ART. VII. MYCORRHIZÆ FROM THE UINTA BASIN

By L. K. Henry

Sometime ago, I received for investigation a collection of tree and shrub rootlets from the Uinta Basin, Utah. These rootlets were collected during April, May, and June, 1933, by Dr. Edward H. Graham, Assistant Curator of Botany at the Carnegie Museum, while on his second expedition to the region.

Microscopical examination of these rootlets revealed ectotrophic mycorrhizæ on eight out of fifteen plants collected. The mycorrhizæ occurred on one Aspen, one Birch, one Fir, two Spruces, and three Pines. No mycorrhizæ were found on the Juniper, Sagebrush, Greasewood, Maple, Service-berry, or Sumach.

The ectotrophic mycorrhizæ on all three pines were very similar. Externally, they consisted of coralloid clusters and swollen short roots; and internally, of thin prosenchymatous fungal mantles with hyphæ projecting from the outer edge, intercellular fungal nets, and cortical cell hypertrophy. These eight hosts have been checked with an unpublished Mycorrhizal Host Index check-list and four are, I believe, new mycorrhizal hosts.

The fifteen specimens examined may be arranged according to presence or absence of mycorrhizæ:

ECTOTROPHIC

Abies lasiocarpa (Hooker) Nuttall.—Dwarf tree, Mt. Emmons, 11,400 feet elevation.

**Betula fontinalis* Sargent.—Dinosaur National Monument, in narrow ravine near spring, 5,000 feet elevation.

Picea Engelmanni Parry.—Dwarf tree, Mt. Emmons, 11,400 feet elevation.

Picea Engelmanni Parry.—Peak north of Trout Creek Ranger Station, 11,500 feet elevation.

**Pinus brachyptera* Engelmann.—Big Park, wooded base of Uinta River Canyon, 7,500 feet elevation.

*New mycorrhizal host plants.

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Pinus edulis Engelmann.—North Slope of Grouse (Summit) Creek, circa 7,000 feet elevation (north slope of north rim of Basin).

Pinus Murrayana Balfour.—Trout Creek Ranger Station, 9,300 feet elevation.

**Populus aurea* Tidestrom.—Big Park, wooded base of Uinta River Canyon, 7,500 feet elevation.

NO MYCORRHIZÆ

Acer interius Britton.—Dinosaur National Monument, 5,000 feet elevation.

Amelanchier utahensis Koehne.—Dinosaur National Monument, 5,000 feet elevation.

Artemisia tridentata Nuttall.—Dinosaur National Monument, 5,000 feet elevation.

Juniperus utahensis (Engelmann) Lemmon.—Five miles north of Vernal, 6,000 feet elevation.

Juniperus sibirica Burgsd.—Low shrub, Trout Creek Ranger Station, 9,000 feet elevation.

Rhus trilobata Nuttall.—Dinosaur National Monument, 5,000 feet elevation.

Sarcobatus vermiculatus (Hooker) Torrey.—South of Skull Pass Quarry, east side of Green River, 20 miles south of Vernal, 5,000 feet elevation.

The specimens examined were collected in the following vegetation zones[1] beginning at the desert and ascending to the mountain top:

Mixed Desert Shrub Zone.—4,500 to 5,500 feet, typical desert, soil strongly alkaline.

Artemisia tridentata
Betula fontinalis
Sarcobatus vermiculatus

*New mycorrhizal host plants.

[1]The names used for the altitudinal zones are those suggested by Dr. Graham and those which he plans to use in describing the vegetation of the south slope of the Uinta Mountains in connection with his work on the flora and phytogeography of the Uinta Basin of northeastern Utah and northwestern Colorado.

Juniper-Pinyon Zone.—5,500 to 7,000 feet, desert-woodland, soil strongly alkaline.

Acer interius
Amelanchier utahensis
Juniperus utahensis
Rhus trilobata

Sub-montane Shrub Zone.—7,000 to 8,000 feet, desert-woodland.

Pinus brachyptera—in wooded base of Uinta River Canyon.
Pinus edulis—north slope of Grouse (Summit) Creek.
Populus aurea—in wooded base of Uinta River Canyon.

