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CLIX

SOME NORTH AMERICAN CORYLACEAE (BETULACEAE)

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SOME NORTH AMERICAN CORYLACEAE (BETULACEAE)

M. L. Fernald

(Plates 963–989)[1]

I. Notes on Betula in eastern North America

(Plates 963–975)

It has long been evident that the ultraconservative treatment of *Betula*, published by me in 1902, as *Relationships of some American and Old World Birches*[2], can not be accepted, in view of the many characters of aments, their bracts and samaras then not understood. That sophomoric study, based on complete lack of understanding, well illustrates how an over-conservative treatment may be as far afield as are those which split beyond the normal divergencies in Nature. In a recent attempt to set in order the White Birches and the Dwarf Birches as they occur in the Gray's Manual range the names applied to our species and varieties have necessarily changed in several cases. The entire treatment can hardly be given here, but, in order to clarify the situation, the key to our members of Series *Albae* is here given.

a. Bark opaque, chalky- or ashy-white, close, the layers not readily exfoliating; staminate ament usually 1 and, before expanding, pointing stiffly forward; leaves glabrous or merely glutinous on both sides, abruptly ending in prolonged tail-like tips (caudate); fruiting aments 1–2.5 cm. long; their mature bracts nearly horizontally divergent, crowded, 3–4.5 mm. long, uniformly ashy-puberulent on back. . . . . 1. *B. populifolia.*

a. Bark lustrous, creamy- or pinkish-white to warm-brown, in maturity often exfoliating or separating into layers; staminate aments 1–few; leaves not prominently caudate-tipped; fruiting aments (except in the dwarf shrubby no. 4) mostly larger; their bracts (except in the introduced no. 2) ascending, glabrous or pilose on back, the lobes ciliate. . . . *b.*

b. Samaras 3.5–6.5 mm. broad, the wings broader than the achene; trees or coarse shrubs.

[1] The cost of preparing and engraving the plates met in part through a grant from the American Philosophical Society.

[2] Contrib. Gray Herb. n. s. xxiii., Am. Journ. Sci., ser. 4, xiv. 167–194, plates v and vi (1902).

c. Leaves glabrous on both sides; young shoots glabrous or merely with resinous warts. . . . *d.*

d. Trees with whitish bark; leaves deltoid-ovate, acuminate from broad base, those of fertile branches 3–10 cm. long; staminate aments 4–10 cm. long; lateral lobes of pistillate bracts divergent, larger than terminal lobe; species of low or intermediate altitudes.

Leaves of fertile branches 3–7 cm. long, their cuneate to truncate bases entire; fruiting aments 2–4 cm. long, their bracts divergent; introduced species. . . 2. *B. pendula.*

Leaves of fertile branches 5–10 cm. long, their rounded bases toothed except near petiole; fruiting aments 2.5–5 cm. long, their bracts ascending; indigenous. . . . . 3. *B. caerulea-grandis.*

d. Shrub with dark close bark; leaves ovate, merely acute to blunt, those of fruiting branches 1.5–4.5 cm. long; staminate aments 1.5–3.5 cm. long; lateral lobes of pistillate bracts ascending, scarcely broader than terminal lobe; subarctic-alpine species. . . . . *4. B. minor.*

c. Leaves pubescent beneath, at least when young, or on veins or in their axils; young vegetative shoots pubescent or puberulent.

Buds lustrous with resin; leaves merely acute, those of fertile branches 3–5 cm. long; mature fertile aments 1.5–3 cm. long; introduced species. . . . . 5. *B. alba.*

Buds scarcely resinous; leaves mostly acuminate, those of fertile branches 2.5–10.5 cm. long; mature fertile aments 1.5–6.5 cm. long; indigenous. . . . . 6. *B. papyrifera.*

b. Samaras 2–3.5 mm. broad, the wings scarcely to barely as broad as the achene; new sprouts pubescent; leaves elliptic, rhombic-oval or ovate; shrub with close dark bark. . . . . 7. *B. borealis.*

1. B. POPULIFOLIA Marsh. Arb. Am. 19 (1785). *B. alba* L., var. *populifolia* (Marsh.) Spach, Ann. Sci. Nat. sér. 2, xv. 187 (1841).—Sterile dry to wet acid soils, Prince Edward Island to Laurentide region of Quebec, west to southern Ontario, south to Delaware, Pennsylvania, upland to Virginia, northern Ohio and northern Indiana.

B. POPULIFOLIA Marsh., forma **incisifolia,** f. nov., foliis lacerato-incisis, laciniis attenuatis plus minusve incisis.—MASSACHUSETTS: old field at border of woods, Auburndale, July 23, 1941, *D. S. Correll* (TYPE in Herb. N. E. Bot. Club). PENNSYLVANIA: along trail just north of highway, below the Pagoda, Mt. Penn, Berks Co., Aug. 14, 1943, a single young individual, *Wherry.* Illustrated as var. *laciniata* Loud. by Correll in RHODORA, xliv. plate 708 opp. p. 236 (1942).

Unfortunately the name *Betula populifolia,* var. *laciniata* (Lodd.) Loud., currently used for this "cut-leaved" form, is not a safe one to take up. The identity is too doubtful since Loudon based it on a *nomen nudum* which had been published by Conrad Loddiges and Sons, Nurserymen, in their 16th Catalogue

of Plants, 44 (1836). Loddiges and Sons merely had the name *Betula laciniata* in a list of hardy trees and shrubs cultivated by them. There was no description; consequently when Loudon, Arb. and Frut. Brit. iii. 1707 (1838), published *B. populifolia*, var. *laciniata*, "*B.* laciniata *Lodd.* Cat. ed. 1836, has large, smooth, shining, deeply cut leaves, and appears to us to belong to *B.* (*a.*) *p*opulifolia, rather than to *B.* alba", he based his combination on a *nomen nudum*. If he had omitted the citation of Loddiges' identical *nomen* which was further invalidated by the well described *B. laciniata* Ehrh. (1788), the case would be different. At least, if it be maintained that Loudon gave a sufficient diagnosis and thus validated the name, it is not at all certain what he had. It is safer to establish our indigenous form on surer ground.

2. B. PENDULA Roth, Tent. Fl. Germ. i. 405 (1788). *B. alba* L. Sp. Pl. 982 (1753), in part; Koch, Syn. 662 (1837). *B. alba*, β. *pendula* Ait. Hort. Kew. iii. 336 (1789). *B. verrucosa* Ehrh. Beitr. vi. 98 (1791–1793).—Introduced from Europe; spread to roadsides, thickets, open woods, etc., Nova Scotia to Ontario, south to Pennsylvania, Michigan, Wisconsin and Iowa.

Forma DALECARLICA (L. f.) Schneid. Handb. Laubholzk. i. 112 (1904). *B. alba*, β. *dalecarlica* L. f. Suppl. 416 (1781).—Similarly spreading from cultivation.

Those who treat this half of the mixed *Betula alba* L. as typical *B. alba* (for instance Beck von Mannagetta and Wilmott) go back only to Koch (1837) for their cue. Evidently they have overlooked the fact that Roth in 1788 had removed *B. pendula*, thus leaving the other species (*B. pubescens* Ehrh., 1791) to stand as true *B. alba*. See comments under our no. 5.

3. B. CAERULEA-GRANDIS Blanchard, Betula, i. no. 1 (May 7, 1904); Fernald in RHODORA, xxiv. 171 (1922). *B. caerulea* Blanchard, var. *grandis* Blanchard in Vermont Phoenix for May 13, 1904 and Betula, i. no. 2 (May 13, 1904). *B. caerulea*, var. *Blanchardi* Sargent, Man. Trees. N. A. 202, fig. 168A (1905).—Dry woods, Gaspé Peninsula to Montmorency Co., Quebec, south to Nova Scotia, northern New England and eastern New York.

× B. CAERULEA Blanchard, Betula, i. no. 1 (May 7, 1904); Sargent, Man. 201, fig. 168 (1903); Fernald in RHODORA, l. c. 172 (1922)—A hybrid of no. 3 with no. 1, occasional where they are together.

4. B. **minor** (Tuckerm.), stat. nov. *B. papyracea*, var. *minor* Tuckerman in Am. Journ. Sci. xlv. 31 (1843). *B. dahurica*, β. *americana* Regel in DC. Prodr. xvi². 175 (1868). *B. alba*, subsp. *papyrifera*, β. *humilis* Regel, l. c. 166 (1868), in small part only (i. e. *B. papyracea*, var. *minor* Tuckerm., the TYPE of which is also the type of Regel's *B. dahurica*, var. *americana!*) *B. papyrifera*, var. *minor* (Tuckerm.) Wats. & Coult. in Gray, Man. ed. 6, 472 (1889), at least in part. *B. odorata*, var. *tortuosa* sensu[1] Fernald in RHODORA, iii. 173 (1901), not (Ledeb.) Lange. *B. alba*, var. *minor* (Tuckerm.) Fernald in Am. Journ. Sci. ser. 4. xiv. 179 (1902).—Acidic rocky barrens, peats and alpine summits, Labrador Peninsula, south to Newfoundland, Shickshock Mts., Gaspé Peninsula, and Laurentide Mts., Quebec, highest mountains of northern New England and northeastern New York, and shores of James Bay, Ontario. The following are characteristic. LABRADOR: head of pond, 30 miles west of Nain, Anatolak Bay, *Potter & Brierly*, no. 2614; Anatolak, *C. S. Sewall*, no. 449; Hopedale, Aug., 1935, *Agnes Ayre;* granite hills, Salmon Bight, 53° 27′ N., 55° 47′ W., *A. E. Porsild*, no. 37, as *B. papyrifera*, var. *cordifolia;* Square Island, lat. 52° 49′, Aug. 16, 1882, *J. A. Allen;* large shrubs on upper crests and on gneiss plain, Blanc Sablon, *Fernald & Wiegand*, nos. 3248 and 3249. NEWFOUNDLAND: shrub 0.5–0.8 m. high, turfy and rocky slopes of Cape Dégrat, Quirpon Island, *Fernald & Long*, no. 28,071, erroneously distributed as *B. microphylla* Bunge; thickets, brooksides and ravines, western side of Quirpon I., *Wiegand, Gilbert & Hotchkiss*, no. 28,076 (as *B. microphylla*); quartzite one half mile south of Deer Pond, Highlands of St. John, *Wiegand, Gilbert & Hotchkiss*, no. 28,078 (as *B. microphylla*); erect, 1 m. or less high, peaty or turfy upper quartzite slopes, alt. 600–650 m., Killdevil, Bonne Bay, *Fernald, Long & Fogg*, no. 1635 (as *B. microphylla*); diorite tableland, alt. about 550 m., northern region of the Blomidon ("Blow-me-down") Mts., Bay of Islands, *Fernald & Wiegand*, no. 4263; diorite tableland, near Franchman's Cove, Bay of Islands, *Griscom*, no. 10,242; about 4 feet high, Riverview Camp, Grand Codroy R., *Pease & Edgerton*, no. 27,113; damp thickets on hill southwest of Tilt Cove, Notre Dame Bay, *Fernald & Wiegand*, no. 5307. QUEBEC: rocky hillsides, Vieux-Fort, Pontchartrain, Saguenay Co., *St. John*, no. 90,831 (as *B. glandulosa*); tundra, Ile Herbée, Archipel de Vieux-Fort, *St. John*, no. 90,832 (as *B. glandulosa*); sur les gneiss près des chutes, Natashquan, Côte-Nord, *Victorin & Rolland*, no. 28,101 (as *B. microphylla*); Seven Islands, Saguenay Co., *C. B. Robinson*, nos. 864 and 867; plateau dénudé, Botanists' Dome, Montagne de la Table, *Rousseau & Fortier*, no. 31,429; abondant près du sommet, Mt. Lyall, Gaspé Co., *Victorin, Rolland &*

[1] For these more erroneous identifications one is tempted to write "*nonsensu.*"

Jacques, no. 33,516 (as *B. microphylla*); parties sèches près des sommets, Mont Sterling, Gaspé Co., *Victorin, Germain & Jacques*, no. 33,481 (as *B. microphylla*); rocky slopes and barrens, alt. 650–1100 m., Mt. Albert, Gaspé Co., *Collins & Fernald*, no. 67; on hornblende schist, alt. 900–1060 m., north slope, Mt. Albert, *Fernald & Collins*, nos. 214 and 529 (as *B. microphylla*); sur les schistes hornblendiques et les paragneiss, Mt. Albert, *Victorin, Brunel, Rolland & Rousseau*, no. 17,598 (as *B. pumila* ?); bare hornblende schist near summit, about 1100 m. alt., Mt. Fortin, Matane Co., *Fernald & Pease*, nos. 25,023 and 25,024 (as *B. microphylla*); Port à Pueis, below Cap à l'Aigle, *J. Macoun*, no. 68,776. MAINE: summit of Mt. Katahdin, Aug., 1847, *Aaron Young*, Bot. Surv. Me., Aug. 25, 1847, *George Thurber*, Aug. 12, 1873, *Scribner*, Aug. 1874, *Scribner* (as *B. glandulosa*), Sept. 1898, *E. D. Merrill* (as *B. glandulosa*); small shrubs, summit of 1st North Peak, Mt. Katahdin, July 14, 1900, *Fernald*. NEW HAMPSHIRE: "In alpinis Mont. Alborum", *Tuckerman* (ISOTYPE); White Mts., 1842, *A. Gray*, this and the preceding the types of *B. dahurica*, var. *americana* Regel; Alpine Garden, Mt. Washington, July 10, 1893, *E. & C. E. Faxon*, June 26, 1898, *E. F. Williams* (as *B. glandulosa*), Aug. 5, 1901, *Robinson*, August 13, 1902, *Pease*, no. 445, July 31, 1926, *Pease*, no. 19,828; Oakes Gulf, Mt. Washington, July 4, 1878, *Faxon* (as *B. glandulosa*), July 8, 1895, *Kennedy, Williams;* Oakes Gulf, *Eggleston*, no. 2376 (as *B. odorata*, var. *tortuosa*); 5-mile post on Carriage Road, Mt. Washington, July 27, 1886, *Faxon* (as *B. glandulosa*), *Greenman*, no. 1088 (as *B. glandulosa*), *Pease*, no. 10,532; "Cape Horn", Mt. Washington, June 24, 1898, *Williams, Robinson*, no. 955; Lake of the Clouds, Mt. Washington, July 4, 1878, *Faxon* (as *B. glandulosa*), *Pease*, no. 446; near Duck Fall, Low & Burbank Grant, *Pease*, no. 14,160; Nowell's Ridge, Low & Burbank Grant, *Pease*, no. 12,316; Ice Gulch, Randolph, *Pease*, nos. 10,750 ("trees 2 ft. high"), 16,707; upper rocky slopes of Mt. Lafayette, *St. John*, no. 439. NEW YORK: summit of Mt. McIntyre, alt. 4800–5000 ft., *House*, no. 9488. ONTARIO: Hasey Island, Moose River, James Bay, *D. Potter*, no. 804. PLATE 963, FIGS. 1–7.

Betula minor closely simulates the Arctic Eurasian and Greenland shrub, there passing as *B. alba*, var. *tortuosa* (Ledeb.) Schneider or *B. odorata* Bechst., var. *tortuosa* (Ledeb.) Lange or *B. tortuosa* Ledeb. (PLATE 963, FIG. 11). That shrub, however, apparently an arctic extreme of *B. alba*, has the samaras elliptic to obovate (as long as or longer than broad) with wings about equaling the narrow achene. *B. minor*, on the other hand, has the broadly subreniform samaras definitely broader than long,

the wings as broad as or broader than the broadly elliptic achene. A great number of specimens (through my original sin) have been misidentified as the Siberian *B. microphylla* Bunge, but that poorly understood species seems to be unlike anything American (see discussion under *B. borealis*). As for its relationship to *B. papyrifera*, *B. minor* has, somewhat naturally, been inferred to be merely a dwarfed alpine or subarctic extreme of the tree of lower altitudes and more favorable climatic conditions. Examination of the two, however, brings out several important characters. In *B. papyrifera* (PLATES 964, 965 and 967–972) the vigorous young shoots are pubescent; in *B. minor* glabrous but often so gummy as to be mistaken for those of *B. glandulosa*. In *B. papyrifera* the expanding leaves are pubescent beneath, the mature ones with traces of pubescence beneath, at least in the axils of the veins. In *B. papyrifera* the bracts of the pistillate aments (except in vars. *macrostachya* and *cordifolia*) have broad and widely divergent lateral lobes; in *B. minor* the lateral and terminal lobes are of about the same breadth and porrect. Although the lateral lobes of *B. papyrifera*, vars. *macrostachya* (PLATE 968) and *cordifolia* (PLATE 970) are porrect, the bracts are much longer than in *B. minor* and the other characters sufficiently different: both with pubescent new shoots and young foliage, var. *macrostachya* with mature fruiting aments 1.3–2 cm. thick, the samaras 5–6 mm. broad; var. *cordifolia* similar but with definitely cordate leaves; *B. minor* glabrous from the first, often gummy, with very short staminate and fruiting aments, the latter at most 9 mm. thick, and samaras averaging 4.6 mm. wide.

5. B. ALBA L. Sp. Pl. 982 (1753), in part; emend. Roth, Tent. Fl. Germ. i. 404 (1788); Schneid. Handb. Laubholzk. i. 116 (1904); Rendle & Britten in Journ. Bot. xlv. 441 (1907). *B. alba*, *α. vulgaris* Ait. Hort. Kew. iii. 336 (1789). *B. pubescens* Ehrh. Beitr. v. 160 (1790), *nomen only*, vi. 98 (1793—on title page as 1791). *B. tomentosa* Reitter & Abel, Beschr. und Abbild. Deutschl. selt. wild. Holz.-Art. 17, t. 15 (1803).—Introduced from Europe; naturalized on roadsides, in thickets and at borders of woods, Newfoundland to Pennsylvania, west to Michigan.

Although this characteristic European species is passing in this country as *B. pubescens* Ehrh. (1793) it is clear, I think, that

we should retain for it the name *B. alba* L. (1753), as emended by Roth (1788) and as taken up by Aiton (his var. *vulgaris*, as opposed to his var.β. *pendula*). Roth properly split the bipartite *B. alba* of Linnaeus in 1788 into what he considered true *B. alba* and the newly segregated *B. pendula*. Except to those who, following the very simple but also very doubtful Germanic practice of rejecting all Linnean names of European species if they included what are now considered two or more species, the case seems quite clear. *B. alba* in the sense of Roth, who first made the split, and of Aiton, who, the next year, split the species into its two primary elements (as varieties) was thus retained by those very keen students of nomenclature, Schneider in Vienna and Rendle & Britten in London.

If we should apply to North American species of Linnaeus the Germanic idea of rejecting all of his names, which were used for two or more specific elements but which Linnaeus supposed to be conspecific and to both of which the original Linnaean name has been frequently applied, the havoc would be amazing and futile. An embarrassingly large number of the American species of Linnaeus, to say nothing of Old World species from the Orient, were hopeless confusions. Nevertheless, we try to typify them by singling out the element most definitely seeming to be what he primarily intended; or we accept the first clear breaking of the mixture into its primary elements. In case of *Betula alba* the bipartite species was clearly separated into its two primary elements by Roth in 1788. Unless someone earlier segregated them under different names, Roth's typification of *B. alba* should stand.

The name *Betula tomentosa* and that of one of its authors, Reitter (or Reiter) have made endless trouble for those who merely compile from others rather than check the original sources. Thus, from the statement in Dippel, Handb. Laubholzk. ii. 174 (1892), a work in which the illustrations (and apparently the bibliography), right or wrong, were copied from others, we find under *B. alba*, subsp. *pubescens* the following bibliography: "Bet. pubescens Ehrh. Beitr. z. Naturk. VI. S. 98. 1793. . . . Bet. tomentosa Reitter u. Abel Abbild. d. 100 wild. deutsch. Holzart. I. 17. 1790." If Dippel's bibliography were correct, the name *B. tomentosa* ("1790") would obviously antedate *B.*

pubescens (1793). This, however, is not the case. It is simply one of the many errors which the incorrect citations of Reitter & Abel have started.

In the first place, the name of the first of the two authors has been so misinterpreted that one wonders if later authors have ever taken the trouble to look up the books. Thus, in Index Kewensis he appears as Retz[ius]. Von Hayek, Fl. Steyerm. i. 105 (1908), swallowed without evident choking the predigested date, 1790, and displaced *B. pubescens* (1793) by *B. tomentosa* "Reith et Abel"; and Schneider, Ill. Handb. Laubholzk. ii. 886 (1912) also said "Reith et Abel". Ascherson & Graebner, Syn. iv. 398, got nearer the facts as to the first author but by omitting a period made the authors and the place of publication erroneously appear as "Reitt u. Abel Abb. 100 wild. Holzart. I. 17 (1790)." Even the very careful Bradley Bibliography called them Reiter & Abel in vol. i. 370, but one looks in vain for them under Reiter in the Index, for there (vol. iv. 716) they are entered only under Reitter.

The author himself (or his editors, collaborators or publishers) was doubtful as to his own name. There were two quite different books by the pair of authors. In the citations by later authors these have been hopelessly confused. These books were

1. Abbildung der Hundert deutschen wilden Holz-Arten, etc. Stuttgart. 1790. With colored plates. The authors given as Reitter und Abel and the first author's name spelled in the dedication very definitely "Reitter". The somewhat altered second edition, with the dedication and much of the introductory matter omitted, the plates uncolored, came out in 1805. Here he appears as "Reiter".
2. Beschreibung und Abbildung der in Deutschland seltener wildwachsenden und einiger bereits naturalisirten Holz-Arten, etc. Stuttgart. 1803. The authors given as Reiter und Abel.

No. 1 alone was caught by Pritzel's Thesaurus. Since no. 2 was evidently unknown to Pritzel it must be very rare. I have, fortunately, been able to consult them both, as well as the 2nd edition of no. 1, at the Arnold Arboretum; and the Librarian, Mrs. Schwarten, kindly refers me to the biography of Johann Daniel Reitter in Hess, Lebensbilder, 287 (1885), the biographer there listing book no. 1, Abbild. Hundert deutsch. wild. Holz-Art., but not no. 2, Beschreib. und Abbild. Deutschl. Holz-Art. Now, when both these works are examined it will be found that in no. 1, Abbild. Hundert deutsch. wild. Holz-Art., there is no

Betula tomentosa. The only true Birch there is on p. 7 (not 17), "XV. *Kupfertafel*. Die *Birke*. Wonnerbaum. Betula alba"; while plate 15 has merely the text "*Betula alba. Die Birke*". Dippel, von Hayek and others who have started *B. tomentosa* there have obviously been mistaken.

In work no. 2, Beschr. und Abbild. 17 (1803) there is a detailed account of *Betula tomentosa*, the "wohlriechende Birke" and t. 15 shows it in color, also as *B. tomentosa*. That, however, was in 1803, not in 1790, so that for those who maintain *B. pubescens* as a species the name *B. tomentosa* offers no competition. The rarity of Reitter & Abel's Beschr. und Abbild. (1803) is further indicated by the absence of a reference to its plate 15 in Index Londinensis. Plate 15 of the Abbildung (1790) is there correctly cited under *B. alba*.

6. B. PAPYRIFERA Marsh. Arb. Am. 19 (1775). *B. papyracea* Ait. Hort. Kew. iii. 337 (1789). *B. alba*, δ. *papyrifera* Spach in Ann. Sci. Nat. Bot. sér. 2, xv. 188 (1841); Regel in Nouv. Mém. Soc. Sci. Nat. Mosc. xiii. 81—repr. Mon. Bet. 23—t. v. fig. 5–16 (1861). *B. alba* sensu Fernald in Am. Journ. Sci. ser. 4, xiv. 169 and 190, in small part (1902).—Highly variable; represented in eastern North America by the following varieties and forms,

a. Leaves merely rounded to tapering at base....*b*.
  b. Bracts of pistillate aments 3-lobed; peduncle usually shorter than fruiting ament; the latter 2.5–6.5 cm. long....*c*.
    c. Mature fertile bracts 3.5–7 mm. long, with divergent lateral lobes; samaras 3.5–5 mm. broad....*d*.
      d. Branchlets spreading or ascending, not strongly drooping; leaves of fertile branches broadly ovate, mostly rounded at base; pistillate aments mostly solitary on the spurs....*e*.
        e. Bark of trunks of fruiting trees (or shrubs) creamy- to pinkish-white, very soon exfoliating.
          Leaves membranaceous to firm, hardly lustrous ..... *B. papyrifera* (typical).
          Leaves thick and leathery, lustrous above..... Forma *coriacea*.
        e. Bark of fruiting trunks warm-brown, only on oldest bases with smooth outer brown layer exfoliating ..... Var. *commutata*.
      d. Branchlets pendulous; leaves of fertile branches narrowly ovate to ovate-lanceolate, only slightly rounded to gradually tapering to petiole; pistillate aments often in fascicles of 2–4 on the spurs..... Var. *pensilis*.
    c. Mature fertile bracts 7–10 mm. long, with ascending lateral lobes; samaras 6–8 mm. broad; leaves ovate, with rounded bases; fruiting aments solitary or paired.
      Peduncles of fruiting aments 0.5–1.5 cm. long, many times shorter than ament..... Var. *macrostachya*.
      Peduncles 2–3 cm. long, one half to essentially as long as pendulous ament..... Forma *longipes*.

b. Bracts unlobed or with merely rudimentary lateral lobes, elliptic-oblong; pistillate aments 1.5–2 cm. long, about equaled by arched-recurving peduncle; leaves rhombic-oval, dentate. . . . . Var. *elobata.*

a. Leaves definitely cordate at base; bracts of mature pistillate aments 5–10 mm. long, mostly with ascending lobes; bark of mature trunks warm-brown to creamy- or pinkish-white Var. *cordifolia.*

B. PAPYRIFERA, typical.—Woods, especially on slopes, Labrador to Alaska, south to Newfoundland, Nova Scotia, New England, New York, upland of Pennsylvania and West Virginia, northern Ohio, northern Indiana, northern Illinois, northern Iowa, South Dakota, etc. PLATE 964.

