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A manual of the genus *Usnea*, as represented in North and
Middle America, north of the 15th parallel

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(WITH PLATES 1-7)

In my "Preliminary review of the genus *Usnea*" (Bull. Torrey Club 36: 309-327. *pl.* 21-23. 1909), based on a long field and laboratory study of the plants as represented particularly in New England, I made no attempt to cast aside the nomenclature adopted by Tuckerman, the recognized authority for American workers. I intimated then, however, that a broader study of the genus, with the application of the present rules of nomenclature, would lead no doubt to a better understanding and hence to a more lucid taxonomy. I have now reached a point where the continuous use of a carefully determined classification finds no inadequacies, and I therefore see no reason to withhold its publication for a longer period of time, as I believe it soundly based and likely therefore to meet with general adoption, at least by the broader and more conservative workers. It is in no way new, but rather very old.

A revision of the genus becomes necessary for three reasons: first, the current use of a nomenclature that is illegitimate according to the accepted rules; secondly, the unwarranted use of the specific term *barbata*, fulfilling at least a sectional, if not almost a generic conception; and, lastly, the hopeless misunderstanding of species and subspecies, evidenced by the extensive synonymy. Linnaeus' species *Lichen plicatus*, *L. barbatus*, *L. hirtus*, and *L.*

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floridus, here named in order of pagination * priority, all seem to intergrade and belong to one species ; with a broader conception, however, true transitional examples are in reality rare, if in some cases occurring at all.

The difficulty has been that too many purely contingent varieties have been described and recognized, so that the Linnaean conception and nomenclature has been embarrassed ; whereas, for the papillate species (all he considered), it was exceedingly near the proper elucidation. Each of the following species represents a variable, but a distinct, plant, found both fruited and sterile. Though true intergrades may appear occasionally, they are not important enough to make it necessary for us to blind our understanding by adopting a special nomenclature to explain their presence ; if we should do this and should follow the present rules of nomenclature, we must cast aside appropriate names, applicable original descriptions, and good recognizable figures, and the general procedure of nearly two hundred years, and use the names simply as handles with no other significant connection whatever. This, it is plain, would be distinctly undesirable.

That there must come a reaction from the naming of contingent phases in lichenology is evident. There is no halting if once it is begun, and the inevitable result is, names standing for unique individuals, and type localities reduced to certain fallen logs or crumbling ledges. The law of variability is being sadly overlooked. A study of the limits of variation in species will throw hundreds of names already given into a now tangled synonymy.

Two distinct types of subspecies have been recognized, only one of which has a proper claim to recognition. The first type is what I have termed in my former paper "contingent phases," states of development brought about by very local and temporary conditions ; as a result of separations thus based we have in our synonymy such subspecies and forms as *hirta*, *rubiginea*, etc. The second type of subspecies, based on the results of actual morphological differentiation, due to the fixed but varied environmental effects of wide geographical distribution or of altitude, are, it is needless to say, scientifically grounded and worthy of recognition, if the separations of this nature are well defined and not of

* Unrecognized by the Vienna Rules.

trivial and opinionable character. Of this type we have, curiously enough, in our area no named examples in this genus. Others based on mere morphological reduction, a condition seen in *U. plicata*, *U. longissima*, and *U. angulata*, as represented by comparing specimens from the southern and northern limits of their range, hardly need titles of separation, nor do the abnormally developed examples growing in regions under particularly acceptable conditions. *Usnea strigosa* (Ach.) and *U. californica* Herre represent this class.

USNEA * (Dill.) Adans. Fam. Pl. 2: 7. 1763

DESCRIPTION: *Apothecia* lateral, subterminal or terminal, peltate, applanate, coriaceous, emarginate, periphery generally ciliate; thalline exciple glabrous, lacunose, echinate or ciliate, concolorous, pale stramineous or virescent, sometimes pruinose (rarely dichroic-red). *Asci* clavate, containing 8 spores; *paraphyses* gelatinous, filamentous. *Spores* monoblast, hyaline, ellipsoid. *Spermogones* lateral, immersed in shallow, colorless conceptacles. *Sterigmata* simple or subsimple. *Spermatia* fusiform or acicular-cylindrical, incrassate, apices truncate. *Soredia* normal, occasional on all forms. *Cephalodia* lateral, concolorous or darker, sometimes black. *Thallus* erect, subpendulous, or pendulous, branched, fibrillose or efibrillose, terete, compressed or angulate, nitidous, glabrous, scabrous, squamose, or foveolate, papillate or epapillate, pale stramineous, virescent, green, or tawny; cortex subcrustose, subcontiguous, bambusaceous, or articulate; gonidia "*Protococcus*"; † medulla cottonous, central indurated chondroid cord percurrent. ‡

Thallus papillate

USNEA FLORIDA (L.) Web.

TYPE: Species based on *Usnea vulgatissima* of Dillenius; the Dillenian specimens "typical and fertile" are in the Dillenian herbarium, Botanic Gardens, Oxford, England, and are "*Usnea florida* (L.)" *fide* Crombie. §

* From the Arabic = usnah.

