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REMARKS ON THE DISTINCTIVE CHARACTERS
OF THE
CANADIAN SPRUCES—

SPECIES OF PICEA.

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Our native spruces (belonging to the genus *Picea*) have received attention at different times from many botanists, but their conclusions in regard to the number of species, and the exact relations of these to each other, have not been concordant. It seemed desirable to invite attention again to the subject, and this was done in a preliminary paper read in Section IV of the Royal Society of Canada, at the Meeting held at Ottawa in May last (1887). The discussion on that occasion, and subsequent correspondence, have shown that the matter is not without interest, and have suggested the desirability of publishing some of the facts then stated, as well as results subsequently reached, together with some historical details,—so as to indicate our present knowledge on the subject, the information still needed, and the directions in which profitable enquiry may be made. Local observers and collectors throughout the Dominion, and travellers visiting northern points, may do much to aid in determining the geographical range of the several species, varieties, and forms, and the continuity or intermittence of their distribution in different regions.

The beautiful evergreen coniferous trees called "spruces," form a marked feature of the wild forest lands of the Canadian Dominion, especially in the Atlantic maritime districts, and in the tracts of country lying around the great lakes. The spruces are valued, not only for their large yields of useful lumber, applicable to so many purposes of life on land and sea, and for the summer shade and winter shelter which, as living trees, they afford our dwellings, but they are likewise regarded with interest, and as having some importance, from scientific points of view. How far the differences in structure and habit presented by the several species, and their aberrant or so-called intermediate forms, are to be regarded as indicative of genetic differences, or may be accounted for by the mere effects of past or present external conditions, is a question of more than incidental interest. It naturally leads to a comparison of these trees with their allies in other parts of the northern hemisphere, far beyond the range of the present Canadian forest, immense as it is, and to the consideration of other facts bearing upon their probable ancestry, in regard to which, however, the results, so far, are insufficient to warrant satisfactory conclusions.

These trees, and their extra-Canadian allies, have been variously described by botanists, at different times, under the several generic names: *Pinus*, *Abies*, *Picea*. Linnæus, upon whose system our nomenclature is founded, embraced under *Pinus*: the true pines, the Lebanon cedar, the larch, the silver (or balsam) fir, and the hemlock. In selecting specific names for the silver fir and spruce, he adopted those used by Pliny and other classical writers, who called the spruce *Picea*, and the silver fir *Abies*. But he unfortunately transposed these names, calling the spruce *Pinus Abies*, and the silver fir *P. Picea*. This opened the way for much confusion, for when the old aggregate genus *Pinus* came to be successively divided up into segregate genera, and the classical names were adopted as generic ones, choice had to be made between two courses,—either to apply these names so as to denote the trees intended by the classical writers, or to use them, at variance with classical usage, in accordance with the Linnæan nomenclature. As has just been indicated, succeeding botanists separated the true pines, and other marked groups of the Linnæan genus *Pinus*, into separate genera; at first the spruces and

firs were classed together under the one generic name *Abies*. Link, in 1841, separated the two groups into distinct genera, restoring the classical names, *Picea* for the spruces, and *Abies* for the firs. But in Britain, where Coniferæ have been grown to an enormous extent, both for ornament and use, especially since the middle of the present century, a silver fir continued to be almost universally called a *Picea*, and a spruce an *Abies*,—until within the last few years, when English scientific writers have adopted Link's use of the names, and thus adapted their nomenclature to continental custom and classical usage. Among English foresters, gardeners, and nurserymen, however, the old way, so long familiar, will be given up slowly, and not without regret.

The Canadian Spruces, so far as regards their distinctive specific characters, have been a puzzle to botanists. They were not known to Linnaeus. Miller and Aiton recognized two species, *alba* and *nigra*, and Lambert introduced a third (*rubra*) that had been recognized by the younger Michaux as a variety of *nigra*. Accordingly, in most of the works on Coniferæ published since Lambert's (1825) by European and English botanists,* we find the three species described without hesitation. But, there have not been wanting expressions of doubt as to the permanent distinctness of the third species, and of suspicion even, that all three were connected by intermediate forms so closely as to be doubtfully entitled to rank as more than varieties of one species. A full statement of synonymy would occupy too much space, and indeed be out of place, in this publication; a brief indication of the views held by a few prominent botanists will suffice for the present.