Forma CORIACEA Fernald & Wiegand in RHODORA, XXV. 209 (1923)—Dunes of Lake Ontario, New York.

Var. **commutata** (Regel), comb. nov. *B. occidentalis* Hook. Fl. Bor.-Am. ii. 155 (1839) as to specimen from *Scouler* only, not as to other specimens and detailed description; sensu Lyall in Journ. Linn. Soc. vii. 134 (1864); sensu Sargent in Bot. Gaz. xxxi. 237 (1901); not Hook. l. c. as to detailed descr. (1839), nor Nutt. N. A. Syl. i. 23, pl. 7 (1853), nor S. Watson in Bot. King Report—U. S. Geol. Expl. 40th Parallel, v. 323, pl. xxxv (1871), nor Sargent, Sylva, ix. 65, pl. cccclv (1896), nor S. Wats. Bot. Calif. ii. 79 (1880). *B. alba,* subsp. *occidentalis* (Hook.) Regel, β. *commutata* Regel in Bull. Soc. Nat. Mosc. xxxviii. 401 (1865)—repr. as Bemerk. Gatt. Bet. Aln. 14, pl. 7, figs. 6–10 (1866) and in DC. Prodr. xvi^2. 166 (1868), as to TYPE from Sumass Prairie, *Lyall. B. papyracea,* var. *occidentalis* sensu Dippel, Handb. Laubholzk. 177 (1892). *B. Lyalliana* Koehne in Mitt. Deutsch. Dendr. Gesellsch. 1899: 53 (1899), *nomen only. B. alba,* forma *occidentalis* sensu Fernald in Am. Journ. Sci. ser. 4, xiv. 173 and 190 (1902), not *B. occidentalis* Hook. basonym. *B. papyracea Lyalliana* Koehne ex Schelle in Beisner, Schelle & Zabel, Handb. Laubh.-Ben. 55 (1903). *B. papyrifera,* var. *Lyalliana* (Koehne) Schneid. Ill. Handb. Laubhk. i. 115 (1904), based on "*B. occidentalis* LYALL, in Jour. Lin. Soc. VII. 134. *1864,* ex parte, non Hook." *B. papyrifera,* var. *occidentalis* sensu Sargent in Journ. Arn. Arb. i. 63 (1919), not *B. occidentalis* Hook. basonym.—Woodlands near the coast, Labrador to northeastern Massachusetts; western North America south to Oregon. PLATE 965.

In 1902 I pointed out that the character of permanently close and dark bark, which Sargent (1901) took as the single *specific* character of the tall tree of the Pacific slope, "perhaps the largest of all birch-trees" (Sargent, l. c. 238), breaks down in the West and that in the East trees, otherwise inseparable from *B. papyrifera,* may have the bark permanently quite as dark as in the tree

of Puget Sound and the lower Fraser River. Subsequently I have seen forests in Newfoundland and at the tip of the Gaspé Peninsula where the large trunks (up to 9 dm. in diameter) were covered with smooth deep-brown bark. In the oldest trees, however, the dark bark of the base of the trunk (up to 2 or 3 m.) will sometimes exfoliate and there leave perfectly characteristic exfoliating pale bark (PLATE 965, FIGS. 2 and 3) of typical *B. papyrifera.* One of the southernmost stations in the East seems to be on Cape Ann, large brown-barked shrubs loaded with fruit, near granite-quarries back of Bayview, Gloucester, where it was collected in August, 1944, by Miss Elizabeth Johnston. It might be thought that it was long ago recorded from Essex County, for the three specimens cited by Regel of his *B. alba,* subsp. *occidentalis,* β. *commutata* were from "Sumass Prairie (Lyall), Topsfield, Massachusetts (Asa Gray), Oregon (Lyall). The Topsfield specimen, labelled by Regel as above, was distributed by William Oakes as *B. papyracea;* Asa Gray merely sent it on loan to Regel. There is no note regarding the bark of the trunk; apparently Oakes did not see anything unusual in it. The Lyall specimen from Sumass Prairie is the TYPE of var. *commutata.*

Hooker, Nuttall, Torrey, Sereno Watson and many other careful students of the past correctly understood Hooker's rather vivid description of *Betula occidentalis.* Unfortunately, however, Hooker originally complicated matters by first citing a specimen from "Straits of De Fuca. *Dr. Scouler*", although his description was, it seems to me and to several field-botanists who know both trees, based almost entirely on the characteristic shrub or small tree of the Rocky Mountain region, west to the drier slopes of British Columbia, Washington, Oregon and California, the species which Sargent, l. c. 239 (1901) renamed *B. fontinalis.* These two trees are abundantly distinct but I am unable to follow Sargent's reasoning, except that in 1901 he was following the now abundantly discredited principle of neglecting, if it happened to disagree, the description and taking as type the first cited specimen, in this case the Scouler specimen from the Straits of Juan de Fuca. In doing so, however, he saw in Hooker's description more elements of that species than I can find and consequently set off the cordilleran *B. fontinalis.* He

stated that the specimens cited by Hooker came from three different trees:

First, *Betula papyrifera* Marsh . . .

Second, the large tree which grows on the lower Fraser river, on the shores and islands of Puget sound, and on Vancouver island (PLATE 965, FIGS. 1 and 4–6). This tree has . . . pubescent branchlets, . . . leaves pubescent on the lower surface, . . . Specimens of this tree, which is perhaps the largest of all birch-trees, were first gathered on the shores of the straits of Fuca by Dr. John Scouler . . . The tree from the straits of Fuca appeared first in the description of *Betula occidentalis which was evidently drawn principally from the specimen of that tree* [italics mine], and must be considered the type of Hooker's species . . .

Third, the half-shrubby dark-barked species . . . which ranges as far south as Colorado, Utah, and northern California. This plant was collected by Nuttall on the Sweetwater . . . and was first described and figured by him as *Betula occidentalis* (*Sylva* **I:** 23. *pl. 7*). Torrey in the Botany of Fremont's Expedition repeats this error. This same species was also described and figured in *King's Rep.* (**5:** 323. *pl. 35*) as *Betula occidentalis* by Watson who repeated his error in the *Botany of California*, and it . . . is described and figured as *Betula occidentalis* in my ninth volume of *The Sylva of North America* . . . our tree, for which I now propose the name of **Betula fontinalis.**

Along with many others I have fallen into the trap and have followed Sargent in calling the cordilleran low tree or coarse shrub *Betula fontinalis*. This course, as already stated, ignores the very definite description given by Hooker:

3. *B. occidentalis;* ramis rufo-fuscis copiose resinoso-verrucosis, foliis late rhombeo-ovatis sublobatis grosse inciso-serratis sub lente appresso-hirsutulis v. nudis subtus pallidioribus epunctatis, nervis paucis remotis, amentis foem. lato-cylindraceis, squamis lobis ovato-oblongis lateralibus decurvo-falcatis intermedio longiore.

HAB. Straits of De Fuca. *Dr. Scouler.* Near springs on the west side of the Rocky Mountains. *Douglas;* and on the east side, from the mountains to Edmonton House. *Drummond.* One specimen is in the collection from the Arctic coast* (?) *Dr. Richardson*—This Birch does not agree with any described species, and it is probably confined to the west coast, and to the immediate vicinity of the Rocky Mountains, forming a low, small brush-wood, 6–10 feet high, and never exceeding a few inches in the diameter of its trunk. Mr. Drummond considered it to be the *B. nigra*, but its bark and leaves are quite different; [Then a statement of characters of *B. nigra*]. The main branches are erect, and somewhat virgate, clothed with a red-brown bark, a little inclining to purple, copiously sprinkled with resinous warts in all the specimens. Petioles ½ to ¾ of an inch long, adult leaves 2–2½ inches, broadly ovato-rhomboid, rather acute than acuminate, of a harsh and dry but not thick texture, slightly lobed at the margin, and inciso-serrate, the serratures coarse and sharp, paler beneath, but never, either in the old or younger state, dotted. Male catkins resembling those of the preceding [*B. papyrifera*], 1–2 inches long.

"* There has probably been some mistake in the station of this."

In the two following paragraphs I have quoted the characters as described by Sargent, Man. 204, 205 and 207 (1905) and by Rydberg, Fl. Rky. Mts. 202–204 (1918) of *B. occidentalis* sensu Sargent (i. e. *B. papyrifera*, var. *commutata*) and *B. fontinalis* Sargent (i. e. *B. occidentalis* Hook.); and after each item Hooker's own description in italics. As Bateson used to say, a judicious advocate leaves the conclusion to flow quietly from the evidence.

B. OCCIDENTALIS sensu Sargent (i. e. B. PAPYRIFERA, var. COMMUTATA). "A tree, 100°–120° high, with a trunk 3°–4° in diameter" (*Sargent*); "tree sometimes 30–40 m. high" (*Rydb.*) HOOKER: "*small brush-wood, 6–10 feet high, and never exceeding a few inches in the diameter of its trunk*". The "branches often pendulous on old trees, . . . branchlets more or less glandular and coated with long pale hairs when they first appear, . . . marked by numerous minute pale lenticels and pubescent or puberulous during their first winter and nearly destitute of glands" (*Sargent*); "at first pubescent or puberulent" (*Rydb.*) *Hooker: "ramis . . . copiose resinoso-verrucosis", "The main branches erect, and somewhat virgate, . . . copiously sprinkled with resinous warts on all the specimens".* Leaves "ovate, acute, . . . covered with dark reddish resinous viscid glands, and villous along the midribs and veins, with long white hairs often also in large persistent tufts in the axils of the primary veins, and at maturity thin and firm in texture, marked by the scars of the fallen glands, . . . 3′–4′ long, . . . their petioles stout, glandular, at first tomentose, ultimately pubescent or puberulous, about ¾′ long" (*Sargent*). HOOKER: "*foliis late rhombeo-ovatis . . . sub lente appresso-hirsutulis v. nudis subtus . . . epunctatis*" . . . "*Petioles ½ to ¾ of an inch long, adult leaves 2–2½ inches, broadly ovato-rhomboid, rather acute than acuminate, of a harsh and dry but not thick texture, . . . paler beneath, but never, either in the old or younger state, dotted*". The "staminate aments . . . becoming 3′–4′ long" (*Sargent*). HOOKER: "*Male catkins . . . 1–2 inches long.*"

B. OCCIDENTALIS sensu Nuttall, Torrey, Sereno Watson and Sargent's Sylva (i. e. B. FONTINALIS Sargent): "more commonly shrubby, with many thin spreading stems forming open clusters, 15°-20° high; often much lower, and frequently crowded in almost impenetrable thickets" or more rarely "A tree, occasionally 30°-40° high, with a trunk 12′-18′ in diameter" (*Sargent*); "tree occasionally 10–12 m. high, often growing in clumps and shrub-like" (*Rydb.*). HOOKER: "*forming a low, small brush-wood, 6–10 feet high, and never exceeding a few inches in the diameter of its trunk.*" Branchlets "much roughened at first by large lustrous resinous glands persistent until the second season" (*Sargent*); "twigs densely glandular-resiniferous", "not hairy" (Rydb.). HOOKER: "*ramis copiose resinoso-verrucosis*", "*branches . . . copiously sprinkled with resinous warts in all the specimens*". Leaves "broadly ovate, acute" with "abruptly wedge-shaped . . . base, and sometimes slightly laciniately lobed, . . . pilose above, and covered by conspicuous resinous glands when they unfold, at maturity thin and firm, . . . 1′–2′ long, . . . petioles . . . ⅓′–½′ long" (*Sargent*); "leaves broadly ovate, usually less than 4 cm. long" (*Rydb.*). HOOKER: "*foliis late rhombeo-ovatis sublobatis grosse inciso-serratis sub lente appresso-hirsutulis v. nudis subtus . . . epunctatis*", "*petioles ½ to ¾ of an inch long, adult leaves 2–2½ inches, broadly ovato-rhomboid, rather acute than acuminate, of a harsh and dry but not not thick texture, slightly lobed at the margin, . . . never, either in the old or younger state, dotted*". Staminate "aments . . . becoming 2′–2½′ long" (*Sargent*); "staminate aments 5–7 cm. long" (Rydb.). HOOKER: "*Male catkins . . . 1–2 inches long*".

When we take into account the facts that plenty of mature branches of *Betula occidentalis* (*fontinalis*) have leaves down to ¾ inch long and petioles down to less than ¼ inch in length, while others (*Koehne*, Herb. Dendrol. no. 105; *L. E. Smith*, no. 759; *Muenscher & Maguire*, no. 15,690; *M. E. Peck*, no. 9468; *F. A. Walpole*, no. 323; *Eggleston*, no. 21,998; *St. John*, no. 7655; show blades 2–2½ inches long, while in an extreme variety they may be up to 7 cm. long, it becomes quite clear that in most of his stated characters Hooker was accurately describing the relatively low and often shrubby species which Nuttall, Torrey, Watson and others understood as *B. occidentalis* and which Sargent, without any concrete diagnosis and without designation of type, called *B. fontinalis*.

Returning to *Betula papyrifera*, var. *commutata*, that name started as *B. alba*, subsp. *occidentalis*, var. β. *commutata* Regel in 1865, Regel defining his subsp. *occidentalis*, var. α. *typica* "trunco humili, foliis inciso-sublobatis dentatisque" (i. e., following Hooker's original description), while his var. *commutata* was defined as follows:

> β *commutata* (tab. 7, fig. 6–10); trunco elato, foliis duplicato-dentatis.—Als B. papyracea und papyrifera im Herbarium Asa Grays und Boissiers.—Wächst in Nord-amerika, Sumass Praierie (Lyall), Topsfield, Massachusets (Asa Gray), Oregon (Lyall).
>
> Von der folgenden Unterart [papyrifera] nur durch die gespreizten oder zurück gekrümmten Seitenlappen der Schuppen des Fruchtzäpfchens verschieden.

All three sheets, including the TYPE from Sumass Prairie are before me. In all evident characters they are quite like the tree of the Pacific slope which Sargent took as *B. occidentalis* and they are all easily matched in details by much eastern *B. papyrifera*. The tree of the Fraser River region, including Sumass Prairie, is with reasonable certainty the dark-barked variety, but the Topsfield specimen of William Oakes (not Asa Gray) is, as already explained (p. 313) evidently from the pale-barked and generally commoner eastern *B. papyrifera*. In Lyall's account of "The Lower Fraser River district, which includes the Sumass and Chilukweyuk prairies and other low grounds to the westward of the Cascade Mountains—a moist region", Lyall, in Journ. Linn. Soc. Lond. vii. 131–135 (1864), enumerated from "The banks of the Lower Fraser River . . . *Abies Douglasii*, . . .

Abies Menziesii, . . . *Abies Mertensiana*, . . . *Thuja gigantea*, . . . *Acer macrophyllum*", etc. and then "*Betula occidentalis*, Hook. (a tree growing to the height of 60 or 70 feet [compare Sargent's "100°–120°", also J. K. Henry's "A small or large tree"] and most common about the borders of the forest)". That material was the basis of var. *commutata*. When Schneider published his *B. papyrifera*, var. *Lyalliana*, citing the Lyall account above quoted and the synonym *B. occidentalis* sensu Sargent, not Hooker, he evidently overlooked the earlier name which had been based on the Lyall collections.[1]

[1] The reinstatement of *Betula occidentalis* Hook. necessitates the following new varietal name.

B. OCCIDENTALIS Hook., var. **fecunda**, nom. nov. *Betula*, 3d. described tree in Piper & Beattie, Fl. Palouse Reg. 55 (1901). *B. Piperi* Britton in Bull. Torr. Bot. Cl. xxxi. 165 (1904), as to description, not as to single collection cited. *B. fontinalis*, var. *Piperi* (Britton) Sargent in Journ. Arn. Arb. i. 65 (1919), in part only. PLATE 966.

In their Flora of the Palouse Region Piper & Beattie, with well-understood hesitation, refrained from assigning guesswork names to the three birches of the area. Instead, they described the three in detail but without names. Their third tree was

"B. Graceful tree, 8–15 m. tall, with drooping branches: bark dark bronze . . . branchlets . . . very glandular; leaves ovate, obtuse or acute at the base, . . . shining green above, glandular on both surfaces, 2–4 cm. long . . . : pistillate aments cylindrical: 5 cm. long, .5 cm. thick, often flexuous, mostly in twos, . . . Springy hillsides near Almota."

This description was but slightly, though somewhat, changed by Britton, whose *B. Piperi* was the "tree . . . described by Professor Piper as attaining a height of 15 m. and being slender and graceful, with drooping branches" &c., largely a rewriting of the Piper & Beattie description above quoted. But, most unfortunately, the locality of the "Graceful tree, 8–15 m. tall, with drooping branches", "Springy hillsides near Almota", was not given. Instead, Britton cited only a single station: "Type collected by Professor C. V. Piper, July 9, 1901, nine miles south of Pullman, Washington", with the sad result that Piper himself, accepting for the tree which I am calling *B. papyrifera*, var. *commutata* Sargent's misidentification of it as *B. occidentalis* Hook., was forced to reduce *B. Piperi* to its synonymy. Piper's statement follows: "The name *Betula piperi* was meant by its author to apply to the third unnamed species in the Flora of the Palouse Region, but the specimen actually cited is the eastern Washington form of *B. occidentalis* Hook."—Piper, Fl. Wash., Contrib. U. S. Nat. Herb. xi. 218 (1906).

Var. *fecunda* (PLATE 966) is a remarkably definite variety of the western *Betula occidentalis* (*fontinalis*). In its pendulous branches with the tendency to fascicled and slender aments it is strikingly unlike the shrubby and virgate-branched *B. occidentalis* of Hooker's original description, in which the shorter aments are mostly solitary on the spurs. The latter has been so often illustrated that I am here showing only var. *fecunda*. Piper, puzzled by this beautiful tree, sent, unnamed, 14 sheets (under several numbers) to the Gray Herbarium. These were mostly misidentified by me as the Asiatic *B. microphylla*. Under this misidentification of mine Piper in his Flora of Washington, p. 219, wrote: "The Almota specimens form the basis for the third unnamed species in the Flora of the Palouse Region. This is a tall graceful tree with drooping branches, appearing very different from the ordinary form of *B. microphylla*, and probably distinct from it." As TYPE of var. *fecunda* I am designating *Piper*, no. 1642 in the Gray Herbarium.

Although the leaves of var. *fecunda* were described by Piper as 2–4 cm. long, his material was all rather young. Material from slightly to the southwest, Columbia Co., *St. John, Davison & Scheibe*, no. 6939, has leaves 5–7 cm. long.

Var. **pensilis,** var. nov. (TAB. 967), ramulis pendulis; foliis angusto-ovatis vel ovato-lanceolatis basin versus plerumque angustatis vel vix rotundatis; amentis foemineis solitariis vel 2–4-fasciculatis; bracteis 5.5–7 mm. longis, lobis lateralibus rhomboideis vel late oblongis divergentibus. *B. alba* var. *glutinosa* sensu Fernald in Am. Journ. Sci. ser. 4, xiv. 176 (1902), not Trautv.—Locally abundant, Newfoundland to western Quebec, south to Nova Scotia, Maine, Massachusetts and northern New York. NEWFOUNDLAND: high tableland, Holyrood, Aug. 1, 1931, *Agnes M. Ayre;* Buchan Junction, July 19, 1930, *K. P. Jansson.* QUEBEC: Rivière du Brick, Anticosti, *Victorin & Rolland,* no. 27,773; thickets and borders of woods near mouth of Marsouin River, Gaspé Co., *Fernald & Pease,* no. 25,017; head of l'Anse aux Bouleaux, Bic, Rimouski Co., July 6–10, 1905, *Williams, Collins & Fernald;* Bic, July 17, 1905, *J. R. Churchill;* east side of Lac Tremblant, Terrebonne Co., July 21, 1922, *Churchill;* near Georgeville, Lake Memphremagog, Aug. 12, 1914, *Churchill.* NOVA SCOTIA: "small tree 10 ft. high, branches drooping", banks of Lahave R., Bridgewater, *J. G. Jack,* no. 3510. MAINE: tree by road to Leighton Pond, Pembroke, July 10, 1909, *Fernald* (TYPE in Herb. Gray.); by Wassataquoik River between Roebar's and Dacy Dam, Piscatquis Co., July 17, 1900, *Fernald.* MASSACHUSETTS: large tree by Charles River, Newton Lower Falls, July 23, 1912, *Wiegand.* NEW YORK: banks of Cascade Lakes, Essex Co., *House,* no. 7640; mountain-side, alt. 1800 ft., near Minerva, Essex Co., *House,* no. 14,887; Stony Island 2, west end of Black Lake, St. Lawrence Co., *Muenscher & Maguire,* no. 2168.

Var. *pensilis* is very striking, not only as a "weeping" birch but on account of the mostly acute-based leaves and the very abundant fruiting aments. In 8 of the sheets before me they are often clustered on the spurs in fascicles of 2–4.

Var. **macrostachya,** var. nov. (TAB. 968, FIG. 1–3), ramulis divergentibus vix pendulis; foliis ovatis basi rotundatis; amentis foemineis solitariis vel binis, maturis 3.5–5.5 cm. longis 1–2 cm. crassis pedunculatis; pedunculis arcuato-recurvatis 0.5–1.5 cm. longis; bracteis 7–10 mm. longis, lobis lateralibus rhomboideis porrectis vel adscendentibus; samaris 6–8 mm. latis.—Local, northern Newfoundland to Rimouski County, Quebec, south to Nova Scotia and northern Maine. NEWFOUNDLAND: rich thickets on lower slopes of Ha-Ha Mt., Ha-Ha Bay, *Fernald, Wiegand, Long, Gilbert & Hotchkiss,* no. 28,065; thickets and glades, slopes of Cape Dégrat, Quirpon Island, Straits of Belle Isle, *Fernald & Long,* no. 28,067. QUEBEC: cold northerly calcareous walls of Grande Coupe, Percé, Gaspé Co., *Fernald & Collins,* no. 1000; bois près de la mer, Bic, Rimouski Co., *Victorin & Rolland,* no. 49,461. NOVA SCOTIA: dry mixed woods, Hecta-

nooga, Digby Co., July 31, 1920, *Long & Linder*, no. 21,007 (TYPE in Herb. Gray.; ISOTYPE in Herb. Phil. Acad.). MAINE: in disintegrated volcanic rock, Haystack Mt., Aroostook Co., July 11, 1902, *Williams, Collins & Fernald.*

In its very large aments, bracts and samaras var. *macrostachya* stands midway between typical *Betula papyrifera* and var. *cordifolia.* It is also intermediate in the tendency of its pistillate bracts to have the porrect lateral lobes of the latter, but sometimes nearly or quite horizontal as in the former. Its leaves are like those of typical *B. papyrifera*, without the cordate base so characteristic of var. *cordifolia.* Were it not for this transitional var. *macrostachya*, it would be reasonable to look upon var. *cordifolia* as a fairly distinct species, the status originally given it by Regel.

Var. MACROSTACHYA, forma **longipes,** f. nov. (TAB. 968, FIG. 4), pedunculis 2–3 cm. longis, amentis fructiferis pendulis.—Gaspé Peninsula, QUEBEC: woods, Malbaie, Gaspé Co., *Pease*, no. 6025A, as var. *cordifolia;* mossy meadows and woods at 455 m. (1500 ft.)—915 m. (3000 ft.) in the great basin [Fernald Basin] under the north slope of Mt. Logan, Matane Co., July 22, 1922, *Fernald & Pease*, no. 25,019 (TYPE in Herb. Gray.).

Very striking in its long drooping peduncles often essentially as long as the pendulous aments.

Var. ELOBATA (Fernald) Sargent in Journ. Arn. Arb. i. 63 (1919). *B. alba*, var. *elobata* Fernald in RHODORA, XV. 169 (1913).—Known only from the type-locality in QUEBEC: crevices and talus of serpentine along Ruisseau à la Neige, Mt. Albert, Gaspé Co., *Fernald & Collins*, no. 531. PLATE 969.

It is not improbable that var. *elobata*, when mature fruiting material is secured, may prove to be an endemic species. In its subrhombic and dentate leaves, suggestive of those of *B. nigra* L., and in its very short pendulous pistillate aments with unlobed or only obsoletely lobed bracts, it is very distinct. Unfortunately, the material, collected in an alpine area and only slightly past anthesis in July, does not show mature samaras. The type-colony is near the head of one of the northwestern tributaries of Ruisseau à la Neige, as it abruptly descends the cañon-wall, not far below the serpentine tableland (alt. about 3500 ft.). Under it grow *Polystichum mohrioides*, var. *scopulorum* (D. C. Eaton) Fernald, in its only known area east of local stations in Idaho, while close-at-hand are the type-areas of the endemic or near-

endemic *Salix chlorolepis* Fernald, *S. hebecarpa* Fernald, *Arenaria marcescens* Fernald and *Solidago chlorolepis* Fernald, and endemic or disjunct varieties in *Salix*, *Statice* and *Cnicus*. It is important to secure the fruit of *Betula papyrifera*, var. *elobata*.