† "*Cystococcus humicola*" according to A. Schneider, Text-Book Lich. 99. 1897.

‡ For microscopic anatomy see Schwendener in Naegeli, Beitr. Wiss Bot. 2: 110-144. *pl. 1, 2.* 1860. Nylander, Synop. Lich. *pl. 8. f. 7-11.* 1858-60; and Schulte, Beih. Bot. Centralb. 18²: 1-22. 1904.

§ Jour. Linn. Soc. 17: 554-556. 1880.

TYPE LOCALITY: "Europæ."

ORIGINAL DESCRIPTION: "Filamentosus ramosus erectus, scutellis radiatis," L. Sp. Pl. 1156. 1753.

FIGURES: [Micheli, Nov. Pl. Gen. *pl.* 39. *f.* 5e. 1739.]*
[Dill. Hist. Musc. *pl.* 13. *f.* 12, a, b, c, d; *f.* 13, a, b, c, d. 1741.]
Willd. Röm. & Ust. Mag. Bot. 2⁴: *pl.* 1. *f.* 3. 1788. Hoffm.
Descript. et Adum. Pl. Lich. 2: *pl.* 30. *f.* 1, 2. 1794. Ach.
Kongl. Vet.-Acad. Nya Handl. 16: *pl.* 8. *f.* 1. 1795. Schrad.
Jour. Bot. 1: *pl.* 3. *f.* 1, 2. 1799. Sowerby, Eng. Bot. 13: *pl.*
872. 1801; 19: *pl.* 1354. 1804. Ach. Meth. Lich. *pl.* 6. *f.* 3.
1803. Sprengel, Anleit. 3: *pl.* 10. *f.* 105. 1804. Fée, Essai
sur les Crypt. *pl.* 3. *f.* 4, 5; *pl.* 32. *f.* 5. 1824.

SYNONYMY: [*Usnea vulgatissima*, etc. Dill. *loc. cit.* 67.]

Lichen floridus L. *loc. cit.* 1156.

Usnea florida Web.; Wigg. Prim. Fl. Holsat. 91. 1780.

DIAGNOSIS: *Thallus* erect, cespitose.

DESCRIPTION — typical: *Thallus* erect, cespitose, rigid, terete, virescent; cortex soon scabrous, and annularly scarred; *primary branches* coarse, *divaricate* (max. length 12 cm.); *secondary branches* subpedicellate, subdichotomous; *fibrils* short (6 mm.), *subequiform*, frequent or stipate, rectangularly divergent, rarely dichotomous. *Apothecia* common, terminal, ample, sometimes lacerate; disk pruinose, flesh-colored or buff, rarely virescent; periphery and thalline exciple ciliate. Spores $4-8\ \mu \times 3-6\ \mu$.

CONTINGENT PHASES: (a) With age blackening, crustose, brittle, leprous, abraded, nodular-bambusaceous, articulate, white medulla exposed, indurated cord visible.

(b) Branches sorediate, soredia often becoming confluent near the apices (*Lichen hirtus* L. *loc. cit.* 1155).

(c) Dichroic (red, either affecting all or part of the plant) (*Usnea florida*, var. *rubiginea* Michx. Fl. Bor.-Am. 2: 332. 1803).

(d) Strigose, apothecia very ample, disk now virescent (*Usnea florida*, γ *strigosa* Ach. Meth. Lich. 2: 310. 1803). This phase is most common in Mexican and Arizona plants.

(e) Apothecia small, cyathiform.

(f) Reduced, very cespitose, branches hispid and echinate.

(g) Branches somewhat naked, furcate, and apices attenuate.

(h) Nitidous or granulate, internodes somewhat inflated, apices

* Pre-Linnaean references are enclosed in brackets.

of fibrils recurved and sorediate (*Usnea barbata florida* f. *sorediifera* Arn. Flora 57: 569. 1874).

SUBSTRATA: Living deciduous and coniferous trees, specimens generally degenerate on other substrata.

GEOGRAPHICAL DISTRIBUTION: Common throughout North America, represented in all zones, and reaching its greatest development and luxuriance in the mountains of Mexico (8000 ft.), and becoming rare and poorly exhibited in the upper Boreal zone. It is not reported from Labrador, but it is generally recorded from Alaska, whence I have seen normal and well-fruited specimens.

OBSERVATIONS: This plant, *Usnea barbata*, a *florida* Fr. of Tuckerman, is the most cosmopolitan species of the genus; both its sterile and fertile forms, however, show enormous variation. It is nevertheless the typical species of the papillate group and makes the most natural starting point for the taxonomy and an understanding of the genus. ("Typus speciei est forma *florida*," Fr. Lich. Europ. 19. 1831.)

USNEA PLICATA (L.) Web.

TYPE: Species based on *Usnea vulgaris* of Dillenius; the "fertile" Dillenian specimen "sufficiently characteristic, though . . . broken up into three portions," is in the Dillenian herbarium, Botanic Gardens, Oxford, England, and is "*Usnea ceratina* Ach." *fide* Crombie.