In Persoon's *Synopsis Plantarum*, 1807, (the authorship of which is believed to belong to Richard), *rubra* is described with rubicund cones, slightly bilobed scales, and red brown bark, and is curiously enough assigned geographically to Hudson Strait; *alba*, with incurved leaves, lax subcylindrical cones, entire scales, whitish bark; *nigra*, with straight leaves, ovate black-purple cones, scales undulated at the margins, bark blackish.

Endlicher, in the standard work on Coniferæ for the time (1847), "*Synopsis Coniferarum*," characterized three species as follows: (pp. 112-15): *alba*, cones subcylindrical, lax, pendulous, scales broadly

* Persoon, Antoine, Don, Loudon, Link, Parlatores, Endlicher, Gordon, etc.

obovate undivided, entire, (faces of leaves whitened glaucous, pulvinuli pale brown, cone long-stalked, cylindrical or ovoid oblong, 2 to 2½ inches long, largest diameter, ½ inch., scales quite entire, at first green, changing to pale brown); *rubra*, cones ovate-oblong, scales split into two lobes, margin otherwise quite entire, (doubtfully distinct from the next, leaves more acute, cones larger, green when young, scales constantly and evidently split-lacerate irregularly, margin otherwise entire, the wood becoming reddish); *nigra*, cones ovate-acute, scales obovate, undivided, erose, denticulate, bark blackish, faces of leaves white-dotted; cones shortly peduncled, drooping, an inch and a-half long, at first purpurascens, finally reddish brown, scales with thin margins becoming undulate-lacerate.

Professor Beck, in the Botany of the Northern and Middle States, (1833), which formed the precursor of Dr. Asa Gray's standard Manual, described three species (p. 340), as: *nigra*, * * * leaves straight, strobile ovate, scales elliptical, undulate on the margin, erose denticulate at the apex; *rubra*, * * * strobile oblong, scales rounded, somewhat two-lobed, entire on the margin; *alba*, leaves incurved, strobile subcylindrical, loose, scales obovate, very entire.

I have not been able to refer to the first edition of Dr. Gray's Manual of Botany of the Northern United States, (published in 1848), but in the second edition (1856) the red spruce of Beck is dropped, and only *nigra* and *alba* described,—the former with dark rigid sharp green leaves, cones ovate, or ovate-oblong, (one to one and a-half inch long), the scales with a thin and wavy or eroded edge,—a common variety in New England having lighter coloured or glaucous-green leaves, rather more slender and loosely spreading, and indistinguishable from *alba* except by the cones. *A. alba* is characterized as having oblong-cylindrical cones (one to two inches long), the scales with firm and entire edges; otherwise as in the lighter-colored variety of the last. The remark is added: probably these two, with the red spruce, are mere forms of one species.

In subsequent editions of the same work, the descriptions are amended, the leaves of *nigra* being characterized as either dark green

or glaucous-whitish, and the cones are said to be recurved, persistent whilst those of *alba* are two inches long, nodding, cylindrical, pale, deciduous, the thinner scales with an entire edge, (the latter a handsomer tree than the former, more like a balsam fir). These descriptions point to the red and black spruces being both included under *nigra*.

Professor Alphonso Wood, in his Class Book and Flora of the United States and Canada, also characterized only two species: *alba*, with incurved leaves, cones lax, subcylindric, with entire two-lobed scales; *nigra*, with straight leaves, ovoid cones, scales erosely dentate at the edge.

Dr. Chapman, in the Flora of the Southern United States (1860) likewise gave two species (pp. 434-5): *nigra*, leaves dark green, cone one and one-half inch long, ovate, or ovate-oblong, the scales with a thin wavy or denticulate margin; *alba*, leaves more slender and less crowded, light green, cones 1 to 2 in. long, oblong cylindrical, with the scales entire.

The late Prof. Brunet, of Laval University, an acute and careful botanist of whom Dr. Gray had a high opinion, described three forms: *alba*, *nigra*, and a variety *grisea* (Canadian Naturalist, new series, vol. iii., p. 108).

The Abbe Provancher, in Flore Canadienne, characterized *alba* and *nigra* clearly.

The late Andrew Murray, who took so much interest in American Coniferæ, in his later writings ignored *rubra*.

Professor Fowler, in his carefully prepared list of the plants of New Brunswick, gives two species, *alba* and *nigra*, as common throughout that province.