Var. CORDIFOLIA (Regel) Fernald in RHODORA, iii. 173 (1901), by inference only; Rehder, Man. Cult. Trees and Shrubs, 141 (1927). *B. cordifolia* Regel in Nouv. Mém. Soc. Nat. Mosc. xiii. 86—repr. as Mon. Bet. 28, t. 12, figs. 29–36 (1861). *B. alba*, subsp. *papyrifera*, β. *cordifolia* (Regel) Regel in Bull. Soc. Nat. Mosc. xxxiii. 401 (1865)—repr. as Bemerk. Gatt. Bet. Aln. 14 (1866) and in DC. Prodr. xvi². 166 (1868). *B. papyracea*, a *cordifolia* (Regel) Dippel, Handb. Laubholzk. ii. 177 (1892). *B. alba*, var. *cordifolia* (Regel) Fernald in Am. Journ. Sci. ser. 4, xiv. 177 and 190 (1902). *B. papyracea cordifolia* (Regel) Scheele in Beisn., Scheele & Zabel, Handb. Laubh. Benen. 55 (1903). *B. papyrifera*, var. *communis*, f. *cordifolia* (Regel) Schneid. Handb. Laubholzk. i. 115 (1904).—Labrador to Algoma District, Ontario, south to Newfoundland, Nova Scotia, New England (rare southward), northern New York, Michigan, Wisconsin and northern Iowa; high altitudes on Blue Ridge, North Carolina. PLATE 970.

In its firm and definitely cordate leaves, its long bracts with mostly porrect lobes and its large samaras *Betula papyrifera*, var. *cordifolia* might merit the specific rank originally given it by Regel; but, as already noted, var. *macrostachya*, with leaves merely rounded and not cordate at base, exactly bridges the gap between it and typical *B. papyrifera*. With its very long bracts with mostly porrect (instead of horizontally divergent) lobes it is certainly a well marked geographic variety, which in the western half of the continent is replaced by var. *subcordata* (Rydb.) Sargent. Rare in southern New England and not known south of the Adirondack region in New York, this is the only variety of *B. papyrifera* known on the high mountains of North Carolina. In discussing its discovery and abundance at 5500–6200 ft. altitude, "in the spruce and balsam forest", "about 550 miles" south of its supposed southern limit (in Massachusetts and Connecticut), Ashe in RHODORA, xx. 63, 64 (1918) quoted various northern botanists, some of whom (Britton and Blanchard) regarded it a good species, others (Sargent and Burns, besides the present writer) recognizing intergradient trees; and be concluded: "The fact that the cordate [-leaved] form alone occurs in North Carolina, and that there its leaf-form is strongly marked and

without indication of variation—foliage was examined from more than 100 trees—would at least seem to give it excellent varietal if not specific characterization."

In his original publication of *Betula cordifolia* Regel cited it as in "Novaja Semlaja von Hr. de la Tylaie im Jahre 1826 gesammelte" and compared it with the Asiatic *B. Ermani* Chamisso, arguing for its specific separation since "dass B. Ermani bis jetzt aus Novaja Semlaja noch nicht bekannt ist". Bearing in mind that Novaja Semlaja is the Russian equivalent of Terre-neuve, where Bachelot de la Pylaie (not "Tylaie") spent so many years in botanizing, the intent is obvious. In fact, Regel got the type-locality straightened in his later treatments, where he correctly gave it as "Terra nova (de la Pylaie . . .)."

A small-leaved northwestern variety of *Betula papyrifera*, which may be expected to cross the plains into Minnesota, has leaves in outline resembling those of *B. pendula*. This is

B. PAPYRIFERA Marsh., var. **humilis** (Regel) Fernald & Raup, comb. nov. *B. alba*, subsp. *papyrifera*, var. γ *humilis* Regel in DC. Prodr. xvi. 166 (1868), in part (descr. and Bourgeau specimen from Saskatchewan). *B. alaskana* Sargent in Bot. Gaz. xxxi. 236 (1901), not Lesq. (1883). *B. neoalaskana* Sarg. in Journ. Arn. Arb. iii. 206 (1921). *B. papyrifera*, var. *neoalaskana* (Sarg.) Raup, Contrib. Arn. Arb. vi. 152 (1934). PLATES 971 and 972.

Betula alba, subsp. *papyrifera*, γ. *humilis* was based primarily on a sheet in the Gray Herbarium, collected by Bourgeau in 1857–8 in Saskatchewan ("Bords de la rivière Castor"). This sheet (our PLATE 971, FIGS. 1–4) bears Regel's annotation. Although Regel followed this with citation of Parry and Hall & Harbour specimens, which are of *B. occidentalis* Hook. (*B. fontinalis* Sarg.) and the type of Tuckerman's *B. papyracea*, var. *minor* (*B. minor*) from the White Mts., his description, "folia . . . juniora petiolique saepe pubescentia, . . . subtus ad nervos tantum pilosula. Samararum alae nucula usque triplo latiores", definitely applies to the *Bourgeau* sheet. It can not apply to *B. minor*, for the branchlets and leaves of that more eastern shrub are strictly glabrous and the wings of its samaras are never "nucula usque triplo latiores". Nor could the glabrate branches of Regel's "Ramuli . . . glanduliferi v. juniores pubescentes, dein glabrati" apply to either *B. minor* or *B. occi-*

dentalis, both of which have glabrous branchlets; the "juniores pubescentes, dein glabrati" belongs also to the Bourgeau element. Since this Saskatchewan specimen, clearly labelled by Regel as his *B. alba*, subsp. *papyrifera*, var. *humilis*, agrees with his description in the more diagnostic characters, whereas the Rocky Mountain specimens (*Parry* and *Hall & Harbour*) as well as the White Mountain one (*Tuckerman*) already had legitimate names, we see no way but to take up the name var. *humilis* for the Saskatchewan element primarily described.

There is a second sheet of Bourgeau's Saskatchewan material (1858) in the Gray Herbarium. This one (PLATE 972, FIG. 1) has had a checkered career. In his Bemerkungen über die Gattungen Betula und Alnus, Bull. Soc. Nat. Mosc. xxxviii. 398 (1865)—repr. 11 (1866)—Regel published under the strictly Eurasian *Betula alba*, subsp. *verrucosa*, a var. *resinifera*, based exclusively on a Middendorf specimen from eastern Siberia. In DeCandolle's Prodromus, xvi^2. 164 (1868), however, although otherwise holding his *B. alba*, subsp. *verrucosa* strictly to Eurasia, he cited under var. *resinifera* a single North American specimen: "in America boreali-occidentali ad Saskatchevan (Palliser)". This specimen, *Bourgeau*, 1858, on the Palliser Expedition (Gray Herb.), was originally distributed as *B. papyracea* but it bears Regel's annotation as above. A portion of it is shown in PLATE 972, FIG. 1. The significant point in connection with this second *Bourgeau* (*Palliser*) sheet is that Sargent, describing his *B. alaskana*, selected it as the first specimen to be cited under his new specific name: "Saskatchewan, *E. Bourgeau*, 1858 (in Herb. Gray); near Prince Albert in latitude 53, July 1876, *John Macoun* [our PLATE 971, FIG. 5 and 972, FIGS. 2 and 3]; northwestward, reaching the Alaskan coast", etc. Of this *Bourgeau* specimen Sargent wrote: "The specimen in Herb. Gray collected by Bourgeau in flower on the Saskatchewan was referred by Regel (*Bull. Mosc.* **18:** 398; *DC. Prodr.* **16^2:** 164) to his *Betula alba*, subspecies *verrucosa* δ *resinifera*". The fact that, in spite of Sargent's statement, Regel did not mention the Bourgeau specimen in his first publication (Bull. Mosc.) but only in the second (DC. Prodr.) is significant; otherwise it might be involved in the typification of his *B. alba*, subsp. *verrucosa*, var. *resinifera* which, fortunately, was based solely on the Middendorf material.

The name *B. alba*, subsp. *papyrifera*, var. *humilis* has the right-of-way.

7. B. BOREALIS Spach in Ann. Sci. Nat. sér. 2, xv. 196 (1841). *B. pumila*, γ. *borealis* (Spach) Regel in Nouv. Mém. Soc. Nat. Mosc. xiii. 113—repr. Mon. Bet. 55, t. 13, figs. 38 and 39 (1861) and in DC. Prodr. xvi². 173 (1868). *B. alba*, var. *carpatica* sensu Fernald in Am. Journ. Sci. ser. 4, xiv. 179 and 190 (1902) in part only, not *B. carpatica* Wald. & Kit. *B. microphylla* sensu Eames and sensu Fernald, as quoted by Eames, in RHODORA, xi. 93 (1909), not Bunge.—Southern Labrador to James Bay, Ungava, south, chiefly on calcareous or magnesian soils to Newfoundland, Anticosti Island and Gaspé Peninsula, Quebec, and very rarely to Cape Breton and to northern Vermont.—Since this characteristic and very definite northeastern species has not been understood during the full century since Spach very clearly described it as "Legit cl. de Lapylaie, in insulâ Terrae-Novae" (this later rendered by Regel "von Herrn de la Tylaie in Novaja Semlaja gesammelt"), it is important to cite and illustrate good material (all, unless noted, distributed erroneously as *B. microphylla* Bunge). LABRADOR: common on many barrens and hillsides, Backway, off Lake Melville, *R. H. Wetmore*, no. 102,930. NEWFOUNDLAND: 1 m. high, peaty limestone barrens, southern half of Burnt Cape, Pistolet Bay, *Fernald & Long*, no. 28,070; cool springy glade, Burnt Cape, *F. & L.*, no. 28,075; limestone barrens on the Highlands northeast of Big Brook, Straits of Belle Isle, *Fernald, Wiegand & Hotchkiss*, no. 28,072; shrubs 1–2 m. high, spruce woods and thickets bordering limestone barrens, Brig Bay, *Fernald, Long & Dunbar*, no. 26,596; spruce woods and thickets, St. Barbe, *F. L. & D.*, no. 26,595; 1–2 m. high, thickets along East Brook, St. Barbe Bay, *Wiegand & Hotchkiss*, no. 28,080; slaty gorge of brook below serpentine barrens above Woody Point, Bonne Bay, *R. H. Kimball*, no. 117; 1–2 ft. high, quartzite gravel and talus, Killdevil, *Fernald, Long & Fogg*, no. 1636; gravelly beach, Middle Birchy Pond, Eastern Drainage of Humber R., *Fernald & Wiegand*, no. 3247 (as *B. alba*, var. *carpatica*); coarse shrub, southerly slopes of dry serpentine ridge, North Arm, Bay of Islands, *Long & Fogg*, nos. 217 and 219; dry thicket on exposed slope at about 1650 ft., Blow-me-down Mt., *Eames & Godfrey*, no. 6033; serpentine and magnesian limestone barrens, northeastern base and slopes of Blomidon ("Blow-me-down") Mts., *Fernald & Wiegand*, nos. 3245 (as *B. alba*, var. *carpatica*) and 3246; large shrubs, dry limestone barrens, upper slopes and tablelands, alt. 200–300 m., Table Mt., Port-à-Port Bay, *Fernald & Wiegand*, no. 3250 (as *B. alba*, var. *carpatica*), also *Fernald & St. John*, no. 10,827; coarse shrub, thickets on gneiss ledges along Grandy Brook, Distr. of Burgeo and La Poile,

Fernald, Long & Fogg, no. 218; springy and boggy places in river-gravel, Gander R., Glenwood, *Fernald & Wiegand*, no. 5308 (as *B. alba*, var. *carpatica*); gravelly river-bank, Glenwood, *F. & W.*, no. 5309 (as *B. alba*, var. *carpatica*). Quebec: 4 ft. high, rocky crest, Pointe au Maurier, Charnay, Saguenay Co., *St. John*, no. 90,385; granite hills, Mingan, *St. John*, no. 90,384; limestone sea-cliffs, Ile Ste. Généviève, Mingan Ids., *St. John*, no. 90,830; sur les rivages calcaires près du Lac Salé, Ile St.-Charles, Archipel de Mingan, *Victorin & Rolland*, no. 18,881; bordant le sommet de l'escarpement, Ile Nue, Mingan, *V. & R.*, no. 24,728; rivages, Ile à la Chasse, Mingan, *V. & R.*, no. 24,740 (as *B. glandulosa*); wet places, Becscie R., Anticosti, Sept. 7, 1883, *J. Macoun;* le long des platières calcaires, Rivière à la Patate, Anticosti, *Victorin, Rolland & Louis-Marie*, no. 21,726; à une douzaine de milles de l'embouchure, R. Jupiter, Anticosti, *Victorin & Rolland*, no. 24,729; arborescent, sur le bord de la falaise boisée, le long du portage de la ligne, Sand-top, Anticosti, *V. & R.*, no. 27,775; crevices and talus of serpentine, Ruisseau à la Neige, Mt. Albert, Gaspé Co., *Fernald & Collins*, no. 532; large shrub, steep clay banks of Matane R., Matane, *Fernald & Pease*, no. 25,022; Rupert House, James Bay, *D. Potter*, no. 805. Nova Scotia: low thicket in bog on plateau north of Bay St. Lawrence, Victoria Co., *Roland*, no. 41,354 (as *B. pumila*). Vermont: rock-outcrop, shore of Fairfield Pond, alt. 550 ft., Fairfield, Franklin Co., *S. F. Blake*, no. 3105 (as *B. alba*, var. *minor*); summit of Mt. Mansfield, July 2, 1897, *Kennedy, Williams* (as *B. papyrifera*, var. *minor*), July 23, 1901, *T. O. Fuller* (as *B. papyrifera*, var. *minor*). Plate 973.

Betula borealis was very fully and clearly described by Spach, whose description is worth repeating:

> B. borealis Nob.—Legit cl. de Lapylaie, in insulâ Terrae-Novae; forsàn varietas *Betulae excelsae* v. *Betulae albae*.
>
> Arbor? vel frutex? Rami haud resinoso punctati: novelli tomentosi. Folia floralia 6–15 lineas longa, ovato-v. obovato-v. lanceolato-v. oblongo-rhombea, acuta, subaequaliter serrato-dentata, basin versùs integerrima, brevè petiolata: juniora pubescentia; adulta subtùs glaucescentia, sparsè punctulata, reticulata, praeter nervos glabra. Stroboli subpollicares, erecti (?), brevè pedunculati, cylindracei, graciles; rachi gracili, ferè filiformi; squamis tricarpis cuneiformibus, subciliolatis, samaras obtegentibus, trilobis: lobis obtusis, aut subaequalibus, oblongis, nunc parallelis, nunc divergentibus, aut dissimilibus: lateralibus subfalcatis, deflexis, terminali abbreviato, subovato. Samarae ovatae v. suborbiculares, vix lineam latae, angustè alatae, squamis duplò brevioribus. (V. s. sp. in Herb. Mus. Par.)

The densely tomentulose pubescence of vigorous new shoots, usually without glandular atoms, the elliptic to somewhat

rhombic or ovate merely acute or acutish leaves more or less pubescent beneath, and the small samaras with the wings scarcely broader than the achene, clearly distinguish it from the other dwarf species of the *Albae* in the Northeast: *B. minor*. There is little to induce one who knows *B. pumila* to place it with that, as was finally done by Regel. The identification with the Siberian *B. microphylla* Bunge was a very crude mistake, quite as unclarifying as my reduction to the latter of the cordilleran North American *B. occidentalis* Hook. (*B. fontinalis* Sargent).[1] *B. microphylla*, as originally described and as represented by Altai material sent by Regel to Gray and perhaps isotypic (PLATE 963, FIGS. 8–10), as well as by more modern specimens, has the small obovate leaves with entire cuneate bases, the summit only coarsely dentate; its branchlets are covered with resinous warts and the wings of its samaras (PLATE 963, FIG. 10) are as originally described by Bunge "semen longitudine et latitudine superantibus." In *B. borealis* the acute or acutish leaves are toothed to base, the branchlets rarely glutinous and the wings of the samara narrow. *B. occidentalis* (*B. fontinalis*), although having broadly winged samaras and very gummy but glabrous branchlets and leaves, has the latter of firmer and heavier texture, more regularly serrulate or doubly serrate margins and usually an ovate outline and lingering pubescence on the upper surface. It does not well match true *B. microphylla* and is quite distinct from the eastern *B. borealis* and *B. minor*, the former with new branchlets heavily pubescent, and the samaras with very narrow wings, the latter glabrous from the first, with more slender fruiting aments and narrower samaras (2.5–5, av. 3.5, mm. broad), whereas the western *B. occidentalis* has the aments thick and the samaras 4–6, av. 5.2, mm. broad.

In *Betula*, ser. *Humiles*, two species need special discussion. The first is only doubtfully a member of this series, a tree of the mountains of western Virginia:

B. **uber** (Ashe), stat. nov. *B. lenta*, var. *uber* Ashe in RHODORA, XX. 64 (1918). PLATE 974, FIGS. 1–5.

It is most difficult to feel that the low tree ("20–25 ft. high", according to Ashe's label) described by Ashe as a small-leaved

[1] See discussion, pp. 313–317.

variety of *Betula lenta* has much, except aromatic bark, to do with that species. *B. lenta* (FIGS. 6 and 7) has cordate-ovate and long-acuminate leaves with fine and sharp serrulation and 10–20 pairs of veins impressed into the upper surface (a typical member of series *Costatae*). *B. uber*, on the other hand, as shown by isotypes at the Gray Herbarium and the Arnold Arboretum, has very short and broadly rounded, often nearly orbicular leaves with few coarse dentations and with only 3–6 pairs of veins not impressed above (characteristics of series *Humiles*). Furthermore, the pistillate aments are more slender than in *B. lenta* and the bracts end in low and broad lobes, those of *B. lenta* more elongate, with the middle lobe prolonged.

In describing his *B. lenta*, var. *uber* Ashe made no note of its size and he stated that the material, in young fruit and foliage, was collected on "Banks of Dickey Creek, Smyth County, Virginia, south of Rye Valley Station, January 14, 1914". The isotype deposited in the Gray Herbarium has Ashe's label, stating that the tree is "20–25 feet high" and that it was collected "At 2800 ft., June [not January], 1914". It is very important to learn much more about *B. uber*,—whether it is shrubby, the range of variation of foliage, the characters of the staminate aments, and its abundance and range.

B. **terrae-novae,** sp. nov. (TAB. 975, FIG. 1–4), planta habitu *B. nanae;* ramis novellis tomentosis; foliis late cuneato-flabelliformibus coriaceis glabris valde reticulatis inciso-dentatis basin versus integerrimis; strobilis sessilibus 0.5–1 cm. longis; strobili squamis integerrimis vel subintegerrimis oblongis vel oblongo-lanceolatis vel oblongo-ovatis arcte adpressis apice subsquarrosis; nuculis ovoideis vel subrotundatis apteris margine incrassato.—*B. Michauxii* Spach in Ann. Sci. Nat. sér. 2, xv. 195 (1841), as to description, not as to Michaux plant, basis of the name. *Apterocaryon Michauxii* (Spach) Opiz in Lotos, v. 258 (1855), in part, not *B. nana* sensu Michx., basis of name. *B. nana*, ε *Michauxii* (Spach) Regel in Nouv. Mém. Soc. Nat. Mosc. xiii. 103—repr. Mon. Bet. 45 (1861), excluding Michaux plant, source of name.—Bogs, tundra and peaty, acidic barrens, Newfoundland and adjacent southeastern Labrador Peninsula. TYPE from diorite tableland, altitude about 550 m., northern region of the Blomidon ("Blow-me-down") Mts., Newfoundland, Aug. 22, 1910, *Fernald & Wiegand*, no. 3271, as *B. nana*, var. *Michauxii* (in Herb. Gray.).

It is unfortunate that the name *Betula Michauxii* had so con-

fused a start. The tiny shrub of Newfoundland, southeastern Labrador and the extreme eastern end of the Côte Nord of Quebec is very distinct from the arctic *B. nana* (FIGS. 5–7) in its tomentose (instead of cinereous-puberulent) branchlets, its more flabelliform, more incised and more strongly reticulate leaves, and above all in simple instead of prominently 3-lobed pistillate bracts and its thick-margined, instead of definitely winged samaras. Spach gave a good description of it in general, but his "Strobili 4–8 pollices [inches] longi" was most unfortunate for any American birch and emphatically for a dwarf with strobiles only 5–10 mm. long! For his *B. Michauxii* Spach set up the new section *Apterocaryon*, which was clearly based on Newfoundland material: "Nuculae apterae, margine incrassato, intus suberoso, cinctae.—Squamae strobilae semper 1-carpae, integerrimae, nuculis duplo angustiores", and this was taken up as the genus *Apterocaryon* (Spach) Opiz. Further to confuse matters Spach started his description of the Newfoundland shrub: "B. MICHAUXII Nob.—*Betula nana* Michx.! Flor. Bor. Amer. (excl. syn.)" and gave the range "America borealis [derived from Michaux] et insula Terrae Novae [La Pylaie material at Paris, presumably]". The name *B. Michauxii* automatically belongs with the Michaux element which came from at least 650 miles farther west ("in sphagnosis, a sinu *Hudsonis* ad lacus *Mistassins*") than the western known limit of *B. terrae-novae*. Furthermore, the description of *B. nana* sensu Michx. Fl. Bor.-Am. 180 (1803), nomenclatural type of *B. Michauxii*, was of something quite different: the shrub "glaberrima" (instead of with tomentose branchlets); "amenti squamis profunde 3-partitis, laciniis oblongis" (instead of entire or merely with obscurely undulate margin); "capsulis orbiculatis, subapteris" (instead of quite apteris). Just what Michaux got we cannot learn at the moment. His description suggests one of the dwarf and glabrous or glabrescent extremes of *B. pumila* L., such as var. *renifolia* Fernald, which abounds on much of the Labrador Peninsula and in Newfoundland and which, in exposed situations, may become a tiny depressed mat with round-obovate to reniform leaves down to 8 mm. long and either pubescent or glabrous. Michaux's plant was, obviously, not at all the characteristic little shrub of the Newfoundland barrens.

The fact that Regel confused *Betula Michauxii*, as a variety,

with *B. nana* carries little weight. At the same time he also reduced *B. glandulosa* Michx. to his all-inclusive *B. nana*, as he likewise included the utterly different *B. borealis* Spach (our PLATE 973).

EXPLANATION OF PLATES

PLATE 963, FIGS. 1–7, BETULA MINOR (Tuckerm.) Fernald: FIG. 1, portion of TYPE, × 1; FIG. 2, fruiting branch, × 1, from Oakes Gulf, Mt. Washington, New Hampshire, *Eggleston*, no. 2676; FIG. 3, staminate aments, × 1, from Mt. Washington, New Hampshire, *Greenman*, no. 1087; FIG. 4, lower surface of leaf, × 5, from no. 2676; FIG. 5, branchlet, × 10, from no. 2676; FIG. 6, fruiting bract, × 4, and FIG. 7, samara, × 4, from no. 2676. FIGS. 8–10, B. MICROPHYLLA Bunge: FIG. 8, fruiting branch, × 1, from the Altai of Siberia, probably an ISOTYPE; FIG. 9, fruiting bract, × 4, and FIG. 10, samara, × 4, from same specimen. FIG. 11, B. ALBA L., var. TORTUOSA (Ledeb.) Schneider: samara, × 4, from Kingua Tunugdliarfik, Greenland, Aug. 17, 1888, *Kolderup Rosenvinge.*

PLATE 964, B. PAPYRIFERA Marsh. (typical): FIG. 1, fruiting branch, × 1, from Middlebury, Vermont, July 8, 1908, *E. F. Williams;* FIG. 2, staminate aments, × 1, from Winchester, Massachusetts, May 9, 1897, *E. F. Williams;* FIG. 3, tip of young shoot, × 5, from Lac Ste.-Anne, Gaspé Co., Quebec, *Victorin, Rolland & Jacques*, no. 33,476; FIG. 4, fruiting bract, × 4, and FIG. 5, samara × 4, from Southport, Maine, Aug. 8, 1894, *Fernald.*

PLATE 965, B. PAPYRIFERA, var. COMMUTATA (Regel) Fernald: FIG. 1, portion, × 1, of the *Lyall* specimen from "Cascade Mountains, 49 N. Lat."; FIG. 2, characteristic close bark, × 1, from Percé, Quebec, July, 1905, *Williams, Collins & Fernald;* FIG. 3, outer bark exfoliating, exposing whitish inner bark, × 1, from base of same tree as in fig. 2; FIGS. 4 and 5, fruiting bracts, × 4, from the *Lyall* specimen; FIG. 6, samara, × 4, from the *Lyall* specimen; FIG. 7, fruiting bract, × 4, from Bayview, Gloucester, Massachusetts, Aug., 1944, *Elizabeth Johnston;* FIG. 8, samara, × 4, from the same specimen as fig. 7.

PLATE 966, B. OCCIDENTALIS Hook., var. FECUNDA Fernald: FIG. 1, portion of TYPE, × 1; FIG. 2, younger (flowering) branchlet, × 1, from type-locality, May 11, 1901, *Piper;* FIG. 3, staminate aments, × 1, from type-locality, April 27, 1925, *Constance et al.*, no. 1043.

PLATE 967, B. PAPYRIFERA, var. PENSILIS Fernald: FIG. 1, portion, × 1, of TYPE; FIG. 2, fruiting bract, × 4, and FIG. 3, samara, × 4, from TYPE; FIG. 4, younger branch, × 1, from Bic, Quebec, July, 1905, *Williams, Collins & Fernald.*

PLATE 968, FIGS. 1–3, B. PAPYRIFERA, var. MACROSTACHYA Fernald: FIG. 1, portion. × 1, of TYPE; FIG. 2, fruiting bract, × 4, and FIG. 3, samara, × 4, from TYPE. FIG. 4, forma LONGIPES Fernald: portion, × 1, of TYPE.