TYPE LOCALITY: "Europae & Americae borealis." ("Habeo eandem ex Virginia a Jo. Mitchellio et ex Pennsylvania a Jo. Bartramo transmissam." — Dill.)

ORIGINAL DESCRIPTION: "Filamentosus pendulus, ramis implexis, scutellis radiatis," L. Sp. Pl. 1154. 1753.

FIGURES: [Dill. Hist. Musc. *pl.* 11. *f.* 1. 1741.] Sowerby, Eng. Bot. 4: *pl.* 2. 1795. Ach. Nova Acta Soc. Sci. Upsal. 7: *pl.* 7. *f.* 2. 1815. Schaer. Enum. Crit. Lich. Europ. *pl.* 1. *f.* 1. 1850. A. Schneider, Guide Study Lich. *pl.* 4. 1904.

SYNONYMY: [*Usnea vulgaris*, etc. Dill. *loc. cit.* 56.]

Lichen plicatus L. Sp. Pl. 1154. 1753.

Usnea plicata Web.; Wigg. Prim. Fl. Holsat. 91. 1780.

DIAGNOSIS: *Thallus* pendulous, plicate, strongly papillate; short rectangularly divergent fibrils sparse or wanting.

DESCRIPTION — typical: *Thallus pendulous, coarse, pliant, terete* (rarely angularly deformed), cortex at length proximally scabrous, annularly scarred, stramineous to virescent; *primary branches* coarse, at length intricately plicate, subpatent (max. length 130 cm.); *secondary branches* much divided, subdichotomous; *fibrils* polymorphous, tortuous, sparse or wanting, simple or commonly subdichotomous. *Apothecia* not uncommon, lateral and sessile, or subterminal, ample (1 cm.), now lacerate, disk flesh-colored or buff, periphery naked or ciliate. Spores as in *U. florida*.

CONTINGENT PHASES: (a) As in *U. florida*.

(b) Branches sorediate (*Usnea ceratina*, β *scabrosa* Ach. Lich. Univ. 620. 1810).

(c) Dichroic (red). This condition is rare, and never so far as observed affecting all parts of a plant (*Usnea ceratina*, var. β *scabrosa*, form *ferruginascens* Crombie, Trans. Essex Field Club 4: 60. 1885).

(d) Naked of fibrils, the latter rarely present as a minute hispid clothing (PLATE 3, FIGURE 2).

SUBSTRATA: Deciduous and coniferous trees, occasionally on dead wood.

GEOGRAPHICAL DISTRIBUTION: Common in the Austral and Transition zones, occurring also in a reduced, sterile, but perfectly characteristic state in the Boreal zone, reaching its most dwarf condition in Alaska (and Siberia).* It is best exhibited on the Pacific coast (Marin and San Mateo counties, California), where the plants are stramineous, and very pendulous (130 cm.), reaching possibly its highest development in Alpine Creek Cañon (1000 ft.), San Mateo Co., California, in the species (?) *Usnea californica* Herre, and in Mexico. Atlantic and Gulf coast specimens are less pendulous (30 cm.), generally virescent, and occasionally destitute of fibrils (see Bull. Torrey Club 36: pl. 21).

OBSERVATIONS: I have included under this species all forms heretofore separated under *ceratina*. The slight variation of *Usnea plicata* that answers to Schaerer's *U. ceratina* does not occur in North America so far as I have observed, nor is the form constant or desirable of recognition in the Old World according to the material I have examined, some of which was determined by Schaerer himself.

* This is *U. barbata*, d *plicata* Fr. of Tuckerman and most modern authors.

Usnea plicata barbata (L.) R. H. Howe, comb. nov.

TYPE: Species based on *Usnea barbata* of Dillenius; the "sterile" Dillenian specimen is in the Dillenian herbarium, Botanic Gardens, Oxford, England, and has been determined by Crombie as "*Usnea dasypoga* (Ach.)."

TYPE LOCALITY: "Europae & Americae septentrionalis." ("Eandem habeo ex Pensylvania."—Dill.)

ORIGINAL DESCRIPTION: "Filamentosus pendulus subarticulatus, ramis patentibus," L. Sp. Pl. 1155. 1753.

FIGURES: [Dill. Hist. Musc. *pl.* 12. *f.* 6. 1741.]

SYNONYMY: [*Usnea barbata*, etc. Dill. *loc. cit.* 63.]

Lichen barbatus L. Sp. Pl. 1155. 1753.

Usnea barbata Web.; Wigg. Prim. Fl. Holsat. 91. 1780.

DIAGNOSIS: Similar to *U. plicata* but *less coarse*, secondary branches *closely* beset with *equiform rectangularly divergent fibrils*.

DESCRIPTION—typical: *Thallus* pendulous, less coarse than in *U. plicata*, terete, scabrous, annularly scarred, stramineous to virescent, papillae now sparse, often confined to proximal portions of primary branches (now ruptured-sores); *primary branches* proximally coarse, rarely at length intricate, subpatent (max. length 120 cm.); *secondary branches* simple, occasionally dichotomous; *fibrils* equiform (2–8 mm.), subflexuous, stipate, simple, rarely dichotomous, rectangularly divergent. *Apothecia* as in *U. plicata*, but smaller (6 mm.) and very infrequent. Spores as in *U. florida*.

CONTINGENT PHASES: (*a, b, c*) As of *U. plicata*.

(*d*) Primary branches darkening.

SUBSTRATA: As in *U. plicata*.

GEOGRAPHICAL DISTRIBUTION: Common throughout the upper Austral and Transition zones, occurring also in the lower Boreal. Like the last, it is better exhibited on the Pacific coast, where the plants are stramineous, intricate and very pendulous (130 cm.). On the North Atlantic coast it is virescent, and rarely obtains a pendular length of over 35 cm. Here also it is less intricate, generally consisting of six or eight simple branches arising from a single base.

OBSERVATIONS: This plant, *Usnea barbata*, c *dasypoga* Fr. of Tuckerman, is similar to *U. plicata*, but it is never so coarse, its secondary branches are simple or subsimple and have rectangu-

larly divergent equiform fibrils. These secondary branches taken alone strongly suggest *U. longissima*, but are generally somewhat papillate or papillo-sorediate, and not covered with a white farinaceous soredial crust. Dillenius' figure shows a characteristic intermediary condition, some of the secondary branches suggesting the species *U. plicata*, while the majority are nearly typical of the present subspecies. This intermediary state is not uncommon, a specimen from Newfoundland (Waghorne, 1890, called *U. longissima*) in the herbarium of the Academy of Natural Sciences, Philadelphia, almost exactly duplicates the subject of Dillenius' figure, showing the unusual dichotomously branched fibrils.

Thallus epapillate

USNEA TRICHODEA Ach.

TYPE: Not indicated, but the specimen on which the species was based is in the Acharian herbarium, Universitetets Botaniska Institution, Helsingfors, *fide* Prof. Dr. Fred. Elfring, *in litt.*, Apr. 7, 1909.

TYPE LOCALITY: "Nova Scotia" [*"Menzies," fide* Elfring].

ORIGINAL DESCRIPTION: "Thallo subcrustaceo filamentoso tenerrimo tereti diffuso albo-pallescente, lorulis capillaceis ramosis fibrillis subsecundis; orbillis concoloribus margine tenui inflexo nudo integro," Ach. Meth. Lich. 2: 312. 1803.

FIGURE: Ach. *loc. cit.* pl. 8. f. 1.

SYNONYMY: *Usnea trichodea* Ach. *loc. cit.* 2: 312. 1803.

DIAGNOSIS: *Thallus pendulous*, glabrous, fibrils *capillaceous*.

DESCRIPTION — typical: *Thallus* pendulous, slender, mollitinous, terete, virescent, cortex *glabrous* or *nitidous*, annularly scarred, at length bambusaceous; *primary branches* slender, at length proximally scabrous, much divided (max. length 25 cm.); *secondary branches* subdichotomous, much divided; *fibrils capillaceous*, tortuous. *Apothecia* common, marginate, at length lacerate, lateral, sessile, small (diameter 4 mm.), disk flesh-colored or buff, margins naked or sparsely ciliate. *Spores* 4–8 μ $\times$ 3–6 μ .

CONTINGENT PHASES: (a) As in *U. plicata*.

(b) Cortex now locally ruptured by soredia.

SUBSTRATA: Coniferous trees, frequently on dead wood, and occasionally on accompanying deciduous trees.

GEOGRAPHICAL DISTRIBUTION: Abundant throughout the Tropical, Austral, Transition, and Canadian zones on the Atlantic coast, occurring from Newfoundland (*Waghorne*) to Cuba (*Wright*), extending westward as far as Iowa, Wisconsin, and Minnesota (*Fink*), and south to Tennessee, Missouri, Alabama, Louisiana, and Texas, *U. cavernosa* seeming to replace it from here westward, though (in a peculiar condition) it was recorded from the Yellowstone region in 1872 by Willey.

The type or topotypes of the variety from Texas described by Müller I have not seen; the following original description is, however, applicable to a plant sent me by Professor Macoun from Vancouver Island, at the entrance to Barclay Sound, collected in 1909. A microscopic study of this plant shows it, nevertheless, to be closely affiliated to *U. longissima*, if not simply a young or abnormal specimen of the latter species. "*Usnea trichodea* var. *ciliata* Müll.-Arg." was described as follows: "thallus more *U. trichodeae* tenuis, laevis et albido-cinereus, at longe aut longissime ramigerus et more *U. longissimae* dense fibrillosus; apothecia parva, 1.5–3 mm. lata, raro diametro 6 mm. attingentia, ambitu ciliis 3–8 circ. 2–5 mm. longis ornata, dorso subinde pauci-fibrillogera et elongatione ramilli deflexi saepius praedita, discus glauco-albidus v. albo-carneus; sporae ellipsoideae v. subgloboso-ellipsoideae, 5–8 μ longae. — Habitat ad ramos et ramulos arborum prope Dallas, Texas."

USNEA ARTICULATA (L.) Hoffm.

TYPE: Species based on *Usnea capillacea* and *U. nodosa* of Dillenius; the "sterile" Dillenian specimen is in the Dillenian herbarium, Botanic Gardens, Oxford, England, and is the species commonly understood as "*Usnea articulata* (L.)" *fide* Crombie.

TYPE LOCALITY: "Europae australis."

ORIGINAL DESCRIPTION: "Filamentosus articulatus, ramulis tenuissimis punctatis," L. Sp. Pl. 1156. 1753.

FIGURES: [Dill. Hist. Musc. *pl.* 11. *f.* 4. 1741.] Sowerby, Eng. Bot. 4: *pl.* 258 (?). 1801.

SYNONYMY: [*Usnea capillacea et nodosa*, etc. Dill. *loc. cit.* 60.] *Lichen articulatus* L. Sp. Pl. 1156. 1753.

Usnea articulata Hoffm. Deutsch. Fl. 2: 133. 1795.

DIAGNOSIS: *Thallus* pendulous, *primary branches* articulate and inflated.

DESCRIPTION — typical: *Thallus* pendulous, catenate, terete or compressed, virescent to tawny, cortex nitidous or glabrous (secondary branches and fibrils now papillo-sorediate); *primary branches* deformed, *articulate*, *internodes inflated* (max. diameter 5 mm.), foveolate, dichotomous, glabrous (max. length 30 cm.); *secondary branches* subdichotomous, much divided, scabrous; *fibrils capillaceous*, tortuous. *Apothecia* rare, subterminal, small (max. diameter 5 mm.), disk pruinose, flesh-colored or buff, periphery ciliate. *Spores* $8-10\ \mu \times 5-6\ \mu$.

CONTINGENT PHASES: Unobserved.

SUBSTRATA: Trees, for the most part deciduous.

GEOGRAPHICAL DISTRIBUTION: Reported by Tuckerman as "ill-exhibited in North America; but it is not wholly wanting on the Pacific Coast; *Scouler*; *Macoun*." Professor Macoun reports it (Cat. Can. Pl. 7: 61. 1902) from [Hastings] Burrard Inlet, British Columbia, Canada (1889),* and also from Victoria, Vancouver, British Columbia, Canada (1875). The Victoria record is the one to which Tuckerman referred; the specimen is now in the Museum at Kew, England (*fide* Macoun). Professor Bruce Fink in "Contributions to the Lichens of Minnesota — VII" (Minnesota Bot. Stud. 3: 194. 1903) records three specimens (*nos.* 143, 711, 1636, herb. Univ. Minn.) collected respectively at Beaudette, Emo, and Harding in 1901. These specimens, which Professor Fink writes me he was already aware were wrongly determined, have been kindly sent me by Dr. C. O. Rosendahl of the University of Minnesota and prove to be typical *Usnea cavernosa* Tuck.

Professor Macoun has sent me a sterile specimen, collected Aug. 16, 1909, at Ucluelet Arm, north of Barclay Sound, British Columbia, which, though no doubt closely approaching this species and to be referred only here, is, nevertheless, decidedly atypical. It is only slightly inflated, decidedly papillate, not foveolate, and has non-capillaceous fibrils. It certainly ill exhibits true *Usnea articulata*.

The inclusion of this species as a North American plant is only empirical.

* This specimen (no. 10), kindly sent me by Professor Macoun, is *Alectoria ochroleuca sarmentosa* Nyl.

OBSERVATIONS: This species is certainly closely allied to *U. cavernosa*. Except for articulate inflated thallus, it is in every way similar. None of the specimens I have examined have been truly papillate. That it is an accidental monstrosity was the opinion of Fries and later writers. If not a "monstrositas" its morphological differentiation certainly deserves for it full specific rank. The scarcity of plants of this species in herbaria points to its rarity and limits its study. Only a field investigation of growing plants can solve its true identity.

The variety *dimorpha* of Müller from Cuba I have been unable to see. The following original description must uphold its own case: "*Usnea articulata* Hoffm. v. *dimorpha* Müll. Arg.; straminea, rami tenues et laevissimi, parce articulati, ramillis modice numerosis aliis capillaribus elongatis laevibus aut minute nodulosis et simul aliis intermixtis confertim divaricato-ramosissimis et crebre tuberculosis quasi nodulosis praediti; apothecia parvula, straminea, crebre ciliata, cilia breviuscula, simplicia et rudimentarie divaricato-ramulosa et partim nodulosa. — Habitu ad *U. dasypogoidis* v. *exasperatum* Müll. Arg. accedit, sed rami minus dense ramilligeri, tenuiores et distincte articulati, parce impressuli, ramilli demum dimorphi. — Cuba, ramulicola in Pinal de Sta. Ana, alt. 2400 ped.: Eggers Flor. Ind. Occ. exs. n. 5015." Disposition of type not indicated.

USNEA CAVERNOSA Tuck.

TYPE: In the Tuckerman herbarium, Botanic Museum, Harvard University, Cambridge, Mass.

TYPE LOCALITY: "Ad arbores in oris Lacus Superioris."

ORIGINAL DESCRIPTION: "Thallo pendulo laxo molli glaberrimo tereti compresso plus minus cavernoso ochroleuco, ramis primoribus simpliciusculis subventricosis attenuatis ad apices dichotome ramosis, ramulis ultimis tenuissime capillaceis; apotheciis sessilibus radiatis disco albido-pruinoso demum subcarneo margine obscuriori evanescente." Agassiz & Cabot, Lake Superior, etc. 71. 1850.

FIGURES: None.

SYNONYMY: *Usnea cavernosa* Tuck. Agassiz & Cabot, *loc. cit.* 71. 1850.

DIAGNOSIS: *Thallus* pendulous, terete or subterete, *foveolate fibrils capillaceous*.

DESCRIPTION — typical: *Thallus* pendulous, slender, *mollitinous*, terete or subterete, virescent, cortex glabrous or granulose, annularly scarred, at length bambusaceous; *primary branches* slender, at length proximally scabrous, *foveolate* (max. length 35 cm.); *secondary branches* dichotomous, much divided, *foveolate*; *fibrils capillaceous*, tortuous. *Apothecia* common, emarginate or submarginate, at length lacerate, lateral, sessile, *small* (diameter 4 mm.), disk flesh-colored or buff, periphery ciliate. *Spores* $5-10\ \mu \times 4-7\ \mu$.

CONTINGENT PHASES: Unobserved.

SUBSTRATA: Coniferous and deciduous trees.

GEOGRAPHICAL DISTRIBUTION: Common in a broad sense throughout the Transition zone. I have a typical specimen from Brunswick, Maine. It is reported from the White Mountains by Tuckerman, and I have seen two specimens from Plymouth, N. H. It is common in Minnesota about Lake Superior, and I have examined material from Colorado, Washington (Puget Sound, *Fink*), Arizona, and Mexico (Jalaspasco, 10,000–12,000 ft.); Nylander records it from Michigan; Leighton from Great Slave Lake, Canada, well within the Boreal zone.

USNEA ANGULATA Ach.

TYPE: Not indicated, but the specimen on which the species was based is in the Acharian herbarium, Universitetets Botaniska Institution, Helsingfors, *fide* Prof. Dr. Fred. Elfring, *in litt*.

TYPE LOCALITY: "Americae Septentrionalis" (Pennsylvania—*Muhlenberg*).

ORIGINAL DESCRIPTION: "Thallo pendulo flexuoso subsimplici angulato cinereo-pallido, angulis acutis scabris, fibrillis horizontalibus approximatis simplicibus brevibus tereti-attenuatis," Ach. Synop. Meth. Lich. 307. 1814.

FIGURE: Harris, Bryologist 4: *pl. 1. f.* — ; *pl. 2. f. c.* 1901.

SYNONYMY: *Usnea angulata* Ach. *loc. cit.* 307. 1814.

DIAGNOSIS: *Thallus* pendulous, subsimple, *angulate*.

DESCRIPTION — typical: *Thallus* pendulous, simple, rigid, coarse, *angulate*, stramineous to virescent (at length fuscous), cortex scabrous, now squamose; *primary branches* simple, *angulate* (now compressed particularly in the axils), coarse, dichotomous (max. length 3 m.); *secondary branches* rare (common in tropical examples), *angulate*, dichotomous; *fibrils* terete (or deformed),

equiform (2–8 mm. long.), *attenuate*, stipate, *rectangularly divergent*, sometimes dichotomous and spiculose. *Apothecia* sessile, lateral, terminal or subterminal on secondary branches, ample (max. diameter 1.5 cm.), thalline exciple smooth or reticulate, periphery and exciple ciliate. *Spores* 5–9 $\mu \times$ 4–6 μ .

CONTINGENT PHASES: Unobserved, except of reduction.

SUBSTRATA: Coniferous and deciduous trees.

GEOGRAPHICAL DISTRIBUTION: This plant is best exhibited in South America, and in our area in Mexico. Throughout the United States it is practically confined to the Austral zone, not having been collected north of about the 43d parallel of latitude, nor west of Minnesota, Iowa, Louisiana, and Texas, or roughly the 97th meridian, except in Mexico.

OBSERVATIONS: The typical fertile plant (Bolivia, Ecuador, Brazil, and Somaliland) is the most gross and coarse representative of the genus. It has been obtained in fruit only in the southern limits of the area under consideration, occurring in a most reduced state, except in Mexico and the West Indies. In color it is virescent, soon turning to brown.

USNEA LONGISSIMA Ach.

TYPE: Not indicated, but the specimen on which the species was based is in the Acharian herbarium, Universitetets Botaniska Institution, Helsingfors, *vide* Prof. Dr. Fred. Elfring *in litt*.

TYPE LOCALITY: "Lusatiae."

ORIGINAL DESCRIPTION: "Thallo pendulo filiformi scabro compresso albissimo simpliciusculo longissimo fibrilloso, fibrillis horizontalibus approximatis tortuosis simplicibus cinerascentibus," Ach. Lich. Univ. 626. 1810.

FIGURES: Ach. Nova Acta Soc. Sci. Upsal. 7: *pl.* 7. *f.* 5. 1815 [not 1795 as often cited]. Harris, Bryologist 4: *pl.* 1. 1901.

SYNONYMY: *Usnea longissima* Ach. Lich. Univ. 626. 1810.

DIAGNOSIS: *Thallus* pendulous, *simple*, primary branches covered with a *white furfuraceous crust* (soredia).

DESCRIPTION—typical: *Thallus* pendulous, *simple*, mollitinous, subterete or compressed, stramineous to virescent, primary cortex *albo-furfuraceous* (soredia), fibrils glabrous; *primary branches* simple, slender (max. length 3 m.), *white-sorediate*; *secondary*

branches rare or wanting; *fibrils* equiform (5 mm. to 2 cm. long), stipate, *rectangularly divergent*, rarely dichotomous. *Apothecia* (so far practically unknown in North American specimens) seen only in Bavarian examples, terminal on lateral fibrils, very small (max. diameter 3 mm.) subcyathiform, disk concolorous or buff, periphery ciliate. *Spores* $7-10\ \mu \times 4-6\ \mu$.

CONTINGENT PHASES: (a) Fibrils more or less soresiate.

SUBSTRATA: Coniferous and deciduous trees, occasionally dead wood.

GEOGRAPHICAL DISTRIBUTION: Common throughout the Boreal zone, reaching its highest development, like all the *Usneas*, on the Pacific coast.

OBSERVATIONS: This plant is much reduced throughout our area, and has never been reported in fruit, except from the Santa Cruz peninsula, California (*Herre*), where it is still inferior in development as compared with specimens from Bavaria. In the northernmost limit of its range, and in the east, it is distinctly virescent, whereas in the west and southwest it is stramineous. This characteristic color condition is true of all the filamentose *Usneas* in our area.

The scarcity of North American material of the typically antarctic lichen *Usnea sulphurea* (Zoega) Th. Fr., reported only twice from the Arctic regions of North America (Melville Island, R. Brown, Babington; and Greenland; *J. Vahl*), makes it impossible to give to it the necessary study; I am inclined, however, to agree with Nylander's view, and place this *dark-disked*, at length interruptedly corded species in the genus *Neuropogon* of Nees and Flotow,* where it seems more naturally to belong,—set apart from the *pale-disked*, *percurrently* corded species here included under *Usnea*. The question of the ciliated apothecia, an unstable character, is not important. The spores here average distinctly larger. The species belongs to the papillate division. The genus *Eumitria*† of Stirton does not concern us in connection with our area.

SYNONYMY

The following list of titles is an attempt to give the original citations and type localities for all the described species of the

* *Linnaea*, 9: 496. 1835.

† *Scot. Nat.* 4: 100. 1881.

genus *Usnea* from North and Middle America, and is as complete as a thorough investigation of the literature can make it, though no doubt it has been impossible to trace all descriptions. The citations have all been verified, and checked twice. No attempt has been made to include all the various published combinations, which have varied from binomials even to quinquenomials (Schaerer).

Usnea angulata Ach. Synop. Meth. Lich. 307. 1814: "Americae Septentrionalis."

Lichen barbatus L. Sp. Pl. 1155. 1753: "Europae & Americae septentrionalis."

Usnea californica Herre, Proc. Wash. Acad. Sci. 7: 345. 1906: "Alpine Creek Cañon, San Mateo County, California"; = *U. plicata* (L.) Web.

U. cavernosa Tuck. in Agassiz & Cabot, Lake Superior 171. 1850: "*Lacus Superioris*."

U. trichodea var. *ciliata*, Müll.-Arg. Flora 60: 77. 1877: "Dallas, Texas."

U. cornuta Flot. Linnaea 17: 16. 1843: "In montibus simensibus" (Abyssinia); reported from British America by Stirton.

U. articulata var. *dimorpha* Müll.-Arg. Flora 74: 372. 1891: "Cuba."

U. endochrysea Stirt. Scot. Nat. 6: 107. 1881: "Alabama"; = *U. florida* (L.) Web.

U. filaris Ach. Synop. Meth. Lich. 307. 1814: "America."

U. filipendula Stirt. Scot. Nat. 6: 104. 1881: "America bor."; = *U. plicata barbata* (L.) R. H. Howe.

U. florida var. *intermedia* Michx. Fl. Bor.-Am. 2: 332. 1803: "Carolina."

U. jamaicensis Ach. Lich. Univ. 619. 1810: "Jamaicae."

U. lacunosa (Willd. ex Delise MS.) Nyl. Synop. Lich. 271. 1858-60: "America boreali, Michigan"; = *U. cavernosa* Tuck.

U. linearis A. Schneider, Guide Study Lich. 167. 1898; (?) = *U. plicata* (L.) Web.

U. florida var. *major* Michx. Fl. Bor.-Am. 2: 332. 1803: "Carolina."

U. mutabilis Stirt. Scot. Nat. 6: 107. 1881: "Alabama"; = *U. florida* (L.) Web.

Lichen plicatus L. Sp. Pl. 1154. 1753: "Europae & Americae borealis."

Usnea florida var. *rubiginea* Michx. Fl. Bor.-Am. 2: 332. 1803: "Canada."

U. scoparia Fée, Dict. Class. d'Hist. Nat. 16: 482. 1830: "l'Amérique du Nord."

U. sphacelata R. Brown, Parry's 1st Voy. app. 307. 1824: "Melville Island"; = *Lichen sulphureus* Zoega, in Olafsen & Povelsen, Rejse ig. Island, Tilhang 16. 1772.

U. florida, γ *strigosa* Ach. Meth. Lich. 2: 310. 1803: "America septentrionali."

U. subfusca Stirt. Scot. Nat. 6: 108. 1881: "Owen Sound," Ontario; = *U. florida* (L.) Web.

U. trichodea Ach. Meth. Lich. 2: 312. 1803: "Nova Scotia."

U. variegata Stirt. Scot. Nat. 6: 105. 1881: "Niagara Falls" = *U. florida* (L.) Web.

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Explanation of plates 1-7

PLATE 1

Life zones of the United States, by C. Hart Merriam. Orthochromatic reproduction of colored plate (U. S. Dep. Agric., Div. Biol. Survey, Bull. No. 10). All northern Canada, not shown on this map, is in the Boreal zone.

PLATE 2

1. *Usnea florida* (L.) Web. = [*Usnea vulgatissima*]. Dillenius' figure, Hist. Musc. pl. 13. f. 12, 13. 1741.

2. Specimen representing phase (*h*) from Herbarium Sullivant Moss Chapter.

3. Specimen representing highest type of development (slightly reduced) from herbarium of Dr. L. W. Riddle, Wellesley, Mass. (*Pringle*, no. 10755), collected in Cuyamaloza, State of Hidalgo, Mexico.

4. Fruiting branch of *Usnea florida* (L.) Web. (slightly reduced) showing normal development.

5. Microscopic photograph of cross-section of thallus of *Usnea florida*, showing axis cord, medulla, algal cells, and cortex with papillae.

PLATE 3

1. *Usnea plicata* (L.) Web. ($\frac{1}{3}$ nat. size). Represents the highest development found in eastern North America. Collected in Plymouth, N. H., March, 1901, and kindly loaned for reproduction by Dr. L. W. Riddle from the Herbarium of Wellesley College.

2. Specimen from St. Martinsville, La., kindly loaned by Professor Bruce Fink. Represents phase (*d*).

3. *Usnea plicata* (L.) Web. = [*Usnea vulgaris*]. Dillenius' figure, Hist. Musc. pl. 11: f. 1. 1741.

4. *Usnea plicata* (L.) Web. Represents a portion of a plant ($\frac{1}{3}$ nat. size) showing the highest development attained (= *U. californica* Herre). Specimen collected by Dr. M. A. Howe, April 5, 1893, Coast Range, Marin Co., Cal. No. 1163, author's herbarium, kindly given by Dr. L. W. Riddle.

PLATE 4

1. *Usnea plicata barbata* (L.) R. H. Howe = [*Usnea barbata*]. Dillenius' figure, Hist. Musc. pl. 12: f. 6. 1741. Reduced to about $\frac{3}{8}$.

2. *Usnea trichodea* Ach. Specimen no. 324, author's herbarium, collected Jan. 7, 1907, Fitzwilliam, N. H., reduced to $\frac{3}{8}$ nat. size.

3. *Usnea plicata barbata* (L.) R. H. Howe. Typical specimen representing normal development in northeastern North America ($\frac{9}{16}$ nat. size). Specimen from Westbrook, Me., collected Aug. 22, 1908. In the herbarium of the Portland Society of Natural History, kindly loaned by Mr. A. H. Norton.

4. *Usnea trichodea* Ach. Acharius' original figure, Meth. Lich. 1803. Reduced nearly one half.

PLATE 5

1. *Usnea articulata* (L.) Hoffm. = [*Usnea capillacea* & *nodosa*]. Dillenius' figure, Hist. Musc. pl. 11: f. 4. 1741.

2. *Usnea articulata* (L.) Hoffm. Specimen in the U. S. National Herbarium, probably from the British Isles. Kindly loaned by Assoc. Curator J. N. Rose.

3. *Usnea cavernosa* Tuck. Specimen no. 1148, author's herbarium, from Brunswick, Me., Jan., 1909. Kindly sent by Dr. Manton Copeland.

4. Microscopic photograph of cross-section of thallus of *Usnea cavernosa*, showing axis cord, medulla, algal cells, and foveola.

PLATE 6

Usnea longissima Ach. Acharius' figure, Nova Act. Soc. Sci. Upsal. 7: pl. 7: f. 5. 1815. Reduced.

PLATE 7

1. *Usnea angulata* Ach., representing the highest development. Specimen from eastern Bolivia, Apolo, collected July 18, 1902, above 5500 ft. by Mr. R. S. Williams, New York Botanical Garden, and kindly loaned for reproduction.

2. Specimen of *Usnea angulata* from Granville, Mass., collected by Miss Mary



Howe, Reginald Heber. 1910. "A manual of the genus *Usnea*, as represented in North and Middle America north of the 15th parallel." *Bulletin of the Torrey Botanical Club* 37, 1–18.

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