# NOTES ON AMERICAN WILLOWS

## I. THE SPECIES RELATED TO SALIX ARCTICA PALL.

CAMILLO SCHNEIDER

The more I advance in the study of American willows the more I realize that every species and form needs thorough investigation, and that even the most common and apparently best known species are far from being well understood in their variation and relationship to other forms. It will take two years more before I shall be sufficiently acquainted with all the American species hitherto described and preserved in the leading herbaria of this country to undertake their final arrangement in a monograph. At the advice of Professor SARGENT, therefore, I shall prepare, in the course of my studies, a series[1] of papers dealing with those species and forms which I have had an opportunity to investigate as thoroughly as can be done with herbarium material only. In November 1917 I commenced an investigation of the willows treated by RYDBERG in his paper entitled "Caespitose willows of Arctic America and the Rocky Mountains" (Bull. N.Y. Bot. Gard. 1:257. 1899). I received from the New York Botanical Garden and from the Herbarium of the Geological Survey of Canada at Ottawa the material that RYDBERG had before him. Besides this I had at my disposal the splendid collections of the Gray Herbarium, the Missouri Botanical Garden, and of course of the Arnold Arboretum. Furthermore, I was able to see the Labrador material of the Bebb Herbarium, now in the Herbarium of the Field Museum at Chicago, and also very interesting collections made in Labrador, Greenland, and Alaska from the Herbarium of Cornell University. I take this opportunity to offer my best thanks to the gentlemen in charge of all these herbaria. Unfortunately I have not been able to look over the rich collections of the U.S. National Herbarium at Washington.

It would have been of the greatest advantage if I could have seen the material collected by LUNDSTRÖM and used in his "Kritische

[1] For my first paper see BOT. GAZ. 65:1–41. 1918.

Bemerkungen über die Weiden Nowaja Semljas und ihren genetischen Zusammenhang" (Act. Reg. Soc. Sci. Upsala III. 1877), for without comparing a good series of specimens of *S. arctica* and *S. glauca* from Northern Asia and Europe it is difficult to get a correct understanding of those forms from North America; but at present it is impossible for me to consult any European herbarium.

In this article I shall try to present a critical account of the species related to *S. arctica* Pall.; in a following paper I intend to discuss *S. glauca* L. and the species related to it; while in a third paper a key will be given containing the species treated in the first two papers and also those of sections RETICULATAE and HERBACEAE (RETUSAE), together with a few other species the systematic position of which is not yet fully understood, but which are best placed near one or the other of the groups in question. In this key it is intended to indicate briefly the main characters of the species, because full descriptions cannot be given here except of the new species and varieties I wish to propose.

The history of most of the species must be explained, I am sorry to say, at considerable length, since otherwise it would be impossible to account for the fact that so many well marked types have been interpreted so differently by various authors. I commence with *S. arctica* Pall., which is the nucleus of the group of forms I shall try to elucidate.

1. S. ARCTICA Pall., Fl. Ross. $1^2$:86. 1788.—PALLAS described this species from the "plaga arctica muscosa nuda secundum Sinum Obensem et versus glacialem Oceanum" in such an unmistakable manner that it could never have been misunderstood had not ROBERT BROWN, in 1819, proposed a new *S. arctica*, ignoring altogether the older name of PALLAS. In ROSS, Voy. Expl. Baffin's Bay (appendix, p. 148, and ed. 2, 2:194, both in 1819), BROWN mentioned only the name, and a description of his *arctica* was first given by RICHARDSON in FRANKLIN, Narr. Jour. Polar Sea, Bot. App. $75^2$ (reprint, p. 24). 1823. In the same year BROWN published his own description in Chloris Melvilliana, which was issued separately, while Capt. PARRY'S Voyage, of which the Chloris is only a part (App. Suppl. pp. 259–305), did not appear until 1824; but in 1823 there also appeared a second edition of FRANKLIN'S book and

RICHARDSON'S Appendix. Later, in the synonymy of *S. anglorum* Cham., I shall give the full and exact quotations of *S. arctica* Br.

The earlier *S. arctica* Pall. has also been overlooked by KOCH (1828), who mentioned only BROWN'S species. The first author who recognized the two discrepant *arctica* seems to have been MEYER (De Plant. Labrad. 32. 1830), where in a note to *S. arctica* Br. he says, "Quid est *Salix arctica* Pallas (florae rossicae II. pag. 170 editionis minoris)? Nullibi eam vel ut peculiarem speciem, vel ut synonymon apud botanicos memoratam inveni." In 1831 CHAMISSO (Linnaea **6**:541) proposed the name *S. anglorum* for *S. arctica* Br., non Pallas; see under *S. anglorum*.

In 1832 TRAUTVETTER, in his valuable study "De Salicibus frigidis Kochii," described the 3 following species: *S. crassijulis* Trev., *S. diplodictya* Trvt., and *S. torulosa* Led. Of these in 1833 (in LEDEBOUR, Fl. Alt. **4**:283) he referred *S. crassijulis* and *S. torulosa* as synonyms of *S. arctica* Pall., which had not been mentioned by him in 1832. In this year he described and figured only a *S. arctica* Br., which in 1833, however, he says is nothing but a synonym of *S. glauca* L. In MIDDENDORFF, Reise Sib. **1**²:27 (Florul. Taimyr.), TRAUTVETTER again changed his opinion, saying, "*Sal. arcticam* Pall. et *Sal. arcticam* R. Br. unam eandemque speciem sistere opinor. Planta, quam in dissertatione de Salicibus frigidis N. 7. tab. VI. sub nomine *Sal. arcticae* R. Br. proposui, ad *Sal. glaucam* L. referenda est nec sistit veram *Sal. arcticam* R. Br., uti e descriptione cel. R. Brownii in Fl. Melv. l.c. elucet." See also under *S. anglorum*.

In 1849–51 LEDEBOUR (Fl. Ross. **3**:619) included under *S. arctica* Pall. BROWN'S species as well as TRAUTVETTER'S 3 species of 1832, and also added to *S. arctica* such forms as var. *minor* (*S. phlebophylla* And.) and var. *leiocarpa* (*S. rotundifolia* Trev.). LEDEBOUR seems to have been the first author who mentions *S. anglorum* Cham. in the synonymy.

In a strange way the forms related to *S. arctica* have been treated by ANDERSSON (DC. Prodr. **16**²:285. 1868), who, in 1858, in his previous work on North American willows, only mentioned *S. arctica* Br. as a "species difficile sane definienda, quasi inter *S. myrsinitidem* et *glaucam* prorsus media et formas plures ambiguas

amplectens." To those "formas ambiguas" belong the 3 varieties (*subphylicifolia*, *subreticulata*, and *subpolaris*) proposed by ANDERSSON in 1858, which I have not yet been able to interpret correctly owing to lack of the type material.

In the Prodromus, ANDERSSON created a *S. Pallasii* with the var. *crassijulis* (Trev.) and var. *diplodictya* (Trvt.), and mentioned, strange to say, the type of PALLAS under the last variety, while he is using the name *S. arctica* Pall. to cover a multitude of forms including his var. *nervosa*, *Brownei*, *groenlandica*, *petraea*, and *taimyrensis*. He excluded from his *S. arctica*, therefore, the forms of the true *S. arctica* Pall., and combined under this name a series of very different things like *S. altaica* Ldstr. (recte *S. torulosa* Led.), *S. anglorum* Cham., *S. groenlandica* Ldstr., *S. petrophila* Rydbg., *S. taimyrensis* Trvt., and others.