PLATE 969, B. PAPYRIFERA, var. ELOBATA (Fernald) Sargent: FIG. 1, portion, × 1, of TYPE; FIG. 2, immature samara embraced by bract, × 4, from TYPE; FIG. 3, young bracts, × 1, from TYPE.

PLATE 970, B. PAPYRIFERA, var. CORDIFOLIA (Regel) Fernald: FIG. 1, portion, × 1, of fruiting branch from Malbaie, Gaspé Co., Quebec, August 20, 1904, *Collins, Fernald & Pease;* FIG. 2, tip of vigorous sprout, × 5, from Roberval, Quebec, July 28, 1892, *G. G. Kennedy;* FIG. 3, fruiting bract, × 4, and FIG. 4, samara, × 4, from same specimen as fig. 1.

PLATES 971 and 972, B. PAPYRIFERA, var. HUMILIS (Regel) Fernald & Raup. PLATE 971: FIG. 1, portion, × 1, of TYPE of *B. alba* L., subsp. *papyrifera* (Marsh.) Regel, var. *humilis* Regel, with Regel's identification; FIG. 2, lower surface of leaf (with scattered trichomes), × 10, from TYPE; FIG. 3, fruiting bract, × 4, and FIG. 4, samara, × 4, from TYPE; FIG. 5, fruiting tip, × 1, of specimen from Prince Albert, Saskatchewan (*Macoun*, no. 12,952[a]), one of the 2 specimens cited by Sargent as his *B. alaskana.* PLATE 972, FIG. 1, portions,

× 1, of the Saskatchewan plant (*Bourgeau*, 1858), the first specimen cited by its author for *B. alaskana* Sargent: FIG. 2, fruiting bract, × 4, and FIG. 3, samara, × 4, of the Prince Albert material, *Macoun*, no. 12,952[a]; FIG. 4, fruiting bract, × 4, and FIG. 5, samara, × 4, from near Fairbanks, Alaska, *Ynez Mexia*, no. 2291.

PLATE 973, B. BOREALIS Spach: FIG. 1, branches, × 1, from Glenwood, Newfoundland, *Fernald & Wiegand*, no. 5308; FIG. 2, fruiting branch, × 1, from Glenwood, *Fernald & Wiegand*, no. 5309; FIG. 3, tip of young branch, × 5, from no. 5309; FIG. 4, fruiting bract, × 4, and FIG. 5, samara, × 4, from base of Blomidon, Bay of Islands, Newfoundland, *Fernald & Wiegand*, no. 3246.

PLATE 974, FIGS. 1–5, B. UBER (Ashe) Fernald: FIG. 1, portion, × 1, of ISOTYPE in Herb. Arnold Arboretum; FIG. 2, upper surface of leaf, × 2, to show venation and toothing, from ISOTYPE; FIG. 3, portion of lower surface of leaf, × 2, from ISOTYPE; FIG. 4, fruiting bract, × 4, and FIG. 5, samara, × 4, from ISOTYPE. FIGS. 6 and 7, B. LENTA L.: FIG. 6, portion of lower surface of leaf, × 1, to show venation and toothing, from Jamaica Plain, Massachusetts, August 25, 1885, *C. E. Faxon;* FIG. 7, fruiting bract, × 4, from same specimen.

PLATE 975, FIGS. 1–4, B. TERRAE-NOVAE Fernald: FIG. 1, portion of TYPE, × 1: FIG. 2, tip of branchlet, × 5, from Goose Pond, upper Humber River, Newfoundland, *Fernald & Wiegand*, no. 3272; FIG. 3, fruiting bracts, × 10, and FIG. 4, nutlet, × 10, from TYPE. FIGS. 5–7, B. NANA L.: FIG. 5, tip of branchlet, × 5, from Velmunden, Norway, July 23, 1909, *Fr. Lange;* FIG. 6, fruiting bract, × 4, and FIG. 7, samara, × 10, from the *Lange* specimen.

(*To be continued*)

CONTRIBUTIONS FROM THE GRAY HERBARIUM OF HARVARD UNIVERSITY—No. CLIX

M. L. Fernald

II. Eastern North American Representatives of Alnus incana

(Plates 976–989)

In 1906, while he was a student with me, Dr. Harley H. Bartlett joined me in collecting at different stages of development through the season material of the Swamp Alders of northeastern Massachusetts, for it was quite apparent that the variations within this group were not satisfactorily disposed of merely by calling them all simply *Alnus incana* and *A. serrulata* or *rugosa*. With the cooperation of the late Professor J. Franklin Collins in Rhode Island, we assembled many collections but their final identification was interrupted by Bartlett's finishing his studies at Cambridge and the mass of material was stored, with the hope that one of those eclectic students, who specialize on our trees and shrubs, to the exclusion of herbs, would be interested to clarify the situation. More than quarter of a century later, when he was studying with me, Dr. Ernst C. Abbe, working primarily on morphological problems in the *Corylaceae* (*Betulaceae*), made a fresh start on the problem and, although he was obliged to cut short this special work, he had, before he finished, assembled striking evidence that the shrub or small tree, which in North America passes as the Eurasian *A. incana*, really differs from that species in very many important characters. Following up Abbe's unfinished studies, I undertook to conclude the quest and a decade or more ago wrote the introduction to the present paper.

Interrupted by more immediately pressing matters, I likewise failed to bring the study to completion. Now, after these repeated interruptions, I am again endeavoring to set the group in such order as I can establish in it. Fortunately but somewhat unhappily, I am faced by vastly more numerous, though more satisfactorily made, collections to deal with than Bartlett and I had before us 39 years ago, for wherever I have been, in Newfoundland, eastern Canada, New England, New York, Michigan or Virginia, my companions and I have had our eyes open for variations of the Alders. The present paper cannot, therefore, be called a hasty and off-hand study.

The name *Alnus incana* for the common Swamp Alder of the Labrador Peninsula, Newfoundland, eastern Canada and the more northeastern United States (PLATES 977–982) has been so thoroughly established, especially since Edward Tuckerman in 1843 so identified the northern shrub or small tree with leaves glaucous beneath, that to those who are more influenced by long-established usages than by precision its abandonment might seem mere iconoclasm. At the beginning, however, the name belonged strictly to a Eurasian tree and, of course, it must be retained for that variable but morphologically definite species. True *Alnus incana* (L.) Moench (PLATE 976) was so named because of the hoary (incanous) pubescence which so generally characterizes it; ordinarily its leaves are permanently quite gray with soft and velvety pilosity, as are the young branchlets and the axes of the inflorescences. The terminal lobes (FIGS. 5 and 6) of the bracts of the pistillate and fruiting aments (FIGS. 4 and 5) are depressed and slightly recurving or sometimes almost suppressed. This species is found in North America only in cultivation or where introduced from Europe, as formerly on the sand-hills near Provincetown, at the tip of Cape Cod, where it was originally planted and was abundant as late as 1919 (*Fernald & Long*, nos. 18,354, 18,355 and 18,360) but where, by 1944, none of it seems to have persisted.[1]

[1] The introduction of European plants for the reclamation of the sand-dunes back of Race Point Life Saving Station near Provincetown is typical of much of the practice in holding or reclaiming loose soils. The natural dunes of Cape Cod are very effectively and automatically reclaimed by the indigenous eastern North American *Ammophila breviligulata* Fernald and *Pinus rigida* (Pitch Pine), while the Alders of the dunes and hollows are endemic Americans. Nevertheless, the reclamation of the dunes of the old province-lands was largely attempted through the planting of imported

The eastern North American shrub or (rarely) small bushy so-called tree (PLATES 977–982) which erroneously passes as *Alnus incana* is not truly incanous. Its new branchlets and the axes of its inflorescences, are, with rare exceptions, glabrous or only very sparsely pilose and very gummy, having, when dry, a crackled or subverrucose surface. The oval or ovate to round-elliptical and usually coarsely undulate or doubly toothed leaves are less pubescent or glabrous beneath or, if strongly pilose, with usually rufescent pubescence. The pale cross-veins (between the strong parallel ribs) are, in mature foliage, coarse and prominent beneath (PLATES 977, FIG. 2, 978, FIG. 2, and 979, FIG. 4), freely confluent and forming a conspicuously scalariform and rugose pattern, the veins in European *A. incana* (PLATE 976, FIG. 2) being very slender and comparatively delicate. In the American species the pistillate aments are usually more numerous than in the European species; and the outer lobes of the summit of each bract of the pistillate cone are suberect or arching and prolonged (PLATES 977, FIG. 3, and 978, FIGS. 3 and 5). That the so-called *A. incana* of North America is really very different from true Eurasian *A. incana* is quite obvious; but for clarity of discussion this American shrub, which for more than a century has erroneously passed with us as Old World *A. incana*, may be temporarily designated SPECIES NO. 1.

All the characters above noted are such as can be seen in a good herbarium. Others of equal significance are not often there displayed. Eurasian *Alnus incana* is a large shrub or, more often, a considerable tree, up to 35 or even to 85 feet high and with single erect trunks up to 3 feet in diameter, the cortex lustrous and whitish-gray. "In . . . Europe . . . in the south . . . sometimes attaining a height of seventy feet; it is the common Alder of Siberia and southeastern Asia [this

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European White Alder, Scotch Pine and Scotch Broom; but the Broom is there now relatively unimportant, the Scotch Pine is secondary to the native Pitch Pine, and the European Alder has not survived. That is as it should be: the climate of the dunes of western Eurasia, with prevailingly western winds off the Atlantic, is so unlike the dry and hot summer conditions at the eastern border of North America, that western European shrubs are too much handicapped. Some years ago I received a call from an American soil-conservator who stated that he was going on a federal government mission to India, to find some Asiatic species which would control erosion in our "dust-bowl". A few days later I had a brief visit from a prominent botanist of India, who had been sent to America by his government to see if in our "dust-bowl" he could secure some plant to control wind-erosion in India. Tra-la-la!

sometimes separated], . . . a stately tree fifty or sixty feet in height, with a trunk often two or three feet in diameter"—Sargent, Silva, ix. 69, in footnote (1896). "Strauch oder bis 10 (25) m hoher Baum. . . . Rinde glatt, glänzend weissgrau" —Hegi, Ill. Fl. Mitt.-Eu. iii. 89, with illustration of the arborescent habit as fig. 483. "Arbre à écorce lisse, d'un gris blanc"—Rouy, Fl. France, xii. 261 (1910); "meist 6 bis etwa 23 m hoch, in der Tracht der *A. glutinosa* ähnlich, aber meist niedriger, mit ziemlich dichter Krone. Stamm glatt mit hellgrauer Rinde"—Ascherson & Graebner, Synop. Mitteleur. Fl. iv. 423 (1911). Certainly the North American shrub or bushy "tree", which for a century or more has passed as *A. incana* (our SPECIES NO. 1), does not have sufficiently erect or solitary trunks to rank as a real tree; otherwise it would have been included among the trees in such compendious works as Sargent's *Silva* and his *Manual of the Trees of North America* and in Britton's *North American Trees*, in none of which is it included. If a tree, it should also be in Sudworth's *Check List of the Forest Trees of the United States*. Rightly enough, however, *A. incana* is mentioned by Sudworth only in a footnote as "a shrub", "as it occurs in northeastern North America and United States" (Sudworth, p. 80). In a footnote Sargent, Silva, l. c., refers to it (as *A. incana*) in the following terms: "In North America, where it is the common Alder of swamps and river-banks in the northeastern parts of the continent, forming dense shrubby thickets rarely more than ten or twelve feet high"; while F. A. Michaux, describing it as his *A. glauca* and comparing it with *A. serrulata*, said "c'est-à-dire qu'on en trouve souvent des individus qui ont de 18 à 20 pieds . . . de hauteur, sur environ 3 pouces (12 centim.) de diamètre". And surely the cortex of our northern shrub is never *whitish gray*, the color so consistently stated by Eurasian botanists for their *A. incana*. The thin cortex of ours is a warm purple-black, purple-brown or gray-brown, with conspicuous elongate white lenticels (PLATE 980, FIG. 2). "L'écorce qui couvre le tronc, ainsi que les branches secondaires, est d'une teinte brune très-foncée" (Michx. f. in describing his *A. glauca*); "bark gray brown with lighter horizontal markings" (Mathews, Field Book Am. Trees and Shrubs, 126). "A shrub 8–20 feet high; the stem sometimes 3–4 inches in diameter, with a smooth brown bark"—

Torrey, Fl. N. Y. ii. 202 (1843). In fact, so dark is the bark that, when the younger Michaux published his *Alnus glauca*, with "*foliis subrotundò-ellipticis, duplicatò-serratis, subtùs glaucis*", he gave our shrub of "les États du New-Hampshire, Massachusetts et de Vermont" which has the foliage so "vert pâle et comme bleuâtre, ce qui les fait reconnoître au premier abord", the English name "*BLACK ALDER*"; whereas in Europe *A. incana* is frequently called "WHITE" or "GRAY ALDER". Furthermore, in Europe witches' brooms (*Hexenbesen*) are frequent on *A. incana*, sometimes as many as 100 on a single tree; our dark-barked northeastern shrub, Professor Faull informs me, has never been known to produce them; and Professor Arthur Stanley Pease tells me that his students in Latin, familiar with the shrubbiness of alders in eastern North America, always have a great laugh as they read passages (at least 11 of them) by the Latin poets, telling of ships built of alder! Surely no argument beyond the mere facts and the plates is needed to show that we have been far astray in calling our northern Swamp Alder the same as the Eurasian *A. incana!*

The only other indigenous Swamp Alder of temperate North America, excluding the quite definite autumn-flowering *Alnus maritima* (Marsh.) Muhl., is the generally more southern shrub (PLATE 983–989) with the white lenticels of the bark much smaller than in SPECIES NO. 1 or often very obscure (PLATE 985, FIG. 5); the leaves of a generalized obovate type, mostly subcuneately narrowed (but sometimes more rounded) to base, usually with regularly or subuniformly fine-serrulate margins, with cross-veins beneath (PLATES 984, FIG. 4, 985, FIG. 4, 987, FIG. 4 and 988, FIG. 3) more delicate and less conspicuous, the lower leaf-surfaces fulvous-green to reddish, glabrous, glabrate or reddish-pubescent; the axis of the pistillate inflorescence (PLATES 983, FIGS. 3 and 4, 985, FIG. 3, 986, FIG. 3, 988, FIG. 4, and 989, FIG. 4) commonly with right angles or strongly geniculate bends. The outer terminal lobes of the cone-bract (PLATE 986, FIG. 4) are low and broadly rounded. This shrub, the northern limits of which interlock with the southern outposts of SPECIES NO. 1, long passed correctly as *A. serrulata* (Ait.) Willd.; but, especially since Karl Koch in 1872, Coulter in 1894 and Sargent's Silva (1896), it has recently been incorrectly passing as *A. rugosa* (Du Roi) Sprengel. Since the

latter name must be considered in connection with Species no. 1, it will make for clarity, until the application of the various names is investigated, to designate the more southern shrub as Species no. 2.

Almost from the start, at least beginning with Willdenow in 1796, the names *rugosa* and *serrulata*, whether under *Betula* or *Alnus*, were hopelessly confused. Regel at last got them clearly separated but, depending chiefly on variable leaf-outline and -pubescence, without noting the striking differences of bark and inflorescences, he maintained them both as variations of one species. With the two eastern American species defined as Species nos. 1 and 2 and clearly shown in the plates, we may proceed to examine the specific names published for them, somewhat in chronological order, that we may settle their correct application. In so doing I am omitting the several *nomina nuda* of Steudel and others, undefined names which by various authors have been placed in the vague synonymy of one or another of the properly defined ones.

The first of these two American species defined was *Betula Alnus* (*rugosa*) Du Roi, Obs. Bot. p. xxxii (1771). The original diagnosis and discussion of the shrub growing in the botanic garden of Harbke near Brunswick was as follows:

> 5. Betula Alnus (*rugosa*) foliis mucronatis acute serratis, subtus venoso-rugosis.
> *Germ.* Nordamerikanische Eller.
> Habitat in America septentrionali.
> Species horti Harbeccensis *foliis* ovatis mucronatis, acutius serratis et angustioribus, quam in B. Alno incana, viridibus glabris, subtus venis albidis rugosis. *Rami* tenues, cortice nigricante. E semine misso culta arbor in horto nondum adhuc floruit.

This was followed by the fuller account in Du Roi's detailed Die Harbkesche wilde Baumzucht, i. 112 (1771):

> 3. Betula Alnus (rugosa) foliis mucronatis acute serratis, subtus venoso-rugosis.
> The American Alder.
> Aune d'Amerique septentrionale.
> Die Nordamerikanische Eller.
> Sie unterscheidet sich deutlich von den beiden vorigen, und ist hier aus Saamen gezogen, welcher aus Nordamerika geschickt worden ist.

Die **Blätter** erscheinen schmaler als bei den vorhergehenden, und in den mehresten an vier Zoll Länge und zwei Zoll Breite. Sie sind oval zugespizt, am Rande scharf und fein gezahnt, auf der oberen Fläche hell grün und glatt, und auf der unteren ebenfals hellgrün. Auf der lezteren lauft der Länge nach eine weissgrüne erhabene Ader hin, welche in schrägen Linien nach dem Rande aus etwas feinere Nebenäste Paarweise gegen einander über ausschicket, und aus diesen lezteren kleinen Adern gehet ein Gewebe noch kleinerer Adern heraus, die das Blatt etwas runzlicht bilden.

Die äussere Rinde ist dunkelgrau an alten Zweigen, an iungen aber grün.

Ehrhart, improving on the trinomial nomenclature of Du Roi, redescribed the shrub growing in the Harbke Garden as *Betula rugosa* (Du Roi) Ehrh. Beitr. iii. 21 (1788).

6. *Die Haselleller.*
Betula rugosa.
Betula gemmis elevatis, obtusis; foliis ovatis, acutis, repando-angulatis, serratis, nudis, superne glabris, subtus venoso-rugosis; racemis subtristrobilis, aphyllis.
Ihr Vaterland ist Nordamerika.
Die Plantage zu Herrnhausen, die Gärten zu Harbke, Destedt und mehrere haben sie.
Betula Alnus rugosa. Duroi baumz, v. i, p. 112.

Sprengel, too, in transferring the species to *Alnus*, in Syst. iii. 848 (1826), was equally clear:

*rugosa** 8. A[lnus] foliis basi rotundata ovato-oblongis acutis duplicato-denticulatis subtus rugulosis, axillis venarum villosis. *Amer. bor.*

but Sprengel made the serious mistake of suggesting identity with the Peruvian *A. acuminata* HBK.

From the original accounts of Du Roi, Ehrhart and Sprengel, then, it is clear that *Alnus rugosa* rests upon material cultivated in Germany and having dark or blackish bark, leaves ovate or oval, acutish, rounded at base, doubly toothed, green and glabrous or glabrescent beneath, a leaf which so resembles that of *Corylus* as to suggest to Ehrhart the name "*Haseleller*" (Hazel-Alder). These descriptions are so vivid for the common extreme of the shrub of northeastern America which has erroneously passed as the European *A. incana*, var. *hypochlora* Call.[1], that it is doubly reassuring to see a photograph (our PLATE 979, FIG. 1) of a speci-

[1] As by Fernald in RHODORA, xxiii. 257 (Feb. 27, 1922).

men distributed by Ehrhart as his *Betula rugosa* and coming from the Harbke Garden. The photograph, for the use of which I am indebted to Professor Alfred Rehder and the Arnold Arboretum, was taken by Professor Rehder at the Botanical Museum at Berlin-Dahlem; and, since the destruction of that invaluable herbarium, it is a most fortunate photograph to have. The foliage shown is young first-year leaves and is closely matched by the leaves on young and vigorous sprouts of our greener-leaved so-called "*A. incana*, var. *hypochlora*". Surely no one, familiar with the obovate and usually cuneate-based leaf of *A. serrulata*, would think of matching the latter with the authentic foliage from the Harbke Garden. Neither would they call our *A. serrulata* "Hazel-Alder". That name is wholly appropriate for our shrub (SPECIES NO. 1) which has been passing as *A. incana*. A characteristic leaf was shown by Regel in his *Monographia Betulacearum* in Nouv. Mém. Soc. Nat. Mosc. xiii. 165, t. xi. fig. 8—repr. as Mon. Bet. 107 (1861)—of the shrub "in den Gärten Europas" and which Regel, with remarkable conservatism, called *A. glutinosa*, lusus *rugosa!* Regel in 1861 stated that the shrub was widely grown in the botanical gardens of Europe and he identified with it the *A. hybrida* of Alexander Braun in Reichenb. Ic. Fl. Germ. xii. 3, t. 630, fig. 1292 (1850), which had been found wild in various parts of Germany and in Bohemia. Such a shrub, from a wild habitat in Wittenberg, was distributed in *Baenitz. Herb. Dendrol.* no. 1214, as *A. rugosa*. This material, unlike the Ehrhart specimen, shows mature fruiting branches with the characteristic cones and the typical foliage of fruiting branches of our greener-leaved "*A. incana*". It is shown in our PLATE 977. Native American specimens, almost like it in every respect, are shown in PLATE 978.

Confusing as it may temporarily prove, there seems to be no escape from taking up for the North American shrub which passes as *Alnus incana*, our SPECIES NO. 1, its earliest name, A. RUGOSA (DuRoi) Spreng.

Chronologically, the names of Humphrey Marshall, Arb. Am. 20 (1785), have to be noted. The first, "BETULA-ALNUS glauca. *Silver-leaved Alder*" of "low marshy ground", had no diagnosis whatever but from its names may be inferred as being the common northern variety of *A. rugosa*, which reaches northeastern

Pennsylvania, a species which had already been described by DuRoi (1771) and which in 1813 F. A. Michaux properly described and illustrated, with no reference to Marshall, as *A. glauca*. Marshall's second species, "BETULA-ALNUS maritima, *Sea-side-Alder*", was sufficiently defined as to give an unquestioned basis for *A. maritima* (Marsh.) Nutt., a clear-cut autumn-flowering species which we are not here discussing. His third had no good description, merely very brief and inconclusive comments. though geographically it was obviously intended for *A. serrulata* (Ait.) Willd., our SPECIES NO. 2. This was

> BETULA-ALNUS rubra. *Common Alder.*
> This grows very common in most parts of Pennsylvania. The leaves are broader than the other kinds and rough or wrinkled. This flowers in the spring, and perfects its seeds in the fall.

From its abundance in Pennsylvania Marshall's species, as said, should be some form of *Alnus serrulata*. The leaves "broader than the other kinds and rough or wrinkled" is inconclusive but there are plenty of broad-leaved variations of *A. serrulata*. Tuckerman interpreted it as unmistakable *A. serrulata* and described *A. rubra* (Marsh.) Tuckerm. in Am. Journ. Sci. xlv. 32 (1843), with leaves obovate and with *Betula serrulata* Ait. and *A. serrulata* (Ait.) Willd. as synonyms, Tuckerman giving the naïvely nationalistic explanation:

> The name of our own botanist should have the priority: his description, though short [he might have said inconclusive], notices the most striking features of the species, and cannot be mistaken. The A. rubra of Bongard [1833], is many years later [than *Betula-Alnus rubra*]. Add to this, that Marshall's name is far more expressive and apt than that of Aiton [1789].

Nevertheless, *Alnus rubra* Bongard (1833), the Pacific North American species, has right of way and under present-day rules no other species can validly bear the same name, even though its name-bringing typonym was earlier. *A. rubra* (Marsh.) Tuckerm. (1843) is fortunately, in view of its vague origin, a later homonym.

The next name, chronologically, was *Betula serrulata* Aiton, Hort. Kew. iii. 338 (1789). Aiton's diagnosis was brief but its characterization of the leaf definite:

serrulata. 11. B. pedunculis ramosis, foliis obovatis acutis; venis et axillis venarum subtus villosis, stipulis ovalibus obtusis.
Notch'd-leaved Alder Tree.
Nat. of Pensylvania.
Cult. 1769, by Peter Collinson, Esq.