Prof. Parlatore, in the Monograph of Coniferæ in De Candolle's Prodrômus, Vol. xvi., second section, pp. 413-14, published in June, 1868, recognizes our Canadian species as three: *nigra*, the black spruce or double spruce of Anglo-Americans; *rubra*, with leaf-faces albo-glaucous (indicating that he probably had a form of

nigra in view); and *alba*, with oval-oblong, or oval-cylindrical cones, pendulous, on longer branchlets than the others, (the geographical range extending to the Rocky Mountains, on authority of specimen from Bourgeau).

In Dr. Robert Bell's chart of the northern limits of trees forming the Canadian forests, the two spruces, *alba* and *nigra* are lined together.

Prof. Macoun, in the Catalogue of Canadian Plants of the Geological Survey of Canada, gives two species, combining *rubra* with *nigra*.

Sir Joseph Hooker, in his tabulation in the Outlines of Distribution of Arctic Plants (Linnæan Transactions, 1864), gives only *alba* and *nigra*, and Sereno Watson, in the Botany of California, also dismisses our spruces in N.E. America as "two species."

The following descriptions of the several species are not thrown into systematic form, being merely intended to call attention to points of difference, and to suggest observation and enquiry, so that the necessary information may be obtained for the formation of accurate and permanent diagnostic characters :

1. *PICEA ALBA*.—Link, in Linnæa, xv. p. 519.

Picea alba, the white spruce of Canada, is recognized at a distance, from the allied species, by the comparative massiveness of the foliage with which its horizontal or pendant boughs are clothed, and by its glaucous or whitish-green tint,—the leaves when newly expanded being pale and silvery, as if covered with the most delicate coating of hoar frost. This appearance, however, is caused by the individual leaves not being wholly green, but having longitudinal rows of apparently white or colourless dots or spaces, owing to the non-development of chlorophyll in certain surface cells at regular intervals. The old bark of the stem is grayish; not dark-colored, and the young shoots of the year present a smooth, shining, ivory-white surface, altogether destitute of trichomes or roughness of any kind. The leaves vary in actual size with the vigour of the tree, but are longer in proportion than those of either of the other species; the leaf-bases from which they arise are arranged uniformly around the horizontal

branches, but, although spreading in direction at their bases, are more or less curved upwards in a second manner, presenting a nearly uniform flattened brush-like surface of foliage. The cones vary in absolute size, according to vigour of tree, etc., but are always of much greater length and usually more slender than those of the other species, being nearly cylindrical, not sensibly thickened in the middle as in *nigra*, nor below the middle as in *rubra*. Dr. Bell well expresses their form as finger-shaped. The scales are also more numerous than in the allied species, and the spiral arrangement is different. The cones are green at first, the individual scales being sometimes clouded with a slight brown band-like patch on the exposed part, but not extending to the edge. In ripening, the green color mellows into a more or less decided straw color, but the cones when mature are never either dark or decidedly reddish. When of a lively straw-color, and profusely produced all over the tree, as we often see them along the shore, hanging down from the drooping tips of the young branchlets, the contrast with the bright silver-frosted needle foliage is very pleasing, so that the white spruce is one of the most ornamental of our native trees, and admirably adapted for sea-side shelter. The edges of the cone scales are always quite entire.

Prof. Bell, M.D., President of the Fourth Section of the Royal Society, has very kindly made careful observations, and communicated them to me, on the several points of difference between the white and black spruces. Through his kindness, also, I have had opportunity of examining specimens from widely separated localities throughout the Dominion. His opportunities of travel, for observation and collection of specimens, during his long connection with the Geological Survey of Canada, have been exceptionally favorable. Dr. Bell points out that the most obvious distinctions between the black and white spruce are (1) that the latter is a larger tree than the black, coarser, lighter in general color, as well as in color of bark, twigs, etc.; (2) that, in the white spruce, the boughs are stiffer, more vigorous, and flatter than in the black; (3) that the cones differ in many ways; in the white, they are scattered all over the tree, although most abundant near the top, and drop off every year, whereas the black spruce cones adhere for two, three, four or five years—the current year's crop being at the top (mostly), the previous year's next

