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A Key and Annotations for Some Characeae Collected in Wyoming

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The *Butler University Botanical Studies* journal was published by the Botany Department of Butler University, Indianapolis, Indiana, from 1929 to 1964. The scientific journal featured original papers primarily on plant ecology, taxonomy, and microbiology. The papers contain valuable historical studies, especially floristic surveys that document Indiana's vegetation in past decades. Authors were Butler faculty, current and former master's degree students and undergraduates, and other Indiana botanists. The journal was started by Stanley Cain, noted conservation biologist, and edited through most of its years of production by Ray C. Friesner, Butler's first botanist and founder of the department in 1919. The journal was distributed to learned societies and libraries through exchange.

During the years of the journal's publication, the Butler University Botany Department had an active program of research and student training. 201 bachelor's degrees and 75 master's degrees in Botany were conferred during this period. Thirty-five of these graduates went on to earn doctorates at other institutions.

The Botany Department attracted many notable faculty members and students. Distinguished faculty, in addition to Cain and Friesner , included John E. Potzger, a forest ecologist and palynologist, Willard Nelson Clute, co-founder of the American Fern Society, Marion T. Hall, former director of the Morton Arboretum, C. Mervin Palmer, Rex Webster, and John Pelton. Some of the former undergraduate and master's students who made active contributions to the fields of botany and ecology include Dwight. W. Billings, Fay Kenoyer Daily, William A. Daily, Rexford Daudenmire, Francis Hueber, Frank McCormick, Scott McCoy, Robert Petty, Potzger, Helene Starcs, and Theodore Sperry. Cain, Daubenmire, Potzger, and Billings served as Presidents of the Ecological Society of America.

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A KEY AND ANNOTATIONS FOR SOME CHARACEAE COLLECTED IN WYOMING

FAY KENOYER DAILY
Butler University
and
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A number of specimens of the Characeae collected by C. L. Porter and Marjorie Porter have been added to the Rocky Mountain Herbarium, University of Wyoming. Duplicates of these as well as the extant collections there were made available to the senior author for study. Distribution maps and ecological data were also supplied. A few collections from other sources were added.

Thirteen taxonomic categories were distinguished as being represented in these specimens representing three genera and eleven species. The finding of a new variety of the rare species, *Tolypella hispanica,* marked the first record of a dioecious *Tolypella* in the United States. It was also found that some charophytes infrequently reported for the United States were represented as follows: *Chara longifolia* Robinson, *Chara hirsuta* Allen, *Nitella acuminata* ssp. *glomerulifera* A. Br., *Nitella opaca* Ag., *Chara zeylanica* f. *inconstans* (Kütz.) H. & J. Groves. Some common charophytes represented were *Nitella flexilis* (L.) Ag., *Chara contraria* A. Br. ex Kütz., *Chara vulgaris* Vaill. ex L., *Chara globularis* Thuill. and the somewhat less common *Chara delicatula* Ag.

Wyoming is located in northwestern United States of America between 41° and 45° latitude. Elevation ranges from 3,100 to 13,785 ft. above sea level. Life zones include the low plains and fertile river valleys, high sagebrush and grassy plains, basal slopes of the mountains, middle mountain slopes, a narrow subalpine zone in the timberline region, and the arctic-alpine mountain peaks and crests above the timberline. Its boundaries contain the western part of the great plains, high desert plateaus and mesas of the intermountain west cut by deep canyons or walled by high mountains, and the continental divide. The soils where charophytes were found chiefly range from the stony soils of the mountains, to the fertile river valleys, bogs and glacial drift. The waters range in temperature from the cool alpine aquatic habitats to hot springs (32° C. for a spring in which *Chara* was growing).


