambrian-Ordovician system. In the northwestern portions the purer limestones and cherts of the Mississippian series appear, and similar beds of the same age underlie a narrow strip on the eastern side, with sandstones alternating with the limestones southward. On the southwestern side in portions of the Boston and Ouich'ta Mountains the shales and sandstones of the Pennsylvanian series predominate. Each of these formations has given rise to a more or less clearly distinct topography, and has influenced in a minor degree the character of the flora and the distribution of forest species. The ancient crystalline rocks rise in a series of isolated peaks and domes from the surrounding country. Their areal extent is too limited to support a very distinct ligneous flora, but on exposed faces and slopes such arid and sterile conditions prevail as to exclude nearly all plant life. Barrens, with a peculiar herbaceous flora, are sometimes found on exposures where the slope is not too steep, and in the rubble and detritus at the base, especially on the northern and eastern sides considerable soil and moisture accumulates, supporting a varied ligneous as well as herbaceous growth. Red Oak, Slippery Elm, June-berry and a small, often shrubby form of the Red Maple are fond of such situations. Hickories, Oaks and various other hard wood species occupy the more open slopes and often attain a considerable size. The short-leaved Pine (*Pinus echinata* Mill.) is rarely found on a few of the hills; and perhaps the most marked feature of this section is the abundance of *Vacciniums* and allied *Ericaceae* which thrive upon the acid soil resulting from the decomposition of the igneous rocks. *Rhododendron oblongifolium* (Small) Millais, reaches its most northern point in the Mississippi Valley here. The areas of the magnesian and semi-crystalline limestones are characterized by wide stretches of comparatively level uplands, with sheer escarpments and perpendicular bluffs about its margins and bounding the deep V-or-U-shaped valleys, and by ridges and slopes deeply covered with fragments of residual chert. This comprises the greater and most characteristic parts of the Ozark plateau, and its floral features will be described later. The magnesian limestones, cherts and quartzites of the Ozark series underlie some of the most rugged portions of the Boston Mountains; but where the sandstones and shales of the Pennsylvanian occur they have sometimes been carved into low domes or canoe-shaped hills, standing out conspicuously from the broad surrounding valleys.

The entire Ozark region lies in a zone of rather abundant rainfall; the greater part of it receiving an annual average of between 35 and 40 inches, and the southeastera portion rather more than 40 inches according

to the charts of the United States Weather Bureau. The precipitation is well distributed throughout the year, spring and autumn being the wettest seasons, while there is often a short period of drouth in midsummer or winter. Extending over about four degrees of latitude there is a perceptible though not very marked difference in the mean average temperature in the northern and southern extremes. In the vicinity of the Missouri River the average annual depth of snow is about 25 inches, while along the Arkansas River it is scarcely a fourth of that amount; in the former region winter temperatures of from 15 to 20 degrees below zero Fahrenheit are not infrequent while in the latter the zero point is seldom passed. However, mild winters or a succession of them are not infrequent at the north, while rarely in extremely cold winters the thermometer falls below twenty minus there, and to ten or twelve minus at the south; and it is, of course, these occasional low extremes rather than the average temperature that limits the northward range of the less hardy species.

The humid division of the Upper Austral life-zone, as defined and mapped by the United States Biological Survey, embraces most of the Ozark region, including all of the Ozark plateau and the higher portions of the Boston Mountains. Agriculturally it is a country where the northern cereals, forage crops, apples and small fruits abound, and in its more fertile portions is particularly adapted to stock raising, dairying and fruit growing. The timber industries consist of pine and hard wood lumbering on a small scale in many sections, and of the wasteful production of railway ties from the Oak-forests. Red Cedar (*Juniperus virginiana* L.) is cut in considerable quantities in some places for posts, pencil and chest lumber, and Hickory and Ash supply material for some local industries. A small corner in Oklahoma and many tongue-like projections up the valleys of the larger streams on the southern and southeastern border is included in the humid division of the Lower Austral zone. Here cotton, watermelons, yams and peanuts compete with maize and other cereals as staple crops and the heavier growth of forest and easier transportation have in the past made lumbering and the manufacture of timber products one of the leading lines of industry. Saw mills and plants for the manufacture of barrel staves and other hard wood products still operate at many places, but the industry is rapidly declining and the fertile cleared land is now cultivated. Most of this humid division, however, although broadly within the boundaries of the Ozark region is scarcely a part of it.

In the composition and character of the forest flora there are no such clearly recognizable divisions as in the topography; but in the Boston Mountain area and in the southern part of the Ozark plateau adjoining it a number of species are found which disappear gradually northward; and generally speaking the forest growth over this portion is heavier, more continuous and richer in types than over the central, northern and especially the northwestern parts of the plateau. Conspicuous among

the southern species that characterize it are the Spanish Oak (*Quercus rubra* L. formerly and more commonly known as *Quercus falcata* Michx.), Sweet Gum, Fringe-tree (*Chionanthus virginica* L.), Red-flowered Buck-eye (*Aesculus discolor* var. *mollis* Sarg.), Southern Linden (*Tilia floridana* Small), Indian Cherry (*Rhamnus caroliniana* Walt.), French Mulberry (*Callicarpa americana* L.), Deciduous Holly (*Ilex decidua* Walt.) and Small Cane (*Arundinaria macrosperma* Michx.). Some of these are much commoner and more widely distributed than others; such species as the Southern Linden, Indian Cherry and Deciduous Holly being found almost throughout the region, while the Fringe-tree, Red-flowered Buck-eye and French Mulberry are confined to the southern border. The Sweet Gum extends up many of the river valleys for some distance into the interior; it has been noted by the writer along White River and its tributaries in Baxter and Marion Counties, Arkansas, and farther west in Boone and Newton Counties of the same state. Along the eastern border of the region in Missouri it ascends the Mississippi River more than half way to the mouth of the Missouri, and is found generally in the southeastern counties bordering the lowlands. Professor Shepherd includes it in his list of trees of Greene County, Missouri, and if it is native there it must be an isolated station. The Spanish Oak, which is so common in the lowlands of the Coastal plain has so worked its way up many of the streams of the Ozark region. While in its southern home it is often found growing in low, flat woods it has not taken to the low, alluvial valleys here, but has established itself upon the dry, rocky ridges bordering the streams. It has been found in such situations in Baxter and Marion Counties, Arkansas, and in Wayne and Carter Counties, Missouri.

The Cucumber-tree (*Magnolia acuminata* L.) is also confined to the southern border of the Ozark region, where it is rather widely distributed but nowhere common. It is known to grow in Cape Girardeau, Barry and Butler Counties, Missouri, near Cotter, Arkansas, and in the Ouichita Mountain area near Mena, Arkansas and Page, Oklahoma. It is found more abundantly in southern Illinois, along the southern border of the Shawnee Hills, from which direction it appears to have entered the Ozarks. The Broad-leaved Mock Orange (*Philadelphus pubescens* Schrad.), of similar southeastern origin, is rarely found in the Boston Mountains, having been collected by the writer in Newton and Marion Counties, Arkansas. The occurrence of *Halesia monticola* var. *vestita* Sarg. near Heber Springs, Cleborne County, Arkansas, and of the even more southern *Halesia parviflora* far to the west in the Ouichita Mountains of southeastern Oklahoma is very interesting, these stations being quite remote from the previously known range of these species.

