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PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

IV.

THE TREE WILLOWS OF ALASKA.

[Plate XV, figs. *a-e*.]

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THE duty of making botanical collections on the Harriman Expedition was officially entrusted to Dr. William Trelease assisted by Professor De Alton Saunders, Professor William H. Brewer assisted by Dr. Wesley R. Coe, and Mr. Frederick V. Coville assisted by Mr. Thomas H. Kearney, Jr. Other members of the expedition also collected plants, incidentally to their specific work, as follows: Professor B. E. Fernow, Dr. Charles Palache, Professor Trevor Kincaid, Mr. Leon J. Cole, and Miss Mary Harriman. The Alaska collections were made between June 4 and July 28, 1899, at about fifty localities along the coast, from the southernmost point of the Territory to Bering Strait. The frequent stops and the exceptional facilities afforded for drying the material brought on board the steamer made it possible to secure an extensive series of specimens. The collections are by far the largest made since the American occupancy of Alaska in 1867, and probably exceed those of any one of the Russian or English expeditions of the early part of the cen-

tury. Representing as they do the three floral districts of the Alaska coast—the heavily forested Sitkan flora, the forestless but temperate Aleutian flora, and the all but perennially frozen Arctic flora—the collections furnish excellent material for studies in geographic distribution. Even the remaining fourth floral district of Alaska, that of the Yukon Valley, in the interior of the Territory, is sparingly represented in the plants collected at Skagway and in Cook Inlet.

In order to give more comprehensive scope to the work as a whole, it was arranged that Dr. Trelease should devote his attention primarily to the cryptogams, except the algæ, which were entrusted to Professor Saunders; Mr. Kearney was to take the flowering plants, except the trees and shrubs, which were to be left to the writer; and the other collectors were to secure such material as they could, particularly in localities visited by only a few members of the expedition. A full set of the cryptogamic plants is to be deposited in the herbarium of the Missouri Botanical Garden at St. Louis, and a full set of the flowering plants in the United States National Herbarium at Washington, Dr. Trelease and the writer having in charge the preparation of the reports on these groups, respectively.

Among the genera of flowering plants that have given difficulty to students of Alaska botany, the willows probably stand first. About fifteen species were collected in Alaska on the Harriman Expedition. By their habit of growth these species fall easily into three groups: they either grow prostrate on the ground, or form upright shrubs 2 to 6 feet high, or develop into small trees. The lack of knowledge of the tree willows of Alaska is shown by the fact that as late as 1896, in the ninth volume of Professor Sargent's 'Silva of North America,' only two species, *Salix sitchensis* and *Salix nuttallii*, were credited to that Territory, while from our present information this number must be increased to five. The three additional species are *Salix bebiana*, which has been discovered in the region of Cook Inlet; the old *Salix speciosa* of Hooker and Arnott, a willow of middle and western Alaska, which clearly attains the dimensions of a tree; and a hitherto undescribed species from Yakutat Bay. The key here given will serve to distinguish the species.

KEY FOR USE WITH SPECIMENS BEARING PISTILLATE CATKINS.

- Ovary smooth; fully developed leaves broadly oval or obovate, rounded at the base.....*S. amplifolia*.
- Ovary hairy; leaves narrower, usually wedge-shaped at the base.
Ovary short-pedicelled, the pedicel about once or twice the length of the nectary.
Hairs of the catkin scales, except sometimes those of the lower ones, extending about a third or a half the length of the scale beyond its apex; stigmas ovate to lanceolate, entire or 2-lobed; pistillate catkins seldom exceeding 6 mm. in diameter in flower and 10 mm. in fruit; leaves satiny beneath with straight appressed hairs.....*S. sitchensis*.
- Hairs of the catkin scales extending about the full length of the scale beyond its apex; stigmas divided into two very slender divisions, the style therefore apparently surmounted by four filiform stigmas; pistillate catkins commonly about 10 mm. in diameter in flower and 15 to 18 in fruit; leaves densely woolly beneath with tangled hairs.....*S. alaxensis*.
- Ovary long-pedicelled, the pedicel three to several times the length of the nectary.
Catkins appearing before the leaves; scales black or sometimes dark brown, obovate to oblanceolate; stalk of the ovary commonly 3 to 4 times the length of the nectary, barely elongating in fruit.....*S. nuttallii*.
- Catkins appearing with the leaves; scales pale, buff, or straw-colored when dry, linear-oblong; stalk of the ovary several times the length of the nectary, in fruit usually exceeding the scale and sometimes becoming twice or three times as long.
S. bebbiana.

KEY FOR USE WITH SPECIMENS BEARING STAMINATE CATKINS.