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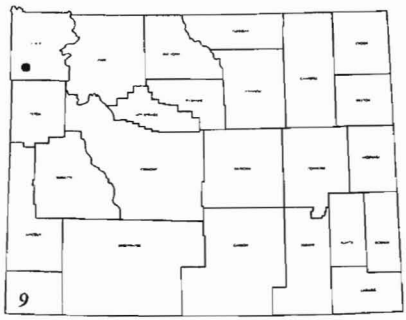

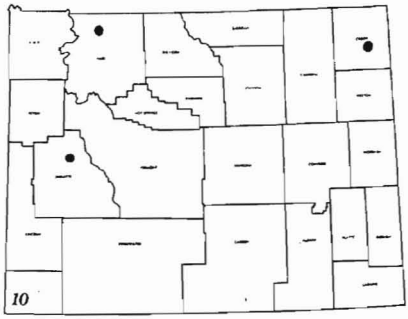

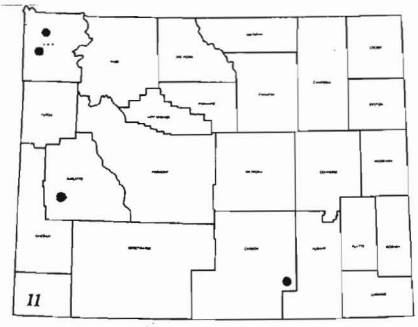

Distribution of the charophytes of Wyoming indicated by a dot or circle at the location of a collection site. Map 1. *Nitella acuminata* ssp. *glomerulifera* A. Br. Map. 2. *Nitella flexilis* (L.) Ag. Map. 3. *Nitella opaca* Ag. Map 4. *Tolypella hispanica* var. *porteri* Daily. Map. 5. *Chara longifolia* Robinson. Map 6. *Chara hirsuta* Allen. Map 7. *Chara contraria* var. *contraria* A. Br. ex Kütz. (dot), *Chara contraria* var. *hispidula* A. Br. (circle). Map 8. *Chara vulgaris* var. *vulgaris* Vaill. ex L. (dot), *Chara vulgaris* var. *condensata* Breb. (circle). Map. 9. *Chara zeylanica* forma *inconstans* H. & J. Groves. Map 10. *Chara globularis* Thuill. Map 11. *Chara delicatula* Ag.

If the accompanying maps (Maps 1-11) showing the distribution of the charophytes of Wyoming were superimposed on a topographic map of the state, the dots and circles representing the location of collecting sites would be associated with the mountains and river systems. This reflects the recent soils and greater moisture in these areas. Although the continental Wisconsin glaciation did not reach Wyoming, glaciers formed in the mountains during this period. When they receded, they left alluvial fans, lake terraces, and stream terraces in a region of sufficient moisture with soil of sufficient essential minerals to maintain suitable aquatic habitats for charophytes. This area covers only about 10 percent of the state, with the soils of the remaining portion drier and having been subject to much leaching and erosion for many thousands of years.

In the citation of specimens, the location of collections are designated as follows: RM, Rocky Mountain Herbarium, University of Wyoming, Laramie, Wyo.; BUT, herbarium of F. K. Daily, Butler University, Indianapolis, Ind.; F, Chicago Natural History Museum, Chicago, Ill.; UC, University of California Herbarium, Berkeley, Cal.

If a collection contains a mixture of species, for instance, if a collection of *Chara contraria* also contains some *Chara globularis* this is indicated in the citation of specimens under *Chara globularis* by the phrase "with *Chara*

contraria" under which name the collection is filed in the herbarium at Butler University.

A KEY FOR SOME WYOMING CHARACEAE

Coronula with 10 cells in two tiers
- Mature oospore laterally flattened; antheridium apical at a branchlet node ..... NITELLA
  - Ultimate ray one-celled
    - Monoecious
      - Tip of ultimate ray long-acuminate ... 1. *Nitella acuminata*
      - Tip of ultimate ray acute ..... 2. *Nitella flexilis*
    - Dioecious ..... 3. *Nitella opaca*
- Mature oospore terete; antheridium lateral and below the oogonium at a branchlet node ..... TOLYPELLA
  - Dioecious ..... 4. *Tolypella hispanica*

Coronula with 5 cells in one tier ..... CHARA
- Stipulodes in one series around stem ..... 5. *Chara longifolia*
- Stipulodes in two series around stem; stem corticated
  - Primary cortex (with spines) alternating with short secondary cortical cells (without spines) ..... 6. *Chara hirsuta*
  - Primary cortex alternating with longer secondary cells (diplostichous)
    - Primary cortical cells prominent ..... 7. *Chara contraria*
    - Secondary cortical cells prominent ..... 8. *Chara vulgaris*
  - Primary cortex alternating with two secondary cortical ranks (triplostichous)
    - First branchlet internode ecorticate..... 9. *Chara zeylanica*
    - First branchlet internode corticate
      - Stem cortex cells all about equal in diameter; stipulodes rudimentary..... 10. *Chara globularis*
      - Stem cortex cells unequal in diameter, primary prominent; stipulodes developed ..... 11. *Chara delicatula*