That *Betula serrulata* was our SPECIES NO. 2 (especially as shown in PLATE 983) is clear from the *obovate, acute* leaves; but, with wholly vague conceptions of our two species, European authors promptly produced confusion of names, like most botanists who study names to the exclusion of the plants! Thus, Willdenow, in his Berlinische Baumzucht, 45 (1796), took up *Betula serrulata* with Aiton's original diagnosis of 1789 and placed unquestioningly in its synonymy *B. rugosa* Ehrh. (1788), which went back to Du Roi's original publication of 1771. And later, when he made the combination *Alnus serrulata* (Ait.) Willd. Sp. Pl. iv[1]. 336 (1805), Willdenow merged with this species, correctly described "foliis obovatis", the above discussed *Betula rugosa* "foliis ovatis . . . repando angulatis". Further augmented by the failure of André Michaux (1803) definitely to distinguish our two species, the mixing of the two, started by Willdenow in 1796, became general and, consequently, has resulted in the recent erroneous and highly uncritical application of the name *A. rugosa* to the abundantly different and usually more southern *A. serrulata.* Michaux's confusion of the two may be stated as follows: in his Flora Boreali-Americana, ii. 181 (1803) he described *Betula rugosa* (American "*incana*") as *B. serrulata* "foliis lato-ovalibus" and then added the

Obs. Folia saepe obovalia, interdum subglanduloso-repanda, basi semper acuta,

the observation referring to the relatively southern *A. serrulata.* Michaux gave the range from "Pensylvania ad Carolinam", the specimen in his Herbarium at Paris, which I examined in 1903, being of the southern species. Somewhat surprisingly, André Michaux, who had explored eastern Canada as far north as Rupert River and west to Lake Ontario and who knew northern New England, gave no intimation in his Flora that there is any Alder of this group north of his "Pensylvania ad Carolinam". Having collected *A. serrulata* in that area, he possibly did not further feel any special interest in the group; at any rate,

the only Alder he noted from Canada in his Flora was *Betula crispa* Ait. More probably, however, northern material was lost before the writing of the Flora Boreali-Americana. It is fairly clear that Michaux recognized the northern species as distinct from the southern, for in his Journal—*Journal of André Michaux. 1787–1796. with an Introduction and Notes,* by Charles Sprague Sargent, Proc. Am. Phil. Soc. xxvi. no. 129 (1888)—he noted, among the plants seen on his trip up the Saguenay and across to Lake Mistassini, "Alnus glauca stipulis lanceolatis" (Sargent, l. c. 75, under "Le 15" of August). To be sure, Sargent (l. c.) identified Michaux's *Alnus glauca* as *Betula pumila*, but Michaux knew the difference, for on the 19th of August on "la riv. ditte Mistassin", he specially noted *Betula pumila.*[1]

F. A. Michaux, the son, carried the confusion still further, describing *A. serrulata* "foliis duplicatò-serratis, ovalibus, acutis"[2], stating that it is found in the Northern, Central and Southern States ("on la trouve aussi bien dans les États du Nord que dans ceux de Centre, du Sud et de l'Ouest"), and illustrating the round-based doubly serrate leaf of typical *A. rugosa*, already discussed. With such inauspicious beginnings, it is little to be wondered at that the correct applications of the names *A. rugosa* and *A. serrulata* have been hopelessly confused by those who have relied more upon "the books" than upon the morphological characters of the plants.

The next specific name to consider is *Alnus glauca.* Although the undefined name "BETULA-ALNUS glauca" had been used by Marshall in 1785, that publication was not cited by F. A. Michaux when he described and illustrated his own *Alnus glauca*, Michx. f. Hist. Arb. Forest. Am. Sept. iii. 322, t. 4, fig. 2 (1813). The diagnosis and figure are unequivocal, the former being

[1] Unfortunately, most others of Sargent's identifications of Michaux's plants need correction. For instance, "Sparganium natans", collected on the same trip, was identified by Sargent (p. 75) as *S. minimum.* Michaux's collection, labeled "Hab. in Amnibus à Québec ad Lacus Mistassins", was the type of *S. angustifolium* Michx. Fl. Bor.-Am. ii. 189 (1803), the only species of the genus in the *Flora.* Similarly Michaux's Journal recorded as growing with the *Sparganium* and near the *Alnus* "Alisma subulata", which Sargent identified as "*Alisma Plantago*, L. var. *Americanum*, Gray". But Michaux knew the broad-leaved plant and in his Flora, i. 218, had it as *A. Plantago.* He there included *A. subulata* L. from Florida only, the plant now known as *Sagittaria subulata* (L.) Buchenau. The plant of Canada, which Michaux mistook in the field for *Alisma subulata* L., is the type of *Sagittaria graminea* Michx. Fl. Bor.-Am. ii. 190 (1803).

[2] Michx. f., Hist. Arb. Forest. Am. Sept. iii. 320, fig. 1 (1813).

ALNUS *glauca, foliis subrotundò-ellipticis, duplicatò-serratis, subtus glaucis,*

the species said to be unknown in the South, very rare in the Middle States but abundant in New Hampshire, Vermont and Massachusetts ("Cette espèce d'Aulne qui ne se trouve pas dans les États du Sud, qui est assez rare dans ceux du Milieu, est, au contraire, plus multipliée dans les États du New-Hampshire, Massachusetts et de Vermont"). The description, figure and abundance in northern New England clearly indicate the common shrub of the North with gray or glaucous lower leaf-surfaces (PLATES 980 and 981), which erroneously and almost universally passes as the Old World *A. incana*, the only possible excuse for such an interpretation being the glaucous lower surface of the leaves. This familiar shrub is, of course, one of the extreme and usually most northern variations of *A. rugosa*.

In 1894, the late Dr. Britton collected on Staten Island fruiting material from a "large alder in swampy woods, . . . ; these were at the time referred to *Alnus incana*, though with doubt, inasmuch as the height of the tree seemed much too great for that species, and the large, strongly pointed leaves seemed also to be different from those of any specimens of *incana* that I had seen. The woods in which this tree grew were cut away soon after my collection was made, and, though a search was made in the vicinity for other plants, I was never able to find another specimen".—Britton in Torreya, iv. 124 (1904). Since, however, the late Eugene P. Bicknell subsequently found somewhat similar shrubs on Long Island, the Staten Island specimen was made the type of *Alnus noveboracensis* Britton in Torreya, l. c. (1904) our PLATE 995. It was more fully described and illustrated in Britton, N. Am. Trees, 264, fig. 224 (1908), but in Britton & Brown, Ill. Fl. ed. 2, i. 613 (1913) it was noted after "*A. rugosa*", i. e. *A. serrulata*, with the justifiable comment: "It may be a race of this species". The latter disposition of it seems about right; it is an occasional and rather marked extreme in the broad range of *A. serrulata*, from Maine to Georgia, Tennessee and Louisiana. Unfortunately the type from Staten Island, which I have before me through the courtesy of Dr. Gleason, had been badly pressed, poorly mounted and seriously broken. It is, therefore, not a very good subject for illustration, but in PLATE 985 Dr. Schubert has cannily covered the most broken parts.

Numerous varietal names must be considered but, since they do not disturb the specific epithets which we must apply to our two native species, their discussion will be deferred until the varieties of the two species are defined.

As I understand our spring-flowering native Alders of this group they fall into the two species following.

Cortex of trunks and older branches bearing abundant linear transverse whitish lenticels up to 7 mm. or more long; axis of young or flowering inflorescence arching, without right angles, the pistillate branch or branches (in monoecious inflorescences) then drooping and appearing to be below the staminate ones; leaves ovate, oval, subelliptic or rounded, broadest below or near the middle, with rounded to subcordate bases, oftenest double-serrate or -dentate, often repand-undulate, not at all or only slightly glutinous, the mature blades with the cross-veins beneath prominent and forming ladder-like reticulation between the main lateral veins ..... 1. *A. rugosa.*

Cortex with fewer and shorter orange to gray lenticels or these obsolescent; axis of young inflorescence with 1 or more abruptly geniculate or right-angled bends, the pistillate branches erect or strongly divergent and thus appearing to be above the drooping staminate ones; leaves obovate or obovate-elliptic, broadest above middle, cuneate to but slightly rounded at base, simply serrulate, only exceptionally strongly undulate, the expanding ones glutinous, often aromatic, the mature blades with the lower surface delicately or finely reticulate or with only weak cross-veins ..... 2. *A. serrulata.*

1. A. RUGOSA (Du Roi) Spreng. Syst. iii. 848 (1826).—The following varieties and forms are recognized.

a. Leaves green or fulvous, not glaucous, beneath.

Lower surfaces of leaves glabrous or promptly glabrate, only the principal veins or their axils sometimes permanently pilose ..... Var. *typica.*

Lower surfaces of leaves permanently soft-pilose or subvelutinous (to touch) ..... Forma *Emersoniana.*

a. Leaves glaucous or whitened beneath ..... *b.*

b. Lower surfaces of leaves glabrous or promptly glabrate.

Leaves ovate or oval to rounded-elliptic, with low toothing ..... Var. *americana..*

Leaves narrowly elliptic to ovate-lanceolate, lacerate or jagged-toothed ..... Forma *tomophylla.*

b. Lower surfaces of leaves densely soft-pilose or subvelutinous (to touch) ..... Forma *hypomalaca.*

A. RUGOSA, var. TYPICA H. Winkl. in Engler, Pflanzenr. iv[61]. 119 (1904), as to name of the type. *Betula Alnus* (*rugosa*) Du Roi, Obs. Bot. 31 (1771) and Harkb. Wilde Baumz. i. 112 (1771). *Betula rugosa* (Du Roi) Ehrh. Beitr. iii. 21 (1788). *A. serrulata* sensu Michx. f. Hist. Arb. Forest. Am. Sept. iii. 320, fig. 1 (1813), not Willd. (1805). *A. rugosa* (Du Roi) Spreng. Syst.

iii. 848 (1826); Callier in Mitteil. Deutsche Dendr. Gesellsch. 1918: 114 (1918), in small part only (a bad mixture). *A. latifolia* Desf. Cat. Pl. Hort. Par. ed. 3: 352 (1829), *nomen nudum*, cited in synonymy of the next by Spach (1841). *A. hybrida* A. Br. ex Reichenb. Ic. Fl. Germ. xii. 3, t. 630, fig. 1292 (1850). *A. serrulata*, β. *macrophylla* Spach in Ann. Sci. Nat. sér. 2, xv. 206 (1841). *A. macrophylla* Desf. ex Spach, l. c. in synonymy (1841). *A. autumnalis* Hartig. Naturgesch. Forste, Kulturpfl. 337 (1850). *A. glutinosa*, δ. *serrulata*, lusus c. *rugosa* (Du Roi) Regel in Nouv. Mém. Soc. Nat. Mosc. xiii. 165, t. xi. figs. 8–10—repr. as Mon. Bet. 107 (1861). *A. serrulata* β. *rugosa* (Du Roi) Regel in DC. Prodr. xvi². 188 (1868). *A. glutinosa*, var. *autumnalis* (Hartig) Ktze. Rev. Gen. ii. 638 (1891). *A. incana*, var. *hypochlora* sensu Fernald in Rhodora, xxiii. 257 (Feb. 27, 1922), not Callier (1918).—Low grounds, western Nova Scotia to northern Michigan, south to southern New England, locally to northern and eastern Pennsylvania and northern Indiana. The following, mostly distributed as *A. incana* and selected from more than 300 specimens before me, are characteristic. Nova Scotia: Cedar L., Digby Co., *Fernald & Long*, no. 23,781 (as *A. incana*, var. *hypochlora*); Eel L., Yarmouth Co., *F. & L.*, no. 23,782 (as *A. incana*, var. *hypochlora*). Maine: Milford, Penobscot Co., *Fernald & Long*, no. 13,474 (as *A. incana*, var. *hypochlora*); Rowe P., Pleasant Ridge, Somerset Co., Sept. 10, 1909, *J. F. Collins;* New Sharon, Franklin Co., July 23, 1904, *Knowlton* (as *A. serrulata*); Whitney P., Oxford, Oxford Co., July 12, 1914, *Weatherby;* Mud P., Greenwood, Oxf. Co., June 12, 1931, *Bill, Eaton, Fernald, Griscom & Hunnewell;* Washington, Knox Co., *J. G. Jack*, no. 3398 (as *A. incana*, var. *hypochlora*); Isle au Haut, Knox Co., Aug. 11, 1918, *Kidder* (as *A. incana*, var. *hypochlora*), *A. F. Hill*, no. 1652; Waterville, Kennebec Co., July 5, 1904, *Knowlton;* Livermore, Androscoggin Co., 1879, *Kate Furbish;* Baldwin, Cumberland Co., *Fernald & Long*, no. 13,476; Limington, York Co., *F. & L.*, no. 13,475; Cape Neddick, York Co., *J. G. Jack*, nos. 3388 and 3392. New Hampshire: Lebanon, Grafton Co., June 12, 1920, *Fernald, Hunnewell and R. W. Blanchard;* Hookset, Merrimac Co., Aug. 2, 1925, *C. F. Batchelder;* Durham, Strafford Co., Sept. 7, 1918, *Knowlton:* Derry, Rockingham Co., Aug. 25, 1917, *C. F. Batchelder;* Nashua, Hillsborough Co., *Robinson*, no. 800; Jaffrey, Cheshire Co., *Robinson*, no. 156. Vermont: Essex Junction, Chittenden Co., *S. F. Blake*, no. 2218; Middlebury, Addison Co., Sept. 25, 1880, *Brainerd* (as *A. serrulata*); West Rutland, Rutland Co., *Eggleston*, no. 3211; Townshend, Windham Co., June 2, 1912, *L. A. Wheeler;* Manchester, Bennington Co., *M. A. Day*, no. 163. Massachusetts: Emerson Point, Rockport, Essex Co., *L. B. Smith & R. G. Gates*, no. 1009; West Manchester, Essex Co., June 7, 1913, *F. T.*

Hubbard; Plum Island, Essex Co., *White & St. John,* nos. 528 and 543; Winchester, Middlesex Co., *Fernald & Bartlett,* no. 7; West Cambridge, Mid. Co., *F. & B.,* no. 2; Concord, Mid. Co., July, 1857, *E. S. Hoar;* Boxboro, Mid. Co., *Hubbard & Torrey,* no. 477; West Roxbury, Suffolk Co., April 9 and September 11, 1906, *F. F. Forbes* (as hybrid of *A. incana* and *A. rugosa*); Dorchester, Suf. Co., Sept. 23, 1919, *Kidder,* Brookline, Norfolk Co., March 19, Sept. 9 and Nov. 24, 1902, *F. F. Forbes;* Dedham, Norfolk Co., Sept. 8, 1895, *E. F. Williams;* Hanson, Plymouth Co., *Knobloch, Smith & Stebbins,* no. 2562; North Tisbury, Martha's Vineyard, Dukes Co., Oct. 3, 1912, *Bicknell;* Copaum P., Nantucket, Nant. Co., June 8, 1908, *Bicknell;* Hardwick, Worcester Co., Aug. 9, 1935, *C. F. Batchelder;* Sutton, Worc. Co., *Anderson, Smith & Weatherby,* no. 2446; Montague, Franklin Co., May 11, 1912, *Wheeler & Wiegand;* Chicopee, Hampden Co., *Murdoch & Torrey,* no. T 435; Smith's Ferry, Northampton, Hampden Co., Aug. 10, 1912, *F. F. Forbes;* Proven Mt., Agawam, Hampden Co., May 18, 1913, *Knowlton & White;* North Adams, Berkshire Co., May 14, 1915, *Knowlton;* Lenox, Berks. Co., Aug. 24, 1902, *Hoffmann;* Centre P., Becket, Berks. Co., Sept. 22, 1904, *Hoffmann;* Mount Washington, Berks. Co., Sept. 10, 1915, *Floyd.* Rhode Island: Cumberland, Providence Co., May 30, 1911, *Knowlton;* East Providence, Prov. Co., *J. F. Collins,* no. 15,010. Connecticut: Middlebury, New Haven Co., April 25 and July 16, 1897, *Shepardson;* Oxford, N. H. Co., April 12, 1888 and Sept. 17, 1897, *Harger.* New York: Black Lake, St. Lawrence Co., *Fernald, Wiegand & Eames,* no. 14,251; Canton, St. L. Co., *Phelps,* no. 373; Sandy Creek Township, Oswego Co., *Fernald, Wiegand & Eames,* nos. 14,249 and 14,250; Spruce P., Black Lake Forest, Orange Co., *Raup,* no. 7589; Taughannock Ravine, Ulysses, Tompkins Co., *Eames & Wiegand,* no. 11,930. Pennsylvania: Kenney's P., e. of West Auburn, Susquehanna Co., *Wahl,* no. 489; 7 miles s. of Moscow, Lackawanna Co., *Randolph & Randolph,* no. 57; Martic Forge, Lancaster Co., Aug. 16, 1914, *J. F. Collins;* Crawford Co., *Dickey,* no. 23. Michigan: Isle Royale, Keweenaw Co., *Cooper,* no. 7; Keweenaw Co. (without stated localities), Oct., 1904, *Farwell* (some as *A. incana,* var. *americana,* some as var. *glauca*); north of St. Ignace, Mackinac Co., *Benner,* no. 6715. Indiana: south of Tamarack, Porter Co., *Deam,* no. 8064.—Spread from cultivation in Europe. Plates 977–979.

Var. typica, forma **Emersoniana,** f. nov. (tab. 979, fig. 4), foliis subtus piloso-tomentulosis, pilis plus minusve rufescentibus. —*A. incana* sensu Emerson, Trees and Shrubs in Mass. i. 251, with plate (1875), not (L.) Moench.—Differing from typical *A. rugosa* in having a permanently and usually densely pilose-tomentulose lower surface, the pubescence mostly ferruginous.

Of essentially the same range but forming individual and constant large colonies. The following, selected from thrice as many sheets, are characteristic. NOVA SCOTIA (all distrib. as *A. incana*, var. *hypochlora*): Lahave R., Bridgewater, Lunenburg Co., *Fernald & Long*, no. 23,779; Wallace Lake, Italy Cross, Lun. Co., *F. & L.*, no. 23,780; Sloane L., Pleasant Valley, Yarmouth Co., *Fernald, Bissell, Graves, Long & Linder*, no. 21,015. MAINE: Fairfield, Somerset Co., *Fernald & Long*, no. 13,472; Pembroke, Washington Co., *Fernald*, no. 1700; Burnham, Waldo Co., July 24, 1940, *Knowlton;* Nequasset L., Woolwich, Sagadahoc Co., *Fernald & Long*, no. 13,477; Cape Elizabeth, Cumberland Co., *Chamberlain*, no. 682; Limington, York Co., *Fernald & Long*, nos. 13,475, 13,479 and 13,480; Alfred, York Co., *F. & L.*, no. 13,478; Wells, York Co., *F. & L.*, no. 13,467; York Harbor, York Co., Aug., 1892, *Bicknell* (with unpublished new specific name). NEW HAMPSHIRE: Haverhill, Grafton Co., *Fernald*, no. 15,525; Mason, Hillsborough Co., Aug. 20, 1917, *C. F. Batchelder;* Dover, Strafford Co., *Hodgdon*, no. 2567; Hampton Falls, Rockingham Co., Sept. 10, 1916, *C. F. Batchelder;* Derry, Rock. Co., Aug. 15, 1926, *Batchelder;* Hinsdale, Cheshire Co., Aug. 23, 1919, *Batchelder*. VERMONT: Milton, Chittenden Co., July 25, 1927, *Knowlton;* Hartford, Windsor Co., June 12, 1920, *Eaton & St. John;* Wallingford, Rutland Co., May 30, 1907, *Kennedy*. MASSACHUSETTS: Lynnfield, Essex Co., *Fernald & Bartlett*, no. 786; Round Pond, Tewksbury, Middlesex Co., April 14 and Oct. 14, 1906, *M. L. Fernald & H. H. Bartlett*, nos. 14 (TYPE in Herb. Gray.) and 18; Fresh Pond, Cambridge, Mid. Co., 1842 or 43, *Asa Gray* (sheet sent to and identified by Regel as "*Alnus serrulata* Willd., β. *rugosa*"); West Cambridge, *Fernald & Bartlett*, no. 4; West Roxbury, Suffolk Co., March 25, April 5 and May 28, 1904, *F. F. Forbes;* Brookline, Norfolk Co., Oct. 11, 1914, *F. F. Forbes;* Milton, Norf. Co., March 26 and May 26, 1921, *Kidder;* Hanson, Plymouth Co., Aug. 30, 1941, *Knowlton;* Gunning P., Falmouth, Barnstable Co., *Fernald*, no. 578; Dennis P., Yarmouth, Sept. 19, 1913, *Fernald & Long*, as *A. noveboracensis;* Lambert Cove, Martha's Vineyard, Dukes Co., *Bicknell*, no. 3432; Great P., Martha's Vineyard, *Bicknell*, no. 3143 (as *A. noveboracensis*); Nantucket, *Bicknell*, no. 3438; Leominster, Worcester Co., *Fernald & Bean*, no. 14,017; Princeton, Wor. Co., July 22, 1913, *Weatherby;* Barre, Wor. Co., May 14, 1915, *Hunnewell, Macbride & Torrey;* Northfield, Franklin Co., May 11, 1912, *Fernald & Floyd;* Longmeadow, Hampden Co., May 18, 1913, *Hill & St. John;* Chester, Hampd. Co., May 17, 1913, *Weatherby & Bean;* Worthington, Hampshire Co., *B. L. Robinson*, no. 812; Adams, Berkshire Co., *Knowlton & Bean*, no. 15,107. RHODE ISLAND: Newport, N. Co., *Mearns*, no. 603. CONNECTICUT: Woodstock, Windham Co., July 31, 1919, *Weatherby;*

Pomfret, Wind. Co., July 4, 1901, *Driggs;* Franklin, New London Co., Aug. 27 and Nov. 21, 1912, *Woodward;* Sprague, N. L. Co., Sept. 3, 1913, *Woodward;* Tyler P., Goshen, Litchfield Co., *Weatherby*, no. 3350. NEW YORK: Bear P., French Mt., Warren Co., June 9, 1920, *Burnham;* Long L., Hamilton Co., *House*, no. 10,172; Mud Pond, Oswego, O. Co., *Fernald, Wiegand & Eames*, no. 14,246. MICHIGAN: Douglas L., Cheboygan Co., *Ehlers*, no. 534. INDIANA: Tremont, Porter Co., Sept. 9, 1920, *D. C. Peattie.*

The extreme with soft-pubescent lower leaf-surfaces, *Alnus rugosa,* forma *Emersoniana,* is named for that remarkably accurate and unexcelled student of Massachusetts trees and shrubs, GEORGE BARRELL EMERSON (1797–1881), author of the scholarly Report on the Trees and Shrubs in Massachusetts (2 vols., 1875), a famous and greatly honored educator, an intimate of Jacob Bigelow, adviser of Horace Mann, and one of the three trustees of the Arnold bequest which, as a result of his guidance, became the initial fund of the Arnold Arboretum. Emerson clearly understood and first discriminatingly stated the strong specific differences which separate the northern *Alnus rugosa* and the southern *A. serrulata.* These he accurately illustrated but, like every one of his period and up to the present, he did not get away from the conviction that our dark-barked shrub is identical with the whitish-barked tree of Europe. Although in Trees and Shrubs in Mass. i. 248 he definitely wrote "White Alder of Europe is a very beautiful tree, sometimes rising to the height of seventy feet", on p. 251 he began his very accurate account of "THE SPECKLED ALDER. *A. incana,* Willdenow", "easily distinguished by the brilliant, polished, reddish green color of its stem-bark", "speckled with conspicuous light gray dots", "The stem is usually eight or ten feet high and from one to three inches in diameter".

Emerson distinguished three variations of the Speckled Alder: (1) what he considered typical, with "leaves . . . broad oval, rounded or somewhat cordate at base . . . , doubly serrate or denticulate-serrate . . . smooth and conspicuously impressed at the veins and veinlets above; of a soft coriaceous texture; covered with abundant, soft, often ferruginous pubescence beneath, with the veins and veinlets strikingly prominent" (*A. rugosa,* forma *Emersoniana*); (2) *A. glauca* Michx.:

"A striking and very beautiful variety of the speckled alder, called the glaucous alder by the younger Michaux, is distinguished by the pale blue or glaucous color of the lower surface of the leaves. The pubescence is less abundant, but the veins and footstalk are often, as in the common form [i. e. *A. rugosa*, forma *Emersoniana*] of the tree, of a rusty color"; and (3) a series which Emerson considered "intermediate between the common [*A. serrulata*] and the glaucous alder . . . It differs from the common alder in its leaves being always acute and never obovate, and from the speckled, in having its leaves shining and free from down . . . The general aspect of this alder is similar to that of the speckled alder, differing in the greenness of the under surface of the leaves". Emerson's third variety was, apparently, a mixture of typical *A. rugosa* and the extreme of *A. serrulata* with subelliptic and round-based leaves.

Var. **americana** (Regel), comb. nov. *A. incana*, β. *americana* Regel in Nouv. Mém. Soc. Nat. Mosc. xiii. 155—repr. as Mon. Bet. 97 (1861); H. Winkl. in Engler, Pflanzenr. iv[61]. 123 (1904). *A. glauca* Michx. f. Hist. Arb. Forest. Am. Sept. iii. 320, t. 4, fig. 2 (1813). *A. incana*, var. *glauca* (Michx. f.) Loudon, Arbor. Brit. iii. 1688 (1838) pro parte, excl. citation of Ait.; Gray, Man. ed. 2: 412 (1856); Callier in Mitteil. Deutsche Dendr. Gesellsch. 1918: 143 (1918)[1], not Ait. Hort. Kew. ed. 2, v. 259 (1813). *A. incana*, α. *vulgaris* Spach in Ann. Sci. Nat. sér. 2, xi. 206 (1841) in small part only (*A. glauca* Michx. fil), excluding the synonyms "*Alnus incana* auctor", "*Alnus undulata* Pursh" (Pursh correctly giving *A. undulata* Willd. as a synonym of *A. crispa* Ait.) and "Foliis . . obovatis". *A. incana* sensu Tuckerm. in Am. Journ. Sci. xlv. 32 (1843) and most later Am. auth., not (L.) Moench. *A. americana* (Regel) Hort. ex K. Koch, Dendrol. ii[1]. 636 (1872).—Generally more northern in range, Labrador to Hudson Bay region and Saskatchewan, south to Newfoundland, Nova Scotia, Maine, New Hampshire, Massachusetts, uplands of Pennsylvania, Maryland and West Virginia, northern Ohio, northern Indiana, Wisconsin and northeastern Iowa. The following, selected from nearly 200 sheets before me, are characteristic. LABRADOR: Paradise R., Sandwich Bay (lat. 53° 30′, long. 57° 15′), *Harlow Bishop*, no. 275. NEWFOUNDLAND: Clarenville, July 30, 1938, *Agnes M. Ayre;* Quarry, *Fernald &*

[1] Callier showed the usual Germanic lack of understanding of American geography, citing one specimen from "Dakota: New Anglia leg. Blake" and Mrs. Chase's no. 2105 from Dune Park, Indiana, as from "Michigan: Lake Michigan, Done Park". On a preceding page the strictly northeastern *A. rugosa* was cited from anywhere, including California.