Aspen Zone.—8,000 to 8,700 feet, pH reading neutral. No rootlets collected here, see above zone for Aspen.

Lodgepole Pine Zone.—8,700 to 10,000 feet, pH reading slightly acid.

Juniperus sibirica—low shrub.
Pinus murrayana

Spruce-Fir Zone.—10,000 to 11,000 feet, pH reading slightly acid at junction of this zone with former one.

Picea Engelmanni

Alpine Zone.—11,000 to 13,500 feet, pH reading neutral. This zone is above tree line.

Abies lasiocarpa—dwarf shrub.
Picea Engelmanni—dwarf shrub.

According to Dr. Graham's findings, made with a La Motte Soil Teskit, the soils in the Mixed Desert Shrub zone and the Juniper zone were strongly alkaline with a pH reading of 7.5 as shown at Skull Pass Quarry and the Dinosaur National Monument. Certain localities in the Aspen zone showed a pH of 7.0, while at the Junction of the Lodgepole Pine and the Spruce-Fir zones readings of pH 6 and pH 6– were obtained.

The majority of the plants which possessed no mycorrhizæ were growing in the alkaline desert-shrub or desert-woodlands below the Aspen zone, while all but three possessing mycorrhizæ were located in neutral or acid soils at elevations above the Aspen zone. *Juniperus sibirica*, a low spreading shrub growing in the Lodgepole Pine zone, was the only non-mycorrhizal plant to appear above the alkaline desert habitats.

Populus aurea, *Pinus edulis*, and *Pinus brachyptera* from the Submontaine Shrub zone harbored ectotrophic mycorrhizæ. However, they were growing in the forested sections and were not under typical desert conditions. A reading of pH 6+ was obtained from the soil around *Pinus brachyptera* indicating a slightly acid condition, due possibly to the decaying forest litter present there. Likewise, *Betula fontinalis* growing in a narrow canyon near a spring in the Mixed Desert Shrub zone showed ectotrophic mycorrhizæ.

Although *Abies lasiocarpa* and *Picea Engelmanni* have already been reported as mycorrhizal hosts, I feel that a detailed description of the ectotrophic mycorrhizæ from these two dwarfed species growing at an elevation of 11,400 feet is not out of place here. Both species were growing among broken rock, Uinta quartzite, which forms the crest of the mountains throughout this region, and were above tree line which is at 11,000 feet elevation. They were deformed, dwarfed trees about four to five feet high located on a broad morainal mound above the Chain lakes on the southeast slope of Mt. Emmons. Although no pH readings were made near these dwarfed trees, a pH of 7 was obtained in small meadow-like patches among the same type of rocks in this Alpine zone. Sufficient litter was collected under these dwarfed trees to form soil. Externally, the rootlets of *Abies lasiocarpa* possessed typical coralloid clusters of mycorrhizæ, some of which were gray in color, and gray swollen mycorrhizal short roots (plate X, fig. 2a); while internally, the mycorrhizæ showed thick prosenchymatous fungal mantles with hyphæ projecting from the outer edge, some of which have cross-walls and clamp connections, intercellular fungal nets, and cortical cell hypertrophy (plate X, fig. 2b).

Mycorrhizæ of *Picea Engelmanni* possessed similar external characteristics (plate X, fig. 3a), while the internal structures were alike except for the thin prosenchymatous fungal mantles and absence of clamp connections on the projecting hyphæ (plate X, fig. 3b). This thin prosenchymatous fungal mantle is in accord with the ones found upon the same species growing in the Spruce-Fir zone at an elevation of 10,500 feet.

The habitat, external form and internal structure of mycorrhizæ on four new host plants are described in Table I.