- Scales of the staminate catkins subtending but a single stamen each.
S. sitchensis.
- Scales subtending two stamens each.
Scales pale, buff, or straw-colored when dry; staminate catkins about 4 to 5 mm. in diameter exclusive of the exerted portions of the stamens*S. bebbiana*.
- Scales black to brown; staminate catkins, exclusive of the exerted portions of the stamens, 8 to 10 mm. or more in diameter.
Catkins appearing before the leaves, on twigs entirely devoid of leaves or green bracts.....*S. nuttallii*.
- Catkins appearing with the leaves, the twigs always bearing at the time of flowering some young leaves or green herbaceous bracts.
Leaves densely white-woolly beneath, smooth or nearly so above.
S. alaxensis.
- Leaves smooth or with some villous pubescence on either surface.
S. amplifolia.

SALIX SITCHENSIS Sanson. Satin Willow.

Salix sitchensis SANSON; Bongard, Mem. Acad. Petersb. 2: 162. 1831.¹

Type locality near Sitka, Alaska, the precise spot pointed out in detail below.

Salix sitchensis is ordinarily a large shrub or small tree, individual specimens often reaching 10 to 15 or rarely 30 feet in height, with a trunk four to six inches or occasionally even a foot in diameter. In exposed situations it sometimes flowers and fruits as a small shrub a few feet in height, and on the morainal gravels at the Muir Glacier it even joined the other smaller willows in becoming almost prostrate. In addition to the attractiveness of a rather graceful form, this willow bears a foliage of singular beauty. On close inspection the leaves present a satiny sheen of indescribable delicacy and softness, varying in intensity with the unevenness of the leaf surface. This appearance, which is largely lost in the dried specimens, is due to a dense covering, on the lower surface of the leaves, of closely appressed short hairs. No other Pacific Coast willow has the same character, and when one has familiarized himself with it in the field he can readily distinguish the satin willow, by its foliage alone, from all the other species. The leaves are oblanceolate to obovate, broadly acute to obtuse at the apex, narrowed at the base, entire or rarely denticulate, and when fully developed about 4 to 6 cm. long, except on vigorous shoots, where they often reach 10 cm. In different published works the plant has been given the names Sitka willow, silky willow, and velvet willow, but the name satin willow seems preferable to all of these.

Salix sitchensis 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. It was observed at as high an elevation as 1400 feet. Where the forests of Sitka spruce were dense the willow grew along the streams and beaches and in similar sunshiny situations, but where the forest was open or wanting it might occur anywhere on the solid upland at the proper elevation. South of Alaska, *Salix sitchensis* extends along the coast to California, having been reported from as far south as Santa Barbara, and through British Columbia into the Cascade Mountains of Washington and Oregon.

The distribution of the satin willow in Alaska as observed on the Harriman Expedition is here given in detail.

¹ For synonymy, see Sargent's 'Sylva of North America' and 'Sudworth's Nomenclature of the Arborescent Flora of the United States.'

Wrangell.—Only a few specimens, and these closely grazed by cattle (426).¹

Stephens Passage.—Abundant in Taku Harbor (481).

Skagway.—On the lower mountain slopes.

Juneau.—Abundant in Silver Bow Basin and occurring on the adjacent mountain slopes as far as 1400 feet above sea level (566, 594, 2534).

Glacier Bay.—Abundant all about the bay on soil once denuded by the glaciers but now in process of reclothing with vegetation (624, 698, 701). Normally here a shrub three to five feet high, and on the gravels recently emerged from the retreating Muir Glacier and on a 'nunatak' in the same glacier even occurring almost prostrate. On the east side of Muir Inlet, about six miles below the glacier and at an elevation of about 500 feet, occurred a tree five inches in diameter and about fifty years old.

Sitka.—Scattered along Indian River below the rapids (838). It was undoubtedly here that Henry Mertens, the botanist of Captain Lütke's Expedition, in an excursion from Sitka to the summit of the neighboring Mount Verstovia, in the year 1827, discovered this willow. And here the writer on June 16, 1899, on a similar excursion found it still growing. The dense forests of spruce about Sitka do not afford suitable conditions for the tree, and it was not observed at any other point in the vicinity, the same situation as in Mertens' time, for he says, "Here alone [at the crossing of a 'wild mountain current'] is seen the solitary species of *Salix* which the environs of Sitka afford."²

Yakutat Bay.—Abundant along the west shore (1121, 1154), at the Hubbard Glacier (1082), and at Hidden Glacier (998, 999).

Prince William Sound.—Sparingly on the moraine of Columbia Glacier; seen also by Dr. Merriam at Port Wells.