Wiegand, no. 5302; Grand Falls, *F. & W.*, no. 5301; near mouth of Badger Brook, *Robinson & Schrenk*, no. 35; Little Red Indian Lake, *F. & W.*, no. 5300; Goose P., *F. & W.*, no. 3276; Winterhouse Brook, Bonne Bay, *Fernald, Long & Fogg*, no. 1647; Summerside, Bay of Islands, *F. & W.*, no. 3277; Table Mt., Port-à-Port Bay, *Fernald & St. John*, no. 10,828. QUEBEC: Natashquan R., Saguenay Co., July, Aug., 1912, *C. W. Townsend;* Piashtibaie, Sag. Co., *St. John*, no. 90,395; Seven Islands, Sag. Co., *C. B. Robinson*, no. 900; Douglastown, Gaspé Co., Aug. 22, 1904, *Collins, Fernald & Pease;* R. Ste. Anne des Monts, Gaspé Co., *Fernald & Collins*, no. 217; Bonaventure R., Bonav. Co., Aug. 4–8, 1904, *C. F. & P.;* Matane, M. Co., Aug. 5, 1904, *F. F. Forbes;* Bic, Rimouski Co., *Rousseau*, no. 21,457; Cap-à-l'Aigle, Charlevoix Co., *J. Macoun*, no. 68,768; Lac Tremblant, Terrebonne Co., July 23, 1922, *Churchill;* Black Lake, Megantic Co., *Fernald & Jackson*, no. 12,076; Georgeville, Stanstead Co., Aug. 22, 1914, *Churchill;* East Main, E. Coast of James Bay, *D. Potter*, no. 265; Rupert House, E. Coast, *Potter*, no. 260. MAGDALEN ISLANDS: Brion Island, *St. John*, no. 1847; Ile de l'Étang-du-Nord, *Victorin & Rolland*, no. 9418; Grindstone I., *Fernald, Bartram, Long & St. John*, no. 7310. NEW BRUNSWICK: Kent Co., 1870, *Fowler*. NOVA SCOTIA: Pottle's L., North Sydney, Cape Breton Co., *Bissell & Linder*, no. 21,020; Glenbard, near James River Sta., Antigonish Co., *Perry, Wetmore, Hicks & Prince*, no. 10,256; Musquodoboit Harbor, Halifax Co., *Rousseau*, no. 35,263; Deception L., Shelburne Co., *Fernald & Long*, no. 23,777; Clyde River, Shelb. Co., *J. G. Jack*, no. 3454; Butler's L., Gavelton, Yarmouth Co., *Fernald, Long & Linder*, no. 21,021; Lake Annis, Yarm. Co., *Bissell, Pease & Linder*, no. 21,017; Journeay L., Weymouth, Digby Co., *Fernald & Long*, no. 23,778. MAINE: Fort Kent, Aroostook Co., *Fernald*, no. 2446; Masardis, Aroost. Co., *Fernald*, no. 2447; Orono, Penobscot Co., May 30, 1904, *Fernald;* Foxcroft, Piscataquis Co., Aug. 31, 1897, *Fernald;* St. John P., Township iv, Range 17, Somerset Co., *St. John & Nichols*, no. 2272; Dead River, Som. Co., *Fernald & Strong*, no. 409, in part; Chesterville, Franklin Co., Aug. 28, 1904, *E. B. Chamberlain;* Calais, Washington Co., Aug. 24, 1928, *Knowlton;* Roque Bluff, Wash. Co., July 31, 1918, *Knowlton;* Northfield, Wash. Co., Aug. 2, 1941, *Knowlton;* Nicatous L., Twp. 3, Hancock Co., *Fassett*, no. 2378; Seal Harbor, Hanc. Co., July 8, 1889, *Redfield;* Brooklin, Hanc. Co., *A. F. Hill*, no. 1051; Isle au Haut, Knox Co., Aug. 26, 1927, *Kidder;* Monhegan I., Lincoln Co., Aug., 1911, *Kate Furbish;* Brunswick, Cumberland Co., Aug. 26, 1910, *Kate Furbish;* Baldwin, Cumb. Co., *Fernald & Long*, no. 13,470; North Berwick, York Co., Aug. 31, 1894, *Parlin*. NEW HAMPSHIRE: White Mountains, Tuckerman, labeled, "*Alnus incana*, Willd. *A. glauca*, Michx. f. species unica", with reference

to Tuckerman's treatment in Am. Jour. Sci. xlv. 32 (1845), this sheet marked by Regel *A. incana* β. *glauca;* Lake Umbagog, Cambridge, Coös Co., *Pease,* no. 18,150; Pittsburg, Coos Co., *Pease,* no. 10,297; summit of Cape Horn, Northumberland Co., Coös Co., *Pease,* no. 16,451; Jackson, Carroll Co., Aug. 1895, *E. W. Hervey;* Bow, Merrimack Co., Sept. 21, 1930, *G. M. Bryant;* Hillsborough, H. Co., Sept. 2, 1921, *C. F. Batchelder;* New Hampton, Belknap Co., Sept. 5, 1904, *F. F. Forbes;* Richmond, Cheshire Co., Aug. 21, 1919, *C. F. Batchelder;* Cheshire Co., *Robinson,* no. 156. VERMONT: Brunswick Springs, Essex Co., *S. N. F. Sanford,* no. 1083; Willoughby, Orleans Co., July, 1898, *Kennedy:* Worcester, Washington Co., Aug. 25, 1875, *Blanchard;* Charlotte, Chittenden Co., April 15 and Sept. 29, 1879, *Pringle;* Hartland, Windsor Co., *J. G. Underwood,* no. 3116. MASSACHUSETTS: Lexington, Middlesex Co., March 23 and May 20, 1931, *L. B. Smith;* Buckland, Franklin Co., April 11 and Aug. 19, 1904, *F. F. Forbes;* Worthington, Hampshire Co., *B. L. Robinson,* no. 507; Pittsfield, Berkshire Co., Aug. 5, 1915, *Churchill.* NEW YORK: Norfolk, St. Lawrence Co., *Phelps,* nos. 1139–1141; Selkirk, Oswego Co., *Fernald, Wiegand & Eames,* no. 14,245; Canadice, Ontario Co., *C. C. Thomas,* no. 3926; Penn Yan, Gates Co., *Sartwell* (Sartwell Herb., Hamilton College, presumable duplicate of the TYPE of *A. incana* β. *americana* Regel); western New York, *Asa Gray,* identified by Regel as *A. incana,* var. *glauca.* PENNSYLVANIA: Little Mud P., e. of Porter's L., Pike Co., *Fogg,* no. 10,767; Pocono Plateau, Monroe Co., July, Aug., 1904, *Harshberger.* MARYLAND: s. of Finzel, Garrett Co., Aug. 15, 1936, *Wherry.* WEST VIRGINIA: at 2500 ft. alt., e. of Gormannia, Grant Co., *Svenson,* no. 4439. ONTARIO: Lake Rosseau, Muskoka Co., *W. F. Wright,* no. 140; Moose River, James Bay, Nipissing Distr., *David Potter,* nos. 262–264; Sand Point, Algoma Distr., *Taylor et al.* no. 842; Batchawana R., Alg. Distr., *Taylor et al.* no. 839; Nipigon, Thunder Bay Distr., *Jennings & Daily,* no. 481. MICHIGAN: Baraga, B. Co., *Fernald & Pease,* no. 3081. OHIO: Hiram, Portage Co., *R. J. Webb,* no. 1377. INDIANA: Chesterton, Porter Co., Aug. 12, 1925, *Churchill.* WISCONSIN: Kewaunee, K. Co., Aug. 2, 1902, *Schuette;* Brodhead, Green Co., *Fassett,* no. 12,931; Dayton, Green Co., *Fassett,* no. 13,990; Brown Co., 1880, *Schuette.* MINNESOTA: Sect. NW.-SW. 35, T. 144, R. 36, Clearwater Co., *M. L. Grant,* no. 3368; Cass L., Cass Co., *Pammel,* no. 5; Centre City, Chisago Co., July, 1892, *B. C. Taylor;* Bembridge, *Pammel,* no. 892. IOWA: Postville, Allamakee Co., June, 1914, *Schultz, Pammel & Orr;* Bluffton, Winneshiek Co., March 28 and Sept. 16, 1903, *Shimek;* New Hampton, Chickasaw Co., *Pammel,* no. 475. PLATES 980 and 981.

Var. AMERICANA, forma **tomophylla** (Fernald), comb. nov. *A. incana*, var. *glauca*, f. *tomophylla* Fernald in RHODORA, xvi. 56 (1914). *A. incana*, var. *tomophylla* (erroneously attributed to Fernald) by Rehder, Man. Cult. Trees and Shrubs, 147 (1927).—Local. NEWFOUNDLAND: Norris Arm, *Fernald & Wiegand*, no. 5303 (TYPE). MAINE: Hartford, Oxford Co., Aug., 1892, *Parlin*. PLATE 982, FIG. 4.

Var. AMERICANA, forma **hypomalaca,** f. nov. (TAB. 982, FIG. 1–3), foliis subtus molliter persistenterque piloso-tomentulosis, pilis cinereis.—Local, often abundant, through much of the area of var. *americana*. QUEBEC: Pointe du Lac, St. Maurice Co., Aug. 2, 1923, *Chamberlain & Knowlton*. NEW BRUNSWICK: Shediac Cape, Westmoreland Co., July 3, 1914, *F. T. Hubbard;* Seal Cove Brook, Grand Manan, Charlotte Co., July 24, 1941, *C. A. & Una F. Weatherby*, no. 7015 (TYPE in Herb. Gray.). PRINCE EDWARD ISLAND: St. Charles, Kings Co., *Fernald & St. John*, no. 11,030. NOVA SCOTIA: Central Port Mouton, *Fernald, Bissell, Graves, Long & Linder*, no. 21,019; Meteghan, Digby Co., *Fernald & Long*, no. 21,016; Middleton, Annapolis Co., *Fernald, Pease & Long*, no. 21,018. MAINE: Houlton, Aroostook Co., Aug. 26, 1897, *Fernald;* Patten, Penobscot Co., Aug. 23, 1897, *Fernald;* Milford, *Fernald & Long*, nos. 13,468 and 13,469; Fryeburg, Oxford Co., *C. E. Faxon;* Cutler, Washington Co., July 1, 1902, *Kennedy et al.;* Pembroke, Wash. Co., *Fernald*, no. 1699; Dedham, Hancock Co., *Fernald & Long*, no. 13,465; Deer Isle, Hanc. Co., *A. F. Hill*, no. 2096; Atlantic, Swans Island, Hanc. Co., *Hill*, no. 2281; Rockport, Knox Co., *Rossbach*, no. 1207; Nequasset L., Woolwich, Sagadahoc Co., *Fernald & Long*, no. 13,477; Leeds, Androscoggin Co., July 23, 1913, *Knowlton;* Falmouth, Cumberland Co., *Chamberlain & Bissell*, no. 389; Limington, York Co., *Fernald & Long*, nos. 13,479 and 13,480; Alfred, York Co., *F. & L.*, no. 13,466; Kennebunkport, York Co., Aug. 1929, *C. A. Cheever*. NEW HAMPSHIRE: Mt. Washington, Coös Co., July 16, 1891, *Kennedy:* Randolph, Coös Co., *Pease*, no. 11,179; Shelburne, Coös Co., *Pease*, no. 11,133; Jackson, Carroll Co., July 12, 1883, *C. W. Jenks;* Warren, Grafton Co., July 24, 1908, *E. F. Williams;* Merrimack, Hillsborough Co., Aug. 11, 1917, *C. F. Batchelder;* Rindge, Cheshire Co., May 30, 1912, *F. F. Forbes*. VERMONT: Stowe, Lamoille Co., July 27, 1884, *C. W. Swan*. MASSACHUSETTS: Round Pond, Tewksbury, Middlesex Co., *Fernald & Bartlett*, no. 15; Beaver Brook Reservation, Mid. Co., May 26, 1894, *G. L. Chandler;* Brookline, Norfolk Co., Sept. 25, 1905, *F. F. Forbes;* Needham, Norf. Co., *T. O. Fuller;* Springfield, Hampden Co., June 17, 1913, *Luman Andrews;* Cheshire, Berkshire Co., July, 1912, *E. J. Winslow;* Sheffield, Berks. Co., July 24, 1912, *Hoffmann*. NEW YORK: Axton, Franklin Co., July 10,

1899, *Rowlee, Wiegand & Hastings;* Conklingville, Saratoga Co., *Fogg,* no. 15,161. ONTARIO: Kokoko Bay, Timagami Region, *Edgar & Dorothy M. Anderson,* no. 26,045B; Stokes Bay, Bruce Peninsula, *Krotkov,* no. 8948. INDIANA: Dune Park, Porter Co., *Greenman,* no. 2683.

Alnus rugosa, vars. *typica* and *americana* are not mere forms, the former with green to rufescent lower leaf-surfaces, the latter with them glaucous, gray or cinereous. The latter is decidedly more northern in range. I am indebted to Professor Rehder and Dr. A. C. Smith for the use of a Sartwell sheet from Penn-Yan, New York, lent by the Herbarium of Hamilton College. This is presumably part of the original collection upon which Regel founded his *A. incana,* β. *americana.* The approximately 400 sheets showing foliage in the Gray Herbarium and the herbarium of the New England Botanical Club, when tabulated, give the following proportions (in percentages).

LABRADOR PENINSULA, var. *typica* 0, var. *amer.* 100%; NEWFOUNDLAND, var. *typica* 0, var. *amer.* 100; QUEBEC (south of Lab. Pen.), var. *typica* 0, var. *amer.* 100; NEW BRUNSWICK, var. *typica* 0, var. *amer.* 100; NOVA SCOTIA, var. *typica* 43, var. *amer.* 57; NORTHERN MAINE (northern tier of counties), var. *typica* 59, var. *amer.* 41; SOUTHERN MAINE, var. *typica* 80, var. *amer.* 20; COÖS CO., NEW HAMPSHIRE, var. *typica* 5, var. *amer.* 95; REST OF NEW HAMPSHIRE, var. *typica* 65, var. *amer.* 35; VERMONT, var. *typica,* 62, var. *amer.* 38; MASSACHUSETTS, var. *typica* 89, var. *amer.* 11; RHODE ISLAND, var. *typica* 100, var. *amer.* 0; CONNECTICUT, var. *typica* 100, var. *amer.* 0.

The variations which I treat as forms show no such geographic concentrations; they are scattered throughout the range of the variety under which they are placed.

2. A. SERRULATA (Ait.) Willd. Sp. Pl. iv[1]. 336 (1805).—The following varieties and forms are recognized.

a. Principal leaves definitely obovate, cuneate, or subcuneate to subacute at base; those of vigorous 1st. year's shoots obtuse or acute; those of fertile branches of 2nd. year one third to two thirds as broad as long.
Lower surfaces of mature leaves glabrous or strongly glabrescent. . . . . Var. *vulgaris.*
Lower surfaces of mature leaves permanently and densely pilose-tomentulose, plush-like to touch. . . . . Forma *noveboracensis.*

a. Principal leaves broadly elliptic-obovate to broadly oblong-elliptic or subrotund (though broadest at or above the middle), gradually rounded at base; those of fertile branches of 2nd. year mostly three fifths to nine tenths as broad as long. . . . *b.*

b. Lower surfaces of mature leaves glabrous or strongly glabrescent.

Leaves gradually rounded to subacute (or more rarely acute) at apex, mostly 6–15 cm. long; staminate aments 3–7 cm. long.....Var. *subelliptica*
Leaves broadly retuse or emarginate at apex, mostly 2–5 cm. long; staminate aments 2 cm. long.....Forma *emarginata.*

b. Lower surfaces of mature leaves permanently and densely pilose-tomentulose, plush-like to touch.
Large shrub or small tree; principal leaves 6–12 cm. long; mature cones 1–2 cm. long; staminate aments 3–7 cm. long.....Forma *mollescens.*
Dwarf shrub 0.5–1 m. high; principal leaves 2–5 cm. long; mature cones 6–12 mm. long; staminate aments 1.3–1.8 cm. long.....Forma *nanella.*

A. SERRULATA, var. VULGARIS Spach in Ann. Sci. Nat. sér. 2, Bot. xv. 206 (1841), in part ("Foliis . . . lanceolato-obovatis, v. obovatis, v. oblongo-obovatis, saepius obtusis v. vix acuminatis, basi cuneatis"). *Betula-Alnus rubra* Marsh. Arb. Am. 20 (1785), presumably. *Betula serrulata* Ait. Hort. Kew. iii. 338 (1789); Willd. Berlin. Baumzucht, 45 (1796), at least as to citation of Ait. *A. serrulata* (Ait.) Willd. Sp. Pl. iv[1]. 336 (1805). *A. rubra* (Marsh.) Tuckerm. in Am. Journ. Sci. xlv. 32 (1843), not Bong. (1833). *A. glutinosa,* δ. *serrulata* (Ait.) Regel in Nouv. Mém. Soc. Nat. Mosc. xiii. 164, t. xi. fig. 7—repr. as Mon. Bet. 106, t. xi. fig. 7 (1861), in part, incl. basonym. *A. glutinosa,* δ. *serrulata,* lusus a. *genuina* Regel, l. c. fig. 6 (1861). *A. glutinosa,* δ. *serrulata,* lusus b. *obtusifolia* Regel, l. c. fig. 7 (1861). *A. serrulata,* α. *genuina* Regel in DC. Prodr. xvi[2]. 188 (1868), in part. *A. serrulata,* δ. *obtusifolia* Regel, l. c. (1868). *A. rugosa* sensu K. Koch, Dendrol. ii. 635 (1872); sensu Coulter in Mem. Torr. Bot. Cl. v. 131 (1894); sensu Sargent, Silva, ix. 69 (1896) and subseq. auth.; not Spreng. (1825). *A. rugosa,* var. *serrulata* (Ait.) H. Winkler in Engler, Pflanzenr. iv[61]. 120 (1904). *A. rugosa,* var. *obtusifolia* (Regel) H. Winkler, l. c. (1904). *A. serrulata pumila* Dameker in Mitt. Deutsch. Dendr. Ges. 1909: 326 (1909).—Northern Florida to Louisiana, north to southwestern Nova Scotia, central and southern Maine, southern New Hampshire, central Vermont, New York, West Virginia, Ohio, Indiana, Illinois, Missouri and southeastern Oklahoma. The following, selected from many hundreds of sheets, are characteristic. NOVA SCOTIA: Ponhook L., Queen's Co., *Weatherby,* no. 6955: Cameron L., South Brookfield, Queen's Co., *C. A. & Una F. Weatherby,* no. 7059. MAINE: North P., Norway, Oxford Co., *Pease,* no. 24,100; near Jordan P., Mt. Desert I., Hancock Co., *Stebbins,* no. 235; Bristol, Lincoln Co., *E. B. Chamberlain,* no. 716; South Poland, Androscoggin Co., 1893, *Kate Furbish;* Wilson's Mill, Cumberland, C. Co., *Chamberlain, Morris & Ricker,* no. 852; Limington, York Co., *Fernald & Long,* no. 13,481; Cape Neddick, York Co., *J. G. Jack,* no. 3394. NEW HAMPSHIRE: Wild Goose P., Strafford, S. Co., *Hodgdon & Cham-*

berlain, no. 2886; Nottingham, Rockingham Co., *A. A. Eaton*, no. 435; Danville, Rock. Co., *Pease*, no. 28,210; Manchester, Hillsborough Co., Oct. 2, 1896, *F. W. Batchelder;* Walpole, Cheshire Co., *Fernald*, no. 505; Sandy P., Richmond, Chesh. Co., Sept. 3, 1916, *C. F. Batchelder*. VERMONT: L. St. Catherine, Wells, Rutland Co., *Dodge & Fassett*, no. 822. MASSACHUSETTS: Andover, Essex Co., *Pease*, no. 3432; Ashby, Middlesex Co., May 30, 1914, *Knowlton;* Concord, Mid. Co., April 4 and July 20, 1858, *E. S. Hoar;* Wilmington, Mid. Co., *Fernald & Bartlett*, no. 9; West Roxbury, Suffolk Co., Aug. 9 and Sept. 9, 1904, *F. F. Forbes;* Blue Hills Reserv., Aug. 11, 1895, *E. F. Williams;* Lakeville, Plymouth Co., *Fernald & Long*, no. 9345; Prospect Hill P., Taunton, Bristol Co., *F. C. Seymour*, no. 4460; Brewster, Barnstable Co., *Fernald*, no. 16,684; Provincetown, Barns. Co., *Fernald & Long*, no. 18,356; Chilmark, Martha's Vineyard, Dukes Co., *F. C. Seymour*, no. 1671; Harvard, Worcester Co., Aug. 6, 1916 and April 22, 1917, *F. F. Forbes;* Gill, Franklin Co., May 11, 1912, *St. John & Weatherby;* Ware, Hamshire Co., *Goodale, Potsubay & St. John*, no. 64,660; Stockbridge, Berkshire Co., Aug. 6, 1917, *Hoffmann*. RHODE ISLAND: Lincoln, Providence Co., *St. John*, no. 894: Barrington, Bristol Co., May 20, 1911, *E. J. Winslow;* Warren, Bristol Co., July 25, 1919, *Sanford;* Prudence I., Newport Co., *Sanford*, no. 10,377; Richmond, Washington Co., Aug. 30, 1919, *Fernald & Collins;* Hopkinton, Wash. Co., Sept. 1, 1919, *Fernald, Woodward & Collins*. CONNECTICUT: Woodstock, Windham Co., *Weatherby*, no. 4519; Franklin, New London Co., Oct. 4, 1913, *Woodward;* Tolland, T. Co., *Weatherby*, no. 5330; Tariffville, Hartford Co., May 17, 1913, *Winslow & Hill;* North Guilford, New Haven Co., July 11, 1904, *W. R. Dudley*. NEW YORK: West Fort Ann, Washington Co., Aug. 17, 1913, *Dobbin & Burnham;* Ballston L., Saratoga Co., Aug. 11, 1906, *Burnham;* Sutherland P., Black Lake Forest, Orange Co., *Raup*, no. 7746; Fishers Island, Suffolk Co., *St. John*, no. 2683; Sandy Creek Township, Oswego Co., *Fernald, Wiegand & Eames*, no. 14,248; Ithaca, Tompkins Co., *MacDaniels*, no. 3928. NEW JERSEY: Oradell, Bergen Co., April 16 and Oct. 8, 1905, *Mackenzie;* Denville, Morris Co., Aug. 13, 1905, *Mackenzie;* Vincetown, Burlington Co., *Long*, no. 11,091; Pleasantville, Atlantic Co., *Tidestrom*, no. 11,377; Friendship, Salem Co., *Long*, no. 51,606. PENNSYLVANIA: Scotrun, Monroe Co., Aug., 1906, *B. Long;* Chester Co., *Sharpless*, no. 276; Smithfield Swamp, Lancaster Co., Aug. 30, 1889, *Heller;* Mifflinville, Columbia Co., *Fogg*, no. 14,537; Farrandsville, Clinton Co., *Fogg*, no. 11,516; Fayette Co., *Dickey*, nos. 21 and 205. DELAWARE: Cool Spring, Sussex Co., *Larsen*, no. 459. MARYLAND: Chesapeake City, Cecil Co., *Tidestrom*, no. 11,679; St. Mary's Co., *Tidestrom*, no. 5062. DISTRICT OF COLUMBIA: Brookland, Oct. 15, 1898,

Holm; Terra Cotta, Aug. 18, 1915, *Holm.* WEST VIRGINIA: Huttonsville, Randolph Co., *Greenman,* no. 330; Tygart Junction, Barbour Co., *Greenman,* no. 329; between Gilmer and Read, Gilmer Co., *Greenman,* no. 331. VIRGINIA: se. of Alexandria, Fairfax Co., *Wiegand & Manning,* no. 958; ne. of Mechanicsville, Louisa Co., *Adams & Wherry,* no. 2228; Capital Landing Creek, York Co., *Mentzel,* no. 145; Oceana, Princess Anne Co., *Fernald & Long,* nos. 3896 and 3897; eastern shore, Lake Drummond, Norfolk Co., *J. Arthur Harris,* no. C 18,233; Zuni, Isle of Wight Co., *Fernald, Griscom & Long,* no. 6582; south of South Quay, Nansemond Co., *F. & L.,* no. 11,559; south of Franklin, Southampton Co., *F. & L.,* no. 8235; e. of Dan River, Halifax Co., *Fosburg,* no. 15,383; Hollins School, Roanoke Co., *C. E. Wood, Jr.,* no. 5483; "Mts., Virg. 1843", *Asa Gray* (type of var. *obtusifolia* Regel, in Gray Herb.); Bane, Giles Co., *Fogg,* no. 14,714, as *A. crispa;* Peak Creek, Pulaski Co., at 2200 ft. alt., July 16, 1892, *Small.* NORTH CAROLINA: Snow Hill, Greene Co., *L. F. & F. R. Randolph,* no. 776; Clinton, Sampson Co., *Godfrey,* no. 5895; Biltmore, Buncombe Co., *Bilt. Herb.* no. 1240[b]; at 4000 ft. alt., Pisgah Forest, Transylvania Co., *House,* no. 4041; at 1700 ft. alt., Great Smoky Mts., Swain Co., July, 1891, *Beardslee & Kofoid.* SOUTH CAROLINA: s. of Myrtle Beach, Horry Co., *Weatherby & Griscom,* no. 16,511; Georgetown, G. Co., *Godfrey & Tryon,* no. 988; Santee Canal, *Ravenel* (identified by Regel as his var. *genuina*); Summerville, Dorchester Co., *B. L. Robinson,* no. 114; se. of Elloree, Orangeburg Co., *Godfrey & Tryon,* no. 1503. GEORGIA: se. of Ludowici, Long Co., *Wiegand & Manning,* no. 962; s. of Cuthbert, Randolph Co., *Harper,* no. 1782. FLORIDA: River Junction, Gadsden Co., *Nash,* no. 2590; Peters Creek, Clay Co., *Small & DeWinkeler,* no. 9706. INDIANA: s. of Chestnut Ridge, Jackson Co., *Deam,* no. 13,740. KENTUCKY: Keyser Creek, Boyd Co., Sept. 25, 1937, *T. N. McCoy;* Tygart's Creek, Carter Co., Oct. 16, 1937, *E. L. Braun;* "Fernbank—ad ripas fluminis Ohio, prope 'North Bend'", *Short.* TENNESSEE: Rugby, Morgan Co., *Svenson,* no. 4048; Sunbright, alt. 2200 ft., Morgan Co., *Svenson,* no. 4117; n. of Manchester, Coffee Co., *Svenson,* no. 9256; Hollow Rock Jc., Carroll Co., *Svenson,* no. 374. ALABAMA: n. of Headland, Henry Co., *Wiegand & Manning,* no. 964; Perdido, Baldwin Co., *Blanton,* no. 7087. ILLINOIS: Pope Co., July 31, 1898, *G. P. Clinton.* MISSOURI: Jefferson Co., July, 1887, *Eggert;* Bismark, St. Francois Co., *E. J. Palmer,* no. 18,065; Monteer, Shannon Co., *Bush,* nos. 204 and 7852. ARKANSAS: Kensett, White Co., *Demaree,* no. 8658; Siloam Springs, Benton Co., *Demaree,* no. 4626; Washington Co., Aug. 17, 1895, *Blankinship;* Howard Co., *Demaree,* no. 9734; Murfreesboro, Pike Co., *Demaree,* no. 9377; Locksburg, Sevier Co., *Demaree,* no. 9890. LOUISIANA: New Orleans, 1832, *Drummond;* n. of Kisatchie, Natchitoches Parish,

D. S. & H. B. Correll, no. 9765. OKLAHOMA: Page, LeFlore Co., *Stevens*, no. 2619; Valliant, McCurtain Co., *Demaree*, no. 12,022 (appr. var. *subelliptica*). PLATES 983 and 984.