The first who attempted to clear up the *Pallasii-arctica* mixture of ANDERSSON was LUNDSTRÖM in 1877, in his interesting study previously mentioned. He confined *S. arctica* Pall. to its typical forms, and distinguished besides *S. Brownei* (And.) Ldstr., for which *S. anglorum* Cham. is the oldest name, *S. groenlandica* (And.) Ldstr., and *S. altaica* Ldstr., in which case he overlooked the priority of *S. torulosa* Led., a species founded on the same type. LUNDSTRÖM did not use CHAMISSO'S name because, following ANDERSSON, he referred *S. anglorum* to *S. phlebophylla;* see under *S. anglorum*. Another attempt to interpret properly *S. arctica* Pall. and *S. arctica* R. Br. was made by BEBB (BOT. GAZ. **14**:115. 1889), who, however, did not know LUNDSTRÖM'S work. Consequently he proposed another *S. Brownii* which, sensu stricto, corresponds with *S. anglorum*, a name likewise overlooked by BEBB, who refers some different forms to his *Brownii*. In 1899 BALL (Trans. Acad. Sci. St. Louis **9**:89) mentioned that "the methods by which Professor ANDERSSON succeeded in greatly augmenting the then existing confusion in regard to *S. arctica* R. Br. and *S. arctica* Pall. have been exposed by Mr. BEBB," and stated that BEBB had ignored the existence of LUNDSTRÖM'S earlier homonym; but BALL, in his turn, overlooked the name given by CHAMISSO many years before. It was RYDBERG who, in 1899, reinstated the name *S. anglorum* as the oldest correct name for *S. arctica* Br., non Pall.

I have seen but one leaf of the type specimen of PALLAS. It does not possess stomata in the epidermis of the upper surface, a character upon which I am inclined to lay considerable stress. It is true that by A. and E.-C. CAMUS (Class. Saules Europe 2:55. 1905) *S. arctica* is said to possess "stomates ... assez nombreux" in the upper leaf epidermis, but judging by their synonymy these authors include under *S. arctica* so many widely different forms that they probably did not examine a true *arctica* at all. So far as I can see, this species is represented in the New World only in Alaska, the Yukon Territory, and the adjacent part of the northwest corner of British Columbia, and in the apparently well marked var. *subcordata* in southern British Columbia. I am not yet quite sure how far the range of *S. arctica* extends toward the east, but it seems not to cross 130° W. longitude except in the var. *subcordata*, of which the geographical distribution is not yet fully known. The specimen collected by BELL on Nottingham Island, Hudson Strait (no. 24623 O.[2] olim 18825), which is cited by RYDBERG under *S. arctica* Pall., belongs certainly to *S. anglorum*.

There seems to be no great difficulty in distinguishing typical forms of *S. arctica* from those of *S. anglorum* if one has well developed specimens. Very often, however, it is necessary to deal with mere fragments, and in this case the best character seems to be furnished by the presence or absence of stomata in the upper leaf surface. While they are entirely lacking in what I take for typical *S. arctica*, they are more or less numerous in all the specimens I have seen of *S. anglorum*. Generally, *S. arctica* is a much more robust plant with larger leaves and catkins and thicker branchlets, but when we compare the shape and pubescence of the leaves and the different characters of the flowers and fruits it is rather difficult to express in words those signs that the eye can more or less easily perceive. The best description of the American form of *S. arctica* is given by COVILLE in his excellent study of the "Willows of Alaska" (1901), to which is added a good plate. I shall say something more about the differences between *S. arctica* and *S. anglorum*

[2] In citing herbarium specimens I use the same abbreviations as in my first paper; see BOT. GAZ. 65:9. 1918. There are to be added the following: C., Herb. Field Columbian Museum; Cor., Herb. Cornell University; O., Herb. Geol. Surv. Canada.

under the latter species; otherwise I refer to the keys that will be given in my third paper.

Regarding the variability of *S. arctica*, COVILLE said: "The large number of specimens examined tends to confirm the idea that the extreme variation in the leaves is chiefly an individual characteristic and does not mark recognizable incipient species. The nearest approach I have found to a subspecific differentiation is in some of the specimens from the Pribilof and St. Matthew Islands in Bering Sea, and the Shumagin Islands. In these specimens the leaves are orbicular, or nearly so, and only about 2–3 cm. in diameter, while the catkins are shorter than usual, about 1.5–3.5 cm. in length." These forms represent ANDERSSON'S *S. Pallasii* α, *crassijulis* 3 *obcordata* (1868) (*S. Pallasii* var. *obcordata* Turner; *S. arctica obcordata* Rydb.), who also distinguished f. *grandifolia* and f. *oblongata* of his var. *crassijulis*. The last two forms are, I believe, without any taxonomic value, while f. *obcordata* well deserves to be mentioned as a form or even as a variety. It differs chiefly in the characters mentioned by COVILLE. In addition to the localities cited by this author, I saw specimens from the Yacutat Bay, Glacier Bay (Muir Glacier), and Unalaska which should be referred to var. *obcordata* (And.) Rydbg. The following extract from an account given by TURNER (Contrib. Nat. Hist. Alaska 75. 1886) seems to me worth quoting.

> *S. Pallasii* Anders. var. *obcordata* Anders. This species of willow attains the largest size of any among the Aleutian Islands. The growth is exceedingly crooked, rarely straight for more than a foot, attaining a diameter of 2 to 3 inches, but often decayed within. In all the valleys and wider ravines this species is found in abundance. The roots form an intricate mass, often much exposed, and with the crooked branches and trunks form an impenetrable thicket of considerable area. . . . . VEMAMINOF [a Russian traveler] states that in former years this willow grew to such a size in one of the ravines opening on the west side of Captain's Harbor at Unalaska Island that the Russians and Aleuts procured sufficient of these trunks to be used advantageously in making bidaras (open skin boats). . . . . I visited the locality to find traces of such former growth and found the willows to be of but little better size than in other places near by.

There is another form which has very glabrescent capsules and may be identical with *S. arctica* var. *glabrata* Trautvetter (Act. Hort.

Petrop. 5:107. 1877), of which he remarks: "Solum modo ovariis et bracteis parce puberulis a var. *typica* recedit. Forsan *S. arcticae* proles hybrida." Without having seen TRAUTVETTER'S type, which had been collected by CZEKANOWSKI and MUELLER "inter fl. Olenek et fl. Lena inferiorem, ad fl. Tyria in tundra," I am not sure whether the following plants really represent TRAUTVETTER'S variety: Unalaska, Kiuliuk, September 30, 1871, *M. W. Harrington* (fr.; G.), Dutch Harbor, July 17, 1899, *B. E. Fernow* (f., fr.; Cor.), Kodiak Island, July 2–4, 1899, *B. E. Fernow* (f., m.; Cor.), and Yakutat Bay, Disenchantment Bay, August 13, 1892, *F. Funston* (no. 117 partim, fr.; Cor., M., N.). LEDEBOUR (Fl. Ross. 3:619. 1849–51) has described a variety with entirely glabrous fruits under the name var. *lejocarpa*, the type having been collected by ERMAN in Kamchatka in "ignivomo Schiwelutsch" (Shivelutch). This specimen, which I have not yet been able to compare, was mentioned by CHAMISSO (Linnaea 6:541. 1840) as a form of *S. arctica* Pall., while ANDERSSON (1868) referred it to his *S. Pallasii* var. *diplodictya*. The true *S. diplodictya* Trautv. came from the "insula St. Laurent," and its main difference from typical *S. arctica* is, according to the author's description and figure, the "folia . . . . subtus pallidiora nec glauca nec glaucescentia, utrinque lucida." I have seen no specimen with such leaves, but COVILLE states that "occasionally specimens are found which lack the glaucousness of the lower leaf surface, a character on which TRAUTVETTER based chiefly his separation of *diplodictya*." RYDBERG, who kept *diplodictya* as a species, interpreted it in a very different way, and referred to it certain forms of which I shall speak under *S. ovalifolia*.