Cook Inlet.—Sparingly on the delta of a glacier in Halibut Cove, Kachemak Bay.

Kadiak.—Abundant at Eagle Bay, about 10 miles south of the town of Kadiak, along a stream-bottom wooded with balsam of gilead trees, the trunks of individual willows here reaching a diameter of six to eight inches (1440).

The wood of the satin willow is sometimes used by the Indians of the southern Alaska coast in the drying of salmon, since the smoke does

¹ The numbers given, unless otherwise specified, refer to the collection of Frederick V. Coville and Thomas H. Kearney, Jr., made on the Harriman Expedition.

² See Hooker, Bot. Misc. 3: 18. 1833.

not give the fish a bad taste as do some other kinds of fuel. The pounded bark is sometimes used, applied directly to a cut or wound, to assist its healing. Its name among the Tlinkit tribes, which extend from Yakutat Bay nearly to the British Columbia line, is 'chahtl,' or, more precisely, 'ch-ä'-tlh.'¹ The fact that the same name is applied to other and probably to all the species of willow in that region indicates how little the willows enter into the useful arts of the aborigines there, for in those parts of the United States in which the willow is employed in basket-making, the widely different textile qualities of the various species have caused the Indians to give them discriminating names. Among the Aleuts of Kadiak the word for various other species of willow 'nimuyok' (ni-mö-yäk'), is doubtless applied also to the satin willow.

SALIX ALAXENSIS (Anders.). Felt-leaf Willow.

Salix speciosa HOOK. & ARN. Bot. Beech. Voy. 130. 1832. Not Host. 1828.

Salix speciosa alaxensis ANDERS. in DC. Prodr. 16, pt. 2: 275. 1868.

Type locality of the original *speciosa*, Kotzebue Sound, Alaska; of *speciosa alaxensis*, "in Alaxa Americae occidentali-borealis."

As Hooker and Arnott's name for this willow had been used earlier for an old world species, the oldest available name, *alaxensis*, is here taken up.

Salix alaxensis extends from the northern part of the Alexander Archipelago westward along the Alaska coast to the peninsula, northward along the eastern side of Bering Sea through Bering Strait to Cape Lisbourne, and apparently more sparingly through the interior of Alaska to the Mackenzie River in British America. East of Kadiak Island it is associated with other species of tree willows, but west and north of that point it is the only willow that presents the form and dimensions of a tree. From the Shumagin Islands eastward full-grown specimens are ordinarily 20 to 30 feet in height with a trunk four to six inches in diameter. Under suitable conditions it doubtless reaches a still larger size. On the wind-swept Aleutian Islands, like all other arboreal vegetation, it appears to be wanting, but on the mainland to the north it appears again, on Buckland River, at the eastern end of Kotzebue Sound, reaching a height of 16 to 20 feet (according to Seemann in the 'Botany of the *Herald*'), farther north in the sound only eight feet, and at its northern limit, Cape Lisbourne, being reduced to a shrub only two feet in

¹The diacritic marks used are those of the Century Dictionary.

height. Like *Salix sitchensis*, it becomes almost prostrate on the naked gravels at the Muir Glacier, while only a few miles away, on older glacial deposits which have been reclothed with an abundant vegetation of shrubs, it develops into a handsome small tree, a difference of habit illustrating the marked effect of different local conditions. This willow differs notably from all the other Pacific Coast species in its foliage, so much so, indeed, that Hooker and Arnott, the conservative authors of the 'Botany of Captain Beechey's Voyage in the Blossom,' described the plant from specimens devoid of flowers or fruit. The under surface of the leaves is covered with a dense white wool or felt made up of curled and tangled hairs, presenting an appearance quite different from the velvety, or satiny, or cobwebby pubescence of other species. The leaves are narrowly to broadly elliptical-lanceolate, acute at the apex and base, smooth or nearly so on the upper surface, of an apparently thick texture, due largely to the dense woolly covering of the lower surface, often corrugate-reticulate, the margins of the very young leaves often minutely glandular-denticulate, at maturity usually entire and sometimes revolute, the stipules usually present, narrowly linear-lanceolate to filiform, and entire. The fruiting catkins are very long and thick, some of those collected reaching a length of 14 cm. and a diameter of 1.8 cm.

The detailed distribution of the felt-leaf willow as observed on the Harriman Expedition is as follows:

Glacier Bay.—Common on all the shores and lower mountain slopes about the bay, its gray foliage conspicuous among the alders. Specimens were collected in Muir Inlet (622, 639), at the Hooniah Village (663), and at Point Gustavus (696, 698, 699, 702).