Var. VULGARIS, forma **noveboracensis** (Britton), stat. nov. *A. noveboracensis* Britton in Torreya, iv. 124 (1904) and N. Am. Trees, 264, fig. 224 (1908). *A. rugosa*, race? Britton in Britt. & Brown, Ill. Fl. ed. 2, i. 613 (1913).—Differing from typical var. *vulgaris* only in the persistent plush-like pubescence of the lower leaf-surfaces.—Scattered through the range, often abundant. MAINE: Orono, Penobscot Co., *Fernald & Long*, no. 13,473, as *A. incana*, var. *hypochlora*. MASSACHUSETTS: West Roxbury, April 5 and May 18, 1904, *F. F. Forbes*. RHODE ISLAND: Washington P., Kent Co., May 24, 1914, *Thos. Hope*. NEW YORK: Grant City, Staten I., Aug. 5, 1894, *Britton* (TYPE of *A. noveboracensis*); Selkirk, Oswego Co., *Fernald, Wiegand & Eames*, no. 14,247. NEW JERSEY: South Amboy, Middlesex Co., *Mackenzie*, no. 1465. VIRGINIA: Blackwater R., Princess Anne Co., *Fernald & Long*, no. 3898; w. of Franklin, Southampton Co., *F. & L.*, no. 6583; se. of Branchville, South. Co., *F. & L.*, no. 10,231; n. of Skipper's, Greensville Co., *F. & L.*, no. 8693. SOUTH CAROLINA: *M. A. Curtis*. GEORGIA: s. of Athens, Clarke Co., *Duncan & Roland*, no. 3877; Augusta, Richmond Co., *Olney & Metcalf*, no. 91. KENTUCKY: Harlan Court House, Harlan Co., *Kearney*, no. 7; s. of Albany, Clinton Co., *Smith & Hodgdon*, no. 3992. TENNESSEE: between Lexington and Natchez Trace Forest, Henderson Co., *Svenson*, no. 10,499. LOUISIANA: *Hale* (identified by Regel as his *A. serrulata*, var. *genuina*). PLATE 985.

Var. **subelliptica,** var. nov. (TAB. 986), foliis late elliptico-obovatis vel oblongo-ellipticis vel subrotundo-obovatis basin versus sensim rotundatis, subtus glabris vel glabratis; amentis masculis 3–7 cm. longis; strobilis maturis 1–2 cm. longis.—Georgia, north to southern New Hampshire, Massachusetts and New York. NEW HAMPSHIRE: Wheelwright P., Lee, Strafford Co., *Hodgdon*, no. 2576. MASSACHUSETTS: Rockport, Essex Co., *L. B. Smith & R. C. Gates*, nos. 964 and 965; Round P., Tewksbury, Middlesex Co., *Fernald & Bartlett*, no. 17; sandy swamp, Tewksbury, April 14 and October 14, 1906, *Fernald & Bartlett*, no. 16 (TYPE in Herb. Gray.); Winchester, Mid. Co., *F. & B.*, nos. 8, 11 and 13; West Cambridge, Mid. Co., *F. & B.*, no. 3; Fresh Pond, Cambridge, Sept. 29, 1894, *Robinson*, also *F. & B.*, no. 1; Bedford, Mid. Co., Sept. 12, 1903, *Knowlton;* Needham, Norfolk Co., April 20 and July 3, 1883, *T. O. Fuller;* Bellingham, Norf. Co., Sept. 17, 1935, *Ordway & Sanford;* Silver L., Kingston, Plymouth Co., Aug. 30, 1941, *Knowlton;* Wareham, Plym. Co., Sept. 18, 1925, *Knowlton;* Waquoit, Falmouth, Barnstable Co., *R. A. Ware*, no. 336; East Sandwich,

Barn. Co., Sept. 16, 1916, *F. F. Forbes;* Seward's P., West Barnstable, Barn. Co., *St. John & White,* no. 924; Great P., Centerville, Barn. Co., June 16, 1895, *E. F. Williams;* Walker P., Brewster, Barn. Co., *Fernald,* no. 16,681; Sheep P., Brewster, *Fernald,* no. 16,683; Cliff P., Brewster, *Fernald & Long,* no. 16,685; Davis P., Greenwich, Hampshire Co., *Pease,* no. 20,353. RHODE ISLAND: Limerock, Lincoln, Providence Co., Oct. 19, 1906, *J. F. Collins;* East Providence, Prov. Co., Oct. 17, 1906, *Collins;* Wash. P., Block Island, Newport Co., *Fernald, Hunnewell & Long,* no. 9344. CONNECTICUT: Coventry, Tolland Co., Aug., 1916, *Weatherby & Smith;* Ladd Fool Bridge, Franklin, New London Co., Aug. 24 and Sept. 6, 1912, *Woodward;* Rainbow, Windsor, Hartford Co., Sept. 20, 1908, *H. S. Clark;* Southington, Hartford Co., *L. Andrews,* no. 182; Oxford, New Haven Co., April 16, 1888 and July 30, 1899, *Harger.* NEW YORK: Long L., Hamilton Co., *House,* no. 13,513; Ashokan, Ulster Co., *Muenscher,* no. 16,104; Glycerine Hollow, Black Lake Forest, Orange Co., *Raup,* nos. 7789 and 7792; Peconic R., Southampton, Suffolk Co., *St. John,* no. 2682: Renwick Flats, Ithaca, Tompkins Co., *MacDaniels,* no. 3927. PENNSYLVANIA: near Kimbles, Pike Co., *Fogg,* no. 10,780; Allegheny Co., *Dickey,* no. 24. VIRGINIA: n. of Keyesville, Charlotte Co., *Fosberg,* no. 15,531; se. of Whitemarsh School, Nansemond Co., *Fernald & Long,* no. 11,558 (transitional); south of South Quay,Nans. Co., *F. & L.,* no. 10,611. NORTH CAROLINA: Parkville, Perquimans Co., *L. F. & F. R. Randolph,* no. 682; Raleigh, Wake Co., *Godfrey,* no. 4957; Hamlet, Richmond Co., *Wiegand & Manning,* no. 960. SOUTH CAROLINA: Pee Dee R. at Mars Bluff, Florence Co., *Wiegand & Manning,* no. 961. GEORGIA: e. se. of Statesboro, Bulloch Co., July 5, 1936, *Wherry.*

Var. SUBELLIPTICA forma **emarginata,** f. nov. (TAB. 987). Frutex ad 1.5 m. alta; foliis subrotundo-obovatis 2–5 cm. longis 1.5–4 cm. latis basin versus rotundatis apice late emarginatis paginis inferioribus glabratis; amentis masculis 2 cm. longis; strobilis maturis 5–10 mm. longis.—CONNECTICUT: open, rather sphagnous, swamp, Rainbow, Windsor, Hartford Co., Sept. 16, 1906 and April 6, 1907, *C. H. Bissell & C. A. Weatherby* (*Weatherby,* no. 2031), TYPE in Herb. Gray.

Var. SUBELLIPTICA, forma **mollescens,** f. nov. (TAB. 988). Frutex altus vel arbor fastigiata ad 8 m. alta; foliis ut in var. *subelliptica* 6–12 cm. longis apice obtusis vel acutis basin versus rotundatis subtus dense persistenterque subvelutinis; strobilis maturis 1–2 cm. longis.—Scattered through the range of the variety. NEW ENGLAND: old specimen from "Nova Anglia", *Oakes,* identified by Regel as his var. *genuina.* MASSACHUSETTS: Plum Island, Essex Co., *St. John,* no. 837; Winchester, Middlesex Co., July, 1907, *Knowlton;* Sharon, Norfolk Co., *S. F. Poole,*

no. 3; Barnstable, B. Co., *Fernald & Woodward*, nos. 15,124 and 15,126; Sheep P., Brewster, Barn. Co., *Fernald*, no. 16,682; Seth's P., West Tisbury, Dukes Co., *Fernald & Fogg*, no. 888; Brookfield, Worcester Co., *Hill, St. John & Torrey*, no. T. 261. CONNECTICUT: Thompson, Windham Co., June 11, 1922, *Eaton, Fassett, Jack, Linder & Peattie*. NEW YORK: wet hollow, Riverhead, Southampton, Suffolk Co., July 25–Aug. 3, 1920, *St. John*, no. 2681 (TYPE in Herb. Gray.). NEW JERSEY: South Amboy, Middlesex Co., *Mackenzie*, no. 1906. VIRGINIA: Little Neck, Princess Anne Co., *Fernald & Long*, no. 3899. NORTH CAROLINA: Raleigh, Wake Co., *Godfrey*, no. 4052; Gilson, Scotland Co., *Godfrey*, no. 5073.

Var. *subelliptica*, at the northern border of its range, has often been taken for a hybrid of *Alnus serrulata* (var. *vulgaris*) and *A. rugosa* (var. *typica*) and in outline of leaf it is suggestive of such an origin. It has, however, the characteristic bark, glutinous or gummy quality, branching of inflorescence and venation and serrulation of leaves of *A. serrulata*, not of *A. rugosa*. In southern New England and New York the two species meet, but farther south, from eastern Maryland to Georgia, no representative of the latter species is known.

Var. SUBELLIPTICA, forma **nanella,** f. nov. (TAB. 989), nana, 0.5–1 m. alta; foliis elliptico-obovatis 2–5 cm. longis, subtus subvelutinis; strobilis maturis 6–12 mm. longis.—VIRGINIA: dwarf shrubs with scattered simple stems only 5–8 mm. thick, springy sphagnous and argillaceous bog, Ram-hole Swamp, Seward Forest, near Triplett, Brunswick Co., June 22 and Sept. 13, 1944, *Fernald (and Lewis)*, no. 14,596 (TYPE in Herb. Gray.); with *Lachnocaulon anceps, Sarracenia flava*, etc., bushy sphagnous swamp southeast of Petersburg, at head of Poo Run, Prince George Co., *Fernald & Long*, no. 6167.

EXPLANATION OF PLATES

PLATE 976, ALNUS INCANA (L.) Moench.: FIG. 1, leading shoot, with foliage and young aments, × 1, from Breslau, Sept. 20, 1908, *Ziesché;* FIG. 2, lower surface of leaf, × 10, from Charlottenbrunn, Silesia, *Baenitz*, no. 1373; FIG. 3, inflorescence, × 1, from Möenlycke, April, 1890, *Walter Unlemann*, Fl. Scand.; FIG. 4, mature cones, from *Baenitz*, no. 1373; FIG. 5, half a cone, × 4, from Wurzburg, *Fl. exsicc. Bavar.*, no. 56; FIG. 6, bract, × 10, from Bohemia, July, 1887, *Fopitze;* FIG. 7, nutlet, × 10, from same specimen as fig. 6.

PLATES 977 and 978, A. RUGOSA (Du Roi) Spreng., var. TYPICA H. Winkl. PLATE 977: FIG. 1, fruiting branch, × 1, of shrub spread from cultivation in Europe, from Gehölze an der Lüneburger Eisenbahn nach Motrich, Wittenberge, *Baenitz, Herb. Dendrol.* no. 1214; fig. 2, venation of lower leaf-surface, × 10, from no. 1214; FIG. 3, half a cone, × 4, from no. 1214; FIG. 4, nutlet, × 10, frrom no. 1214. PLATE 978: FIG. 1, fruting branch from Narrows Island, Black Lake, New York, *Fernald, Wiegand & Eames*, no. 14,251; FIG. 2,

venation of lower leaf-surface, × 10, from no 14,251; FIG. 3, portion of cone, × 4, from no. 14,251; FIG. 4, achene, and FIG. 5, bract, × 10, from no. 14,251.

PLATE 979, FIGS. 1–3, A. RUGOSA, var. TYPICA: FIG. 1, terminal leaves of vegetative sprout, × ca. ½, from TOPOTYPE, Harbke Garten, *Ehrhart*, no. 88; FIG. 2, branches of strictly pistillate shrub, × 1, from Townshend, Vermont, June 2, 1912, *L. A. Wheeler;* FIG. 3, inflorescence, × 1, from West Roxbury, Massachusetts, April 9, 1906, *F. F. Forbes.* FIG. 4, forma EMERSONIANA Fernald: lower surface of leaf, × 10, from TYPE.

PLATES 980 and 981, A. RUGOSA, var. AMERICANA (Regel) Fernald. PLATE 980: FIG. 1, fruiting branch, × 1, from Douglastown, Gaspé Co., Quebec, Aug. 22, 1904, *Collins, Fernald & Pease;* FIG. 2, bark, × 1, from Rindge, New Hampshire, Sept. 8, 1917, *C. F. Batchelder;* FIG. 3, group of cones, × 4, from same specimen as fig. 1. PLATE 981: FIG. 1, foliage and young aments of larger-leaved specimen, × 1, from Hillsborough, New Hampshire, Sept. 3, 1921, *C. F. Batchelder;* FIG. 2, inflorescence, × 1, from Buckland, Massachusetts, April 11, 1904, *F. F. Forbes.*

PLATE 982, FIGS. 1–3, A. RUGOSA, var. AMERICANA, forma HYPOMALACA Fernald: FIG. 1, foliage, × 1, of TYPE; FIG. 2, foliage of vigorous sprout, × 1, from Tewksbury, Massachusetts, *Fernald & Bartlett*, no. 15; FIG. 3, lower surface of leaf, × 10, from TYPE. FIG. 4, var. AMERICANA, forma TOMOPHYLLA Fernald; leaf, × 1, from TYPE.

PLATES 983 and 984, A. SERRULATA (Ait.) Willd., var. VULGARIS Spach. PLATE 983, extreme with more acute leaves, "Foliis obovatis acutis", *Aiton:* FIG. 1, foliage of vigorous sprout-shoot, × 1, from Newton, Massachusetts, *Wm. Boott;* FIG. 2, foliage and incipient inflorescence of fertile branch, × 1, from Oceana, Virginia, *Fernald & Long*, no. 3896; FIG. 3, inflorescence, × 1, from Centerville, Massachusetts, April 18, 1897, *E. F. Williams;* FIG. 4, old cones, × 1, from Weymouth, New Jersey, *Long*, no. 25,358; FIG. 5, half a cone, × 4, from Stoneham, Massachusetts, April 16, 1896, *W. P. Rich;* FIG. 6, nutlet, × 10, from *Long*, no. 25,358. PLATE 984, extreme with obtuse leaves; FIG. 1, TYPE, × 1, of var. *obtusifolia* Regel; FIG. 2, narrower leaf (approaching forma *nanella*), × 1, from Richmond, Rhode Island, Aug. 20, 1919, *Fernald & Collins;* FIG. 3, broadest-leaved extreme, approaching var. *subelliptica*, × 1, from Wareham, Massachusetts, Sept. 18, 1928, *C. H. Knowlton;* FIG. 4, venation of lower leaf-surface, × 10, from same leaf as in fig. 2; FIG. 5, young inflorescences of staminate shrub, × 1, from south of South Quay, Virginia, *Fernald & Long*, no. 11,559.

PLATE 985, A. SERRULATA, var. VULGARIS, forma NOVEBORACENSIS (Britton) Fernald: FIG. 1, TYPE, × ½, of *A. noveboracensis* Britton; FIG. 2, tip with incipient inflorescence, × ½, from Selkirk, Oswego Co., New York, *Fernald, Wiegand & Eames*, no. 14,247; FIG. 3, fruiting cones, × 1, from no. 14,247; FIG. 4, lower surface of leaf, × 10, from no. 14,247; FIG. 5, bark, × 1, from Orono, Maine, *Fernald & Long*, no. 13,473.

PLATE 986, A. SERRULATA, var. SUBELLIPTICA Fernald, all figs. from TYPE: FIG. 1, foliage and incipient inflorescence, × 1; FIG. 2, inflorescence, × 1; FIG. 3, fruit, × 1; FIG. 4, bract, × 10; FIG. 5, nutlet, × 10.

PLATE 987, A. SERRULATA, var. SUBELLIPTICA, forma EMARGINATA Fernald, all figs. from TYPE: FIG. 1, fruiting branch, × 1; FIG. 2, largest leaves, × 1; FIG. 3, flowering tip, × 1; FIG. 4, lower surface of leaf, × 10.

PLATE 988, A. SERRULATA, var. SUBELLIPTICA, forma MOLLESCENS Fernald: FIG. 1, leaf and incipient inflorescence, × 1, from TYPE; FIG. 2, old cones, × 1, of TYPE; FIG. 3, lower surface of leaf, × 10, from TYPE; FIG. 4, branch with unusually long cones, × 1, from Little Neck, Virginia, *Fernald & Long*, no. 3899.

PLATE 989, A. SERRULATA, var. SUBELLIPTICA, forma NANELLA Fernald, all figs. from TYPE: FIGS. 1 and 2, fruiting branches, × 1; FIG. 3, lower surface of leaf, × 10; FIG. 4, nutlet, × 10.

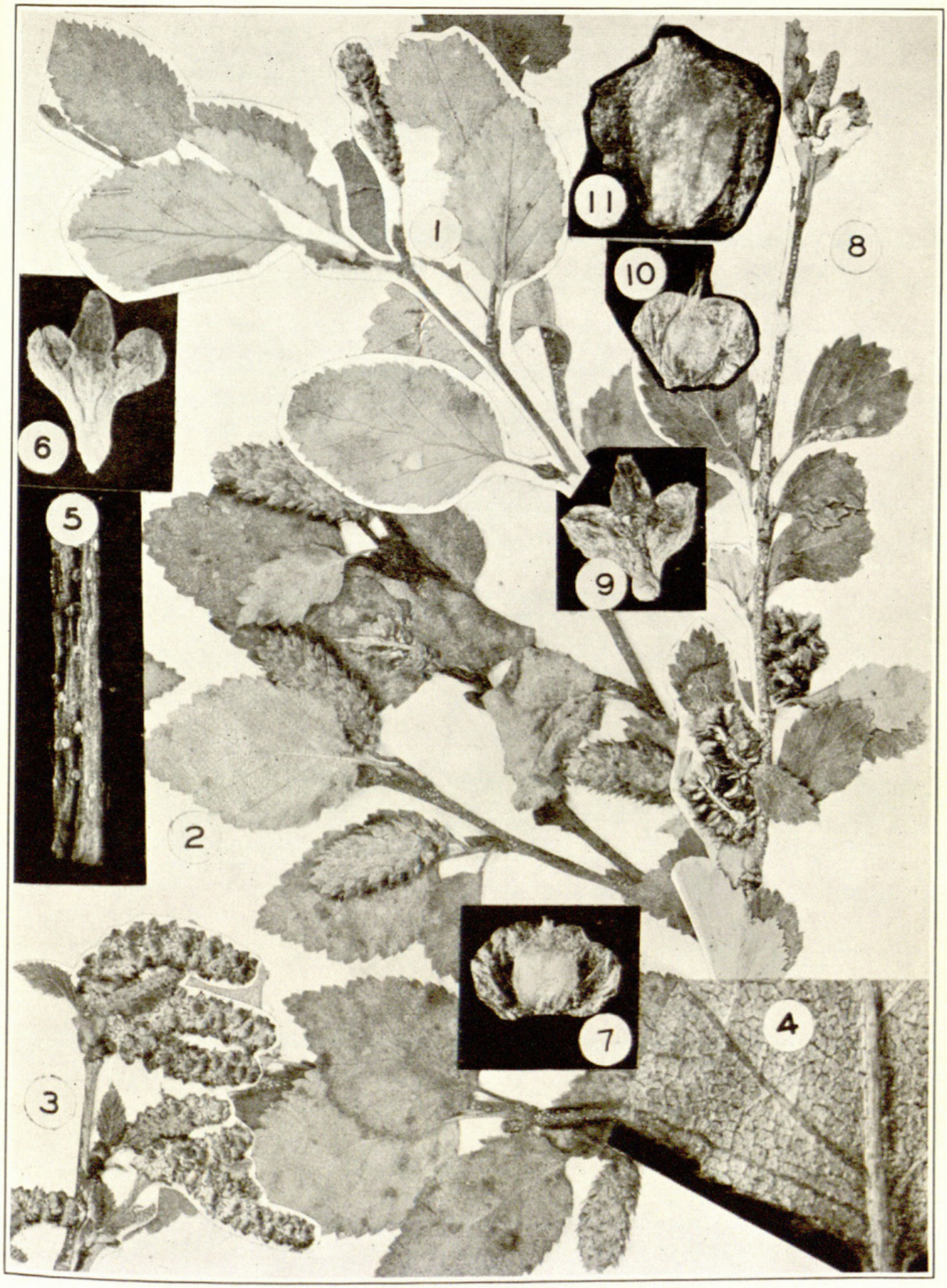

Photo. B. G. Schubert

BETULA MINOR: FIG. 1, portion of TYPE, × 1; FIG. 2, fruiting branch, × 1; FIG 3, staminate aments, × 1; FIG. 4, lower surface of leaf, × 5; FIG. 5, branchlet, × 10; FIG. 6, fruiting bract, × 4; FIG. 7, samara, × 4.

B. MICROPHYLLA: FIG. 8, fruiting branch (probably of ISOTYPE), × 1; FIG. 9, fruiting bract, × 4; FIG. 10, samara, × 4.

B. ALBA, var. TORTUOSA: FIG. 11, samara, × 4.

Photo. B. G. Schubert

BETULA PAPYRIFERA: FIG. 1, fruiting branch, × 1; FIG. 2, staminate aments, × 1; FIG. 3, tip of young shoot, × 5; FIG. 4, fruiting bract, × 4; FIG. 5, samara, × 4.