1. NITELLA ACUMINATA subsp. GLOMERULIFERA Braun. Abh. Kön. Akad. Wiss. Berlin (1882): 39, Plate 4, fig. 88. 1883.

For descriptions and illustrations see Allen (2, p. 43, fig. 45), and Braun *loc. cit.*

Only a single collection (Map 1) was made in Wyoming of this rather rare subspecies. The plants were growing in shallow water of an alpine lake at 10,000 ft. elevation. They are said to occur in the pure water of ponds and ditches (Braun, loc. cit.).

Specimen seen: CARBON COUNTY: Sierra Madre near the Continental Divide, in Battle Lake, shallow water, July 14, 1953 *C. L. Porter 6325* (RM, BUT).

2. NITELLA FLEXILIS (L.) Ag. Syst. Alg., p. 124, Lund, 1824.

Descriptions and illustrations are given in Wood (10, p. 348, plate 1, 3C and plate 2, 8A), Daily (4, p. 12, plate 2A) and descriptions are in Allen (1, p. 38) and fructifications are described in Horn af Rantzien (6, p. 176, plate 2, figs. 8-14).

The distribution of this species in Wyoming (Map 2) is primarily in the mountains of the Wind River Range and one collection in the Laramie Range. Usually this species grows in streams and lakes near the inlet in deep water or in shaded and silted areas of lakes. It was found in a stream at one location in Wyoming and the possibility of shading is likely in the timbered recesses of the meadows of the Wind River Range.

Specimens seen: ALBANY COUNTY: Laramie Range, Middle Crow Creek east of Vedauwoo, 7,700 ft. In a shallow, sluggish stream. *C. L. Porter & Marjorie W. Porter 8488*, July 29, 1960. (RM, BUT). SUBLETTE COUNTY: Wind River Range, western slope, in Horseshoe Lake, in about 10 ft. of clear, cold water, 9,000 ft., August 1, 1952. *C. L. Porter 6151*, (RM, BUT); Wind River Mountains, 7 mi. due west of Fremont Peak, Lower No-name Lake, *O. H. Robertson*, August 9, 1943, (BUT). TETON COUNTY: Wind River Range near Lake of the Woods, 9,400 ft. Forming separate tufts in sandy bottom of lake in 1-3 ft. of clear water. August 8, 1956. *C. L. Porter 7198*. (RM, BUT).

3. NITELLA OPACA Ag. Syst. Alg., p. 124, Lund, 1824.

Descriptions and illustrations are given in Wood (10, p. 347, plate 1, fig. 5A, plate 2, figs. 7 B & C), Daily (3, p. 152, plate 1C), and descriptions in Allen (1, p. 37).

A single collection (Map 3) was made in Wyoming. This species is scattered over the United States and infrequently reported, usually being associated with a habitat having rock outcrops and boggy soil. In the habitat where the species was collected in Wyoming, Cretaceous shale and nearby coal deposits apparently provide the proper organic and mineral requirements.

Specimen seen: CROOK COUNTY: With *Chara globularis*, Sundance, 4,750 ft. July 8, 1896. *A. Nelson 2249a*. (RM, BUT).

4. TOLYPELLA HISPANICA var. PORTERI Daily. Butler Univ. Bot. Stud. 11:144-148. 2 pls. Nov., 1954.

Description and illustrations are given in Daily *(loc. cit.)* and the fruiting bodies of the species are described by Horn af Rantzien (6, p. 198 ff.).

Only one collection (Map 4) was made in Wyoming. Repeated attempts to find it again have failed. It was growing in a small, shallow, alkaline pond with a soft, mucky bottom (black ooze) on the Laramie plains in

southeastern Wyoming. The plants formed cushion-like tufts in about 2 feet of water. The Laramie Plains are a plateau with a short growing season, but with a great deal of sunlight because of the clear air, and this is a good agricultural center.

Specimen seen: ALBANY COUNTY: Pond 7 miles southwest of Laramie. 7,200 ft. August 25, 1952. *C. L. Porter 6191.* (RM, *isotype;* BUT, *holotype*).