The var. *subcordata* previously mentioned from southern British Columbia is a form that needs further investigation. It has been described by ANDERSSON in Öfvers. K. Vet.-Acad. Förh. 15:128 (Bidr. Känned. Nordam. Pilart.). 1858; in Proc. Amer. Acad. 4:69 (Sal. Bor.-Am. 24). 1858; in Walp., Ann. Bot. 5:754. 1858, from specimens collected by DRUMMOND in the "Rocky Mountains." In 1890 BEBB (BOT. GAZ. 15:55) dealt with this rather obscure plant and stated that "the specimens from which the description of this supposed new species was drawn are all attached to a single sheet

in the Kew herbarium; they belong to three distinct and well known species." BEBB had received, through BAKER, nothing but a drawing and copies of the labels and "a few fragments, a capsule or two, to show minute characters." Through the kindness of Sir DAVID PRAIN the Arnold Arboretum has received (together with a series of photographs of other *Salix* types of the Hookerian herbarium) an excellent photograph of the type sheet of *S. subcordata* and also fragments of leaves and flowers. According to this material the fact stands as follows. In the upper left corner there are "two large specimens of *S. arctica* Pall." which BEBB believed had been labeled "almost certainly by some mistake" as "from the Rocky Mts. coll. *Drummond*" because, as BEBB had explained before, "nothing approximating in character to *S. subcordata* And. has been found." There are before me, however, the excellent specimens mentioned later from the Chilliwack Valley, which, in my opinion, are identical with DRUMMOND'S plant. Where this collector obtained his material I cannot ascertain, and so far as I know, he did not collect in this part of British Columbia. Beneath these two "*arctica*" specimens there are 3 (not 2, as BEBB stated) pieces, of which the one in the left corner is sterile, while the middle one bears female and the right one male flowers. Of both of them the Arboretum received fragments which show that they represent the same species as the older branchlets above them. BEBB refers those flowering branchlets to "*S. cordifolia* Hook.," and he is right in so far as HOOKER included in his *cordifolia* those Rocky Mountain forms. But ANDERSSON separated in 1858 just those western forms as *S. subcordata* from the eastern ones, which he then named *S. alpestris americana* (*S. cordifolia* Hook., pro parte).

The most critical part of the type sheet is the two sterile right hand branchlets which BEBB stated to be "two stunted specimens of *S. adenophylla*, leaves only, habitat not given." To those branchlets refers Dr. BARRATT'S label: "no. 92, *S. cordifolia* β *serrulata*." Of those pieces the Arnold Arboretum did not receive fragments, but, so far as I can judge by the photograph and by the corresponding number in Herb. N., they do not at all belong to *S. adenophylla* sensu BEBB (*S. syrticola* Fern.), but seem to represent a form of *S. Barclayi*, which grows together with *arctica subcordata*,

at least in the Chilliwack Valley. This fact explains the confusion of the two species, and there is to me no great "mystery how they came to be placed together on the same Kew sheet." It is, however, "more inexplicable how so critical a salicologist as ANDERSSON should have been misled into combining the characters of the two in his *S. subcordata*." I have also seen the "corresponding numbers of the HOOKER, BARRATT, and TORREY distribution in the Torrey Herbarium" mentioned by BEBB. There are 3 sheets before me. One contains a large leaf and 2 sterile young branchlets, and all 3 pieces belong to var. *subcordata*. This sheet bears the following 2 labels: "No. 90. Herb. H.B. [&T., crossed out; instead of it is written beneath "fig."] *S. obovata* var. *glabra*," and "88 Barratt, Rocky Mts. Ament leafy at the base about 4 leaves—Smooth and paler beneath." Underneath the big leaf BEBB, in 1887, has written "*S. crassijulis* Trev.?, *S. subcordata* And. in part." The second sheet contains two flowering branchlets and bears the label "No. 89 Herb. H.B. & T. Rocky Mts." as well as the statement in BEBB's handwriting "*S. subcordata* And. in part." These flowering branchlets are identical with those in Herb. Kew. The third sheet bears the *Barclayi* form previously mentioned.

ANDERSSON apparently had no clear idea of his *S. subcordata;* in 1858 he stated, "Quoad habitum quasi hybrida a *S. cordata* (cujus folia habet sed breviora) et *S. glauca* (amenta!)." In 1868 he referred to it some more specimens collected by BOURGEAU and DE LA PYLAIE, which I have not yet seen. The material before me looks very much like other robust specimens of *S. arctica*, but the leaves possess some stomata in the upper surface, at least along the main nerves. I think, therefore, that it is best to keep these forms as a variety of *S. arctica*, and I use ANDERSSON'S name.[3]

S. ARCTICA var. **subcordata** (And.) nov. var. seems to differ from typical *arctica* chiefly by the following characters: foliis maximis obovato-ellipticis ad 8:6 cm. vel obovali-oblongis ad 7:2.5 cm. vel ellipticis ovali-ellipticisve ad 8.5:5 cm. magnis

[3] RYDBERG (Fl. Rocky Mts. 167. 1917) uses the name in a different sense. I am not yet quite sure what form is meant by him.

superne stomatiferis; amentis (saltem fructiferis) permagna ad 11 cm. longis et 1.5 cm. crassis.

As already stated, the exact locality where DRUMMOND collected the type is unknown to me. The other material came from British Columbia: Chilliwack Valley, between latitude 49°–49° 10′ and longitude 121° 25′–122°, 1650 m., August 29, 1901, *J. M. Macoun* (no. 26909 O., fr.; G., N.); Selese Mt., 1290 m., July 25, 1906, *W. Spreadborough* (no. 79556 O., fr.; Cor., N.; 79557 O., m.; Cor., N.; 79558 O., f., fr.; Cor.; 79559 O., m., fr.; Cor.); Skeena River, Hazelton Mountains, July 13, 1917, *J. M. Macoun* (no. 95405 O., f.).

There is also a forma incerta foliis oblongo-ellipticis utrinque acuminatis, collected by *G. E. Cooley*, in Juneau, Alaska, above Silver Bow Basin, August 6, 1891 (m.; G., N.), which has been referred by RYDBERG to *S. anglorum*. In my opinion it has nothing to do with that species, but may represent a special form of *S. arctica*, under which species it is cited by COVILLE.

2. S. ANGLORUM Chamisso in Linnaea **6**:541. 1831, exclud. specim. citat.—*S. arctica* R. Brown in Ross, Voy. Expl. Baffin's Bay, app. p. 143. 1819, and ed. 2. **2**:194. 1819, nomen nudum, non Pallas; Chloris Melv. 24. 1823; Capt. Parry's Voy. App. Suppl. p. 282. 1824; Richardson in Franklin, Narr. Jour. Polar Sea 752 (reprint 24). 1823; ed. 2. 765 (reprint 37). 1823.—*S. arctica* β *Brownei* Andersson in DC. Prodr. **16**²:286. 1868, pro parte.—*S. Brownei* Lundström in Nova Act. Reg. Soc. Sci. Upsala III. 1877. 37, pro parte max.—*S. Brownii* Bebb in BOT. GAZ. **14**:115. 1889, pro parte max.

As already stated under *S. arctica* Pall., the existence of this previous name had apparently been overlooked by BROWN in establishing his new *arctica*, of which RICHARDSON was the first to give a description. It may be that this diagnosis was prepared by BROWN, because RICHARDSON in his preface expressly acknowledges the great assistance BROWN gave him, but the first edition of RICHARDSON'S Botanical Appendix appeared shortly before the Chloris Melvilliana, in which BROWN published an excellent description of his species. When in 1831 CHAMISSO changed BROWN'S

name to *S. anglorum* after having given a good account of *S. arctica* Pall., non Br., he said nothing but the following:

*Salix anglorum* N.—*S. arctica* R. Brown ex Ed. Nees 1. p. 406, supl. to the append. of Cap. Parry's Voy. p. 282. E. Meyer Lab. p. 32 (non Pallas).—Insula et sinus Sti. Laurentii.—Ex insula Chamissonis, capsulis maturis vetustate calvescentibus.