SUMMARY

Ectotrophic mycorrhizæ were found on eight of the fifteen different plant rootlets collected in the Uinta Basin, Utah. Five of the ectotrophic hosts were growing above the Aspen zone where soil is neutral or

slightly acid, while the remaining three occurred in the Sub-montane Shrub zone but in locations where the soil conditions were not that of a typical alkaline desert. All but one of the non-mycorrhizal species were located in the desert-shrub and desert-woodlands where the soil was distinctly alkaline. The dwarfed trees of *Abies lasiocarpa* and *Picea Engelmanni* growing in scanty soil among the rocks in the Alpine zone were excellent mycorrhizal hosts. These findings would seem to indicate that the ectotrophic mycorrhizæ were able to develop and flourish in sand and sand-humus mixtures as long as the soil remained in neutral or acid condition, but were unable to live under the alkaline soil conditions of the desert.

Betula fontinalis, *Pinus brachyptera*, *Pinus edulis* and *Populus aurea* are new additions to the mycorrhizal host list.

TABLE I

DATA FOR NEW MYCORRHIZAL HOST PLANTS

Host Plants	Date of Collection	Habitat	External form of Infected Rootlet	Internal Structure
Ectotrophic:				
Betula fontinalis	May, 1933	Narrow ravine near a spring, 5000 feet elevation.	Coralloid clusters and short roots—all very fine (plate IX, fig. 1a).	Thick prosenchyma fungal mantle, intercellular net with radially elongated cells on one side, cortical cell hypertrophy. Hyphæ that project from mantle show cross-walls and clamp connections. Some mantles are pseudoparenchymatous (plate IX, fig. 1b).
Pinus brachyptera	June, 1933	Wooded base of Uinta River Canyon, 7500 feet elevation.	Coralloid clusters and swollen short roots (plate IX, fig. 2a).	Thin prosenchyma fungal mantle with hyphæ projecting from the outer surface, intercellular net, cortical cell hypertrophy. No radially elongated cells in cortex (plate IX, fig. 2b).
Pinus edulis	June, 1933	Wooded north slope of Grouse (Summit) Creek, c. 7000 feet elevation.	Coralloid clusters, young ones light tan (plate IX, fig. 3a).	Thick prosenchyma fungal mantle with hyphæ projecting from the outer surface, intercellular net, cortical cell hypertrophy (plate IX, fig. 3b).
Populus aurea	June, 1933	Wooded base of Uinta River Canyon, 7500 feet elevation.	Coralloid clusters—very fine (plate X, fig. 1a).	Pseudoparenchyma fungal mantle with hyphæ projecting from outer surface, intercellular net, with radially elongated cortical cells on one side, cortical cell hypertrophy (plate X, fig. 1b).

EXPLANATION OF PLATE IX

FIG. 1a. Coralloid cluster of ectotrophic mycorrhizæ from *Betula fontinalis* × 14.