A general survey of this southern portion of the Ozark region discovers a country for the most part heavily forested, with a few prairie openings, usually of quite limited extent, commonest toward the western side, and in the more eroded parts broken by many small rocky barrens, upon which only a stunted and scattered growth of trees and shrubs has been

able to establish itself. In the alluvial valleys and in the protection of the high bluffs which bound them there was originally a magnificent growth of hardwood trees, many of the mature specimens having tall, symmetrical trunks of ample dimensions. Cottonwood, River Birch, American Elm, Mulberry, Red Oak, Pin Oak, White Oak, Bur Oak, Silver Maple, Sweet Gum, Shellbark and Pignut Hickories and Green and White Ash made up a large part of the forest, but many other trees and shrubs were more or less abundant. In the lower valleys, near the margin of the region, a few species more strictly belonging to the coastal plain are sometimes present; conspicuous among them are the Bald Cypress, Downy Poplar, Overcup Oak, Basket Oak and Swamp Maple; none of these, however, can properly be regarded as belonging to the Ozark flora.

The high bluffs and escarpments shelter many kinds of trees and shrubs, several of which are not found elsewhere in the region. Among them the Butternut, Cucumber-tree, Yellow-wood (*Cladrastis lutea* K. Koch) Missouri Currant, Prickly Gooseberry and Arrow-wood (*Viburnum molle* Michx.), and on the western side the Soap-berry (*Sapindus Drummondii* Hook. & Arn.) and Smoke-tree (*Cotinus americanus* Nutt.) occur. Very characteristic of this zone also, both here and in the plateau division to the north, are the Red Oak, Schneck's Oak, Chinquapin Oak, Slippery Elm, Kentucky Coffee-tree, Sugar Maple, Blue Ash, Wahoo (*Eronymus atropurpureus* Jacq.) and Bladder-nut (*Staphylea trifoliata* L.). Along the higher and more exposed portions of the bluffs the Winged Elm, June-berry (*Amelanchier canadensis* Med.), the shrubby or low Hackberries (*Celtis pumila* Pursh and its variety *georgiana* Sarg.) and the Red Cedar abound. The ancient, gnarled and much twisted specimens of Juniper, upon which long and widespread custom had fastened the misnomer of Cedar, render some of the high rocky bluffs with their castle-like projections and pinnacles very picturesque. Large specimens still left in situations too inaccessible even for the indefatigable seeker after post or pencil timber are amongst the oldest living things in the region, their title to this distinction being possibly challenged only by the lofty *Taxodium* of the lowlands. Some of them were probably flourishing at least when Columbus sailed.

Ascending to the higher levels we find over the steep rocky slopes and flats a forest somewhat changed in composition and diminished in density of stand and size of individuals, but still in many places containing fine specimens of Pine, Oaks and other hard wood trees.

The Yellow or Short-leaved Pine (*Pinus echinata* Mill.) and the Red Juniper are the only conifers of the Ozark region. The Pine is found intermittantly throughout, except in the extreme northern part of the plateau. This species is also widely distributed and grows in pure stands on the sandy ridges and low hills of the coastal plain; but here it seeks the high cherty ridges, where it has to contest the ground with various species of Oaks, Hickories and other deciduous-leaved trees. In such situations or upon outcrops of the sandstones of the Cambro-Ordovician system,

furnishing a porous, acid soil, it flourishes, producing tall, straight trunks surmounted by a small crown of branches, frequently far overtopping the largest specimens of broad-leaved species. These ancient lofty trees lording it over the humbler but more widespread and dominant deciduous species evidently are survivors from an earlier period in the botanical history of the region. At present the young growth of broad-leaved shrubs and trees has so closely invested the Pine-colonies in most places that there is little chance for extension or even for the replacement of the stand. Only in the most sterile and uninviting spots or occasionally in artificial or accidental clearings can the young Pine-seedlings find much opportunity to develop; and it is apparent that under natural conditions the species would ultimately be eliminated by its more aggressive competitors.

North of the White River, in the Ozark plateau, as has been indicated, a somewhat different topography prevails; but the character of the forest growth is generally quite similar. There is here the same succession of heavily wooded alluvial valleys along the streams, a bordering zone of bluff and ravine supporting a rich and diverse ligneous and herbaceous flora, and a widespread upland forest composed mainly of a few deciduous-leaved species. But the gradual disappearance of some of the rarer southern trees and shrubs may be noted; the forest consists of fewer forms, and the average size of the trees is somewhat smaller, the growth in places having a decidedly stunted aspect. The prairie openings also become more frequent and of larger size toward the northwest, and grasses and other herbaceous plants of the western plains begin to appear in them. Pine is still found occasionally in restricted colonies, and the Red Juniper is often abundant along bluffs, both becoming rarer and finally disappearing along the northern border.

Over most of the level interior portions of the plateau there are but few streams of consequence, much of the surface water sinking into the fractured or porous limestone underlying the area and being carried off through extensive systems of underground drainage and finally issuing in many perennial springs, some of them of great volume, in the deep valleys and canyons about the dissected margins of the region. Such surface streams as occur are usually shallow, often intermittant or with currents that have the curious habit of disappearing at intervals beneath the gravel or shingle of their beds to reappear lower down in pools or to ripple over exposed rocky ledges. Of this character are many of the creeks and branches that unite to form the head waters of the more important streams that drain the region. Amongst the latter are the Current River and its several forks on the southeast, flowing into Black River, the Gasconade, formed of numerous branches in the central portion, flowing northward to the Missouri, and towards the west the Big Niangua and Pomme de Terre, tributaries of the Osage.

On the uplands between these streams there are often wide rocky stretches supporting a scanty forest growth or locally almost devoid

of trees and with a peculiar prairie flora. White Oak, Post Oak, Black Jack and the Hard-shell Hickories (*Carya alba* K. Koch, *C. Buckleyi* var. *arkansana* Sarg. and var. *villosa* Sarg.) are amongst the commonest trees and often almost the only ones found over considerable areas. The unforested openings of the Ozark plateau vary greatly in character and extent; they may be conveniently classed under two heads: prairies, and rocky barrens, although these sometimes intergrade and the peculiarities of both may be present in close proximity. Some of the larger prairies are several miles across, but they are usually much smaller, and remnants of a typical prairie flora still cling in places to open rocky hill-sides entirely surrounded by the forest. Such areas are often only a few rods in extent. The term barrens is sometimes used colloquially in the Ozarks to designate the larger prairies, but is here restricted to the limited rocky areas with a quite distinct flora described later. The prairie openings are so well marked and so impressed the early settlers that many of them were given definite names such as "Cowan's Barrens," "Diamond Prairie" and "Round Prairie," While in some of the smaller prairies the sterile nature of the soil seems to have placed a check upon the advance of the forest, as in the rocky barrens, in many of the larger ones its fertility is quite equal to that of the surrounding woodlands, and the explanation of their origin or preservation must be sought elsewhere. The more fertile portions of these natural "clearings" were for obvious reasons attractive to settlers, and if not too remote from a natural water supply were early brought under cultivation. Consequently the prairie flora has usually been preserved fully only in the smaller and more rocky areas.