These specimens, however, do not belong to *S. anglorum*, but what in 1839 HOOKER (Fl. Bor.-Am. **2**:153) referred to *S. retusa*. HOOKER, therefore, quotes *S. anglorum* in his synonymy of this species, for which ANDERSSON (1858) proposed the name *S.* (*retusa**) *phlebophylla*, and made it a species (*S. phlebophylla*) in the Prodromus (1868). Here he also quotes *S. anglorum* in the synonymy, having in 1858 ignored entirely CHAMISSO's name, which has been used by some later authors for *phlebophylla* instead of *anglorum*. RYDBERG (1899) was the first to state that CHAMISSO's name "must be regarded as equivalent" to *S. arctica* Br.

What, however, is the typical *S. arctica* Brown? It was first collected by Ross during his exploration of the "Baffin Bay, Lat. 70° 30′ to 76° 12′ on the east side, or at Possession Bay, Lat. 73°, on the west side." RICHARDSON probably based his description chiefly on his own plants collected on "barren grounds from Point Lake to Arctic Sea" (or, as the explanation in ed. 2 runs, on "barren grounds from Lat. 64° to the Arctic Sea, in Lat. 60°"); while BROWN, besides the plants of ROSS, mentioned those of PARRY'S Expedition from Melville Island, Winter Harbor. I have not yet seen a type specimen, but RICHARDSON'S and BROWN'S descriptions are sufficient to furnish us with the following characters:

Frutex depressus. Rami, decumbentes, floriferi omnes et sterilium nonnulli adscendentes, adulti glabri. Folia elliptico-obovata vel obovata, integerrima, novella pilis sericeis vestita, adulta utrinque glabra, venis subtus parum eminentibus, venulis anastomosantibus. Amenta utriusque sexus ramos brevissimos foliatos terminantia. Squamae orbiculato-obovatae, saepe retusae, fusco-nigricantes pilis sericeis vestitae. Mascula 8–10 lin. longa, densa. Stamina 2, filamentis distinctis, antheris purpureis. Glandulae

duae. Ovaria sessilia vel brevissime pedicellata, dense griseo-tomentosa. Stylus longitudine varians, nunc stigma aequans, nunc fere dimidio brevior. Glandula unica.

Judging by these characters, there seems no doubt what form must be taken for the true *S. arctica* Br., that is, *S. anglorum* Cham. According to TRAUTVETTER (see under *S. arctica* Pall.) there have been distributed by HOOKER specimens under the name of *S. arctica* Br. which do not belong to this species, and TRAUTVETTER (1847) says that his *arctica* of 1832 (t. VI.) is not identical with BROWN'S plant. However, so far as I can judge by TRAUTVETTER'S diagnosis and figure, I believe that he had the true *S. anglorum* before him. Of course, only an inspection of his type can make a final decision regarding its identity possible. Of ANDERSSON'S treatment of *S. arctica* Br. I have already spoken. LUNDSTRÖM, who apparently misinterpreted the name *anglorum*, chose ANDERSSON'S (varietal) name *Brownei* for what he believed to be *S. arctica* Br. I strongly suspect that *S. Brownei* Ldstr. only partly belongs to *S. anglorum*, and an investigation of LUNDSTRÖM'S specimens from Nowaja Semlja is needed to decide what he really understood by his *S. Brownei*. It seems to me most unlikely that the true *S. anglorum* should at all occur on Nowaja Semlja or in Arctic Asia or Europe; and the description given by LUNDSTRÖM, in my opinion, does not fit BROWN'S species. There may be in Arctic Asia and Europe similar forms which, however, in reality belong to *S. arctica* Pall.

BEBB, as already stated, unfortunately did not know LUNDSTRÖM'S work when proposing a new *S. Brownii* which comprised *S. arctica* And. (1868) "excl. var. *nervosa*." He created a new mixture of forms, including *S. groenlandica*, *S. petrophila*, *S. taimyrensis*, and others. In April 1899 RYDBERG said: "There is scarcely a species that has been so misunderstood as this [*S. arctica* Br.]. Even Mr. BEBB, who cleared up somewhat the discrepancy between *S. arctica* Pall. and *S. arctica* Br., had a very vague idea about the latter." RYDBERG himself did not interpret correctly BROWN'S species. He quotes as type "Franklin Expedition, Dr. *Richardson*," and cites a specimen of the "Herb. Hooker, Barratt, and Torrey, no. 93," which I have before me and which bears the label

"*S. arctica*, Fort Franklin, Mackenzie River." It contains male and female branchlets with young flowers and very young, narrowly lanceolate, rather acute leaves. So far as I can judge by the thinly pubescent and distinctly pediceled ovaries, by the oblong bracts, and by the absence of a dorsal gland in the male flowers, the specimen does not belong to *S. anglorum*, but may probably be referable to *S. groenlandica* Ldstr. Furthermore, RYDBERG states that his *S. anglorum* "is characterized by . . . . the exceedingly large catkins, which are rather loosely flowered below, and the large conic capsule, which is only moderately hairy." If we compare this statement and the specimens cited by RYDBERG, his misinterpretation of BROWN'S species is evident. RYDBERG refers to his *S. anglorum* mostly specimens that in reality belong to *S. groenlandica*, about which species he certainly had a very wrong idea.

Almost simultaneously with RYDBERG (May 1899), BALL published a statement regarding *S. arctica* and BEBB'S treatment of this species. He knew LUNDSTRÖM'S study, but overlooked *S. anglorum* Cham.; he said, however, "I shall not rename the plant now, for I believe the name which has been in use for 80 years (*S. arctica* R. Br.) can yet do duty until both the numerous variations and the synonymy have been given careful study." In BRITTON and BROWN'S Ill. Fl. (ed. 2. 1:605, *fig. 1489*. 1913) the name *S. anglorum* is applied to forms from "Labrador to Alaska, and in the Rocky Mountains to Colorado" in a way I do not understand.

Judging by the ample material before me, *S. anglorum* seems more variable than *S. arctica*. The habitat of the northeast American plant ranges from Northwest Greenland (about Disco Island) and Labrador (where it apparently does not occur south of the 55th parallel) through northern Ungava along the Hudson Strait and the northern shores of the Hudson Bay to the Franklin Bay, reaching, as it seems, its most western point at Cape Bathurst and not ranging beyond 130° W. longitude. There are some forms collected on Herschel Island (coast of Yukon Territory) which might be taken for *S. anglorum*, but on account of the absence of stomata in the upper surface of the leaves I refer them to *S. arctica*. Between 130° and 140° W. longitude there may be the meeting ground for the 2 species, and we need much more and well collected material from

there to get a correct conception of the relationship of those arctic forms. I am not fully convinced that the presence of stomata in the leaf surface of *S. anglorum* and their absence in *S. arctica typica* can be regarded as a decisive character in distinguishing certain similar forms, but I think this specific character is of great taxonomic value at least in several species. A. and E.-C. CAMUS lay much stress upon this character in establishing their systematic arrangement according to anatomical features, and an excellent observer like the well known dendrologist E. KOEHNE was always inclined to pay much attention to those characters. In studying willows we should bear in mind the following remarks of the distinguished English salicologist, F. BUCHANAN WHITE (Jour. Linn. Soc. **27**:346 [Rev. Brit. Willows]. 1890):

> Whilst all the parts of the plant are variable, some characters, on which a great deal of reliance has been placed, are so inconstant that they may, in many cases at least, be almost or quite ignored, though in other instances they are really of importance. Familiarity with the species can alone teach the student what are the points on which he can depend.

At present it is impossible to interpret properly certain forms because we do not yet know the degree of variation of the species in question. There are, I am convinced, many hybrids, and the fact that has been recognized by all the leading salicologists in Europe "that willows hybridize with the greatest facility adds," as WHITE (*loc. cit.*, p. 340) says, "immeasurably to the intricacies of the study." Here in America we are only just beginning to get a better understanding of the taxonomy, variation, and distribution of the numerous willows, and everyone who attempts to further our knowledge of them ought to be lenient in his criticism of those interested in this study.