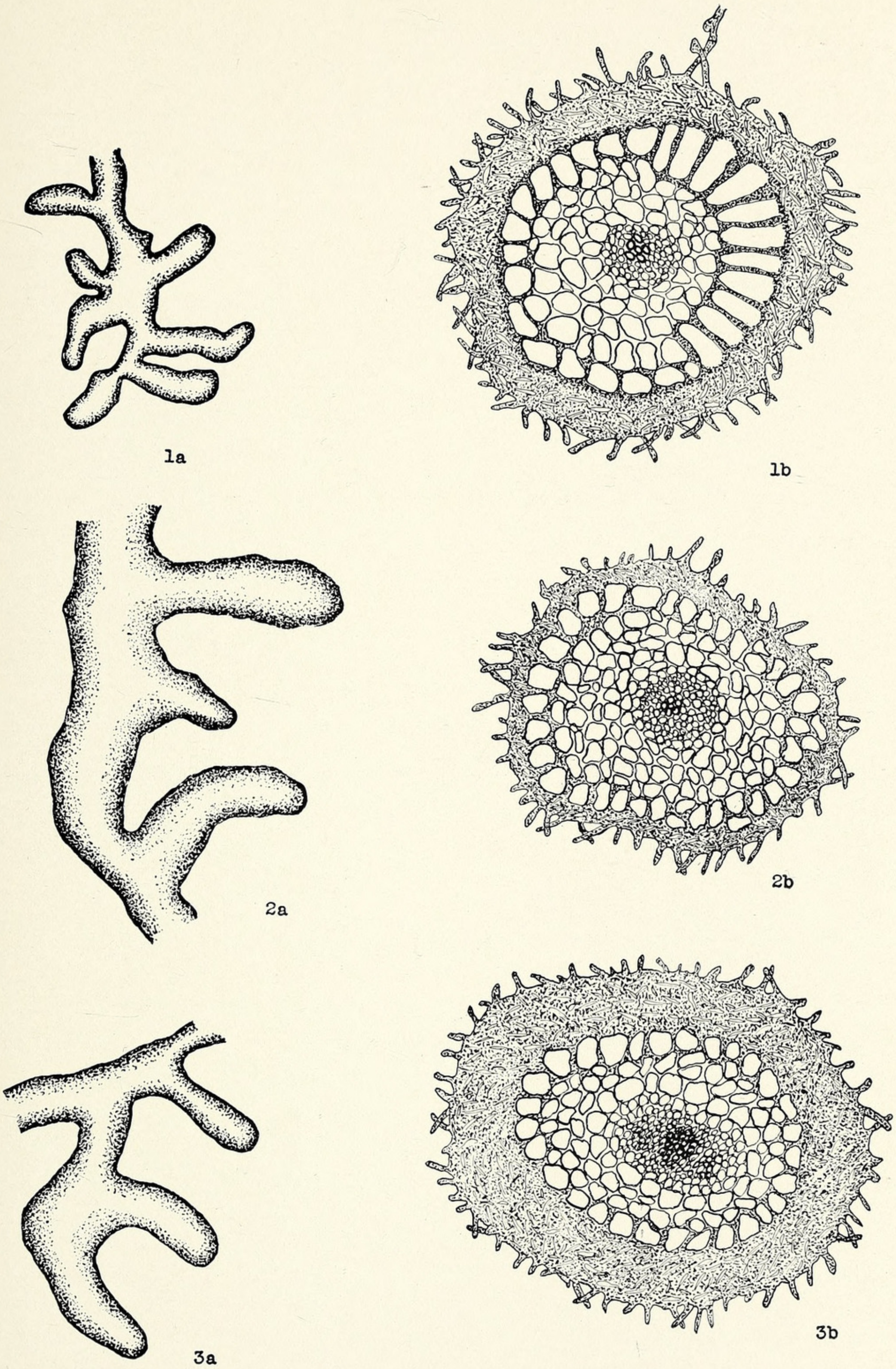
FIG. 1b. Cross section of ectotrophic mycorrhiza from *Betula fontinalis* × 156.

FIG. 2a. Mycorrhizal short roots from *Pinus brachyptera* × 14.

FIG. 2b. Cross section of ectotrophic mycorrhiza from *Pinus brachyptera* × 156.

FIG. 3a. Coralloid cluster of ectotrophic mycorrhizæ from *Pinus edulis* × 14.

FIG. 3b. Cross section of ectotrophic mycorrhiza from *Pinus edulis* × 156.


1a
1b
2a
2b
3a
3b

EXPLANATION OF PLATE X

FIG. 1a. Coralloid cluster of ectotrophic mycorrhizæ from *Populus aurea* × 14.

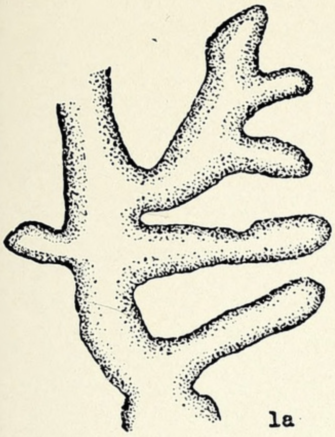
FIG. 1b. Cross section of ectotrophic mycorrhiza from *Populus aurea* × 156.

FIG. 2a. Mycorrhizal short roots, one dichotomously branched, from *Abies lasiocarpa* (dwarf tree) × 14.

FIG. 2b. Cross section of ectotrophic mycorrhiza from *Abies lasiocarpa* × 156.

FIG. 3a. Mycorrhizal short roots from *Picea Engelmanni* (dwarf tree) × 14.