5. CHARA LONGIFOLIA Robinson. Bul. N. Y. Bot. Gard. 4(13): 272. 1906.

A description is given in Robinson *(loc. cit.)*

This little known species has been found in Kansas and Iowa. Indiana was also mentioned by Robinson, but this specimen has not been found. It is described as possibly appearing dioecious, but is monoecious. The material from Wyoming has only female gametangia or fructifications.

Another collection by L. Whitford came from 2-3 ft. of water in a woods pool, one mile west of the ocean, Kill Devil Hill, Dare Co., N. C.

It is uncommon in Wyoming, but forms very extensive and deep beds in 2-10 feet of murky water in large alkaline lakes at about 5,000 to 5,500 ft. in the central and northern part of the state (Map 5).

Specimens seen: FREMONT COUNTY: Ocean Lake, forming great beds in 2-10 ft. of water. 5,200 ft. in elevation. July 17, 1953. *C. L. Porter 6332.* (RM, BUT). PARK COUNTY: Alkaline lake 2 miles east of Cody. 5,000 ft. Forming extensive beds in 2-3 ft. of water. July 21, 1955. *C. L. Porter 6790.* (RM, BUT).

6. CHARA HIRSUTA Allen. Bul. Torrey Bot. Club 27 (6): 301, plates 10 and 11, June 1900.

Descriptions and illustrations are given in Allen *(loc. cit.)* and Daily & Kiener (5, p. 42, plate 1B).

Distribution (Map 6) in Wyoming is limited to the one collection. This species was known only from the type before the collection in Nebraska (Daily & Kiener, 5) where it was found in a sandhill pond and marsh pond in Sheridan County. It was originally found in some sink-hole lakes at Lakeside, San Diego County, California. The Wyoming specimen was labeled *Chara Nelsonii* Allen. No record of publication of this name nor any other herbarium specimen of it has been found, and the specimen seems to fit the above category very well so it is placed here.

Specimen seen: ALBANY COUNTY: Soda Lakes, 10 miles southwest of Laramie. 7,300 ft. September 24, 1898. *A. Nelson 5351.* (RM, BUT).

7. CHARA CONTRARIA A. Br. ex Kütz. Phyc. Germ., p. 258, 1845.

Descriptions and illustrations can be found in Daily (3, p. 158, plate 3B), descriptions in Robinson (9, p. 265) and descriptions and illustrations of the fruiting bodies in Horn af Rantzien (6, p. 260 ff., plate 12, figs. 1-11).

Distribution for Wyoming (Map 7) is in sluggish rivers, streams, ponds and lakes often forming dense beds and this is the commonest species of charophyte there. One interesting collection came from the warm water of a

hot spring. Elevational range is from about 4,000-7,500 feet. This species seems to be well distributed over North America, being especially abundant in gravel pit ponds and lakes of glacial origin. Since there is a great degree of variation in this species, varietal names lose much of their usefulness and are used here only to point out the extremes of variation.