below, that of the year before still farther down, etc., the quantity of cones diminishing downwards and their age increasing. (4). The white spruce cone is finger-shaped, and green in color till it dries and opens, whereas the black is deep purple and plum-shaped, bulging in the centre. (5). The white is attached by a straight peduncle, the black by a curved thickening one. (6). The number of scales in each is very different, numerous counts of the scales of cones from many trees in northern regions of the Dominion yielding the following results: the white spruce cone seldom has fewer than 60 scales or more than 90—average about 70; whilst the black seldom has many over 30, the average may be about 33,—so that the white spruce cone has more than double the number that the black has. Eleven white spruce cones from a tree at Kingston, Ontario, gave an average number of 77, and of five cones of the same from a tree at the Emerald Mine near Buckingham, (Co. Ottawa, P.Q.), the average is 61.

The white spruce is observed especially along the shores of the ocean, estuaries and lakes, as in Cape Breton Island, around the Atlantic and Bay of Fundy shores of Nova Scotia and New Brunswick, also around the shores of the St. Lawrence Gulf and up the St. Lawrence, River, and along the Ontario lakes. Dr. Bell sends a beautiful photograph of this species, showing its characters well, from Grand Lake House, on the Upper Ottawa. I have a specimen collected at Lake Winnipeg by his Hon. Lieut.-Governor Schultz, M.D., in the summer of 1860.

I desire specially to call the attention of observers to one point in regard to the geographical distribution of *Picea alba*. For many years it has appeared to me to be essentially a maritime species, growing around the Atlantic and northern coasts of Canada, and extending by way of the St. Lawrence westward to the great lakes, as far, at least, as shewn by Governor Schultz's specimen, as Lake Winnipeg. Its absence in inland localities is not noticed, so far as I have ascertained, in published works, yet, even in the narrow peninsula of Nova Scotia, bounded on one side by the Atlantic Ocean, and on the other by the Bay of Fundy and waters connecting with the Gulf of St. Lawrence, the absence or scarcity of this tree in inland localities,

or even in such as are only a few miles distant from the shore, is very marked. It appears, therefore, to be especially desirable, in recording localities for its occurrence, to note their distance from seaboard or great lakes. I have already endeavored to impress upon observers the consideration that the only reliable material for tracing geographical distribution must consist of substantial data, actual local observations carefully noted and authenticated by specimens, corrected, reduced and compared, after the manner of H. C. Watson, and left on record in such form as to render elimination of errors possible, and that mere general impressions received by travellers over the country, although often of great practical value, are not to be regarded as absolute scientific results.* In the early days, when Douglas and Thomas Drummond were solitary wanderers over the Continent, and Menzies was touching the coast at Chebucto and nameless points on the Northern Pacific shores, every scrap of information, and especially their notes on range of species, was of substantial value, but now we have the means of working out problems by more systematic and scientific methods, and of eliminating the errors of individual observation.†

2. *PICEA NIGRA*, *Link.*, in *Linnaea* xv, p. 520.

The black spruce is a sombre tree, the old bark of dark color, the surface of young shoots of the year of a dark brown, and clothed with a short sparse fur of thick short curved trichomes. The foliage is of a decidedly dark green colour, but distinctly glaucous or hoary. The leaves are short, almost straight, radiating from the branch in a bottle brush fashion at a nearly uniform angle except that they are turned away from the lower surface of the branch. The leaves (as in other species) vary in size with vigor of tree, but are always much shorter than in the other species, and blunt at the apex. The cones, when young, are of a deep purple, or purpurascenscent color, becoming reddish-brown as they ripen, darkening with age, and ultimately changing to a deep dark gray-black when old. The other species drop their cones during the first winter after they are formed; *P. nigra* retains them for several years, the recent crop of the

* See *Trans. Royal Soc. of Canada*, Vol. II. Sec. iv. p. 16.

† *Abies arctica*, Murray, *Seeman's Journal*, 1867, p. 273, cum ic., is referred by Parlatore as a variety of *alba*.—DC, *Prodromus*, XVI, p. 414. On same page there is description of something no doubt quite different, *Abies arctica*, Cunningh., ex Henk. & Hochst. This is referred to *rubra*.

year being near the top of the tree mostly, the previous years next below, that of the year before further down, and so on, the cones diminishing in quantity downwardly as their age is increased. The cone is attached to its branchlets by a curved stalk (whereas that of *P. alba* is straight), and the cone itself is conspicuously much wider in the middle than towards base or apex ; several of these differences are taken from Dr. Bell's notes, but are entirely in accordance with my own observations.