FIG. 3b. Cross section of ectotrophic mycorrhiza from *Picea Engelmanni* × 156.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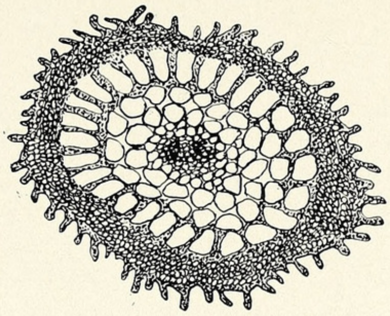
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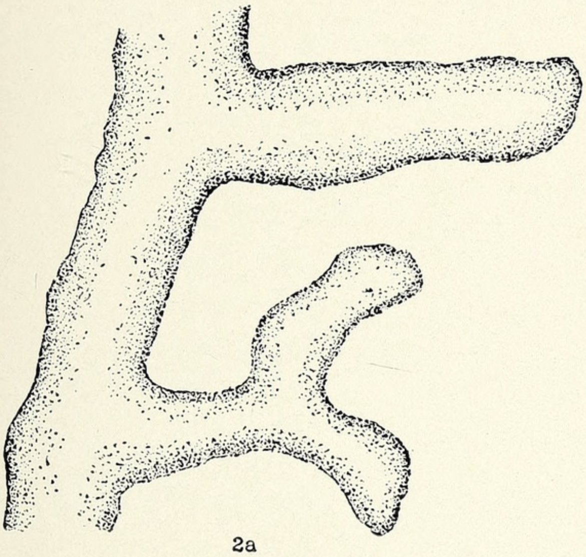
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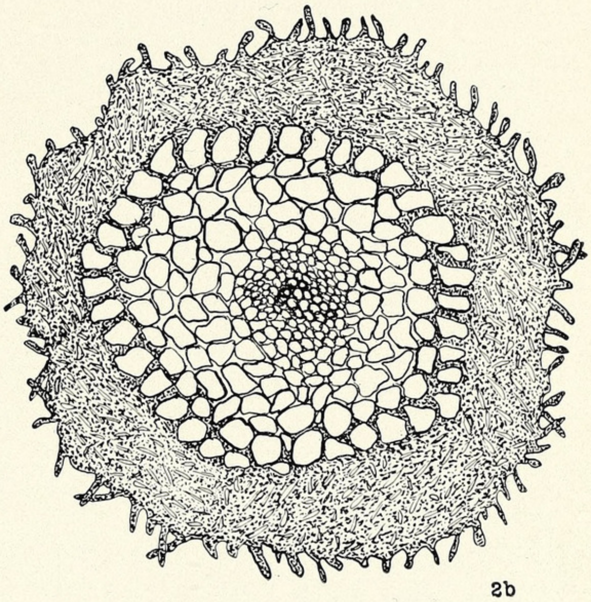
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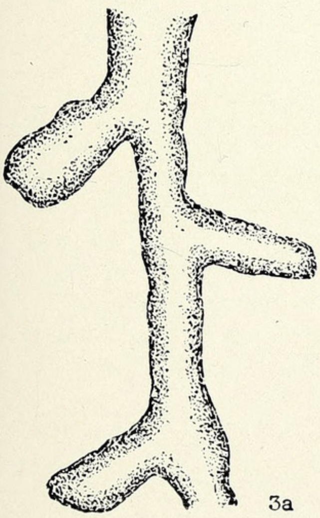
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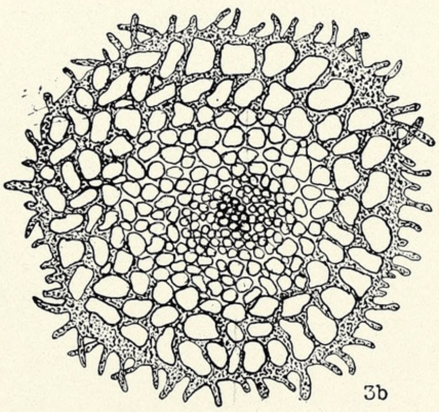
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