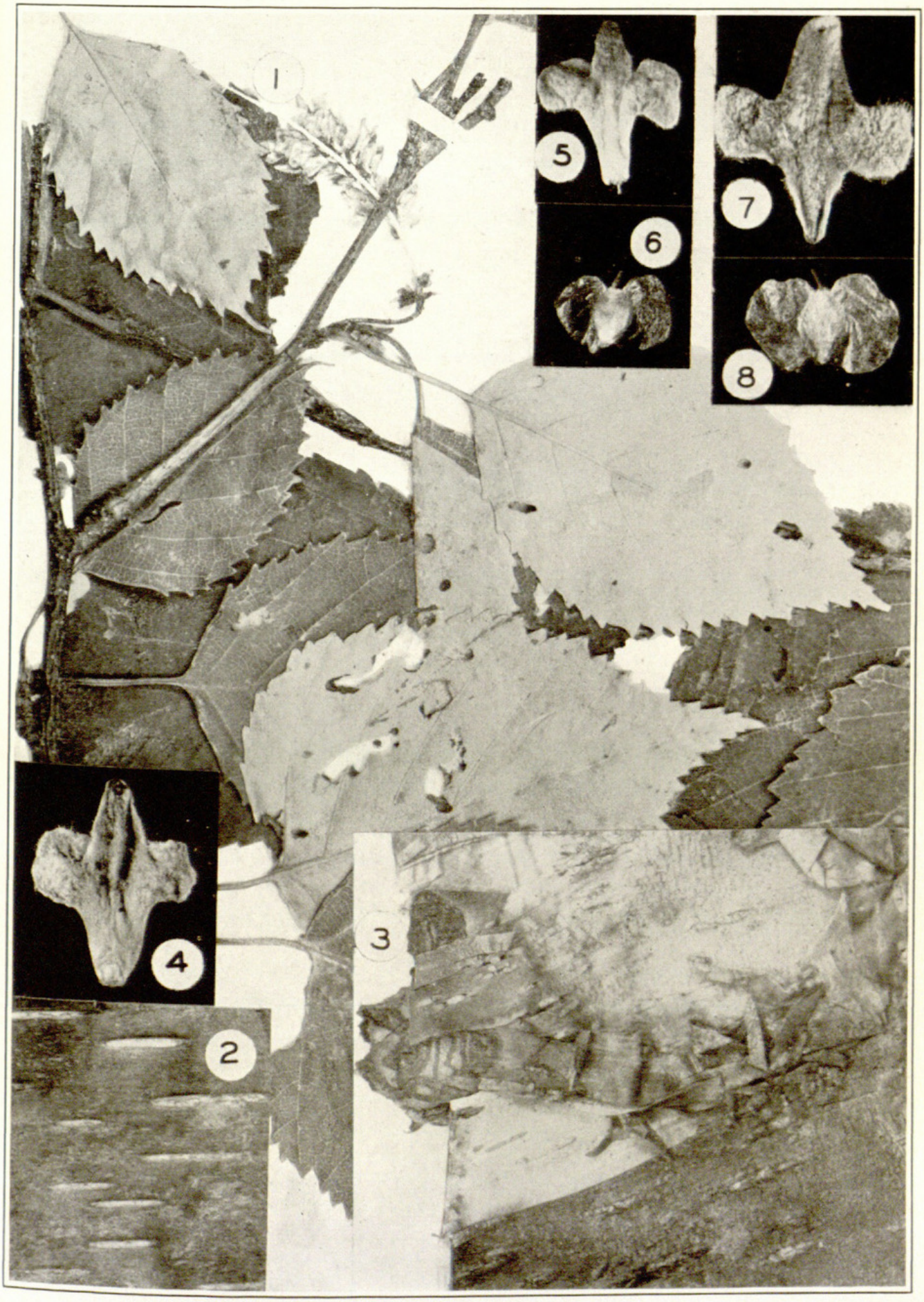

Photo. B. G. Schubert

BETULA PAPYRIFERA, var. COMMUTATA: FIG. 1, portion of *Lyall's* specimen, × 1; FIG. 2, characteristic close bark, × 1; FIG. 3, exfoliating bark from base of old trunk, × 1; FIGS. 4, 5 and 7, fruiting bracts, × 4; FIGS. 6 and 8, samaras, × 4.

Photo. B. G. Schubert

BETULA OCCIDENTALIS, var. FECUNDA: FIG. 1, portion of TYPE, × 1; FIG. 2, flowering branchlet, × 1; FIG. 3, staminate aments, × 1.

Photo. B. G. Schubert

BETULA PAPYRIFERA, var. PENSILIS: FIG. 1, portion of TYPE, × 1; FIG. 2, fruiting bract, × 4; FIG. 3, samara, × 4; FIG. 4, branch with younger aments, × 1.

Photo. B. G. Schubert

BETULA PAPYRIFERA, var. MACROSTACHYA: FIG. 1, portion of TYPE, × 1; FIG. 2, fruiting bract, × 4; FIG. 3, samara, × 4.

Var. MACROSTACHYA, forma LONGIPES: FIG. 4, portion of TYPE, × 1.

Photo. B. G. Schubert

BETULA PAPYRIFERA, var. ELOBATA: FIG. 1, portion of TYPE, × 1; FIG. 2, immature samara embraced by bract, × 4; FIG. 3, immature bracts, × 4.

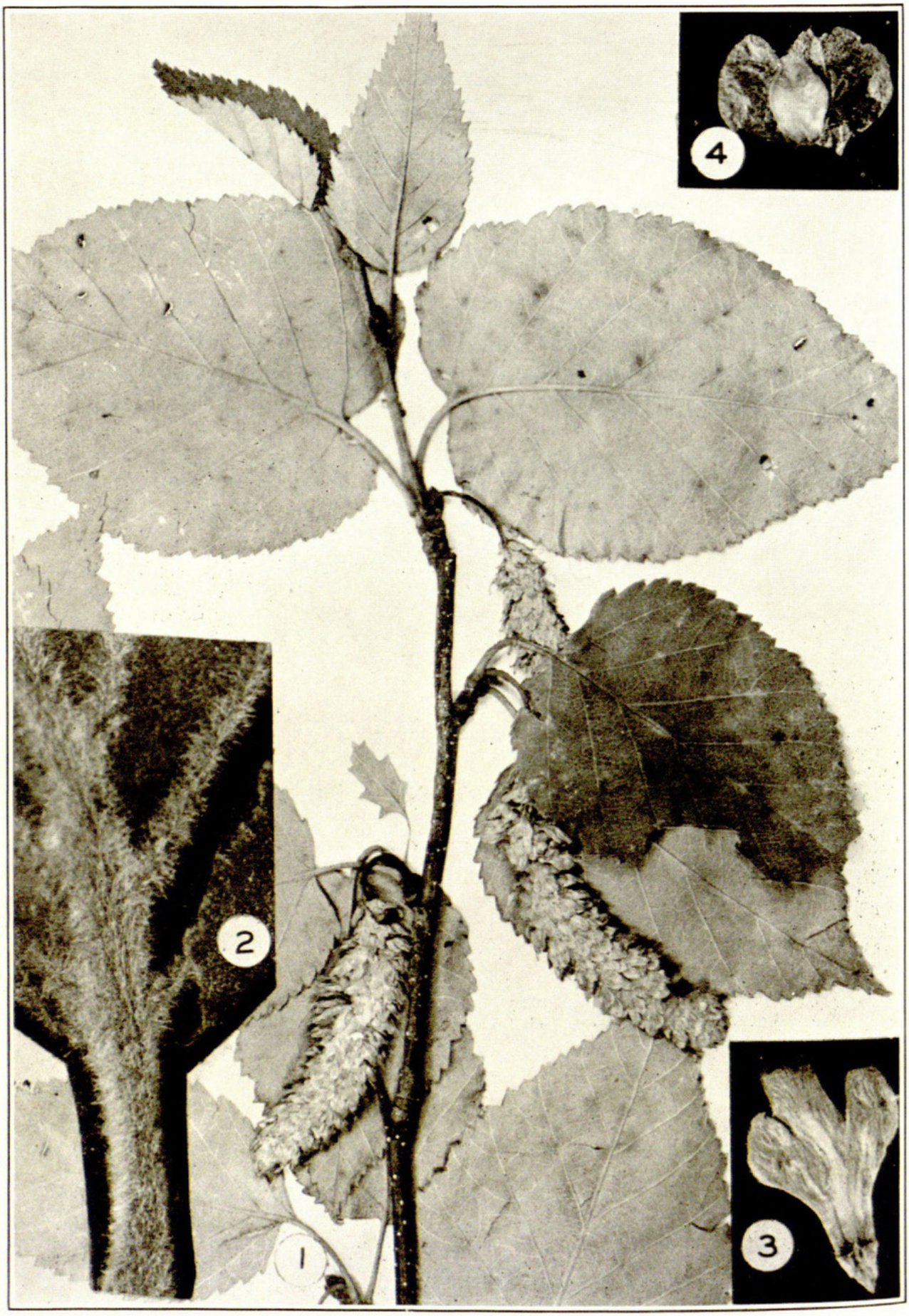

Photo. B. G. Schubert

BETULA PAPYRIFERA, var. CORDIFOLIA: FIG. 1, portion of fruiting branch, × 1; FIG. 2, tip of vigorous sprout, × 5; FIG. 3, fruiting bract, × 4; FIG. 4, samara, × 4.

Photo. B. G. Schubert

BETULA PAPYRIFERA, var. HUMILIS: FIG. 1, portion of branch and Regel's label, from TYPE, × 1; FIG. 2, lower surface of leaf, × 10; FIG. 3, fruiting bract, × 4; FIG. 4, samara, × 4; FIG. 5, fruiting tip, × 1.

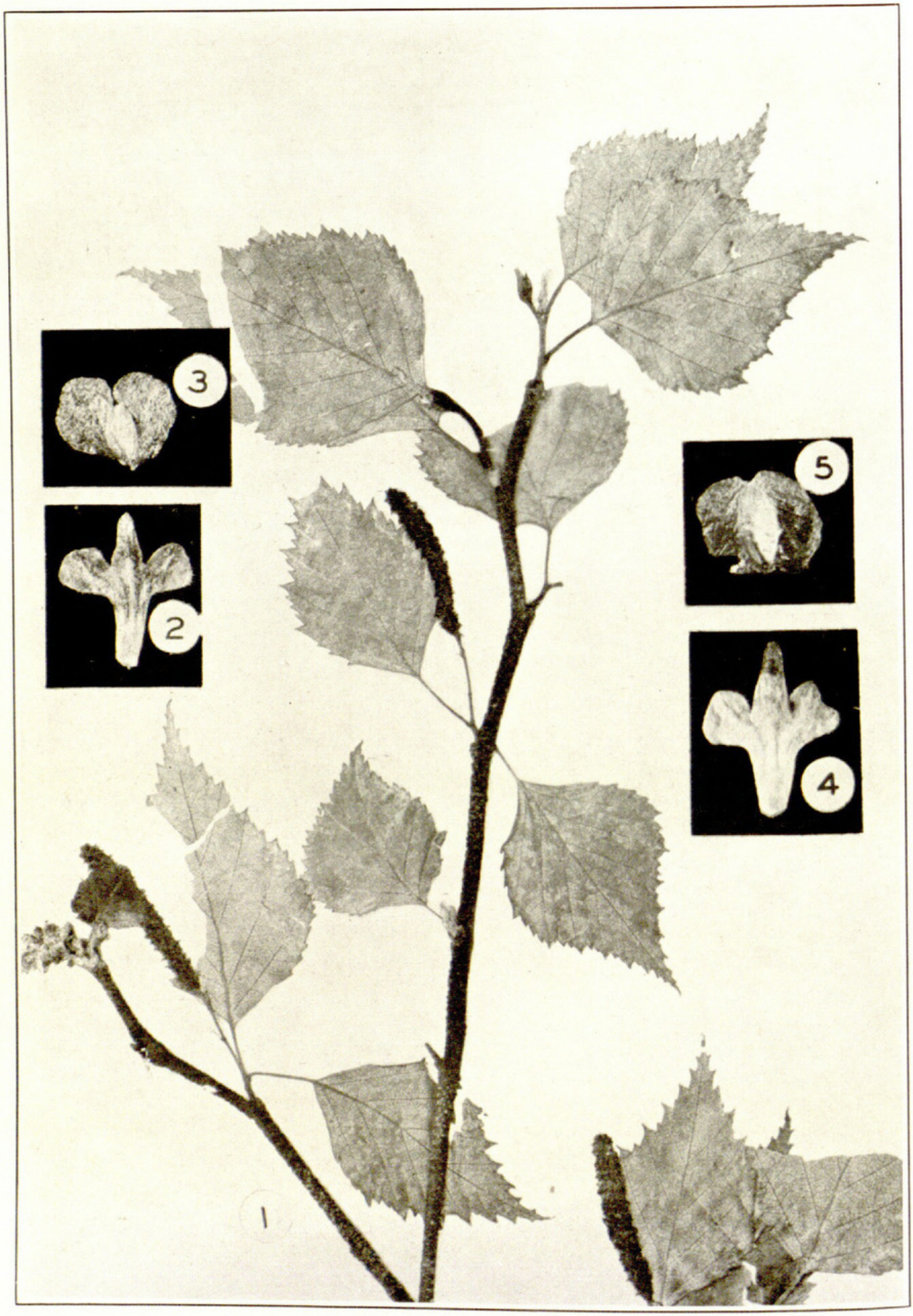

Photo. B. G. Schubert

BETULA PAPYRIFERA, var. HUMILIS: FIG. 1, specimen, × 1, cited by Sargent as his *B alaskana;* FIGS. 2 and 4, fruiting bracts, × 4; FIGS. 3 and 5, samaras, × 4.

Photo. B. G. Schubert

BETULA BOREALIS: FIG. 1, mature branchlets, × 1; FIG. 2, immature fruiting branch, × 1; FIG. 3, tip of young branch, × 5; FIG. 4, fruiting bract, × 4; FIG. 5, samara, × 4.

Photo. B. G. Schubert

BETULA UBER: FIG. 1, fruiting branchlets from ISOTYPE, × 1; FIG. 2, upper surface of half a leaf, × 2, showing venation and toothing; FIG. 3, portion of lower surface of leaf, × 2; FIG. 4, fruiting bract, × 4; FIG. 5, samara, × 4.

B. LENTA: FIG. 6, lower surface of half a leaf, × 1, to show venation and toothing; FIG. 7, fruiting bract, × 4.

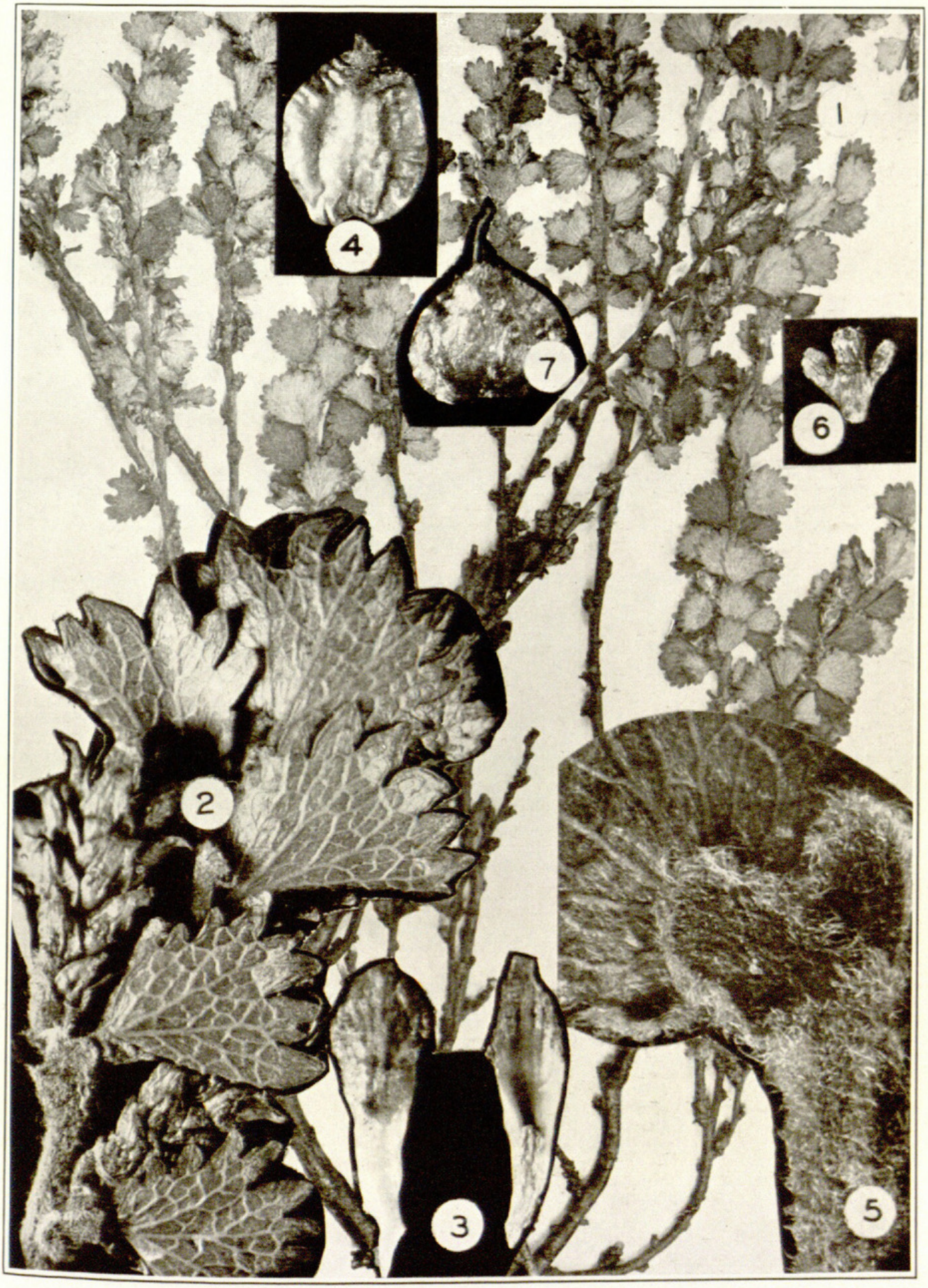

Photo. B. G. Schubert

BETULA TERRAE-NOVAE: FIG. 1, portion of TYPE, × 1; FIG. 2, tip of fruiting branchlet, × 5; FIG. 3, two fruiting bracts, × 10; FIG. 4, nutlet, × 10.
B. NANA: FIG. 5, tip of branchlet, × 5; FIG. 6, fruiting bract, × 4; FIG. 7, samara, × 10.

Photo. B. G. Schubert

ALNUS INCANA: FIG. 1, shoot with foliage and young aments, × 1; FIG. 2, lower surface of leaf, × 10; FIG. 3, inflorescence, × 1; FIG. 4, mature cones, × 1; FIG. 5, half a cone, × 4; FIG. 6, bract, × 10; FIG. 7, nutlet, × 10.

Photo. B. G. Schubert

ALNUS RUGOSA, var. TYPICA: FIG. 1, fruiting branch of the shrub cultivated and naturalized in Germany, derived, presumably, from the original specimen; FIG. 2, venation of lower leaf-surface from same collection, × 10; FIG. 3, half a cone from same collection, × 4; FIG. 4, nutlet, × 10.

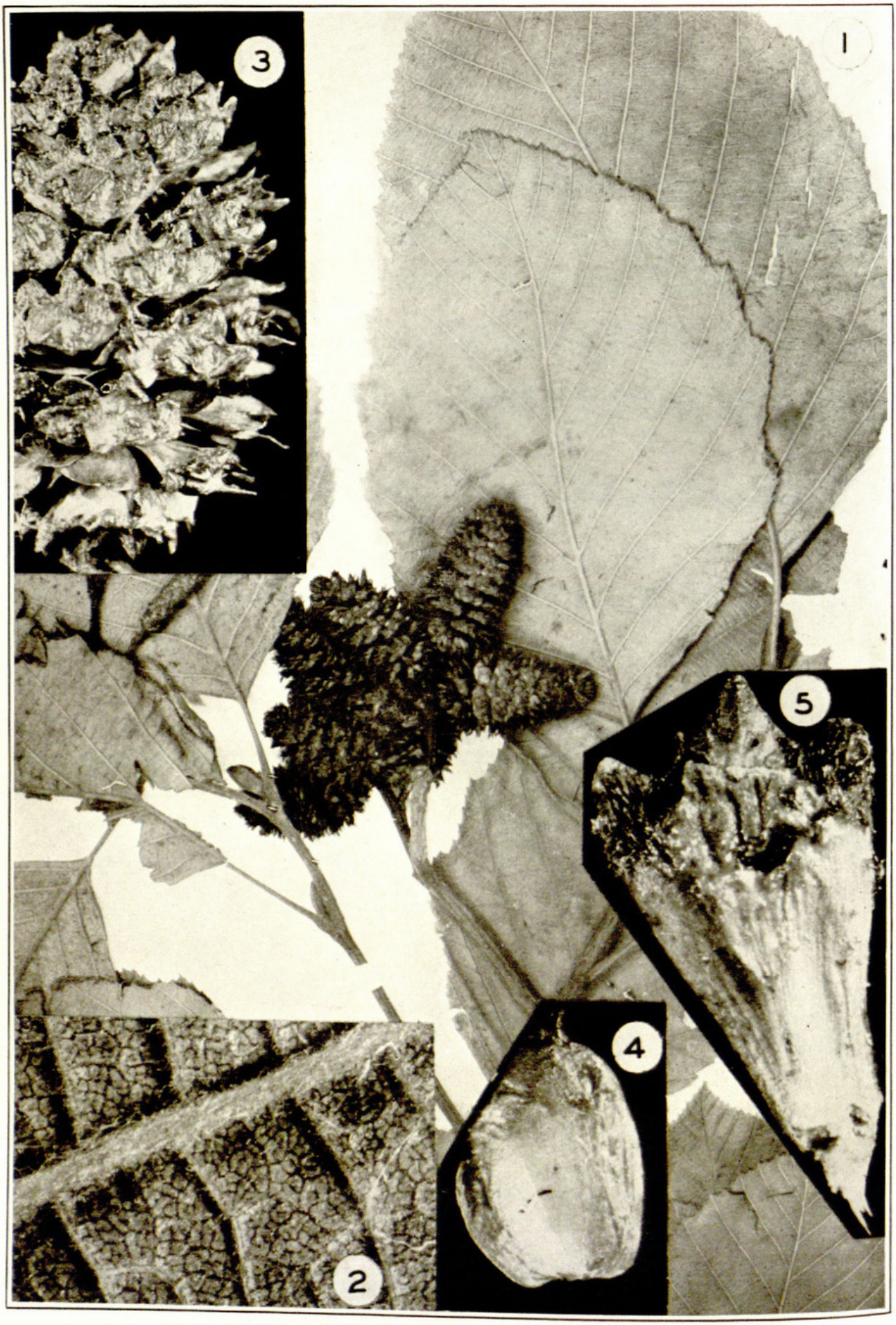

Photo. B. G. Schubert

ALNUS RUGOSA, var. TYPICA, native American shrub: FIG. 1, fruiting branch, × 1; FIG. 2, venation of lower leaf-surface, × 10; FIG. 3, portion of cone, × 4; FIG. 4, achene, × 10; FIG. 5, bract, × 10.

Photo. B. G. Schubert

ALNUS RUGOSA, var. TYPICA: FIG. 1, terminal leaves of vegetative sprout of TOPOTYPE, × ?1/2, after photo. by Professor *Alfred Rehder;* FIG. 2, branches of strictly pistillate shrub, × 1; FIG. 3, typical inflorescence, × 1.
A. RUGOSA, forma EMERSONIANA: lower surface of leaf of TYPE, × 10.

Photo. B. G. Schubert

ALNUS RUGOSA, var. AMERICANA: FIG. 1, fruiting branch, × 1; FIG. 2, bark, × 1; FIG. 3, cones, × 4.

Photo. B. G. Schubert

ALNUS RUGOSA, var. AMERICANA: FIG. 1, foliage and young aments of large-leaved shrub, × 1; FIG. 2, inflorescence, × 1.

Photo. B. G. Schubert

ALNUS RUGOSA, var. AMERICANA, forma HYPOMALACA: FIG. 1, foliage of TYPE, × 1; FIG. 2, leaf of vigorous sprout, × 1; FIG. 3, lower surface of leaf, × 10.
Var. AMERICANA, forma TOMOPHYLLA: FIG. 4, leaf of TYPE, × 1.

Photo. B. G. Schubert

ALNUS SERRULATA, var. VULGARIS, extreme with more acute leaves as in Aiton's type, "foliis obovatis acutis": FIG. 1, foliage of vigorous sprout, × 1; FIG. 2, fertile branch, × 1; FIG. 3, inflorescence, × 1; FIG. 4, old cones, × 1; FIG. 5, half a cone, × 4; FIG. 6, nutlet, × 10.

Photo. B. G. Schubert

ALNUS SERRULATA, var. VULGARIS, extreme with obtuse leaves: FIG. 1, type, × 1, of var. *obtusifolia* Regel; FIG. 2, narrow leaf, × 1; FIG. 3, broad leaf, × 1; FIG. 4, venation of lower leaf-surface, × 10; FIG. 5, inflorescence of staminate shrub, × 1.

Photo. B. G. Schubert

ALNUS SERRULATA, var. VULGARIS, forma NOVEBORACENSIS: FIG. 1, TYPE, × ½; FIG .2, tip of branchlet with incipient inflorescence, × ½; FIG. 3, fruiting cones, × 1; FIG. 4, lower surface of leaf, × 10; FIG. 5, bark, × 1.

Photo. B. G. Schubert

ALNUS SERRULATA, var. SUBELLIPTICA, all figs. from TYPE: FIG. 1, foliage and incipient inflorescence, × 1; FIG. 2, inflorescence, × 1; FIG. 3, cones, × 1; FIG. 4, fruiting bract, × 10; FIG. 5, nutlet, × 10.

Photo. B. G. Schubert

ALNUS SERRULATA, var. SUBELLIPTICA, forma EMARGINATA, all figs. from TYPE: FIG. 1, fruiting branch, × 1; FIG. 2, largest leaves, × 1; FIG. 3, flowering tip, × 1; FIG. 4, lower surface of leaf, × 10.

Photo. B. G. Schubert

ALNUS SERRULATA, var. SUBELLIPTICA, forma MOLLESCENS, FIGS. 1–3 from TYPE: FIG. 1, leaf and incipient inflorescence, × 1; FIG. 2, old cones, × 1; FIG. 3, lower surface of leaf, × 10; FIG. 4, unusually long cones, × 1.

Photo. B. G. Schubert

ALNUS SERRULATA, var. SUBELLIPTICA, forma NANELLA, all figs. from TYPE: FIGS. 1 and 2, fruiting branches, × 1; FIG. 3, fruiting cones, × 1; FIG. 4, lower surface of leaf, × 10; FIG. 4, nutlet, × 10.