This species appears to be widely distributed, both in coast and inland districts, extending apparently far north, and in the south ascending the mountains. Black spruce is famed among lumbermen as a tree yielding sound, strong and lasting timber. In Nova Scotia it is found, not on dry ground, but on wet flats, apparently irrespective of atmospheric moisture. In inland districts, groves of it occur in the red spruce forests, on the wet lands around lakes, and along river sides, and on shelving terraces on the hill sides, but it also grows down to the sea-shore intermixed with *P. alba*—the favoring condition apparently being a retentive moist soil. In the north and north-west, the tree appears, from accounts and photographs received, to be more vigorous than along the Atlantic region of Nova Scotia.

3. *PICEA RUBRA*, *Link*, in *Linnæa*, xv, p. 521.

Picea rubra, the red spruce, is readily known by its clean, uniform bark (not broken into large scales) of a distinctly reddish color, by its long slender shoots, giving it the appearance of being a more rapid grower than *nigra*, but not so robust in habit as *alba*, and by its bright green foliage, without any trace of hoariness or glaucescence. The leaves, as compared with those of the allied species, are short, incurved, not so secundly as in *alba*, but bent inwards towards the branchlets, and on the leading shoots they are more or less closely appressed to the leader, giving it a very elongated slender appearance. The year's shoots are of a lively chestnut-red color, and are beset with short, erect, thickish, curved, epidermal processes (trichomes), which arise especially around the edges of the flat basal plates of the leaf-bases, variously called peg-processes, sterigmata, etc. The cones are of a bright chestnut color, regularly ovate in form. The wood is softer than that of the black spruce, it is also less enduring

under open air exposure, as we know from experience; every season the red spruce poles have to be replaced more frequently than the black in fences.

The best general description that has hitherto been published of *P. rubra* is that of my late friend William Gorrie, in the Transactions of the Botanical Society of Edinburgh, Vol. x, p. 353. Mr. Gorrie's description was taken from the tree as observed by him in the plantations and pleasure grounds in Britain, but, so far as it goes, it corresponds entirely with the tree as seen in the Nova Scotian woods:—"The red spruce fir, or Newfoundland red pine, is found in Nova Scotia, some parts of Lower Canada, and northward to Hudson Bay, but is not included in Dr. Asa Gray's Flora of the Northern United States. It is said to be a better and finer tree than either of its allies—the black and white spruces—from which it further differs in being entirely devoid of that glaucous green by which the leaves of these two are distinguished. It is in fact exactly like the common Norway spruce in the color both of its foliage and young branches, but differs from it in its thinner and more slender growth, shorter leaves, and much smaller cones. From this close resemblance in color of *rubra* and *excelsa*, Americans call the latter the red spruce of Europe. Like the *alba*, the *rubra* drops its cones in the course of the first winter and succeeding spring, while those of *nigra* are retained on the tree for two or more years. Like its two American associates, *alba* and *nigra*, *rubra* seems to delight in moist soils containing a proportion of peat, and moist upland climates. Those now growing at Tynehead were reared from seeds gathered in Newfoundland, and a portion of the plants which were planted on good, dry, heavy soil, within from two to three miles, and at half the altitude, dwindled away after the first few years, till they entirely perished. The trees at Dunmore are no doubt growing at a low altitude, but they are sheltered by a high wooded bank on the south, and are on a damp bottom. Mr. Andrew Murray, a distinguished member of the Botanical Society, and recognized authority on Coniferæ, has ignored the existence of *rubra*, but he has probably never seen it growing, as, although long introduced, it is still scarce in Britain." In illustration of these remarks Mr. Gorrie exhibited and presented to the

Botanical Society branches and cones of (1) *P. r bra* taken from a group of trees growing on the railway banks, near Tynehead Station, in Midlothian, at an altitude of about 800 feet. The trees had then, (13th January, 1870), been about fifteen years planted, and were from 12 to 18 feet in height; (2). *P. r bra*, from a group of trees growing in drained and improved ground, which must once have been marshy, in Dunmore Park, near Stirling, Scotland, not 50 feet above high-water mark, seemingly about the same age as the last, and from 15 to 20 feet in height; (3). *P. alba*, from near Tynehead Station; (4). *P. nigra*, from Dunmore Park.

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