It is not without hesitation that I propose the following varieties of *S. anglorum*, but I am encouraged by the fact that such a keen observer as Professor M. L. FERNALD, who has collected most of the material of the new forms and to whom I wish to express my gratitude, agrees with my treatment of them.

S. ANGLORUM var. **kophophylla**,[4] nov. var.—Frutex prostratus ramis subterraneis ad ultra 1 cm. crassis, ramulis repentibus pl. m.

[4] The name is derived from κωφός, blunt.

elongatis, fructiferis ut videtur tantum ascendentibus; ramuli novelli sparse, rarius subdensius pilosi, vulgo citissime glabrescentes, in sicco nigrescentes vel flavescentes vel hornotini autumno ut annotini purpurascentes, ad 2 mm. crassi, annotini biennesque purpurei badiive, interdum ut vetustiores pl. m. pruinosi, vetusti crassiores pl. m. nigrescentes. Gemmae ovatae, obtusae, glabrae, badiae, saepe leviter pruinosae, ad circ. 5 mm. longae, floriferae ut videtur obovatae, obtusiores. Folia adulta satis chartacea, inferiora minora variabilia, superiora majora vulgo late ovalia, ovato-rotundata, obovata, late elliptica ad orbicularia, apice rotundata vel satis breviter acuta, interdum brevissime plicato-apiculata, basi late cuneata, rotundata ad subcordata, 1.5:1.2 vel 2.3:1.8 ad 3.5:2.5–2.8 cm. magna, interdum ovato-rotunda ad 3.5 cm. longa et 3 cm. lata, margine integerrima, rarius partim sparse subdenticulata, vulgo parce (juniora densius) ciliata, superne ut videtur tantum novella pl. m. sparse villosula et in costa pilosula, cito glabra, saturate et vivide viridia, stomatifera, costa subimpressa nervis lateralibus subprominulis et etiam graciliter reticulata, subtus valde discoloria, glaucescentia, pruinosa, initio magis quam superne sericeo-villosa sed etiam (infimis minoribus exceptis) cito glabra, costa nervisque primariis utrinque 5–8 pl. m. flavescentibus vel brunnescentibus elevato-nervata et graciliter sed distincte reticulata. Petioli longitudine satis variabiles, superne sulcati, initio pl. m. pilosi, dein glabri, 2–14 mm. longi. Stipulae nullae vel raro evolutae, lineari-lanceolatae, glanduloso-denticulatae, subglabrae, visae vix ultra 2 mm. longae. Amenta satis serotina, ramulos foliatos 0.5–2(–2.5) cm. longos pl. m. pilosos terminatia, cylindrica, rhachi villosa; mascula (no. 3232) 1–2 cm. longa et circ. 8 mm. crassa; bracteae obovato-oblongae ad late obovatae, apice obtusae vel retusae, omnino fuscae vel apicem versus atrae (in vivo pl. m. purpurascentes?), utrinque satis longe sericeo-pilosae; stamina 2; filamenta libera, glabra, bracteis demum duplo longiora; antherae parvae, ellipsoideae, ut videtur violaceae; glandulae 2 (vel interdum 1), ventralis ovato-rectangularis, truncata, integra (semper?), bractea duplo brevior, dorsalis (3232) duplo minor et angustior (in no. 510 nulla); amenta feminea sub anthesi ut videtur circ. 1–1.5 cm. longa et 0.6 cm. crassa, satis densiflora, fructifera

ad 3.5:1.4 cm. magna; bracteae ut in floribus masculis; ovaria sub anthesi ovoideo-oblonga ellipticave, sessilia vel subsessilia, albo- vel griseo-villoso-tomentosa; styli distincti, vulgo apice bifidi, rarius subbipartiti, stigmatibus oblongis bifidis 2–2½plo longiores; glandula 1 ventralis, anguste ovato-conica, truncata, integra vel ut videtur pleraque bifida bipartitave, bractea subduplo brevior fructus elliptico-conici, circ. 7 mm. longi, fere sessiles, ut ovaria vel minus dense pilosa (interdum in forma porro observanda [nos. 61 et 62] fere glabri), valvis apertis paullo recurvatis.

TYPE LOCALITY.—Western New Foundland, Bay of Islands, northeastern region of the Blomidon Mountain.

RANGE.—Western New Foundland, Bay of Islands and Bonne Bay, and western Gaspé Peninsula, Mt. Albert.

SPECIMENS EXAMINED.—Western New Foundland, northeastern region of the Blomidon ("Blow-me-down") Mountains, serpentine tableland, alt. about 550 m., July 24, 1910, *Fernald* and *Wiegand* (no. 3231, f.; G.; "prostrate near melting snow"; no. 3232, m., 3233, fr. type; G.; "prostrate"); Blomidon Range, July 3–5, 1911, *C. S. Stewart* (no. 29, st.; G.); Bonne Bay, serpentine tableland, alt. about 380 m., August 27, 1910, *Fernald* and *Wiegand* (nos. 3227, 3228, fr.; G.)—Gaspé Peninsula, Mt. Albert, deep ravine near snow, July 23, 1881, *J. A. Allen* (m., f.; G.); north slope of Allen's ravine, on hornblende schist, July 26, 1906, *Fernald* and *Collins* (nos. 501, 503[b], f., 507, fr.; G.); on wet serpentine slopes, July 23, 1906, *Fernald* and *Collins* (nos. 508, f., 510, m., 514, fr.; G.); brookside near permanent water, alt. 700 m., August 13, 1905, *Collins* and *Fernald* (no. 60, fr.; G., N.; partim fructibus satis glabrescentibus); dry serpentine barrens, 1000–1050 m. alt., August 9, 1905, *Collins* and *Fernald* (no. 62, fr.; G.; partim fructibus glabratis ut in no. 60).

In its rather short and dense catkins, at the base not or hardly loosely flowered, this variety approaches typical *S. anglorum*, but differs in its firmer, more rounded, and soon glabrous leaves and the glabrate twigs, in which characters it comes near to the following varieties. There is also no. 3235 of *Fernald* and *Wiegand*, collected at the same time as no. 3231 "from near sea level to serpentine tableland, alt. about 550 m." as a prostrate shrub. It occurs, according to the specimens in Herb. G., with the rounded leaves of the typical *kophophylla*, and also with more acute, lanceolate leaves, and both forms seem not to possess stomata in the upper leaf surface. So far as we know at present, there is no *S. cordifolia* in the Blomidon Mountains, and therefore this form cannot be connected in any way with *cordifolia* var. *Macounii* (Rydbg.) m. (see my second article). It certainly needs further observation. No. 3234, collected by *Fernald* and *Wiegand* in the northeastern region of the Blomidon Range, on serpentine tableland, about 550 m. alt., July 24, 1910

(fr.; G.), much resembles *S. cordifolia*, but I found stomata in the upper side of the leaves. We do not know enough of the willows of this range to be able to determine this form properly.

S. ANGLORUM var. **araioclada**,[5] nov. var.—Frutex ut sub var. *kophophylla* descriptus sed sequentibus signis distinctus: folia adulta satis tenuiter papyracea, minora inferiora obovalia, obovato-oblonga vel ut majora superiora ovalia, elliptica, ovato-elliptica, obovato-elliptica vel rarius obovato-lanceolata, apice vulgo magis obtusa vel rotunda quam acuta, raro retusa vel subito plicato-acutata, basi rotundata ad late cuneata, rarius sensim attenuata, margine integerrima, minimis exceptis 1.5:1 vel 3:2 ad 4:2.7 vel 5:2.9 cm. vel angustiora acutiora ad 4:1.8 cm. magna, superiora vulgo ab initio glaberrima; petioli interdum ad 10 mm. longi; stipulae rarissime evolutae, minimae, lineari-lanceolatae, caducae; amenta fructifera ramulos foliatos ad 4 cm. longos terminantia; mascula 1.5–2.5:1 cm. magna, minus quam in typo sericea; bracteae longe sed satis laxe sericeae; glandulae 2–1; feminea sub anthesi ad 3.5:1 cm. magna, fructifera vulgo 3.5–5.5 cm. longa et 1.8 cm. crassa, basim versus vulgo distincte laxiflora; bracteae interdum quam in masculis oblongiores sed saepissime densius sericeae, extus ad apicem interdum partim glabrescentes; ovaria ovoideo-oblonga, griseo-villoso-tomentosa, sessilia vel subsessilia; styli distincti, integri vel apice breviter bifidi, quam stigmata oblonga bifida vix duplo (rarius in floribus valde juvenilibus fere $2\frac{1}{2}$plo) longiores; glandula ut in typo longa, pl. m. anguste conica, bractea duplo brevior; fructus ovato-conici, maturi ad 7–8 mm. longi pedicello subnullo vel brevi glandula $\frac{1}{3}$ ad 2plo breviore excluso, laxius quam ovaria villoso-tomentosi, fulvi.

TYPE LOCALITY.—Gaspé Peninsula, north slope of Mt. Albert.

RANGE.—Gaspé Peninsula and the Selkirks and Rocky Mountains in British Columbia, Asulkan Valley, and in Alberta, near Laggan and Jasper Park.

SPECIMENS EXAMINED.—CANADA: Quebec, Gaspé County, Mt. Albert, deep ravine near snow, alt. 810 m., August 2, 1881, *J. A. Allen* (m.; G.; amentis parvis ovatis, glandula dorsali nulla, forma porro observanda); alt. 750–1050 m., July 26, August 2, 1881, *J. A. Allen* (m., f.; G. ex herb. Bebb;

[5] Derived from ἀραιός, slender, and κλάδος, branch.

amentis parvis); head of Allen's ravine, August 8–15, 1905, *Collins* and *Fernald* (fr. im.; G.); north slope of same mountain, on hornblende schist, July 26, 1906, *Fernald* and *Collins* (no. 500, m. paratype; G.; 501[a], f.; G.; 503, 503[a], f. adult., 505, f. type; G.); July 20, 1906, *Fernald* and *Collins* (no. 506, fr.; G.); on wet serpentine slopes, July 23, 1906, *Fernald* and *Collins* (no. 510[a], m.; 514, fr.; G.).—BRITISH COLUMBIA: Selkirk Mountains, Rogers Pass, alt. 1350 m., July 31, 1890, *J. Macoun* (no. 18[a], f.; N.); Asulkan Valley, Glacier, alt. 1590 m., *J. G. Jack*, August 14, 1904 (fr.; A., G.); same place and date, *A. Rehder* (fr.; A.; both specimens identical with those like no. 506 from Gaspé).—ALBERTA: Lake Agnes near Laggan, August 11, 1904, *A. Rehder* (m., f.; A.; forma incerta quamvis ad *S. petrophilam* spectans); slopes of ravine on Mt. Aylmer, alt. 2250 m., August 4, 1899, *W. C. McCalla* (no. 2248, m., f.; Cor.); mountains above Lake Louise, alt. 1800–2400 m., July 21, 1907, *F. K. Butters* and *E. W. D. Holway* (no. 262, f.; N.; forma quasi ad *S. petrophilam* transiens sed foliis magis quam in hac specie discoloribus); Lake Louise, July 22, 1904, *J. Macoun* (no. 68883 O., fr.; N.); Fitzhugh Mountain, near Jasper Park, August 1917, *J. M. Macoun* (nos. 95379, 95397, 95398, 95401 O., fr., m.).

This peculiar variety differs from the type chiefly in its less pubescent, mostly much more elongated, and yellowish twigs, in its almost glabrous young leaves, and in its aments which, on an average, are longer and thinner, at least much more loosely flowered toward the base. It is, apparently, closely connected with var. *kophophylla*, which as a whole has firmer leaves and denser and shorter catkins, but in its glabrous character comes nearer to var. *araioclada* than to the typical *anglorum*. See also my remarks under the following form.

S. ANGLORUM var. **antiplasta,**[6] nov. var.—Frutex habitu ramulisque ut in var. *araioclada;* folia adulta chartacea, anguste ovalia, elliptico-oblonga, anguste obovato-oblonga, interdum oblanceolata, rarius elliptica vel obovato-elliptica, utrinque pl. m. acuta, raro rotundata, saepe apice breviter plicato-acuminata, vulgo 1.5–2.5 cm. longa et vix ultra 1 cm. lata, maxima ad 3:1.3–1.5 (rarius 1.8) cm. magna, integerrima vel interdum basim versus obsolete parce denticulata, superne subtusque ut in var. *araioclada* sed nervis lateralibus vulgo ut in *petrophila* angulo acutiore a costa abeuntibus et magis versus apicem currentibus; petioli graciles, 2–8 mm. longi, vulgo sparse pilosi; amenta cylindrica, sub anthesi satis brevia et tenuia, vulgo sublaxiflora, ramulos laterales in masculis vix ad 1 cm. longos ceterum ut in *araioclada* terminantia,

[6] Derived from ἀντίπλαστος, similar.

rhachi parteque nudo pedunculi pl. m. villosa; mascula vix ad 1.5:0.7 cm. magna, bracteae et cetera ut in *araioclada*, glandula dorsalis (an semper?) nulla; feminea sub anthesi 1–2:0.5–0.7 cm. magna, fructifera vix ad 3 cm. longa et 1.2 cm. crassa, bracteae ut in masculis; ovaria ovoideo-oblonga, pl. m. sessilia; styli distincti, saepe apice breviter bifidi, stigmatibus brevibus oblongisve paullo vel ad 2.5plo longiores, glandula ut in varietate precedente; fructus ovato-conici, subsessiles, ad 6 mm. longi, laxius quam ovaria villoso-tomentosi vel anni praeteriti subglabrescentes.

TYPE LOCALITY.—Gaspé Peninsula, serpentine slopes of Mt. Albert.

RANGE.—As above.

SPECIMENS EXAMINED.—CANADA: Quebec, Gaspé Peninsula, Mt. Albert, serpentine slopes, July 23, 1906, *M. L. Fernald* and *J. F. Collins* (no. 509, f., fr., type; G.); exposed serpentine barrens, alt. 1000 m., August 9, 1905, *Collins* and *Fernald* (no. 61, m., f.; G., N., O.); sheltered mossy knolls, August 10, 1905, *Collins* and *Fernald* (no. 61[a], f.; G., N., O.; a precedente nonnisi petiolis vulgo longioribus differe videtur); on wet serpentine slopes, July 23, 1906, *Fernald* and *Collins* (no. 511, fr.; G.; forma gracilis juvenilis, habitu *S. petrophilae* valde similis); north slope of same mountain, on hornblende schist, July 26, 1906, *Fernald* and *Collins* (no. 504, f. defl.; G.; forma satis vegeta, ramulis elongatis, foliis pl. m. plicato-acuminatis).

At first sight this variety much resembles *S. petrophila* in its habit, the shape of the leaves, and the yellowish color of the young twigs, but the leaves are of a deeper green on the upper surface and much paler and glaucescent on the lower surface, and do not differ in this respect from any other form of *S. anglorum*. It is, however, much easier to distinguish herbarium specimens of both species than to express the differences in exact words. The two species meet each other in the Rockies of Alberta and British Columbia, and there are also certain forms in northern Montana, and even in Wyoming which at present I am at a loss to determine. Some of them may represent hybrids between *S. petrophila* and other species with which I am not yet sufficiently acquainted.

3. S. PETROPHILA Rydbg., in Bull. N.Y. Bot. Gard. 1:268. 1899, is the species which seems to be nearest related to *S. anglorum*. It was first described by ANDERSSON (DC., Prodr. 16[2]:287. 1868) as *S. arctica petraea* from specimens collected by *E. Bourgeau* "in summo Rocky Mountains." I have seen a photograph of the type at Kew and a cotype in the Gray herbarium. Both specimens bear the label of PALLISER'S Brit. N. Am. Expl. Expedition, with the printed indication "Rocky Mountains" and "coll. E. Bourgeau

1858"; and upon them is written "*Salix arctica* R. Br. *subalpestris* And. (forte n. sp.)." ANDERSSON apparently changed the varietal name later to *petraea*. The Kew sheet also bears, in the lower left corner, the inscription "*Salix herbacea*. Montagnes rocheuses Palouse près les Glaciers. 18 août 1858." According to MACOUN (Cat. Canad. Pl. preface, p. viii. 1883), BOURGEAU "spent some time, in August 1858, in the Bow River Pass and the adjacent mountains" in Alberta. *S. petrophila* differs from *S. anglorum* chiefly in the color of the rather pale or grayish green leaves, which are not distinctly paler and never whitish beneath. The differences indicated by RYDBERG between the two species are of no value, because his *S. anglorum* is mostly *S. groenlandica*. As I have already said, there are some forms in the northern habitat of *petrophila* which I have not yet been able to interpret properly. So far as I can judge by the specimens before me, the species ranges from about 52° N. latitude in southwestern Alberta and southeastern British Columbia through western Montana, northeastern Wyoming, and central Colorado to the Truchas Peak in northern New Mexico. I have not seen specimens from Washington and it is not mentioned in PIPER'S Flora. In eastern Oregon I know only of two localities. From Utah and Nevada I have seen very little material, and in California it is found in the Sierra Nevada from Sierra County to Tulare County.

In western Nevada and the Californian Sierra, *S. petrophila* is mostly represented by a form which has been described as *S. caespitosa* by KENNEDY (Muhlenbergia 7:135, *pl.* 9. 1912). Through the kindness of Professor C. W. LANTZ I have seen the type, which is preserved in the herbarium of the Agricultural Experiment Station at Reno. It was collected by the author on Mount Rose, Washoe County, Nevada, August 17, 1905 (no. 1173, fr.). It differs from typical *petrophila* in the more copious pubescence of the upper leaf surface, the acuter leaves, and the very short style. The last character seems very variable, and the type material before me consists only of fruits with withered styles and stigmas. Nevertheless, I am inclined to use the name *caespitosa* for a variety which seems to be the prevailing form in the western part of the range of *petrophila*, and this var. **caespitosa** (Kennedy), nov. var., may be

distinguished by its foliis utrinque acutioribus apice subacuminatis superioribus superne (saltem in parte) satis villosis, subtus vulgo glabris ad 3.5:1.3 cm. magnis, amentis femineis (immaturis) interdum ad 6:1.3 cm. magnis basi valde laxifloris longe pedunculatis. The most extreme form of this variety has been collected by *Hall* and *Chandler* on Mount Goddard, Fresno County, California, July 24–26, 1900 (no. 685, m., f.; G.); and I refer to it also a specimen collected by *F. W. Congdon* on Mount Dana, Mono County, California, August 27, 1895 (m., fr.; N.).

It may be mentioned here that *S. cascadensis* Cock. (*S. tenera* And., non A. Br.) is regarded as very closely related to *petrophila* by RYDBERG, or as "perhaps only a variety" of it by BALL. I prefer to place it in a different group next to *S. phlebophylla*, and I shall speak of it later.

There are three more willows, which, in my opinion, should be included in the same group with *S. arctica*, namely *S. stolonifera* Cov., *S. ovalifolia* Trautv., and *S. groenlandica* Ldstr. The first two have been well treated by COVILLE (1901), and need only a few remarks, while the history and taxonomy of the last ought to be explained in detail.

4. S. STOLONIFERA Coville, in Proc. Wash. Acad. Sci. **3**:333. *pl. 41. fig. 1* (Willows of Alaska). 1901, "is a species of eastern Alaska, in the glacier region from Yakutat Bay to Glacier Bay and Lynn Canal." RYDBERG (1899) mentioned this species under the name of *S. unalaschensis* "Cham. Linnaea **6**:539." As COVILLE has explained, CHAMISSO did not propose such a species, but merely describes a "*Salix* unalaschcensis, multis cum *arctica* Pall. conveniens, pluribus ab illa abhorrens, nulli nostrarum propius accedens," to which he did not give a specific name. His form from Unalaska is the same as *S. ovalifolia* Trvt., and ANDERSSON has already mentioned in the Prodromus "*S. unalaschkensis* Chamisso" among the synonyms of TRAUTVETTER'S species. COVILLE describes the ovaries as "smooth or with some traces of pubescence toward the apex," and he regards the glabrous form as the typical and common one. I think it best to propose a f. **subpilosa,** f. nov., fructibus pl. m. interdum satis dense pilosis, because such forms resemble somewhat *S. arctica*, especially when the old fruits have lost the

style. The leaves, so far as I can see, always possess stomata in the upper epidermis, as is the case with typical *S. stolonifera*, while they are wanting in the leaves of typical *S. arctica* and *S. ovalifolia*. The length of the style and the rather long linear stigmas seem to be the best characters to distinguish *S. stolonifera* from the other species of this group. "The characteristic of the production of slender leafless, subterranean branches or stolons" is not always clearly seen on herbarium specimens, and the presence of such stolons may possibly be detected in other related species.

5. S. OVALIFOLIA Trautvetter in Nouv. Mém. Soc. Nat. Mosc. **2**:306, *pl. 13* (De Salic. Frig. Kochii). 1832.—*S. myrtilloides* forma 4 Chamisso in Linnaea **6**:539. 1831.—*S. unalaschkensis* Chamisso ex Andersson in Öfv. K. Vet.-Akad. Förh. **15**:130. 1858.—*S. rotundata* Rydberg apud Macoun, List Pl. Pribilof Islands in Jordan, Fur Seals N. Pac. **3**:571. 1899, non Forbes 1829.—*S. cyclophylla* Rydberg in Bull. N.Y. Bot. Gard. **1**:275. 1899, non Gandoger 1882.—The type locality of the species is Cape Espenberg in the Kotzebue Sound. Its range extends from the Bering Strait, where it is probably also found on the Siberian Coast,[7] northward to Point Barrow and Martin Point, where it has been found by *F. Johansen*, July 30, 1914 (no. 136[b] or 93484 O., fr.); and southward to the Pribilof and Aleutian Islands and the Alaskan Peninsula, but it has also been collected on Kodiak Island, and to the eastward as far as Yakutat Bay. The typical form has glabrous ovaries and fruits; there are, however, specimens with loosely pubescent capsules collected by *Trelease* and *Saunders*, St. Paul Island (no. 3442, fr.; M.), which may represent the var. *pubescens* And. (DC. Prodr. **16**[2]:291. 1868). This is described as being distinguished by "capsulis tenuiter hirsutis griseo-pubescentibus petiolis et foliis basi longius hirsutis." As no type is given, I cannot decide whether ANDERSSON'S variety is identical with this specimen.

Some other specimens which COVILLE has cited as typical *S. arctica*, while RYDBERG took them for *S. diplodictya* Trautv., should be discussed. The last species has been described, as I have explained, as having the leaves green and glossy on both sides, and

[7] Lg. C. WRIGHT in 1853–56 on Arakam Island. Those specimens are distributed as *S. uva-ursi*, but agree well with *S. ovalifolia* except that the fruits are not glaucous.

it has certainly nothing in common with the forms in question. These specimens seem to represent a form somewhat intermediate between typical *S. ovalifolia* and typical *S. arctica*. It may be characterized briefly as follows: ab *ovalifolia* satis diferre videtur foliis amentisque majoribus, floribus masculis tantum (an semper?) glandula ventrali instructis, ovariis satis pubescentibus etiam fructibus tenuiter vel partim (fere ut in var. *pubescente* supra) pilosis sed non distincte glaucescentibus; ab *arctica* praecipue recedit foliis minoribus pl. m. rotundatis vel obovato-rotundis, amentis parvioribus, fructibus minoribus (perfecte maturis non visis) pl. m. glabrescentibus vel partim glabris. I do not want to propose a new name for this form, because it needs further observation, but it is by no means identical either with *S. ovalifolia pubescens* or with *arctica*. It may be referred provisionally to *S. ovalifolia* var. *subarctica* Lundström in Nov. Act. Roy. Soc. Sci. Upsala III. 1877. p. 41, where the following characters are given: "β, *subarctica* nob. capsulis pubescentibus; foliis majoribus, subtus parce villosis." As I have said, the forms described by LUNDSTRÖM cannot be fully understood until his type material is examined.