Yakutat Bay.—Abundant on the west side and at the north end of the bay and its arms. Collected along the west side of the bay (1120, 1149), at Hidden Glacier, Russell Fiord (996), and at Hubbard Glacier, Disenchantment Bay (1058).

Prince William Sound.—At Port Wells (1270).

Cook Inlet.—Sparingly on the delta of a glacier at Halibut Cove, Kachemak Bay (2419).

Kadiak.—Abundant in the same situation as *Salix sitchensis* at Eagle Bay (1441).

Shumagin Islands.—A few trees observed at Sand Point (1798) and found sparingly by Mr. De Alton Saunders at various points on Unga and Popof.

Alaska Peninsula.—In Kukak Bay (1622), and abundant in Stepvak Bay, along valley-bottoms, according to Dr. Charles Palache, who collected a specimen there.

Unalaska.—A single small tree was seen in cultivation in a yard at Unalaska, but the species was not observed in that vicinity in a wild state.

In addition to the specific localities given above, at which this willow was observed by the members of the Harriman Expedition, it has been found in Alaska to the eastward by Miss Grace Cooley on the moraine of the Davidson Glacier, and to the westward at Nushagak in Bristol Bay by McKay; in Norton Sound, Kotzebue Sound, and at Cape Lisbourne by Seemann; at the type locality, in Kotzebue Sound, by the botanists of the 'Blossom,' and at several points in the interior of the Territory.

SALIX AMPLIFOLIA sp. nov. Yakutat Willow.

Plant a shrub or small tree, attaining a height of 6 meters with a trunk 30 cm. in diameter; twigs stout, densely villous-pubescent the first season and usually retaining their villosity till the second or third year; leaves large, oval to broadly obovate, when fully developed 5 to 8 cm. long and half to two-thirds as broad, rounded at the base, but the lower ones sometimes wedge-shaped, entire or denticulate-serrulate on the margin, particularly below, obtuse and rounded at the apex or broadly acute, villous on both surfaces when young, but becoming smooth or nearly so at maturity, slightly glaucous beneath, on petioles seldom exceeding a centimeter in length; stipules, none on our specimens; catkins appearing with the leaves from bud scales usually densely villous or sometimes, like the twigs, glabrous from the early dropping of the pubescence, on leafy-bracted peduncles commonly a centimeter or two in length, stout, about 1.5 cm. in diameter and 4 to 6 cm. in length; staminate catkins with oblanceolate or lanceolate, dark brown or black, long-hairy scales, the two stamens in each flower with glabrous filaments about three times the length of the scales; pistillate catkins with light to dark brown scales similar to those of the staminate, the pistils on short hairy pedicels one or two millimeters in length and once to twice the length of the nectaries, the lanceolate ovary smooth or rarely showing a tendency to hairiness, the styles smooth, usually 3 to 4 mm. in length, though sometimes shorter, surmounted by the four linear-filiform stigma lobes about 1 mm. long; fruiting catkins often becoming at least 2 cm. in diameter, the capsules ovoid-lanceolate, smooth, and sometimes 9 mm. in length. (See Plate XV.)

Type specimen in the United States National Herbarium, collected on sand dunes on the west side of Yakutat Bay, Alaska, between June 19 and June 23, 1899, by Frederick V. Coville (No. 1153 of Coville & Kearney's collection).

Amplifolia resembles *alaxensis* in its size and robust growth, the usually densely villous character of its twigs, its very large catkins, the staminate catkins of the two being scarcely distinguishable, its long styles, and its slender stigma lobes. It has no real affinity with that species, however, but its nearest relative along the Alaska coast is possibly *Salix barclayi* Anders., a shrubby willow of abundant and wide distribution in that region. At our camp on the west side of Yakutat Bay, among the mouths of the streams that flow from the glaciers of the St. Elias mountain range, a series of sand dunes skirted the beach for a few miles and upon and near the dunes grew this willow, associated with *alaxensis*. It was ordinarily 10 to 15 feet high, with a trunk 3 to 4 inches in diameter, but some trees attained a height of 25 feet, with a trunk a foot thick. The numbers collected here are 1122, 1123, 1153, and 1158. Mr. Kearney, working meanwhile in Disenchantment Bay, a name applied to a portion of the upper waters of Yakutat Bay, collected specimens at the Hubbard Glacier (1061, 1062, 1074), on Egg Island (1013a), and on Haenke Island (1089). At these localities, as on the sand dunes below, it sometimes flowered and fruited as a shrub. Such specimens do not show in all respects the full vigor and typical characters of the larger plants, but they are believed to represent the species as influenced by various adverse conditions, such for example as drifting sand and shifting gravels.

SALIX BEBBIANA Sargent. Bebb Willow.

Salix rostrata RICHARDSON in Franklin, Journ. Pol. Sea. 753. 1823. Not Thuill. 1799.

Salix bebbiana SARGENT, Gard. & For. 8 : 463. 1895.

Type locality not given, but the description was based on specimens collected on Sir John Franklin's first expedition, in the interior of British America.

This willow is widely distributed, extending almost entirely across British America and occurring in most of the northern portions of the United States, extending southward in the East to Pennsylvania, in the Rocky Mountain region to New Mexico and Arizona, and on the Northwest Coast to Oregon. The leaves in the Alaska specimens are elliptical-lanceolate or ovate-lanceolate, either rounded or acute at the base, acute or acuminate at the apex, sparingly pubescent when young, becoming nearly smooth in age, usually crenate-denticulate, but sometimes entire, commonly 3 to 5 cm. long. *Salix bebbiana* was not observed by the members of the Harriman Expedition, but three speci-

mens of it, all from the Cook Inlet country, are now in the National Herbarium: one from the vicinity of Homer, collected in 1897 by Walter H. Evans (No. 470); another at Kussilof, in 1898, also by Mr. Evans (No. 693); and the third by Captain E. F. Glenn in 1899, probably from near the mouth of the Sushitna River. At the Homer locality, on the brushy portion of the sand spit east of the point, it grew as a shrub or small tree 4 to 15 feet in height; at Kussilof it grew 10 to 15 feet high, and 6 to 8 inches in diameter, often forming thickets. This willow is doubtless abundant throughout Cook Inlet, and is a member of that group of plants of the same region which belong geographically not to the Sitkan floral district, of the moisture-laden coast of southern Alaska, nor to the Aleutian flora, but to the flora of the interior of British America. Only further exploration can show decisively whether Cook Inlet forms an isolated western pocket of this interior flora, where certain species, in migrations caused by changing climatic conditions of earlier centuries, have found congenial surroundings similar to those of their intracoastal home, or whether the interior flora, which abuts against the Sitkan coast flora, extends in a continuous strip across the headwaters of the Yukon to the watershed of Cook Inlet, having pushed its way westward around the northern end of the Sitkan flora and between it and the southern limit of the subarctic flora. The data already at hand indicate that the distribution of some at least of these interior species is almost continuous to Cook Inlet, while that of others, like *Salix bebbiana*, may be interrupted over a wide area.

SALIX NUTTALLII Sargent. Nuttall Willow.

Salix flavescens NUTT. Syl. 1: 65. 1842. Not Host. 1828.

Salix nuttallii SARGENT, Gard. & For. 8: 463. 1895.¹

Type locality "in the range of the Rocky Mountains."

This willow belongs to a variable species finding its eastern limit in the Rocky Mountains, its western limit at the shore of the Pacific. It occurs as far south as Utah and Arizona, and in California extends southward along the coast to the bay of Monterey and along the Sierra Nevada to the San Bernardino range. Northward from California it is abundant along the coast and in the mountains to British Columbia. In Alaska it has been very sparingly collected, and along the coastal portion of the Territory it is apparently of rare occurrence. It was observed on the Harriman Expedition only at Wrangell (442), near

¹ For further synonymy, see Sargent's 'Silva of North America' and 'Sudworth's Nomenclature of the Arborescent Flora of the United States.'

Skagway (493, 503), and at Halibut Cove in Cook Inlet (2416). None of the Alaska specimens that we saw were more than 12 to 15 feet in height and 3 or 4 inches in diameter. The leaves are obovate to oblanceolate, tapering at the base, obtuse or sometimes acute at the apex, entire or occasionally somewhat crenate-denticulate, the lower surface with some scattered appressed hairs or, on vigorous shoots, a somewhat velvety pubescence, but without the satiny lustre of *sitchensis*. The series is so imperfect that, particularly in the lack of a critical revision of the various forms of this species known in the United States and British America, it is impossible to state conclusively the geographical relationship of these localities to the general range of the species. For the benefit of future observers, however, it may be suggested that the Cook Inlet and Skagway localities perhaps represent extensions of the interior or Rocky Mountain form through thin spots in the Sitkan coast flora, while the Wrangell locality may represent a northern extension of the form abundant on the coast of Oregon, Washington, and British Columbia.

PLATE XV.

Salix amplifolia.

- FIG. *a.* Pistillate catkin, seven-eighths natural size.
b. Pistillate flower, enlarged five diameters.
c. Staminate catkin, seven-eighths natural size.
d. Staminate flower, enlarged five diameters.
e. Fruiting branch, seven-eighths natural size.



Salix amplifolia sp. nov.