7a. Var. CONTRARIA

Specimens seen: ALBANY COUNTY: Porter Lake, in 2-5 ft. of murky water, alkaline muck bottom, 7,500 ft., July 22, 1952. *C. L. Porter 6032* (RM, BUT); small lake on Pablo Lane, 20 miles southwest of Laramie, shallow water, alkaline muck bottom, 7,200 ft., July 26, 1953. *C. L. Porter 6348* (RM, BUT), Laramie River east of Lookout, in 2 ft. of sluggish water, 7,000 ft., July 28, 1953. *C. L. Porter 6351* (RM, BUT); Lake Hattie, in 1-3 ft. of murky water, sandy bottom, 7,200 ft., July 11, 1955, *C. L. Porter 6769* (RM, BUT), Laramie Range, Laramie River, 6,000 ft., ponds along river, July 27, 1956, *C. L. Porter 7161* (RM, BUT). CARBON COUNTY: Near Difficulty, 6,400 ft., shallow stream in arid hills, July 14, 1955. *C. L. Porter 6778* (RM, BUT). FREMONT COUNTY: Wind River, Aug. 9, 1894, *A. Nelson 796* (RM, BUT); at Diversion Dam on Wind River, 5,600 ft. in a cattail swamp, August 18, 1954, *C. L. Porter 6618* (RM, BUT); Ocean Lake, 5,200 ft., in 3 ft. of murky water, Aug. 18, 1954. *C. L. Porter 6623* (RM, BUT). LARAMIE COUNTY: Iron Mountain, Aug. 26, 1896. *A. Nelson 2738* (RM, BUT). LINCOLN COUNTY: At the north end of the Star Valley, near Thayne, 6,100 ft., small roadside ponds, July 1, 1954. *C. L. Porter 6503* (RM, BUT). PLATTE COUNTY: Platte River in the canyon, Aug. 27, 1896. *A. Nelson 2767* (RM, BUT). SUBLETTE COUNTY: With *Chara delicatula*, near Big Piney on Quintal Ranch, 6,400 ft., shallow water of a reservoir lake, Aug. 12, 1958. *C. L. Porter & Marjorie W. Porter 7638* (RM, BUT); Wind River Mountains, west flank, 21 miles NNW of Pinedale, SE ¼, sec. 26, T. 37N, R. 110W, about 5 mi. NNW of outlet of Lower New Fork Lake, spring-fed, sink-hole lake on Bill Dew Ranch, surface temperature 69° F., at about 4 ft., 57° F., Aug. 21, 1960. *Robert C. Bright* (BUT). SWEETWATER COUNTY: Along Black's Fork, about 12 miles south of Green River, 5,600 ft., alkaline stream in shallow water, July 9, 1961. *C. L. Porter & Marjorie W. Porter 8744a* (degenerate form), and *8744b*. (RM, BUT). TETON COUNTY. Two Ocean Lake, 7,000 ft. Sandy bottom, in shallow water. Sept. 2, 1956, *C. L. Porter 7241*. (RM, BUT). YELLOWSTONE NATIONAL PARK: Mammoth Hot Springs, in a pond, July 20, 1899, *A. & E. Nelson 6022*. (RM).

7b. Var. HISPIDULA A. Br.

Specimen seen: PLATTE COUNTY: Richeau Creek, 7 mi. north of Chugwater, 5,200 ft. August 19, 1959. *C. L. Porter & Marjorie W. Porter 8033* (RM, BUT).

Included here are the specimens reported as *Chara contraria, Nelson 6022* by Nelson (8) (identified by T. F. Allen); as *Chara* sp. (Nelson, 7) and *Chara foetida* (= *C. vulgaris*) (Nelson, 8), *Nelson 796* (perhaps ecorticate juvenile filaments scattered in this collection led the collector to describe this as an unusual charophyte at first); as *C. foetida* by Nelson (8), *Nelson 2738* and *2767*.

8. CHARA VULGARIS Vaill. ex L. Sp. Pl., p. 1156. Stockholm, 1753.

Descriptions are given in Robinson (9, p. 269) and descriptions and illustrations under the name *C. foetida* can be found in Daily (3, p. 160, plates 3C & 4A), and a discussion of the var. *condensata* Breb. is in Daily (4, p. 33).

Distribution (Map 8) of this species in Wyoming is in streams and boggy places. The var. *condensata* is typically found in boggy places. Elsewhere this species seems associated with habitats fed by mineral springs. Some, at least, of the habitats in Wyoming are known to be of this category. Two collections were associated with hot springs in temperature as high

as 32° C. The elevational range is from about 4,500 to 7,200 ft. occurring in widely scattered locations over the state.

8a. Var. VULGARIS

Specimens seen: ALBANY COUNTY: Laramie, 7,200 ft., Sept. 7, 1896. *A. Nelson 2780* (RM, BUT). Rock Creek near Rock Dale, Aug. 21, 1897. *A. Nelson 4263* (RM, BUT). Laramie Range, canyon of the north fork of Sybille Creek, along Highway 34, 6,400 ft., in 6 in. water in sluggish places, Sept. 26, 1960. *C. L. Porter & Marjorie W. Porter 8534* (RM, BUT). CROOK COUNTY: Sundance Creek, 4,750 ft., July 6, 1896. *A. Nelson 2208* (RM, BUT). TETON COUNTY: Quaking bog, 2 miles southwest of Jackson, 6,000 ft., *J. F. Reed 2730*, Aug. 30, 1949 (RM, BUT). WESTON COUNTY: Cambria Canyon, July 29, 1896. *A. Nelson 2540* (RM, BUT). YELLOWSTONE NATIONAL PARK: In edge of Bath Lake (30-32° C.), Mammoth Hot Springs, Aug. 31, 1898. *W. A. Setchell* (UC, BUT).