There remains another arctic form which I should have regarded as not separable from typical *S. ovalifolia* but for the fact that I found stomata in the upper leaf epidermis in most of the specimens cited later. So far as I can judge by the rather scanty material before me, this variety, for which I propose the name var. **camdensis,** var. nov., seems chiefly to differ from *S. ovalifolia* in the following respects: foliis nondum perfecte evolutis minoribus vel oblongioribus elliptico- vel ovato-oblongis vel oblanceolatis apice acutis vel obtusis basi acutis vel pl. m. rotundatis vix ultra 1.5 cm. longis et 1 cm. latis in epidermide superiore vulgo pl. m. stomatiferis adultis textura tenuiore et subtus minus distincte reticulatis, petiolis saepe quam gemma brevioribus, amentis masculis submajoribus ad 1.5:1 cm. magnis, fructiferis subminoribus ad 1.5 cm. longis et 1.2 cm. crassis.

I examined the following specimens: Alaska, Camden Bay, Collinson Point, July 17, 1914, *F. Johansen* (no. 116 or 93482 O., fr., type in O.); June 1914, *F. Johansen* (no. 44[a] or 93807 O.; f.; stomata non visa; no. 44[b] or 93806 O., m.); Kongenevik, July 1914, *F. Johansen* (no. 82[a] or 93805 O., m.

syntype; no. 82[b] or 93804 O., fr.; stomata superne in foliis non visa); west of Martin Point, July 30, 1914, *F. Johansen* (no. 136[a] or 93483 O., st.; folia superne stomatibus numerosis instructa breviter petiolata, forma porro observanda).

Dr. FRITS JOHANSEN has been so kind as to give me the following information regarding this variety: "Nos. 44a, b, Collinson Point. This willow grew on more bare, gravelly tundra near the beach (transition region to the latter), in patches of several plants. Its growth was very prostrate and depressed (among stones and vegetation), with the stems and branches lying very close to the ground and spreading widely, so that only the catkins showed up from a little distance. Especially the subterraneous parts (roots and stem parts) were less extensive and spreading than with those found at Kongenevik, Alaska (see below); probably because they did not grow on sand dunes as is the case at the former place.—Nos. 82a, b, Kongenevik. The collecting place was where the seashore (beach) through low sand dunes goes over into the more typical tundra behind. On these sand dunes the vegetation is very characteristic and consists almost exclusively of *Elymus*, *Carex*, *Salix*, *Chamaerium*, etc.; each species spreading (both above and under the ground) over large patches (areas) and dominating more or less to the exclusion of the other species. This *Salix* seemed to be very prostrate, but the larger part of each plant is buried in the sand, so that only the leaf and catkin-carrying branch parts (outer third) protruded. It was mostly large plants widely spreading (both roots and stems); the branches often having the form of long "runners" intersecting the sand rhizome-like in all directions. The sand-covered parts of the branches were without leaves or catkins and pale (white-yellow). When growing in less sandy soil the growth is naturally more condensed (see above under Collinson Point). The plants were in full bloom in the end of June.—Nos. 136a, b, Martin Point. The collecting place was a sandy gravel spit of slight elevation, with the sand dunes less pronounced than at Kongenevik. Vegetation rather scattered and in patches, except around the several ponds and the big lagoon between the sand spit and the mainland behind. On sandy places the vegetation was much like that at Kongenevik, with *Honckenyia* taking the place of *Chamaerium*. As the character of the spit was somewhat intermediate between the beach regions at Collinson Point and at Kongenevik, so did also the growth of the *Salix* in question resemble those of the same species from both of the foregoing places. At the time of collecting the plants had dropped ♂ catkins and had unripe ♀ catkins."

6. S. GROENLANDICA Lundström, Nov. Act. Reg. Soc. Sci. Upsala III. 1877. p. 36.—*S. arctica* Liebmann, Fl. Dan. XIV. fasc. 42:7, *pl. 2488*. 1849, non Pall.—*S. arctica* γ, *Groenlandica* And. in DC., Prodr. 16[2]:287. ut videtur excl. forma 6 *pusilla*.—ANDERSSON

based his var. *groenlandica* on "*S. arctica* Fl. Dan. t. 2488," and he distinguished 6 forms: (1) *hebecarpa*, which is nothing but the type; (2) *lejocarpa*, with glabrous ovaries; (3) *latifolia*, which probably only represents a vigorous form with "foliis orbiculato-ovalibus"; (4) *angustifolia*, a mere form with "foliis lanceolatis"; (5) *macrocarpa*, which is nothing but the typical plant with normal big aments; and (6) *pusilla*, which I cannot interpret because the description ("fruticulus vix digitalis, foliis 1–3 lin. longis densissime confertis. *Salici retusae serpyllifoliae* analoga") is insufficient, and ANDERSSON does not cite a type or any locality for it. The description and figure given by LIEBMANN are quite sufficient to understand what form is meant, and it is rather surprising that this well marked species could be misunderstood by later authors. LUNDSTRÖM did not say much about it, because he was dealing with Asiatic and European forms, and only wanted to separate it from the related species. LANGE (Consp. Fl. Groenl. 1:108. 1880), in adding his var. "*minutifolia* And. mscr." to those already described by ANDERSSON (but omitting f. *macrocarpa*), referred *S. arctica* Br. (*S. Brownei* Ldstr.) as a synonym to *S. groenlandica*, and seems to have misunderstood BROWN's plant. RYDBERG, in his turn, as I have said, mixed the real *S. groenlandica* with his *S. anglorum*, and gave the name *groenlandica* to specimens of the latter species and to several forms of different origin. In my opinion the true *S. groenlandica* may easily be recognized by its glabrous leaves, which are shining dark green and without stomata above and distinctly glaucescent beneath, the margin being entire or often more or less glandular denticulate, by its large aments which measure from 5:1.2 to 10:1.6 cm. in fruit, and by its distinctly pediceled ovaries, which bear a rather thin and short silky pubescence even when young and possess a short and broad gland of about half the length of the pedicel. The shape of the ventral gland, which is the same in both sexes, differs much from that of the other species of this group where, as a rule, it is oblong or ovate-conical and longer than the pedicel. The thin pubescence of the ovaries and fruits, which are often almost glabrate or entirely glabrous in var. *lejocarpa* (And.) Lange, gives them a different aspect from the tomentose capsules of *S. arctica*, *S. anglorum*, or

*S. petrophila*. In the size of the fruiting aments *S. groenlandica* is next to vigorous forms of *S. arctica* and to *S. arctica* var. *subcordata*.

The type of *S. groenlandica* has been collected by VAHL "in locis humidis Groenlandiae orientalis et occidentalis a limite maris ad alt. 200 pedum." I have not seen a specimen of VAHL's and no material from eastern Greenland. Judging by the specimens I have examined, its range extends from Disco Island (70° N. latitude) through the southern part of Baffin's Land westward to the Bathurst Inlet (about 109° W. longitude), and southward along the shores of the Hudson Bay through Ungava and Labrador to the western Gaspé Peninsula and the Port à Port Bay in western Newfoundland. There are also some rather uncertain and fragmentary specimens from the Lancaster and Jones Sound, and probably the habitat of *S. groenlandica* reaches its northern limit at about the 76th parallel. Other specimens have stomata in the upper epidermis of their leaves and may represent a different variety or be of hybrid origin; they need further observation.

ARNOLD ARBORETUM
JAMAICA PLAIN, MASS.