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Characeae of Nebraska

Fay K. Daily
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Butler University Botanical Studies

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Edited by

Ray C. Friesner

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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THE CHARACEAE OF NEBRASKA

By FAY KENOYER DAILY

Early in 1943 during the course of correspondence between W. A. Daily and Dr. Walter Kiener, it was arranged for some of the Nebraska Characeae to be sent to the author for study and identification. This taxonomic work was in conjunction with a geographical and ecological consideration of the family in Nebraska in which Dr. Kiener was interested at that time. Later that year, when he had an opportunity for an extended collecting trip for the Game and Fish Commission, Dr. Kiener conceived the idea for the related studies presented in this issue. Toward this end, specimens found at the University of Nebraska were made available and subsequent collections by Dr. Kiener were supplied for study. The object of this resulting paper is to review the Characeae already published for the state and to report additional collections. To aid other students in identification of this group a key, descriptions and illustrations are given.

A complete representation of specimens cited in this study may be found in the herbarium of the University of Nebraska, and an almost complete set may be found in the personal herbarium of the author at Butler University. Duplicate sets of the specimens collected by Dr. Kiener are now being distributed.

Terminology used is the same as that published in a convenient glossary by Groves and Bullock-Webster (15).

Five species of Nitella and nine species of Chara are included in this paper. Two species of Nitella formerly reported for Nebraska by Woods (23) and Webber (22), viz. *Nitella flexilis* Ag. and *Nitella mucronata* A. Br., are not included because specimens were not found to support these reports. *Nitella translucens* forma *confervoides* Thuill. reported by Woods (23), and possibly the same specimen reported by the Nebraska Botanical Survey III (13), is also not included because it was not found in the specimen indicated.

The author is indebted to Dr. Walter Kiener of the Conservation and Survey Division of Nebraska for suggesting this work and aiding in assembling plants and literature for study; to the University of Nebraska for the loan of specimens; to Dr. Ray C. Friesner of

Butler University for making available the facilities of the Butler University Botany Department and for making helpful suggestions; to Dr. C. M. Palmer and Dr. J. E. Potzger of Butler University for offering encouragement and advice; to Dr. Francis Drouet of the Chicago Natural History Museum for making available the facilities of the cryptogamic herbarium of the museum and for constructive criticism; and to W. A. Daily of the Butler University Herbarium for helpful suggestions.

KEY TO THE CHARACEAE OF NEBRASKA

Coronula composed of two superimposed rows of five cells each.
Antheridia terminal ..... NITELLA
Ultimate rays of branchlets one-celled. Coronula deciduous.
Monoecious.
Heterophyllous (branchlets of two sorts; accessory, simple branchlets produced below and alternately with once-furcate branchlets.....
.....1. *Nitella clavata*
Homoeophyllous (branchlets' similar, once-furcate).....
.....2. *N. subglomerata*
Dioecious; branchlets simple, once-furcate.....3. *N. opaca*
Ultimate rays of branchlets all two-celled, one-half total length of branchlet.
Coronula persistent .....4. *N. batrachosperma*
Ultimate rays of branchlets two to three-celled, length insignificant as compared with total branchlet, especially in sterile branchlets. Coronula persistent .....5. *N. axillaris*
Coronula composed of one row of five cells. Antheridia produced below oogonia in monoecious species .....CHARA
Ecorticate; stem and branchlets naked.....6. *Chara coronata*
Corticated; stem and portions of branchlets covered by a sheath consisting of longitudinal rows of cells.
Stem falsely haplostichous; secondary cells developed, but extend only a very short distance from node.....7. *C. evoluta*
Stem diplostichous; secondary cells sometimes overlap a short distance.
Primary cells prominent.....8. *C. contraria*
Secondary cells prominent .....9. *C. foetida*
Stem triplostichous, sometimes irregular.
Lowest branchlet internode diplostichous.
Monoecious.
Cells equal in diameter and rather regularly corticated.....
.....10. *C. fragilis*
Cells unequal in diameter; primary cells larger and more prominent, regularly triplostichous.....11. *C. verrucosa*
Dioecious; cells about equal in diameter and prominence, irregularly triplostichous due to long overlapping secondary cell ends.....
.....12. *C. aspera*

Lowest branchlet internode ecorticate, next internode triplostichous, rarely all naked.

Antheridia and oogonia conjoined (borne at same node).....13. *C. gymnopus*

Antheridia and oogonia disjoined (borne at different nodes).....14. *C. sejuncta*

1. NITELLA CLAVATA (Bertero) A. Br., Char. Aust. Hook. Journ. 1: 195. 1849.

Plate I-A

Habit lax in lower portions, crowded in upper, about 10 cm. high; monoecious; branchlets heterophyllous, i. e. whorl is compound with once-divided branchlets occurring alternately with and directly above simple undivided ones; sometimes there is no simple branchlet found between divided branchlets, or, perhaps more than one can be found there; about six divided branchlets at node, each bearing 2-4 one-celled ultimate rays; ultimate rays inflated, sharply-pointed; simple branchlets also inflated and sharply-pointed in upper portions of plant, linear in lower portions; oogonia 1-3 at node of divided branchlets in upper portion of plant, coronulae short and not deciduous; oospores red brown, 0.27-0.32 mm. long, 0.27-0.32 mm. wide with 6-7 sharply flanged ridges; membrane red brown, surface minutely granulated, translucent; antheridia about 0.27 mm. in diameter. Specimens seen: PERKINS COUNTY: mud of intermittent pool east of Grant, *Walter Kiener 10779,* Aug. 4, 1941.

2. NITELLA SUBGLOMERATA A. Br. Characeen aus Colombia, Guyana und Mittelamerika. Monatsbericht Berlin Akad. p. 356. 1858. *Nitella acuminata var. subglomerata* A. Br. of later publ.

Plate I-B

Habit spreading and diffusely branched; plants about 20 cm. high; stem about 1.0 mm. wide, sterile branchlets slightly narrower; monoecious; sterile verticels somewhat exceeding fertile verticels, i. e. sterile branchlets are about 2-7 cm. long and overtop the fertile whorls which are about 3-5 mm. long and which are borne on peduncles of varying length located in the axils of the sterile whorls; branchlets similar; fertile branchlets 6-8 at node, once-divided into 2-4 one-celled terminal rays which gradually taper to a point and which are about one-third to one-half the total length of the branchlet; sterile branchlets 6-8 at node, once-divided into 2-3 one-celled terminal rays which gradually taper to a point and which are about one-

third to one-half the total length of the branchlet; fructification not enveloped in jelly; oogonia 1-3 at a node; coronulae short, persistent; oospores with 6-7 ridges, 0.24-0.28 mm. long, about spherical, red-brown; membrane light brown, translucent, roughened with irregular granules which give the appearance of reticulation in mature oospores when a 15X ocular and 10X objective are used; in immature oospores, granules are scattered and even not seen in some cases; antheridia about 0.32 mm. in diameter.

No specimens were seen to support the following report: Woods (23), *"Nitella subglomerata* A. Br.—Minden."

Specimens seen: LANCASTER COUNTY: pond south of penitentiary near Lincoln, collector unknown, July 30, 1891 (probably the basis of Webber's (22) report, *"N. acuminata* A. Br. var. *glomerata* A. Br. Ponds near Lincoln (Bessey)." YORK COUNTY: with *C. coronata* Ziz., *May Hopper 625*, June, 1891; York, *May Hopper*, 1893 (probably the basis of Woods' (23) report, *"Nitella subglomerata* A. Br.—York.")

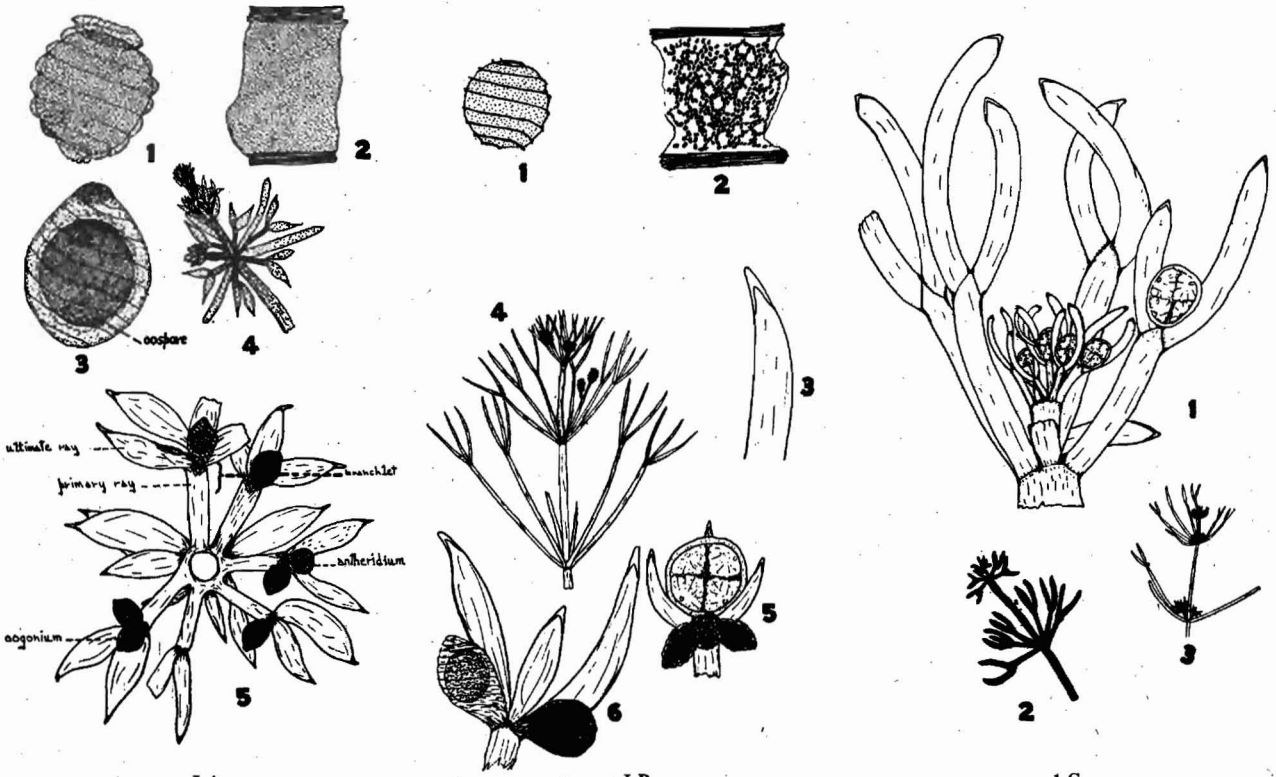
3. NITELLA OPACA Ag. Syst. Alg. p 124. 1824.

Plate I-C

Habit elongate and lax, not greatly branched, stem internodes usually two to four times length of branchlets; dried plants dark green and opaque; dioecious; stem about 0.8 mm. wide; fertile verticels usually contracted into dense heads but sometimes lax; sterile verticels elongate, spreading; branchlets of fertile verticels up to 4-5 mm. long, once-furcate into 2-3 one-celled, rather blunt ultimate rays with mucronate tips; branchlets in sterile whorls 6-7, up to about 3-4 cm. long, variable in length, simple or once-furcate into 2-3 one-celled bluntish ultimate rays with mucronate tips; fertile verticels not enveloped in jelly; no mature oogonia seen in material examined, but Braun (14) reported, "Nord-Amerika.—Sporangienkern 0.36-42 mm. lang, 0.32-35 mm. dick." (Braun used this method to indicate 0.36-0.42 mm. etc.); antheridia up to 0.74 mm. in diameter—still probably not mature.

Included here is the specimen reported by Woods (23), *"Nitella opaca* Ag.—Deadman's Run, Lincoln."

Specimens seen: LANCASTER COUNTY: Deadman's Run, Lincoln, *H. J. Webber 7430, 7431*, May, 1890, and *6093*, May 1890. (It is uncertain whether the following citation refers to any of these specimens:



I-A I-B 1-C

I-A. NITELLA CLAVATA A. Br. 1. Oospore. 2. Portion of the membrane of the oospore. 3. Oogonium. 4. Portion of plant, natural size. 5. Fertile verticel seen from above.

I-B. NITELLA SUBGLOMERATA A. Br. 1. Oospore. 2. Portion of the membrane of the oospore. 3. Apex of branchlet. 4. Portion of the plant, natural size. 5. Portion of young fertile branchlet. 6. Portion of the older fertile branchlet.

I-C. NITELLA OPACA Ag. 1. Tip of male plant enlarged. 2. Portion of male plant, natural size. 3. Portion of female plant, one-half natural size (reproduced from Woods, 23, Pl. XXVII).

Bessey and Webber (12), "*Nitella opaca* Ag. 834½. In small, stagnant pond, Lincoln, May 5, 1890. A medium sized dioecious species found in considerable quantity by Mr. Shimek, of the State University.")

4. NITELLA BATRACHOSPERMA A. Br. in N. Denks. Schweiz. Ges. Naturw. 10:10. 1847. (nomen.); in Cohn's Krypt. Fl. Schles p. 400. 1876. non Agardh.

Plate II-A.

Habit similar to *N. tenuissima*, small and delicate, stem internodes 1-3 times length of branchlets; monoecious; branchlets similar, 8 in whorl, about 1.0-1.5 mm. long, 1-2 furcations with secondary rays about 4 and ultimate rays about 4; ultimate ray about one-half length of whole branchlet, uniformly two-celled ending in slender sharply-pointed mucro; fertile verticel not enveloped in jelly (some forms may be enveloped according to the literature); oogonia borne singly at the first and sometimes the second furcation; coronulae small, persistent; oospores bear 6-7 flanged ridges, about 0.19 mm. long and about as broad, dark brown; membrane showing interrupted reticulation, translucent, pliable; no mature antheridia seen.

Specimen seen: PERKINS COUNTY: bottom of intermittent pool east of Grant, *Walter Kiener 10641a*, Aug. 1, 1941.

5. NITELLA AXILLARIS A. Br. Monatsber. der Berl. Akad. p. 355. 1858.

Plate II-B.

Habit slender, not greatly branched, bearing about 8 branchlets at a node; sterile branchlets long, spreading; fertile verticels contracted into axillary heads; monoecious; fertile branchlets with about 2-3 furcations, primary ray 0.11 mm. by 0.42 mm., at first furcation 4 secondary rays 0.08 mm. by 0.32 mm., at second furcation 3-4 ultimate rays or tertiary rays as the case may be 0.05 by 0.1-0.53 mm.; if divided again, usually 3-4 ultimate rays about the same size as the tertiary rays; ultimate ray two-celled ending in mucro 0.02-0.025 mm. in width at base by 0.05-0.1 mm. long; sterile branchlets once-furcate ending in crown of 4 minute 2-celled rays 0.04 mm. wide by 0.1 mm. long or shorter; oogonia aggregated at either first or second node; coronulae rather long, persistent; oospores have 5-7 ridges, 0.27 mm. by 0.24 mm., light brown; membrane bears 4-5 reticulations to

each 0.027 mm., light brown, translucent; antheridia about 0.3 mm. in diameter.

Included here is the specimen reported by Woods (23) as *Nitella translucens* Pears. and Nebraska Botanical Survey Report for 1893 (13) as the same.

Specimen seen: YORK COUNTY: with *Chara coronata* Ziz., *May Hopper 625,* June, 1891.

6. CHARA CORONATA Ziz. A. Br. Ann. d. sc. Nat. Series 2, 1: 353. 1834; Flora 18 (1): 59. 1835.

Plate II-C.

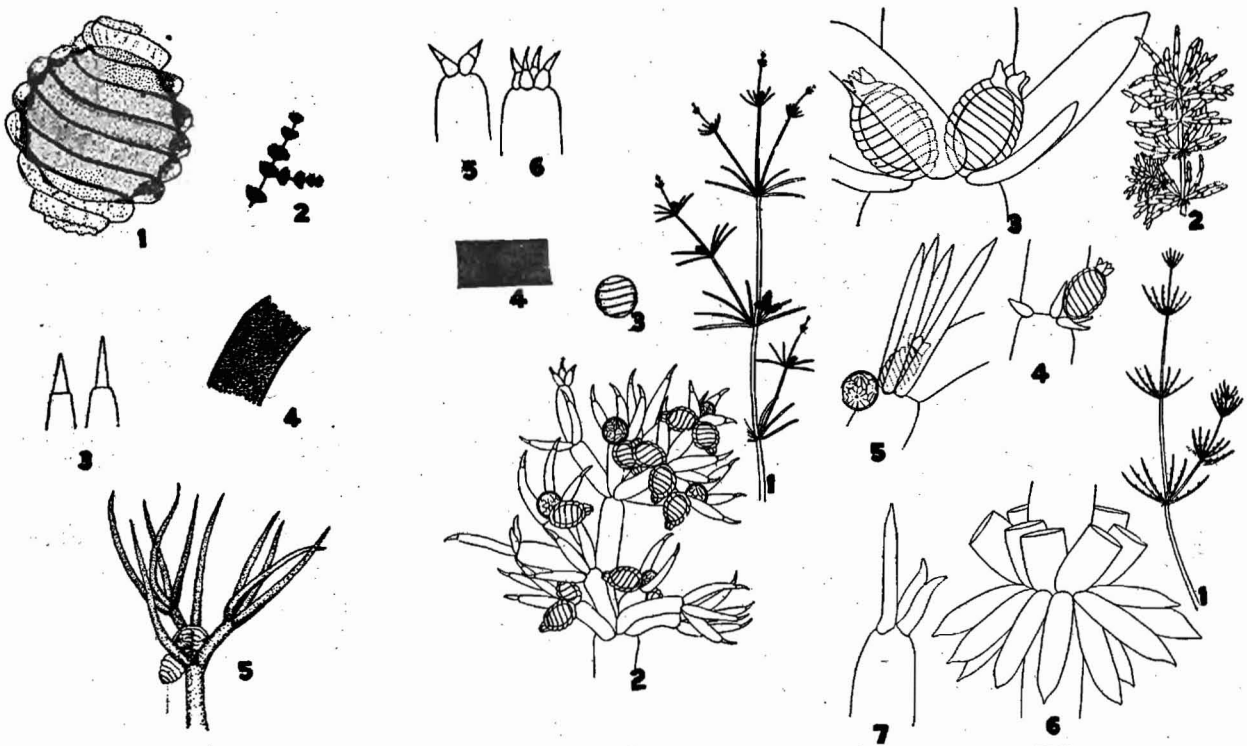
Habit sometimes tufted, stem and branchlets entirely uncorticated and usually unincrusted, so generally not rigid, often frequently branched; 8-10 branchlets bearing a variable number of segments tipped by a crown of short bract cells surrounding an equally short terminal cell; monoecious; stipulodes in one series alternate with the branchlets and varying greatly in size; bracteoles slightly shorter to a little longer than oogonia, variable; posterior bract cells developed or entirely lacking, variable; oospores with 7-9 ridges, 0.43-0.58 mm. long, dark brown to black; membrane dark brown to light brown, granular; antheridia found up to 0.4 mm. in diameter.

Included here are the specimens reported by Smith and Pound (21), *"Chara coronata* A. Br. In small lake, Cherry county, July 18. (265)."; Woods (23), *"Chara coronata* Ziz. The specimens in the herbarium of the Botanical Survey from Cherry county and from Greenwood . . .".

No specimens were seen to support the following reports: Bessey and Webber (12), ". . . Belmont; Ft. Robinson, July 29."; Pound and Clements (19), *"C coronata* . . . pools and small lakes in the wet valleys of the Loup district."

Some authors have divided *Chara coronata* Ziz. into subspecies *Chara braunii* Gmelin and *Chara Schweinitzii* A. Br. representatives of which might be recognized in specimens from Nebraska. Confusing intermediates occur, however, so the present paper only points these out as the extremes of *Chara coronata* Ziz. that may be found.

Robinson (20) who cites illustrations found in Woods (23) Pl. 30, figs. 1, 4 and Pl. 30, figs. 2, 3, 5-7 respectively gives these a tentative differentiation as follows:



II-A

II-B

II-C

II-A. NITELLA BATRACHOSPERMA (Reich.) A. Br. 1. Oospore. 2. Portion of plant, natural size. 3. Tips of two branchlets showing mucro on each. 4. Portion of membrane of oospore. 5. Fertile branchlet.

II-B. NITELLA AXILLARIS A. Br. (Rearranged and reproduced from Woods, 23, Pl. XXIX, Nitella translucens.) 1. Portion of plant, one-half natural size. 2. Fertile verticel. 3. Oospore. 4. Portion of the membrane of the oospore. 5, 6. Tips of sterile branchlets.

II-C. CHARA CORONATA Ziz. (Rearranged and reproduced from Woods, 23, Pl. XXV.) 1. Portion of plant, one-half natural size. 2. Portion of plant, one-half natural size. 3, 4, 5. Fertile branchlet nodes. 6. Stem with bases of branchlets, showing stipulodes. 7. Tip of branchlet.

"Bracteoles shorter than the mature sporocarp; posterior leaflets nearly always wanting. (In key.)

Stipulodes—0.4-0.8 mm. long and 0.17-0.21 mm. wide (In text.)

C. Braunii Gmelin

Plate II-C, figs. 1,4.

Bracteoles at least as long as the mature sporocarps (In key.)

Stipulodes—usually 1.5-3.5 mm. long and 0.56-1.5 mm. wide (In text.)

C. Schweinitzii A. Br."

Plate II-C, figs. 2, 3, 5, 7.

Specimens seen: CASS COUNTY: in ponds at Greenwood, *J. G. Smith,* July 2, 1890. CHERRY COUNTY: *J. G. Smith* and *Roscoe Pound 265,* July 18, 1892; with *Chara fragilis* Desv., *J. G. Smith* and *Roscoe Pound 262,* July 19, 1892; at Simean, *John M. Bates,* July 21, 1892; Wood Lake, *John M. Bates,* Aug. 13, 1898; with *Chara fragilis* Desv., Hackberry lake, *Palmatier* and *Porter,* June 11, 1936. FILLMORE COUNTY: soil of intermittent pool west of Fairmont, *Walter Kiener 10401,* July 21, 1941; wet soil of intermittent pool at Shickley, *Walter Kiener 11056,* Aug. 14, 1941. FRANKLIN COUNTY: shallow water of intermittent pool south of Macon, *Walter Kiener 11044,* Aug. 13, 1941. HAMILTON COUNTY: on bottom of intermittent pool southwest of Aurora, *Walter Kiener 10415,* July 21, 1941. KEITH COUNTY: with *Chara contraria* A. Br., pools on Whitetail creek near Keystone, *Walter Kiener 15607,* Sept. 20, 1943. PERKINS COUNTY: bottom of intermittent pool east of Grant, *Walter Kiener 10641,* Aug. 1, 1941. PHELPS COUNTY: submerged on bottom of intermittent pool near Loomis, *Walter Kiener 10446,* July 23, 1941. THOMAS COUNTY: stagnant ponds at Thedford, *H. J. Webber 6524 (No. 5),* July 14, 1889 (this may be the specimen referred to by Bessey and Webber, 12, "833. *Chara coronata* A. Br. Very common in the ponds of central and western Nebraska. Thedford, July 10." Collection date is different however). YORK COUNTY: *May Hopper 625,* June, 1891 (probably the basis of Woods', 23 report, "*Chara coronata* Ziz. The specimens collected at York 1893 by Miss Hopper . . .").

7. CHARA EVOLUTA Allen. Bull. Torrey Bot. Club 9: 41. pl. 19. 1882.

Plate III-A.

Habit short, much branched, very spinose; monoecious; stem falsely haplostichous having secondary cells developed but usually only extended a very short distance either side of the node; spine cells single to three together usually two together—one short and one

long, may be two long ones together; stipulodes in two series, well developed, variable; lowest branchlet internode haplostichous; tip of branchlet made up of a short uncorticated cell surrounded by a tuft of bract cells; bracteoles long up to about twice length of oogonium; posterior bract cells slightly shorter; oospore with 10-12 inconspicuous ridges, about 0.58 mm. long, dark brown to black; membrane light to dark brown, granular; antheridia 0.27-0.37 mm. in diameter.

Included here are specimens reported by: Woods (23) as *"Chara evoluta* Allen. In a lake, Sheridan county, Smith and Pound No. 264."; Smith and Pound (21), *"Chara foetida* A. Br. var. *longibracteata* A. Br. Ponds in wet valleys, Sheridan county, July 12, 13. (264)"; Bot. Surv. of Neb. III (13), *"Chara evoluta* Allen. Sheridan county, part of material reported as *C. foetida longibracteata* in 1892 Report. (265½)"; Anderson and Walker (10), "Phalaris lake—*C. evoluta.*"

Robinson (20) cited illustration by Woods (23) Pl. 34.

Specimens seen: CHERRY COUNTY: with *Chara contraria* A. Br., *J. G. Smith* and *Roscoe Pound 263,* July 15, 1892; "Phalaris" lake, *Elda R. Walker* 38, July 1912. SHERIDAN COUNTY: lake, *J. G. Smith* and *Roscoe Pound 264,* July 19, 1892. SIOUX COUNTY: with *Chara foetida* A. Br., Pine Ridge, *Webber,* June 29, 1889.

8. CHARA CONTRARIA A. Br. Übersicht der Schweizerischen Characeen (neue Denkschriften d. allegemeinen schweizerischen Gesellschaft für die gesammten Naturwissenschaften 10. 1849). Kutz. Phyc. Germ. p. 258. 1845.

Plate III-B

Habit variable, not greatly branched, at times loose and rough in appearance similar to *Chara foetida,* but usually more rigid; monoecious; stem diplostichous, primary cells prominent (sometimes cells almost equal), sometimes regular, but more often irregular with secondary cell ends slipping past one another a considerable distance or with secondary cells developed from both sides of a node but one developed only in one direction; spine cells variable, usually short spines in younger portions of stems, in older portions usually deciduous, in some varieties may develop to considerable length, however; stipulodes in two series, usually short, blunt, deciduous in many cases leaving only scars; lowest internode of branchlet diplostichous; tip of branchlet with 1-5 ecorticate cells, end cell usually the shortest; bracteoles variable, from shorter than to 6-7 times as long as oogonia;

posterior bract cells usually papilliform but sometimes developed to as long as 5 times their breadth; coronulae of oogonia usually short and connivent; oospores bearing 9-14 ridges, sometimes extending downward to form basal claws or cage, 0.48-0.74 mm. long, dark brown to black; antheridia up to 0.58 mm. in diameter when mature.

Included here are the specimens reported by Smith and Pound (21) as *Chara contraria* A. Br. "Ponds in wet valleys, Cherry county, July 17, 18. (263)"; Woods (23), as *Chara contraria* A. Br. "Ponca river, Boyd county."

No specimens were seen to support the reports of Anderson and Walker (10) for *Chara contraria* in Hackberry lake, in Watts lake and in Phalaris lake; Webber (22), "149. *C. contraria* A. Br. Flowing or standing water and cold springy lakes. Fremont. July (Williams)"; Woods (23), as *Chara contraria* A. Br. "Fremont"; Pound and Clements (19), "pools and small lakes in the wet valleys of the Loup district."

Robinson (20) cites illustration by Woods (23) Pl. 31.

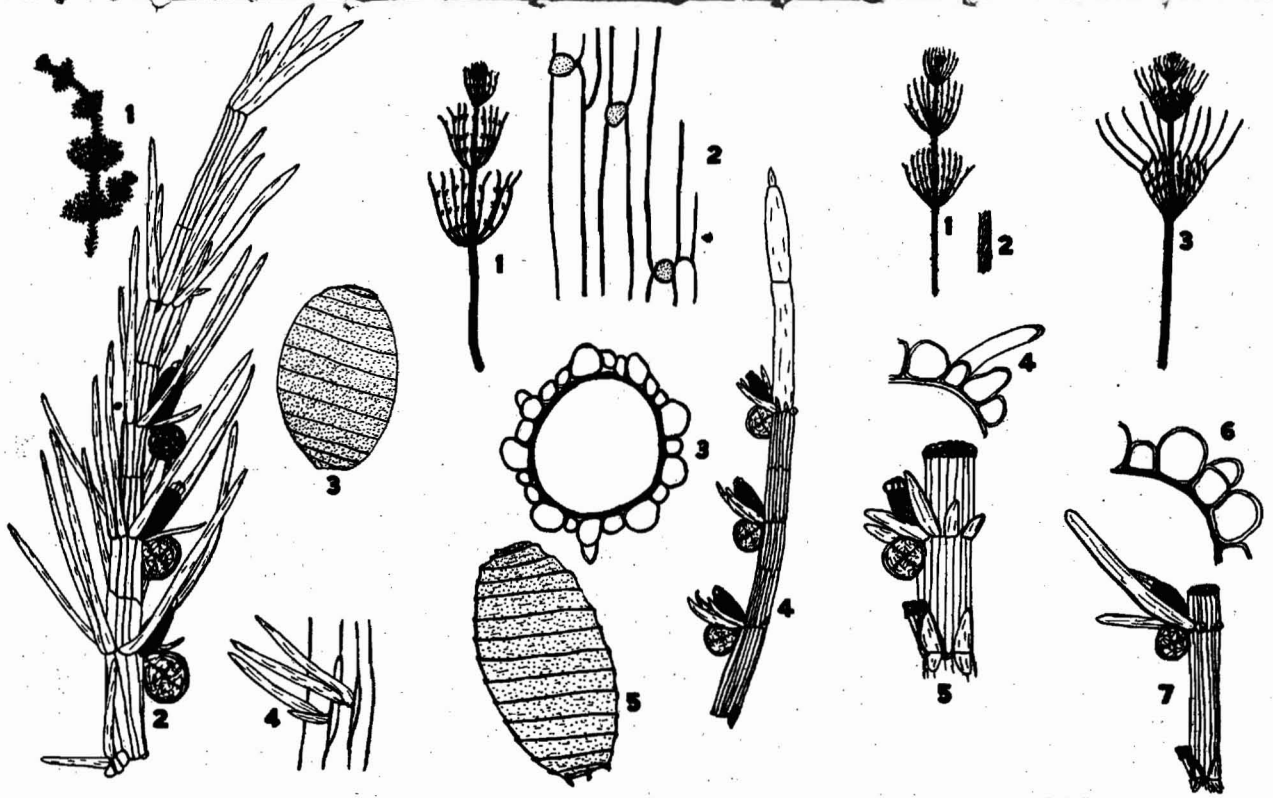
Specimens seen: (Specimens labeled here and elsewhere in this paper as "probable" are so mentioned since complete observations were not possible due to the state of preservation of the material, but enough characteristics were seen to be reasonably sure of identification.) ARTHUR COUNTY: probably *Chara contraria* A. Br. with *C. fragilis* Desv., in intermittent sandhill pool, 3 mi. south of Arthur, *Walter Kiener 15444,* Sept. 10, 1943. BOYD COUNTY: Ponca river, *Clements,* 1893. BUFFALO COUNTY: gravel pit pond south of Kearney, *Walter Kiener 15181,* Sept. 1, 1943. CHASE COUNTY: probably *C. contraria* in shallow water of swamp, Spring creek valley, *Walter Kiener 10753,* Aug. 3, 1941; mud of intermittent pool, Imperial, 5 mi. north, *Walter Kiener 10807,* Aug. 6, 1941. CHERRY COUNTY: *J. G. Smith* and *Roscoe Pound 263,* July 15, 1892 (probably the basis of Wood's, 23 report of *Chara contraria* A. Br. from ponds in Cherry county); Watts lake, *J. M. Bates 10,* 1894; Wood Lake, *J. M. Bates 655,* July 30, 1897; Hackberry lake, *Palmatier* and *Porter,* June 11, 1936. DAWES COUNTY: Crawford, *J. M. Bates 659,* July 13, 1897; at Wood Lake, Crawford, *J. M. Bates 7279,* date (?). DAWSON COUNTY: gravel pit pond at Lexington, *Walter Kiener 15218,* Sept. 2, 1943; probably *C. contraria* A. Br. in gravel pit pond at Lexington, *Walter Kiener 15985, 15986, 15987, 15988, 15989, 15990, 15996,* Oct. 14, 1943; in gravel pit pond at Lexington, *Walter Kiener 15991,* Oct. 14, 1943; probably *C. contraria* A. Br. in sandpit lake at

Lexington, *Walter Kiener 15997,* Oct. 14, 1943. DUNDY COUNTY: on mud in shallow creek, Rock Creek recreation grounds, *Walter Kiener 10538a,* July 26, 1941. GARDEN COUNTY: probably *C. contraria* A. Br. in North Platte river pool south of Oshkosh, *Walter Kiener 16243* and *16244,* Nov. 6, 1943. HALL COUNTY: gravel pit pond near Grand Island, *Walter Kiener 15158* and *15160,* Aug. 28, 1943; probably *C. contraria* A. Br. in gravel pit near Grand Island, *Walter Kiener 16397,* Feb. 4, 1944. HAMILTON COUNTY: on shallow bottom of pond, Platte river near Phillips, *Walter Kiener 10422,* July 22, 1941; submerged in pond, Platte river near Phillips, *Walter Kiener 11123,* Aug. 19, 1941; with *C. fragilis* Desv. submerged in sandpit lake, Platte river near Phillips, *Walter Kiener 14852* (in portion preserved in formalin), *14857,* July 30, 1943; submerged in sandpit lake, Platte river near Phillips, *Walter Kiener 14853, 14854, 14854a, 14854b, 14854c, 14855, 14856,* July 30, 1943; probably *C. contraria* A. Br. in gravel pit west of Phillips on Platte river, *Walter Kiener 16408, 16409, 16410,* Feb. 4, 1944. HITCHCOCK COUNTY: shallow water of intermittent pool, Stratton, Republican river pools, *Walter Kiener 10911,* Aug. 8, 1941. KEITH COUNTY: shallow water of intermittent pool at Ogalalla, South Platte river, *Walter Kiener 10683,* Aug. 1, 1941; gravel pit pond at Ogalalla, *Walter Kiener 15345,* Sept. 7, 1943; gravel pit pond at Kingsley Dam, *Walter Kiener 15488, 15493, 15496,* Sept. 13, 1943; gravel pit pond at Kingsley Dam, *Walter Kiener 15526, 15539, 15540, 15541, 15542,* Sept. 14, 1943; pools on Whitetail creek near Keystone, *Walter Kiener 15607* and *15607a* Sept. 20, 1943; with *C. fragilis* Desv. in dried-up pool west of Keystone, *Walter Kiener 15704,* Sept. 24, 1943; with *C. fragilis* Desv. in sandhill pond, Kingsley Dam, 9 mi. north, *Walter Kiener 16080, 16081,* Oct. 27, 1943; probably *C. contraria* A. Br. with *C. fragilis* Desv. in sandhill pond, Kingsley Dam, 9 mi. north, *Walter Kiener 16082,* Oct. 27, 1943. LINCOLN COUNTY: creek on flood plain, Platte river near Sutherland, *Walter Kiener 14899,* Aug. 1, 1943.

9. CHARA FOETIDA A. Br. Ann. Sci. Nat. ser. 2, I: 354. 1834. *Chara vulgaris* L. Sp. Pl. 1156. 1753.

Plate III-C and IV-A.

Habit spreading; stem moderately stout, branchlets 6-11 in a whorl; monoecious; stem diplostichous, secondary cells prominent, sometimes irregular; spine cells variable, usually papilliform or short, but in some varieties quite long; stipulodes in two series usually



III-A III-B III-C

III-A. CHARA EVOLUTA Allen. 1. Portion of plant, natural size. 2. Fertile branchlet with stipulodes at its base. 3. Oospore. 4. Portion of stem cortex.

III-B. CHARA CONTRARIA A. Br. 1. Portion of plant, natural size. 2. Portion of the stem cortex. 3. Transverse section of the stem. 4. Fertile branchlet. 5. Oospore.

III-C. CHARA FOETIDA A. Br. 1. Portion of plant, natural size. 2. Portion of stem showing size attained. 3. Portion of plant, natural size. 4. Portion of transverse section of the stem. 5. Basal portion of a branchlet. 6. Portion of a transverse section of the stem. 7. Basal portion of a branchlet.

short, stout, and blunt; lowest branchlet internode diplostichous; tip of branchlet of 1-4 ecorticate cells sometimes forming a long whip-like extremity; bracteoles from about as long as oogonia to 5 times their length; posterior bract cells usually papilliform, but sometimes length developed to 4-5 times breadth; oospores with 10-14 ridges, 0.53 to 0.74 mm. long, brown to black; antheridia up to 0.58 mm. in diameter.

Included here are specimens reported by Bessey (11) in a supplementary list, "89. *Chara foetida* A. Br. collected by J. M. Bates at Valentine, (Bessey)."; Bessey and Webber (12), "834. *Chara* sp. in ponds . . . Thedford; Belmont.": Woods (23), *"Chara foetida* A. Br. Form *subinermis longibracteata* A. Br. Pumpkinseed creek, Cheyenne county; Kimball; Ponca river, Boyd county. Form *subhispida microptila* et *brachyteles* A. Br. Buffalo Creek, Haigler. *Chara crassicaulis* Schleich. Form *subinermis macrophylla* and Form *subhispida macrophylla longibracteata* Pine Ridge (type and forms mixed), Haigler form 2."; Nebraska Bot. Surv. III (13), *"Chara crassicaulis* Schleich. Haigler (3366, 3367), Pine Ridge. (3368)."

No specimens were seen to support the following reports: Woods (23), "Form *subinermis longibracteata* A. Br., Cherry county. Form *subhispida macroptila* et *macroteles*. Cherry county.". Anderson and Walker (10), *"Chara foetida rabenhorstii";* Pound and Clements (19) reported *Chara foetida longibracteata* A. Br. from "pools and small lakes in the wet valleys of the Loup district."

The specimen reported by Smith and Pound (21) as *Chara foetida* A. Br. var. *longibracteata* (264) was changed in the Nebraska Bot. Surv. III (13) to *Chara evoluta* Allen and appears as such in this paper.

Robinson (20) cites illustration in Woods (23) Pl. 32.

Some authors have divided the group of plants within the range of the above description into numerous varieties, subspecies, or new species many of which might be recognized in the Nebraska Characeae. However, the extent of variation within this species complex and even in the same plant sometimes results in considerable confusion; so for the present the following possibilities are cited only to show the extremes that may be found:

(subsp.) *crassicaulis* A. Br.—stem stout, secondary cortical cells very prominent; posterior bract cells about twice as long as broad (sometimes shorter); oospores 0.52-0.62 mm. long; spine cells short and blunt; branchlets short, incurved. Plate IV-A, figs. 1, 4, 6.

(Specimen illustrated: Dawes county, Fort Robinson, *H. J. Webber 6533,* July 31, 1889.)

(var.) *subhispida* A. Br.—stem stout, secondary cortex very prominent, irregular; posterior bract cells usually long; bracteoles long; oospores 0.46-0.55 mm. long; spine cells long and deciduous; branchlets long. Plate III-C, figs. 1, 2, 4, 5.

(Specimen illustrated: Dundy county, Buffalo creek, Haigler, *Woods* and *Saunders, Bottle C,* Aug. 4, 1893.)

(var.) *longibracteata* A. Br.—stem stout; cortex regular; bracteoles up to six times length of fruit; spine cells short. Plate III-C, figs. 3, 6, 7, (Specimen illustated: Keith county, gravel pit pond, Kingsley Dam, *Walter Kiener 15490,* Sept. 13, 1943.)

(sp. nov.) *Chara intumescens* Robinson—(Woods' illustration of *Chara crassicaulis* forma *subhispida longibracteata* cited) stem stout; cortex regular, cells about equal; posterior bract cells papilliform to 4 times as long as broad; bracteoles usually greatly exceeding oogonia; oospores 0.56-0.63 mm. long; spine cells variable. Plate IV-A, figs. 3, 5, 7.

(Specimen illustrated: Dundy county, Haigler, *Woods* and *Saunders,* Aug. 4, 1893.)

Specimens seen: BANNER COUNTY: probably *Chara foetida* A. Br. Pumpkinseed valley in creek, *Rydberg,* no date given but date on newspaper in which wrapped was Aug. 11, 1891. CASS COUNTY: Louisville, probably *Smith* and *Pound,* about 1892. BOYD COUNTY: Ponca river, *Clements,* 1893. CHERRY COUNTY: probably *C. foetida,* Valentine, *John M. Bates,* June 1890; Valentine, *John Bates,* Aug. 26, 1891; probably *C. foetida,* Valentine, *Bates 58b,* Aug. 26, 1891; Wood Lake, *J. M. Bates 7280, 1146,* Aug. 13, 1898; with *C. fragilis* Desv., Watts lake, *Elda Walker 42,* July 17, 1912. DAWES COUNTY: Pine Ridge, *Webber,* June 29, 1889 (Herbarium sheet no. 2776 in the Univ. of Neb. Herb. was apparently *C. foetida* alone, but sheet no. 2774 bearing similar label had some *C. evoluta* mixed with it.); pond in canyon, Belmont, *H. J. Webber 6534 (no. 2),* July 20, 1889; Fort Robinson, *H. J. Webber 6533,* July 31, 1889; Crawford, *J. M. Bates,* June 23, 1891; Crawford, *J. M. Bates 658* and *7287,* July 13, 1897. DUNDY COUNTY: Haigler, *Woods* and *Saunders Bottle C, Bottle D,* one without label, Aug. 4, 1893. GREELEY COUNTY: Greeley Center, *Tom A. Williams,* date (?) (This probably is the specimen reported by H. J. Webber, 22, "150. *C. fragilis* Desv. In ponds. Greeley Center —Williams)". KEITH COUNTY: gravel pit pond, Kingsley Dam,

Walter Kiener 15490, Sept. 13, 1943. KIMBALL COUNTY: Kimball, *Rydberg,* 1891. MERRICK COUNTY: U. P. sand pit, Central City, *Irene Mueller,* July 4, 1936. MORRILL COUNTY: probably *C. foetida* A. Br., Pumpkinseed creek, *Jared G. Smith,* Aug. 23, 1889. SIOUX COUNTY: Canyon creek, Hat Creek Basin, *H. J. Webber 6535,* Aug. 2, 1889. THOMAS COUNTY: Thedford, *H. J. Webber 6525 (No. 4),* July 10, 1889, *6526,* Aug. 7, year (?), *6527 (Th. 14), 6528 (Th. 14), 6529 (Th. 14), 6530, 6531 (Th. 14), 6532,* date (?).

10. CHARA FRAGILIS Desv. in Loiseleur Not. aj. Fl. France p. 157. 1810.

Plate IV-B.

Habit variable, slender; stem internodes slightly longer than branchlets; whorls of 9 branchlets; monoecious; stem regularly triplostichous, cells about equal; spine cells usually undeveloped, at times, however, papillae are formed; stipulodes in two series, usually rudimentary but occasionally developed; lowest branchlet internode diplostichous; tip of branchlet made up of 1-3 short ecorticate cells; bracteoles usually much shorter than but sometimes as long as oogonia; posterior bract cells undeveloped or papilliform; coronulae usually of long, slender, connivent cells; oospores with 10-14 ridges usually extended downward into a cage, 0.48-0.66 mm. long, dark brown to black; antheridia up to 0.42 mm. in diameter.

Included here is the specimen reported by Smith and Pound (21), "*Chara fragilis* Desv. In small lake, Cherry county, July 19. (262)".

No specimens were seen to support the following reports: Webber (22), "150. *C. fragilis* Desv. In ponds, Greenwood, Fremont. (Williams)."; Anderson and Walker (10), "Phalaris lake. *Chara fragilis";* Pound and Clements (19), *C. fragilis* from "pools and wet valleys of the Loup district."

Robinson (20) cited illustration in Woods (23) Pl. 35.

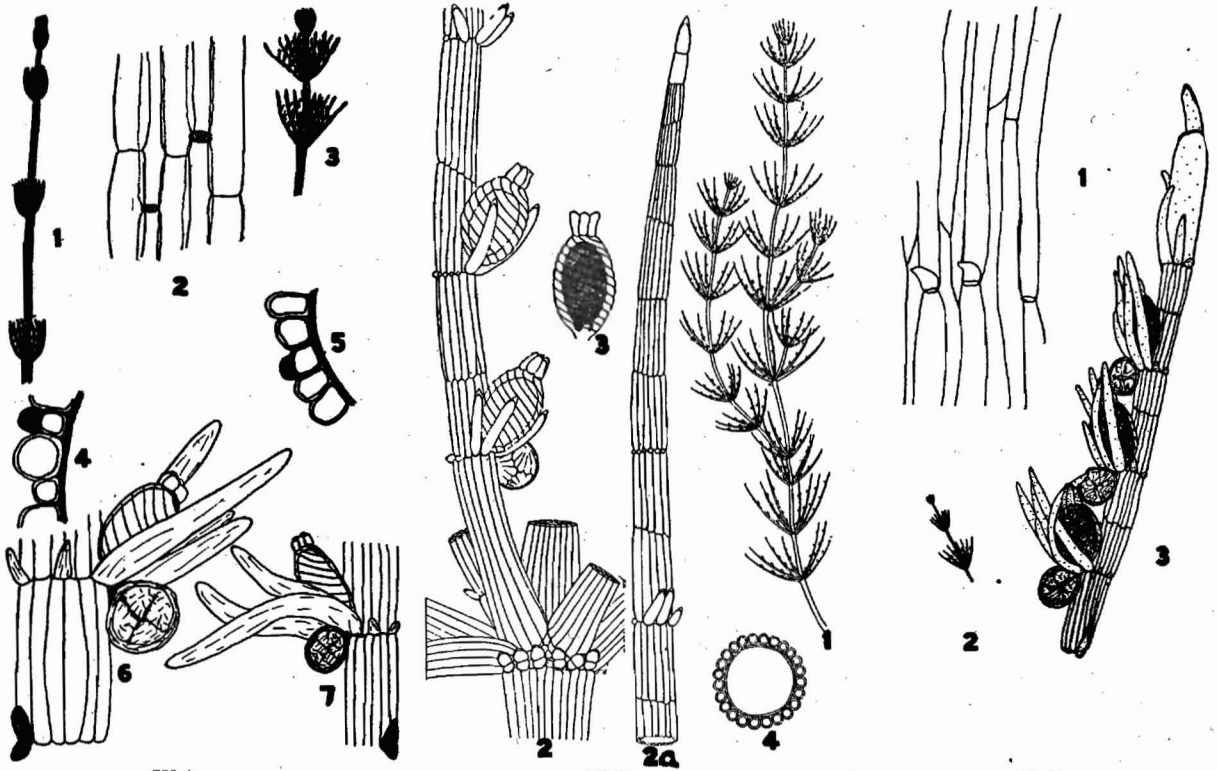
Specimens seen: Mixtures from GRANT, CHERRY and DAWES COUNTIES: lakes 3 mi. N. E. of Whitman, Wood Lake, and Crawford, *J. M. Bates,* date (?) (This may include the specimen which is the basis for the report by Woods (23) p. 128, "*Chara fragilis* Desv.—Whitman.": ARTHUR COUNTY: in intermittent sandhill pool, Arthur, 3 mi. south, *Walter Kiener 15444,* Sept. 10, 1943; offset pond, Beeken lake, *Walter Kiener 16034* and *16036,* Oct. 22, 1943; probably *C. fragilis,* offset pond, Beeken lake, *Walter Kiener 16035,* Oct. 22, 1943. BROWN COUNTY: Long Pine, *J. M. Bates,* June 9, 1894. CHERRY

COUNTY: probably *C. fragilis* Desv., Valentine, *Bates 58,* Aug. 26, 1891; *Smith* and *Pound 262,* July 19, 1892 (herbarium sheet in the Univ. of Neb. Herb. no. 2770 was apparently *C. fragilis* alone, but sheet no. 2771 bearing a similar label had some *C. coronata* mixed with it); Wood Lake, *J. M. Bates 1145,* Aug. 13, 1898 (herbarium sheet no. 25775 in the Univ. of Neb. Herb. was apparently *C. fragilis* alone, but no. 23196 bearing a similar label had a mixture with *C. verrucosa*); with *C. foetida* A. Br., Wood Lake, *J. M. Bates 1146,* Aug. 13, 1898; with *C. contraria* A. Br., Watts lake, *J. M. