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CONWAY MACMILLAN, *State Botanist*

Minnesota Botanical Studies

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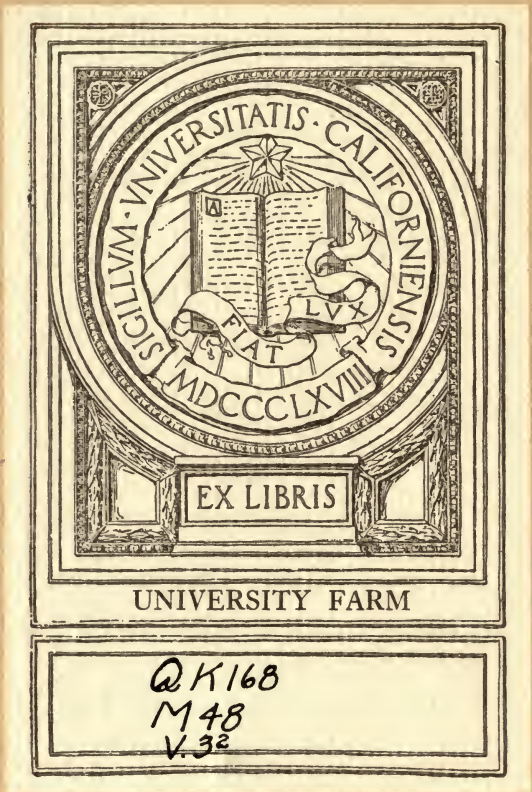

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To Recipients of Minnesota Botanical Studies:

The copy of Minnesoto Botanical Studies sent to you, herewith, is in exchange. You are earnestly requested to communicate your own publications to the undersigned.

Respectfully,

CONWAY MACMILLAN,
State Botanist of Minnesota.

July 3, 1903.

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At this point the securing and care of material was greatly facilitated by the many courtesies of Judge Lycurgus R. Moyer, resident at Montevideo, and it seems proper in this connection to make acknowledgment of his assistance. From here on

XII. THE MOSS FLORA OF THE UPPER MINNESOTA RIVER.

JOHN M. HOLZINGER.

The material on which this report is based was collected under the auspices of the Minnesota Botanical Survey, on an exploring trip during June and the first half of July, 1901, mostly through Kandiyohi, Chippewa, Lac qui Parle and Big Stone counties.

Four days were spent in exploring portions of Kandiyohi county with its numerous glacial lakes (June 9–13). Collections were made on the shores of Green lake and Diamond lake, in the vicinity of the village of Kandiyohi.

The main valley of the Minnesota river was touched at Granite Falls, where part of two days was spent on the outward trip (June 13, 14). This region was however more fully explored on the return trip (July 10–15).

The next collecting center was Montevideo, in Chippewa county (June 15–21). Though lying on the Chippewa river, a short distance above its confluence with the Minnesota, this base offered excellent opportunities for studying the main valley, which is here studded by numerous low outcrops of archæan granites. Except in the broad valley of the river, these oldest rock formations are, in this part of the state, covered deep with moraines and glacial drift. This overlies them 200 feet and more, forming the bluff slopes of the general valley. Two small bodies of water, mere pools but by courtesy called Carlton lake and Cedar lake having no connection with the main stream, lie nestled among these outcrops near Montevideo, in the main valley. The borders of these ponds afforded especially profitable collecting grounds.

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Mr. Moyer accompanied the writer, assisting generously in all possible ways to make the expedition a success. The fact that he had traversed the region some years before in the capacity of a surveyor rendered him the more valuable both as guide and adviser.

Another member of the little exploring party from this point on was Mr. John Anderson, science teacher at the high school in Dubuque, Iowa, who came to study the flowering plants of the region on his own account, and whose informal assistance made possible a more effective survey by the writer.

The region around the lower end of Big Stone lake, from Ortonville to several miles down the valley, was explored from June 22 to 26. Then the party made a trip on a farmer's wagon around Big Stone lake, going up on the west, and returning on the east side. Here Mr. John Conrad, who acted as driver and guide, rendered valuable assistance in leading the party to the most productive collecting grounds accessible along the lake. Unfortunately, by the deplorable shortsightedness of the farmers whose lands abut on the lake, this fine sheet of water, some forty miles long, is almost completely fenced in, making it difficult and in places impossible of approach. At the lower end the public highway lies for a few miles along the shore of the lake. Here we passed through Simpson park, the summer camping ground for the Chautauqua Assembly (June 26). From here on we saw little of the lake till late in the day, when we reached Hartford, twenty miles above on the bank of the lake. Hartford is not a village, but is the site of a recent attempt at establishing one, the only evidence being the burnt-out ruins of a hotel. Here the wooded slope, a spring-fed rivulet that reaches a short distance back into a willow-bordered swamp, and several broad areas of shaded seepage springs which seem to be very abundant on both banks of the lake, furnished excellent collecting ground (June 26, 27).

Camp was broken next day in time to reach Brown's Valley at the upper end of the lake before nightfall. The weather being showery, only a short stop was made here (June 28). Camp was broken between showers, and an attempt made to reach Foster, on the east bank of the lake, opposite Hartford. Here we collected from daybreak till toward noon next day (June 29), breaking camp early enough to reach Ortonville before night that day.

The next week (till July 8) was spent in further exploration below Ortonville. On the return trip stops were made at Montevideo (July 8–10), and at Granite Falls (July 10–15), with such good results as the systematic list of species shows.

The region of the upper Minnesota river thus explored is a part of the area treated by Professor C. W. Hall in the Bulletin of the United States Geological Survey, No. 157 (1899). The prairies back of the general valley are made up entirely of morainic and drift materials. The valley is from two to four miles and more wide; and the bordering bluffs are from 150 to 200 feet high. Scattered over this valley, in numerous clusters, are the ice-rounded, or frequently jagged outcrops of gneisses and granites mentioned above. In and out among these the present river winds. Not so in the recently past geological time, the time of great Lake Agassiz, now shrunken to a mere shadow of its former self, into Lake Winnipeg and the cluster of lakes surrounding it. At that time, the Red river of the North, instead of flowing into Lake Winnipeg and contributing its waters to the Hudson Bay system, was an outlet from Lake Agassiz in the opposite direction, through the present Minnesota valley, into the Mississippi system. That ancient river, in the height of its use as a drainage channel for these northern waters, must have appeared more like a great estuary, stretching across what is now southern Minnesota, than like an inland river. And, judging from the stately sweep of its valley, it must, in its time, have received the present Mississippi as a secondary stream of comparatively small volume. That this stream has had a great influence upon the distribution of organisms, notably of plants, along its course, especially during interglacial and postglacial time, as the ice cap receded, can hardly be doubted. I take it that the occurrence in this great valley, to which of course we must add the Mississippi valley proper, of such Rocky Mountain species as the two North American *Coscinodons*, of *Grimmia brandegei*, of *Ceratodon conicus*, and others, was made possible through that ancient channel. Like stranded strangers, these plants persist among the archæan and silurian rocks of these great rivers, far sundered from their kindred by a climatic barrier at present impassable for them. For, the western border of our state, including the region explored, approaches that doubtful strip across the great North American farm lands between the 95th and 100th meridians approximately,

to the east of which lie the great prairies with rainfall sufficient to insure perennial fertility, while to the west there is what the early explorers called the Great American Desert, stretching to the base of the Rocky Mountains, suffering from a deficiency of rainfall.

This climatic condition, approaching semi-aridity, appears to have come on gradually, if we may judge from the considerable number of stunted, starved and sterile species that were collected, several of which it has not been possible to determine satisfactorily. Of the ninety-six species worked out forty-four are new to the state, that is, have not been reported before. Of these, six are new species.

Finally, grateful acknowledgment is due to the following persons: to Dr. A. J. Grout for naming the species of *Brachythecium* and *Eurhynchium;* to Dr. G. N. Best for naming the species of *Anomodon*, *Leskea* and *Thuidium;* to Mrs. E. G. Britton for naming species of *Orthotrichum;* to Prof. L. S. Cheney for naming a number of species, principally *Amblystegium;* to Messieurs Cardot and Thériot for naming the species of *Bryum* and of several other genera; to M. F. Renauld for naming species of *Hypnum*, principally of the section *Harpidium*, and to Dr. N. Bryhn for naming the species of *Philonotis*.

Following is the list of additions to the moss flora of Minnesota:

Amblystegium brachyphyllum CARD. ET THER., n. sp.
Amblystegium brevipes CARD. ET THER., n. sp.
Amblystegium compactum (C. M.) AUST.
Amblystegium irriguum (WILS.) B. S.
Amblystegium riparium trichopodium BRID.
Archidium ohioense SCH.
Astomum crispum HPE.
Brachythecium cyrtophyllum KINDB.
Brachythecium rivulare B. S.
Bryum capillare flaccidum BR. EUR.
Bryum holzingeri CARD. ET THER., n. sp.
Bryum meesioides KINDB.
Bryum minnesotense CARD. ET THER., n. sp.
Bryum obconicum HSCH.
Bryum pseudotriquetrum SCHW.
Catharinæa macmillani HOLZ.
Ceratodon conicus HPE.

Encalypta rhabdocarpa leptodon (BR.) SCH.
Eurhynchium strigosum fallax REN. ET CARD.
Fissidens viridulus (SWARTZ) WAHLENB.
Fissidens viridulus lylei (WAHLENB.) DIXON AND JAMESON.
Fontinalis obscura CARD. ET THER., n. sp.
Funaria americana LINDB.
Grimmia brandegei AUST.
Grimmia leucophæa GREV.
Hedwigia ciliata viridis SCH.
Hypnum aduncum HEDW.
Hypnum aduncum intermedium SCH.
Hypnum aduncum intermedium, forma *laxa* SCH.
Hypnum aduncum intermedium, forma *laxifolia* SNO.
Hypnum aduncum kneiffii SCH.
Hypnum aduncum tenue SCH.
Hypnum aduncum tenue, forma *amblystegioides* REN.
Leskea arenicola BEST.
Octodiceras julianum (SAVI) BRID.
Orthotrichum porteri AUST.
Orthotrichum schimperi HAMMAR.
Phascum sp.
Philonotis alpicola JUR.
Plagiothecium sullivantiæ SCH.
Pleuridium subulatum B. S.
Pterygoneurum subsessile (BRID.) JUR.
Pyramidula tetragona (BRID.) BRID.
Trichostomum tophaceum BRID.
Webera cruda (L.) BRUCH.

SYSTEMATIC LIST OF SPECIES.

1. **Archidium ohioense** SCH.

On the ground, at Granite Falls (June 13–14).
At Ortonville (June 22).

2. **Phascum** sp.

The plants found are not in good condition for specific determination, but doubtless belong to this genus.

On earth, at Ortonville (June 24).

3. **Pleuridium subulatum** B. S.

The plants show the sporadically double lamina in the upper part of the leaf described by Limpricht, in Laubm.

Among grass in small tufts, at Granite Falls (June 13–14).
At Montevideo (June 16).
At Ortonville (June 22).

4. **Astomum crispum** Hpe.
On earth, at Montevideo (June 16).

5. **Dicranum bonjeani** De Not. (*D. palustre* La Pyl.)
At Cedar lake, near Montevideo (June 18).
Only one large cushion was found.

6. **Fissidens viridulus** (Swartz) Wahlenb.
At Ortonville (June 24).
At Foster, on the east shore of Big Stone lake (June 29).
At Granite Falls (July 12).

7. **Fissidens viridulus lylei** (Wahlenb.) Dixon & Jameson.
Intermediate forms occur here, just as described by Dixon in the Hand-book of British Mosses, p. 120.
On a porous limestone bowlder, in Simpson Park at the south end of Big Stone lake, on the Dakota side (June 26).

8. **Octodiceras julianum** (Savi) Brid. (*Conomitrium julianum* Mont.)
In water on submerged sticks, at Granite Falls (July 15).

9. **Ceratodon purpureus** Brid.
Very abundant, in large cushions in the depressions of granitic outcrops, at Granite Falls (June 13 and 14).
At Montevideo (June 16).
At Ortonville (June 24).
At Foster, east shore of Big Stone lake (June 29).

10. **Ceratodon conicus** Hpe. (Determined by Cardot & Thériot.)
At Montevideo (June 16).

11. **Pterygoneurum subsessile** (Brid.) Jur. (*Pharomitrium subsessile* Sch.)
On the ground, on gravel hills near Ortonville (July 1).

12. **Didymodon rubellus** (Hoffm.) Br. eur.
In Kandiyohi county (June 9–13).
At Granite Falls (June 14).
At Ortonville (June 24).
At Hartford, on the Dakota shore of Big Stone lake (June 27).
At Foster, on the Minnesota shore of Big Stone lake (June 29).

13. **Trichostomum tophaceum** BRID. (?) Sterile.

On a perpendicular wall of porous limestone dripping with water, at Foster, on the Minnesota shore of Big Stone lake (June 29).

14. **Ditrichum glaucescens** (HEDW.) HPE.

At Granite Falls (July 12).

15. **Barbula fallax** HEDW.

In Kandiyohi county (June 9–13).
At Granite Falls (June 14).
At Ortonville (June 22).

16. **Barbula mucronifolia** (BRID.) BR. EUR.

In Kandiyohi county (June 9–13).
At Granite Falls (June 14).
At Ortonville (June 24).
At Foster, on the east shore of Big Stone lake (June 29).

17. **Barbula ruralis** (L.) HEDW.

At Cedar lake, near Montevideo (June 18).
At Ortonville (June 23).

18. **Barbula unguiculata** (HUDS.) HEDW.

On the ground, in Kandiyohi county (June 9–13).
At Foster (June 29).

19. **Grimmia brandegei** AUST.

I am persuaded that this plant is specifically distinct from the European *G. plagiopodia*, and should not be referred to it as a variety, as is done in Lesq. and James' Manual, p. 138. And Austin's name has the right of way over the varietal name imposed by Lesquereux and James. This Minnesota plant compares perfectly with one collected by Professor C. F. Baker, near Durango, Colo., the region of the type locality of *G. brandegei*.

Between Foster and Ortonville, on a calcareous rock along the high banks of Big Stone lake (June 29).

20. **Grimmia apocarpa** HEDW.

On rocks.
At Ortonville (June 22).
At Foster, a small form (June 29).
At Montevideo, also a small form (July 7).

21. **Grimmia leucophæa** Grev.

Abundant, on rocks, at Granite Falls (June 13, 14).
At Carlton lake, near Montevideo (July 10).
Near Ortonville (June 30).

22. **Grimmia pennsylvanica** Schw.

On rocks, at Granite Falls (June 13, 14).
At Cedar lake, near Montevideo (June 18 and July 8).
The plants from Cedar lake show hardly any hair points, but agree otherwise with this species.

23. **Hedwigia ciliata viridis** Sch.

On rocks.
At Granite Falls (June 14).
At Ortonville (June 23).
At Carlton lake and Cedar lake near Montevideo (July 2–10).
Forms approaching the species are found, but *Hedwigia ciliata* proper seems rare in the Upper Minnesota valley.

24. **Orthotrichum anomalum** Hedw.

On rocks at Granite Falls (June 13, 14).
At Cedar lake, near Montevideo (June 18).
This was verified by Mrs. E. G. Britton.

25. **Orthotrichum porteri** Aust.

On rocks associated with *O. anomalum*. (Determined by Mrs. E. G. Britton.)
At Cedar lake, near Montevideo (June 18).
At Granite Falls (July 14).

26. **Orthotrichum schimperi** Hamm.

On ash and elm trees. (Determined by Mrs. E. G. Britton).
At Ortonville (June 23).
At Hartford, west shore of Big Stone lake (June 27).

27. **Encalypta ciliata** Hedw. On shaded ground.
At Granite Falls (July 13).

28. **Encalypta rhabdocarpa leptodon** (Bruch) Limpr.

A form distinct from the species, apparently deserving varietal rank, although Husnot (Muscol. Gall., p. 198) refers to it as "forma *gymnostoma* Jack." Boulay, in Muscinées de la France, p. 313, remarks on this point that "it often happens that in consequence of the extremes of climatic conditions to

which this plant is exposed the peristome is not developed, or remains rudimentary (var. *leptodon*)." This exposure to extremes of climate is doubtless responsible for our Minnesota form.

At Granite Falls (June 14).

29. **Pyramidula tetragona** (BRID) BRID.

Very common in the shallow depressions on the granitic "roches moutonnées," from Granite Falls to Big Stone lake. All the plants collected were badly weathered, and in poor condition. Husnot gives "spring" as the season for this species. But if the plants found grew and matured in the spring of 1901, it seems remarkable that they should become so badly weathered by the middle of June.

At Granite Falls (June 14).
Near Montevideo (June 18).
Near Ortonville (June 24).

30. **Physcomitrium hookeri** HAMPE.

On the ground in Kandiyohi county (June 9–13).
Near Montevideo (June 17).
At Foster (June 29).

31. **Physcomitrium turbinatum** C. M.

On the ground, at Granite Falls (June 13–14).
Near Montevideo (June 17; July 8).
At Cedar lake (June 18).
On the shore of Lac qui Parle lake (June 20).
Near Ortonville (July 4).

32. **Funaria americana** LINDB.

On the ground, always in rich, black, sandy soil, in shaded situations, near Ortonville (June 23).

At Granite Falls (July 13).

See also the Bryologist, Jan., 1902, p. 7.

33. **Funaria hygrometrica** (L.) SIBTH.

On the ground, in Kandiyohi county (June 9–13).
At Granite Falls (June 14).
Near Montevideo (June 20).
At Simpson Park, on the Dakota side of Big Stone lake (June 26).
At Hartford, on the west shore of Big Stone lake (June 27).

34. **Bartramia pomiformis** (L. ex p.) HEDW.
At Granite Falls (July 14).

35. **Philonotis alpicola** JUR. (Determined by Dr. N. Bryhn.)
The plants formed a dense sod on a granitic ledge where moisture filtered through a crevice. Near Ortonville (June 24).

36. **Leptobryum pyriforme** (L.) SCH.
Common in Kandiyohi county (June 9–13).
At Hartford (June 27).
At Foster (June 29).

37. **Webera albicans** (WAHLENB.) SCH. (*Mniobryum albicans* (WAHLENB.) LIMPR. in Laubm., II., p. 277.)
On moist earth, at Hartford (June 27).
At Brown's Valley (June 28).
At Foster (June 29).

38. **Webera cruda** (L.) BRUCH.
On the ground, near Ortonville (June 22).

39. **Webera nutans** (SCHREB.) HEDW.
(See Limpr. Laubm., II., p. 249.)
Near Ortonville (June 25).

40. **Bryum argenteum** L.
In Kandiyohi county (June 9–13).
At Granite Falls (June 13, 14).
At Hartford (June 27).

41. **Bryum capillare flaccidum** BR. EUR.
On the shady side of granite rock, on scant but well moistened soil. The alga-like fragile threads, considered to be vegetative gemmæ, and found on the European specimens, are found in great abundance on the Minnesota plants. See Limpr. Laubm., II., p. 377. Also Correns, Unters. ü. d. Verm. d. Laubm., p. 185, also the Bryologist for Jan., 1902, p. 9.
At Granite Falls (June 13, 14).
At Cedar lake (June 18).

42. **Bryum pendulum** (HORNSCH.) SCH.
On the ground, at Cedar lake, near Montevideo (June 18).
Near Ortonville (June 22–26).
At Granite Falls (July 10).

43. **Bryum meesioides** KINDB.
On moist, shaded ground, at Hartford, on the west shore of Big Stone lake (June 27).
At Foster, on the east shore (June 29).

44. **Bryum obconicum** HRHS.
On shaded ground, in Kandiyohi county (June 9–13).

45. **Bryum pseudotriquetrum** (HEDW. ex p.) SCHW.?
On moist, springy ground.
At Granite Falls (June 13, 14).
At Cedar lake, near Montevideo (June 18).
Near Ortonville (June 22).

46. **Bryum torquescens** BR. EUR.
On shaded ground, at Granite Falls (June 13, 14).

47. **Bryum minnesotense** CARD. ET THÉR., sp. nov. (Plate XX., 1.)

Dioicum, dense cæspitosum. Caulis 5–10 millim. altus, erectus, radiculosus, innovationibus numerosis. Folia caulina madida erecto-patentia, sicca appressa, circa 2 millim. longa, 1–1.5 lata, ovato-lanceolata, breviter acuminata, integra, apiceve denticulis nonnullis prædita, nervo excurrente sat longe cuspidata, marginibus e basi usque ad apicem revolutis; folia ramea longiora, longius acuminata, sicca subtorta; cellulis basilaribus hyalinis, elongato-rectangulatis, mediis superioribusque breviter hexagonis, valde chlorophyllosis, marginalibus linearibus, in 4 vel 5 seriebus dispositus, limbum distinctum efformantibus. Capsula in pedicello 2–2.5 centim. longo, basi pro more geniculato, nutans vel subhorizontalis, oblongo-pyriformis, collo elongato attenuato siccitate plicato, operculo conico. Annulus latus. Exostomium *B. penduli*, 0.36 millim. altum, lamellis inferioribus anastomosatis. Endostomium adhærens, membrana dimidiam partem dentium æquante, ciliis non appendiculatis. Sporæ 18–20 μ. Planta mascula ignota.

Differs from *B. pendulum*, by its narrower, longer capsule, provided with longer neck, longer cilia and diœcious inflorescence.

At Granite Falls (June 13, 14).

48. **Bryum holzingeri** CARD. ET THÉR., sp. nov. (Plate XXI., 1.)

Præcedenti valde affine, a quo differt: floribus synoicis, foliis basi angustatis, margine minus longe revoluto, superne plano, acumine longiore apice distinctius denticulato, cellulis mediis circa duplo longioribus, limbo latiore, e 6 vel 7 seriebus cellularum composito, denique capsula etiam longiore et pro longitudine angustiore.

The longer and narrower capsule easily distinguishes this species from *B. pendulum*.

At Cedar lake (June 18).
At Hartford (June 27).
At Foster (June 29).

49. **Bryum roseum** (WEIS.) SCHREB.
In Kandiyohi county (June 9–13).
Near Ortonville (June 22).

50. **Mnium cuspidatum** (L. ex p., SCHREB.) LEYSS.
At Granite Falls (June 13, 14).
Near Ortonville (June 25).
At Hartford (June 27).
Near Browns Valley (June 28).

51. **Aulacomnium palustre** (L.) SCHWAEGR.
At Granite Falls (June 13, 14).

52. **Timmia bavarica cucullata** (MX.).
On a shady wooded bank.
At Hartford, on the west shore of Big Stone lake (June 27).

53. **Catharinæa macmillani** sp. nov. (Plate XIX.)
Dioica, floribus inventis femineis. Planta simplex, usque ad 2 centim. longa. Folia sicca involuta et circinata, madida erecto-patentia, margine bistratoso e duabus seriebus cellularum constructo dentibus geminis serrato; lamina utraque facie valde papillosa, inferiore etiam dentata; lamellis 7–10 cellulas 8–12 altis, cellula terminali leviter papillosa. Cætera ignota.
This species is at once distinguished by its papillose leaves. It is dedicated to Professor Conway MacMillan, director of the Minnesota Botanical Survey.
On the ground near Ortonville (June 25).
NOTE. — The original spelling of the generic name is *Catharinæa*, not *Catharinea*.

54. **Polytrichum commune** L.
Near Ortonville (June 25), in the shade of a granitic outcrop.

55. **Polytrichum juniperinum** WILLD.
At Granite Falls (June 14).
Near Montevideo (June 17).

56. **Polytrichum piliferum** SCHREB.
At Granite Falls (June 12).
Near Ortonville (June 23).

57. **Fontinalis obscura** CARD. sp. nov. (Plate XXII., 2.)
Planta sat mollis, obscuro- vel atro-viridis, inferne nigricans. Caulis 10–15 centim. longus, flexuosus, basi denudatus, irregu-

lariter divisus pinnatusve, ramis patentibus vel patulis, obtusis vel breviter cuspidatis. Folia sat conferta, caviuscula, mollicula, erecto-patentia, ad apicem caulis et ramorum imbricata, fragilia, sæpe erosa vel effracta, caulina ovato- vel oblongo-lanceolata, obtuse vel acute acuminata, integra, 3–3.5 millim. longa, .9–1.2 lata, ramea angustiora, .6–.85 lata, 2.1–3.5 longa. Cellulæ alares subquadratæ vel oblongæ, parum distinctæ, ceteræ lineares, subflexuosæ, superiores breviores, omnes chlorophyllosæ. Cetera ignota.

Seems to be related to *F. novæ-angliæ* Sulliv., but readily distinguished from this species by the leaves (chiefly the branch leaves) which are narrower, longer acuminate, entire at apex, and by the much smaller and less distinct alar cells. It belongs to the section *Heterophyllæ*.

Habitat: In the Minnesota river channel, at Granite Falls (July 12).

58. **Fabronia octoblepharis** (SCHLEICH.) SCHWÄGR.

On the shaded side of granitic ledges kept moist by trickling water, at Cedar lake (June 18).

At Carlton lake (July 10).

At Granite Falls (July 12).

59. **Fabroleskea austini** (SULL.) BEST. (Determined by Dr. G. N. Best.)

On trees, in Kandiyohi county (June 9–13).

At Foster, on the east shore of Big Stone lake, and southward (June 29).

60. **Leskea arenicola** BEST MS. (Determined by Dr. G. N. Best.)

At base of elm trees, near Montevideo (June 19).

61. **Leskea obscura** HEDW. (Determined by Dr. G. N. Best.)

At base of trees, near Hartford (June 27).

62. **Anomodon attenuatus** (SCHREB.) HÜB. (Determined by Dr. G. N. Best.)

On the shaded side of granitic bowlders and ledges.

At Granite Falls (July 15).

63. **Anomodon minor** (P. BEAUV.) FÜRN. (Determined by Dr. G. N. Best.)

In Kandiyohi county (June 9–13).

Near Montevideo (June 15–21).

At Granite Falls (July 15).

64. **Anomodon rostratus** (Hedw.) Sch. (Determined by Dr. G. N. Best.)
At Cedar lake (June 18).
At Granite Falls (June 13, 14; July 12–15).
At Hartford (June 27).

65. **Cylindrothecium cladorrhizans** (Hedw.) Sch. (Determined by Dr. A. J. Grout.)
At base of trees, near Granite Falls (July 14).

66. **Cylindrothecium seductrix** (Hedw.) Sull. (Determined by Dr. A. J. Grout.)
Growing over stones, at Cedar lake (June 18).
At Granite Falls (July 14).

67. **Platygyrium repens** (Brid.) B. S. (Determined by Dr. A. J. Grout.)
On the ground, in Kandiyohi county (June 9–13).
At Ortonville (June 22).

68. **Climacium dendroides** (L.) Web. & Mohr. (Determined by Dr. A. J. Grout.)
On a shaded spot, at Granite Falls (July 12).

69. **Thuidium abietinum** (L.) B. S. (Determined by Dr. G. N. Best.)
In broad cushions on rocks, at Montevideo (June 16).
Near Ortonville (June 23).

70. **Thuidium philiberti** Limpr. (Dr. G. N. Best det.)
On the ground, at Granite Falls (July 14).

71. **Brachythecium acuminatum** (Hedw.) Kindb. (Determined by M. Jules Cardot.)
At the base of trees, near Montevideo (July 6).

72. **Brachythecium acutum** (Mitt.) Sull. (Determined by Dr. A. J. Grout.)
On the ground, at Hartford (June 27).

73. **Brachythecium rivulare** B. S. (Determined by Dr. A. J. Grout.)
On wet ground, at Foster (June 29).

74. **Brachythecium rutabulum** (L.) B. S.
On the ground, near Ortonville (June 25).
At Hartford (June 27).

75. **Brachythecium cyrtophyllum** KINDB.

At the base of trees, in Kandiyohi county (June 9–13).
At Montevideo (June 21).
Near Ortonville (June 22).
At Simpson park (June 26).
At Foster (June 29).

76. **Brachythecium oxycladon** (BRID.) JAEG. & SAUERB.

On the ground, in Kandiyohi county (June 9–13).
At Montevideo (June 21).
At Hartford (June 27).
At Foster (June 27).

77. **Eurhynchium strigosum fallax** R. & C. ("Not typical." Grout.)

On the ground, near Montevideo (June 16).

78. **Plagiothecium sullivantiæ** SCH.

On granitic ledges, shaded, and kept moist by trickling water, at Cedar lake, near Montevideo (June 18).

79. **Amblystegium adnatum** (HEDW.) AUST. (Determined by Cardot & Thériot.)

Over rocks and on the ground, at Granite Falls (July 12).

80. **Amblystegium brachyphyllum** Card. & Thér. sp. nov. (Plate XX., 3.)

A. ripario affine, a quo differt foliis brevioribus, ovato-lanceolatis, 1.6–1.7 millim. longis, .7 latis, breviter acuminatis, apice obtuso vel subobtuso. Costa valida, basi dilatata, 50–80 μ lata, usque ad $\frac{2}{3}$ vel $\frac{3}{4}$ folii producta. Cellulæ mediæ lineares, 70–90 μ longæ, 9 μ latæ. Fructus ignotus.

By the blunt or subobtuse acumen this moss resembles *A. vacillans* Sulliv., but it has much shorter and broader leaves. From *A. brevipes* Card. & Thér. it is well distinguished by the larger size, the blunt acumen, the longer and narrower cells, and the stronger costa.

The polymorphous *A. riparium* constitutes a vast group of forms, some of which are constant enough and are sufficiently characterized to be considered as secondary or tertiary species; such are: *A. kochii* Br. eur., *A. vacillans* Sulliv., *A. brachyphyllum* and *A. brevipes* Card. & Thér., *A. floridanum* Ren. & Card., and probably *A. argillicola* Lindb.

Habitat: Granite Falls (July 15).

81. **Amblystegium brevipes** CARD. ET THÉR. sp. nov. (Plate XX., 2.)

E. sectione *A. riparii*. Caulis gracilis, repens, ramis brevibus. Folia erecto-patentia, circa 1.2 millim. longa, .6 lata, late ovata, breviter acuminata, integra, costa angusta, basi 30 μ lata, ultra medium evanida, sæpius ad $\frac{2}{3}$ vel $\frac{3}{4}$ folii producta, rete laxiusculo, cellulis basilaribus rectangulatis, nonnullis quadratis, mediis subhexagonis, 55–70 μ longis, 12–15 μ latis, superioribus brevioribus latioribusque. Folia perichætialia late ovata, in acumine angusto subito constricta, ad basin acuminis sæpe irregulariter denticulata, ultra medium costata. Capsula in pedicello brevi pro more 10, varius 1.5 millim. longo, oblongo-arcuata, sicca sub ore constricta, operculo conico.

This species differs from the small forms of *A. riparium* by the shortly acuminate leaves, the looser areolation, the shape of the perichætial leaves, and the short pedicel. A species from the Caucasus, *A. argillicola* Lindb., of which we know only the description published by Dr. V. F. Brotherus in his valuable paper, *Enumeratio Muscorum Caucasi*, seems to be nearer to this species, but still stands distinct from it by its leaves, which are minutely denticulate from almost the base, its longer costa, vanishing below the apex, and its narrower perichætial bracts with a less distinct nerve.

Habitat: Near Montevideo (June 15); at Hartford (June 27).

82. **Amblystegium compactum** (C. M.) AUST. (Determined by Prof. L. S. Cheney, and by Messieurs Cardot & Thériot.)

M. Cardot remarks on the several forms of this species that he does not separate *A. subcompactum* and *A. dissitifolium* of Kindberg.

Along shady, moist banks of rivulets, at Hartford (June 27). At Foster (June 29).

83. **Amblystegium irriguum** (WILS.) B. S. (Determined by Cardot & Thériot.)

On moist, shaded ground at Hartford (June 27).
At Foster (June 29).

84. **Amblystegium riparium** (HEDW.) B. S. (Determined by Cardot & Thériot.)

On stones near the water's edge, at Cedar Lake (June 18).

85. **Amblystegium riparium trichopodium** BRID. (Determined by F. Renauld, and by Cardot & Thériot.)

On granitic rocks submerged in a stagnant pool of water, near Ortonville (June 25).

86. **Amblystegium serpens** (HEDW.) B. S. (Determined by Prof. L. S. Cheney and by Cardot & Thériot.)

On shaded ground, at Cedar lake (June 18).
Near Ortonville (June 22).
At Hartford (June 27).
At Foster (June 29).

87. **Amblystegium varium** (HEDW.) LINDB. (Determined by Cardot & Thériot.)

In moist situations.
In Kandiyohi county (June 9–13).
At Granite Falls (June 13, 14).
At Simpson Park (June 26).
At Hartford (June 27).

M. Cardot states that the plant from Kandiyohi county is indifferently referable to *A. serpens* or *A. varium*.

88. **Amblystegium varium orthocladon** (BRID.). (Determined by Cardot & Thériot.)

On the ground, at Foster (June 29).

89. **Hypnum aduncum** HEDW. (typicum), forma ad var. *kneiffii* SCH. accedens.

At Foster (June 29).

90. **Hypnum aduncum tenue** SCH. (Determined by Dr. G. N. Best, Prof. L. S. Cheney, and Capt. F. Renauld.)

At Hartford (June 27).
At Foster (June 29).

91. **Hypnum aduncum tenue** SCH., forma **amblystegioides** REN. in litt.

Near Montevideo (June 19).
Near Ortonville (June 22).
At Hartford (June 27).

NOTE. — Concerning the Ortonville plant M. Renauld remarks that it "approaches much more closely than the plant from Montevideo to *H. aduncum tenue*." And he suggests that it be designated as forma *amblystegioides*.

The plant from Montevideo is of uncertain relationship. M. Renauld disposes of it by the following suggestions:

"On the one hand the quadrate alar cells form no distinct auricles, suggesting rather an *Amblystegium*. On the other hand the form of the leaves is rather that of *H. aduncum tenue*. The plant being fertile, it ought to be possible to determine the mode of inflorescence. I have not found male flowers, which leads to the suspicion that it is dioicous, and consequently belongs with *Hypnum aduncum;* but inquiry on this point should be made more searching. It is possible that we have to do here with a new species. I commend this plant as well as the one from Ortonville to your attention, since they have in common the *square alar* cells, which form no *auricles*, while the general appearance and the form of the leaves are rather as in *H. aduncum tenue*."

The plant from Hartford is apparently a more luxuriant form of the same species as that from Montevideo. It has the general appearance of *H. filicinum*, agrees fairly in areolation, but lacks paraphyllia. In sending it to M. Renauld I therefore suggested that it looked like a form of *H. filicinum*. Following is his comment: "It is easy to be deceived about the relationship of this plant, which is intermediate between *H. filicinum* and *H. aduncum tenue*. I am on the whole inclined to see in it rather *H. filicinum*. The areolation is very nearly as in this species; the costa is stronger than it is in *H. aduncum*, not reaching the apex, it is true, but I have observed this in several American forms of *Hypnum filicinum*. I have not found any paraphyllia. But there are *radicles*, which are not found on *H. aduncum*. If hybridity in mosses were well demonstrated, I should believe this a hybrid form."

Dr. Best, who has also seen this plant, considers it to be *H. aduncum gracilescens* Sch. And the reference of it rather to some variety of *H. aduncum* than to *H. filicinum* seems, on the whole, to be the more satisfactory disposition. This view appears the more plausible when we consider the richness of forms of *H. aduncum* in the upper Minnesota river valley, together with their numerous intergradations. The explanation lies in the evident susceptibility of *Hypnum aduncum* to variation under extremes of climatic influences which obtain in that region, especially as regards temperature.

92. **Hypnum aduncum intermedium** SCH.
At the edge of water, near Ortonville (June 22, 25).
At Hartford (June 27).
Between Foster and Ortonville (June 29).
At Granite Falls (July 14).

93. **Hypnum aduncum intermedium** SCH., forma **laxa** SCH.
In stagnant water, at Granite Falls (June 14).

94. **Hypnum aduncum intermedium** SCH., forma **laxifolia** SNO., ad group pseudofluitans transiens.

This form was most abundant in a swamp formed in a "prairie kettle," where it covered considerable areas, square rods in extent, excluding apparently all other vegetation, resting like a soft carpet on the water-soaked soil. The whole formation was readily distinguishable at quite a distance by its light yellowish-green color.

In Kandiyohi county (June 9–13).

95. **Hypnum aduncum kneiffii** SCH.
On the edge of the water in the Chippewa river, near Montevideo (June 19).

96. **Hypnum hispidulum** SCH.
At the base of a tree.
In Kandiyohi county (June 9–13).

XIII. TWO NEW SPECIES OF FONTINALIS.

JULES CARDOT.

1. **Fontinalis holzingeri**, sp. nov. (Plate XXI., 2.)

Planta sat mollis, lurido-viridis, subnitens. Caulis basi longe denudatus, flexuosus, 12–20 centim. longus, irregulariter pinnatus, ramis ascendentibus, gracilibus, apice cuspidatis. Folia sat remota, rigidiuscula, erecto-patentia, apice caulis et ramorum convoluto-imbricata, dimorpha: caulina magna, plana, oblongo-vel lineari-lanceolata, sensim angustata, late acuminata, obtusiuscula subacutave integra, 3.5–5 millim. longa, 1–1.5 lata; ramea minora, marginibus inflexis subcanaliculata, apice obtusiusculo acutove, integro vel obsolete denticulato, 2.5–3.5 millim. longa, .6–.8 lata. Cellulæ alares oblongæ vel subquadratæ, parum distinctæ, ceteræ longe lineares, subflexuosæ, sat chlorophyllosæ, parietibus sat firmis, superiores breviores. Flores feminei in caulis parte superiore numerosi; folia perichætialia juniora orbiculari-ovata, apiculata, apiculo obsolete denticulato. Fructus ignotus. Planta mascula femineæ similis; folia perigonialia perichætialibus subsimilia.

Species closely related to *F. missourica*, but distinct by the leaves, which are less soft, of a firmer texture, of longer and thin-walled cells, and the shorter and often subobtuse acumen. The dimorphism of the leaves is little pronounced, and, on this account, *F. holzingeri* rather resembles some species of the group *Malacophyllæ*, but is distinguished from these species by the firmer leaves and the concave subcanaliculate branch leaves.

Habitat: At the second falls of Granite river ascending from Lake Saganaga (June 17, 1897). See MINN. BOT. STUDIES, June 15, 1898, p. 43, where a preliminary description of this species appears.

2. **Fontinalis umbachi** sp. nov. (Plate XXII., 1.)

Planta sicca rigidula, inferne obscure, superne lurido-viridis. Caulis basi denudatus, 7–15 centim. longus, irregulariter pinnatus, ramis remotis patulis vel erecto-patulis, apice cuspidatis. Folia rigidula, erecto-patula, apice caulis et ramorum

convoluto-imbricata, dimorpha: caulina magna, oblongo-lanceolata, sensim late et obtuse acuminata, integra, circa 5 millim. longa, 1.5–1.75 basi lata; ramea multo minora, strictula, ad apicem ramorum curvatula et subhomomalla, anguste lanceolata, marginibus inflexis pro more canaliculata, sensim obtusiuscule acuminata, integra, 3–4 millim. longa, .5–.75 basi lata. Cellulæ alares subquadratæ vel subhexagonæ, parum dilatatæ, ceteræ lineares, subflexuosæ, sat chlorophyllosæ, parietibus crassiusculis sat firmis, superiores breviores. Cetera ignota.

This moss was discovered by Mr. L. M. Umbach, in the Des Plaines river, Illinois, June 18, 1898. But I have recognized in my herbarium some stems of the same plant collected in September, 1895, by Prof. Conway MacMillan in northern Minnesota, near the International Boundary, together with *F. macmillani*, and which I referred erroneously to *F. dichelymoides* Lindb.

Fontinalis umbachi Card. is near *F. missourica* Card., from which, however, it is easily distinguished by its shorter and rather rigid stems, its more shortly acuminate stem leaves and its rigid, canaliculate branch leaves, which are narrower at base and entire at apex. *F. holzingeri* Card. is a softer plant with more elongated and more flexuous stems and smaller stem leaves.

CHARLEVILLE, FRANCE, November 1, 1902.

EXPLANATION OF PLATES.

Nachet's objectives 1, 3, 5 and 6, oculars 1, 2 and 3, with camera lucida.

All drawings are reduced one fourth in photo-engraving. The magnification indicated is true for the *drawings as printed.*

PLATE XIX.

Catharinæa macmillani. 1. Entire plant, slightly enlarged. 2. Stem section. 3. Two perichætial leaves. 4. An antheridium with paraphyses. 5. A leaf apex showing dorsal teeth. 6, 7, 8. Cells from apex, middle and base of leaf. 9, 10, 11, 12. Leaf sections from near apex to near base of leaf. 13, 14. Cells from leaf margin, more enlarged. 15. Cells from lamina, more enlarged.

PLATE XX.

1. *Bryum minnesotense.* *a.* Entire plant, nat. size. *b.* Stem leaf, × 13. *c.* Branch leaf, × 13. *d.* Basal areolation, × 135. *e.*

Areolation in the middle, × 135. *f*. Marginal areolation, × 195. *g*. Capsule in dry state, × 13. *h*. The same in moist state, × 13.

2. *Amblystegium brevipes*. *a*. Entire plant, nat. size. *b*, *b*. Leaves, × 26. *c*. Perichætial leaf, × 26. *d*. Basal areolation of a leaf, × 195. *e*. Areolation in the middle, × 195. *f*. Areolation of the upper part, × 195. *g*. Capsule in dry state, × 13. *h*. The same in a moist state, × 13. *i*. Lid, × 13.

3. *Amblystegium brachyphyllum*. *a*. Entire plant, nat. size. *b*. Leaf, × 26. *c*. Basal areolation of a leaf, × 195. *d*. Areolation in the middle, × 195. *e*. Areolation of the upper part, × 195.

PLATE XXI.

1. *Bryum holzingeri*. *a*. Entire plant, nat. size. *b*, *b*. Stem leaves, × 13. *c*. Branch leaf, × 13. *d*. Basal areolation, × 135. *e*. Areolation in the middle, × 135. *f*. Marginal areolation, × 195. *g*. Capsule in moist state, × 13. *h*. The same in dry state, × 13.

2. *Fontinalis holzingeri*. *a*. Entire plant, nat. size. *b*, *b*, *b*. Stem leaves, × 13. *c*, *c*, *c*. Branch leaves, × 13. *d*. Basal areolation, × 138. *e*. Areolation in the middle, × 138. *f*. Areolation of the apex, × 138. *g*. Young perichætial leaf, with an archegone and two paraphyses, × 32. *h*. Apex of the same, × 138. *i*. Perigonial leaf, × 32. *j*. Another perigonial leaf, with an antheridium, × 32.

PLATE XXII.

1. *Fontinalis umbachi*. *a*. Entire plant, nat. size. *b*. Stem leaf, × 13. *c*, *c*, *c*. Branch leaves, × 13. *d*. Basal areolation, × 138. *e*. Areolation in the middle, × 138. *f*. Areolation of the apex, × 138.

2. *Fontinalis obscura*. *a*. Entire plant, nat. size. *b*, *b*, *b*, *b*. Stem leaves, × 13. *c*, *c*, *c*, *c*. Branch leaves, × 13. *d*. Basal areolation, × 138. *e*. Areolation in the middle, × 138. *f*. Areolation of the apex, × 138.

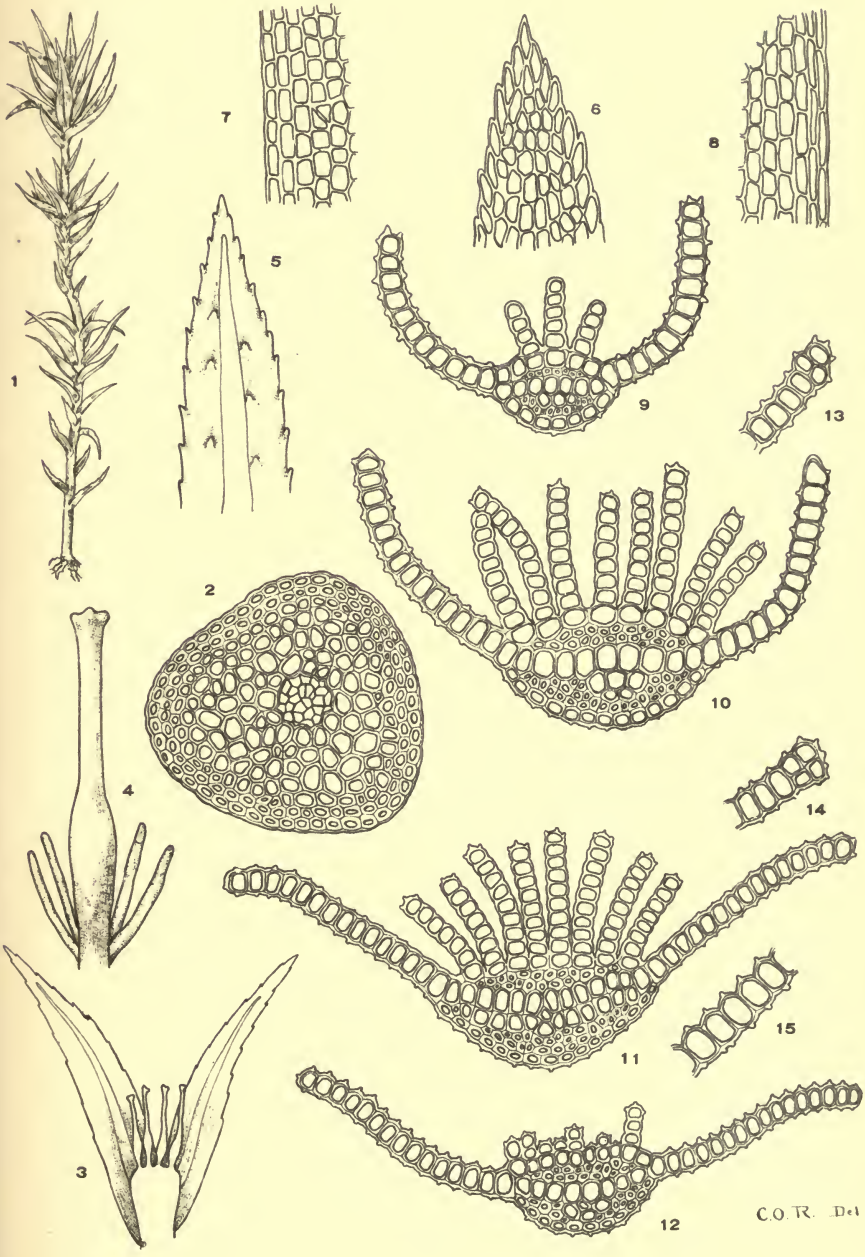

PLATE XIX.

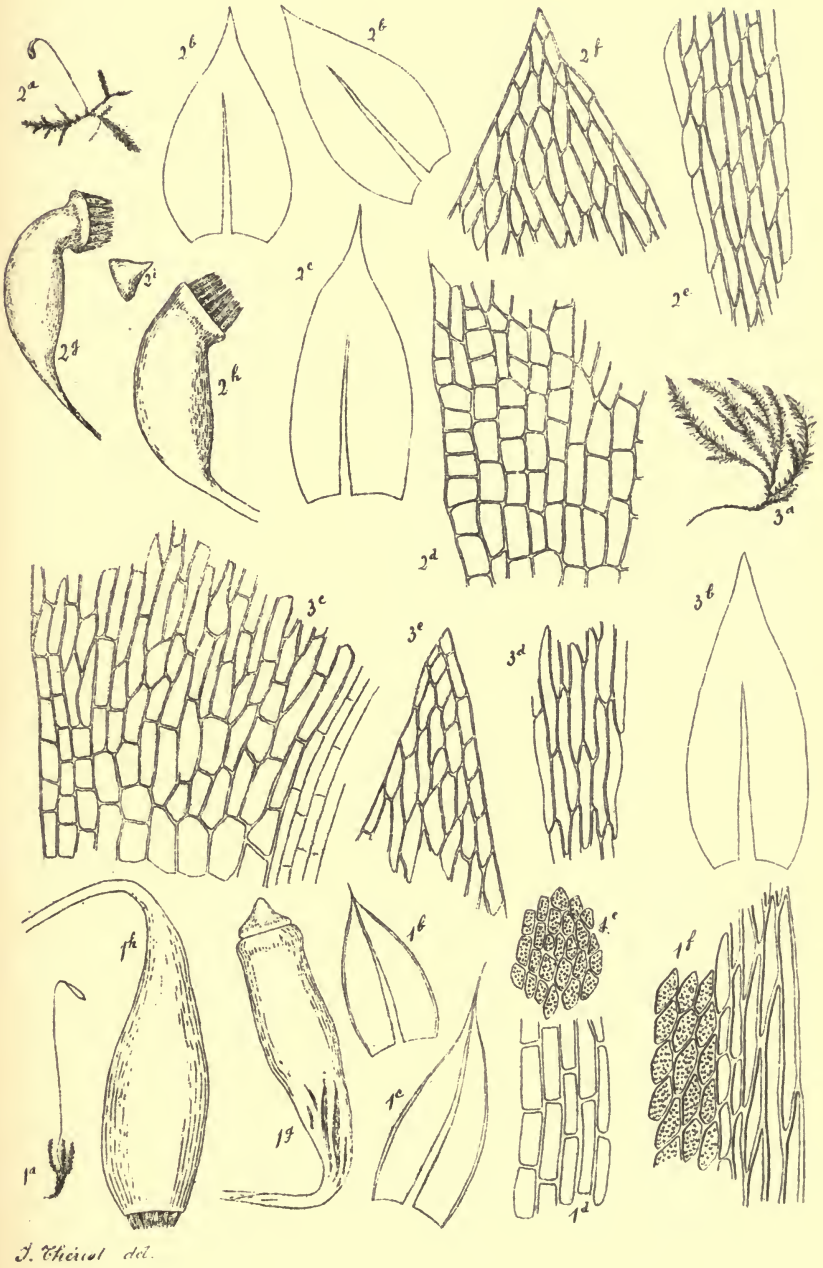
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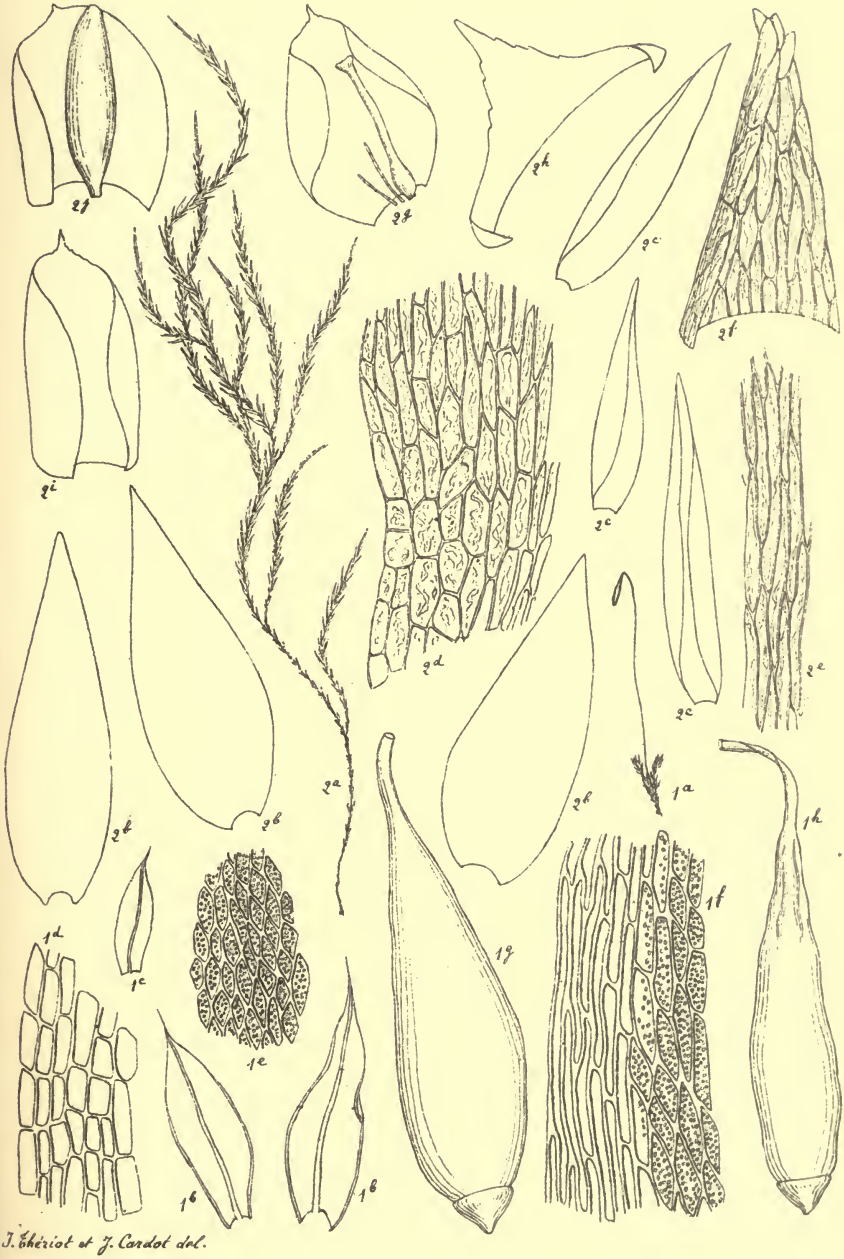
PLATE XX.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J. Thériot et J. Cardot del.

PLATE XXI.

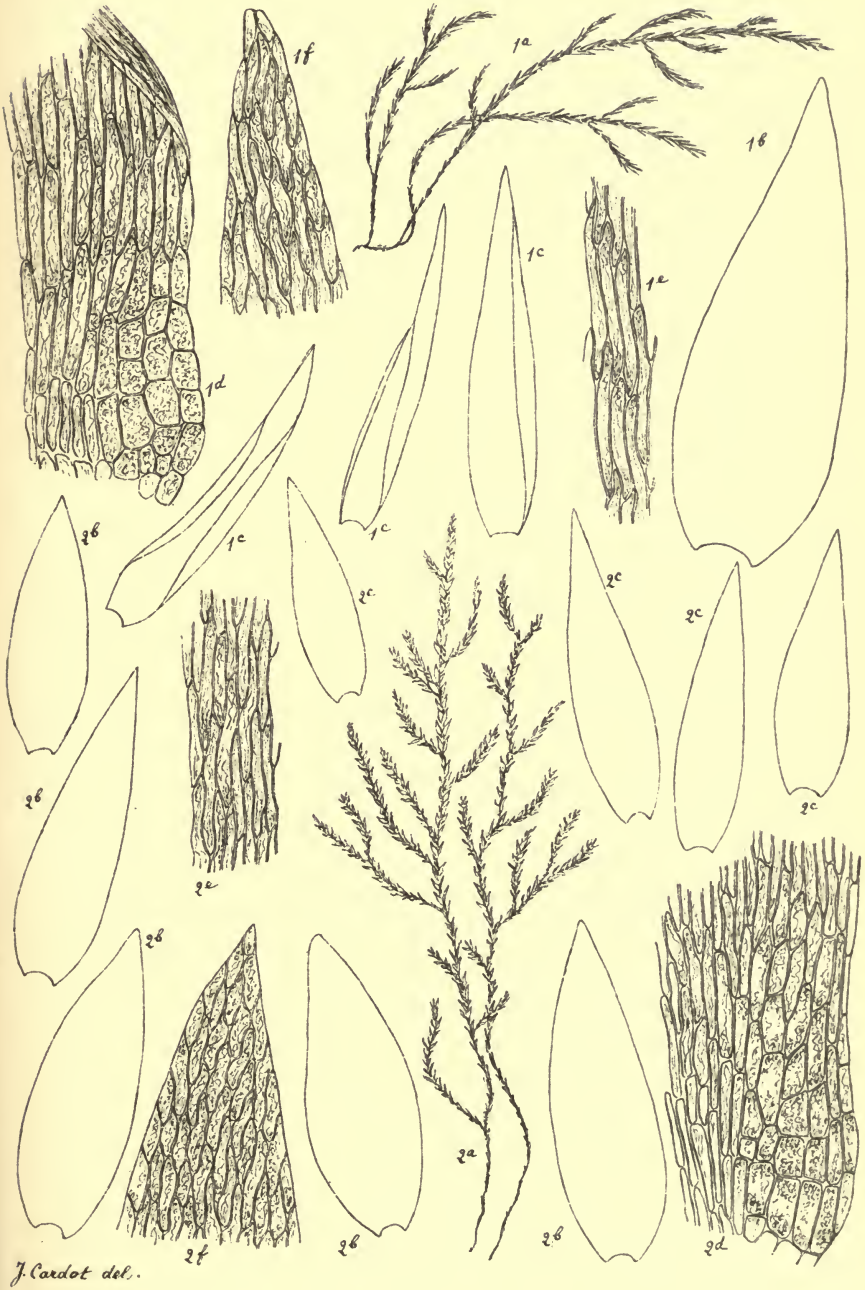

PLATE XXII.

XIV. OUTLINE OF THE HISTORY OF LEGUMINOUS ROOT NODULES AND RHIZOBIA WITH TITLES OF LITERATURE CONCERNING THE FIXATION OF FREE NITROGEN BY PLANTS.—III.

Albert Schneider.

The first and by far the greatest installment of titles was collected by Dr. D. T. MacDougal and appeared in the Minnesota Botanical Studies, issue of September 27, 1894. The second installment, by the writer, appeared in the same journal, issue of May 31, 1897. In all about 780 titles are given. It is not intended to imply that the list of titles is complete. There are undoubtedly numerous omissions and many of them very important. The writer would be very grateful if those interested would supply from time to time titles not already given.

At some future time it is intended to prepare a fairly complete history of the study of leguminous root nodules, and rhizobia, accompanied by a citation up to date of the more important titles on the subject, giving the titles in alphabetical as well as in chronological order. Such a record is intended for the benefit of future investigators. The following preliminary outline is intended to indicate the plan which is to be followed and suggestions and criticisms would be highly appreciated.

First Period: Initial Study of Leguminous Root Tubercles—From Clos (1848) to Lawes and Gilbert (1860).

During this period nothing of marked scientific value was done regarding the root tubercles of leguminous plants. Occasional attention was called to their presence and theoretical or hypothetical assumptions were made regarding their function and structural nature. Clos was among the first to make more extended observations and call especial attention to them, expressing it as his opinion that they were lenticular outgrowths of the roots. Malpighi was perhaps the first author of note to

mention them. In his Anatomy of Plants (1687) he describes them as galls, without stating definitely what caused their development. De Candolle (1825) looked upon them as pathological outgrowths, likewise refraining from expressing a definite opinion as regards their origin. Treviranus expressed the opinion that they were undeveloped buds.

Second Period: Collateral Investigations which led to the Discovery of the True Nature of Root Tubercles — From Lawes and Gilbert (1860) to Frank (1879).

Perhaps criticism may be made for giving this as a period in the history of the subject under discussion since the investigations referred to originally had absolutely no relationship to the study of leguminous root nodules, nor did the investigators about to be mentioned have any conception of the significance of these root structures when they planned and began their researches.

The chief investigators of this period were Lawes and Gilbert of England and Hellriegel and Willfarth of Germany. Their investigations pertained to the differences in the nitrogen supply and nitrogen assimilation of certain plants, as grasses, sugar beets, and leguminous plants. The final conclusion reached by Hellriegel was that there was some definite significant relationship between the root nodules and nitrogen assimilation of leguminous plants. Immediately these root tubercles were given marked attention which led to the discovery of their characteristic contents, namely the bacteria, now more generally known by the generic name rhizobia.

Third Period: The Scientific Investigation of Leguminous Root Tubercles and Rhizobia — From Frank (1879) to Schneider (1893).

The first work of this period was really not done by Frank (see Woronin and Hellriegel) but this investigator certainly took the lead in doing active painstaking work in the study of the leguminous root tubercles as well as the contained rhizobia. Numerous other investigators of Germany, France, England and America also did excellent work. Disputes and changes of opinion were frequent. Not until the close of the period were satisfactory conclusions reached regarding the true nature of the root tubercles and the biological identity of the rhizobia.

FOURTH PERIOD: PRELIMINARY INVESTIGATIONS RELATING TO THE POSSIBLE AND PROBABLE PRACTICAL UTILITY OF RHIZOBIA AND FUNCTIONALLY RELATED ORGANISMS. FROM SCHNEIDER (1893) TO ——.

This period corresponds to a period of renewed activity on the part of investigators. As far as known the first paper outlining a course of research and giving a preliminary report of work done with regard to the possible practical utility of rhizobia in agriculture appeared in 1893, followed in 1896 by the preliminary reports of researches by Nobbe and Hiltner and still later reports by Hartleb and Caran. So far no entirely satisfactory results have been obtained, but it is hoped that in the near future (five to ten years or more) satisfactory and conclusive results may be obtained which will initiate the fifth period, namely the Economic Value of Rhizobia and Functionally Related Organisms.

For the benefit of those interested, it may be stated that nearly all of the titles of literature of the fourth period (up to date) are found in the following list. A few are found in the first and second installments.

TITLES OF LITERATURE.

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CHICAGO.

XV. REPORT ON TWO COLLECTIONS OF HEPATICÆ FROM NORTHEASTERN MINNESOTA.

ALEXANDER W. EVANS.

The two collections embodied in the present report were both made in Cook county, the first by Messrs. MacMillan, Lyon and Brand, in 1901, the second by Mr. Holzinger in 1902. Although these collections contain no new species, they add quite a little to our knowledge of the distribution of Hepaticæ in North America. Thirty-two species, all belonging to the Jungermanniaceæ, are represented, and the collection of 1901 contains in addition a sterile *Pellia* and a sterile *Riccardia*, neither of which can be determined with certainty. So far as can be learned, sixteen of the thirty-two species are here recorded from Minnesota for the first time, and three of these, *Lophozia rutheana*, *Sphenolobus exsectæformis* and *Odontoschisma macounii*, have not before been reported south of the Canadian boundary. The numbers refer to the specimens in the collection of 1901; Mr. Holzinger's specimens, which are unnumbered, are simply designated by his initial; species new to Minnesota are marked with an asterisk.

1. **Marsupella emarginata** (EHRH.) DUMORT.*
   Near Grand Marais (H).

2. **Jamesoniella autumnalis** (DC.) STEPH.
   Grand Marais (24); portage between North and South lakes (143 *p. p.*); Arrow lake (172 *p. p.*); Stair portage (164); Grand Portage island, Old Iron trail, Little Devil's Track trail and Gunflint trail (H).

3. **Lophozia barbata** (SCHREB.) DUMORT.
   Grand Marais and vicinity (183 *p. p.*, 238, H); Stair portage (181 *p. p.*); summit of Mt. Josephine (H).

4. **Lophozia heterocolpa** (THED.) M. A. HOWE.*
   Near Grand Marais (H).

5. **Lophozia incisa** (SCHRAD.) DUMORT.

Gunflint trail (48 *p. p.*); Grand Portage island and Hat point (H).

6. **Lophozia Lyoni** (TAYL.) STEPH.

Portage between North and South lakes (143 *p. p.*); Stair portage (181 *p. p.*); summit of Mt. Josephine and Hat point (H).

7. **Lophozia Rutheana** (LIMPR.) M. A. HOWE.*

Near Grand Marais (H). Previously known in America from the Yukon Territory only.

8. **Lophozia ventricosa** (DICKS.) DUMORT.

Grand Marais and vicinity (231 *p. p.*, H); portage between North and South lakes (143 *p. p.*); Gunflint trail and Hat point (H).

9. **Sphenolobus exsectæformis** (BREIDL.) STEPH.*

Near Grand Marais (H). This species is very closely related to the following but differs from it in its larger leaf-cells and angular gemmæ. It was first recognized as an American plant by M. Dismier,[1] who examined specimens collected by Professor Macoun in British Columbia. It is now known from many localities in Europe and probably has an equally wide distribution in North America.

10. **Sphenolobus exsectus** (SCHMID.) STEPH.*

Near Grand Marais (H).

11. **Sphenolobus Hellerianus** (NEES) STEPH.*

Portage between North and South lakes (143 *p. p.*); Little Devil's Track trail (H). Badly mixed in both cases with other hepatics.

12. **Sphenolobus Michauxii** (WEB.) STEPH.*

Stair portage (182).

13. **Plagiochila asplenioides** (L.) DUMORT.

Near Grand Marais (H).

14. **Lophocolea heterophylla** (SCHRAD.) DUMORT.

Grand Marais (22, 28); Grand Portage island and Little Devil's Track trail (H).

15. **Harpanthus Flotowianus** NEES.*

Near Grand Marais (H).

[1] Bull. Soc. Bot. de France, 49 : 209. 1902.

16. **Cephalozia bicuspidata** (L.) DUMORT.*
Near Grand Marais (H).

17. **Cephalozia catenulata** (HÜBEN.).
Grand Marais (236).

18. **Cephalozia curvifolia** (DICKS.) DUMORT.
Portage between North and South lakes (140); Arrow lake (172 *p. p.*); Stair portage (165, 187); Hungry Jack lake (88); Old Iron trail, Little Devil's Track trail and Gunflint trail (H).

19. **Cephalozia divaricata** (SM.) DUMORT.*
Near Grand Marais and at summit of Mt. Josephine (H).

20. **Cephalozia fluitans** (NEES) SPRUCE.*
Grand Marais (231 *p. p.*).

21. **Odontoschisma Macounii** (AUST.) UNDERW.*
Near Grand Marais (H).

22. **Bazzania trilobata** (L.) S. F. GRAY.
Grand Marais (211); Gunflint trail (21, H); Old Iron trail, Hat point and base of Mt. Josephine (H).

23. **Lepidozia reptans** (L.) DUMORT.
Grand Marais (183 *p. p.*); portage between North and South lakes (143 *p. p.*); Stair portage (166); Grand Portage island, Little Devil's Track trail, Gunflint trail and Hat point (H).

24. **Blepharostoma trichophyllum** (L.) DUMORT.
Portage between North and South lakes (143 *p. p.*); Gunflint trail (48 *p. p.*, 58, H); Grand Marais, Old Iron trail and Little Devil's Track trail (H).

25. **Ptilidium ciliare** (L.) NEES.
Grand Marais and vicinity (25, 26, 27, H); portage between North and South lakes (142); Stair portage (184); Gunflint trail (51, 53, H); Reve Lake portage (175); Grand Portage island, Old Iron trail, summit of Mt. Josephine and Hat point (H).

26. **Scapania subalpina** (NEES) DUMORT.*
Near Grand Marais (H).

27. **Scapania undulata** (L.) DUMORT.*
Clear Creek, at crossing of Gunflint trail (46); near Grand Marais and Gunflint trail (H).

28. **Radula complanata** (L.) DUMORT.

Gunflint trail (56, H); Grand Portage island and Old Iron trail (H).

29. **Porella platyphylla** (L.) LINDB.

Old Iron trail (H).

30. **Porella rivularis** (NEES) TREVIS.*

Stair portage (42).

31. **Frullania Eboracensis** GOTTSCHE.

Grand Marais and vicinity (30, 245, H); portage between North and South Lakes (139, 141, 144); Stair portage (191); Poplar creek (113); Gunflint lake (38 *p.p.*); Grand Portage sland, Old Iron trail and Little Devil's Track trail (H).

32. **Frullania Oakesiana** AUST.*

Gunflint lake (38 *p.p.*); Little Devil's Track trail (H). The discovery of this species in Minnesota makes a very interesting extension of its known range. It had previously been reported from New England and Nova Scotia only and was supposed to have a rather restricted geographical distribution.

YALE UNIVERSITY.

XVI. OBSERVATIONS ON THE TIDE POOL VEGETATION OF PORT RENFREW.

S. A. Skinner.

During the summer of 1902 I had the privilege of spending a part of the months of July and August at the Minnesota Seaside Station at Port Renfrew, Vancouver Island, B. C.

The observations upon which this article is based were made during that time, at the suggestion of Professor Conway MacMillan, and I am greatly indebted both to Professor MacMillan and to Miss Josephine E. Tilden for many valuable suggestions and for assistance in determining the plants collected.

The problem studied is of interest not only in the determination of the plants of the various tide pools, but it becomes of some ecological importance as well when the various factors which have an influence on the distribution of the vegetation of the different pools are taken into consideration.

The following conditions received especial attention in the series of pools studied.

The rock formation in which the pool occurs.

Its location, whether high-tide, mid-tide, or low-tide.

Its distance from the ocean and its elevation.

Its exposure to wave action; its position relative to direction of movement of the wave; the direction of drainage.

The nature of the pool; dimensions; condition of the bottom; condition and position of the sides.

A series of eight pools was studied with some degree of care. The water was removed either with buckets or by syphons improvised from *Nereocystis* stems, and observations both at high and low tide were made.

The pools studied were situated on a ridge of rocks which jutted into the sea some sixty feet and was about thirty feet across at its widest point. It was exposed to wave action on the south, west and east.

The ridge descends gradually to the south by a series of nearly horizontal planes, each plane being from two to four feet

lower than the one above, The lower plane slopes gradually to the surface of the water at medium low tide, ending in an abrupt ledge about six feet high, which is exposed only at times of very low tide.

One or more pools from each plane were selected and studied. The formation in which this series occurs may be best described as a somewhat hard coarse sandstone, weathering in rather irregular masses, plentifully sprinkled with bowlders or concretions of a somewhat harder character. These concretions seem to be largely responsible for the origin of many of the pools of this locality. Becoming loosened in their beds, in the cavity thus formed, they are used by the waves as chisels, cutting out in the course of time pools several feet in depth and diameter. In many of the pools these "chisels" are still actively at work.

Pool No. I.

Location.—High tide pool. Situated on the summit of the ridge about fifteen feet above the water at medium low tide: Distant from the edge of the ridge twenty-five feet.

Exposure to Tide.—On August 9th, during high tide, the pool was entered but twice and then only by small dashes of spray thrown up from below.

On August 11th, during a squall at high tide it was filled repeatedly in the same manner. The water entered from the southwest. Drainage was to south and west.

Shape and Dimensions.—Nearly circular. Greatest diameter four and one half feet. Depth two and one half feet.

Bottom quite smooth except for the presence of a few small pebbles. Sides smooth. North side sloping. South side almost perpendicular except for a shelf of rock which extends along the south and part of the east and west sides.

Flora: Kind and Distribution.

1. **Corallina aculeata.**

On the shelf on the south and on the sloping side on the north extending across the bottom of the pool. All except a few plants at the bottom appeared to be dead.

2. **Codium mucronatum.**

About twelve specimens were found on the west and south side near the bottom. All of the upper ones were seemingly dead.

3. **Enteromorpha** sp.

Near the rim of the pool a few, seemingly dead, specimens were found.

Pool No. II.

Location.—High tide pool. At a level about four feet below Pool No. I.

Exposure to Tide.—Filled mostly by surf thrown up from west and southwest. Drainage in same direction. During a squall at high tide some waves rolled completely across the pool.

Shape and Dimensions.—Elongated northeast and southwest. Diameter four and one half feet. Depth two and one half feet.

Bottom is covered with small pebbles and several larger rocks from one to two and one half feet long. Sides uneven. South wall overhanging. On east, west, and north there is a gentle slope for a short distance, then an abrupt descent to the bottom.

Flora: Kind and Distribution.

1. **Cladophora** sp.

Occurs abundantly around the pool.

2. **Corallina aculeata.**

Occupies a zone about four inches wide around the rim of the pool. Upper plants seemingly dead.

3. **Phyllospadix scouleri.**

Occupies a zone about eight inches wide below No. 1.

Following down some cracks nearly to the bottom, and again lowering itself by means of long stout runners over an almost smooth perpendicular surface to some point below where a foothold can be obtained.

4. **Codium mucronatum.**

Eight plants were found under the overhanging wall on the southeast.

5. **Amphiroa cretacea.**

Two plants were found in a crevice below the *Phyllospadix* and sheltered by it.

6. **Cheilosporum planiusculum.**

Occupies a zone below the *Phyllospadix.*

The lower twelve inches of the pool were free from plant life.

Pool No. III.

Location.—Mid-tide pool. At a level one half foot below. No. 2. Distance from the ridge twenty feet.

Exposure to Tide.—During high tide filled repeatedly from south and west and subject also to a strong return flow as the waves are thrown back from the edge of the ledge above. Drainage to the south and west.

Shape and Dimensions.—Nearly circular. Greatest diameter three feet. Depth two and one half feet.

Sides smooth and uniform, almost perpendicular with the edge overhanging at the very top. Bottom covered by stones varying in size from a small marble to rocks two feet in length.

Flora: Kind and Distribution.

1. **Corallina aculeata.**

Occupies a zone around the rim of pool for three inches.

2. **Amphiroa cretacea.**

Occurs below No. 1, creeping down cracks nearly to the bottom of the pool.

3. **Amphiroa tuberculosa.**

Associated with No. 2.

4. **Codium mucronatum.**

Occupies a zone around the pool about eight inches from the top. Most abundant on the south side from which the waves enter.

5. **Codium adhærens.**

Occurs on south side with No. 4.

6. **Polysiphonia** sp.

Abundant with No. 4.

7. **Gigartina** sp.

Occurs around the edge of pool in small tufts.

8. **Cladophora.**

A few specimens occur a few inches below the rim of the pool.

9. **Cheilosporum californicum.**

Occurs on south side below No. 1.

10. **Corallina vancouveriensis.**

Associated with No. 1.

11. **Cheilosporum planiusculum.**

Occurs near the bottom of the pool on the north.

Pool No. IV.

Location. — Mid-tide pool. At a level three feet below No. 3. Distant from the edge of the ridge twelve feet.

Exposure to Tide. — The pool is filled repeatedly at mid tide. An occasional wave enters from the southwest but in general the pool is filled from the east end by the surf thrown up as a wave is broken violently on the ledge to the east.

The drainage is to the south and southwest. The west end of the pool is left usually in comparative quiet.

Shape and Dimensions. — Diameter east and west eleven feet. Diameter north and south six and one half feet. Depth six and one half feet.

In general the edge of the pool overhangs slightly. Sides quite smooth and regular, occasionally broken with crevices and holes. Below the overhanging rim the sides on the north and south slope gradually to the bottom. The east side recedes uniformly. On the west, about one foot below the surface, a shelf of rocks projects. Below this shelf the side slopes gradually to the bottom.

Bottom quite regular. Covered with rocks of various size.

Flora: Kind and Distribution.

1. **Corallina vancouveriensis.**

Occurs around the rim of the pool on the north and west, extends down four feet.

2. **Rhodomela larix** sp. with *Soranthera ulvoides.*

Occupies a zone about one foot wide three feet below the surface.

3. **Phyllospadix scouleri.**

Occurs on the northwest, west, and southwest. On the northwest it extends nearly to the bottom.

4. **Cheilosporum californicum.**

Occurs three feet below the surface on the east and south beneath No. 2.

5. **Cheilosporum frondescens.**

Occurs about four feet below the surface on the south and north. Seemingly protected by Nos. 5 and 3.

6. **Amphiroa cretacea.**

Occurs below the *Phyllospadix* on the northwest and southwest, three feet below the surface.

7. **Laminaria cloustoni.**

One plant was found in a crevice on the south and one on the east three feet below the surface.

8. **Codium mucronatum.**

A few plants occur on the north one and one half feet below the surface.

9. **Costaria turneri.**

One plant was found one foot below the surface on the west and one three feet below the surface on the east.

10. **Laminaria bullata.**

One plant was found on the east end three feet below the surface.

11. **Codium adhærens.**

A small amount occurs on the southwest end, one foot below the surface.

Pool No. V.

Location.—Mid-tide pool. On a level three feet below No. 4. Distant from the edge of the ridge one foot.

Exposure to the Tide.—The waves enter from the east and southwest. The waves thus coming from nearly opposite directions frequently meet and give rise to a strong vortex motion.

Shape and Dimensions.—Circular. Edge overhanging on the north and east. The sides slope gradually for about two and one half feet and then recede. On the south and west the sides recede from the very top. Sides, in general smooth but pitted somewhat with small holes.

Bottom covered with small pebbles which are kept in almost constant movement by the vortex action mentioned above.

Diameter four and one half feet. Depth four and one half feet.

Flora: Kind and Distribution.

1. **Corallina aculeata.**

Occurs on the northeast side for about two and one half feet.

2. **Cheilosporum planiusculum.**

A few plants occur with No. 1.

3. **Callophyllis** sp.

Occurs on the northeast with No. 1.

4. **Iridæa** sp.

A few plants occur along the upper edge on the east.

5. **Corallina vancouveriensis.**

A few plants occur below No. 1.

6. **Microcladia borealis.**

A few plants were associated with No. 3.

7. **Endocladia muricata.**

Occurs under a small ledge on the southwest near the surface.

8. **Codium adhærens.**

A few plants occur under an overhanging ledge on the north near the top.

The lower two and one half feet of the pool has no plant life.

Pool No. VI.

Location. — Mid-tide pool. On a level four feet below No. 3. Distant from the edge of the ridge four feet.

Exposure to Tide.—The water enters from the south and west and drains to the south, west and east.

Shape and Dimensions.—Irregular in shape. It consists of a deep nearly circular part on the east, and a shallow arm extending to the west. The south and west walls of the shallow arm are abrupt. The north side slopes gradually. The bottom is thickly covered with mussels.

The sides of the circular part of the pool are almost perpendicular. Very irregular. Covered with holes and cracks. The edge somewhat overhanging. The bottom is covered with pebbles and rocks.

Diameter of circular pool four feet. Depth three and one half feet.

Shallow arm. Length six feet. Width three feet. Depth three feet.

Flora: Kind and Distribution.

No plants occur on the south side of the circular pool except at the very edge. On the other sides they extend down two feet. The bottom of the shallow arm is abundantly covered with plant life.

1. **Phyllospadix scouleri.**

Occurs abundantly around the upper edge of the circular pool on the southwest and west, and a few much worn plants on the north. In the shallow arm it occurs on the south side and across the bottom.

2. **Cheilosporum frondescens.**

Occurs around the upper edge of the pool on the north and northeast. Extending down one foot. It occurs abundantly on the bottom of the shallow arm.

3. **Cheilosporum planiusculum.**

Occupies a zone below No. 1, following down crack two feet below the furface.

Abundant on bottom of shallow arm.

4. **Cheilosporum californicum.**

Occurs below No. 2 in protected crevices and beneath the *Phyllospadix.*

5. **Polysiphonia** sp.

Occurs in scattered tufts over the bottom of the shallow arm.

6. **Corallina aculeata.**

A small amount occurs beneath No. 1 on the south side of the shallow arm.

7. **Amphiroa cretacea.**

A few plants were found on a mussel on south side of the shallow arm.

Pool No. VII.

Location. — Mid-tide pool. At a level one half foot below No. 6. Distance from edge of ridge four feet.

Exposure to Tide. — The waves enter from southwest and drain to the southwest and east. The pool is subject to a vortex action as described in No. 5.

Shape and Dimensions. — Circular. Sides covered with mussels. South side somewhat overhanging. The other sides almost perpendicular.

Bottom covered with small pebbles. Diameter three feet. Depth two feet.

Flora: Kind and Distribution.

1. **Corallina vancouveriensis.**

Occurs around the edge of the pool except on the south. Extending down eight inches.

2. **Cheilosporum planiusculum.**

Associated with No. 1.

3. **Amphiroa cretacea.**

Covering a group of mussels on the southeast below No. 1.

4. **Halosaccion hydrophora.**

A very imperfect specimen was found under the overhanging ledge on the south.

Pool No. VIII.

Location. — Low-tide pool. About ten feet from the end of the ridge.

Exposure to Tide. — The waves enter from the southwest and drain to the southwest. Subject to a strong back flow. The pool is free from the surf but a few minutes at a time during low tide. During high tide the pool receives both surf and surge.

Shape and Dimensions. — Irregular in shape. Consisting of a rather shallow part on the north and a smaller deeper part on the south. Sides and bottom covered with mussels except the small pool on the south which has its bottom covered with pebbles.

Dimensions eight feet by six feet. Depth of small pool two and one half feet.

Flora: Kind and Distribution.

1. **Corallina aculeata.**

Occurs around the edge of the pool and sparingly over the bottom.

2. **Cheilosporum californicum.**

Occurs over the bottom on the mussels.

3. **Laminaria clustoni.**

Several small plants on the north in exposed position.

4. **Hedophyllum subsessile.**

Abundant over the pool.

5. **Alaria** sp.

A few plants occur on the bottom in an exposed position.

6. **Iridæa** sp.

A few plants found with No. 3.

7. **Lessoniopsis littoralis.**

Several plants occur on the edge of the deeper pool. Greatly exposed to the surf.

8. **Polysiphonia** sp.

Abundant over the bottom.

9. **Cheilosporum planiusculum.**

Covering the mussels on the bottom of the pool.

10. **Corallina vancouveriensis.**

Associated with No. 9.

Summary.

A comparison of the preceding results admits of the following generalizations.

I. *Corallina aculeata* inhabits the high-tide pools and occupies a zone near the surface of the mid-tide and low-tide pools. *Corallina vancouveriensis* was not found so abundantly in the series studied but occupies a zone similar to *Corallina aculeata*.

The species of *Cheilosporum* occur abundantly in the mid-tide and low tide pools.

Cheilosporum planiusculum seems to have somewhat the wider range, extending from the surface to a depth of two and one half feet to three feet. *Cheilosporum frondescens* and *Cheilosporum californicum* occur in general from one to four feet below the surface, frequently covering the mussels on the bottom of the pool.

Amphiroa cretacea and *Amphiroa tuberculosa* occur in the mid-tide and low-tide pools at some distance from the surface, frequently covering the mussels on the bottom and sides of the pool.

Phyllospadix occurs in general around the surface of the pool, in some cases extending some distance toward the bottom as convenient footholds offer and occasionally swinging by means of long stout rhizomes over a smooth perpendicular wall to some coveted point below. It seems to choose the more sheltered places where it will be free from the shock of the waves. If in an exposed position the plants found were always much frayed and battered.

The various surge and surf plants such as *Lessoniopsis*, *Laminaria*, *Hedophyllum* and *Costaria* occur in somewhat limited numbers in the low tide pools. *Lessoniopsis*, true to its nature, choosing the place of greatest exposure.

The species of *Codium* were found in the more sheltered parts of the pools, usually where the illumination was weak.

II. In general the higher the elevation of the pool and the less exposed to wave action, the fewer the species found, though the number of individuals may be abundant.

III. The more gradual the slope and the rougher and more irregular the sides, the more abundant the plant life. A perpendicular or receding wall is unfavorable for the location of plants.

IV. The presence of pebbles and loose rocks on the bottom of a pool prevent the distribution of plants over the bottom or far down the sides of the pool.

V. Pools which are subject to a strong vortex action are more or less completely circular in outline.

Where the waves enter quite uniformly from the same direction the pool is usually elongated in the direction of movement of the wave.

The work on tide pools, as outlined above, must be considered in no sense complete. Several conditions which have an influence on tide pool vegetation have received no consideration in this article. The effect of temperature; the effect of illumination; the condition of the water in regard to its salinity; the rate of repopulation of a pool from which all plant life has been removed and a comparison of the tide pools of the different rock formations occurring at Port Renfrew readily suggest conditions, the investigation of which should prove both interesting and profitable.

XVII. OBSERVATIONS ON ALARIA NANA SP. NOV.

HERMAN F. SCHRADER.

INTRODUCTION.

The genus *Alaria* is represented at the Minnesota Seaside Station by at least two species. The larger of these, *Alaria cordata* Tilden, is chiefly found in the same zone as *Egregia* and various species of *Laminaria*, attached to rocks which are seldom exposed except at low tide. It often reaches a length of six feet or more.

The species on which these observations are based, is found only among the *Postelsiæ*, attached to rocks which are seldom submerged completely, except at high tide, but which are always exposed to surf.

Part of the general morphology was studied from fresh material, but most of these observations are based on preserved material, collected by the writer, at the Minnesota Seaside Station during July and August, 1902.

Distribution.—The genus *Alaria* was founded by Greville in 1830. At present, according to Kjellman, eighteen or nineteen species are recognized, most of which are North Pacific and Arctic. Three species are North Atlantic, one of them extending as far south as the coast of Ireland and of France (De Toni, *Alaria esculenta*).

GENERAL MORPHOLOGY.

The young plants are usually found growing among the branches of the holdfast of maturer forms of their own species, or of *Postelsia palmæformis*, along with other young kelps, coralline algæ and acorn barnacles. The writer succeeded in collecting young specimens, less than two centimeters long, others, a little more mature, showing the first appearance of the gonidiophylls, and also mature specimens in all conditions. The species under discussion is small, for two of the most typi-

cal specimens were but thirty-two and forty-two centimeters long, respectively, and the largest specimen seen was not more than a third longer than this.

In all these specimens, a root or holdfast area, and a shoot, or stipe and lamina area, could be made out. The broad characteristic midrib was present in all, and even in the smallest specimens collected, it was just as wide and thick, comparatively speaking, as in the largest plants. The presence of this midrib makes it easy for a collector to determine whether he is handling an *Alaria* or another kelp.

The following figures give the measurements in centimeters of four typical young plants, and of two of the largest specimens collected.

Plant number,	1.	2.	3.	4.	5.	6.
Total length,	3.	1.5	4.	5.5	42.	32.
Length of stipe area including rachis,	.75	.4	.75	1.5	10.	6.
Width of lamina,	1.	.6	1.75	3.2	8.	6.5
Width of midrib,	.3	.1	.3	.5	.75	.6
Length of gonidiophyll,				*	10.2	8.
Width of gonidiophyll,					2.55	2.25
Number of gonidiophylls,					44.	32.

Alaria is unbranched and the chief difference between a young and a mature plant is the absence of gonidiophylls in the former. The largest specimen collected was but forty-two centimeters long, rather small, when one considers that specimens of other species, six feet or more in length, may be found less than a hundred yards away. In healthy specimens the tissue of the lamina is elastic and thin, but when the plant gets older, portions of the lamina begin to decay, forming large bladders of mucilage all over the surface. Perfect mature specimens are seldom if ever found, owing to the violent beating of the surf on the rocks to which they are attached.

The holdfast area is well developed in this *Alaria*. In the youngest plants collected, it consists merely of a small disc-shaped area, very little wider than the diameter of the stipe. Above this disc-shaped portion a few hapteric branches grow out from the base of the stipe. In larger specimens there are a great number of these hapteres. They are brown in color, branch dichotomously, and their tips are flattened somewhat where they clasp the rocks. These hapteres form a dense and solid network, between the meshes of which the young plants find a secure foothold.

* Two gonidiophylls appearing on upper portion of stipe.

The stipe is rather dark in color, especially in older plants. Its general shape is terete, but the upper or rachis portion, upon which the gonidiophylls are borne, becomes somewhat elliptical in shape as it reaches the lamina, where it becomes the midrib. The surface of the stipe is smooth; it is tough, and does not branch although it gives rise to the gonidiophylls in the area just below the lamina.

The lamina is lighter in color than the stipe. It is rather thin and elastic, and varies in maximum width from about one eighth to one sixth of its length. A thick midrib runs through the center, and the lamina proper may be considered as simply a flattened expansion of the midrib. In perfect specimens the lamina tapers somewhat at the tip, but owing to the action of the surf, the lamina is usually torn considerably at its upper end, sometimes only the midrib remaining to show the former length.

The gonidiophylls are proliferations of the stipe, situated just below the base of the lamina. When they first appear they look like little, conical, smooth outgrowths, on the side of the stipe. As they elongate, they flatten out. They vary considerably in number, according to the size and age of the plant on which they are borne, and from thirty to forty or more in mature specimens is nothing unusual. The oldest gonidiophylls are found nearest the base of the cluster, the youngest nearest the lamina. They have no midrib, nor any similar structure, but their base is somewhat thickened and narrowed into a short stalk, which does not differ in structure from the rest of the gonidiophyll except that it is sterile. The color is almost as dark as that of the stipe. Patches of sori, consisting of gonidangia and paraphyses are found on both sides, except in the case of the very young gonidiophylls.

Anatomy.

The anatomical study was based upon slides, made from both young and old material. Most of the material was killed in formalin solution four per cent. and before being used was washed for twenty-four hours in running water, dehydrated and embedded in paraffin by the usual methods. Most of the sections were stained on the slide, and mounted in Canada balsam, but in some cases it was found that heating the sections in order to fasten them to the slide distorted them. In such cases the sections were dissolved out in xylol, gradually brought into

fifty per cent. alcohol, and after staining, mounted in glycerine jelly. Free-hand sections were found best for the cross-section of the stipe. Bismarck brown, iron-alum-hæmatoxylin, and Delafield's hæmatoxylin, were on the whole the most satisfactory stains, although aniline blue and safranin were found useful for sections of the stipe.

The Holdfast.—The holdfast area consists originally of a disc-like structure, as in *Nereocystis* and other kelps. In the smallest specimen at the writer's disposal the first few hapteric branches had already appeared but the primitive disc could still be made out without much difficulty. The hapteres originate in a special growth region at the base of the stipe (*fig. 18*, *fig. 11*, *b*, *fig. 20*) just above the primitive disc. They branch dichotomously. In cross-section (*fig. 11*, *b*) it is seen that no pith area is present in the hapteres, but that their central tissue is parenchymatous, consisting of rather large cells of irregular shape, which gradually become smaller as the hypodermis and epidermis are reached. Chloroplasts are very common in the hypodermal tissue of hapteres, especially the upper portion. By comparing the longitudinal and cross-sections of the haptere, very little difference between them is found (*figs. 18 and 19*). Growth rings, such as are reported for *Pterygophora*, were not found in this species of *Alaria*.

The Stipe.—To study the stipe the smallest specimens collected were first used, then some of the larger plants on which gonidiophylls were just beginning to appear, and finally, mature plants.

Mucilage ducts are not present in *Alaria*. In general, three areas of tissue may be made out, *viz.*, epidermis, cortex, and pith, which latter is of the same elliptical shape as in the other kelps (*fig. 11*, *a*, *b*). It is chiefly composed of an interwoven mass of anastomosing filaments, embedded in a gelatinous matrix (*fig. 15*). The cortical area may be divided into an outer and inner layer. The cells of the inner cortex tend rather towards a round shape than a hexagonal (*fig. 14*), but as the outer cortex is reached the cells become polyhedral in shape and gradually smaller in size (*fig. 13*). The epidermal cells appear rectangular in shape. Chloroplasts were found only in the outermost layers of cortex. In a cross-section of a mature stipe, the cells of the outer cortex give the appearance of being radially arranged. This is no doubt due to the radial division

of certain rows of cambial cells, situated between the inner and outer cortex. This difference in outer and inner cortex, caused by this radial growth of the outer cortex, seems to the writer, to account for the growth rings figured by Postels and Ruprecht. Growth in thickness is also due to the activity of these cambial cells.

Young stipes are rather soft, but older ones are quite tough and hard, although in this respect they are comparable to stipes of *Laminaria* rather than to those of *Lessonia* or *Pterygophora*.

The Lamina. — In *Alaria* the lamina is provided with a very distinct midrib, which is practically a flattened extension of the stipe. The lamina proper, may be compared to a flattened expansion of the midrib (*fig.* 22).

As in the stipe, a medullary or pith area is found in the midrib, but no distinction into outer and inner cortex can be made out. In a cross-section the pith area will appear very similar to that of the stipe, except that it is much looser (*fig.* 25) but the cortex will be seen to consist of fairly regular, polyhedral cells of medium size, and tightly packed (*fig.* 23). Chloroplasts seem to be present only in the outermost layers, as in the case of the stipe (*fig.* 24). When a section of the lamina (*fig.* 26) perpendicular to the midrib, and close to it, is examined, it is readily seen that the lamina is morphologically but an expansion of the midrib, for the epidermis and cortex differ from the same areas in the midrib in no respect whatever, but the inner layers of cells gradually become very much elongated and tend to anastomose at their ends. In sections taken parallel to the midrib, and at some distance from it (*fig.* 27) it is seen that practically all the tissue except the epidermis consists of long anastomosing cells which are cut at various angles owing to their position. This portion of the plant is very gelatinous, and as soon as decay sets in bladders of mucilage are formed all over its surface by the decay of the tissue.

The meristem or growing area in *Alaria* is at the junction of the stipe and the lamina. The lamina, therefore, grows at its lower end, and the stipe at its upper end. This is also shown by the fact that the base of the lamina is usually elastic, while the tip, which is older, is more flabby and gelatinous.

The gonidiophylls arise at the upper end of the stipe, just below the meristematic area. They first appear as little conical outgrowths of the stipe, but flatten out very soon (*figs.* 4, 5,

6). The basal portion remains somewhat thicker than the rest, and at its end narrows into a short stalk (*fig. 12*). As the stipe grows from its upper end, more and more gonidiophylls are produced laterally by the activity of the meristem, so that finally from thirty to fifty, with the youngest nearest the base of the lamina, may be present. The stipe, which normally is terete in form, becomes somewhat compressed in the area where the gonidiophylls are situated, but its anatomical characters do not change. The sori cover both surfaces of the gonidiophyll. The paraphyses, found among the gonidangia are much larger than these (*fig. 30*). The gonidangia are club-shaped with a thick base; the paraphyses, on the other hand, are very thin and delicate at their bases but as they reach above the gonidangia they thicken out into a club-shaped upper end which has a large cuticular cap on its upper surface, as in the case of *Pterygophora*. This cap is lamellate in character. Probably the presence of the paraphyses is a great protection to the gonidangia, both in preventing their being preyed on, and in the gonidia being set free before ripe, by the action of the surf. Mature gonidangia measured from 70 mic. to 100 mic. in length, paraphyses from 150 mic. to 180 mic. in length. The cuticular cap of the paraphyses measured in width from 26 mic. to 33 mic. at the top, and from 14 mic. to 17 mic. thick.

Description of Species.

Alaria nana sp. nov.

Plant rather small, thirty to fifty centimeters long, green to greenish brown in color; stipe rather long (4.5–7 cm. long), firm, elastic, robust, terete; rachis rather long (2–4 cm.), slightly compressed, passing into the midrib gradually at upper end; blade about one sixth as wide as long (6.5–8.5 cm. in widest part), rather thin, elastic, tapering slightly at upper end, midrib prominent, .40–.75 cm. wide, projecting equally on both surfaces, somewhat rectangular in cross-section; gonidiophylls long, narrow, elliptical (6–12 cm. long, .75–1.50 cm. wide), narrowed and thickened at base into a short stalk; rachis bears 25–50 gonidiophylls as lateral outgrowths; fruiting area covering both entire surfaces.

Abundant in very exposed situations, covered only at high tide, but always beaten about by the surf.

Collected at Postelsia point, Minnesota Seaside Station, July–August, 1902.

Summary.

1. *Alaria nana* is one of the smallest Alariæ known, mature plants seldom being longer than 50–70 cm.

2. At the Minnesota Seaside Station it is a surge plant, belonging in the same group as *Lessonia littoralis* and *Postelsia palmæformis*.

3. The holdfast does not show growth rings.

4. The growth of the stipe in thickness is radial, and this difference in growth and shape of the outer and inner cortex, caused by a cambial layer, sometimes gives a ringed appearance to the stipe. Mucilage ducts are not present; cryptostomata were found neither in stipe nor in lamina.

5. The sori occur in large patches on both sides of gonidiophylls produced laterally on the stipe. The paraphyses have large thick mucilaginous caps as in *Lessonia* and *Pterygophora*.

Explanation of Figures.

All drawings, except diagrams of sections were made with the Abbe camera lucida, under an enlargement of × 530, unless otherwise stated.

Plate XXIII.

Postelsia Point at Minnesota Seaside Station — showing *Postelsia palmæformis*, *Alaria* and other surf plants. Photographed by C. J. Hibbard.

Plate XXIV.

Photograph of two mature and fair sized plants, and of three small plantlets, one third natural size. Photographed by C. J. Hibbard.

Plates XXV and XXVI.

1–10. Various young stages of *Alaria* drawn natural size; Figs. 4 and 5 showing very young gonidiophylls; Fig. 9 the gonidiophylls are quite mature.

11. Diagrams of sections of stipe. *a*, transverse section showing different tissue areas; *b*, longitudinal section at base showing origin of secondary hapteres in the cortex and two burrows in the stipe, made by small crustaceans; *e*, epidermis; *c*, cortex; *p*, pith; *x*, burrow of crustacean; *h*, hapteres.

12. Sections of upper portion of stipe (rachis) to show origin of gonidiophylls. *a*, transverse section; *b*, longitudinal section in which the midrib has also been sectioned. Areas indicated as for Fig. 11. *g*, gonidiophyll; *l*, lamina.

13. Cross-section of stipe showing outer cortex and epidermis. The chloroplasts in the cortex are shown.

14. Inner cortex of stipe, cross-section.

15. Pith area of a stipe in cross-section showing the anastomosing cells, embedded in a gelatinous matrix.

16. Epidermis and outer cortex of stipe in longitudinal section.

17. Inner cortex of stipe in longitudinal section.

18. Tip of a haptere of holdfast, longitudinal section.

19. Longitudinal section of haptere from the side.

20. Longitudinal section of stipe at origin of a haptere. *a*, cortex of stipe; *b*, cortex of haptere.

21. Cross-section of a haptere at a branch.

22. Diagram, cross-section of midrib indicating the lamina proper and the tissues of the midrib, × 10 by measurement.

23. Cortex of midrib in cross-section.

24. Longitudinal section showing epidermis and cortex of midrib.

25. Pith area of midrib in longitudinal section. There is practically no difference whatever between the long and cross-sections, as the anastomosing cells run in all directions.

26. Section of lamina cut perpendicular to and very close to the midrib.

27. Section of lamina cut parallel to the midrib and at a distance from it.

28. Diagram of gonidiophylls, natural size. *a*, large and mature; *b*, before the formation of gonidangia.

29. Cross-section of a young gonidiophyll before the formation of gonidangia.

30. Cross-section of a mature gonidiophyll showing gonidangia and paraphyses.

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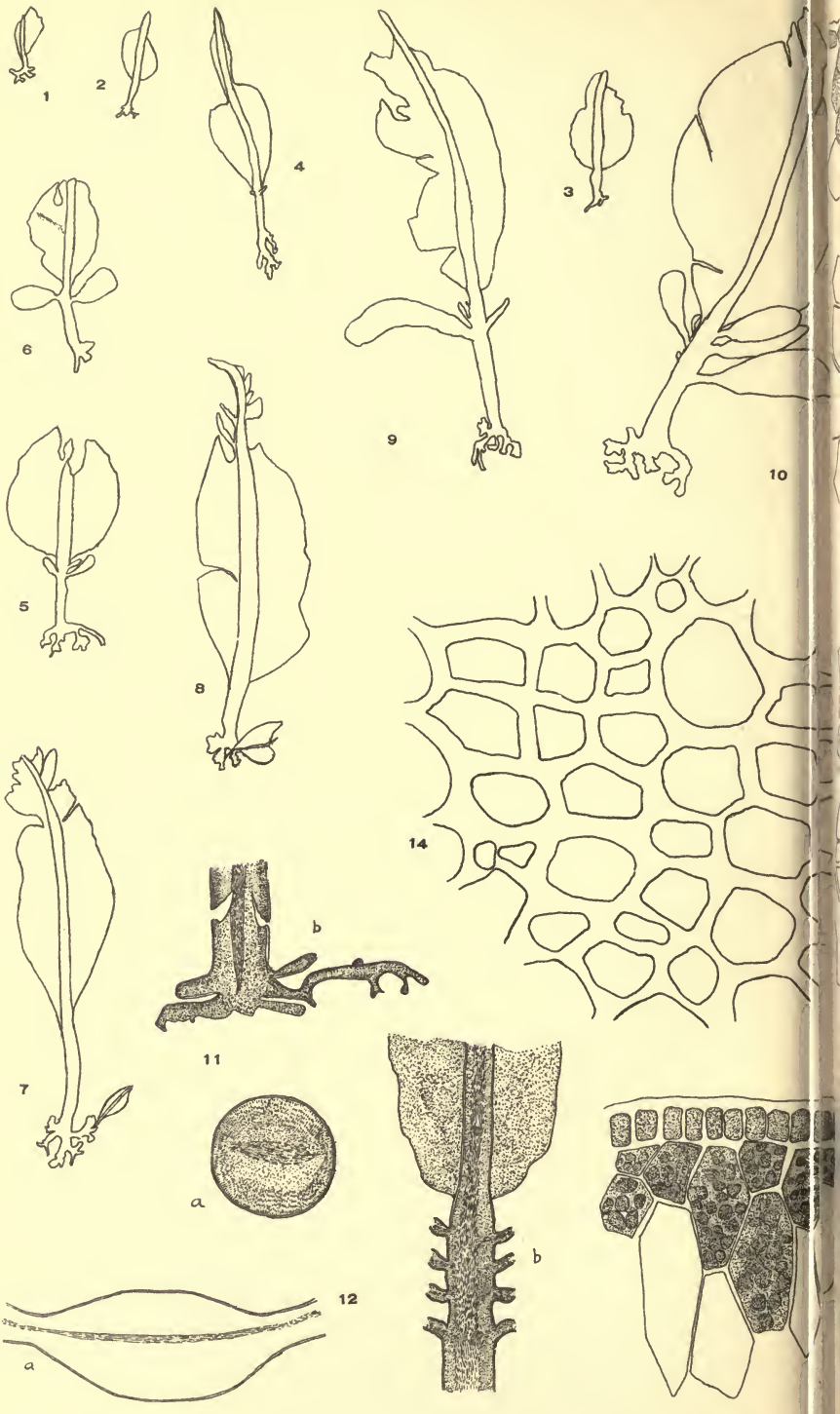
PLATE XXIII.

PLATE XXIV.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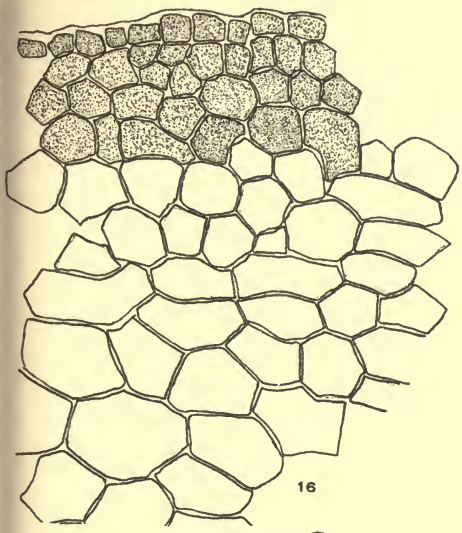
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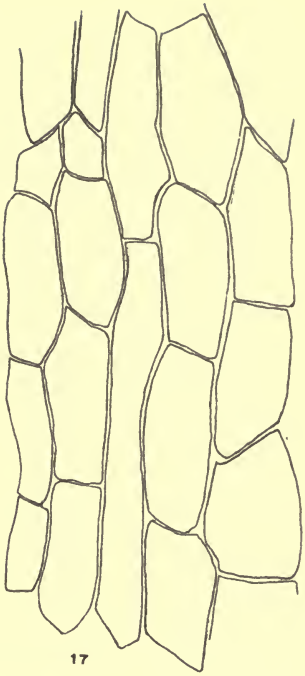
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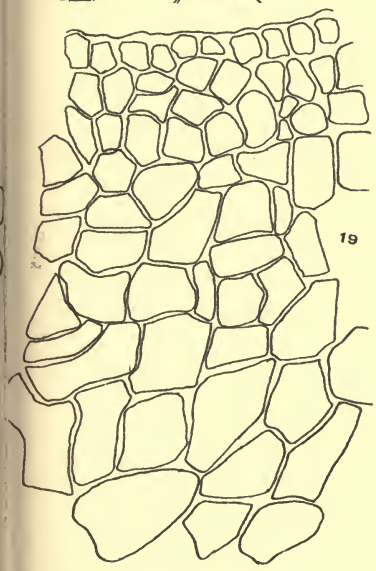
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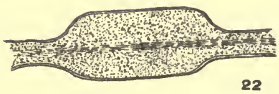
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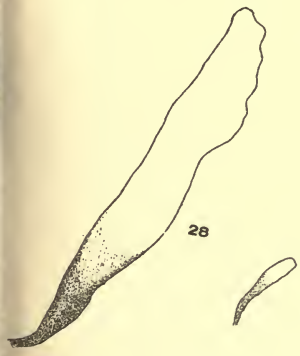
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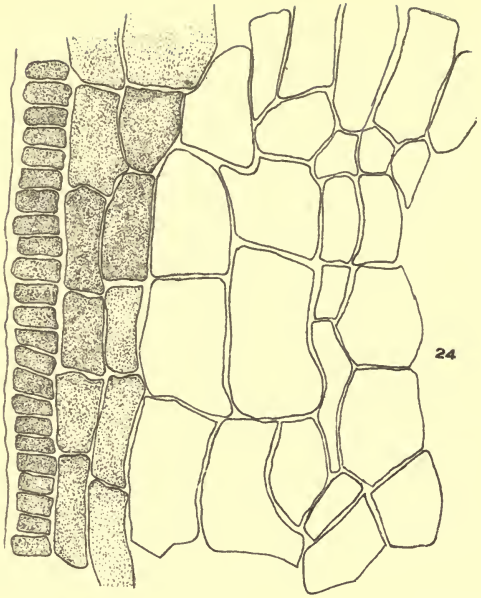
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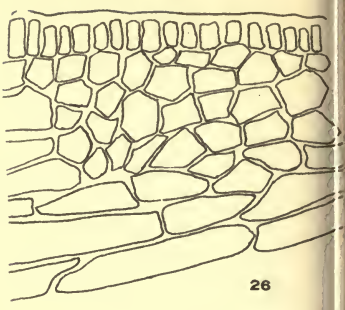
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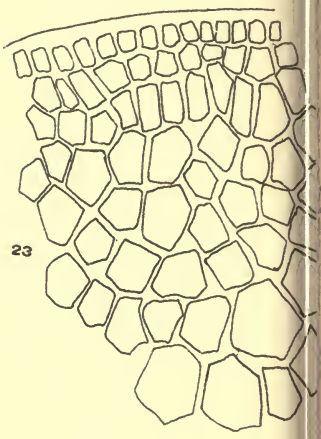
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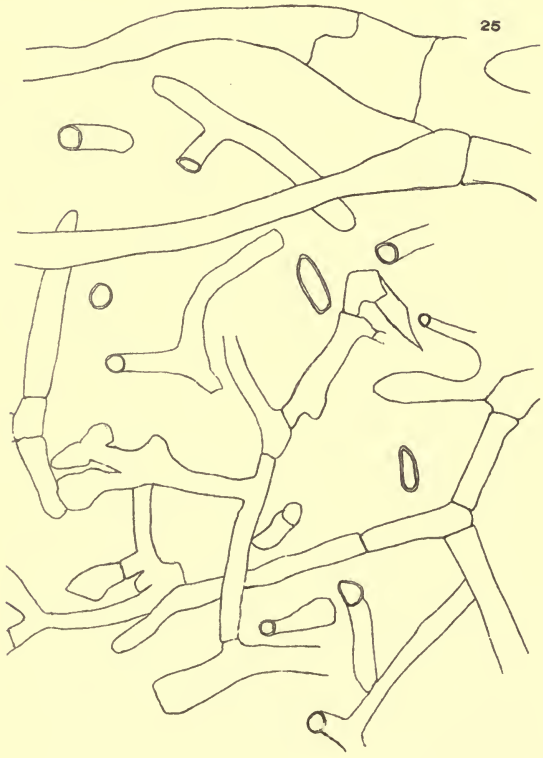
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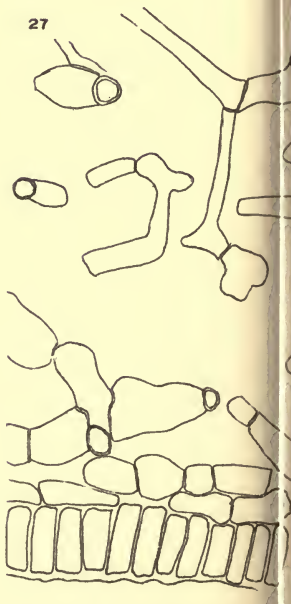
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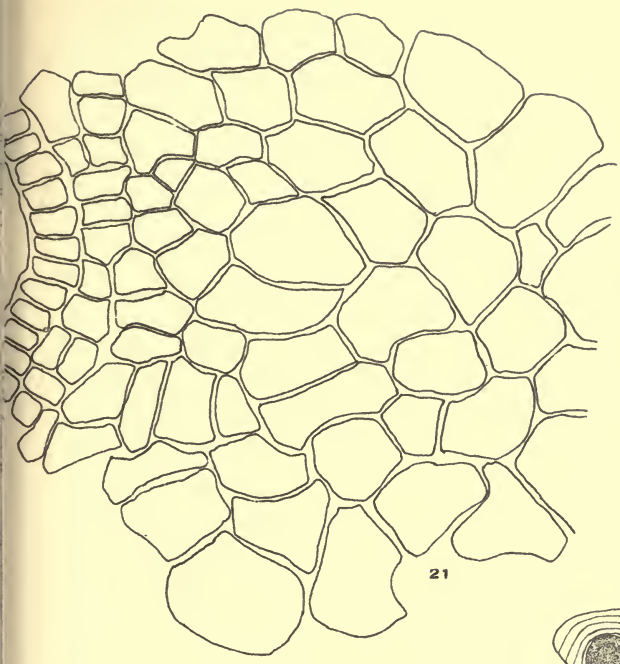

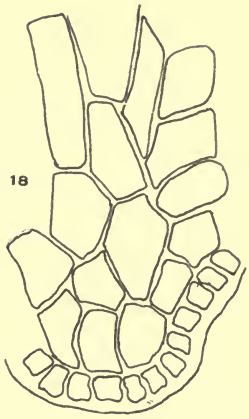
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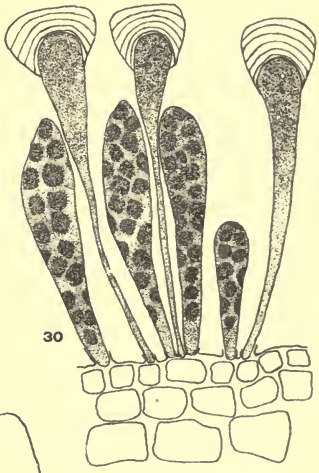
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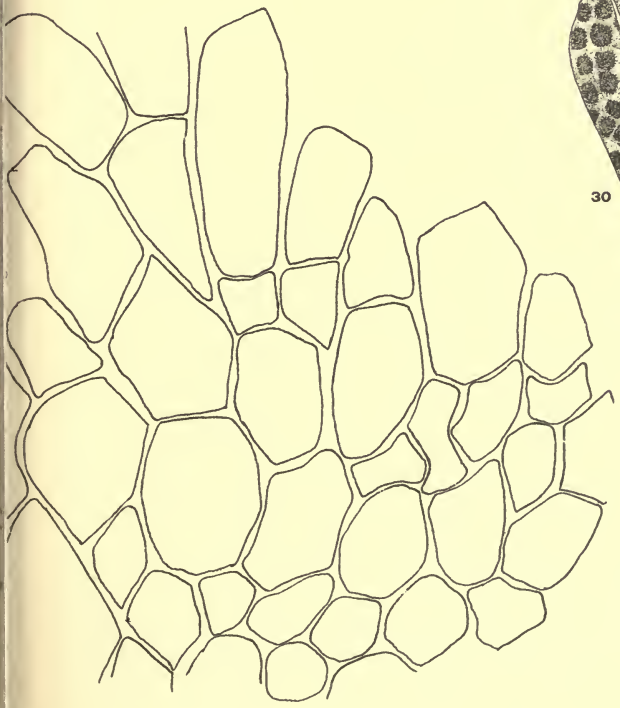

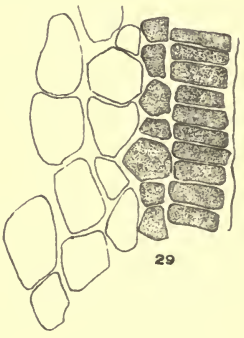
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XVIII. CONTRIBUTIONS TO A KNOWLEDGE OF THE LICHENS OF MINNESOTA. — VII. LICHENS OF THE NORTHERN BOUNDARY.

Bruce Fink.

Considerations of Distribution and Habitat.

During the summer of 1901, the writer spent eleven weeks in field study of lichens for the Minnesota botanical survey, and the following paper is the outcome of that work and subsequent careful study of the material collected. In the study of the *Cladonias*, Dr. E. Wainio has continued his valuable aid till nearly 200 of the Minnesota collections within the genus have passed through his hands, and the work of the whole genus bears the impress of his remarkable knowledge of *Cladonias*. Dr. A. Zahlbrückner has also examined more material since the publication of the last number of this series, but little of his work happens to contribute to the present paper. Moreover, we have found in Dr. T. Hedlund, of Upsala, Sweden, a most excellent helper in the genera *Biatora*, *Lecidea* and *Buellia*, and we are under lasting obligations to him as well as the two men previously named for much aid in the work.

The area considered in the present paper lies along the northern boundary of the state from Warroad eastward by south to Harding, thence southward to Tower. In order to study the flora of a wooded region nearer the northern boundary than Warroad, and at the same time well to the west, Oak island, in Lake of the Woods, and some other islands near by, were studied. The region covered by this paper was selected with a view to obtaining as complete a knowledge as possible of the lichen flora of the extreme northern portion of the state and to supplement the knowledge recorded in the fourth and sixth papers of this series. That the area was well selected for the latter purpose will appear, and its richness is shown in that the list of species and varieties has reached 312 as against 258

for the Lake Superior region. True, the time spent in the territory treated in this paper was nearly twice as long, but after one has been in a limited area for some time, species new to the region do not appear so often; and the larger number of the present list can scarcely be entirely due to the additional time spent, especially when it is remembered that each locality was studied carefully for the sake of distribution rather than merely for species new to the state. However, previous knowledge of the lichens of the state in general and their habitats, gained through long-continued study in the field, made it possible to work more effectually and added considerably to the whole number collected and especially to the number new to the state. So on the whole, it can scarcely be said that the portion of the boundary covered in 1901 is richer in lichen species than the Superior region to the east and southeast. Indeed, the latter region has more diversity as to elevation and temperature with scarcely less as to kinds of trees and other lichen-bearing substrata and should be, and probably is, richer in lichen species. The cold winds along the north shore of lake Superior add materially to the number of northern forms found there, while the influence of the smaller Lake of the Woods and Rainy lake in this respect is less marked. For this reason, again, the lake Superior area should be the more productive of lichen species. Turning to the region whose lichen flora was recorded in the sixth paper of this series, various portions of which lie 50 to 150 miles south of the present area, it may be confidently stated that the former with its 215 recorded forms is considerably poorer than the latter with about one third more recorded. The greater richness in lichen forms in the present region is to be accounted for partly by the fact that there are more rocky substrata and, on the whole, more variety as to substrata. The difference due to presence of rocks is apparent enough, when we record that the present region, like the lake Superior area, has nearly as many forms on rocks as on wood, while the territory farther south has only about half as many. Indeed, some portions of the region now under consideration are doubtless even richer in proportion of rock lichens than the lake Superior area, for in the present paper, a close analysis of the region about Rainy Lake City shows that there are fully ten per cent. more rock than tree lichens. And it may be remarked in passing that the richness in rocky substrata, and more effective

study of them due to long experience, accounts for the fact that this region about Rainy Lake City has furnished a larger number of lichen forms than any other in the state — 163.

The collecting stations were Oak island and a few surrounding islands, Warroad, Beaudette, Emo, Koochiching, Rainy Lake City, Kettle falls, Harding and Tower — also a few plants were collected at Le Claire, and on the mainland near Oak island. The islands possess the rock exposures and the hard wood and the coniferous trees as well as the swamps of certain other portions of the area studied and were found to be fully as rich in lichen forms and to present no special distributional peculiarities, except the presence of a somewhat larger per cent. of northern forms. Beaudette was the poorest field visited as regards numbers collected and only furnished 102 forms. This is due to the presence of a vast cedar and tamarack swamp with only a very few hard-wood trees and almost no rocks at all. The swamp is unexcelled in richness of species characteristic of such environment, but comparatively few other lichens are to be found. Warroad presented little better conditions in general, and had it not been for the finding of a single rock exposure one half mile long, toward Roosevelt, would have furnished few more species. This exposure of rock, said to be thirty miles from other surface rocks, furnished many of the *Biatoras*, *Lecanoras*, *Buellias*, *Cladonias*, *Umbilicarias*, and *Rinodinas* characteristic of such habitat and was surprisingly rich in lichens for such an isolated area of rock. Oak and other neighboring islands furnished 144 forms and Warroad, with the rock exposure mentioned, 130. At Emo on Rainy Lake river, lichen-bearing rock exposures were not numerous, and the number was 128. At Koochiching, at the west end of Rainy lake, rock exposures became more plentiful, and the number reached 145. The number for Rainy Lake City is 163, for Kettle falls 129, for Harding 125 and for Tower 145. At Kettle falls and Harding a special effort was made to study the woods and swamps more especially, so that the work on the rock exposures was not thoroughly covered; and it may be said that the apparent differences in richness in lichens in various portions of the area covered is almost wholly due to differences in amount of rocky substrata, or to amount of work done on them.

One feature of the work that has added to the whole number

of species reported in this paper is that *Cladonias* were sought for with unusual care, knowing that Dr. Wainio would work them out carefully so that a good contribution to Minnesota and North American lichens could be thus made. Also a number of *Buellias*, confusingly like *Buellia petræa* (Kbr.) Tuck., were for the first time detected in the field, as well as a number of *Buellias* parasitic on other lichens.

The region furnished many elements of interest similar to those met in the lake Superior region, but these must be passed over lightly to give place to some ecologic considerations. For instance, the succession of lichen forms following fires and preceding arboreous vegetation could be studied most splendidly in the region and constantly tempts one away from a predetermined line of study. The sensitiveness of the *Cladonias* to the effects of sun and wind are very apparent and would furnish an interesting and very instructive field for extended study. The part that lichens play in soil formation may also be most beautifully studied, especially at Rainy Lake City. A mere suggestion of the possibilities in such a study has been given in these studies,* and the subject must be passed over for the present. The succession of species on trees suggested there has since been followed out in the studies of the arboreous formations and will be continued in the present paper. Also a detailed study of distribution within the present area as was presented in the above-cited paper would be instructive, but we can only give a brief statement as to comparative numbers of arctic or subarctic forms. For the lake Superior region, 41 such lichens were recorded.† For the present area, some 27 such lichens were noted. The following is the list, 20 of which marked (C) occur also in the lake Superior territory.

Ramalina pusilla (Prev.) Tuck. C.
Ramalina pusilla (Prev.) Tuck. var. **geniculata** Tuck. C.
Usnea cavernosa Tuck. C.
Peltigera canina (L.) Hoffm. var. **spongiosa** Tuck.
Physcia hispida (Schreb.) Fr. C.
Umbilicaria vellea (L.) Nyl. C.
Umbilicaria hyperborea Hoffm. C.

*Fink, B. Contributions to a Knowledge of the Lichens of Minnesota.—IV. Lichens of the Lake Superior Region. Minn. Bot. Stud., 2: 221. 29 D. 1899.

†Fink, B. *l. c.*, 227–233.

Nephroma lævigatum Ach. var. **parile** Nyl. C.
Nephroma tomentosum (Hoffm.) Neck. C.
Lecanora frustulosa (Dicks.) Mass. C.
Lecanora verrucosa (Ach.) Laur. var. **mutabilis** Th. Fr.
Stereocaulon paschale (L.) Fr. C.
Stereocaulon tomentosum (Fr.) Th. Fr.
Cladonia deformis Hoffm. C.
Cladonia digitata (L.) Hoffm. C.
Cladonia amaurocræa (Flk.) Schaer. C.
Bæomyces æruginosus (Scop.) DC. C.
Biatora lucida (Ach.) Fr. C.
Lecidea lapicida Fr. C.
Lecidea platycarpa Ach. C.
Buellia geographica (Pers.) Tuck. C.
Buellia petræa (Flk.) Tuck. C.
Buellia petræa (Flk.) Tuck. var. **montagnæi** Tuck. C.
Buellia badioatra (Flk.) Kbr.
Buellia concreta (Kbr.) Eck.
Buellia obscurata (Ach.) Eck.
Buellia concentrica (Dav.) Fink.

Inspection of the lists for the two regions involved shows conclusively that the one first studied has a much larger proportion of arctic and subarctic lichen forms; for the proportion is approximately two to one, while the whole number of lichens is considerably smaller. This is what had been anticipated, though areas some fifty miles farther north were reached in the study of the region treated in the present paper. As was stated in the paper cited above,* it was not expected that the northwestern part of the state would give a large number of northern lichens, and the number found is larger considerably than was supposed to exist when the study was begun. Professor Conway MacMillan † has noted the difference between the spermaphytic floras of the two regions; and we conclude from his statements that the post-glacial change in flora has been more rapid for the higher plants than for lichens, and that the lichen flora of the region about Lake of the Woods contains a larger proportion of northern forms than does the spermaphytic flora of the same area.

* Fink, B. l. c., 233-234.

† MacMillan, C. Observations on the distribution of plants along the shore at Lake of the Woods. Minn. Bot. Stud. 1: 954. 1897.

Avoiding unnecessary detailed statement, it may be briefly stated that the present list adds 64 lichen species and varieties to the flora of the state, and with about 20 Minnesota lichens yet undetermined, brings the whole number of lichens for the state very near to the 500 mark set by the State Botanist a few years ago.* The estimate seemed high at the time, but a month's search for new species in northern Minnesota would pass it considerably; and it is now safe to increase the estimate to 700, a number which may not be reached, though there is little doubt that many lichen forms exist in the state. Of the 64 one is new, and 13 more are new to North America. Besides these, several are not yet determined. The northern portion of the state has now been studied more than parts farther south, but this part of Minnesota is by far the most interesting to the lichenist and would surely still yield more new material than most areas farther south in the state.

All of the northern boundary has been studied more or less, except the region in the Red river valley, which is very poor in lichens; and as other features of origin and distribution were considered in the work to the eastward of the present area in 1897, it is the more fitting that the formations should receive special attention in this paper. The two areas are somewhat similar as to lichen floras, and the two papers will thus supplement each other, the present bringing out features which constantly obtruded themselves in 1897, but which could not receive attention.

Before passing to the lichen societies of the region, some general statement as to substrata will be in order. No limestones were seen during the summer, all of the rocks being those of the Archæan or Algonkian groups. To the westward cedar and tamarack swamps abounded, especially the former. Hard-wood trees were found here, but they are not numerous, and attention was given largely to the swamps, which furnish the most interesting field in Minnesota for the lichenist. Passing eastward and southward fewer and smaller swamps were found, and more rock exposures. A great variety of substrata was investigated, as will appear in passing in order the large number of formations to follow. A matter of special interest was the opportunity offered of studying further the swamp formations previously investigated farther south. Also, time was

* MacMillan, C. Minnesota Plant Life, 95. 1899.

found for the first time to give detailed attention to the lichen communities of wet rocks and to the poplar tree formations about Lake of the Woods. The *Umbilicaria* formations also were studied ecologically for the first time, and the *Cladonias* of humus over rocks as well. Finally, a brief mention of the unusually large number of lichens found living parasitically on other lichens is in order.

In passing to the consideration of formations, it may be said that, as in the previous studies of this series, in covering so large a region in limited time and making extensive collections and taking notes on ecologic distribution at the same time, it was not found possible to give attention to other than the more general ecological considerations. Some general statement may be made of various adaptations noted and not previously reported, and some of them must be taken as merely suggestive and as yet little more than mere guesses thrown out with the hope that others may be inclined to study some of them more in detail. First of all, it is certain that, in many of the fruticose lichens as the *Ramalinas*, some *Cetrarias*, *Evernias*, *Usneas*, *Stereocaulons* and *Cladonias*, there is in dry weather a drawing together of branches as if to lessen exposure to wind and lessen transpiration of moisture. The same seems true of the crisping and bringing together of lobes in many of the foliose species in dry weather or the dry portion of a day. This may be seen in *Peltigeras*, some foliose *Cetrarias* and certain *Nephromas*, *Leptogiums*, *Collemas* and *Theloschistes*. The writer has made some preliminary studies on *Peltigera* and *Ramalina* and is convinced that some species of the former genus are as responsive to moisture relations as are certain seed-plants as *Oxalis* and many legumes to light and temperature. Also he believes that many lichens are quite responsive to light and temperature conditions in passing from their moist flexible state to the dry and fixed condition. There is here a most excellent field of work open to any one who may wish to cultivate it. But such problems are to be studied at leisure and not in the hurry of a general survey of many lichen societies. Then, too, there is the hairiness or ciliate condition of a number of the lichens of northern Minnesota. This finds expression sometimes as strong rhizoids on the lower surface as in the *Peltigeras*, in the smaller ones forming a dense nap on the lower surface as in *Nephromas* and in

the same sort of development on the upper surface as in the trichomatic hyphæ of some *Peltigeras*. There is more or less of the same development of such structures in other genera as in *Physcia ciliaris* (L.) DC. and *P. hispida* (Schreb.) Tuck. and even in some *Cladonias*, though usually quite overlooked in the last. These structures may be protective in part, are surely related to some extent to moisture conditions, but they seem to be better developed as a whole toward the north and no doubt have a temperature relation as well. Thus when we add the many adaptations in thallus structure, which have been dwelt on in the last paper of this series and will receive attention in the following pages, and which are surely more than purely mechanical adaptations, it becomes very apparent that to dismiss lichens ecologically, as is sometimes done, with the mere statement that they can endure complete desiccation and therefore have and need no special adaptations is quite erroneous. That they can endure great desiccation is to be admitted; but since they have the unusual power of absorbing moisture directly from the atmosphere, it is doubtful whether the drying process often goes so far as has been commonly supposed. However much of drying the lichens may be able to endure, we are convinced that the condition is unfavorable to them and that, like xerophytes in general, they show certain structural adaptations, and these we shall consider as well as may be done in a general survey. Moreover, in this survey of a large region involving many conditions, a large number of geological, climatic, physiographic, hydrodynamic, biotic, general atmospheric and even some of the more important edaphic factors could not receive the attention deserved.

Beginning with the previously studied and better known formations and passing to the less known and finally to a few here introduced for the first time, we may take first the following:

Lecanora Formation of Exposed (Usually Horizontal) Rocks. (Rainy Lake City.)

Parmelia saxatilis (L.) Fr. var. **panniformis** Ach.
Parmelia olivacea (L.) Ach. var. **prolixa** Ach.
Parmelia conspersa (Ehrh.) Ach.
Physcia stellaris (L.) Tuck. var. **apiola** Nyl.
Physcia cæsia (Hoffm.) Nyl.
Placodium elegans (Link.) DC.

Placodium cinnabarrinum (ACH.) ANZ.
Placodium citrinum (HOFFM.) LIGHT.
Placodium cerinum (HEDW.) NAEG. and HEPP. var. **sideritis** TUCK.
Placodium aurantiacum (LIGHT.) NAEG. and HEPP.
Placodium vitellinum (EHRH.) NAEG. and HEPP. var. **aurellum** ACH.
Lecanora rubina (VILL.) ACH.
Lecanora rubina (VILL.) ACH. var. **heteromorpha** ACH.
Lecanora muralis (SCHREB.) SCHAER. var. **saxicola** SCHAER.
Lecanora frustulosa (DICKS.) MASS.
Lecanora varia (EHRH.) NYL.
Lecanora cinerea (L.) SOMMERF.
Lecanora cinerea (L.) SOMMERF. var. **lævata** FR.
Lecanora fuscata (SCHRAD.) Th. FR.
Rinodina oreina (ACH.) MASS.
Rinodina lecanorina MASS.
Urceolaria scruposa (L.) NYL.
Lecidea lapicida FR.
Buellia concreta (KBR.) ECK.
Buellia petræa (FLK.) TUCK.
Buellia petræa (FLK.) TUCK. var. **montagnæi** TUCK.

Similar formations were found well developed in other places, as on Oak island, at Kettle falls, and at Tower, where they were especially well represented. Turning to the similar formation recorded for Granite falls in the fifth paper of this series, it appears that there is the usual marked resemblance in the formations of the similar substrata in remotely separate portions of the state. The genera are the same practically and the species remarkably near so, except for the presence in the above formation of a few more northern forms of *Lecidea* and *Buellia*. By adding *Biatora rufonigra* Tuck. from the similar formation at Kettle falls and the *Endocarpon* from the one at Emo, the genera would be identical in the two formations. However, it would be accidental rather than otherwise if exactly the same forms existed in two distinct formations even when much less remote. The northern *Buellia obscurata* (Ach.) Eck. occurs in the like formation at Kettle falls, and passing to the Oak island region, where were met more arctic and subarctic lichens than anywhere else on account of more northern location, and yet more because of the influence of the larger Lake of the Woods,

we find in the formations on some of the islands the northern *Lecidea goniophila* Kbr., *Lecidea platycarpa* Ach., *Buellia badioatra* (Fl.) Kbr. and *Buellia geographica* (L.) Th. Fr.

As to the structural adaptations, they are very apparent. First of all there is not a very large or loosely adnate lichen in the society, much less a fruticose form. The two varieties of *Parmelia* are forms having rather more closely adnate thalli and thicker cortex than their relatives in the same species on trees or more shaded rocks. Also the third *Parmelia* is rather smaller and more closely adnate than its near relative, *Parmelia caperata* (L.), Ach., more commonly found on trees. Careful comparative studies of the microscopic characters of these last two have not been made, but such study would doubtless show that the exposed-rock-inhabiting species has a cortex better adapted to exposure. An adaptation in all the closely adnate thalli of the formation is protection from wind and consequent more rapid transpiration and even destruction by being blown loose, which would surely come to the larger fruticose forms as certain *Cladonias* in such positions. On the whole, the larger the thallus of a given lichen in the present formation, the better the cortex, the larger ones commonly having good cortex both above and below, and the smaller usually at least a good upper cortex. More definite statements regarding the structure of the thalli of the lichens in the various genera may be found in certain portions of the last paper of this series and need not be repeated here.

We may now pass most appropriately to the consideration of another lithophytic lichen formation, designated as follows:

Mixed Lichen Formation of Shaded Rocks (Rainy Lake City).

A. *Naturally belonging to the rocks.*

Ramalina polymorpha (Ach.) Tuck.
Ramalina calicaris (L.) Fr. var. **farinacea** Schaer.
Theloschistes lychneus (Nyl.) Tuck.?
Parmelia perlata (L.) Ach.
Parmelia perlata (L.) Ach. var. **ciliata** (DC.) Nyl.
Physcia obscura (Ehrh.) Nyl. var. **endochrysea** Nyl.?
Sticta quercizans (Michx.) Ach.?
Pannaria microphylla (Sw.) Delis.

Collema flaccidum ACH.
Leptogium lacerum (SW.) FR.
Leptogium tremelloides (L.) FR.
Cladonia cæspiticia (PERS.) FLK.
Bæomyces byssoides (L.) SCHAER.
Biatora lucida (ACH.) FR.

B. *Probably migrated from trees near by.*

Parmelia conspurcata (SCHAER.) WAINIO.
Parmelia physodes (L.) ACH.?
Parmelia borreri TURN. var. **rudecta** TUCK.
Parmelia caperata (L.) ACH.
Physcia stellaris (L.) TUCK.
Physcia speciosa (ACH.) NYL.
Physcia hispida (FR.) TUCK.?
Physcia obscura (EHRH.) NYL.
Nephroma tomentosum (HOFFM.) KBR.?

C. *Species that have migrated from earth.*

Peltigera canina (L.) HOFFM.
Peltigera aphthosa (L.) HOFFM.

Similar formations were met elsewhere during the summers' work, but were not carefully studied and would add nothing to the list recorded above. The formation listed above lies along some perpendicular rock exposure some twenty rods back from the shore line and about a half mile from Rainy Lake City, while the exposed rock formations, like the one first recorded in this paper, may be found at many points along the lake shore, and at a few places back from the shore, but here usually poorly developed because of recent fires or the presence of trees over the rocks. The two formations recorded above are the extremes for the region, and every gradation between the pure exposed rock lichen formation and the mixed one in more shaded spots may be found. The society listed last above was found on rocks for the most part perpendicular, and it has been thought best to give later another formation found here and elsewhere on more horizontal rocks, more covered with humus. This formation will be recorded as a *Cladonia rangiferina formation of humus-covered horizontal rocks.* Attention is directed to it here lest those familiar with the luxuriance of the *Cladonias* of the region and not so familiar with our analysis should wonder why these

plants are excluded from the present formation. Indeed, *Cladonias* were almost entirely absent from the present formation, though the *Cladonia* society named above was fairly well developed on more horizontal rocks a few rods away. It is needless to say that these two lichen societies also grade into each other in the most confusing manner in some areas.

Some of the plants of the formation seem, in the region at least, to belong indifferently to the trees or to the rocks. These have been designated (?) in the above list. As may be inferred from statements above, tension lines are very apparent between the present formation and others of the surrounding earth and rocks, and it is a noticeable fact that the wandering of lichen floral elements is almost always from trees to the shaded rocks. In this region, devoid of limestone, *Pannaria languinosa* (Ach.) Kbr. is frequently present in such formations and was frequently seen in other similar formations near by and elsewhere.

If we compare again the present formation with the similar one at Granite falls, even though the trees surrounding the former are partly coniferous and the latter hard-woods, we note almost as much similarity in the two remote societies as was seen in the exposed rock formations of the same localities. No special mention need be made of the resemblances, as a glance at the two lists will reveal them forcibly enough. One striking difference, however, is the absence of the *Endocarpons*, *Verrucarias* and *Staurotheles*. If present, they were forgotten in the special study and not collected on the spot because abundant at the water's edge a few rods away. Moreover, we are now in a lake region where these plants, if in the present formation at all, would be there by chance and out of their more natural habitat on the moist rocks at the shore line. They will be found recorded below in what we have seen fit to designate the *amphibious angiocarpic wet rock lichen formation*, better studied at Tower.

Passing to the matter of adaptations, they may be summed up shortly. The plants are larger forms than those of the first formation above and as a rule have well-developed cortex on both sides of the foliose thallus. Many of them are plants which may grow on trees or earth and in less shaded stations, and the society is by no means so strictly lithophytic as the one of the exposed rocks. On the whole, the *Ramalinas*, the *Collema* and the *Leptogiums* are the most typical members of the society.

The first genus shows a good cortex on all sides of the fruticose thalli, but the plants, rising from the substratum, need such protection even in the shaded habitat. The *Collema* of course has no cortex and is a shade and moisture loving plant *par excellence*. The members of the last genus have a poorly developed cortex and are nearly as strictly ombrophytic as the *Collema*. The *Cladonia* and the *Bæomyces* show podetia protected by a good cortex, so that they rise easily from the substratum. The single *Biatora* has a thallus consisting merely of a tangle of epilithic algal cells and fungal hyphæ and is as strictly confined to shaded habitats as is *Pannaria languinosa* (Ach.) Kbr. The *Peltigeras* have a good cortex above, and the abundant rhizoids of lower layer horizontally disposed hyphæ serve well enough for protection to the lower side of such shade or moisture loving plants as the members of the genus commonly are. Other members of the formation need no further mention than the statement already made that they have a good cortex on both sides and are not so strictly ombrophytic.

In considering the more familiar formations first, we shall now pass from the rock lichens to those of trees, and these may be passed over with a brief statement. These formations have been duly considered in the fifth and sixth papers of this series, and nothing would be added by giving space to long lists of species; nor is it thought necessary to repeat the statements regarding adaptations as already given in the sixth paper. Briefly then, regarding the *Parmelia formation of trees with rough bark* as studied in a number of localities, the only new plants of such formations noted in any of the localities were *Ramalina pusilla* (Prev.) Tuck., *Cetraria juniperina* (L.) Ach. var. *pinastri* Ach., *Alectoria jubata* (L.) Tuck. and *Parmelia conspurcata* (Schaer.) Wainio. These are partly plants not found in the regions farther south, too rare to include in the formations or found growing in slightly different relations and not included. Reviewing next in order the *Pyrenula formation of trees with smooth bark*, the additional plants are *Lecanora variolascens* (Fr.) Nyl., *Lecanora verrucosa* (Ach.) Laur. var. *mutabilis* Th. Fr., *Biatora varians* (Ach.) Tuck. and *Biatora atropurpurea* (Mass.) Hepp.; and all of these plants were found in one or both of the regions discussed in the papers mentioned above, but either were rare or not present at the places where the formations were studied. These formations were noticed more at Emo than

elsewhere in the region covered in the present paper, partly because well developed there and in part also because there was less else of special interest there to claim attention. Hard woods were sought for these studies, but the influence of conifers is seen in the nature of the four species added above for the rough-bark formations of the present region.

Favorable opportunity for study of the lichens of pine trees was not found till Rainy Lake City was reached. Here the further investigation of the *Usnei formation of the pines* begun at Red Lake and Bemidji and recorded in the sixth report was continued, as it was thought to be desirable to record the formation from a locality somewhat removed from these two. Here again the usual remarkable similarity was found, and in the formation of conspicuous and well-known lichens, none new to the state or to the formation were found. However, *Theloschistes chrysopthalmus* (L.) Norm, found in both of the other two localities, was wanting and *Parmelia saxatilis* (L.) Fr. and *Parmelia caperata* (L.) Ach., doubtless occasionally occurring on the pines at Red Lake and Bemidji, but not considered a conspicuous part of the formation, were at Rainy Lake City, so commonly associated with the other plants of the society that they could not be overlooked as forming a conspicuous portion of it. Again, since it is intended to avoid repetition and make the papers of the series supplement each other as much as possible, it is not thought necessary to reproduce either the list of species or the statement of adaptations as given in the sixth report.

The next in order is a *Cladonia* formation, and the one found at Emo is sufficiently different from the similar ones recorded in the fifth and sixth reports for Mankato and Bemidji, so that it seems desirable to give a list of species as follows:

Cladonia Lichen Formation of Rotten Wood (Emo).

Cladonia fimbriata (L.) Fr. var. **coniocræa** (Flk.) Wainio.
Cladonia gracilis (L.) Willd. (and two varieties).
Cladonia verticillata Hoffm.
Cladonia pyxidata (L.) Fr. var. **neglecta** (Flk.) Mass.
Cladonia pityrea (Flk.) Fr. (two varieties).
Cladonia squamosa (Scop.) Hoffm.
Cladonia cristatella Tuck.
Bæomyces æruginosus (Scop.) Nyl.

A noticeable difference between the present list and those for the two areas named above is the omission of the *Peltigeras* from the present one. Both of the forms of the genus recorded in the previous reports were seen frequently enough at Emo and at other points where the formation was noted with less care, but they were seldom seen on rotten wood. Some of the apparent difference in the three lists as to the forms of *Cladonia* is due to the adoption of Dr. Wainio's nomenclature, but *Cladonia squamosa* (Scop.) Hoffm. and the two forms of *Cladonia pityrea* (Flk.) Fr. are additions. The last lichen of the above list is a species not known farther south, as is also the *Cladonia* named last above. Inspection of the three lists will show that there is more than the usual amount of variation in these formations in different regions. The adaptations have received sufficient attention in the sixth report.

Passing now to the swamp formations, we may best record two that are somewhat closely related and sometimes confusingly intermingled. These are the formations of the tamaracks and those of the cedars of the swamps. The first recorded below was studied at Henning and the second at Bemidji, and the formations as observed at those places have been recorded in the sixth report of this series.

Usnea Lichen Formation of Tamaracks in Swamps (Beaudette).

Cetraria ciliaris (Ach.) Tuck.
Cetraria juniperina (L.) Ach. var. **pinastri** Ach.
Evernia prunastri (L.) Ach.
Usnea barbata (L.) Fr. var. **florida** Fr.
Usnea barbata (L.) Fr. var. **ceratina** Schaer.
Usnea cavernosa Tuck.
Alectoria jubata (L.) Tuck. var. **chalybeiformis** Ach.
Parmelia physodes (L.) Ach.
Parmelia olivacea (L.) Ach.
Physcia hispida (Ach.) Tuck.
Ramalina pusilla (Prev.) Tuck.

The above formation was studied on a few tamarack trees of a swamp some distance from Beaudette along the railroad that was being surveyed during the summer and on the Canadian side. The trees were surrounded by cedars, and most of the lichens of the above list were found on the cedars also. In short, most

lichens of cedars and tamaracks like the cedars better, but those of the above list are those that are at least fully as much inclined to the tamaracks, and may be regarded as making up a definite formation in pure tamarack swamps; though it must be admitted that the results are most confusing in the presence of cedars, and indeed so much so that I am inclined to believe that, had I first encountered a mixed swamp for study, I might have seen a cedar-tamarack formation instead of two distinct ones. However, the conclusion that there are two is secure, and it may be remarked in passing that for purposes of study of either of the formations it matters little whether one enters one of the vast swamp regions or a small swamp a few rods in diameter. And, indeed, one is surer of his results if he confines himself to what may be called a small society rather than to attempt the study of a widely extended formation. In the small swamp one is impressed with the fact that the characteristic lichens of the formation seem to have entered from all sides from less favorable habitats or substrata, and they are more easily studied on the small area. And the species may be found in nearly as large numbers in the small as in the large swamp. It may well be added in passing that the above principle in the study of lichen societies has impressed the writer in the investigation of lichen formations in general, and it usually seems to matter little whether the small formation is near other similar ones or far removed and isolated. The adaptations of the above recorded formation have been dwelt upon in the sixth report and need not be repeated here. So we may pass at once to the formation of the swamp cedars.

Sticta Pulmonaria Lichen Formation of Cedar Swamps (Boucherville).

Cetraria ciliaris (Ach.) Tuck.
Cetraria lacunosa Ach.
Cetraria aurescens Tuck.
Parmelia borreri Tuck. var. **rudecta** Tuck.
Pyxine sorediata Fr.
Sticta pulmonaria (L.) Ach.
Sticta amplissima (Scop.) Mass.
Sticta fuliginosa (Dicks.) Ach.
Nephroma helveticum Ach.
Nephroma lævigatum Ach.

Pannaria rubiginosa (THUNB.) DELIS.
Pannaria rubiginosa (THUNB.) DELIS. var. **conioplea** FR.
Pannaria leucosticta TUCK.
Leptogium myochroum (EHRH.) TUCK.
Leptogium pulchellum (ACH.) TUCK.
Lecanora subfusca (L.) ACH. var. **allophana** ACH.
Lecanora pallescens (L.) SCHAER.
Pertusaria communis DC.

This swamp at Boucherville was studied on one of the trips out from Emo, a few miles farther up Rainy river. The landing called Boucherville is on the Canadian side, and the swamp lies a few rods west of the few houses and along the river bank. Most of the surrounding land is now cultivated; and what were the original surroundings was difficult to determine in the short time at hand, nor was note made of conditions farther down stream. But to all intents we entered a small cedar swamp and there found in fifteen minutes all of the plants of the above formation, which is the most characteristic one yet found on the cedars. The number of plants is the largest seen in such formations in any one place, but all of the genera, except *Pyxine*, and about two thirds of the species may be found in almost any cedar swamp of the region. In the present formation the *Cetrarias* and *Pannarias* are as characteristic of the society as any of the *Stictas*. *Cetraria lacunosa* Ach. and *Pannaria rubiginosa* (Thunb.) Delis. are especially fond of the cedars, and the last three plants of the list are scarcely less so. In the presence of tamaracks the formation is still reasonably distinct, though it must not be understood that there are here recorded all the lichens that occur on cedars; and when tamaracks are near by or mixed with the cedars, members of the last formation come in and confuse to some extent. The pecular thing is that while the lichens of the tamaracks wander to the cedars in mixed swamps, those more characteristic of the cedars are very seldom seen on the tamaracks. An attempt was made at the similar formation at Bemidji. The further study confirms the existence of such formations, but also a comparison of the two lists proves that the first results were very meager. The *Pannarias* and *Leptogiums*, as is well known, like moist and shaded habitats, and are possibly quite as numerous on certain hard-wood trees when mixed with the cedars in swamps. This was noted especially in swamps about

Koochiching, where *Sticta amplissima* (Scop.) Mass. was also frequent on hard-woods of the swamps. The other members of the formation are in the main at least plants frequently seen on higher ground and on other trees, and at present we can only say as to adaptation that for some reason they find the cedars to be especially congenial hosts, or are perhaps attracted also in part by moisture. The discussion of the formation must not be closed without mentioning two lichen parasites almost always found in the formation on the *Parmelia* and another frequently seen on the *Pertusaria*, all helping to form one of the most fascinating lichen communities known to the writer. The two on the *Parmelia* are *Biatora oxyspora* (Tul.) Tuck. and *Buellia parmeliarum* (Sommerf.) Tuck. The one on the *Pertusaria* is *Calicium turbinatum* Pers.

There are yet two lichen societies of the swamps to record, following out observations begun at Henning and Bemidji. These were in those places noted especially in the more common tamarack swamps, but in the present region the cedars are more common and very similar societies were detected under them and on the dead branches. Possibly it may appear to one not especially familiar with lichens that we are doing violence to the conception of plant associations in general in the formation of some of our lichen societies in the midst of other plants and also in making so many subdivisions. However, the establishment of the conception of an exclusively licheno-series of formations has seemed to be the only way to deal with the problems at hand successfully. Possibly our last formation above and the next two below, for the sake of less subdivision, might be regarded as different strata of a single society; but the fact remains that the presence of the plant assemblage of the list last above seems more dependent upon the occupation of the swamp by cedars, while those of the two below are dependent in the first instance mainly upon the presence of dead coniferous wood and in the second upon the moisture of the soil and more or less shade furnished by the trees. The method pursued has at least seemed best in working out results in the swamps as well as elsewhere, and it appears to the writer that a very similar one, though perhaps couched in different terms and having less of subdivision, must be followed by any one who attempts to deal with the ecologic distribution of the lichens of a region thoroughly. The two remaining formations of

the cedar swamps of the region will now be recorded and discussed in order.

CALICIUM LICHEN FORMATION OF OLD LOGS AND STUMPS IN CEDAR SWAMPS (BEAUDETTE).

Lecanora pallida (SCHREB.) SCHAER.
Biatora turgidula (FR.) NYL.
Calicium trichiale ACH. var. **cinereum** NYL.
Calicium phæocephalum (TURN.) TURN. and BORR.
Calicium parietinum ACH.

Such formations were noted at a number of places and were found to vary considerably. Yet there are always the *Caliciums* and a number of them at one place. However, it is not easy to distinguish several of the species macroscopically, and one can not be at all certain that he has not collected the same over and over and left some untouched, even after the most careful work. The *Cladonias* listed in the formation from Henning in the sixth paper of the present series did not, under the cedars, seem to form an essential portion of the formation and were omitted, though some were present and might be regarded as a basal stratum. As to adaptations, nothing need be added to what was given in the last paper of this series.

Several rare *Biatoras* were noted on the cedars, but so little was known of them that their relation to the formation could not be successfully studied at any one place. Also, the *Caliciums* of the upland woods were not successfully studied as attention was directed to the less well known and better developed formations of the cedar swamps. There is no doubt that at least the *Calicei formation of dead wood*, worked out in the fifth and sixth reports, exists in the region, but no satisfactory results were obtained.

The last formation of the cedar swamps was studied previously at Bemidji and several other localities in tamarack swamps and has received the following name, though subsequent study makes the variety on which it is based somewhat uncertain, and the work in the area now under consideration shows this variety to be more rare than was previously supposed.

PELTIGERA CANINA LEUCORRHIZA LICHEN FORMATION OF EARTH IN CEDAR SWAMPS (OAK ISLAND).

Peltigera canina (L.) HOFFM.
Peltigera canina (L.) HOFFM. var. **leucorrhiza** FLK.

Peltigera canina (L.) HOFFM. var. **spongiosa** TUCK.
Peltigera aphthosa (L.) HOFFM.
Peltigera horizontalis (L.) HOFFM.
Cladonia pyxidata (L.) FR. var. **neglecta** (FLK.) MASS.
Cladonia gracilis (L.) NYL. (a variety not carefully noted).
Cladonia furcata (HUDS.) FR.?

The *Cladonias* previously included in such formations seemed here also to form an essential though plainly subordinate portion of it and have been retained. The *Peltigeras* are the largest forms known to the writer, and, in their wet and more or less shaded habitat, reach unusual size. Three or four of them may be found in almost any such swamp of the region, and detailed statement as to which occur in a given swamp would be of little or no value. The adaptations were briefly summed up in the last paper of this series, and nothing need be added, except to state that lying prostrate on the moist earth or mosses of the swamp and partly out of reach of winds, the plants have an abundance of moisture, seldom being dry as their related forms on higher ground, and hence the usual luxuriance.

The last of the previously recorded formations to be noted is the *Biatora lichen formation of mosses*. This was found well developed at Beaudette, Koochiching and Rainy Lake City. The last locality furnished all of the species recorded for Bemidji in the last paper of this series, and *Biatora sanguineoatra* Fr. may be added, and each of the other two localities showed three of them. The adaptations have been discussed previously, nor is it necessary to reproduce the list of five species.

Proceeding to formations not previously recorded, first may be considered the following:

POPULUS LICHEN FORMATION (WARROAD).

Ramalina calicaris (L.) FR. var. **fastigiata** FR.
Cetraria ciliaris (ACH.) TUCK.
Evernia prunastri (L.) ACH.
Usnea barbata (L.) FR. var. **florida** FR.
Theloschistes polycarpus (EHRH.) TUCK.
Parmelia tiliacea (HOFFM.) NECK.
Parmelia saxatilis (L.) FR.
Parmelia olivacea (L.) ACH.
Parmelia conspurcata (SCHAER.) WAINIO.
Physcia stellaris (L.) TUCK.

Physcia hispida (Fr.) Tuck.
Physcia obscura (Ehrh.) Nyl.
Placodium cerinum (Hedw.) Naeg. and Hepp.
Lecanora varia (Ehrh.) Nyl.
Lecanora variolascens (Fr.) Nyl.
Rinodina sophodes (Ach.) Nyl.
Biatora mixta (Fr.)
Biatora atropurpurea (Mass.) Hepp.
Arthonia patellulata Nyl.
Pyrenula leucoplaca (Wahl.) Kbr.

The formation varies with the age of the poplars, from one having more of the crustose lichen species to one having a larger proportion of foliose species. It has been noted frequently in various portions of northern Minnesota, but has not been carefully studied elsewhere. Enough has been noted, however, to know that such a lichen society exists in many places in northern Minnesota and does not differ greatly from the above. Though small and inconspicuous, the last four lichens are decidedly the most characteristic of the formation. Yet the *Rinodina*, the *Placodium* and some of the foliose species are quite partial to the poplars wherever found. Of these foliose forms, *Physcia stellaris* (L.), *Theloschistes polycarpus* (Ehrh.) Tuck. and perhaps *Parmelia olivacea* (L.) Ach. are most constant on the poplars. The adaptations are obviously those of the formations of trees with smooth or rough bark as already given and need not be restated here.

The next to be introduced is a *Cladonia* formation and may be designated as follows:

Cladonia Lichen Formation of Humus-Covered Rocks (Rainy Lake City).

Cladonia rangiferina (L.) Web.
Cladonia coccifera (L.) Willd.
Cladonia amaurocræa (Flk.) Schaer.
Cladonia uncialis (L.) Web.
Cladonia furcata (Ach.) Schrad. (forms of).
Cladonia cenotea (Ach.) Schaer.
Cladonia turgida (Ehrh.) Hoffm.
Cladonia cariosa (Ach.) Spreng.
Cladonia gracilis (L.) Willd. (form of).
Cladonia degenerans (Flk.) Spreng.

Cladonia verticillata Hoffm.
Cladonia pyxidata (L.) Fr. var. **neglecta** (Flk.) Mass.
Cladonia cristatella Tuck.
Cladonia fimbriata (L.) Fr. (forms of).
Cladonia decorticata (Flk.) Spreng.
Peltigera malacea (Ach.) Fr.
Peltigera canina (L.) Hoffm.

This lichen formation is a very common one in northern Minnesota, and as large an assemblage of species as that given above may frequently be seen on a few square feet of the humus-covered rocks. We have purposely omitted a number of rarer forms seen in the present formation and have not given the varieties of several of the species of *Cladonia*. The formation is very similar to the *Cladonia-Peltigera formation of shaded earth* as recorded for Bemidji in the last report of this series, and the adaptations there stated need not be introduced here. These formations are also almost identical with the *talus Cladonia formations* as presented by the writer in the Botanical Gazette.* As there shown, these formations vary according to amount of humus, age and kind of trees and other factors which can not be considered here. According to various conditions, the present formations may tend toward the larger *Cladonia rangiferina* or the smaller *Cladonia gracilis* formations of the talus, and may pass into the one or the other. *Stereocaulon paschale* (L.) Fr., *Cladonia alpestris* (L.) Rabenh. and *Cladonia sylvatica* (L.) Hoffm. are species usually seen, but which did not appear in the society studied at Rainy Lake City. Like the talus formations, the societies composed of the larger species especially thrive best where protected from wind as well as where shaded more or less. Before leaving this sort of societies we must note that a most interesting formation of the kind was found on one portion of the large isolated rock exposures near Roosevelt previously mentioned. And since such formations have not been extensively recorded and this one is unique because of its isolation, space may well be given to it as follows.

Cladonia Lichen Formation of Humus-Covered Rocks (Roosevelt).

Cladonia furcata (Huds.) Schrad. var. **paradoxa** Wainio.
Cladonia cristatella Tuck.

*Fink, B. Bot. Gaz. 35: 195–208. Mr. 1903.

Cladonia gracilis (L.) WILLD. (forms of).
Cladonia verticillata HOFFM.
Cladonia coccifera (L.) WILLD.
Cladonia pyxidata (L.) FR. var.?
Cladonia fimbriata (L.) FR. (forms of).
Cladonia rangiferina (L.) WEB.
Cladonia uncialis (L.) WEB.
Cladonia alpestris (L.) RABENH.
Cladonia turgida (EHRH.) HOFFM.
Peltigera malacea (ACH.) FR.
Peltigera canina (L.) HOFFM.
Peltigera aphthosa (L.) HOFFM.

Professor Conway MacMillan finds such *Cladonia* formations especially well developed at Stair Portage and other points along the international boundary, and the writer has found them in many places in northern Minnesota. Next we will consider the *Umbilicaria* formations noted in many places along or near the international boundary from Grand Portage westward to Oak island in Lake of the Woods. And it should be stated that Professor MacMillan has noticed some of these *Umbilicaria* and *Cladonia* associations as well as those of the *Endocarpons* to follow below.*

UMBILICARIA FORMATION OF SHORE ROCKS (KETTLE FALLS).

Umbilicaria muhlenbergii (ACH.) TUCK.
Umbilicaria dillenii TUCK.
Umbilicaria vellea (L.) NYL.
Umbilicaria pustulata (L.) HOFFM.
Umbilicaria hyperborea HOFFM.

The formation recorded above may all be seen on a small area of partly flat and partly perpendicular and more shaded rocks along the shore of Rainy Lake at Kettle falls, and may be found almost as well developed near Rainy Lake City and in places on Oak and neighboring islands in Lake of the Woods. The formations were noted also at Koochiching and Tower and more poorly developed elsewhere. They are also finely developed in the region traversed in 1897 along the shores of Lake Superior and along the northern boundary from Grand Portage westward to Ely. At Grand Portage the formations

* MacMillan, C. Observations on the distribution of plants along the shore at Lake of the Woods. Minn. Bot. Stud. 1: 1004–1020. 1897.

are well developed and were studied again during the summer of 1902. Here, on the upper slopes of Mount Josephine, may be observed almost pure formations of *Umbilicaria muhlenbergii* (Ach.) Tuck. and higher up this mixed with the last two species of the above list. Again, passing down to the more perpendicular and shaded rocks, the second and third species come in more and more, till in favorable spots we may find the two mixed in the same formation or limited pure formations of one, usually the second of the list. But even *Umbilicaria muhlenbergii* (Ach.) Tuck. does not shun shaded habitats when not occupied by other plants, and specimens exceeding one foot may be found on the shaded talus of Hat point at Grand Portage. And it must be taken into account that this is not one of the large species of the genus. On the surface of one of the large talus blocks of the point, figured in the Botanical Gazette,* Mr. C. J. Hibbard and the writer observed at the shore of Lake Superior one of these *Umbilicaria* societies in miniature with all of the species of the above list growing on the area of the rock about two feet square. Since these societies have not been previously studied in this series of papers, it has seemed best to pass somewhat beyond the proper confines of the present paper. The *Umbilicarias* like high rocks, but will descend nearly to the water level along the shores where they thrive best in Minnesota. No doubt the adaptation lies in the fact that these rock lichens, with unusually large thalli for lithophytic species, seek the moisture of the lake winds. Also, the species being in general arctic, subarctic or alpine forms, there is a temperature relation as well, and the cooling effect of the winds of the larger lakes influences their distribution materially. As is well known, the *Umbilicarias* are attached to the rocks in an unusually secure manner by a strong umbilicus. This protects them from destruction by being blown away on the high and frequently exposed rocks, though larger and less closely adnate to the substratum than most exposed rock lichens. Again, the thalli are strengthened by an unusually strong cortex, which holds them firmly against the rocks when dry and more easily broken. It is also noteworthy that the lower cortex is usually thicker than the upper and serves to hold against the upward tendency of strong winds, as well as for support of the large centrally attached thallus. It should be noted further that all of the spe-

* Fink, B. Bot. Gaz. l. c., Fig. 3.

cies of the genus known in Minnesota are included in the list above and may all be found in several portions of the state in an area of a few square rods or even a few feet.

Finally, another formation not previously presented, may be taken up, designating it as follows:

Amphibious Angiocarpic Lichen Formation of Wet Rocks (Tower).

Endocarpon fluviatile DC.

Endocarpon miniatum (L.) Schaer. var. **complicatum** Schaer.

Staurothele umbrina (Wahl.) Tuck. var. **clopima** (Whlnb.) Nyl.

Verrucaria viridula Ach.

This formation may be seen complete in places along the shore of Vermillion lake and less well represented at other portions of the lake shore. The same formation was observed in its entirety at Harding and all but the last member at Rainy Lake City. In a less close analysis this might of course be considered as a zone of a general lichen, or even general shore plant society, extending backward some distance from the shore line. The plants of the formation are quite different as to external appearance, and just what the adaptation is cannot be definitely stated. However, the three genera are closely related phylogenetically as may be seen in apothecial and spore structure as well as a general similarity as to algal symbionts. As to the latter, the last word has not been said, and some yet unknown difference in the algal members of these lichen-partnerships may account for the fact that some members of the genera of the above list are especially fond of wet rocks frequently inundated. Or it is possible that the plants have been recently forced to the water's edge by competing rivals and have become accustomed to the habitat without yet developing any noticeable structural adaptations.

Thus have been passed in order some fifteen or sixteen distinct classes of lichen formations, giving adaptations not previously stated in the earlier papers of this series as fully as seemed consistent with the general purposes of this survey, stating relationships between the formations especially presented and others of the region covered by this paper or the earlier papers, and thus attempting to make the present paper not only present the dominant features of ecologic distribution of lichens

in the area covered herein, but also to supplement as far as possible the work previously done. That a considerable amount of preliminary work could yet be profitably done both on the distribution and taxonomy of Minnesota lichens is apparent enough, and indeed the subject could hardly be completely exhausted. Yet, if nothing more is accomplished in a preliminary way, it is at least to be hoped that the results now scattered throughout several papers may be further correlated, somewhat amplified and brought together into more accessible form in a final report.

LIST OF SPECIES AND VARIETIES.

1. **Ramalina calicaris** (L.) Fr. var. **fraxinea** Fr.

On trees, rare. Warroad, July 1, 1901, no. 292. Oak island, July 10, 1901, no. 484. Emo, July 17, 1901, no. 644. Koochiching, July 27, 1901, no. 942 and July 26, 1901, no. 895. Kettle falls, August 13, 1901, no. 1426.

2. **Ramalina calicaris** (L.) Fr. var. **fastigiata** Fr.

On trees, common. Beaudette, June 18, 1901, no. 22 and June 22, 1901, no. 98. Warroad, June 25, 1901, nos. 165 and 169. Oak island, July 9, 1901, no. 438. Emo, July, no. 671 and July 18, 1901, no. 718. Koochiching, July 2, 1901, nos. 876 and 879. Rainy Lake City, August 3, 1901, nos. 1159 and 1172 and August 6, 1901, no. 1240. Kettle falls, August 13, 1901, no. 1415 and August 15, 1901, no. 1487. Harding, August 16, 1901, no. 1514. Tower, August 29, 1901, no. 1875.

Some specimens varying toward var. *canaliculata* Fr.

3. **Ramalina calicaris** (L.) var. **farinacea** Schaer.

Frequent on rocks and more rarely on trees. Beaudette, June 19, 1901, no. 47. Blueberry island, July 13, 1901, no. 508. Mainland, July 16, 1901, no. 635. Emo, July 19, 1901, no. 735 and July 22, 1901, no. 820. Koochiching, July 30, 1901, no. 1018. Rainy Lake City, August 1, 1901, no. 1100 and August 5, 1901, no. 1179. Kettle falls, August 10, 1901, no. 1375 and August 13, 1901, no. 1448. Harding, August 16, 1901, no. 1524, August 19, 1901, no. 1586 and August 21, 1901, no. 1666.

4. **Ramalina pusilla** (Prev.) Tuck.

On trees, rare except on balsams. Beaudette, June 24, 1901, no. 139. Oak island, July 8, 1901, no. 385. Emo, July, 1901, no. 657. Koochiching, July 29, 1901, no. 988.

5. **Ramalina pusilla** (PREV.) TUCK. var. **geniculata** TUCK.

With the last. Warroad, July 2, 1901, no. 325. Koochiching, July 27, 1901, no. 967. Rainy Lake City, August 3, 1901, no. 1149.

6. **Ramalina polymorpha** (ACH.) TUCK.

On rocks, rare. Rainy Lake City, August 5, 1901, no. 1203.

7. **Cetraria aurescens** TUCK.

On cedars in swamps, rare. Beaudette, June 20, 1901, no. 75. Warroad, June 29, 1901, no. 29. Mainland, July 16, 1901, no. 637. Koochiching, July 31, 1901, no. 1034. Kettle falls, August 13, 1901, no. 1423. Harding, August 16, 1901, nos. 1781 and 1798.

8. **Cetraria ciliaris** (ACH.) TUCK.

On trees, common, especially in swamps. Beaudette, June 18, 1901, nos. 23 and 30. Warroad, June 24, 1901, no. 270. Oak island, July 8, 1901, no. 392. Koochiching, July 27, 1901, no. 944. Rainy Lake City, August 5, 1901, no. 1179a. Kettle falls, August 9, 1901, no. 1334. Harding, August 19, 1901, no. 1569. Tower, August 27, 1901, no. 1834.

9. **Cetraria lacunosa** ACH.

On cedars in swamps, frequent. Beaudette, June 18, 1901, no. 26. Warroad, July 5, 1901, no. 376. Emo, July 19, 1901, no. 739. Koochiching, July 29, 1901, no. 993. Kettle falls, August 13, 1901, no. 1459. Harding, August 16, 1901, no. 1517. Tower, August 26, 1901, no. 1772.

10. **Cetraria juniperina** (L.) ACH. var. **pinastri** ACH.

On trees, rare and wandering to rocks near by. Beaudette, June 19, 1901, no. 35. Warroad, June 28, 1901, no. 240 and July 4, 1901, no. 357. Oak island, July 10, 1901, no. 505. Flag island, July 12, 1901, no. 546. Emo, July 25, 1901, no. 845. Koochiching, July 27, 1901, no. 960. Rainy Lake City, August 2, 1901, no. 1111. Kettle falls, August 9, 1901, no. 1349. Harding, August 19, 1901, no. 1571. Tower, August 23, 1901, no. 1689.

11. **Evernia prunastri** (L.) ACH.

On trees, common on cedars and tamaracks in swamps and wandering to rocks. Beaudette, June 18, 1901, no. 6. Warroad, June 27, 1901, no. 250. Oak island, July 9, 1901, no. 458 and July 10, 1901, no. 486. Emo, July 17, 1901, no. 641 and July 22, 1901, no. 822. Koochiching, July 26, 1901, no.

894 and July 31, 1901, no. 1046. Rainy Lake City, August 3, 1901, no. 1165. Kettle falls, August 13, 1901, nos. 1358 and 1403. Harding, August 19, 1901, no. 1573. Tower, August 23, 1901, no. 1692.

12. **Usnea barbata** (L.) Fr. var. **florida** Fr.

On trees, and infrequent, rarely wandering. Beaudette, June 18, 1901, no. 20. Warroad, June 26, 1901, no. 185. June 27, 1901, no. 207, June 28, 1901, no. 248, July 1, 1901, no. 297 and July 2, 1901, no. 332. Oak island, July 9, 1901, nos. 459 and 475. Emo, July 17, 1901, nos. 658 and 666 and July 22, 1901, no. 821. Koochiching, July 27, 1901, no. 938 and July 31, 1901, nos. 1023 and 1045. Rainy Lake City, August 2, 1901, no. 1116. Kettle falls, August 12, 1901, no. 1401 and August 13, 1901, nos. 1413 and 1429. Harding, August 16, 1901, no. 1519. Tower, August 23, 1901, no. 1676 and August 26, 1901, no. 1807.

13. **Usnea barbata** (L.) Fr. var. **hirta** Fr.

On trees, rare. Warroad, June 28, 1901, no. 245. Emo, July 18, 1901, no. 716. Koochiching, July 25, 1901, no. 875. Kettle falls, August 13, 1901, no. 1439 and August 14, 1901, no. 1469. Tower, August 26, 1901, no. 1790.

14. **Usnea barbata** (L.) Fr. var. **ceratina** Schaer.

On trees, frequent, especially on cedars in swamps. Beaudette, June 18, 1901, no. 33. Emo, July 18, 1901, no. 715. Rainy Lake City, August 3, 1901, no. 1176. Harding, August 16, 1901, no. 1512 and August 20, 1901, no. 1637. Tower, August 26, 1901, no. 1777.

15. **Usnea barbata** (L.) Fr. var. **articulata** Ach.

On trees, rare. Beaudette, June 24, 1901, no. 143. Emo, July 18, 1901, no. 711. Harding, August 20, 1901, no. 1636.

Not previously reported from Minnesota.

16. **Usnea longissima** Ach.

On cedars in swamps, locally common. Kettle falls, August 15, 1901, no. 1584.

17. **Usnea cavernosa** Tuck.

On trees, usually cedars in swamps, frequent. Beaudette, June 18, 1901, no. 4. Warroad, July 2, 1901, no. 322. Oak island, July 9, 1901, no. 437. Emo, July 17, 1901, no. 677. Koochiching, July 25, 1901, no. 874 and July 31, 1901, no. 1032. Kettle falls, August 13, 1901, no. 1354. Harding,

August 16, 1901, no. 1503. Tower, August 26, 1901, nos. 1795 and 1806.

18. **Alectoria jubata** (L.) TUCK.

On trees, especially cedars and tamaracks, in swamps, rare. Warroad, July 5, 1901, no. 381. Emo, July 19, 1901, no. 726. Rainy Lake City, August 7, 1901, no. 1259. Kettle falls, August 13, 1901, nos. 1357 and 1449. Harding, August 20, 1901, no. 1631. Tower, August 26, 1901, no. 1778.

19. **Alectoria jubata** (L.) TUCK. var. **chalybeiformis** ACH.

On trees and old wood, frequent. Beaudette, June 19, 1901, no. 39. Warroad, June 28, 1901, no. 247. Oak island, July 8, 1901, no. 393. Koochiching, July 27, 1901, no. 951 and July 29, 1901, no. 978. Rainy Lake City, August 8, 1901, no. 1309. Kettle falls, August 9, 1901, no. 1331 and August 13, 1901, no. 1418. Harding, August 20, 1901, no. 1655 and August 21, 1901, no. 1668. Tower, August 24, 1901, no. 1741.

20. **Theloschistes chrysopthalmus** (L.) NORM.

On trees, rare. Le Clair, July 6, 1901, no. 381. Oak island, July 10, 1901, no. 485, and July 11, 1901, no. 520. Tower, August 28, 1901, no. 1865.

21. **Theloschistes polycarpus** (EHRH.) TUCK.

On trees, common. Beaudette, June 18, 1901, no. 10. Warroad, June 25, 1901, no. 153. Oak island, July 10, 1901, no. 488. Emo, July 18, 1901, no. 701. Koochiching, July 25, 1901, no. 887 and July 31, 1901, no. 1051. Kettle falls, August 14, 1901, no. 1467. Harding, August 17, 1901, no. 1568. Tower, August 23, 1901, no. 1707.

22. **Theloschistes lychneus** (NYL.) TUCK.

On trees and rocks, infrequent. Beaudette, June 21, 1901, no. 87. Warroad, June 26, 1901, no. 181. Oak island, July 10, 1901, no. 502 and 516. Emo, July 20, 1901, no. 782. Rainy Lake City, August 8, 1901, no. 1190. Harding, August 19, 1901, no. 1826.

23. **Theloschistes concolor** (DICKS.) TUCK. var. **effusa** TUCK.

On trees, rare. Rainy Lake City, August 7, 1901, no. 1260. Kettle falls, August 14, 1901, no. 1474. Harding, August 20, 1901, no. 1619.

24. **Parmelia perlata** (L.) ACH.

On rocks and trees, infrequent. Koochiching, July 29, 1901, no. 990. Rainy Lake City, August 5, 1901, no. 1214. Ket-

tle falls, August 10, 1901, no. 1366. Harding, August 19, 1901, nos. 1583 and 1612.

25. **Parmelia perlata** (L.) Ach. var. **ciliata** (DC.) Nyl.

On mossy shaded rocks, rare. Rainy Lake City, August 5, 1901, no. 1223.

Very similar to plants referred to *P. perforata* (Jacq.) Ach. and *P. crinita* Ach. from the Superior region.

Not previously reported from Minnesota.

26. **Parmelia tiliacea** (Hoffm.) Flk.

On trees, common. Beaudette, June 18, 1901, no. 9. Warroad, June 25, 1901, no. 152. Emo, July 18, 1901, no. 693. Koochiching, July 26, 1901, no. 922. Rainy Lake City, August 2, 1901, no. 1125. Kettle falls, August 13, 1901, no. 1417. Harding, August 17, 1901, no. 1560. Tower, August 23, 1901, no. 1698.

27. **Parmelia borreri** Turn.

On trees and rocks, rare. Beaudette, June 22, 1901, no. 114. Oak island, July 10, 1901, no. 517. Emo, July 20, 1901. no. 777. Kettle falls, August 15, 1901, no. 1496.

28. **Parmelia borreri** Turn. var. **rudecta** Tuck.

On rocks and trees, especially common on cedars in swamps. Beaudette, June 22, 1901, no. 111. Warroad, June 24, 1901, 267. Koochiching, July 29, 1901, no. 989. Rainy Lake City, August 3, 1901, no. 1136. Kettle falls, August, 12, 1901, no. 1395. Tower, August 26, 1901, no. 1788.

29. **Parmelia saxatilis** (L.) Fr.

On trees and rocks, common especially on cedars in swamps. Beaudette, June 18, 1901, no. 29, June 22, 1901, no. 112 and June 24, 1901, no. 129. Warroad, June 25, 1901, no. 166 and July 4, 1901, no. 355. Oak island, July 9, 1901, no. 435. Emo, July 19, 1901, no. 723 and July 20, 1901, no. 768. Koochiching, July 29, 1901, no. 999. Harding, August 16, 1901, no. 1506. Tower, August 24, 1901, no. 1748 and August 27, 1901, no. 1842.

30. **Parmelia saxatilis** (L.) Fr. var. **sulcata** Nyl.

On trees, frequent. Beaudette, June 18, 1901, no. 14. Warroad, June 25, 1901, no. 170. Flag island, July 12, 1901, no. 536. Koochiching, July 25, 1901, nos. 886 and 896 and July 31, 1901, no. 1056. Rainy Lake City, August 1, 1901, no. 1082. Kettle falls, August 12, 1901, no. 1380. Tower, August 23, 1901, no. 1710.

31. **Parmelia saxatilis** (L.) FR. var. **panniformis** ACH.

On rocks, infrequent. Blueberry island, July 13, 1901, no. 567. Rainy Lake City, August 7, 1901, no. 1252. Kettle falls, August 9, 1901, no. 1332. Harding, August 19, 1901, no. 1597 and no. 1607.

32. **Parmelia physodes** (L.) ACH.

On trees and rocks, common on trees in swamps. Beaudette, June 18, 1901, no. 6 and no. 28. Warroad, June 28, 1901, no. 246. Koochiching, July 27, 1901, no. 965 and July 31, 1901, no. 1050. Rainy Lake City, August 1, 1901, no. 1099 and August 7, 1901, no. 1267. Kettle falls, August 9, 1901, no. 1351 and August 12, 1901, no. 1402. Harding, August 17, 1901, no. 1553. Tower, August 24, 1901, no. 1720.

33. **Parmelia olivacea** (L.) ACH.

On trees, common. Beaudette, June 19, 1901, no. 56. Warroad, June 25, 1901, no. 147. Oak island, July 9, 1901, no. 464 and July 10, 1901, no. 492. Emo, July 18, 1901, no. 684. Koochiching, July 25, 1901, no. 889. Rainy Lake City, August 3, 1901, no. 1167. Harding, August 20, 1901, no. 1623. Tower, August 23, 1901, no. 1688.

34. **Parmelia olivacea** (L.) ACH. var. **prolixa** ACH.

On rocks, infrequent. Blueberry island, July 13, 1901, nos. 575 and 588. Rainy Lake City, August 8, 1901, nos. 1206 and 1281. Kettle falls, August 9, 1901, no. 1337. Tower, August 28, 1901, no. 1859.

35. **Parmelia conspurcata** (SCHAER.) WAINIO.

Frequent on trees and rarely on rocks. Beaudette, June 21, 1901, nos. 92 and 95. Warroad, June 25, 1901, no. 162 and June 26, 1901, no. 183. Oak island, July 11, 1901, no. 519. Emo, July 17, 1901, no. 667. Koochiching, July 31, 1901, no. 1029. Rainy Lake City, August 30, 1901, no. 1162. Tower, August 24, 1901, no. 1735.

36. **Parmelia caperata** (L.) ACH.

On trees and rocks, frequent, more common on trees in swamps. Beaudette, June 18, 1901, no. 18 and June 19, 1901, no. 50. Warroad, June 26, 1901, no. 182, June 28, 1901, no. 239 and July 4, 1901, no. 356. Oak island, July 11, 1901, no. 524. Emo, July 17, 1901, no. 646 and July 20, 1901, no. 769. Koochiching, July 27, 1901, no. 943 and July 31, 1901, no. 1059. Harding, August 16, 1901, no. 1510. Tower, August 24, 1901, no. 1718.

37. **Parmelia conspersa** (EHRH.) ACH.

On rocks, abundant. Warroad, July 4, 1901, no. 368. Emo, July 22, 1901, no. 814. Koochiching, July 31, 1901, no. 1041. Rainy Lake City, August 1, 1901, no. 1062. Kettle falls, August 9, 1901, no. 1330. Harding, August 19, 1901, no. 1601. Tower, August 24, 1901, no. 1743.

38. **Physcia speciosa** (WULF., ACH.) NYL.

On trees and rocks, frequent. Beaudette, June 19, 1901, no. 45, June 21, 1901, no. 93, and June 22, 1901, no. 117. Warroad, June 26, 1901, no. 180 and July 1, 1901, no. 300. Oak island, July 8, 1901, no. 398 and July 9, 1901, no. 441. Emo, July 17, 1901, no. 644. Rainy Lake City, August 1, 1901, no. 793. Koochiching, July 29, 1901, nos. 969 and 973 and July 31, 1901, no. 1058. Kettle falls, August 13, 1901, no. 1437. Harding, August 16, 1901, no. 1505 and August 17, 1901, no. 1558. Tower, August 23, 1901, no. 1691 and August 26, 1901, no. 1814.

39. **Physcia aquila** (ACH.) NYL.

On trees, rare. Harding, August 20, 1901, no. 1620. Tower, August 26, 1901, no. 1771 and 1784.

40. **Physcia aquila** (ACH.) NYL. var. **detonsa** TUCK.

On cedars, rare. Emo, July 23, 1901, no. 837. Koochiching, July 31, 1901, no. 1024.

41. **Physcia pulverulenta** (SCHREB.) NYL.

On trees, frequent. Beaudette, June 18, 1901, no. 13 and June 24, 1901, no. 140. Warroad, June 25, 1901, no. 163. Oak island, July 8, 1901, no. 407 and July 10, 1901, no. 486. Emo, July 17, 1901, nos. 639 and 664, July 18, 1901, no. 706 and July 22, 1901, no. 813. Koochiching, July 29, 1901, no. 982. Rainy Lake City, August 2, 1901, no. 1103 and August 5, 1901, no. 1210. Kettle falls, August 15, 1901, no. 1494. Harding, August 20, 1901, no. 1652. Tower, August 23, 1901, no. 1686.

42. **Physcia pulverulenta** (SCHREB.) NYL. var. **leucoleiptes** TUCK.

On trees and rocks, rare. Emo, July 23, 1901, no. 830. Rainy Lake City, August 5, 1901, no. 1196.

43. **Physcia stellaris** (L.) TUCK.

On trees and rocks, common. Beaudette, June 18, 1901, no. 7. Warroad, June 25, 1901, no. 148 and July 4, 1901, no.

363. Emo, July 18, 1901, no. 697. Oak island, July 10, 1901, nos. 489 and 495. Koochiching, July 26, 1901, no. 925 and July 31, 1901, no. 1052. Rainy Lake City, August 5, 1901, no. 1184. Kettle falls, August 9, 1901, no. 1326 and August 15, 1901, no. 1483. Harding, August 19, 1901, no. 1595. Tower, August 23, 1901, nos. 1695 and 1704.

44. **Physcia stellaris** (L.) Tuck. var. **apiola** Nyl.

On rocks, rare. Oak island, July 9, 1901, no. 451. Rainy Lake City, August 15, 1901, no. 1098.

45. **Physcia astroidea** (Fr.) Nyl.

On rocks, infrequent. Oak island, July 8, 1901, no. 388 and July 10, 1901, nos. 501 and 510. Emo, July 22, 1901, no. 795. Koochiching, July 26, 1901, no. 906 and July 31, 1901, no. 1042. Tower, August 27, 1901, no. 1818.

46. **Physcia tribacia** (Ach.) Tuck.

On trees and rocks, infrequent. Le Clair, July 6, 1901, no. 382. Blueberry island, July 13, 1901, nos. 577 and 580. Emo, July 22, 1901, nos. 796 and 797. Koochiching, July 25, 1901, no. 885 and July 31, 1901, no. 1044. Harding, August 17, 1901, no. 1555. Tower, August 23, 1901, nos. 1685 and 1705 and August 27, 1901, no. 1816.

47. **Physcia hispida** (Schreb., Fr.) Tuck.

On trees and rocks, infrequent. Beaudette, June 19, 1901, no. 36. Warroad, June 25, 1901, no. 172. Le Clair, July 6, 1901, no. 384. Oak island, July 10, 1901, no. 497. Emo, July 18, 1901, no. 717. Koochiching, July 25, 1901, no. 860 and July 31, 1901, no. 1047. Rainy Lake City, August 1, 1901, no. 1077 and August 7, 1901, no. 1249. Tower, August 24, 1901, no. 1725.

48. **Physcia cæsia** (Hoffm.) Nyl.

On rocks, infrequent. Koochiching, July 31, 1901, no. 1048. Rainy Lake City, August 1, 1901, no. 1070, August 1, 1901, no. 1262 and August 8, 1901, no. 1297. Harding, August 20, 1901, no. 1618.

49. **Physcia obscura** (Ehrh.) Nyl.

On trees and rocks, frequent. Beaudette, June 18, 1901, no. 8 and June 24, 1901, no. 136. Warroad, June 25, 1901, no. 156 and July 4, 1901, no. 364. Oak island, July 9, 1901, no. 450. Emo, July 19, 1901, no. 727 and July 20, 1901, nos. 793, and 803. Koochiching, July 26, 1901, no. 924 and July 31,

1901, no. 1053. Kettle falls, August 14, 1901, no. 1476. Harding, August 19, 1901, no. 1587.

50. **Physcia obscura** (Ehrh.) Nyl. var. **endochrysea** Nyl.

On rocks, rare. Rainy Lake City, August 2, 1901, no. 1127 and August 3, 1901, no. 1148. Harding, August 19, 1901, no. 1585 and 1611. Tower, August 23, 1901, no. 1683.

51. **Pyxine sorediata** Fr.

On cedars in swamps, rare. Emo, July 17, 1901, no. 652. Koochiching, July 29, 1901, no. 991. Rainy Lake City, August 7, 1901, no. 1250. Harding, August 20, 1901, no. 1653.

52. **Umbilicaria hyperborea** Hoffm. ?

On rocks, common in western portion of the region. Warroad, July 4, 1901, no. 345. Oak island, July 9, 1901, no. 477. Flag island, July 12, 1901, nos. 541 and 559. Blueberry island, July 13, 1901, no. 587. Emo, July 22, 1901, no. 801. Rainy Lake City, August 5, 1901, no. 1206. August 7, 1901, no. 1253 and August 8, 1901, no. 1298. Kettle falls, August 9, 1901, no. 1350 and August 15, 1901, no. 1495. Harding, August 21, 1901, no. 1658.

Part of the material seems much like *Umbilicaria flocculosa* Hoffm.

53. **Umbilicaria muhlenbergii** (Ach.) Tuck.

On rocks, frequent. Warroad, July 4, 1901, no. 346. Emo, July 20, 1901, no. 767. Koochiching, July 27, 1901, no. 939. Rainy Lake City, August 5, 1901, no. 1218. Kettle falls, August 12, 1901, no. 1398. Harding, August 17, 1901, no. 1538. Tower, August 24, 1901, no. 1727.

54. **Umbilicaria vellea** (L.) Nyl.

On rocks, rare. Oak island, July 9, 1901, no. 478. Blueberry island, July 13, 1901, no. 595. Rainy Lake City, August 7, 1901, no. 1268. Kettle falls, August 12, 1901, no. 1591. Tower, August 29, 1901, no. 1880.

55. **Umbilicaria dillenii** Tuck.

On rocks, infrequent. Blueberry island, July 13, 1901, no. 569. Rainy Lake City, August 3, 1901, no. 1134. Kettle falls, August 12, 1901, no. 1397. Harding, August 17, 1901, nos. 1536 and 1537. Tower, August 29, 1901, no. 1879.

56. **Umbilicaria pustulata** (L.) Hoffm.

On rocks, rare. Blueberry island, June 13, 1901, no. 571. Rainy Lake City, August 3, 1901, no. 1335. Kettle falls,

August 12, 1901, no. 1387. Harding, August 19, 1901, no. 1580.

57. **Sticta amplissima** (SCOP.) MASS.

On cedars in swamps, infrequent. Emo, July 19, 1901, no. 759 and July 23, 1901, no. 848. Koochiching, July, 31, 1901, no. 1038. Kettle falls, August 13, 1901, no. 1452. Harding, August 20, 1901, no. 1624.

58. **Sticta pulmonaria** (L.) ACH.

On cedars in swamps, frequent. Beaudette, June 18, 1901, no. 5. Warroad, June 29, 1901, no. 275. Oak island, July 8, 1901, no. 421. Emo, July 17, 1901, nos. 642 and 648. Koochiching, July 27, 1901, no. 933 and July 30, 1901, no. 1005. Rainy Lake City, August 5, 1901, no. 1215. Kettle falls, August 13, 1901, no. 1453. Harding, August 17, 1901, no. 1546. Tower, August 26, 1901, no. 1794.

59. **Sticta quercizans** (MICHX.) ACH.

On trees and rocks, rare. Emo, July 19, 1901, no. 744. Koochiching, July 31, 1901, no. 1037. Rainy Lake City, August 8, 1901, No. 1034.

Not previously reported from Minnesota.

60. **Sticta fuliginosa** (DICKS.) ACH.

On cedars in swamps, rare, and once on rocks. Emo, July 19, 1901, no. 743 and July 23, 1901, no. 846. Koochiching, July 29, 1901, no. 998. Kettle falls, August 10, 1901, nos. 1360 and 1362. Harding, August 17, 1901, no. 1550. Tower, August 26, 1901, no. 1774.

Not previously reported from Minnesota and new to the Mississippi valley.

61. **Sticta crocata** (L.) ACH.

On shaded rocks and trees, rare. Rainy Lake City, August 5, 1901, no. 1226. Kettle falls, August 10, 1901, nos. 1356, 1359 and 1378.

62. **Nephroma tomentosum** (HOFFM.) KBR.

On rocks and trees, rare. Warroad, July 5, 1901, no. 382. Rainy Lake City, August 5, 1901, no. 1221. Kettle falls, August 10, 1901, nos. 1370 and 1410. Tower, August 24, 1901, no. 1747.

63. **Nephroma helveticum** ACH.

On rocks and trees, especially cedars, in swamps, frequent. Beaudette, June 21, 1901, no. 101. Warroad, July 1, 1901,

no. 299. Emo, July 17, 1901, no. 669 and July 19, 1901, no. 754. Koochiching, July 31, 1901, no. 1028. Rainy Lake City, August 1, 1901, no. 1074, August 2, 1901, no. 1123 and August 7, 1901, nos. 1205 and 1274. Kettle falls, August 9, 1901, no. 1336, August 13, 1901, no. 1361 and August 12, 1901, nos. 1383 and 1387. Harding, August 17, 1901, no. 1549. Tower, August 23, 1901, no. 1699 and August 26, 1901, no. 1800.

64. **Nephroma lævigatum** Ach.

Common on rocks at first locality and less frequent on cedars in swamps at the other three. Beaudette, June 20, 1901, no. 69. Oak island, July 8, 1901, no. 402. Koochiching, July 29, 1901, no. 1000. Rainy Lake City, August 3, 1901, no. 1138 and August 5, 1901, no. 1221.

65. **Nephroma lævigatum** Ach. var. **parile** Nyl.

On rocks, rare. Kettle falls, August 10, 1901, no. 1361.

66. **Peltigera aphthosa** (L.) Hoffm.

On earth, especially in cedar swamps, frequent. Beaudette, June 18, 1901, no. 17. Warroad, June 28, 1901, no. 226 and July 4, 1901, no. 356. Oak island, July 8, 1901, no. 424. Emo, July 19, 1901, no. 736 and July 23, 1901, no. 849. Koochiching, July 27, 1901, No. 947. Rainy Lake City, August 5, 1901, nos. 1213 and 1214. Kettle falls, August 10, 1901, no. 1356 and 1357 and August 12, 1901, no. 1390. Harding, August 17, 1901, no. 1544. Tower, August 27, 1901, no. 1835.

67. **Peltigera horizontalis** (L.) Hoffm.

On earth, usually in swamps, frequent. Beaudette, June 18, 1901, no. 1. Warroad, July 1, 1901, no. 313 and July 5, 1901, no. 373. Oak island, July 8, 1901, no. 425. Emo, July 19, 1901, no. 738. Koochiching, July 27, 1901, no. 929. Rainy Lake City, August 5, 1901, no. 1224. Kettle falls, August 10, 1901, no. 1377. Harding, August 19, 1901, no. 1584. Tower, August 28, 1901, no. 1853.

68. **Peltigera polydactyla** (Neck.) Hoffm.

On earth, in swamps, rare. Warroad, July 1, 1901, nos. 314 and 316. Koochiching, July 27, 1901, no. 956. Tower, August 27, 1901, no. 1832.

69. **Peltigera malacea** (Ach.) Fr.

On earth, over rocks, rare. Warroad, July 4, 1901, no. 336.

Blueberry island, July 15, 1901, no. 625. Emo, July 20, 1901, no. 765. Rainy Lake City, August 2, 1901, no. 1122. Kettle falls, August 10, 1901, no. 1363 and August 15, 1901, no. 1482. Tower, August 23, 1901, no. 1713.

Not previously reported from Minnesota and new to the Mississippi valley.

70. **Peltigera rufescens** (NECK.) HOFFM.

On earth, rare. Beaudette, June 18, 1901, no. 12. Warroad, June 27, 1901, no. 213. Oak island, July 8, 1901, no. 422. Emo, July 19, 1901, no. 752. Koochiching, July 27, 1901, no. 935. Kettle falls, August 10, 1901, no. 1373 and August 15, 1901, no. 1486.

71. **Peltigera canina** (L.) HOFFM.

On earth, common. Beaudette, June 18, 1901, no. 27, Warroad, June 27, 1901, no. 177. Oak island, July 9, 1901, no. 469. Emo, July 19, 1901, nos. 733, 748 and 750. Koochiching, July 27, 1901, no. 941. Rainy Lake City, August 3, 1901, no. 1128. Kettle falls, August 10, 1901, no. 1372. Harding, August 17, 1901, no. 1547 and August 21, 1901, no. 1665. Tower, August 26, 1901, no. 1844.

72. **Peltigera canina** (L.) HOFFM. var. **spongiosa** TUCK.

On earth in swamps, rare. Beaudette, June 18, 1901, no. 16. Oak island, July 8, 1901, no. 419. Koochiching, July 29, 1901, no. 994. Rainy Lake City, August 2, 1901, no. 1110. Harding, August 17, 1901, no. 1552. Tower, August 29, 1901, no. 1881.

73. **Peltigera canina** (L.) HOFFM. var. **spuria** ACH.

On earth, infrequent, Beaudette, June 24, 1901, nos. 132 and 141. Oak island, July 9, 1901, no. 447 and July 10, 1901, no. 509. Emo, July 19, 1901, no. 751. Koochiching, July 27, 1901, no. 946. Rainy Lake City, August 3, 1901, no. 1137. Harding, August 16, 1901, no. 1526. Tower, August 24, 1901, no. 1719.

74. **Peltigera canina** (L.) HOFFM. var. **sorediata** SCHAER.

On earth and rocks, infrequent. Warroad, June 26, 1901, no. 196. Emo, July 24, 1901, no. 855. Koochiching, July 25, 1901, no. 868. Rainy Lake City, August 1, 1901, no. 1082. Kettle falls, August 10, 1901, no. 1364.

75. **Peltigera canina** (L.) HOFFM. var. **leucorrhiza** FLK.

On earth in cedar swamps, rare. Oak island, July 8, 1901, no. 418. Mainland, July 16, 1901, no. 627.

76. **Pannaria languinosa** (Ach.) Kbr.

On mossy shaded rocks or trees' bases, frequent. Beaudette, June 18, 1901, no. 3 and June 20, 1901, no. 82. Warroad, June 26, 1901, no. 192. Flag island, July 12, 1901, no. 542. Emo, July 17, 1901, no. 638. Koochiching, July 25, 1901, no. 881. Rainy Lake City, August 3, 1901, no. 1169. Kettle falls, August 9, 1901, no. 1334. Harding, August 20, 1901, no. 1641.

77. **Pannaria rubiginosa** (Thunb.) Delis.

On cedars in swamps, rare. Oak island, July 8, 1901, no. 405. Emo, July 17, 1901, no. 654. Kettle falls, August 13, 1901, no. 1422.

Not previously reported from Minnesota.

78. **Pannaria rubiginosa** (Thunb.) Delis. var. **conoplea** Fr.

With the last and more frequent. Beaudette, June 24, 1901, no. 127. Emo, July 17, 1901, no. 637. Harding, August 17, 1901, no. 1565 and August 19, 1901, no. 1579. Tower, August 26, 1901, no. 1779.

Not previously reported from Minnesota and new to the upper Mississippi valley. This and the last above are very close to the plant called *P. lepidiota* Th. Fr. in the last report, and further study may result in bringing the two together. Also the two forms of *P. rubiginosa* (Thunb.) Delis seem to run to the next below, and that in turn is connected by intermediate forms with *P. microphylla* (Sw.) Delis, second below. Thus the three species as exhibited in Minnesota form a connected series.

79. **Pannaria leucosticta** Tuck.

On cedars in swamps, frequent, and more rarely on moss. Beaudette, June 24, 1901, no. 126. Warroad, July 5, 1901, no. 386. Blueberry island, July 13, 1901, no. 598. Emo, July 17, 1901, no. 656 and July 20, 1901, no. 781. Koochiching, July 29, 1901, no. 1003 and July 31, 1901, no. 1022. Rainy Lake City, August 5, 1901, no. 1207 and August 8, 1901, no. 1286. Kettle falls, August 13, 1901, no. 1355 and August 14, 1901, no. 1473. Harding, August 20, 1901, no. 1635. Tower, August 24, 1901, no. 1740 and August 27, 1901, no. 1837.

Not previously reported from Minnesota.

80. **Pannaria microphylla** (Sw.) Delis.

On rocks, locally common. Oak island, July 15, 1901, no. 618. Rainy Lake City, August 1, 1901, no. 1073 and August 3, 1901, no. 1170.

81. **Ephebe pubescens** Fr.

On flat rocks, rare. Harding, August 21, 1901, no. 1659.

82. **Ephebe solida** Born.

On rocks, locally frequent. Rainy Lake City, August 1, 1901, no. 794.

Both of the above were carefully examined and showed fungal hyphæ protruding from the filaments in clusters. The hyphæ in *E. solida* Born. were 3.5 to 6 mic. in diameter, much larger than those in the above species.

83. **Pyrenopsis** sp.

On rocks, rare and sterile. Blueberry island, July 13, 1901, no. 572. Probably one of the species previously found in Minnesota.

84. **Collema pycnocarpum** Nyl.

On trees, rare. Kettle falls, August 9, 1901, no. 1342 and August 13, 1901, no. 1416. Tower, August 26, 1901, no. 1771.

85. **Collema flaccidum** Ach.

Frequent on trees and more frequent on rocks. Beaudette, June 18, 1901, no. 2. Warroad, June 26, 1901, no. 190. Koochiching, July 25, 1901, no. 867 and July 27, 1901, no. 968. Rainy Lake City, August 8, 1901, no. 1280. Harding, August 19, 1901, no. 1606. Tower, August 27, 1901, no. 1829.

86. **Collema nigrescens** (Huds.) Ach.

On trees, frequent. Beaudette, June 18, 1901, no. 24. Warroad, June 26, 1901, no. 179. Oak island, July 8, 1901, no. 399. Emo, July 17, 1901, no. 650. Koochiching, July 31, 1901, no. 1031. Rainy Lake City, August 13, 1901, no. 1157. Kettle falls, August 9, 1901, no. 1340. Harding, August 16, 1901, no. 1511 and August 17, 1901, no. 1543. Tower, August 26, 1901, no. 1802.

87. **Collema nigrescens** (Huds.) Ach. var. **leucopepla** Tuck.

On trees, infrequent. Beaudette, June 20, 1901, no. 67. Warroad, June 26, 1901, no. 189. Emo, July 18, 1901, no. 710. Koochiching, July 29, 1901, no. 977. Kettle falls, August 9, 1901, no. 1323. Tower, August 26, 1901, no. 1815.

Shows the pruinose apothecia of the variety, but scarcely differs otherwise from the above. Not previously reported from Minnesota.

88. **Collema pulposum** (Bern.) Nyl.

On earth, common in last locality. Emo, July 24, 1901, no.

851. Koochiching, July 26, 1901, no. 925 and July 30, 1901, no. 1019.

89. **Collema limosum** Ach.

On shaded earth, rare. Koochiching, July 26, 1901, no. 918.

90. **Leptogium lacerum** (Sw.) Fr.

On earth and mossy rocks, rare. Beaudette, June 22, 1901, no. 119. Oak island, July 9, 1901, no. 440. Emo, July 24, 1901, no. 853. Koochiching, July 29, 1901, no. 970. Rainy Lake City, August 5, 1901, no. 1208. Kettle falls, August 13, 1901, no. 1412.

91. **Leptogium pulchellum** (Ach.) Nyl.

On cedars in swamps, rare. Warroad, June 28, 1901, no. 254 and July 5, 1901, no. 387. Emo, July 23, 1901, no. 835. Koochiching, July 29, 1901, no. 997.

92. **Leptogium tremelloides** (L.) Fr.

Frequent on rocks and less common on cedars in swamps. Beaudette, June 24, 1901, no. 145. Oak island, July 8, 1901, no. 430 and August 9, 1901, no. 433. Emo, July 17, 1901, no. 678 and July 17, 1901, no. 812. Koochiching, July 26, 1901, no. 904. Rainy Lake City, August 1, 1901, nos. 1071 and 1078 and August 8, 1901, no. 1246. Kettle falls, August 12, 1901, no. 1409. Harding, August 20, 1901, no. 1651. Tower, August 23, 1901, no. 1690.

93. **Leptogium myochroum** (Ehrh., Schaer.) Tuck.

Frequent on trees, especially in swamps, rare on rocks. Beaudette, June 19, 1901, no. 42, June 21, 1901, no. 106 and June 24, 1901, no. 144. Oak island, July 8, 1901, no. 412. Emo, July 17, 1901, no. 643. Koochiching, July 27, 1901, no. 934. Kettle falls, August 12, 1901, nos. 1360 and 1388. Tower, August 23, 1901, no. 1684.

94. **Leptogium myochroum** (Ehrh., Schaer.) Tuck. var. **tomentosum** Schaer.

On trees, frequent. Warroad, June 27, 1901, no. 214 and July 1, 1901, no. 310. Rainy Lake City, August 3, 1901, no. 1153. Kettle falls, August 10, 1901, no. 1371. Harding, August 16, 1901, no. 1527.

95. **Placodium elegans** (Link.) DC.

On rocks, infrequent. Flag island, July 12, 1901, no. 548. Emo, July 22, 1901, no. 807. Rainy Lake City, August 5, 1901, no. 1191 and August 6, 1901, no. 1238. Kettle falls,

August 15, 1901, no. 1585. Tower, August 28, 1901, no. 1849.

96. **Placodium murorum** (HOFFM.) DC.

On rocks, rare. Rainy Lake City, August 5, 1901, no. 1192.

97. **Placodium cinnabarium** (ACH.) ANZ.

On rocks, infrequent. Oak island, July 15, 1901, no. 617. Emo, July 22, 1901, no. 809. Koochiching, July 27, 1901, no. 963. Rainy Lake City, August 1, 1901, no. 1063. Tower, August 24, 1901, no. 1746.

98. **Placodium citrinum** (HOFFM.) LEIGHT.

On rocks, common and fruited at Harding, elsewhere rare and sterile. Rainy Lake City, August 7, 1901, no. 1244. Harding, August 20, 1901, no. 1616. Tower, August 23, 1901, no. 1711.

99. **Placodium aurantiacum** (LIGHT.) NAEG. and HEPP.

On rocks, infrequent. Le Clair, July 6, 1901, no. 380. Oak island, July 15, 1901, no. 624. Rainy Lake City, August 16, 1901, no. 1232. Kettle falls, August 14, 1901, no. 1478. Tower, August 27, 1901, no. 1843.

100. **Placodium cerinum** (HEDW.) NAEG. and HEPP.

On trees, common. Beaudette, June 21, 1901, no. 88. Warroad, June 25, 1901, no. 150, June 26, 1901, no. 184 and June 29, 1901, no. 279. Oak island, July 10, 1901, no. 512. Flag island, July 12, 1901, no. 551. Emo, July 18, 1901, no. 698. Koochiching, July 26, 1901, no. 893 and July 31, 1901, no. 1027. Rainy Lake City, August 8, 1901, no. 1299. Harding, August 19, 1901, no. 1581. Tower, August 23, 1901, no. 1692 and August 24, 1901, nos. 1731 and 1739.

101. **Placodium cerinum** (HEDW.) NAEG. and HEPP. var. **sideritis** TUCK.

On rocks, infrequent. Emo, July 20, 1901, no. 787. Koochiching, July 26, 1901, no. 909, and July 31, 1901, no. 1043. Rainy Lake City, August 1, 1901, nos. 1064 and 1075. Tower, August 24, 1901, no. 1749 and August 28, 1901, no. 1848.

102. **Placodium cerinum** (HEDW.) NAEG. and HEPP. var. **pyracea** NYL.

On old wood, rare. Beaudette, June 20, 1901, no. 76. Koochiching, July 29, 1901, no. 976. Rainy Lake City, August 6, 1901, no. 1231. Harding, August 20, 1901, no. 1621.

103. **Placodium ferrugineum** (HUDS.) HEPP.

On dead cedars, rare. Rainy Lake City, August 5, 1901, nos. 1193 and 1199.

104. **Placodium ferrugineum** (HUDS.) HEPP. var. **pollinii** TUCK.

On dead cedars, rare. Rainy Lake City, August 5, 1901, no. 1188.

105. **Placodium vitellinum** (EHRH.) NAEG. and HEPP.

On rocks and old wood, infrequent. Oak island, July 8, 1901, no. 404 and July 10, 1901, no. 490. Emo, July 22, 1901, no. 811. Koochiching, July 27, 1901, no. 948. Rainy Lake City, August 1, 1901, no. 1067 and August 6, 1901, no. 1227.

106. **Placodium vitellinum** (EHRH.) NAEG. and HEPP. var. **aurellum** ACH.

On rocks, infrequent. Flag island, July 12, 1901, no. 544. Blueberry island, July 13, 1901, no. 564. Koochiching, July 31, 1901, no. 1049. Rainy Lake City, August 1, 1901, no. 1068. Tower, August 24, 1901, no. 1738.

107. **Lecanora rubina** (VILL.) ACH.

On rocks, rare or infrequent. July 10, 1901, no. 508. Blueberry island, July 13, 1901, nos. 590 and 599. Emo, July 22, 1901, no. 810. Koochiching, July 31, 1901, no. 1060. Rainy Lake City, August 2, 1901, nos. 1102 and 1104 and August 8, 1901, no. 1207. Tower, August 28, 1901, nos. 1851 and 1852.

108. **Lecanora rubina** (VILL.) ACH. var. **heteromorpha** ACH.

On rocks, infrequent. Blueberry island, July 13, 1901, no. 605. Rainy Lake City, July 8, 1901, no. 1277. Kettle falls, August 9, 1901, no. 1344. Tower, August 28, 1901, nos. 1850 and 1862.

109. **Lecanora muralis** (SCHREB.) SCHAER.

On rocks, locally frequent. Blueberry island, July 13, 1901, no. 591.

110. **Lecanora muralis** (SCHREB.) SCHAER. var. **saxicola** SCHAER.

On rocks, infrequent. Oak island, July 10, 1901, no. 518. Flag island, July 13, 1901, no. 543. Emo, July 22, 1901, no. 823. Koochiching, July 26, 1901, no. 927. Rainy Lake City, August 1, 1901, no. 1069. Harding, August 17, 1901, no. 1541.

111. **Lecanora muralis** (SCHREB.) SCHAER. var. **garovaglii** ANZ.

On rocks, locally common. Koochiching, July 31, 1901, no. 1039.

Not previously reported from Minnesota.

112. **Lecanora pallida** (SCHREB.) SCHAER.

On cedars and tamaracks in swamps, frequent at the second locality. Beaudette, June 19, 1901, no. 54. Warroad, June 28, 1901, nos. 228 and 232.

113. **Lecanora frustulosa** (DICKS.) MASS.

On rocks, infrequent. Oak island, July 11, 1901, no. 521. Blueberry island, July 13, 1901, no. 600. Oak island, July 15, 1901, no. 614. Rainy Lake City, August 1, 1901, no. 1087. Kettle falls, August 15, 1901, no. 1488.

Some of the smaller material suggests forms of *Lecanora subfusca* (L.) Ach.

114. **Lecanora subfusca** (L.) ACH.

On trees, common. Beaudette, June 18, 1901, no. 21 and June 20, 1901, no. 74. Warroad, June 26, 1901, no. 195 and July 5, 1901, no. 384. Emo, July 18, 1901, no. 687. Koochiching, July 25, 1901, no. 888. Rainy Lake City, August 5, 1901, no. 1180. Kettle falls, August 9, 1901, no. 1347. Harding, August 19, 1901, nos. 1589 and 1605 and August 20, 1901, no. 1628. Tower, August 28, 1901, no. 1680.

115. **Lecanora subfusca** (L.) ACH. var. **allophana** ACH.

On cedars in swamps, common. Beaudette, June 22, 1901, nos. 113 and 124. Warroad, July 1, 1901, no. 307. Emo, July 17, 1901, no. 649. Harding, August 19, 1901, no. 1572. Tower, August 26, 1901, nos. 1783 and 1797.

116. **Lecanora subfusca** (L.) ACH. var. **argentata** ACH.

On trees, rare. Beaudette, June 21, 1901, no. 109. Warroad, June 25, 1901, no. 155. Rainy Lake City, August 8, 1901, no. 1279.

117. **Lecanora subfusca** (L.) ACH. var. **coilocarpa** ACH.

On cedars in swamps, rare. Beaudette, June 19, 1901, no. 53. Warroad, July 1, 1901, no. 312.

118. **Lecanora variolascens** (FR.) NYL.

On trees, frequent. Beaudette, June 21, 1901, no. 108. Warroad, June 26, 1901, no. 174. Oak island, July 9, 1901, no. 452. Emo, July 19, 1901, no. 746. Koochiching, July 25, 1901, no. 861. Kettle falls, August 14, 1901, no. 1463.

119. **Lecanora hageni** Ach.

On rocks, rare. Rainy Lake City, August 5, 1901, no. 1200. A peculiar form.

120. **Lecanora varia** (Ehrh.) Nyl.

On rocks and trees, frequent. Oak island, July 10, 1901, no. 503 and July 11, 1901, no. 523. Flag island, July 12, 1901, no. 561. Blueberry island, July 13, 1901, no. 593. Emo, July 22, 1901, no. 819. Rainy Lake City, August 1, 1901, no. 1065, August 5, 1901, no. 1187, August 7, 1901, no. 1251 and August 8, 1901, no. 1280. Harding, August 21, 1901, nos. 1662 and 1663. Tower, August 24, 1901, nos. 1716 and 1737.

121. **Lecanora varia** (Ehrh.) Nyl. var. **symmicta** Ach.

On dead and living wood, frequent. Beaudette, June 20, 1901, no. 71. Warroad, June 26, 1901, no. 187. Blueberry island, July 13, 1901, no. 586. Emo, July 18, 1901, no. 696. Koochiching, July 25, 1901, no. 689, July 26, 1901, nos. 891 and 919, July 27, 1901, no. 949 and July 29, 1901, no. 979. Rainy Lake City, August 2, 1901, nos. 1124 and 1126 and August 6, 1901, no. 1228. Kettle falls, August 9, 1901, no. 1333. Harding, August 20, 1901, no. 1648. Tower, August 23, 1901, nos. 1672 and 1706 and August 26, 1901, nos. 1773 and 1787.

122. **Lecanora varia** (Ehrh.) Nyl. var. **polytropa** Nyl.

On rocks, rare. Warroad, July 7, 1901, no. 367.

123. **Lecanora dispersa** Pers.

On old wood, rare. Warroad, June 29, 1901, no. 277. Le Clair, July 6, 1901, no. 383. Rainy Lake City, August 2, 1901, no. 1112.

Spores somewhat smaller than those of plants from Europe, and the plants also exhibiting better thalline exciple in ours. Also near *Lecanora effusa* (Pers.) Ach. collected in Nebraska by T. H. Williams.

Not previously reported from Minnesota and new to the interior of North America.

124. **Lecanora pallescens** (L.) Schaer.

On cedars in swamps, frequent. Beaudette, June 19, 1901, nos. 60 and 62 and June 20, 1901, no. 70. Warroad, June 29, 1901, nos. 263 and 274 and July 1, 1901, nos. 293, 302, 308 and 309. Oak island, July 9, 1901, no. 434. Mainland, July

16, 1901, no. 628. Emo, July 17, 1901, no. 673 and July 23, 1901, no. 831. Koochiching, July 25, 1901, no. 880 and July 29, 1901, no. 1001. Rainy Lake City, August 3, 1901, no. 1160. Kettle falls, August 9, 1901, no. 1317 and August 13, 1901, no. 1451. Harding, August 16, 1901, no. 1507 and August 19, 1901, no. 1610. Tower, August 26, 1901, no. 1799.

125. **Lecanora verrucosa** (Ach.) Laur. var. **mutabilis** Th. Fr.

On trees, rare. Oak island, July 8, 1901, no. 406 and July 8, 1901, no. 466. Emo, July 18, 1901, no. 694. Harding, August 19, 1901, no. 1592.

126. **Lecanora subepulotica** Nyl.

On rocks, rare. Emo, July 22, 1901, no. 816.

Not previously reported from Minnesota and new to the interior of North America.

127. **Lecanora cinerea** (L.) Sommerf.

On rocks, common. Warroad, July 4, 1901, no. 371. Oak island, July 9, 1901, nos. 454 and 479, July 10, 1901, nos. 483 and 514, July 11, 1901, nos. 522 and 526 and July 15, 1901, nos. 619 and 621. Emo, July 20, 1901, nos. 788 and 791 and July 22, 1901, no. 815. Koochiching, July 26, 1901, no. 911. Kettle falls, August 9, 1901, no. 1346. Harding, August 19, 1901, no. 1603, and August 20, 1901, no. 1617. Tower, August 23, 1901, nos. 1669 and 1708. August 24, 1901, nos. 1728 and 1730 and August 28, 1901, no. 1860.

128. **Lecanora cinerea** (L.) Sommerf. var. **lævata** Fr.

On rocks, common. Warroad, July 4, 1901, nos. 366 and 370. Oak island, July 10, 1901, nos. 499 and 515. Blueberry island, July 13, 1901, nos. 562 and 563. Rainy Lake City, August 6, 1901, no. 1230. Harding, August 19, 1901, nos. 1601 and 1608.

129. **Lecanora cinerea** (L.) Sommerf. var. **gibbosa** Nyl.

On rocks, rare. Oak island, July 15, 1901, no. 620. Koochiching, July 26, 1901, no. 917.

130. **Lecanora calcarea** (L.) Sommerf.?

On rocks, rare. Harding, August 21, 1901, no. 1664.

Scarcely differing from some forms referred to *L. cinerea* (L.) Sommerf., except in the plainly pruinose apothecia.

131. **Lecanora lacustris** (With.) Nyl.

On wet rocks, rare. Harding, August 16, 1901, nos. 1518 and 1528.

Not previously reported from Minnesota and new to the interior of North America.

132. **Lecanora fuscata** (Schrad.) Th. Fr.

Common on rocks and collected at Tower on old wood. Oak island, July 9, 1901, no. 480 and July 10, 1901, no. 482. Emo, July 20, 1901, no. 780. Koochiching, July 26, 1901, no. 923. Rainy Lake City, August 1, 1901, no. 1101. Harding, August 20, 1901, no. 1615. Tower, August 23, 1901, no. 1671, August 24, 1901, nos. 1721 and 1736 and August 27, 1901, no. 1840.

133. **Rinodina oreina** (Ach.) Mass.

On rocks, rare. Warroad, July 4, 1901, no. 358. Oak island, July 9, 1901, no. 474, and July 10, 1901, no. 513. Emo, July 22, 1901, no. 805. Koochiching, July 31, 1901, no. 1057. Rainy Lake City, August 1, 1901, no. 1088. Kettle falls, August 9, 1901, no. 1335. Tower, August 27, 1901, no. 1822.

134. **Rinodina sophodes** (Ach.) Nyl.

On trees and rocks, common. Warroad, June 25, 1901, no. 160 and June 28, 1901, no. 237. Oak island, July 10, 1901, no. 500. Koochiching, July 27, 1901, no. 959. Rainy Lake City, August 6, 1901, no. 1243. Harding, August 21, 1901, no. 1660. Tower, August 23, 1901, nos. 1682 and 1700, August 24, 1901, no. 1729 and August 27, 1901, no. 1819.

135. **Rinodina sophodes** (Ach.) Nyl. var. **exigua** Fr.

On trees and old wood, rare. Warroad, June 23, 1901, no. 223. Koochiching, July 29, 1901, no. 972.

136. **Rinodina sophodes** (Ach.) Nyl. var. **tephraspis** Tuck.

On rocks, rare. Warroad, July 4, 1901, no. 372. Flag island, July 12, 1901, no. 540. Tower, August 23, 1901, no. 1702 and August 24, 1901, no. 1759.

137. **Rinodina lecanorina** Mass.

On rocks, rare. Oak island, July 10, 1901, no. 511. Koochiching, July 20, 1901, no. 901. Rainy Lake City, August 1, 1901, nos. 1072 and 1081.

138. **Pertusaria velata** (Turn.) Nyl.

Frequent on trees and rarely on rocks. Emo, July 17, 1901, no. 680 and July 22, 1901, no. 840. Rainy Lake City, August 1, 1901, no. 1091. Kettle falls, August 13, 1901, no.

1421. Harding, August 14, 1901, no. 1594 and August 20, 1901, no. 1622. Tower, August 26, 1901, no. 1793.

139. **Pertusaria multipuncta** (TURN.) NYL.

On cedars in swamps, frequent. Beaudette, June 22, 1901, no. 125. Warroad, June 29, 1901, nos. 257 and 280 and July 1, 1901, no. 288. Emo, July 23, 1901, no. 843. Koochiching, July 30, 1901, no. 1019.

140. **Pertusaria communis** DC.

On cedars in swamps, common. Beaudette, June 6, 1901, no. 64. Warroad, June 29, 1901, no. 282 and July 1, 1901, no. 304. Oak island, July 9, 1901, no. 448. Emo, July 18, 1901, no. 713. Koochiching, July 30, 1901, no. 1021. Rainy Lake City, August 8, 1901, no. 1282. Kettle falls, August 9, 1901, no. 1341 and August 13, 1901, no. 1441. Harding, August 19, 1901, no. 1577. Tower, August 26, 1901, nos. 1810 and 1805.

141. **Pertusaria pustulata** (ACH.) NYL.

On trees, rare. Kettle falls, August 13, 1901, no. 1438.

142. **Pertusaria leioplaca** (ACH.) SCHAER.

On trees, frequent. Beaudette, June 19, 1901, no. 65. Warroad, June 26, 1901, no. 173, and July 2, 1901, no. 324. Oak island, July 9, 1901, no. 455. Emo, July 18, 1901, no. 703. Koochiching, July 25, 1901, no. 882 and July 26, 1901, no. 899. Rainy Lake City, August 3, 1901, nos. 1166 and 1174, and August 5, 1901, no. 1182. Kettle falls, August 13, 1901, nos. 1420 and 1425. Tower, August 29, 1901, no. 1874.

143. **Pertusaria ophthalniza** NYL.?

On trees, probably common though seldom seen. Beaudette, June 24, 1901, no. 133. Mainland, July 16, 1901, no. 631. Tower, August 26, 1901, no. 1812.

Spores are only 100–155 by 24–45 mic., while published descriptions give 160–205 by 80–100 mic. as the size. However, Dr. Arnold so names a plant from Newfoundland having spores only 90–135 by 35–48 mic.

144. **Gyalecta lutea** (DICKS.) TUCK.

On an old *Polyporus*, rare. Emo, July 23, 1901, no. 828.

But the border of the exciple not radiate.

145. **Urceolaria scruposa** (L.) Nyl.

On rocks, infequent and rarely on cedars in swamps at second locality. Oak island, July 15, 1901, no. 615. Emo, July 17, 1901, nos. 651 and 662, July 20, 1901, no. 784 and July 23, 1901, no. 839. Rainy Lake City, August 2, 1901, no. 1109. Kettle falls, August 9, 1901, no. 1345. Harding, August 20, 1901, no. 1650. Tower, August 27, 1901, no. 1838.

146. **Stereocaulon paschale** (L.) Fr.

On rocks, frequent, or on earth over rocks. Warroad, July 4, 1901, no. 337. Emo, July 20, 1901, no. 766. Koochiching, July 25, 1901, no. 865. Kettle falls, August 12, 1901, no. 1385. Harding, August 20, 1901, no. 1629. Tower, August 23, 1901, no. 1679.

147. **Stereocaulon tomentosum** (Fr.) Th. Fr.

On rocks, locally common. Oak island, July 9, 1901, no. 471.

Not previously reported from Minnesota.

148. **Cladonia rangiferina** (L.) Web.

On earth, generally over rocks, common. Beaudette, June 19, 1901, no. 43. Warroad, June 28, 1901, nos. 233 and 236 and July 4, 1901, no. 349. Flag island, July 12, 1901, nos. 539 and 556. Emo, July 19, 1901, no. 734. Kettle falls, August 12, 1901, no. 1392. Harding, August 17, 1901, no. 1539. Tower, August 24, 1901, no. 1763.

149. **Cladonia sylvatica** (L.) Hoffm. var. **pumila** Ach.

On earth, usually over rocks, common. Warroad, June 26, 1901, no. 273. Oak island, July 10, 1901, no. 491. Kettle falls, August 12, 1901, no. 1405. Tower, August 23, 1901, no. 1701.

Not previously reported from Minnesota.

150. **Cladonia sylvatica** (L.) Hoffm. var. **sylvestris** Oed.

On rocky earth, rare. Warroad, June 27, 1901, no. 202. Blueberry island, July 13, 1901, no. 585. Tower, August 29, 1901, no. 1885.

Not previously reported from Minnesota.

151. **Cladonia alpestris** (L.) Rabenh.

On earth, usually over rocks, infrequent. Warroad, July 14, 1901, no. 340. Flag island, July 12, 1901, no. 552. Kettle

falls, August 13, 1901, no. 1414. Tower, August 29, 1901, no. 1872.

152. **Cladonia bacillaris** Nyl.

On earth and old wood, rare. Kettle falls, August 10, 1901, no. 1365. Tower, August 24, 1901, no. 1723, and August 27, 1901, no. 1823.

153. **Cladonia macilenta** (Hoffm.) Nyl.

On earth and old wood, common. Blueberry island, July 13, 1901, nos. 582 and 584. Harding, August 16, 1901, no. 1504 and August 17, 1901, no. 1561.

154. **Cladonia digitata** Schaer.

On old logs in cedar swamps, rare. Warroad, July 2, 1901, no. 327. Harding, August 17, 1901, no. 1557.

155. **Cladonia coccifera** (L.) Willd.

On earth over rocks, infrequent. Blueberry island, July 13, 1901, no. 578. Rainy Lake City, August 1, 1901, no. 1086.

Previously reported as *Cladonia cornucopiodes* (L.) Fr.

156. **Cladonia coccifera** (L.) Willd. var. **stemmatina** Ach.

On earth over rocks, infrequent. Warroad, July 4, 1901, no. 343. Emo, July 22, 1901, no. 808. Rainy Lake City, August 2, 1901, no. 1147.

Not previously reported from Minnesota.

157. **Cladonia coccifera** (L.) Willd. var. **pleurota** (Flk.) Schaer.

On mossy rocks, infrequent. Rainy Lake City, August 1, 1901, no. 1089. Kettle falls, August 10, 1901, no. 1362.

Not previously reported from Minnesota.

158. **Cladonia deformis** Hoffm.

On earth, rare. Blueberry island, July 13, 1901, no. 592.

159. **Cladonia cristatella** Tuck.

On old wood and earth, frequent. Beaudette, June 19, 1901, no. 40. Warroad, June 27, 1901, no. 219; July 1, 1901, no. 294; July 2, 1901, 328 and July 4, 1901, no. 342. Oak island, July 8, 1901, no. 387 and July 9, 1901, no. 476. Flag island, July 12, 1901, no. 554. Emo, July 18, 1901, no. 695. Koochching, July 25, 1901, no. 873, and July 27, 1901, no. 940 and 958. Rainy Lake City, August 1, 1901, no. 1090; August 2, 1901, no. 1115, and August 7, 1901, no. 1276. Kettle falls,

August 10, 1901, nos. 1368 and 1374. Harding, August 17, 1901, no. 1542. Tower, August 24, 1901, no. 1724.

160. **Cladonia cristatella** Tuck. var. **vestita** Tuck.

On rocks, locally common. Tower, August 2, 1901, no. 1754.

Not previously reported from Minnesota, and new to the Mississippi valley.

161. **Cladonia amaurocræa** (Flk.) Schaer.

On earth over rocks, frequent. Warroad, July 4, 1901, no. 359. Blueberry island, July 17, 1901, nos. 576, 606 and 607. Emo, July 20, 1901, no. 775. Koochiching, July 27, 1901, no. 937. Rainy Lake City, August 3, 1901, no. 1129, and August 8, 1901, nos. 1310 and 1311. Kettle falls, August 12, 1901, no. 1379. Harding, August 17, 1901, no. 1564 and August 20, 1901, no. 1640. Tower, August 29, 1901, nos. 1866 and 1870.

162. **Cladonia uncialis** (L.) Web.

On earth, usually over rocks, frequent. Warroad, July 4, 1901, no. 338. Flag island, July 12, 1901, no. 535. Emo, July 20, 1901, no. 773. Koochiching, July 31, 1901, no. 1036. Rainy Lake City, August 2, 1901, no. 1108, and August 5, 1901, no. 1220. Kettle falls, August 12, 1901, no. 1394. Tower, August 29, 1901, no. 1871.

163. **Cladonia uncialis** (L.) Web. var. **obtusata** Ach.

On earth, rare. Blueberry island, July 13, 1901, no. 597.

Not previously reported from Minnesota and new to North America.

164. **Cladonia furcata** (Huds.) Schrad.

On earth and old wood, rare. Emo, July 19, 1901, no. 728, and July 21, 1901, no. 771. Koochiching, July 30, 1901, no. 1009.

165. **Cladonia furcata** (Huds.) var. **pinnata** (Flk.) Wainio.

On earth over rocks, infrequent. Rain Lake City, August 7, no. 1273.

Not previously reported from Minnesota.

166. **Cladonia furcata** (Huds.) Schrad. var. **scabriuscula** (Del.) Coem.

On earth and old wood, frequent. Warroad, July 5, 1901, no. 374. Emo, July 20, 1901, no. 764. Koochiching, July

25, 1901, no. 900, and July 31, 1901, no. 1032. Rainy Lake City, August 3, 1901, no. 1177, August 5, 1901, no. 1216 and August 7, 1901, no. 1272. Kettle falls, August 10, 1901, 1386.

167. **Cladonia furcata** (HUDS.) SCHRAD. var. **paradoxa** WAINIO.

On old wood and earth, frequent. Beaudette, June 19, 1901, no. 44. Warroad, July 4, 1901, no. 352. Emo, July 20, 1901, no. 779. Koochiching, July 25, 1901, no. 863. Harding, August 20, 1901, no. 1654. Tower, August 23, 1901, no. 1694.

168. **Cladonia furcata** (HUDS.) SCHRAD. var. **finkii** WAINIO.

On earth and old wood, frequent. Beaudette, June 19, 1901, no. 46. Oak island, July 8, 1901, nos. 414 and 415, and July 9, 1901, no. 465. Flag island, July 12, 1901, no. 532. Oak island, July 15, 1901, no. 612. Emo, July 18, 1901, no. 688, July 19, 1901, no. 747 and July 20, 1901, no. 772. Koochiching, July 30, 1901, no. 1011. Rainy Lake City, August 8, 1901, nos. 1283 and 1295. Kettle falls, August 14, 1901, no. 1464. Harding, August 17, 1901, no. 1548. Tower, August 24, 1901, nos. 1726, 1745 and 1763, and August 27, 1901, no. 1828.

A new variety. Dr. Wainio's description is not at hand, but will appear later.

169. **Cladonia crispata** (ACH.) FLT.

On earth and old wood, infrequent. Warroad, June 29, 1901, no. 256 and July 4, 1901, no. 348. Tower, August 24, 1901, no. 1715.

Previously reported as *Cladonia furcata* (Huds.) Fr. var. *crispala* Flk.

170. **Cladonia crispata** (ACH.) FLT. var. **infundibulifera** (SCHAER.) WAINIO.

On earth and old logs, common. Emo, July 19, 1901, no. 731. Koochiching, July 29, 1901, no. 992. Kettle falls, August 12, 1901, no. 1393.

Not previously reported from Minnesota, and new to the Mississippi valley.

171. **Cladonia squamosa** (SCOP.) HOFFM.

On earth and old wood, frequent. Beaudette, June 24, 1901, no. 131. Emo, July 23, 1901, no. 836. Koochiching, July 29, 1901, no. 996 and August 30, 1901, no. 1010. Rainy Lake City, August 1, 1901, no. 1097, August 5, 1901, no. 1225 and

August 8, 1901, no. 1296, and 1300. Kettle falls, August 12, 1901, no. 1396 and 1406. Harding, August 17, 1901, no. 1562. Tower, August 26, 1901, no. 1811 and August 29, 1901, no. 1878.

172. **Cladonia squamosa** (Scop.) Hoffm. var. **multibracteata** Flk.

On earth over rocks, locally frequent. Rainy Lake City, August 3, 1901, no. 132.

Not previously reported from Minnesota and new to North America.

173. **Cladonia squamosa** (Scop.) Hoffm. var. **phyllocoma** Rabenh.

On an old log, rare, Emo, July 23, 1901, no. 847.

174. **Cladonia subsquamosa** Nyl.

On earth among rocks, rare. Emo, July 20, 1901, no. 762.

Not previously reported from Minnesota and new to the United States.

175. **Cladonia cæspiticia** (Pers.) Flk.

On rocks, rare. Rainy Lake City, August 1, 1901, no. 1085 and August 7, 1901, no. 1261. Tower, August 24, 1901, no. 1758.

176. **Cladonia delicata** (Ehrh.) Flk.

On a cedar log in swamp, rare. Warroad, July 1, 1901, no. 21.

177. **Cladonia cenotea** (Ach.) Schaer.

On earth over rocks and on old wood in swamps, frequent. Beaudette, June 18, 1901, nos. 19 and 25, June 19, 1901, no. 48 and June 24, 1901, no. 130. Emo, July 19, 1901, no. 741 and July 23, 1901, no. 850. Koochiching, July 29, 1901, no. 995. Rainy Lake City, August 7, 1901, no. 1245 and August 8, 1901, nos. 1296 and 1302. Kettle falls, August 12, 1901, no. 1399. Tower, August 27, 1901, no. 1821.

178. **Cladonia turgida** (Ehrh.) Hoffm.

On earth and old wood, common on earth over rocks. Warroad, July 4, 1901, nos. 341, 350, 351 and 360. Oak island, July 8, 1901, nos. 410 and 427. Blueberry island, July 13, 1901, no. 608. Emo, July 18, 1901, no. 686 and July 20, 1901, nos. 774 and 776. Koochiching, July 25, 1901, no. 886

and July 31, 1901, no. 1035. Rainy Lake City, August 2, 1901, no. 1114 and August 7, 1901, no. 1247. Kettle falls, August 12, 1901, no. 1408 and August 13, 1901, no. 1481 and August 17, 1901, nos. 1535 and 1563. Tower, August 29, 1901, no. 1867.

179. **Cladonia cariosa** (Ach.) Spreng.

On earth over rocks, locally frequent. Koochiching, July 26, 1901, no. 903. Tower, August 24, 1901, no. 1722 and August 27, 1901, no. 1836.

180. **Cladonia decorticata** (Flk.) Spreng.

On earth and old wood, frequent. Flag island, July 12, 1901, nos. 530 and 553. Rainy Lake City, August 6, 1901, no. 1239. Kettle falls, August 12, 1901, no. 1382. Harding, August 16, 1901, no. 1533.

181. **Cladonia gracilis** (L.) Willd.

On earth and old logs, frequent. Warroad, June 26, 1901, no. 198 and June 27, 1901, no. 203. Emo, July 18, 1901, no. 683. Rainy Lake City, August 1, 1901, no. 795. Harding, August 20, 1901, no. 1633. Tower, August 24, 1901, nos. 1732 and 1765.

182. **Cladonia gracilis** (L.) Willd. var. **dilatata** (Hoffm.) Wainio.

On earth and old logs, frequent. Beaudette, June 19, 1901, no. 37. Warroad, July 1, 1901, no. 298, July 2, 1901, no. 317, July 4, 1901, no. 353 and July 5, 1901, no. 380. Oak Island, July 8, 1901, no. 411. Flag island, July 12, 1901, no. 557. Emo, July 18, 1901, nos. 681 and 699. Harding, August 16, 1901, nos. 1525 and 1531. Tower, August 23, 1901, no. 1696.

Not previously reported from Minnesota.

183. **Cladonia gracilis** (L.) Willd. var. **anthocephala** Flk.

On old wood and earth, frequent. Beaudette, June 19, 1901. no. 52 and June 21, 1901, no. 91. Warroad, June 26, 1901, no. 186, June 29, 1901, no. 272 and July 1, 1901, no. 315. Emo, July 19, 1901, nos. 740 and 749 and July 23, 1901, no. 832. Koochiching, July 31, 1901, no. 1040. Rainy Lake City, August 5, 1901, no. 1217. Kettle falls, August 12, 1901, nos. 1400 and 1407. Harding, August 16, 1901, no. 1521. Tower, August 23, 1901, no. 1675.

184. **Cladonia gracilis** (L.) WILLD. var. **dilacerta** FLK.

On old wood and earth, infrequent. Rainy Lake City, August 8, 1901, no. 1301. Beaudette, June 24, 1901, no. 142. Warroad, July 5, 1901, no. 385. Oak island, July 10, 1901, no. 487.

Not previously reported from Minnesota.

185. **Cladonia degenerans** (FLK.) SPRENG.

On earth over rocks, infrequent. Rainy Lake City, August 3, 1901, no. 1139, August 7, 1901, no. 1269 and August 8, 1901, no. 1303. Tower, August 24, 1901, no. 1752.

186. **Cladonia degenerans** (FLK.) SPRENG. var. **euphorea** (ACH.) FLK.

On earth over rocks, infrequent. Rainy Lake City, August 7, 1901, no. 1264. Kettle falls, August 14, 1901, no. 1465. Harding, August 17, 1901, no. 1540.

Not previously reported from Minnesota, and new to North America.

187. **Cladonia degenerans** (FLK.) SPRENG. var. **cladomorpha** (ACH.) WAINIO.

On earth and over rocks, rare. Emo, July 20, 1901, no. 763.

Not previously reported from Minnesota, and new to North America.

188. **Cladonia verticillata** HOFFM.

On earth and old wood, common especially over rocks. Oak island, July 9, 1901, no. 470 and July 10, 1901, no. 504. Koochiching, July 27, 1901, no. 930. Kettle falls, August 10, 1901, no. 1369, August 12, 1901, no. 1384 and August 13, 1901, no. 1450. Harding, August 17, 1901, no. 1540a and August 16, 1901, no. 1525a. Tower, August 24, 1901, no. 1756 and August 27, 1901, nos. 1830 and 1831.

189. **Cladonia verticillata** HOFFM. var. **evoluta** TH. FR.

On earth, frequent. Oak island, July 9, 1901, no. 461. Emo, July 20, 1901 no. 778. Kettle falls, August 10, 1901, no. 1358.

Not previously reported from Minnesota.

190. **Cladonia pyxidata** (L.) FR.

On earth especially over rocks, frequent. Blueberry island, July 13, 1901, no. 609. Koochiching, July 31, 1901, no. 1054. Tower, August 23, 1901, no. 1709.

191. **Cladonia pyxidata** (L.) Fr. var. **neglecta** (Flk.) Mass.

On earth and old wood, common. Beaudette, June 21, 1901, no. 104. Warroad, June 27, 1901, no. 220 and June 29, 1901, nos. 260 and 268. Oak island, July 9, 1901, no. 467. Emo, July 23, 1901, no. 825. Koochiching, July 27, 1901, no. 964. Kettle falls, August 10, 1901, no. 1376 and August 12, 1901, no. 1381. Harding, August 16, 1901, no. 1532 and August 20, 1901, no. 1630. Tower, August 23, 1901, no. 1678 and August 27, 1901, no. 1817.

192. **Cladonia pyxidata** (L.) Fr. var. **chlorophæa** Flk.

On earth and old wood, infrequent. Beaudette, June 19, 1901, no. 51. Warroad, July 4, 1901, no. 347.

193. **Cladonia fimbriata** (L.) Fr.

On earth, frequent. Oak island, July 15, 1901, no. 116. Rainy Lake City, August 7, 1901, no. 1275.

194. **Cladonia fimbriata** (L.) Fr. var. **prolifera** (Retz.) Mass.

On earth in swamps, rare. Warroad, June 28, 1901, no. 239.

Not previously reported from Minnesota, and new to the United States.

195. **Cladonia fimbriata** (L.) Fr. var. **cornuto-radiata** Coem.

On earth, infrequent. Kettle falls, August 14, 1901, no. 1470. Tower, August 23, 1901, no. 1687.

Not previously reported from Minnesota, and new to North America.

196. **Cladonia fimbriata** (L.) Fr. var. **radiata** (Schreb.) Coem.

On earth and old wood, infrequent. Oak island, July 9, 1901, nos. 468 and 473. Rainy Lake City, August 8, 1901, no. 1312. Kettle falls, August 10, 1901, no. 1367. Harding, August 21, 1901, no. 1667.

Not previously reported from Minnesota.

197. **Cladonia fimbriata** (L.) Fr. var. **subulata** (L.) Wainio.

On earth over rocks, rare. Tower, August 27, 1901, no. 1833.

198. **Cladonia fimbriata** (L.) Fr. var. **nemoxyna** (Ach.) Wainio.

On earth, frequent over rocks. Warroad, July 4, 1901, no. 344. Flag island, July 12, 1901, no. 529. Oak island, July 15, 1901, no. 611. Harding, August 20, 1901, no. 1639. Tower, August 23, 1901, no. 1674 and August 27, 1901, no. 1844.

199. **Cladonia fimbriata** (L.) Fr. var. **apolepta** (Ach.) Wainio.

On old wood, common. Beaudette, June 19, 1901, no. 49. Warroad, June 27, 1901, no. 208. Oak island, July 8, 1901, no. 409. Emo, July 18, 1901, no. 720 and July 23, 1901, no. 844. Koochiching, July 25, 1901, no. 862.

200. **Cladonia fimbriata** (L.) Fr. var. **coniocræa** (Flk.)Wainio.

On old wood and earth, frequent. Beaudette, June 18, 1901, nos. 11 and 13. Oak island, July 8, 1901, no. 413 and July 9, 1901, no. 472. Emo, July 17, 1901, no. 636. Rainy Lake City, August 7, 1901, no. 1265 and August 8, 1901, no. 1287. Emo, July 24, 1901, no. 856. Harding, August 16, 1901, nos. 1508 and 1534. Tower, August 24, 1901, no. 1744.

201. **Cladonia pityrea** (Flk.) Fr. var. **phyllophora** (Mudd.) Wainio.

On earth and old logs, infrequent. Oak island, July 8, 1901, no. 416 and July 15, 1901, no. 610. Emo, July 20, 1901, nos. 761 and 770.

Not previously reported from Minnesota and new to North America.

202. **Cladonia pityrea** (Flk.) Fr. var. **subacuta** Wainio.

On old wood, frequent. Emo, July 19, 1901, no. 742.

Not previously reported from Minnesota and new to North America.

203. **Cladonia botrytes** (Hag.) Willd.

On old wood, frequent. Beaudette, June 19, 1901, no. 41. Emo, July 18, 1901, nos. 700 and 714. Koochiching, July 25, 1901, no. 871. Rainy Lake City, August 3, 1901, no. 1140. Tower, August 24, 1901, no. 1717.

204. **Bæomyces byssoides** (L.) Schaer.

On rocks, rare. Emo, July 22, 1901, no. 817. Rainy Lake City, August 1, 1901, no. 1061, August 5, 1901, no. 1186 and August 8, 1901, no. 1293. Kettle falls, August 9, 1901, no. 1321.

205. **Bæomyces aeruginosus** (Scop.) Nyl.

On rotten wood, rare. Emo, July 18, 1901, no. 685. Koochiching, July 29, 1901, no. 1002. Kettle falls, August 15, 1901 no. 1493. Harding, August 19, 1901, no. 1578.

206. **Biatora rufonigra** Tuck.

On rocks, rare. Kettle falls, August 9, 1901, no. 1325.

207. **Biatora granulosa** (EHRH.) HOFFM.

On earth and on cedars in swamps, rare. Blueberry island, July 13, 1901, no. 579. Koochiching, July 30, 1901, no. 1006.

208. **Biatora mutabilis** (FÉE) TUCK.?

On trees locally frequent. Warroad, June 25, 1901, no. 164.

Not previously reported from Minnesota, and new to the northern states.

209. **Biatora vernalis** (L.) FR.

Frequent on mossy bases of trees, especially in cedar swamps, but also on higher ground and on dead wood and rocks.

Beaudette, June 19, 1901, no. 58, June 22, 1901, nos. 120 and and 122 and June 24, 1901, no. 134. Warroad, June 29, 1901, no. 283 and July 4, 1901, no. 361. Emo, July 18, 1901, no. 721 and July 19, 1901, nos. 730 and 757. Koochiching, July 26, 1901, no. 916 and July 30, 1901, no. 1007. Rainy Lake City, August 2, 1901, no. 1119 and August 3, 1901, no. 1150. Kettle falls, August 9, 1901, no. 1316. Harding, August 16, 1901, no. 1513 and August 19, 1901, no. 1604. Tower, August 26, 1901, nos. 1769, 1791 and 1801.

210. **Biatora sanguineoatra** FR.

On old wood, usually with moss, rare. Koochiching, July 27, 1901, no. 962. Rainy Lake City, August 6, 1901, no. 1241 and August 8, 1901, no. 1289. Kettle falls, August 9, 1901, no. 1327, August 13, 1901, no. 1434, and August 14, 1901, no. 1468. Harding, August 20, 1901, no. 1645. Tower, August 28, 1901, no. 1855.

211. **Biatora carnulenta** TUCK.

On old wood, rare. Warroad, June 26, 1901, no. 216.

Not previously reported from Minnesota.

212. **Biatora turgidula** (FR.) NYL.

On dead and living cedars in swamps, rare. Beaudette, June 19, 1901, no. 66. Warroad, July 1, 1901, no. 286. Koochiching, July 30, 1901, no. 1013. Rainy Lake City, August 5, 1901, no. 1198.

213. **Biatora leucophæa** FLK.?

On cedars in swamps, rare. Warroad, June 29, 1901, no. 276.

214. **Biatora uliginosa** (SCHRAD.) FR.

On earth and old wood, common. Beaudette, June 18, 1901, no. 31, June 21, 1901, no. 104 and June 22, 1901, no. 115. Warroad, July 1, 1901, no. 296. Blueberry island, July 13, 1901, no. 604. Koochiching, July 30, 1901, no. 1024. Rainy Lake City, August 2, 1901, no. 1105 and August 8, 1901, no. 1298. Kettle falls, August 9, 1901, no. 1338. Harding, August 19, 1901, no. 1600. Tower, August 28, 1901, no. 1714.

215. **Biatora fuliginea** ACH.

On an old *Polyporus* in swamp, rare. Beaudette, June 18, 1901, no. 32.

Not previously reported from Minnesota and new to the Missippi valley.

B. uliginosa (Schrad.) Fr., *B. fuliginea* Ach. and *B. asserculosum* Schrad. are very closely related if not synonyms. The last two seem to have smaller spores than the first. Spores of the plant here listed are 6–9 by 3–5 mic.

216. **Biatora flexuosa** (FR.) TUCK.

On old wood, rare. Harding, August 21, 1901, no. 1661.

217. **Biatora myriocarpoides** (NYL.) TUCK.

On old wood and rocks, frequent. Warroad, June 26, 1901, no. 175. Koochiching, July 31, 1901, no. 1030. Rainy Lake City, August 5, 1901, no. 1212. Harding, August 16, 1901, no. 1502, and August 20, 1901, no. 1614. Tower, August 23, 1901, nos. 1673 and 1703, and August 27, 1901, no. 1827.

218. **Biatora varians** (ACH.) TUCK.

On trees, rare. Warroad, June 27, 1901, no. 206. Oak island, July 10, 1901, no. 506.

219. **Biatora quernea** (DICKS.) FR.

On old wood in swamps, infrequent. Warroad, June 26, 1901, no. 249. Rainy Lake City, August 7, 1901, no. 1255.

Not previously reported from Minnesota and new to the Mississippi valley.

220. **Biatora flavidolivens** TUCK.

On cedars in swamps, rare. Warroad, July 1, 1901, no. 289. Apothecia becoming black.

221. **Biatora lucida** (Ach.) Fr.

On shaded rocks, frequent. Rainy Lake City, August 5, 1901, no. 1204, and August 6, 1901, no. 1235. Kettle falls, August 9, 1901, no. 1322. Harding, August 20, 1901, no. 1647.

222. **Biatora heerii** Hepp.

On *Peltigera canina* (L.) Hoffm., rare. Tower, August 29, 1901, no. 1884.

Not previously reported from Minnesota.

223. **Biatora oxyspora** (Tul.) Tuck.

On *Parmelia borreri* Turn. on cedars in swamps, common. Warroad, June 29, 1901, no. 271, and July 1, 1901, no. 301. Oak island, July 8, 1901, nos. 397 and 417. Mainland, July 16, 1901, no. 630. Emo, July 17, 1901, no. 670. Koochiching, July 31, 1901, no. 1026. Rainy Lake City, August 7, 1901, no. 1258. Kettle falls, August 14, 1901, no. 1466. Tower, August 26, 1901, no. 1767.

224. **Biatora mixta** Fr.

On *Populus*, infrequent. Beaudette, June 21, 1901, no. 100, Warroad, June 25, 1901, no. 157.

Not previously reported from Minnesota.

225. **Biatora atropurpurea** (Mass.) Hepp.

On *Populus* and dead wood, common on the former. Warroad, June 25, 1901, no. 168 and July 2, 1901, no. 333. Oak island, July 8, 1901, no. 428. Emo, July 18, 1901, no. 689 and July 23, 1901, no. 833. Koochiching, July 26, 1901, no. 897. Rainy Lake City, August 7, 1901, no. 1263.

Hypothecium frequently brown.

226. **Biatora sphæroides** (Dicks.) Tuck.

On bases of trees, rare. Beaudette, June 19, 1901, no. 57 and June 24, 1901, no. 135. Koochiching, July 29, 1901, no. 983. Rainy Lake City, August 5, 1901, no. 1194.

227. **Biatora hypnophila** (Turn.) Tuck.

Frequent on mossy tree bases and rarely on earth. Beaudette, June 24, 1901, no. 146. Warroad, June 26, 1901, no. 181 and June 27, 1901, nos. 205 and 211. Koochiching, July 29, 1901, no. 985. Rainy Lake City, August 7, 1901, no. 1257.

228. **Biatora rubella** (EHRH.) RABENH.

On trees, common. Beaudette, June 20, 1901, nos. 78 and 80. Warroad, June 26, 1901, no. 197, June 27, 1901, no. 221, June 28, 1901, no. 238 and July 2, 1901, nos. 324 and 326. Oak island, July 9, 1901, no. 457 and July 10, 1901, no. 494. Flag island, July 12, 1901, no. 545. Koochiching, July 26, 1901, no. 892 and June 29, 1901, no. 981. Rainy Lake City, August 3, 1901, no. 1151. Kettle falls, August 13, 1901, no. 1430 and August 14, 1901, no. 1475. Harding, August 16, 1901, nos. 1498 and 1516.

229. **Biatora atrosanguinea** SCHAER.

On trees, frequent. Warroad, July 2, 1901, no. 326.

Not previously reported from Minnesota and new to North America.

230. **Biatora fuscorubella** (HOFFM.) TUCK.

On trees, common on cedars in swamps. Beaudette, June 20, 1901, no. 72 and June 22, 1901, no. 116. Warroad, June 29, 1901, nos. 264 and 284, and July 1, 1901, nos. 301 and 303. Oak island, July 8, 1901, no. 400. Emo, July 18, 1901, nos. 707 and 708, July 18, 1901, no. 712 and July 23, 1901, no. 842. Koochiching, July 30, 1901, no. 1017. Tower, August 26, 1901, no. 1770.

231. **Biatora schweinitzii** FR.

On cedars in swamps, infrequent. Oak island, July 9, 1901, no. 463. Harding, August 19, 1901, no. 1574.

Thallus, apothecia and spores unusually well developed in the first collection.

232. **Biatora atrogrisea** (DELIS.) HEPP.

On trees, rare. Warroad, June 28, 1901, no. 224 and July 2, 1901, no. 331.

233. **Biatora inundata** FR.

On rocks by water, rare. Tower, August 28, 1901, no. 1861.

234. **Biatora akompsa** TUCK.

On cedars in swamps, rare. Warroad, June 29, 1901, no. 261. Emo, July 18, 1901, no. 722.

235. **Biatora umbrina** (ACH.) TUCK. ?

On cedars in swamps, rare. Warroad, July 2, 1901, no. 334.

Spores larger than usual.

236. **Biatora chlorantha** Tuck.

On balsams in swamps, rare. Beaudette, June 21, 1901, no. 97a.

Not previously reported from Minnesota.

237. **Biatora moriformis** (Ach.) Tuck.

On trees, rare. Warroad, July 2, 1901, no. 321. Tower, August 29, 1901, no. 1877.

Not previously reported from Minnesota.

238. **Lecidea goniophila** Kbr.

On rocks, rare. Flag island, July 12, 1901, no. 547. Koochiching, July 29, 1901, no. 975. Tower, August 27, 1901, no. 1824.

Not previously reported from Minnesota, but perhaps should be included in *Lecidea enteroleuca* Fr.

239. **Lecidea platycarpa** Ach.

On rocks, rare. Blueberry Island, July 13, 1901, nos. 596 and 602. Emo, July 20, 1901, no. 789. Tower, August 23, 1901, no. 1681 and August 24, 1901, no. 1750.

240. **Lecidea lapicida** Fr.

On rocks, rare. Emo, July 20, 1901, no. 785. Rainy Lake City, August 5, 1901, no. 1211.

241. **Lecidea enteroleuca** Fr.

Common on trees and less frequent on rocks and old wood. Beaudette, June 21, 1901, no. 90. Warroad, June 26, 1901, no. 191, June 27, 1901, nos. 201 and 218, and June 28, 1901, no. 231. Oak Island, July 9, 1901, nos. 444, 462 and 481. Blueberry island, July 13, 1901, no. 601. Mainland, July 16, 1901, no. 629. Emo, July 22, 1901, nos. 798 and 818. Koochiching, July 25, 1901, nos. 884 and 890, July 26, 1901, no. 908 and July 27, 1901, nos. 950 and 954. Rainy Lake City, August 1, 1901, no. 1079, August 2, 1901, nos. 1107 and 1118 and August 8, 1901, no. 1290. Kettle falls, August 9, 1901, no. 1319. Harding, August 20, 1901, no. 1649. Tower, August 24, 1901, nos. 1753 and 1760.

242. **Lecidea enteroleuca** Fr. var. **theiloplaca** Tuck.

On wet rocks, rare. Harding, August 16, 1901, no. 1524.

Greenish cast of thallus and the wet habitat are unusual for the species.

243. **Lecidea enteroleuca** Fr. var. **flavida** Fr.

On trees, infrequent. Warroad, June 26, 1901, no. 188 and June 27, 1901, no. 212. Rainy Lake City, August 3, 1901, no. 1143. Tower, August 28, 1901, no. 1863.

244. **Lecidea elabens** Fr.

On old wood, rare. Warroad, June 26, 1901, no. 251 and July 5, 1901, no. 383. Kettle falls, August 9, 1901, no. 1329. Tower, August 23, 1901, no. 1697.

Not previously reported from Minnesota and new to the United States. Dr. T. Hedlund, who determined the plant, considers it the same as *Lecidea melancheima* Tuck.

245. **Lecidea cyrtidia** Tuck.

On rocks, rare. Rainy Lake City, August 8, 1901, no. 1308.

246. **Buellia parasema** (Ach.) Th. Fr.

On trees common, especially on balsams in swamps. Beaudette, June 19, 1901, no. 63 and June 20, 1901, nos. 68 and 73. Warroad, June 24, 1901, nos. 269 and 272 and July 1, 1901, no. 290. Oak island, July 8, 1901, nos. 386 and 391. Mainland, July 16, 1901, no. 632. Emo, July 17, 1901, no. 661 and July 18, 1901, no. 702. Koochiching, July 25, 1901, no. 878. Rainy Lake City, August 2, 1901, no. 1124 and August 3, 1901, no. 1175. Kettle falls, August 9, 1901, no. 1314, August 13, 1901, no. 1445 and August 15, 1901, no. 1480. Tower, August 23, 1901, no. 1677 and August 26, 1901, no. 1786.

247. **Buellia alboatra** (Hoffm.) Th. Fr. var. **saxicola** Fr.

On rocks, rare. Rainy Lake City, August 3, 1901, no. 1144 and August 8, 1901, no. 1291.

248. **Buellia myriocarpa** (DC.) Mudd.

Frequent on trees and old wood, and especially common on pines. Warroad, July 3, 1901, no. 335. Oak island, July 9, 1901, no. 449. Rainy Lake City, August 7, 1901, no. 1256. Harding, August 16, 1901, no. 1515 and August 20, 1901, no. 1638. Tower, August 28, 1901, no. 1857 and August 29, 1901, no. 1876.

249. **Buellia myriocarpa** (DC.) Mudd. var. **punctiformis** Hoffm.

On old wood, rare. Oak island, July 9, 1901, no. 446. Koochiching, July 27, 1901, no. 952.

Not previously reported from Minnesota and new to North America.

250. **Buellia turgescens** (NYL.) TUCK.

On old wood, rare. Oak island, July 9, 1901, nos. 442 and 445.

251. **Buellia schaereri** DE NOT.

On pines, rare. Rainy Lake City, August 6, 1901, no. 1242.

Not previously reported from Minnesota.

252. **Buellia badioatra** (FLK. SCHAER.) KBR.

On rocks, rare. Blueberry island, July 13, 1901, no. 566.

Not previously reported from Minnesota and new to the Mississippi valley.

253. **Buellia concreta** (KBR.) ECK.

On rocks, infrequent. Oak island, July 15, 1901, no. 622. Rainy Lake City, August 5, 1901, no. 1189.

Not previously reported from Minnesota and new to the United States.

254. **Buellia obscurata** (ACH.) ECK.

On rocks, frequent. Kettle falls, August 14, 1901, no. 1472.

Not previously reported from Minnesota and new to the United States.

255. **Buellia concentrica** (DAV.) FINK.

On rocks, rare. Rainy Lake City, August 2, 1901, no. 1106. Kettle falls, August 8, 1901, no. 1313.

Not previously reported from Minnesota and new to the United States.

256. **Buellia petræa** (FLOT.) TUCK.

On rocks, common. Warroad, July 4, 1901, no. 365. Flag island, July 12, 1901, no. 560. Blueberry island, July 13, 1901, no. 583. Emo, July 20, 1901, nos. 783 and 790 and July 22, 1901, nos. 794 and 804. Koochiching, July 26, 1901, no. 915. Rainy Lake City, August 3, 1901, no. 1161. Kettle falls, August 10, 1901, no. 1354. Harding, August 17, 1901, no. 1566 and August 20, 1901, no. 1642. Tower, August 24, 1901, no. 1751 and August 28, 1901, no. 1820.

257. **Buellia petræa** (FLT.) TUCK. var. **montagnæi** TUCK.

On rocks, common. Oak island, July 10, 1901, no. 493. Rainy Lake City, August 1, 1901, no. 792 and August 6, 1901,

no. 1229. Kettle falls, August 9, 1901, no. 1320. Harding, August 17, 1901, no. 1567. Tower, August 23, 1901, no. 1712.

258. **Buellia geographica** (L.) TH. FR.

On rocks, rare. Blueberry island, July 13, 1901, no. 57.

259. **Buellia saxatilis** (SCHAER.) KBR.

On *Bæomyces byssoides* (L.) Schaer., rare. Rainy Lake City, August 8, 1901, nos. 1285 and 1291.

Not previously reported from Minnesota, and new to the Mississippi valley.

260. **Buellia inquilina** TUCK.

On *Lecanora cinerea* (L.) Sommerf., rare. Warroad, July 4, 1901, no. 369.

Not previously reported from Minnesota and new to the Mississippi valley.

261. **Buellia parasitica** (FLK.) TH. FR.

On *Pertusaria communis* DC. on cedars in swamps, rare. Oak island, July 8, 1901, no. 398 and July 9, 1901, no. 460. Harding, August 20, 1901, no. 1627. Tower, August 26, 1901, no. 1792.

Not previously reported from Minnesota and new to the Mississippi valley.

262. **Buellia parmeliarum** (SOMMERF.) TUCK.

On *Parmelias* on cedars in swamps, common on *P. borreri* Turn. Beaudette, June 22, 1901, nos. 118 and 121. Warroad, July 1, 1901, no. 311. Oak island, July 8, 1901, nos. 397 and 403. Kettle falls, August 13, 1901, no. 1446. Harding, August 16, 1901, nos. 1501 and 1509. Tower, August 28, 1901, no. 1854.

263. **Buellia glaucomaria** (NYL.) TUCK.

On *Pertusaria* sp. on birch, locally common. Warroad, July 5, 1901, no. 378.

Not previously reported from Minnesota and new to the Mississippi valley.

264. **Lecanactis chloroconia** TUCK.

On cedars, rare. Emo, July 19, 1901, no. 759.

Not previously reported from Minnesota and new to the Mississippi valley.

265. **Melaspilea arthonioides** (Fée) Nyl.

On trees, infrequent. Warroad, June 26, 1901, nos. 176 and 178. Flag island, July 12, 1901, no. 558. Rainy Lake City, August 3, 1901, no. 1141. Kettle falls, August 13, 1901, no. 1833.

266. **Opegrapha varia** (Pers.) Fr.

On trees, especially common on cedars in swamps. Beaudette, June 18, 1901, no. 34. Warroad, July 2, 1901, no. 330. Oak island, July 10, 1901, no. 498. Emo, July 17, 1901, no. 674. Koochiching, July 26, 1901, no. 913, July 27, 1901, no. 966 and July 29, 1901, no. 986. Rainy Lake City, August 3, 1901, no. 1146. Kettle falls, August 13, 1901, nos. 1440 and 1447. Tower, August 26, 1901, no. 1775.

267. **Opegrapha quaternella** Nyl.

On *Peltigera aphthosa* (L.) Hoffm., rare. Emo, July 23, 1901, no. 838.

Not previously reported from Minnesota.

268. **Graphis scripta** (L.) Ach.

On trees, common. Beaudette, June 18, 1901, no. 15. Warroad, July 2, 1901, no. 318. Oak island, July 8, 1901, nos. 420 and 431. Emo, July 17, 1901, nos. 640 and 641. Koochiching, July 26, 1901, no. 926. Rainy Lake City, August 3, 1901, no. 1163. Kettle falls, August 13, 1901, nos. 1424 and 1435. Harding, August 19, 1901, no. 1570 and August 20, 1901, no. 1632. Tower, August 26, 1901, no. 1803.

269. **Graphis scripta** (L.) Ach. var. **recta** (Humb.) Nyl.

On trees, usually birch, rare. Oak island, July 8, 1901, no. 429. Emo, July 23, 1901, no. 824. Kettle falls, August 13, 1901, no. 1442. Emo, July 19, 1901, no. 737. Tower, August 29, 1901, no. 1873.

270. **Arthonia patellulata** Nyl.

On *Populus*. Part of material recorded as *Biatora atropurpurea* (Mass.) Hepp. belongs here. Needs more study.

271. **Arthonia lecideella** Nyl.

On trees, frequent. Beaudette, June 18, 1901, no. 3. Warroad, June 25, 1901, nos. 151 and 158, June 28, 1901, no. 235 and July 2, 1901, no. 320. Emo, July 17, 1901, no. 659. Koochiching, July 25, 1901, nos. 858 and 883. Rainy Lake City, August 5, 1901, no. 1185. Harding, August 19, 1901, no. 1593. Tower, August 23, 1901, no. 1670.

272. **Arthonia dispersa** (SCHRAD.) NYL.

On trees, common especially on *Acer spicatum* Lam. Beaudette, June 24, 1901, no. 137. Warroad, June 26, 1901, no. 194. Koochiching, July 25, 1901, no. 872. Rainy Lake City, August 3, 1901, no. 1142 and August 5, 1901, no. 1181. Harding, August 17, 1901, no. 1554. Tower, August 26, 1901, no. 1782.

273. **Arthonia convexella** NYL.

On balsams, rare. Beaudette, June 21, 1901, no. 97.

Not previously reported from Minnesota and new to North America.

274. **Arthonia punctiformis** ACH.

On trees, locally frequent. Emo, July 19, 1901, no. 758.

275. **Arthonia radiata** (PERS.) TH. FR.

On trees, rare. Beaudette, June 20, 1901, no. 85 and June 24, 1901, no. 137a. Warroad, June 26, 1901, no. 242. Oak island, July 10, 1901, no. 496. Emo, July 17, 1901, nos. 663 and 668 and July 18, 1901, no. 708. Koochiching, July 30, 1901, no. 1016.

276. **Arthonia radiata** (PERS.) TH. FR. var. **swartziana** (ACH.) WILLEY.

On balsams in swamps, frequent. Rainy Lake City, August 3, 1901, no. 1173. Tower, August 28, 1901, no. 1864.

Not previously reported from Minnesota.

277. **Acolium tigillare** (ACH.) DE NOT.

On old wood, rare. Oak island, July 8, 1901, nos. 389 and 394.

278. **Calicium trichiale** ACH.

On cedars in swamps, rare. Oak island, July 9, 1901, no. 453. Rainy Lake City, August 7, 1901, no. 1266.

279. **Calicium trichiale** ACH. var. **cinereum** NYL.

On trees, frequent on pines. Beaudette, June 19, 1901, no. 55. Mainland, July 16, 1901, no. 626. Emo, July 19, 1901, no. 725. Koochiching, July 30, 1901, no. 1004. Kettle falls, August 13, 1901, no. 1436.

280. **Calicium phæocephalum** (TURN.) TURN. and BORR.

On cedars in swamps, frequent. Beaudette, June 20, 1901, no. 83. Emo, July 19, 1901, no. 745.

Not previously reported from Minnesota and new to the Mississippi valley.

281. **Calicium phæocephalum** (TURN.) TURN. and BORR. var. **trabinellum** FR.

On cedars and old wood in swamps, frequent. Beaudette, June 20, 1901, no. 27. Emo, July 19, 1901, nos. 729 and 755. Koochiching, July 29, 1901, no. 974.

Not previously reported from Minnesota and new to North America.

282. **Calicium chrysocephalum** (TURN.) ACH.

On pines, cedars and old wood, infrequent. Emo, July 17, 1901, no. 653 and July 23, 1901, no. 841. Kettle falls, August 14, 1901, no. 1477 and August 15, 1901, no. 1490.

283. **Calicium parietinum** ACH.

On old wood, frequent. Beaudette, June 20, 1901, no. 79 and June 22, 1901, no. 116. Warroad, June 27, 1901, nos. 210, 222 and 223, June 28, 1901, nos. 227 and 230 and July 1, 1901, no. 295. Harding, August 16, 1901, no. 1497, August 19, 1901, no. 1599 and August 20, 1901, no. 1643. Tower, August 28, 1901, no. 1856.

284. **Calicium polyporæum** NYL.

On *Polyporus* on *Populus*, frequent. Emo, July 24, 1901, nos. 854 and 857. Koochiching, July 26, 1901, no. 921. Kettle falls, August 9, 1901, no. 1348. Harding, August 19, 1901, no. 1588. Tower, August 29, 1901, no. 1883.

285. **Calicium lucidum** (TH. FR.) FINK.

On pines, cedars and old wood, infrequent. Warroad, June 28, 1901, no. 243. Rainy Lake City, August 5, 1901, nos. 1200 and 1254. Harding, August 20, 1901, no. 1626. Tower, August 29, 1901, no. 1886.

286. **Calicium trachelinum** ACH.

On dead cedars, wood in swamps, common. Warroad, July 2, 1901, no. 329. Oak island, July 8, 1901, no. 401. Koochiching, July 26, 1901, no. 920. Rainy Lake City, August 5, 1901, nos. 1197 and 1202.

287. **Calicium trabellinum** (SCHAER.) KBR.

On pine stumps, locally frequent. Kettle falls, August 9, 1901, no. 1328. Harding, August 17, 1901, no. 1559.

Not previously reported from Minnesota.

288. **Calicium quercinum** Pers.

On old wood, infrequent. Warroad, June 28, 1901, no. 252, and June 29, 1901, no. 259. Tower, August 24, 1901, no. 1742.

289. **Calicium quercinum** Pers. var. **lentibulare** (Ach.) Nyl.

On pines, cedars and old wood, infrequent. Beaudette, June 21, 1901, no. 94. Warroad, June 28, 1901, no. 255. Oak island, July 8, 1901, no. 390, and July 9, 1901, no. 443. Koochiching, July 27, 1901, no. 957. Rainy Lake City, August 5, 1901, no. 1209. Kettle falls, August 13, 1901, no. 1444.

Not previously reported from Minnesota and new to the Mississippi valley.

290. **Calicium pusillum** Flk.

On dead cedars, in swamps, locally common. Rainy Lake City, August 5, 1901, no. 1205. Tower, August 26, 1901, no. 1785.

291. **Calicium turbinatum** Pers.

On *Pertusaria communis* DC. on cedars in swamps, frequent. Beaudette, June 20, 1901, no. 77. Warroad, July 1, 1901, no. 303. Oak island, July 9, 1901, no. 432. Emo, July 17, 1901, no. 660. Koochiching, July 31, 1901, no. 1033. Kettle falls, August 13, 1901, no. 1428. Harding, August 21, 1901, no. 1656. Tower, August 26, 1901, no. 1809.

292. **Coniocybe pallida** (Pers.) Fr.

On trees, frequent. Beaudette, June 21, 1901, no. 96. Warroad, June 28, 1901, no. 225 and June 29, 1901, no. 266. Emo, July 18, 1901, nos. 704 and 705 and July 19, 1901, no. 753. Koochiching, July 29, 1901, no. 987. Rainy Lake City, August 3, 1901, no. 1152. Kettle falls, August 13, 1901, no. 1443. Harding, August 9, 1901, no. 1598.

293. **Endocarpon miniatum** (L.) Schaer.

On rocks, locally common. Emo, July 22, 1901, no. 800.

294. **Endocarpon miniatum** (L.) Schaer. var. **complicatum** Schaer.

On rocks frequently wet, common. Oak island, July 10, 1901, no. 507 and July 11, 1901, no. 525. Emo, July 22, 1901, no. 799. Koochiching, July 26, 1901, no. 905. Rainy Lake City, August 8, 1901, no. 1278. Kettle falls, August 9,

1901, no. 1339 and August 13, 1901, no. 1411. Harding, August 20, 1901, no. 1625. Tower, August 26, 1901, no. 1780.

295. **Endocarpon fluviatile** DC.

On wet rocks, locally common. Koochiching, July 26, 1901, no. 902. Rainy Lake City, August 6, 1901, no. 1237. Harding, August 21, 1901, no. 1663.

296. **Endocarpon arboreum** SCHWEIN.

On trees, rare. Rainy Lake City, August 8, 1901, no. 1155.

297. **Endocarpon pusillum** HEDW. var. **garovaglii** KPH.

On earth, rare. Tower, August 27, 1901, no. 1838.

298. **Thelocarpon prasinellum** NYL.

On rocks, rare. Kettle falls, August 10, 1901, no. 1355.

299. **Staurothele umbrina** (WAHL.) TUCK. var. **clopima** (WHLNB.) NYL.

On rocks by water, common. Koochiching, July 26, 1901, no. 910 and July 30, 1901, no. 1015. Rainy Lake City, August 1, 1901, no. 1080. Kettle falls, August 15, 1901, no. 1491. Harding, August 25, 1901, no. 1646. Tower, August 28, 1901, no. 1845.

300. **Sagedia oxyspora** (NYL.) TUCK.

Common on birch. Warroad, June 25, 1901, no. 193 and June 21, 1901, no. 204. Emo, July 17, 1901, no. 665 and July 19, 1901, no. 724. Rainy Lake City, August 2, 1901, no. 1113. Kettle falls, August 15, 1901, no. 1492. Harding, August 16, 1901, no. 1522. Tower, August 26, 1901, no. 1789.

301. **Verrucaria epigæa** (PERS.) ACH.

On earth, rare. Rainy Lake City, August 5, 1901, no. 1201. Harding, August 16, 1901, no. 1523.

302. **Verrucaria nigrescens** PERS.

On rocks, frequent. Oak island, July 9, 1901, no. 436. Koochiching, July 27, 1901, no. 953. Harding, Angust 16, 1901, no. 1530.

303. **Verrucaria viridula** ACH.

On rocks by water, frequent. Koochiching, July 27, 1901, no. 955. Harding, August 21, 1901, no. 1657. Tower, August 28, 1901, no. 1847.

304. **Verrucaria viridula** Ach. var. **subfuscella** (Nyl.) Fink.

On perpendicular rocks, rare. Rainy Lake City, August 7, 1901, no. 1248.

Not previously reported from Minnesota and new to the Mississippi valley.

305. **Verrucaria fuscella** Fr.

On rocks by water, rare. Koochiching, July 27, 1901, no. 960.

306. **Pyrenula punctiformis** (Ach.) Naeg. var. **fallax** Nyl.

On birch, common. Beaudette, June 20, 1901, no. 81 and June 21, 1901, no. 89. Emo, July 18, 1901, no. 690. Koochiching, July 25, 1901, no. 898. Rainy Lake City, August 5, 1901, no. 1178.

307. **Pyrenula thelena** (Ach.) Tuck.

On birch, locally common. Beaudette, June 21, 1901, no. 103.

308. **Pyrenula cinerella** (Flt.) Tuck. var. **quadriloculata** Fink.

On birch, locally common. Flag island, July 12, 1901, no. 550.

309. **Pyrenula leucoplaca** (Wallr.) Kbr.

On trees, abundant on *Populus*. Beaudette, June 24, 1901, no. 138 and June 21, 1901, no. 105. Warroad, June 24, 1901, no. 149. Flag island, July 12, 1901, no. 549. Emo, July 18, 1901, no. 682. Koochiching, July 21, 1901, no. 877 and July 26, 1901, no. 914. Rainy Lake City, August 6, 1901, no. 1236. Harding, August 16, 1901, no. 1520 and August 19, 1901, nos. 1582 and 1591. Tower, August 26, 1901, nos. 1796 and 1813.

310. **Pyrenula leucoplaca** (Wallr.) Kbr. var. **pluriloculata** Fink.

On trees, common. Beaudette, June 21, 1901, no. 110. Warroad, June 27, 1901, nos. 200 and 209 and June 28, 1901, no. 229. Flag island, July 12, 1901, nos. 534 and 537. Koochiching, July 25, 1901, nos. 862 and 980. Rainy Lake City, August 3, 1901, no. 1487. Kettle falls, August 13, 1901, no. 1419 and August 15, 1901, no. 1489. Harding, August 17, 1901, no. 1545 and August 19, 1901, no. 1609.

XIX. THE UMBELLALES OF MINNESOTA.

W. A. Wheeler.

This catalog of the Minnesota Umbellales is a result of the examination and redetermination of all the Minnesota specimens in the University Herbarium. The largest family in the order, the Umbelliferæ, was in so confused a state before the publication of the monograph on the order by Coulter and Rose[1] that it has been thought desirable to publish a revised list of the Minnesota Umbelliferæ based upon this monograph, and to include in the list the two other families in the order.

Upham, in his catalog of Minnesota plants, lists five species of Araliaceæ, thirty-two species and varieties of Umbelliferæ, and eight species of Cornaceæ.

The number of Araliaceæ reported from Minnesota in this list, as represented by specimens in the University Herbarium, remains unchanged.

Of the Umbelliferæ there are in the University Herbarium authentic Minnesota specimens of twenty-four species and varieties, of which twenty-two are native and two are introduced. One additional native species is represented by specimen in the National Herbarium. Seven species and varieties reported by Upham are not represented by Minnesota specimens, to the author's knowledge, in any herbarium. The latter are therefore of doubtful occurrence. They are, however, listed here, with an explanatory note to each, giving the authority upon which the report is based.

Of the eight species of Cornaceæ reported by Upham, six are represented by specimens in the University Herbarium. One has been added that was not included by Upham. There are, therefore, seven species known to Minnesota.

In this list individual collections are cited only where the species is poorly represented by specimens from the state. The citations of specimens from the National Herbarium have been taken directly from Coulter and Rose.

[1] Contributions U. S. National Herbarium, Vol. VII., No. 1, December 31, 1900.

ARALIACEÆ.

Aralia racemosa L. Sp. Pl. 273. 1753. American spikenard.
Common in woods throughout.
Herb.: Collections from all parts of the state.

Aralia nudicaulis L. Sp. Pl. 274. 1753. Wild sarsaparilla.
Common in woods throughout.
Herb.: Collections from all parts of the state.

Aralia hispida Vent. Hort. Cels. *pl. 41.* 1800. Bristly sarsaparilla.
Common in the northeastern part of Minnesota.
Herb.: Bailey 341, St. Louis river; Arthur 47, Vermilion lake; J. Scofield, Carlton; T. S. Roberts, Duluth; Sandberg, Tower, Thomson and Two Harbors.

Panax quinquifolium L. Sp. Pl. 1058. 1753. Ginseng.
Aralia quinquefolia DEC. & PL. Rev. Hort. 104. 1854.
At one time common nearly throughout Minnesota. The roots have been dug in so large quantities to supply the demand for export that the plant is at present quite rare.
Herb.: Lyon 210, Mayville, Houston county; Wheeler 469, Jefferson, Houston county; Ballard, 334, Belle Plain; Sheldon, 403, Taylor 711, Madison lake; Aiton, Sandberg, Hennepin county; Holzinger, Winona; Sandberg, Vasa.

Panax trifolium L. Sp. Pl. 1059. 1753. Dwarf ginseng.
Aralia trifolia DEC. & PL. Rev. Hort. 104. 1854.
Rare in woods east.
Herb.: Sandberg, Carlton county.

UMBELLIFERÆ.

Hydrocotyle umbellata L. Sp. Pl. 1: 234. 1753. Marsh pennywort.
Reported from the north shore of lake Superior by Upham. The specimen in the University Herbarium so labeled is *Mitella nuda* L. This species of *Hydrocotyle* probably does not occur in Minnesota.

Hydrocotyle americana L. Sp. Pl. 1: 234. 1753. Marsh pennywort.
Rare in moist soil east. Plentiful on the Wisconsin side of the St. Croix river near St. Croix Falls.

Herb.: Sandberg, Chisago county; Wheeler 314, Houston county.

Sanicula marylandica L. Sp. Pl. 1: 235. 1753. Black snakeroot.

In woods throughout, common.

Herb.: Numerous collections from all parts of state.

Sanicula gregaria BICKNELL, Bull. Torr. Club, 22: 354. 1895. Yellow-flowered snakeroot.

In woods south.

Herb.: Burglehaus, Hennepin county; Ballard 390, Scott county; Sheldon, Milaca; Sheldon 141, Madison lake; Rosendahl 562, Wheeler 177, Houston county; Holzinger, Winona.

Nat. Herb.: Mearns, Fort Snelling.

Sanicula canadensis L. Sp. Pl. 1: 235. 1753. Short-styled snakeroot.

In woods south.

Herb.: Lyon 260, Houston county; Sheldon 983, Brown county.

Sanicula trifoliata BICKNELL, Bull. Torr. Club, 22: 359. 1895. Large-fruited snakeroot.

Rare in woods southeast.

Herb.: Lyon 214, Houston county; Rosendahl 588, Fillmore county.

Eryngium yuccifolium MICHX. Fl. Bor. Am. 1: 164. 1803. Button snakeroot.

Eryngium aquaticum L. Sp. Pl. ed. 2, 336, 1762 in part, not ed. 1.

Frequent south.

Herb.: Sandberg, Cannon falls; Sheldon, Sleepy Eye, Waseca county; Ballard, Nicollet county; Holzinger, Winona; Taylor, Janesville; Aiton, Hennepin county.

Washingtonia claytoni (MICHX.) BRITTON, Ill. Fl. 2: 530. 1897. Sweet cicely.

Osmorrhiza brevistylis DC. Prodr. 4: 232. 1830.

Myrrhis claytoni MICHX. Fl. Bor. Am. 1: 170. 1803.

Common in woods throughout.

Herb.: Numerous specimens.

Washingtonia longistylis (TORR.) BRITTON, Ill. Fl. 2: 530. 1897. Sweet cicely.

Osmorrhiza longistylis DC. Prodr. 4: 232. 1830.

Myrrhis aristata (THUNB.) MACM. Met. Minn. Val. 398. 1892.

Common in woods throughout.

Herb.: Numerous specimens.

Conium maculatum L. Sp. Pl. 243. 1753. Poison hemlock.

A European species reported from the Red river valley by Upham. There are no Minnesota specimens in the University Herbarium.

Zizia aurea (L.) KOCH, Nov. Act. Caes. Leop. Acad. 12: 129. 1824. Early meadow-parsnip.

Thaspium aureum apterum GRAY, Man. ed. 2, 156. 1856.

Very common throughout except northeast. Confused by many authors and collectors with *Thaspium trifoliatum aureum* (Nutt.) Britton and *Thaspium barbinode* (Michx.) Nutt.

Herb.: Very numerous collections.

Zizia cordata (WALT.) KOCH in DC. Prodr. 4: 111. 1830. Heart-leaved meadow-parsnip.

Thaspium trifoliatum apterum GRAY, Man. ed. 2, 156. 1856.

Thaspium aureum cordatum (WALT.) B.S.P. Cat. N. Y. 1888.

Common throughout except northeast.

Herb.: Numerous collections.

Cicuta maculata L. Sp. Pl. 1: 256. 1753. Water hemlock.

Cicuta virosa maculata C. & R. Rev. N. A. Umbell. 131. 1888.

Common throughout, especially south.

Herb.: Numerous specimens.

Cicuta bulbifera L. Sp. Pl. 1: 255. 1753. Bulb-bearing water-hemlock.

Common in moist soil throughout.

Herb.: Many collections.

Deringa canadensis (L.) KUNTZE, Rev. Gen. Pl. 1: 266. 1891. Honewort.

Cryptotænia canadensis DC. Prodr. 4: 119. 1830.

Common in woods throughout.

Herb.: Numerous collections.

Carum carui L. Sp. Pl. 1: 263. 1753. Garden caraway.

Escaped from cultivation in some parts of state.

Herb.: Moyer, Montevideo; Wickersheim, Lincoln county; Sheldon, 2610, Mille Lacs Reserv.; Frost 124, Meeker county.

Tænidia integerrima (L.) DRUDE, Engl. & Prantl. Nat. Pfl. 3^8: 195. 1898. Yellow pimpernel.

Pimpinella integerrima GRAY, Proc. Am. Acad. 7: 345. 1868.

Zizia integerrima DC. Mem. Soc. Phys. Genev. 4: 493. 1828.

Frequent southeast.

Herb.: Wheeler, Houston county; Sandberg, Belle creek.

Nat. Herb.: Holzinger, Winona.

Sium cicutæfolium GMELIN, Syst. 2: 482. 1791. Water-parsnip.

Sium lineare MICHX. Fl. Bor. Am. 1: 167. 1803.

Common in swamps throughout.

Herb.: Numerous collections.

Sium carsoni DURAND; A. Gray, Man. ed. 5, 196. 1867. Carson's water-parsnip.

Probably rare east.

Nat. Herb.: Sandberg, near Minneapolis.

Berula erecta (HUDS.) COVILLE, Contr. Nat. Herb. 4: 115. 1893. Small water-parsnip.

Berula angustifolia M. & K. Deutsch. Fl. 2: 433. 1826.

Sium angustifolium L. Sp. Pl. ed. 2, 2: 1672. 1763.

Springs and streams south.

Herb.: Collections from the southern half of the state.

Æthusa cynapium L. Sp. Pl. 256. 1753. Fool's parsley.

A European species reported by Upham as occurring in Wabasha and Nicollet counties. There are no Minnesota collections in the University Herbarium.

Thaspium trifoliatum aureum (NUTT.) BRITTON, Mem. Torr. Club, 5: 240. 1894. Meadow-parsnip.

Thaspium aureum NUTT. Gen. 1: 196. 1818.

Thaspium aureum trifoliatum C. & R. Bot. Gaz. 12: 136. 1887.

This species and variety have been included in many reports of Minnesota plants. There are, however, no authentic Min-

nesota specimens in the University Herbarium. They have previously been confused with the two Minnesota species of *Zizia*.

Thaspium barbinode (MICHX.) NUTT. Gen. Pl. 1: 196. 1818. Hairy-jointed meadow-parsnip.

Infrequent south.

Herb.: Ballard 971, Nicollet county; Sheldon 791, 989, Sleepy Eye, 1180, New Ulm; Holzinger, Winona.

Conioselinum chinense (L.) B.S.P. Prel. Cat. N. Y. 22. 1888. Hemlock parsley.

Selinum canadense MICHX. Fl. Bor. Am. 1: 165. 1803.

Reported by Upham as occurring along the upper Mississippi river. There are no authentic collections known from Minnesota. Its range apparently does not extend so far west as this state.

Angelica villosa (WALT.) B.S.P. Prel. Cat. N. Y. 22. 1888. Pubescent angelica.

Archangelica hirsuta T. & G. Fl. 1: 622. 1840.

Reported by Upham as collected in Wabasha and Anoka counties. These collections were probably incorrectly determined as Minnesota is rather too far north to be included in the natural range of this species.

Angelica atropurpurea L. Sp. Pl. 1: 251. 1753. Great angelica.

Archangelica atropurpurea HOFF. Umbel. 162. 1814.

In moist soil, east.

Herb.: Several collections from eastern Minnesota.

Cymopterus acaulis (PURSH) RYDB. Bot. Surv. Neb. 3: 38. 1894. Plains cymopterus.

Cymopterus glomeratus DC. Prodr. 4: 204. 1830.

Reported by Upham as collected by Lapham in the Red river valley. Its occurrence, however, is rather doubtful.

Polytænia nuttalli DC. Coll. Mem. 5: 54. 1829.

In dry soil, southeast.

Herb.: Hvoslef, Lanesboro; Sandberg, Vasa.

Oxypolis rigidior (L.) RAF. in Seringe, Bull. Bot. 218. 1830. Cowbane.

Archemora rigida DC. Prodr. 4: 188. 1830.

Tiedemannia rigida C. & R. Bot. Gaz. 12: 74. 1887.

In swamps southeast.

Herb.: Lyon, Houston county; Oestlund, Hennepin county; Sandberg, Goodhue county; Hvoslef, Lanesboro.

Nat. Herb.: Mearns 280, Fort Snelling.

Lomatium orientale C. &. R. Cont. U. S. Nat. Herb. 7: 220. 1900. Hog's fennel.

Peucedanum nudicaule NUTT. in part and of all late authors.

In dry soil southwest.

Herb.: Moyer, Montevideo; Menzel, Pipestone; Wickersheim, Lincoln county; Nels Nelson, Montevideo; Payne, Appleton.

Pastinaca sativa L. Sp. Pl. 1: 262. 1753. Common parsnip.

Escaped from cultivation throughout.

Herb.: Specimens from scattered localities.

Heracleum lanatum MICHX. Fl. Bor. Am. 1: 166. 1803. Cow-parsnip.

Common in moist soil throughout.

Herb.: Numerous collections from all parts.

Daucus carota L. Sp. Pl. 1: 242. 1753. Common carrot.

Occasionally escaped from cultivation throughout.

CORNACEÆ.

Cornus canadensis L. Sp. Pl. 117. 1753. Dwarf cornel.

Common in woods north and occasional southeast.

Herb.: Numerous collections from the northern part of the state and a few collections along the Mississippi river south.

Cornus florida L. Sp. Pl. 117. 1753. Flowering dogwood.

Reported from Minnesota by Upham but probably does not occur here.

Cornus circinata L'HER. Cornus, 7, *pl. 3*. 1788. Round-leaved dogwood.

Common throughout.

Herb.: Numerous collections.

Cornus amonum MILL. Gard. Dict. ed. 8, No. 5. 1768.

Cornus sericea L. MANT. 2: 199. 1771.

Infrequent south.

Herb.: Lyon 351, Jefferson, Houston county; Rosendahl 610, Spring Grove, Houston county; Sheldon, 390, Madison lake; Ballard, 353, Scott county.

Cornus asperifolia MICHX. Fl. Bor. Am. 1: 93. 1803. Rough-leaved dogwood.

Reported from southern Minnesota. There are no authentic specimens in the University Herbarium.

Cornus baileyi COULTER & EVANS, Bot. Gaz. 15: 37. 1890. Bailey's dogwood.

Frequent throughout.

Herb.: Collections from all parts of state.

Cornus stolonifera MICHX. Fl. Bor. Am. 1: 92. 1803. Red-twigged dogwood.

Common throughout.

Herb.: Numerous collections.

Cornus candidissima MARSH. Arb. Am. 35. 1785. Panicled dogwood.

Cornus paniculata L'HER. Cornus, 9, *pl. 15*. 1788.

Common throughout.

Herb.: Numerous collections.

Cornus alternifolia L. f. Suppl. 125. 1781. Alternate-leaved dogwood.

Frequent east.

Herb.: Collections from eastern half of state.

XX. THE PTERIDOPHYTES OF MINNESOTA.

HAROLD L. LYON.

In his "Catalogue of the Flora of Minnesota" (1884) Upham reports sixty-two Pteridophytes as occurring in the state; to this list Cheney* has added two species, and Arthur,† MacMillan,‡ Holzinger,§ Lloyd,‖ and Wheeler¶ one each, making a total of sixty-nine species and varieties.

The following catalog is mainly a record of the Pteridophytes in the herbarium of the University which have been collected in Minnesota. These specimens, as redetermined by the writer, represent sixty species and varieties, five of which have not previously been reported from the state.

PTERIDOPHYTA.

Order LYCOPODIALES.

Family LYCOPODIACEÆ.

Lycopodium selago L. Sp. Pl. 1102. 1753. Fir club-moss.

Reported from the north shore of Lake Superior by Upham, but there are no specimens in the herbarium.

Lycopodium porophilum LLOYD & UNDERW. Bull. Torr. Club, 27: 150. 1900.

On sandstone ledges. Not previously reported from Minnesota.

Herb.: Rosendahl, Minneapolis; Leiberg, Minneopa Falls.

Lycopodium lucidulum MICHX. Fl. Bor. Am. 2: 284. 1803. Shining club-moss.

Frequent in northern Minnesota, in deep, damp woods.

Herb.: Sandberg, Aitkin Co.; Taylor, Taylor's falls; Hall, Devils Track river; Bailey, St. Louis river; MacMillan, Brand & Lyon, North-South lake portage.

*Trans. Wis. Acad. Scien. 9: 247, 248. 1893.
†Geol. and Nat. Hist. Survey, Bull. No. 3, 24. 1887.
‡Bull. Torr. Bot. Club, 18: 13. 1891.
§Minn. Bot. Studies, 1: 518. 1896.
‖Bull. Torr. Bot. Club, 26: 566. 1899.
¶Minn. Bot. Studies, 2: 370. 1900.

Lycopodium inundatum L. Sp. Pl. 1102. 1753. Bog club-moss.

In swamps and bogs. Rare.

Herb.: Wheeler, Echo lake.

Lycopodium obscurum L. Sp. Pl. 1102. 1753. Ground pine.

Common throughout northern Minnesota.

Herb.: Many specimens.

Lycopodium annotinum L. Sp. Pl. 1103. 1753. Stiff club-moss.

Range about the same as the last, less frequent.

Herb.: Many specimens among which is to be found the var. *pungens*.

Lycopodium clavatum L. Sp. Pl. 1101. 1753. Club-moss.

Frequent in the northern part of state.

Herb.: Anderson, Gull lake; MacMillan & Sheldon, Lake Kilpatrick; Arthur, Vermilion lake; Roberts, French river; Sheldon, Milaca; Lugger, Tower.

Lycopodium sabinæfolium Willd. Sp. Pl. 5: 20. 1810. Cedar-like club-moss.

Reported by Upham, but there are no specimens in the Herbarium to verify the report.

Lycopodium complanatum L. Sp. Pl. 1104. 1753. Trailing club-moss.

Frequent throughout northern part of state.

Herb.: Well represented.

Lycopodium tristachyum Pursh, Fl. Am. Sept. 2: 653. 1814.

Lycopodium chamæcyparissus A. Br.; Doell. Rhein. Fl. 36. 1843.

Range probably coextensive with the last.

Herb.: Anderson, Gull lake.

Family **SELAGINELLACEÆ.**

Selaginella selaginoides (L.) Link, Fil. Hort. Berol. 158. 1841. Low selaginella.

Rare, north.

Herb.: Cheney, Grand Marais.

Selaginella rupestris (L.) Spring in Mart. Fl. Bras. 1: Part 2, 118. 1840. Rock selaginella.

Frequent in dry situations throughout.

Herb.: Many specimens.

Family ISOETACEÆ.

Isoetes lacustris L. Sp. Pl. 1100. 1753. Lake quillwort.

Probably occurs quite commonly in lakes of northern Minnesota. Not previously reported from the state.

Herb.: MacMillan, Brand and Lyon, Devil's Track lake and Hungry Jack lake, Cook county.

Isoetes tuckermani A. Br.; A. Gray, Man. Ed. 5, 676. 1867.

Known to occur in but one lake. Not previously reported from Minnesota.

Herb.: Wheeler, Echo lake.

Isoetes echinospora braunii (Durieu) Engelm.; A. Gray, Man. Ed. 5, 676. 1867.

With *Isoetes lacustris*, but more frequent.

Herb.: Arthur, Vermilion lake; MacMillan, Brand and Lyon. Many specimens from lakes of Cook county.

Isoetes echinospora boottii (A. Br.) Engelm. A. Gray, Man. Ed. 5, 676. 1867. With *Isoetes tuckermani.*

Not previously reported from the state.

Herb.: Wheeler, Echo lake.

The species of *Isoetes* were determined by A. A. Eaton.

Order EQUISETALES.

Family EQUISETACEÆ.

Equisetum arvense L. Sp. Pl. 1061. 1753. Field horsetail.

Common in sandy soil throughout the state.

Herb.: Well represented by specimens.

Equisetum pratense Ehrh. Hanov. Mag. 138. 1784. Thicket horsetail.

Rare, south.

Herb.: Lyon, Winnebago valley, Houston Co.

Equisetum sylvaticum L. Sp. Pl. 1061. 1753. Wood horsetail.

Throughout the state, preferring light soil in moist woods and thickets.

Equisetum fluviatile L. Sp. Pl. 1062. 1753. Swamp horsetail.

In swamps and along borders of lakes and streams throughout the state.

Herb.: Many specimens.

Equisetum robustum A. Br.; Engelm. Amer. Jour. Sci. **46**: 88. 1844. Stout scouring-rush.

Reported from Thompson by Holzinger.

Herb.: There are no specimens in the herbarium.

Equisetum hiemale L. Sp. Pl. 1062. 1753. Common scouring-rush.

Frequent throughout the state.

Herb.: Many specimens.

Equisetum lævigatum A. Br.; Engelm. Amer. Jour. Sci. **46**: 87. 1844.

Frequent in clay soil.

Herb.: Several collections.

Equisetum variegatum Schleich. Cat. Pl. Helvet. 27. 1817. Variegated scouring-rush.

Infrequent.

Herb.: Butters, Detroit lake.

Equisetum scirpoides Michx. Fl. Bor. Am. **2**: 281. 1803. Sedge-like scouring-rush.

Infrequent.

Herb.: Ballard, Lake Kilpatrick; Campbell, Grand Lake, Stearns Co.

Order FILICALES.

Family OPHIOGLOSSACEÆ.

Ophioglossum vulgatum L. Sp. Pl. 1062. 1753. Adder's-tongue.

Reported by Upham from Lake of the Woods, there are no Minnesota specimens in the herbarium; the plant, however, undoubtly occurs in the northern part of the state.

Botrychium lunaria (L.) Swz. Schrad. Journ. Bot. **2**: 110. 1800. Moonwort.

Infrequent, northern Minnesota. Cool, damp woods.

Herb.: Cheney, Brule river; Hibbard, Grand Marais; MacMillan and Sheldon, Lake of the Woods.

Botrychium simplex E. Hitchcock, Amer. Jour. Sci. **6**: 103. 1823. Little grape-fern.

Reported by Upham from Thompson, Carlton Co.

Herb.: No specimens from Minnesota.

Botrychium obliquum MUHL.; Willd. Sp. Pl. 5: 63. 1810.

Infrequent in damp woods and meadows throughout.

Herb.: Taylor, Chisago lake; Sandberg, Sandy lake; Campbell, Ottertail Co.; Wheeler, Lyon, Echo lake; Lyon, Ft. Snelling reservation; Rosendahl, Spring Grove; MacMillan, Brand and Lyon, Grand Marais; MacMillan and Sheldon, Lake of the Woods; Wheeler, Rosendahl, Butters and Lyon, Lake Itasca.

The specimens cited above present a most perplexing array of forms. A further field-study and comparison with authentic specimens must, however, be made before they can be assigned to other than this species.

During the spring of the present year, gametophytes of this plant have been collected in considerable numbers by the writer, near Echo lake. In shape they resemble those of *Botrychium virginianum* but are only about one third their size. The reproductive organs are produced on the upper side. The primary root of the embryo sporophyte grows down through the tissue of the gametophyte instead of coming out on the upper side as in *B. virginianum*.

The root often protrudes an inch from the prothallium before the first leaf bursts through the calyptra. The life-history of the plant will be worked out as far as possible from the material obtainable.

Botrychium virginianum (L.) Swz. Schrad. Journ. Bot. 2: 111. 1800. Rattlesnake-fern.

Throughout the state.

Herb.: Many specimens.

The gametophytes of *B. virginianum* have been collected in two localities in this state. Lyon, Grand Marais, 1901; Lyon, Echo lake, 1903.

Family OSMUNDACEÆ.

Osmunda regalis L. Sp. Pl. 1065. 1753. Royal fern. Flowering fern.

Frequent throughout the northern half of the state. Low open woods.

Herb.: Numerous collections.

Osmunda claytoniana L. Sp. Pl. 1066. 1753. Interrupted fern.

Throughout the state. In moist shaded soil.

Herb.: Many specimens.

Osmunda cinnamomea L. Sp. Pl. 1066. 1753. Cinnamon fern.

Range about the same as that of the royal fern but occurring less frequently.

Herb.: Sandberg, Hennepin county; Aiton, Minneapolis; Ballard, Stony Brook and Upper Gull lake; Sheldon, Garrison and Mille Lacs reservation.

Family **POLYPODIACEÆ.**

Polypodium vulgare L. Sp. Pl. 1085. 1753. Common polypody.

Frequent throughout the state on rocks and rocky hillsides.

Herb.: Many specimens.

Adiantum pedatum L. Sp. Pl. 1095. 1753. Maiden-hair fern.

Common throughout the state in woods and shaded ravines.

Herb.: Collections from all parts of the state.

Pteridium aquilinum (L.) KUHN; Decken's Reisen 3: 11. 1879. Brake. Bracken.

Pteris aquilina L. Sp. Pl. 1075. 1753.

Common throughout the state in open woods and brush-covered areas.

Herb.: Many specimens from scattered localities.

Cheilanthes Feei MOORE, Ind. Fil. 38. 1857. Slender lip-fern.

Cheilanthes gracilis (FÉE) METT. Abh. Senck. Nat. Gesell. 3: (reprint 36). 1859.

Rare. Dry cliffs.

Herb.: Lyon 299, Houston county.

Cryptogramma stelleri (GMEL.) PRANTL; Engler's Bot. Jahr. 3: 413. 1882. Slender cliff-brake.

Pellæa stelleri (GMEL.) WATT, Con. Fil. no. 2. 1869–70.

Infrequent or rare. Occurring usually on moist limestone ledges.

Herb.: Anderson, Featherstone; Leiberg, Minneopa Falls; Lyon, Houston county; Sandberg and Holzinger, Winona; Rosendahl, Spring Grove; Lyon, Hastings.

Pellæa atropurpurea (L.) LINK, Fil. Hort. Berol. 59. 1841. Purple-stemmed cliff-brake.

Locally common but localities infrequent. Seeming to prefer exposed limestone cliffs.

Herb.: Holzinger, Winona; Rosendahl, Lyon, Houston county; Sandberg, Cannon Falls; Leiberg, Blue Earth county; Sheldon, Taylors Falls; Lyon, Hastings.

Asplenium platyneuron (L.) OAKES; D. C. Eaton, Ferns N. A. 1: 24. 1879. Ebony spleenwort.

Reported from Taylor's Falls by Upham but there are no specimens in the herbarium to verify the report.

Asplenium trichomanes (L.) Sp. Pl. 1080. 1753. Maidenhair spleenwort.

Reported by Upham as occurring at Taylor's Falls and Lake Pepin. Rare.

Herb.: Nelson, Vasa, Goodhue county.

Asplenium angustifolium MICHX. Fl. Bor. Am. 2: 265. 1803. Narrow-leaved spleenwort.

Known to occur in but one locality.

Herb.: Lyon, Mayville, Houston county.

Asplenium acrostichoides SWZ. Schrad. Journ. Bot. 2: 54. 1800. Silvery spleenwort.

Asplenium thelypteroides MICHX. Fl. Bor. Am. 2: 265. 1803.

Infrequent in eastern portion of state.

Herb.: Sheldon, Mora; Lyon, Houston county.

Asplenium filix-fœmina (L.) BERNH. Schrad. Neues Journ. Bot. 1: Part 2, 26. 1806. Lady-fern.

Common in woodlands throughout the state.

Herb.: A large number of specimens.

Camptosorus rhizophyllus (L.) LINK, Hort. Berol. 2: 69. 1833. Walking-fern.

Infrequent. Occurring in widely separated localities on dry limestone rocks.

Herb.: Sandberg, Goodhue county; Rosendahl, Fillmore county; Lyon, Houston county; Lyon, Hastings.

Phegopteris phegopteris (L.) UNDERW.; Small, Bull. Torr. Club, 20: 462. 1893. Long beech-fern.

Phegopteris polypodioides FÉE, Gen. Fil. 243. 1850–52.

Common in northern Minnesota in moist woods and on shaded banks.

Herb.: Sheldon, Waldo; Roberts, north shore of Lake Superior; Bailey, Basswood lake, Agate bay and Vermilion lake.

Phegopteris hexagonoptera (MICHX.) FÉE, Gen. Fil. 243. 1850–52. Broad beech-fern.

Upham reports this fern as occurring plentifully at Duluth and throughout the southern half of the state, but rare.

Herb.: Not represented by specimens.

Phegopteris dryopteris (L.) FÉE, Gen. Fil. 243. 1850–52. Oak-fern.

Common in northern Minnesota in shaded places.

Herb.: Numerous collections.

Phegopteris robertiana (HOFFM.) A. BR. in Sched.; Milde Filic. Europ. et Atlant. 99. 1867.

Phegopteris calcarea FÉE, Gen. Fil. 243. 1850–52.

Reported from Minnesota by D. C. Eaton, Ferns of North America 2: 277. 1880. There are no specimens in the herbarium.

Dryopteris noveboracensis (L.) A. GRAY, Man. 630. 1848.

Found in eastern Minnesota according to Upham's report. There are no specimens in the herbarium.

Dryopteris thelypteris (L.) A. GRAY, Man. 630. 1848. Marsh shield-fern.

Common in marshes throughout the state.

Herb.: Many specimens.

Dryopteris fragrans (L.) SCHOTT, Gen. Fil. 1834. Fragrant shield-fern.

Frequent on rocks in northern Minnesota.

Herb.: Cheney, Partridge falls, Pigeon river; Bailey, Basswood lake; MacMillan and Sheldon, Lake of the Woods.

Dryopteris cristata (L.) A. GRAY, Man. 631. 1848. Crested shield-fern.

Frequent in tamarack and spruce swamps.

Herb.: Aiton, Rice county; Arthur, Vermilion lake; Bailey, Mud river; Ballard, Chaska; Butters, Detroit; Sheldon, St. Croix Falls; Taylor, Center City.

Dryopteris goldieana (HOOK.) A. GRAY, Man. 634. 1848. Goldie's fern.

In southern Minnesota in rich woods. Quite rare.

Herb.: Sheldon, Leiberg, Blue Earth county; Lyon, Houston county.

Dryopteris filix-mas (L.) SCHOTT. Gen. Fil. 1834. Male fern.

Occurring north of lake Superior according to Upham. This fern has probably been overlooked by collectors, being confused with other species.

Herb.: Sheldon, Minneapolis.

Dryopteris marginalis (L.) A. GRAY, Man. 632. 1848. Evergreen wood-fern.

Reported by Upham, but there are no specimens in the herbarium to verify the report.

Dryopteris spinulosa (RETZ) KUNTZE, Rev. Gen. Pl. 813. 1891. Spinulose wood-fern.

In woods throughout the state.

Herb.: A large collection.

Dryopteris spinulosa intermedia (MUHL.) UNDERW. Native Ferns, Ed. 4, 116. 1893.

With the species.

Herb.: Several specimens.

Dryopteris spinulosa dilatata (HOFFM.) UNDERW. Native Ferns, Ed. 4, 116. 1893.

Herb.: Holzinger, Grand Portage island.

Dryopteris boottii (TUCK.) UNDERW. Native Ferns, Ed. 4, 117. 1893.

Reported from this state by Upham.

Herb.: No specimens.

Polystichum lonchitis (L.) ROTH. Tentamen Fl. Germ. 3: 71. 1800. Holly fern.

Dryopteris lonchitis KUNTZE, Rev. Gen. Pl. 813. 1891.

Not previously reported from Minnesota. Rare.

Herb.: Nelson, Lake Superior.

Polystichum acrostichoides (MICHX.) SCHOTT. Gen. Fil. 2: no. 4. 1834. Christmas fern.

Dryopteris acrostichoides (MICHX.) KUNTZE, Rev. Gen. Pl. 812. 1891.

Reported from Minnesota by Upham.

Herb.: No specimens.

Filix bulbifera (L.) UNDERW. Native Ferns, Ed. 6, 119. 1900. Bulblet-fern.

Cystopteris bulbifera (L.) BERNH.; Schrad. Neues Journ. Bot. 1: Part 2, 26. 1806.

Damp shaded hillsides, preferring rocky slopes.

Herb.: Numerous collections.

Filix fragilis (L.) UNDERW. Native Ferns, Ed. 6, 119. 1900. Brittle fern.

Cystopteris fragilis (L.) BERNH.; Schrad. Neues Journ. Bot. 1: Part 2, 27. 1806.

Common throughout the state in moist shaded places.

Herb.: A large collection.

Onoclea sensibilis L. Sp. Pl. 1062. 1753. Sensitive fern.

Common in damp low woods and meadows throughout the state.

Herb.: Many specimens.

Matteuccia struthiopteris (L.) TODARO, Synops. Plantar. Acotyl. Vascul. in Sicilia sponte cresc. 30. 1866. Ostrich fern.

Onoclea struthiopteris (L.) HOFFM. Deutsch. Fl. 2: 11. 1795.

Throughout the state in moist woods and thickets.

Herb.: Well represented by specimens.

Woodsia ilvensis (L.) R. BR. Trans. Linn. Soc. 11: 173. 1812. Rusty woodsia.

Occurring quite commonly on rocks in northern Minnesota and infrequently in the central portion of the state.

Herb.: Taylor, St. Croix Falls, Taylors Falls; Sheldon, Taylors Falls, New Ulm; Bailey, Vermilion lake, Agate bay; Juni, Beaver bay; MacMillan and Sheldon, Lake of the Woods; Holzinger, Winona.

Woodsia glabella R. BR. App. Franklin's Journ. 754. 1823. Smooth woodsia.

Reported by Upham as occurring at Stillwater, but there are no specimens in the herbarium to verify the report.

Woodsia scopulina D. C. EATON, Can. Nat. 2: 90. 1865. Rocky Mountain woodsia.

Only known to occur in the southern portion of the state. In dry situations.

Herb.: Wheeler, Luverne; Rosendahl, Spring Grove.

Woodsia oregana D. C. EATON, Can. Nat. 2: 90. 1865. Oregon woodsia.

Found at Stillwater according to Upham. Rare.

Herb.: Lyon, Jefferson, Houston county.

Woodsia obtusa (SPRENG.) TORR. Cat. Pl. in Geol. Rep. N. Y. 195. 1840. Blunt-lobed woodsia.

On rocks, infrequent or rare.

Herb.: Rosendahl, Spring Grove; Nelson, Vasa.

Dennstædtia punctilobula (MICHX.) MOORE, Index Fil. 97: 307. 1857–62. Hay-scented fern.

Dicksonia punctilobula (MICHX.) A. GRAY, Man. 628. 1848.

Reported from Minnesota by Upham. Its occurrence however must be considered doubtful.

Herb.: Not represented.

Family SALVINIACEÆ.

Salvinia natans (L.) HOFFM. Deutsch. Fl. 2: 1. 1795. Salvinia.

Rare.

Herb.: Sheldon, Cuzner, Minneapolis.

Azolla caroliniana WILLD. Sp. Pl. 5: 541. 1810. Carolina azolla.

Infrequent. In the sloughs of the Mississippi river below Lake Pepin.

Herb.: Holzinger, Winona; Lyon, Jefferson, Houston county.

XXI. AN ADDITION TO THE KNOWLEDGE OF THE FLORA OF SOUTHEASTERN MINNESOTA.

C. O. Rosendahl.

Further work of the Minnesota Botanical Survey carried on in the southeastern part of the state during the month of June, 1902, resulted in the collection of about 100 species additional to those previously reported from the region by Mr. W. A. Wheeler * and also extended several plant ranges.

The territory covered is limited to the southwestern part of Houston county and the eastern part of Fillmore county as far north as the Root river.

Most of the collecting was done however in Spring Grove and Blackhammer townships, and a single excursion only was made into the part of Fillmore county above mentioned.

The topography of this part of Houston county differs considerably from the remaining region north and east, the largest part of which is much the same as that described in Mr. Wheeler's report.

Spring Grove, the corner township, is the highest part of the county, its elevation ranging from 1,050 feet in the northwest corner to over 1,300 feet on section 16, situated near the center.

There are numerous valleys throughout the southern and southeastern part of the township and a few in the northwestern part. None of these is deep and nearly all of them have gradually sloping sides to within 30–60 feet from the top of the ridges where the incline is more abrupt.

These valleys, and slopes also, are generally cultivated and the valleys possess the richest soil of the region.

They nearly all trend north and northwest and south and southeast from both sides of a high central ridge running from the southwestern to the northeastern part of the township.

*A contribution to the knowledge of the flora of southeastern Minnesota. Minn. Bot. Studies, 2: 353. 1900.

This main ridge, capped by Trenton limestone and underlaid with St. Peter sandstone, represents in this region the farthest eastward extension of the high rolling prairie of northeastern Iowa. Typical prairie plants like *Psoralea argophylla*, *Eryngium yuccæfolium*, *Mesadenia tuberosa*, *Parthenium integrifolium* and others find a home here, in fact prairie vegetation in general is met with upon all the principal ridges.

The sides of the bluffs and the upper narrowing valleys are generally wooded, especially in the eastern portion where even the ridges either have been or still remain forested. Southwestward the timber disappears.

Blackhammer township, adjoining Spring Grove on the north, is considerably lower, and is cut through in the western portion by Riceford creek, flowing north, and in the eastern portion by Beaver creek, also north bound.

The intervening region from north to south has an elevation of about 1,100 feet and is essentially a rolling prairie.

The bluffs along the two creeks are high and steep. As a rule the slopes are heavily wooded except those facing south.

The region of Fillmore county explored is traversed by the South fork of Root river, and by Root river itself. The topography and vegetation are essentially like that described for southeastern Houston county in Mr. Wheeler's report.

That part of Spring Grove township lying to the south of, and westwardly merging into the high central ridge described, proved the most interesting and best collecting ground of the territory covered.

It is interesting because of the fact that it borders immediately upon a true prairie region and yet harbors such species as occur typically in the northern part of the state.

Among the most important of these should be mentioned:

Botrychium obliquum,
Woodsia scopulina,
Woodsia obtusa,
Juniperus sabina,
Carex albursina,
Leptorchis liliifolia,
Sabbaldiopsis tridentata,
Viola leconteana,
Cornus canadensis,
Pyrola secunda,
Chimaphila umbellata,
Arctostaphylos uva-ursi.

It is worth noting that these, with the exception of *Woodsia scopulina*, *Woodsia obtusa*, *Juniperus sabina* and *Carex albursina*, were found in one place.

They were collected on the top and north slope of a ridge running east and west, less than half a mile long, and which rolls off southwestwardly into the prairie.

Pyrola secunda and *Chimaphila umbellata* occur infrequently on some of the wooded ridges. The other plants enumerated, with the exceptions noted, were found only at this place.

Sibbaldiopsis tridentata, growing on exposed rocks at the northwest extremity of the ridge, is of very infrequent occurrence in the state outside the Lake Superior region.

A few of the species collected are of particular interest, as no previous authentic collection of them has been reported from the state before. They are:

Homalocenchrus lenticularis,
Melica diffusa,
Poa wolfii,
Anychia canadensis,
Viola indivisa,
Viola mesochora,
Viola achlydophylla.

The following have been reported, but are not represented by any previous collection from Minnesota in the University Herbarium:

Carex cephalophora, *Carex muhlenbergii*,
Parthenium integrifolium.

Catalogue of Additional Species Collected.

The following catalogue of plants is in the nature of an addition to Mr. Wheeler's report for the region, and out of the entire collection made cites only such species as were not given in his report:

All the collections with one exception were made by the writer and in the region specified.

Prof. E. L. Greene, of the Catholic University of America, determined the violets.

Mr. C. F. Wheeler, of the U. S. Dept. of Agric., determined two species of *Carex*.

Mr. H. L. Lyon, of the University of Minnesota, determined the Pteridophytes, and Mr. W. A. Wheeler, of the University of Minnesota, School of Agriculture, determined all the grasses.

The other determinations were made by the collector. The specimens have been inserted in the University Herbarium.

PTERIDOPHYTA.

OPHIOGLOSSACEÆ.

Botrychium obliquum MUHL.; Willd. Sp. Pl. 5: 63. 1810.
R. 517, 660. Spring Grove.
Infrequent on wooded ridges.

POLYPODIACEÆ.

Woodsia scopulina D. C. EATON, Can. Nat. 2: 90. 1865.
R. 296. Spring Grove.
The only previous collections reported from the state are from Duluth and Taylors Falls by Miss Cathcart, and from Blue Earth county by Mr. Gedge. The only previous collection in the University Herbarium is from Rock county by Mr. W. A. Wheeler.

Woodsia obtusa (SPRENG.) TORR, Cat. Pl. in Geol. Rep. N. Y. 195. 1840.
R. 343. Spring Grove.
Infrequent or rare southeast. Occurs in crevices of the St. Peter sandstone. Reported by Upham as occurring throughout the state. The only previous collection in the University Herbarium is from Goodhue county by N. L. T. Nelson.

METASPERMÆ.

GRAMINEÆ.

Panicum linearifolium SCRIBN. in Br. & Br. Ill. Fl. App. 3: 500. 1898.
R. 259. Spring Grove.

Panicum leibergii (VASEY) SCRIBN.; Vasey, U. S. Dept. Agric., Div. Bot. Bull. 8: 32. 1899.
R. 504, 538, 619, 621. Spring Grove.

Homalocenchrus lenticularis (MICHX.) SCRIBN. Mem. Torr. Club, 5: 33. 1894.
Lyon, 713, Aug., 1900. Jefferson, Houston county.
Not previously reported from Minnesota.

Phalaris arundinacea L. Sp. Pl. 54. 1753.
R. 648, 665. Spring Grove.

Stipa spartea TRIN. Mem. Acad. St. Petersb. (VI) 1: 82. 1831.

R. 314. Spring Grove.

Agrostis hyemalis (WALT.) B.S.P. Prel. Cat. N. Y. 68. 1888.

R. 297. Spring Grove.

Calamagrostis canadensis (MICHX.) BEAUV. Agrost. 157. 1812.

R. 521. Spring Grove.

Danthonia spicata (L.) BEAUV., R. & S. Syst. 2: 690. 1817.

R. 514. Spring Grove.

Eragrostis pectinacea (MICHX.) STEUD. Syn. Pl. Gram. 272. 1885.

R. 258. Spring Grove.

Eatonia obtusata (MICHX.) A. GRAY, Man. Ed. 2, 558. 1836.

R. 533, 612. Spring Grove.

Eatonia pennsylvanica (DC.) A. GRAY, Man. Ed. 2, 558. 1856.

R. 534. Spring Grove. R. 584. Whalan, Fillmore county.

Melica diffusa PURSH, Fl. Am. Sept. 77. 1814.

R. 592. Whalan, Fillmore county.

Rare, along the Root river. No previous collection reported from Minnesota.

Poa flava L. Sp. Pl. 68. 1753.

R. 611, 649. Spring Grove.

Poa wolfii SCRIBN. Bull. Torr. Club, **21**: 228. 1894.

R. 285. Spring Grove.

Infrequent or rare on dry, wooded hillsides. No previous collection reported from Minnesota.

Poa compressa L. Sp. Pl. 69. 1753.

R. 364. Spring Grove.

Panicularia nervata (WILLD.) KUNTZE, Rev. Gen. Pl. 783. 1891.

R. 459, 494, 527, 634. Spring Grove.

Festuca octoflora WALT. Fl. Car. 81. 1788.

R. 298, 689. Spring Grove.

Festuca elatior L. Sp. Pl. 75. 1753.

R. 495, 688. Spring Grove.

Festuca nutans WILLD. Enum. **1**: 116. 1809.

R. 286, 557. Spring Grove.

Bromus purgans L. Sp. Pl. 176. 1753.

R. 434, 574. Spring Grove.

Agropyron pseudorepens SCRIBN. & SM. U. S. Dept. Agric. Div. Agrost. Bull. 4, 34. 1897.
R. 628. Bratsberg, Fillmore county.

Agropyron repens (L.) BEAUV. Agrost. 146. 1812.
R. 446, 447. Spring Grove.

Hystrix hystrix (L.) MILLSP. Fl. W. Va. 474. 1892.
R. 596, 657, 704. Spring Grove.

CYPERACEÆ.

Carex haydeni DEWEY, Am. Journ. (II) **18**: 103. 1854.
R. 405. Spring Grove.

Carex grisea WAHL. Kongl. Vet. Acad. Handl. (II) **24**: 154. 1803.
R. 469, 561. Spring Grove.

Carex granularis MUHL.; Willd. Sp. Pl. **4**: 279. 1805.
R. 554. Spring Grove.

Carex laxiflora blanda (DEWEY) BOOTT, Ill. 37. 1858.
R. 407. Spring Grove.

Carex albursina SHELD. Bull. Torr. Club, **20**: 284. 1893.
R. 597. Whalan, Fillmore county.
Infrequent on densely wooded bluffs along the Root river.
The only previous collections from the state in the University Herbarium are from White Bear lake and Waseca county. by E. P. Sheldon.

Carex pennsylvanica LAM. Encycl. **3**: 388. 1789.
R. 254. Spring Grove.

Carex gravida BAILEY, Mem. Torr. Club, **1**: 5. 1889.
R. 603. Whalan, Fillmore county.

Carex sparganioides MUHL.; Willd. Sp. Pl. **4**: 237. 1805.
R. 246. Spring Grove.

Carex cephaloidea DEWEY, Rep. Pl. Mass. 262. 1840.
R. 433, 457, 507. Spring Grove.

Carex cephalophora MUHL.; Willd. Sp. Pl. **4**: 220. 1805.
R. 227. Spring Grove.
Reported by Upham as frequent in the southern part of the state.
No previous collection from the state in the University Herbarium.

Carex muhlenbergii SCHK., Reidgr. Nachtr. *12. f. 178.* 1806.
R. 547. Spring Grove.

Rare southward according to Upham.

Reported from Chaska, Carver county, by Mr. Juni.

No previous collection from the state in the University Herbarium.

Carex scoparia SCHK. Reidgr. Nachtr. *20. f. 175.* 1806.

R. 406. Spring Grove.

Carex straminea mirabilis (DEWEY) TUCKERM. Enum. Meth. 18. 1843.

R. 508. Spring Grove.

Carex festucacea WILLD. Sp. Pl. 4: 242. 1805.

R. 428. Spring Grove.

Carex bicknellii BRITTON, Br. & Br. Ill. Fl. 1: 360. 1896.

R. 264. Spring Grove.

Frequent on sandy hillsides.

The only previous collection from the state is from Blue Earth county, by W. D. Frost.

JUNCACEÆ.

Juncoides campestre (L.) KUNTZE, Rev. Gen. Pl. 722. 1891.

R. 234. Spring Grove.

LILIACEÆ.

Allium tricoccum AIT, Hort. Kew. 1: 428. 1789.

R. 672. Spring Grove.

Allium canadensis L. Sp. Pl. 1195. 1753.

R. 667, 305. Spring Grove.

SMILACEÆ.

Smilax ecirrhata (ENGELM.) S. WATS. in A. Gray, Man. Ed. 6, 520. 1890.

R. 449. Spring Grove.

IRIDACEÆ.

Sisyrinchium campestre BICKNELL, Bull. Torr. Club, 26: 341. 1899.

R. 241, 242, 265. Spring Grove.

ORCHIDACEÆ.

Lysias hookeriana (A. GRAY) RYDB. Mem. N. Y. Bot. Gard. Vol. I. 103. 1900.

R. 301. Spring Grove.

Corallorhiza corallorhiza (L.) KARST. Deutsch. Fl. 448. 1880–83.
R. 1158. Spring Grove.

POLYGONACEÆ.

Rumex altissimus WOOD, Class-book, 447. 1853.
R. 392. Spring Grove.

Polygonum lapathifolium L. Sp. Pl. 360. 1753.
R. 650. Spring Grove.

Polygonum persicaria L. Sp. Pl. 361. 1753.
R. 647. Spring Grove.

Polygonum aviculare L. Sp. Pl. 362. 1753.
R. 531. Spring Grove.

CHENOPODIACEÆ.

Chenopodium album L. Sp. Pl. 219. 1753.
R. 642, 651. Spring Grove.

Chenopodium leptophyllum (MOQ.) NUTT.; Moq. in DC. Prodr. **13**: Part 2, 71. 1849.
R. 685. Spring Grove.

Chenopodium hybridum L. Sp. Pl. 219. 1753.
R. 1159. Spring Grove.

CARYOPHYLLACEÆ.

Silene noctiflora L. Sp. Pl. 419. 1753.
R. 558. Spring Grove.

Cerastium vulgatum L. Sp. Pl. Ed. 2, 627. 1762.
R. 230. Spring Grove.

Moehringia lateriflora (L.) FENZL. Verb. Alsin. table, p. 18. 1833.
R. 229, 232. Spring Grove.

Anychia canadensis (L.) B.S.P. Prel. Cat. N. Y. 1888.
R. 1160. Spring Grove.
Infrequent on wooded hillsides.
Not previously reported from Minnesota.

RANUNCULACEÆ.

Ranunculus ovalis RAF. Proc. Dec. 36. 1814.
R. 356. Spring Grove.

Ranunculus recurvatus POIR in Lam. Encycl. 6: 125. 1804.
R. 358. Spring Grove.

Ranunculus hispidus MICHX. Fl. Bor. Am. 1: 321. 1803.
R. 284. Spring Grove.

CRUCIFERÆ.

Iodanthus pinnatifidus (MICHX.) STEUD. Nomencl. Ed, 2, 812. 1841.
R. 590. Whalan, Fillmore Co.
Infrequent along the Root River at this place.
The only previous collection from the state is from Red Wing, by Sandberg.

GROSSULARIACEÆ.

Ribes missouriensis NUTT.; Torr. & Gray, Fl. N. Am. 1: 548. 1838–40.
R. 411. Spring Grove.

ROSACEÆ.

Rubus strigosus MICHX. Fl. Bor. Am. 1: 297. 1803.
R. 376. Spring Grove.

Sibbaldiopsis tridentata (SOLAND.) RYDB. N. Am. Potent. 187. 1898.
R. 511. Spring Grove.
Rare and local, on dry sandstone ledge. This appears to be about the most southern point of occurrence in the upper Mississippi Valley.

Fragaria americana (PORTER) BRITTON, Bull. Torr. Club, 19: 222. 1892.
R. 472, 383, 398. Spring Grove.

Sieversia ciliata (PURSH) RYDB. Mem. N. Y. Bot. Garden, Vol. 1, 222. 1900.
R. 251. Spring Grove.

POMACEÆ.

Prunus pumila L. Mant. Pl. 75. 1767.
R. 309. Spring Grove.
Infrequent on dry stony hillsides.

Prunus pennsylvanica L. F. Suppl. 252. 1781.
R. 654. Spring Grove.

PAPILIONACEÆ.

Psoralea argophylla PURSH, Fl. Am. Sept. 475. 1814.
R. 571. Spring Grove.

Astragalus crassicarpus NUTT. Fraser's Cat. 1813.
R. 331. Spring Grove.

Lathyrus palustris L. Sp. Pl. 733. 1753.
R. 613. Whalan, Fillmore county.

RHAMNACEÆ.

Ceanothus ovatus pubescens T. & G.; S. Wats. Bibl. Index, 1: 166. 1878.
R. 252. Spring Grove.

VIOLACEÆ.

Viola indivisa GREENE, ined.
R. 355. Spring Grove.

Viola cuspidata GREENE, Pitt. 3: 314. 1898.
R. 238, 352. Spring Grove.

Viola mesochora GREENE, ined.
R. 386. Spring Grove.

Viola leconteana DON. Gen. Syst. 1, 324.
R. 509. Spring Grove.
Infrequent, in moist shady woods.
There are various collections in the University Herbarium, mostly from the northern part of the state, which are determined as variety *amœna* of *Viola blanda* that should be included under the above-named species.

Viola achlydophylla GREENE, Pitt. 5: 87. 1902.
R. 467. Spring Grove.
Frequent, in moist shady woods.
Not previously reported from Minnesota.

ONAGRACEÆ.

Meriolix serrulata (NUTT.) WALP. Rep. 2: 79. 1843.
R. 568. Spring Grove.
Infrequent, on exposed hillsides.

UMBELLIFERÆ.

Eryngium yuccæfolium MICHX. Fl. Bor. Am. 1: 164. 1803.
R. 678. Spring Grove.
Occurs infrequently on some of the high, dry ridges of the region.

CORNACEÆ.

Cornus canadensis L. Sp. Pl. 117. 1753.

R. 510. Spring Grove.

Rare and local, the most southern collection in the state previously reported is from Wabasha county by J. M. Holzinger.

PYROLACEÆ.

Pyrola secunda L. Sp. Pl. 396. 1753.

R. 518, 564. Spring Grove.

Previously reported as far south as Blue Earth county.

Infrequent, in shady woods.

Chimaphila umbellata (L.) NUTT. Gen. 1: 274. 1818.

R. 380, 520, 645. Spring Grove.

Rare and local, on wooded ridges.

Monotropa uniflora L. Sp. Pl. 387. 1753.

R. 1161. Spring Grove.

Infrequent, throughout the wooded region.

GENTIANACEÆ.

Gentiana puberula MICHX. Fl. Bor. Am. 1: 176. 1803.

R. 1162. Spring Grove.

ASCLEPIADACEÆ.

Asclepias ovalifolia DEC. in DC. Prodr. 8: 567. 1844.

R. 460. Spring Grove.

Infrequent, on dry, sandy hillsides.

Acerates viridiflora ivesii BRITTON, Mem. Torr. Club, 5: 265. 1894.

R. 681, 655. Spring Grove.

Acerates lanuginosa (NUTT.) DEC. in DC. Prodr. 8: 523. 1844.

R. 304, 442. Spring Grove.

CONVOLVULACEÆ.

Convolvulus repens L. Sp. Pl. 153. 1753.

R. 476. Spring Grove.

BORAGINACEÆ.

Lithospermum latifolium MICHX. Fl. Bor. Am. 1: 13. 1803.

R. 408. Spring Grove.

SOLANACEÆ.

Physalis virginiana intermedia RYDB. Mem. Torr. Club, 4: 345. 1896.

R. 310. Spring Grove.

SCROPHULARIACEÆ.

Scrophularia leporella BICKNELL, Bull. Torr. Club, **23**: 317. 1896.

R. 300. Spring Grove.

Previous collections from this region reported as *Scrophularia marylandica* L. should be *Scrophularia leporella* Bicknell.

RUBIACEÆ.

Galium concinnum T. & G. Fl. N. Am. **2**: 23. 1841.

R. 529. Spring Grove.

Abundant, in woods throughout.

CAPRIFOLIACEÆ.

Viburnum pubescens (AIT.) PURSH, Fl. Am. Sept. 202. 1814.

R. 226. Spring Grove.

All Minnesota collections reported as *Viburnum dentatum* L. should be *Viburnum pubescens* (Ait.) Pursh.

Symphoricarpos occidentalis HOOK. Fl. Bor. Am. **1**: 285. 1823.

R. 409. Spring Grove.

Frequent, along Riceford creek.

CICHORIACÆ.

Lactuca canadensis L. Sp. Pl. 796. 1753.

R. 537. Spring Grove.

Nothocalais cuspidata (PURSH) GREENE, Bull. Acad. (II.) **2**: 55. 1886.

R. 319. Spring Grove.

Common, on stony ridges.

COMPOSITÆ.

Kuhnia glutinosa ELL. Bot. S. C. & G. **2**: 292. 1821–24.

R. 1163. Spring Grove.

Previous collections from this region reported as *Kuhnia eupatorioides* L. should be *Kuhnia glutinosa* Ell.

Erigeron philadelphicus L. Sp. Pl. 863. 1753.

R. 441, 447. Spring Grove.

Parthenium integrifolium L. Sp. Pl. 988. 1753.

R. 483. Spring Grove.

Reported by Lapham from the southern part of the state. No previous collection from Minnesota in the University Herbarium.

Occurs occasionally in the valleys but is most frequent on the dry elevated ridges.

Mesadenia tuberosa (NUTT.) BRITTON; Br. & Br. Ill. Fl. 3: 474. 1898.

R. 704. Spring Grove.

Senecio balsamitæ MUHL.; Willd. Sp. Pl. 1999. 1804.

R. 268. Spring Grove.

R. 582. Whalan, Fillmore county.

XXII. A NEW SPECIES OF RAZOUMOFSKYA.

C. O. Rosendahl.

While engaged in the work of collecting the flowering plants and ferns of the west coast of Vancouver island during the summers of 1901 and 1902 excellent opportunity was given to observe the mistletoe which grows in great abundance upon the hemlock of that region.

The fact is perhaps generally known that this parasite causes peculiar fasciations, the so-called *Hexenbesen*, of the stem and branches of *Tsuga heterophylla* and attention is called to this in a recent publication of the U. S. Department of Agriculture.*

In this paper the parasite is designated as *Arceuthobium occidentale* Engelm. (*Razoumofskya occidentalis* (Engelm.) Kuntze), and it has been generally classed with that plant or with its variety *abietinum* Engelm.

Nearly all the specimens of *Razoumofskya occidentalis* (Engelm.) Kuntze, in the Herbarium of the University of Minnesota, have been collected on various species of *Pinus*, and Engelmann in the description of the species states that it occurs "on various conifers of the coast ranges and Sierra Nevada," citing *Pinus insignis*, *P. sabiniana* and *P. ponderosa*. The variety is given as occurring on *Abies grandis*.

Examination and comparison of specimens show that the plant found on the hemlock differs from *Razoumofskya occidentalis*, [redacted] growing mostly on pines, in being more slender, more loosely branched and in having the staminate and pistillate plants of about equal size. Not infrequently the staminate plant is the larger (Plate XXVII, fig. 5), which is the reverse of the condition met with in *R. occidentalis*. The staminate spikes are more slender, less densely flowered, and generally longer than those of the above-mentioned form.

* Allen, Edward T. The Western Hemlock, Bureau of Forestry, U. S. Dept. of Agric., Bull. 33. 1902.

It approaches more closely the variety *abietina*, and because of the fact that only fragmentary material of the latter is at hand for comparison, it is more difficult to show the essential differences, except in so far as those already pointed out for the species include those for the variety also.

From the material examined it is clear that the plant found on the hemlock has the calyx lobes more ovate in shape, and the fruit possesses a slightly shorter and thicker beak than in var. *abietina*.

With sufficient authentic material for comparison its affinities could perhaps be more definitely established.

It does not seem consistent to refer this plant to the variety when it is borne in mind that as far as observations go it is found exclusively on *Tsuga heterophylla* in a forest where abound such species as *Abies grandis*, the tree upon which the variety was first collected, *Abies amabilis*, *Pinus monticola*, *Pinus contorta* and various other conifers.

The hemlock is found almost everywhere on the west coast mixed with the trees mentioned above, but in no case whatever was the parasite found on any other tree than *Tsuga heterophylla* Sarg.

There seems sufficient reason for giving the plant specific rank and the name *Razoumofskya tsugensis* is proposed.

The type specimen is deposited in the herbarium of the University of Minnesota.

Razoumofskya tsugensis sp. nov.

Stems slender, paniculately branched; terminal branches of the staminate plants often apparently dichotomous: stem 1.5 mm. in diameter at the base: staminate plants 3–11 cm. high, brownish-yellow in color: flowers 1–13, sessile in the axils of the connate leaves of the branches, forming spicate inflorescences 4–24 mm. long: internodes of the flowering branches 2.5–3.5 mm. long: calyx 4-parted; lobes ovate, acute, thick: anthers sessile and attached about the middle of the calyx lobes: buds of the lateral flowers slightly flattened dorsi-ventrally, the terminal ones globose: expanded flower 3.5–4 mm. in diameter.

Pistillate plants 4–12 cm. high: generally darker in color than the staminate: flowers borne as in the staminate plants: branches flower-bearing for the last 1–6 nodes: internodes 3.5–

5 mm. long: flowers nearly sessile, partly enclosed by the connate leaves: fruit 4–5 mm. long, 2.5–3 mm. in diameter, obovate, short conic-beaked, slightly compressed dorsi-ventrally, at length becoming shortly stalked and reflexed.

Explanation of Plates.

Plate XXVII.

The figures are from photographs made by C. J. Hibbard and are a little less than natural size.

1. Pistillate plant in fruiting stage.
2. Pistillate plant attached to its host, a younger stage than fig. 1.

3–4. Staminate plants, medium size.

5. Large staminate plants, attached to their host.

Plate XXVIII.

1. Large pistillate plant in fruiting stage, slightly enlarged.
2. Two pistillate flowers, advanced stage, ×5.
3. Single pistillate flower, ×5.
4. Part of fruiting branch with nearly mature fruit in position, ×5.
5. Fruit removed from plant, ×5.
6. Medium sized staminate plant, slightly enlarged.
7. End of staminate spike, flowers in bud, ×5.
8. Terminal staminate flower expanded, ×5.
9. Terminal staminate flower, viewed from above, showing the circular stamens, ×6.

PLATE XXVII.

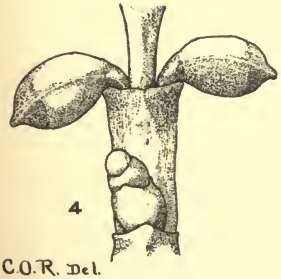
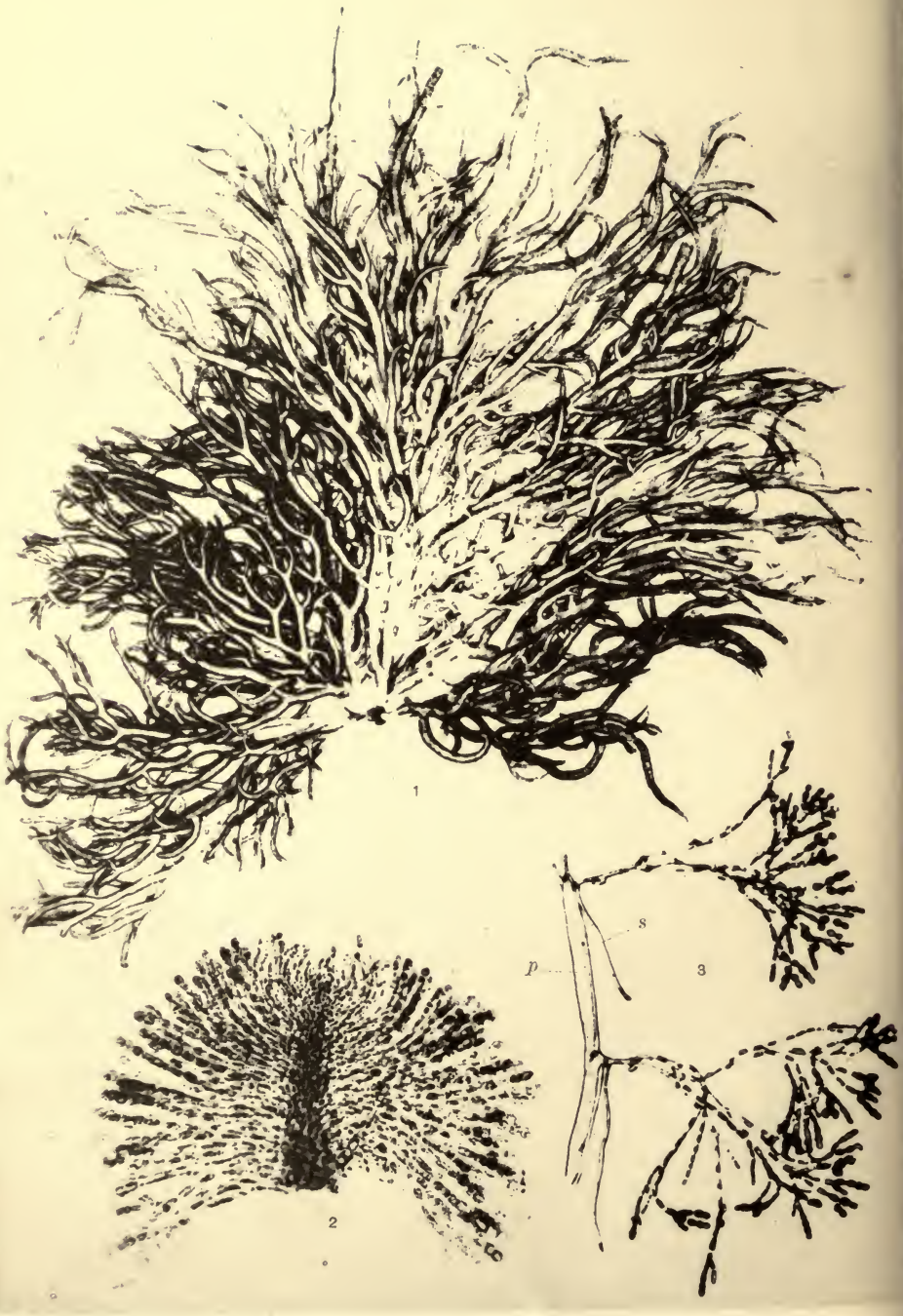


PLATE XXVIII.

INSTRUCTION TO BINDER.

Plates V and XVII, furnished with this part are to be substituted for the Plates correspondingly numbered and issued with Part I of this volume.


1
2
3
s
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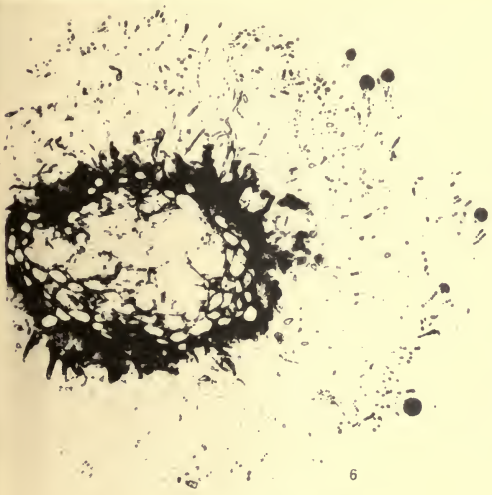
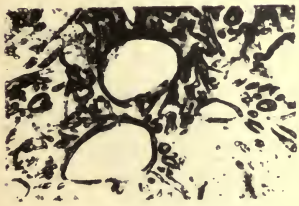


6



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12

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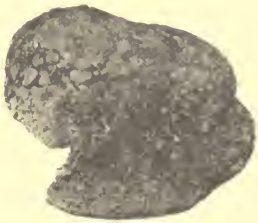
14

1



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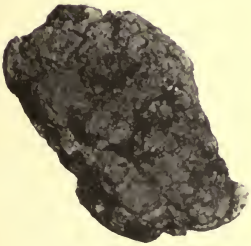
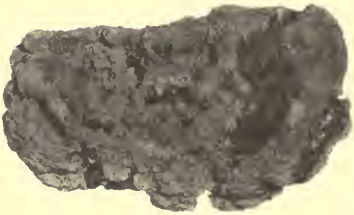


3



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6

PLATE XVII.

Book Slip–20*m*-9,'60 (B3010s4)458

Minnesota
QK168
M48
v.3
pt.2