Glades and rocky barrens occur wherever solid strata are exposed on level or gently sloping surfaces. They are most abundant in the limestone regions, but are sometimes formed upon outcrops of chert, sandstone, granite, riolite or beds of clay. In extent they seldom exceed a few acres without interruption, and are generally quite small. In such places frequently a few bushes or stunted trees occur along ledges and fissures or in depressions where there is some accumulation of soil and moisture, and sometimes they form clumps upon mounds which are often a feature of the barrens. *Juniperus virginiana* L., *Quercus marilandica* Muenchh. and *Bumelia lanuginosa* Pers. are commonly found, although seldom of arborescent size and *Rhus trilobata* Nutt., *Ptelia trifoliata* L. and *Viburnum rufidulum* Raf. are typical shrubs. But over the more exposed portions the flora is entirely herbaceous, consisting of a few bulbous *Liliales* and fleshy perennials, such as *Camassia esculenta* Lindl., *Allium stellatum* Ker, *Agave virginica* L., *Tragia ramosa* Torr., species of *Allionia*, *Talinum* and *Opuntia*, and a variety of annuals. Plants of the last class are by far the most numerous and make up the bulk of the floral population. Every little depression, cleft or spot where there is even the thinnest accumulation of soil is occupied by some, and they cling tenaciously to such vantage points and struggle for their possession,

according to their ranks and requirements from the hydrophytes in the pools to the Selaginellas and Lichens upon the almost naked rocks. Following a rainy season the annuals spring up quickly under the stimulus of the hot sun, pass rapidly through their life cycles and deposit their seeds to lie dormant until favorable conditions again ensue. To the taxonomist and ecologist the barrens furnish rich fields for exploration and study, on account of the many rare plants found in them and the peculiar conditions under which they grow in these bits of semi-desert isolated in the midst of a well watered forest land. But even more interesting are the curious problems in plant geography and in the phyto-graphic history of the region which they suggest, and upon which they may throw some light. A study of the peculiar plants of the barrens shows many of them to be identical with or closely allied to species characteristic of the western plains or of the semi-arid southwest; and their occurrence in the Ozark region, separated in some cases by hundreds of miles of distance and apparently insurmountable ecologic barriers from the main areas of their present range challenges the inquiring mind to theorize upon the questions of how they come here; whether they represent the advance guard of an eastward extension of the plains floras or are survivors of a former occupation; and if the former by what extraordinary means were they transported here, or if the latter what great climatic or ecologic changes must have occurred to drive the plains plants back so many degrees westward and permit the development of so different a type of flora here?

Closely allied to the floras of the barrens and their interesting problems are those of the bare-topped hills found in certain sections of the western Ozark plateau. Over considerable areas, most typically developed in Stone, Taney and Ozark Counties, Missouri, much of the surface has been carved into series of low, dome-like, rounded or flat-topped hills, divided by a net-work of ravines and narrow valleys, some of them traversed by spring-fed streams, but mostly dry except for short periods after rains when they are flooded by the run-off from the hills. This peculiar topography is due to the character of the underlying deposits, made up largely of thin horizontal beds of moderately resistant limestone alternating with softer layers, mainly clay and decomposed calcareous material with some chert. Ledges of the limestone frequently stand out, forming terraces entirely surrounding the hills. There is usually a rather dense growth of trees, shrubs and vines in the intervening valleys, and sometimes this extends for some distance up the slopes of the hills especially on the northern and eastern sides, but often the upper portions and tops are nearly or entirely destitute of woody species, and support a characteristic herbaceous flora. On some of the knobs, however, a few shrubs or stunted trees may be seen following ravines or ledges well up toward the summits, or small colonies may have established themselves upon the level tops. Amongst the commonest woody species in such locations are *Juniperus virginiana* L., *Quercus marilandica* Muenchh., *Quercus Shu-*

mardii var. *Schneekii* Sarg., *Celtis laevigata* var. *texana* Sarg., *Fraxinus americana* L., *Bumelia lanuginosa* Pers., *Rhus trilobata* Nutt., *Ilex decidua* Walt., *Rhamnus lanceolatus* Pursh and *Viburnum rufidulum* Raf. In the protection of the limestone terraces is also sometimes found *Berchemia scandens* K. Koch, and on the more exposed ledges *Salix humilis* Marsh, *Ceanothus oratus* var. *pubescens* and *Andrachne phyllanthoides* Muell. Arg. Stunted specimens of *Quercus Shumardii* var. *Schneekii* found here closely resembling in habit, foliage and in their small acorns the allied *Q. texana* Buckl. of the limestone hills of Texas, and the presence of the *Celtis* and *Andrachne*, both characteristic species of the southwest, together with *Cotinus americanus*, growing on high bluffs in close proximity, and many herbaceous species common to both regions, are certainly significant. Two of the plants in the above list are so interesting, indeed, as to deserve fuller mention. The occurrence of *Andrachne phyllanthoides*, the only woody representative of the large family *Euphorbiaceae*, to which belong so many of the shrubs and trees of the arid southwest and of the tropics, in the central Mississippi Valley, is quite remarkable. In the Ozark region this curious and pretty little shrub is restricted to the rocky barrens and ledges of the open hills and to the low bluffs and gravelly beds of the dividing streams; in Texas it usually grows along small, intermittent streams, on the gravel-bars and shingle, where it is occasionally swept over and irrigated by freshets and floods. The American Smoke-tree (*Cotinus americanus*) appears to be restricted to the vicinity of White River and some of its tributaries, in the Ozark region. Here it grows generally along open rocky bluffs, and is sometimes truly arborescent, attaining a maximum height of six or eight metres. In the dryer region of western Texas it is always shrubby, and seeks the protection of steep hillsides and ravines. The list of herbaceous plants common to the two regions, while not very long in identical species, is, nevertheless, remarkable enough, including such plants as *Lesquerella gracilis* S. Wats.?, *Evolvulus pilosus* Nutt., *Eriogonum hirsutum* Nutt., *Oenothera missouriensis* Sims, *Pentstemon Cobaea* Nutt., *Stenosiphon linifolius* Britt., *Erythraea calycosa* Buckl., *E. texensis* Griseb., and *Marshallia caespitosa* Nutt. Almost equally important are many other plants of common genera and closely allied species inhabiting both the Ozark barrens and the Edwards plateau; some of them are so similar that there is some diversity of opinion as to whether they are really identical or should be treated as distinct species or varieties; a fact not without significance in its bearing upon the antiquity of the Ozark flora.

The singularity of these eroded, treeless hills in the midst of a generally forested region has always attracted the attention of travellers, and the name of bald knobs was applied to them at an early day, a name which later attained some ill fame from the deeds of certain bands of outlaws which once infested the country, the members being known as "Bald-knobbers" from the fact that they are said to have held their secret meeting on the tops of some of the highest "balds." The country,

however, is peaceful enough at present, and attracts many summer tourists, campers and fishermen, as well as more serious romancers; and it is not unknown to the nature and folk-lore fakir and the promoters of fictitious oil booms, to say nothing of occasional naturalists or botanical collectors who stray thither.

There can be no doubt that the forests throughout the Ozark region are at present encroaching rather rapidly upon the prairies and open areas, including the bald knobs, and that if this natural process continues unchecked most of the latter are destined at no very distant day to be completely engulfed and obliterated. Tradition and the testimony of early settlers and of some of the "oldest inhabitants" still living, agree that when this part of the country was first occupied by pioneers it was much more open, with a greater percentage of unforested lands, and that many of the hills now partially covered with shrubs and trees were known to them as barrens and balds. This rather vague evidence is, moreover, supported to some extent by the accounts of early scientific travellers and writers. Schoolcraft and Nuttall both visited the region, and in their journals call attention to the open nature of the country and the scarcity of timber upon the hills. I was also informed by Mr. C. A. Holman, who spent several years as a surveyor in the typical bald knob section in connection with water power and other projects, that the early government surveyors, who worked there in the early decades of the last century, left frequent references and inferences in their field notes, which he had occasion to consult and check, to the untimbered nature of the country, such as the absence of trees for corners and datum marks in localities now covered with a typical forest growth.

It is scarcely necessary in this brief article to give a full list of the woody plants known in the Ozark region, but an analysis of more than 300 species, exclusive of the genus *Crataegus*, reveals the fact that about ninety per cent of them are common forms of the Gulf coastal plain flora. The remainder consists of a few endemic species and varieties, a few from the southwest and a larger number with their range beyond the Ozark region lying to the east and north of the coastal plain. Of the woody plants peculiar to the region none appear to be very distinct from similar forms found in the southern forest. The following are some of the most interesting:

Carya Buckleyi var. *villosa* Sarg. (*Hicoria villosa* Ashe). A small Hickory closely allied to *Carya ovalis*, but with the under surface of the leaves and young branches more or less densely villose. It is often the commonest, and in places the only, Hickory found on dry, flinty hills.

Quercus velutina var. *missouriensis* Sarg. A variety of the Black Oak with the under surface of the leaves permanently stellate-pubescent. It is common in rocky upland woods in many parts of the Ozarks, and sometimes becomes a large tree.

Hamamelis vernalis Sarg. Closely allied in foliage and flora characters to the eastern and southern *H. virginiana*, but strictly shrubby in

habit, flowering in spring and ripening the fruit the same autumn. The leaves are sometimes glaucous. It is common along small rocky streams throughout most of the Ozark region, often growing in the dry shingle or gravelly beds and spreading by root-shoots.

Viburnum affine Bush. A low, slender shrub related to *V. scabrellum* Chapm., found sparingly along rocky bluffs.

Aesculus glabra var. *leucodermis* Sarg. This variety of Buckeye is common along many of the small streams of the Ozark region, where it is often a slender shrub, becoming in richer, alluvial bottoms a small or medium sized tree. It has been reported from southern Arkansas and eastern Texas, beyond the limits of the Ozark uplift, but it is most abundant in our area, where it probably originated, and from whence it has been disseminated.

Crataegus. Of this prolific genus quite a number of species have been described from the Ozark region; some of them are well marked and peculiar, but as so little is known at present of their range beyond the type localities they will not be taken up here, but perhaps may be discussed in a subsequent paper.

A list of the other ligneous plants of the Ozark region, not commonly found in the coastal plain, is given below:

<i>Salix cordata</i> Muhl.	<i>Hydrangea arborescens</i> L.
<i>Salix longipes</i> var. <i>Wardii</i>	<i>Hydrangea cinerea</i> Small
Schneid.	<i>Physocarpus intermedius</i> Schneid.
<i>Juglans cinerea</i> L.	<i>Gymnocladus dioica</i> K. Koch
<i>Corylus americana</i> L.	<i>Robinia pseudoacacia</i> L.
<i>Corylus rostrata</i> Ait.	<i>Acacia angustissima</i> var. <i>hirta</i> Robins.
<i>Quercus borealis</i> var. <i>maxima</i>	<i>Cladrastis lutea</i> K. Koch
Ashe.	<i>Magnolia acuminata</i> L.
<i>Celtis laevigata</i> var. <i>texana</i> Sarg.	<i>Cotinus americanus</i> Nutt.
<i>Celtis pumila</i> var. <i>georgiana</i>	<i>Ilex laevigata</i> A. Gray
Sarg.	<i>Staphylea trifoliata</i> L.
<i>Aristolochia tomentosa</i> Sims	<i>Fraxinus quadrangulata</i> Michx.
<i>Ribes missouriense</i> Nutt.	<i>Sapindus Drummondii</i> Hook. & Arn.
<i>Ribes odoratum</i> Wendl.	<i>Vitis Linsecomii</i> Buckl.
<i>Ribes cynosbati</i> L.	<i>Lonicera flava</i> Sims

It is evident that the majority of these are species of the southern Appalachians and their foothills, a region rather remote from the Ozark uplift and separated from it by the lowlands of the Mississippi valley; but clearly their origin must be sought in that direction. Such plants as *Celtis laevigata texana*, *Acacia angustissima hirta*, *Sapindus Drummondii* and *Vitis Linsecomii* are as certainly southwestern in their present distribution, and are found only on that side of the Ozark uplift. *Sapindus* and *Acacia*, however, have both also invaded the coastal plain as far as western Louisiana; and another common southwestern tree, *Bumelia lanuginosa*, frequently found throughout the southern part of the Ozark region, is even more widely distributed southward.

The fact that the typically northeastern woody plants, associated with many herbaceous species, in the Ozark region are usually confined to the protecting bases of bluffs or steep hillsides having a northern or eastern exposure, while those more characteristic of the arid southwest are found in open rocky barrens or along the ledges and faces of cliffs exposed to the hot southern or western sunshine, is not at all strange and may easily be explained on ecological grounds; but it is at least suggestive of how remnants of shifting floras may persist for a long time in peculiarly favorable spots of a diverse region after the retreat of the main plant formations to which they belong; and when many species grouped together in well marked colonies are found isolated in such situations we can scarcely escape the conclusion that they originated in some such way; and we may well look to them for evidence of the directions such lines of retreat or advance have taken.

Besides the numerous localities throughout the Ozarks where colonies of northern plants may be found growing in protected situations such as those referred to above there are occasionally found other colonies of a quite different character with a somewhat boreal flora so peculiar for the region as to deserve special recognition. One very interesting locality of this class occurs along the bluffs and divides of Jack's Fork of Current River, in Shannon County, Missouri. Here a number of plants rare in this part of the country have been found and widely distributed amongst botanists by Mr. B. F. Bush, with whom the writer visited the locality in the autumn of 1920. Most of the peculiar species found here, as in the southwestern barrens, are herbaceous, and consequently a detailed description, will not be entered into at present, but amongst many interesting species are such plants as *Campanula rotundifolia* L., *Parnassia grandiflora* Raf., *Trautvetteria caroliniensis* Vail, *Plantago cordata* Lam. and *Galium boreale* L. Two notable shrubs far from their general range here are *Berberis canadensis* Mill. and *Cornus alternifolia* L. Nearly all of the peculiar localized plants of this colony are growing in sandy soil, resulting from the disintegration of Cambrian sandstone, which appears at the surface here. Some of them are growing in open sunny situations upon the high ridges, some on the slopes and face of the bluffs and others in boggy ground along small streams.

Anyone who has followed this brief sketch of the Ozark region and its flora can scarcely have failed to perceive that the facts set forth clearly indicate that there has been a gradual advance of the forests from the south or southeast toward the northern portion and, moreover, that the northward movement was one of comparatively recent inception and that it is still in active progress. And to one who has had an opportunity to view the Ozark country and its flora throughout its length and breadth, and who is also somewhat familiar with the floras of the surrounding regions, there can be no doubt as to the direction of the forest invasion and the source from whence it has come. More involved but certainly not less interesting are the questions of what were the geographic,

climatic and other changes that made it possible for the forests of the Gulf coastal plain to begin a great northward movement in the central Mississippi Valley and finally to overrun with many of its species the rocky uplands of the Ozark region; what was the character of the Ozark flora previous to the forest invasion; was it exterminated or absorbed by the incoming races and what traces of the older floras are still to be found in the region?

There is some uncertainty as to the exact period when the movement began that resulted in the present elevation of the Ozark region, but geological evidence indicates that it must have been late in the Tertiary period or toward its close. Prior to that time the ancient land surface of the region had been worn down nearly to base level through the long ages of erosion to which it had been subjected. The floor of this old peneplain can now be seen in the nearly level surface of the uplands of the Ozark plateau and the uniform height of the hilltops in the dissected portions. We may then conceive of it prior to its elevation as a low swampy plain, at least in its eastern portion, through which broad sluggish streams meandered towards the gradually receding Tertiary seas on its southern border. On the southeastern side there persisted to a much later date than marked the retreat of the coast line farther west a great northward extension of the Gulf, known as the Mississippi Embayment. With the warm currents of the southern seas thus brought to its borders the climate must have been much milder and probably more humid than that which prevails at present. Such a region would be in many ways favorable for a dense forest growth; and it is reasonable to suppose that an earlier phase of the great southern forest, with many species closely allied to those of today, and with other semi-tropical forms long since extinct, then occupied it. With the beginning of the movement that obliterated the gulf embayment and elevated the Ozark region, with its consequent rejuvenation of the streams and rapid erosion, carrying off the mantle of soil and exposing the underlying rocks, the swamp and moisture loving flora was gradually driven back and in time all but exterminated. A more severe climate probably associated with the advance of the ice sheets of the Glacial period, the terminal morains of which barely failed to reach the northern border of the Ozarks, may have hastened the doom of this semi-tropical forest, of which remnants survived only in the bordering swamps and lowlands occupying the site of the ancient embayment, the influence of which is still evident in the swamp flora as far north as southern Illinois and southwestern Indiana.

More or less directly associated with the colder climatic cycle ushered in with Glacial period, though probably some time subsequent, was the incursion of a northeastern flora, of which abundant traces are still to be found in cool, protected situations throughout the region and far beyond its borders.

With the final disappearance of the ice sheet from the northern part of the continent came wide-spread climatic changes; but in the meantime

the processes of elevation and erosion had been going steadily forward in the Ozark region, and conditions had evidently become much more arid. The ligneous and herbaceous flora of the northeast, which perhaps had never succeeded in fully occupying the rocky uplands, was now driven back to the protection of the deeper valleys and bluffs. This process probably continued until most of the Ozark region was divested of forest growth, and upon the arid rocky uplands appeared a flora consisting principally of grasses and other herbaceous plants, centering and probably originating in the great plains, occupying the then recently emerged lands to the west. Judging from the flora, remnants of which have been preserved in the southwestern barrens and bald knobs, and its affinity to that of the western plains, the Ozark region must at this period have been a semi-arid, wind swept, treeless plain; and the great deposits of loess just beyond its northwestern border may have been contemporaneous with it.

When climatic conditions again became favorable, responding to complex geographic causes, the southern forest, which had been pushed back many hundreds of miles by the previous cycle, once more began to advance northward. Doubtless this forest had undergone great changes in its composition since its precursor had occupied the lowlands of the unevolved Ozark region in Tertiary times; many of its ancient forms had become extinct and new ones developed, and nearly all had undergone more or less modification; and yet it was essentially a very similar forest in general aspect and floristic affinities. Evidence of this is not wanting both in the field of paleobotany and in the testimony of living forms. Most of the families and genera of the present forest are represented in the fossil floras preserved in the Tertiary shales of the Coastal plain, many of them closely related to those now living and growing above them.

To mention a single instance of an ancient type, evidently once widely distributed, and of which only a few scattered remnants now remain attention may be called to the Cork-wood (*Leitneria floridana*). Very restricted colonies of this curious plant have been found along the Gulf coast from Florida to Texas, and isolated in the central Mississippi valley in northeastern Arkansas and southeastern Missouri. Its occurrence in the last named locality is one of the most remarkable examples of persistence of a forest type in our North American flora, and is significant as indicating the antiquity of the swamp flora of that section.

At the time when the present advance of the southern forest began much of the lowlands bordering the Ozark region on the south was covered with a prairie flora, different in character from that of the rocky plateau and comparable to that now occupying the more recently emerged lands along the Gulf coast, upon which the ligneous plants are gradually encroaching. This prairie phase must have persisted for a considerable time, offering an obstacle to the advance of the forest, but gradually the latter over-ran it until its advance guards stood at the foot of the rocky

plateau. At this line it was doubtless checked, affording time for many of the less mobile species to come up and completely occupy the lowlands, resulting at length in keen competition and a strong demand for further expansion. In the meantime certain pioneer species had begun to push up the alluvial valleys of the streams coming down from the highlands; such trees as Willows, Cottonwood, Elms, Birch and various shrubs perhaps first establishing themselves along the banks; while Sassafras, Persimmon, Dogwood, Plum and Haw-bushes began to appear along the margins of the more fertile prairies. A little later such hardy trees as some of the Oaks and Hickories, that in the southern area had been restricted to the higher sandy ridges and thus inured to a considerable degree of drouth and soil sterility, began to creep up the rocky hillsides and occupy the higher ground. Other forms followed as the developing forest invited the coming of faunal agents that aided in their introduction, or as other consequent or fortuitous opportunities arose, enabling them to emerge from the overcrowded lowlands into the open if less opulent plateau region. This movement has continued with great complexity from that time, and is still in progress; but in certain inaccessible spots small remnants of the ancient floras are still holding out against the invaders.

Much of the foregoing is, of course, hypothetical, but it is in accord with many observed facts, and its fuller confirmation or elaboration depends upon further investigations along various lines, especially in the detailed study of the distribution of living and fossil species and in the correlation of geologic and botanic evidence. The more significant phenomena of the Ozark flora, as described above, may be summarized as follows:

The identity of the great majority of the woody species found in the Ozark region with those of the coastal plain forest and the gradual disappearance of its less hardy and tolerant species towards the northwest strongly point to the source from whence they have come and the direction in which they have travelled; the apparent lack of many endemic species or of well marked varieties or geographic races amongst the woody plants, in striking contrast to the much modified herbaceous floras both of the northeast and southwest, is in accord with what would be expected of a forest of comparatively recent introduction, and one which has never been completely isolated from the main source of its origin; the peculiar flora of the barrens and prairies, its obvious relation to that of the plains and semi-arid regions of the Southwest, and the distribution of the local areas where these plants occur indicate both the lines of the forest invasion and the character of the flora that preceded it in the region. The presence in the swampy lands along the eastern border, reaching nearly as far north as the center of the Ozark plateau, of a rich ligneous flora of markedly southern affinities certainly bears evidence of a climate decidedly milder than that which prevails at present, and which could scarcely have obtained subsequent to the complete elevation of the Ozark region and

obliteration of the Mississippi embayment; it is therefore probable that these plants represent the rear guard of a retreating section of the southern forest, a movement entirely independent of and prior to the present advance over the uplifted region; finally there is the testimony of early explorers and settlers indicating that there has been a marked encroachment of the forest upon the prairies in the northwestern portion within a period corresponding to three or four generations of men. These accounts are interesting as indicating how rapidly the forest has been pushing forward; but most impressive of all is the fact that all of the phenomena of advance, retreat and modification which apparently have taken place in comparatively recent times in the Ozark region may still be observed in operation in its various parts or elsewhere along the margins of the great southern forest.

To the trained observer standing upon a vantage point amid the bald knobs of the Ozarks, noting the manner in which the advance guard of the forest forges its way up the slopes, taking advantage of every ledge and inequality of surface and often succeeding in gaining a foothold upon the level tops when unable to do so on the eroded slopes, there can be no doubt that he is here witnessing the actual encroachment of forest upon prairie lands. Indeed, by the exercise of a little imagination he may almost convince himself that the slow advance of the skirmish line can be seen pushing its way slowly but irresistibly up the steep sides of the prairie strongholds; and if he is of a philosophic turn of mind he may be impelled, by the tragedy he is witnessing in the impending destruction of these last remnants of an ancient flora, to reflect upon the mutability of life and the tragic pageant through which it has passed, involving all things from plant associations to the races of men, since its first appearance upon this planet.

NOTES FROM AUSTRALASIA. II

THE NEW ZEALAND FORESTS

E. H. WILSON

New Zealand, before its settlement by white men, was for the most part densely clothed with mixed rain forest in which old types of Taxads and Conifers were the dominant trees but axe and fire have in less than a century played sad havoc and today much of the land is a jungle of Bracken Fern (*Pteridium aquilinum* Kuhn), Manuka (*Leptospermum scoparium* Forst. and *L. ericoides* A. Rich.), and the naturalized Gorse (*Ulex europaeus* L.) and Bramble (*Rubus fruticosus* L.). Originally all the wetter parts where tree-growth was possible in New Zealand were covered with pure forests of Taxads and Conifers but, save on the west coast of the South Island and excepting the Kauri in the north, these old types have long since been unable to compete successfully against the intrusion of the

more modern broadleaf trees. Even without the destructive intervention of the white man it is evident that, in another 500 years perhaps, broadleaf trees will have completely dominated the forests and the Taxads and Conifers will virtually have become extinct over the greater part of New Zealand. Today for the most part the Taxads and Conifers except the Kauri, are scattered thinly through the forests and are crowded on every side by dicotyledonous trees. The undergrowth, except in pure *Nothofagus* forests, is very dense almost impenetrable and consists of broadleaf shrubs and small trees and Ferns. Climbers, though few in species, are numerically rich and epiphytes, like *Astelia*, crowd the tree-tops. The higher Cryptogams, especially Ferns, are extraordinarily abundant. Stately Tree Ferns drape the tree-trunks and branches and wet rocks. Club-mosses are plentiful and in the densest shade of the dripping forest the exquisite *Todea superba* Col. abounds. There are no deciduous trees in the New Zealand forest and only a small number have conspicuous flowers. The forests of the North Island are obviously older than those of the South, where the glaciers are even now slowly retreating, and a majority of the trees are distributed through the whole of the country from north to south including Stewart Island. In swampy rather open places the Cabbage Tree (*Cordyline australis* Hook. f.) and the New Zealand Flax (*Phormium tenax* Forst.) are common. The margins of ponds and shallow lakes are crowded with a species of *Typha*. The flat areas of the thermal region beyond Rotorua are clothed with Manuka (*Leptospermum scoparium* and *L. ericoides*), Bracken Fern and a narrow-leaved, unhealthy looking species of *Dracophyllum*. The treeless Canterbury Plains now arable land or pastures for sheep and cattle were formerly covered with Tussack grasses as are much of the adjacent mountain ranges and the arid plateau of south Otago. In the alpine areas grow all sorts of curious plants including many herbs with lovely flowers.

The Rimu (*Dacrydium cupressinum* Soland.), Totara (*Podocarpus totara* G. Benn.), White Pine (*P. dacrydioides* A. Rich.), Matai (*P. spicatus* R. Br.) and Miro (*P. ferruginea* Don) and the Kauri (*Agathis australis* Steud.) are the most valuable timber trees in New Zealand. The Kauri, the monarch of New Zealand forest and one of the noblest of existing trees, once formed magnificent forests from a little south of the present city of Auckland northward. Ruthless felling and burning have virtually destroyed the Kauri in so far as commercial lumbering is concerned. There remains only an indifferent State forest at Waipoua where the Kauri is the chief tree, and a national Park (which I visited) of some 700 acres in parts pure stands of Kauri. This valuable conifer is a strikingly handsome tree and its wood is easily worked and exceedingly durable. In young trees the branches are numerous, short and slender and form a narrow pyramidal crown. By means of a layer of special tissue these weak branches are shed after the manner of leaves on deciduous trees and leave a clean trunk quite free of knots. The adult tree is very different in appearance; the crown being open, flattened and fairly wide-spreading.

The trunk is clean, cylindric with no taper and from 50 to 75 or more feet long and is clothed with gray bark which peels off in flakes of no particular shape and form a large mound round the base of the tree. Owing to the smooth, scaling bark no climbing plant hides the beauty of the trunks which stand out above the forest undergrowth like marble pillars in a vast cathedral. The undergrowth is fairly dense but not tall and the Kauri trees tower far above the lovely Tree Ferns and associate plants. The largest tree I saw was about 37 feet in girth and the tallest 150 feet high. The average trees are from 100 to 120 feet tall and from 15 to 20 feet in girth with clean trunks from 60 to 75 feet long. The largest recorded tree had a trunk-girth of 66 feet and there are stories of even larger trees. Owing to the perfectly cylindrical character of the trunk the Kauri yields for its size a greater quantity of timber than any other tree. Millions—young and old—of this magnificent tree have been wantonly destroyed by fire and the fairest of forest scenes laid desolate. The well known Kauri Gum exudes freely from wounds and collects in the axils of the branches. It is also found underground where ancient forests of the tree grew.

The Totara, Rimu, White Pine, Matai and Miro are widely distributed through the length and breadth of New Zealand. The Totara is being rapidly cut out in all accessible places and the Matai and Miro do not seem to be really common trees anywhere but the Rimu and White Pine are still plentiful and on the west coast of the South Island form extensive and fairly pure forest. When young the Rimu is a beautiful tree with long, pendent, light green branchlets but when old is merely a tall pole supporting a small mop-like crown. In fact the same is true of all the chief soft-wood trees of New Zealand when they grow old except the Kauri. A young Totara resembles the common Yew except that its foliage is a lighter green, and young White Pine is very like the Red Cedar (*Juniperus virginiana* L.). The White Pine is best on alluvial river flats where it averages from 120 to 140 feet and has a mast-like trunk buttressed at the base. Its pure white wood is valued for making butter boxes and for this purpose is exported in quantity to Australia. The wood of Rimu, Matai and Miro are used in general carpentry and furniture-making. That of Totara lasts well in the ground and is valued for telegraph poles and the like. So too is that of the Silver Pine (*Dacrydium Colensoi* Hook.), a much rarer tree apparently confined to the west coast. The two species of *Libocedrus* are useful timber trees and so, too, are the *Phyllocladus*. *Libocedrus Doniana* Endl. is not found much south of the city of Auckland but *L. Bidwillii* Hook. f. is widespread from the southern part of the North Island southward.

The broadleaf trees are not considered of much commercial value, though the wood of many is durable and will ultimately be in request. Two of the most aggressive of these trees on the North Island are *Beilschmiedia tarairi* Kirk (Taraire) and *Knightia excelsa* R. Br. Very in-

teresting are the various Ratas (*Metrosideros* spp.) which in the thick forests often commence life as epiphytes on the Taxads, Conifers and other trees. For a time they behave as ordinary root climbers but when their roots reach the ground their strangle-hold on the supporting tree intensifies and the Rata grows round completely enclosing and killing its former host. Often these same species of Rata grow and behave as normal trees do from their youth onward. The wood is heavy, hard and tough and is used for cross-arms on telegraph and telephone poles. But next to the Gymnosperms the most interesting trees are the species of *Nothofagus* which in many parts of the South Island and the more southerly parts of the North Island form dense, pure forests of considerable extent. Especially is this the case in the drier parts in stony gullies and on the tops of moderately high mountains; in some places they even descend to sea-level. The bark is more like that of the Common Hornbeam than that of our northern Beech. The *Nothofagus* regenerate readily and singularly resembles our Hemlock (*Tsuga canadensis* Carr.) in general appearance. I saw only small or moderately large trees but was told of specimens 100 feet tall and 25 feet in girth of trunk. They grow thickly together and in pure forests allow no undergrowth. Quite often patches of *Nothofagus* occur in the ordinary mixed forests but whether under these conditions they are intrusive or vestigial it is difficult to determine.

The forests of New Zealand are not only full of interest but highly instructive phylogenetically since their cycle is clearly manifest. The types are old, very old, even many of the broad-leaves, and the country itself is but a minute remnant of a vast continent which once linked together South America on the one hand and Tasmania and eastern Australia on the other. First in the dim and distant past above the Mosses, Ferns and other Cryptogams rose the Taxads and the Kauri soon to be followed by other Conifers. Possibly the very species existing today but in so far as the sequence of forest types is concerned it does not matter whether it were they or their ancestral types. For a period these trees, unchallenged, forested all the suitable land. Later came the broadleaf dicotyledonous trees, the struggle for supremacy began and today the broadleaf usurpers hold the field. There are no Cycads in New Zealand and the arborescent Monocotyledons are limited to a few small trees which include two *Cordylines* (*Cordyline australis* Hook. f. and *C. indivisa* Kunth) and a Palm (*Rhopalostylis sapida* H. Wendl. & Drude) known as the Nikau. To these may be added the scandent *Freyinetia Banksii* A. Cunn. which scales to the tops of the highest trees.

In the dense forest shade the New Zealand Taxads and Conifers cannot grow. The seeds often germinate but the seedling plants die after a short struggle. The broad-leaf trees on the other hand regenerate readily in the forests. Where the Taxads and Conifers flourish the soil is humus and peat from 3 to 6 feet deep and it is seldom that the roots descend into the mineralised subsoil. When planted in ordinary soil they grow

very slowly. The broadleaf trees grow under a variety of shade and soil conditions and their roots ramify in all directions. I pulled up seedlings and small plants (I have them dried) of every Taxad and Conifer I came across and in every case found the roots clothed with tubercles. I did the same with the broadleaf trees but found no tubercles present. My attention was directed to the presence of tubercles on the roots of Taxads and Conifers by Captain L. MacIntosh Ellis, the Director of the Forests. Later I found that their presence was known to others but the significance does not appear to have been grasped by anyone but by the Director of Forests and no investigations of this phenomenon have been attempted. The tubercles are analogous with those on the roots of Leguminous plants and in all probability the bacteria break up the raw humic acids and convert them into readily available salts. It is a simple and beautiful case of symbiosis but I have no knowledge of such in our northern Taxads and Conifers though it is known in the case of the Alders and a few other broadleaf trees other than Leguminosae with which it is general. This discovery is important for, if I am right in my conclusions, the organisms within the tubercles are controlling factors in the rate of growth of the Taxads and Conifers of New Zealand. As evidence let us consider what happens in the forests. The lumberman fells and removes the merchantable trees thus opening up the forest floor to the full influence of the sun and wind. The peaty soil quickly dries, fires come up and destroy not only the remaining growing vegetation but also the peat and the organisms in it thereby rendering the very soil virtually useless for the regrowth of the Taxads and Conifers. When plants of these trees are placed in ordinary garden soil there is no humic acid present even if there be tubercles on the roots of the plants when brought from the forest and consequently they merely linger and their growth is very slow without the acid of the symbiotic organisms. This, I believe, is briefly the whole story of the poor regeneration and slow growth of the Taxads and Conifers in the cut over forests of New Zealand.

HOBART, TASMANIA, *March, 1921.*

BIBLIOGRAPHICAL NOTES

ETHELYN M. TUCKER

Hempel und Wilhelm. Bäume und sträucher des waldes. The inclusive dates of the three abtheilungen of "Die bäume und sträucher des waldes in botanischer und forstwirthschaftlicher beziehung, von Gustav Hempel und Karl Wilhelm" are readily found to be 1889 to 1899. The dates of publication of the twenty lieferungen forming these abtheilungen are, however, not obtained so easily and are worthy of notice. From *Botanische zeitung* and *Oesterreichische botanische zeitschrift*, with occasional reference to *Flora* for these years, the dates and pages included

in each *lieferung* have been ascertained, with the exception of *lieferungen* 6 and 16, in which cases, though actual dates are not found, there is very little doubt of the correctness of the dates attributed to them in the following note:

Abth. 1			
Lief. 1	pp. 1-32	1889	
" 2	" 33-56	1889	
" 3	" 57-80	1890	
" 4	" 81-96	1890	
" 5	" 97-128	1891	
" 6	" 129-152	1892 (possibly 1891)	
" 7	" 153-176	1892	
" 8	" 177-200	1893	

Abth. 2			
Lief. 9	pp. 1-16	1893	
" 10	" 17-40	1894	
" 11	" 41-64	1895	
" 12	" 65-88	1895	
" 13	" 89-112	1896	
" 14-15	" 113-148	1897	

Abth. 3			
Lief. 16	pp. 1-24	1898 (probably)	
" 17	" 25-48	1898	
" 18	" 49-72	1899	
" 19	" 73-96	1899	
" 20	" 97-140	1899	

The work is illustrated by 342 figures in the text and 60 beautiful colored plates from original paintings by W. Liepoldt, the whole forming one of the best books on the trees and shrubs of central Europe in their relation to culture and forestry.

Siebold, P. F. von. *Flora japonica*.

In the *Gardeners' Chronicle* for 1867 is a sketch of the life of Philipp Franz von Siebold written by his friend, Professor Oudemans, of Amsterdam, which forms an interesting introduction to his "*Flora Japonica*," and to this, chiefly, we are indebted for the following note:

In 1823 Siebold accompanied the Dutch embassy to Japan as physician and naturalist. Upon his arrival there he was compelled, like all other foreigners, to confine his explorations to the vicinity of *Dezima*, to which he refers in his "*Flora Japonica*" as the "*Eldorado of the Hollanders*." Soon, however, in consequence of his reputation as a man of science, he acquired more freedom, the Japanese flocked to learn of him and from them in turn he obtained the best and most reliable information respecting the political, historical and geological features of a country then com-

paratively unknown. In 1826 he had the good fortune to accompany the Dutch ambassador to the court of Yeddo. In 1828 on the point of his departure for Europe he was arrested and thrown into prison, nearly losing his life in an effort to save his friend, the Imperial astronomer and librarian, who had furnished him with a hitherto unpublished map of the empire. However, on the 7th of July, 1830, he was allowed to return home and soon after his arrival in Holland he set about arranging his rich store of scientific material, and published several valuable works relating to Japan. Among the latter was his "*Flora Japonica; sive, Plantae, quas in imperio japonico collegit, descripsit, ex parte in ipsis locis pingendas curavit, Dr. Ph. Fr. de Siebold. Sectio prima continens plantas ornatui vel usui inservientes. Digessit J. G. Zuccarini.*" This is one of the most important works on the Japanese flora. The two volumes bearing the dates respectively 1835 and 1870 were issued in 30 fascicles, the dates of which, so far as we have been able to ascertain them, are as follows:

Vol. i.		
Fasc. 1-2	(tafel 1-10)	1835
" 3-4	(" 11-20)	1836
" 5-6	(" 21-30)	1837
" 7-8	(" 31-40)	1838
" 9-10	(" 41-50)	1839
" 11-12	(" 51-60)	1840
" 13-14	(" 61-70)	1840
" 15-16	(" 71-80)	1841
" 17-18	(" 81-90)	1841
" 19-20	(" 91-100)	1841
Vol. ii.		
Fasc. 21-23	(tafel 101-115)	1842 (or 1843)
" 24-25	(" 116-124 ^b)	1844
" 26-30	(" 125-150)	1870

This work is usually quoted as "Siebold and Zuccarini. *Flora japonica*," the descriptions having been written by Zuccarini, "et il a ajouté aux figures des espèces un grand nombre d'analyses extrêmement instructives." In the second edition of Pritzel it is entered under the two names and the dates given as 1835-44. "Centuria prima (fasc. i-xx) 1835. — Centuria altera. Fasc. i-x. 1842-70." These dates, at first perplexing, are explained by the fact that Zuccarini's connection with the work ended with fasc. 25, 1844, his death occurring in 1848. After Siebold's death, in 1866, the completion of the work was undertaken by Miquel who edited fasc. 26-30, including plates 125-150; these fascicles, together with the title-page for volume ii, which reads "Ab auctoribus inchoatum relictum ad finem perduxit F. A. G. Miquel" were issued in 1870. On the verso of this title we find "Hujus voluminis paginas 1-44 curavit b. Zuccarini, sequentes F. A. Guil. Miquel, speciminibus plantarum siccis, tabulis et schedis a b. de Siebold relictis usus."

In volume one there is an engraved title-page having an illustration of a monument erected to Kaempfer and Thunberg in Dezima, upon which the inscription:

E. Kaempfer, C. P. Thunberg
Ecce! virent vestrae hic plantae florentque quotannis
Cultorum memoresserta feruntque pia
Ph. Fr. de Siebold.

Beneath this illustration is inscribed:

Monimentum in memoriam
Engelberti Kaempferi et Caroli Petri Thunbergii
In Horto botanico insulae
Dezima
Cura et sumptibus
Ph. Fr. de Siebold
Positum.
MDCCCXXVI.

In his "Nippon. Archiv zur beschreibung von Japan," 2^e Aufl., bd. i, Siebold mentions the existence of such a monument, but perhaps through excessive modesty forbears to mention his connection with it. There can be little doubt that the date 1826 refers to the year in which the monument was erected.

Following this ornamental title page is another engraved page, reading: "Hommage à son altesse impériale royale Madame la Princesse d'Orange Anne Paulowna, Grande Duchesse de Russie."

One of the greatest services rendered by Siebold to horticulture was the laying out of his nursery ground in the immediate vicinity of Leyden in 1843. This garden was better known as "Jardin d'acclimatation du Japon et de la Chine," and in it were introduced many valuable trees and other plants.

ERRATA AND ADDENDA

Page 59, line 14 from below for XXXIII read XXXII.

Page 60, line 1 from above for *subferruginea* read *rufoferruginea*.

Page 126, add to LONICERA SUBSESSILIS as a synonym: *Lonicera diamantica* Nakai in Jour. Coll. Sci. Tokyo, XLII. art. II. 100 (1921).

Page 127, add to LONICERA DEMISSA as a synonym: *Lonicera ibotaeformis* Nakai, l. c. 77 (1921).

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