8b. Var. CONDENSATA Bréb.

Specimen seen: YELLOWSTONE NATIONAL PARK: Narrow Gauge Terrace on moist path (25° C.) Mammoth Hot Springs, Aug. 31, 1898. *W. A. Setchell 1991*. (UC, BUT).

Included here are specimens reported as *Chara foetida* (= *C. vulgaris* in Nelson (8) identified by T. F. Allen, *Nelson 2208* and *2780*.

9. CHARA ZEYLANICA Willd. Mem. Acad. Roy. Sc. Berl. (1803): 86. 1805. Berlin.

A key including this form of *Chara zeylanica*, f. *inconstans*, occurring in Wyoming can be found in Daily (4, p. 40). A single specimen was found in Indiana, too. Since *Chara zeylanica* is more abundant in southern locations and since a lack of or irregularity in cortication seems to occur in the Characeae relative to adverse growing conditions, this form may be this kind of expression. Map 9 shows the location of the single collection in Wyoming.

Specimen seen: YELLOWSTONE NATIONAL PARK: Along the Bechler River at Three Rivers Junction, July 27, 1954. *Ross Skiver* (RM, BUT).

10. CHARA GLOBULARIS Thuill. Flor. Env. Paris, ed. 2, p. 472. 1799.

This species is described under the name of *C. fragilis* Desv. in Robinson (9, p. 279) and it is described and illustrated under the same name in Daily (3, p. 164, plate 4B). See Horn af Rantzien (6, p. 264, plate 13, figs. 1-7, p. 14, figs. 1-7, for oospores).

Distribution in Wyoming (Map 10) is in ponds and lakes at 4,500-6,400 ft. in northern Wyoming. Elsewhere this species is usually associated with ooze or finely divided soil in the substrate. The information about the Wyoming habitats where it is found suggests this condition there, too.

Specimens seen: CROOK COUNTY: Sundance, July 8, 1896. (Contains some *Nitella opaca*) *A. Nelson 2249b*. (RM, BUT). PARK COUNTY: Swampy Lake, Sunlight Basin north of Cody, 6,400 ft. Shallow water, July 21, 1955. *C. L. Porter 6793*. (RM, BUT). SUBLETTE COUNTY: Wind River Mountains, 18 mi. NNW of Pinedale and about 1.7 mi. NNW of outlet of Lower New Fork Lake, SE ¼, NW ¼, sec. 9, T. 36N, R 110W. In a kettle depression atop Wisconsin till. Bridger National Forest. Aug. 21, 1960. *Robert C. Bright* (BUT).

11. CHARA DELICATULA Ag. Syst. Alg., p. 130. Lund, 1824. (Non Desv.)

For descriptions see Robinson (9, p. 280) and descriptions and illustrations are given in Daily (3, p. 165, plate 4C), under the name *C. verrucosa*.

Distribution (Map 11) in Wyoming is in the clear water of quiet ponds and lakes, usually in isolated tufts, and often associated with tepid water from geysers or hot springs. The elevational range is 6,000-8,000 ft. It has been noted before that this species does not compete well with other aquatic plants and occurs in isolated spots.

Specimens seen: CARBON COUNTY: Long Lake, Medicine Bow Range, 8,000 ft. In 2 ft. of clear water, July 8, 1954. *C. L. Porter 6512* (RM, BUT). SUBLETTE COUNTY: Near Big Piney on the Quintal Ranch, 6,400 ft. Shallow water of reservoir lake. Aug. 12, 1958. *C. L. Porter & Marjorie W. Porter 7638* (contains some *Chara contraria*) (RM, BUT). YELLOWSTONE NATIONAL PARK: Nez Perces Creek, abundant in the warm water of the creek July 30, 1899, *A. & E. Nelson 6238* (RM); Firehole River, south of Madison Junction, 6,800 ft., in 2 ft. of tepid water of flowing stream. Aug. 5, 1953. *C. L. Porter 6384*. (RM, BUT).

Included here is the specimen reported by Nelson (8) identified by T. F. Allen as *Chara fragilis* Desv., *Nelson 6238*.

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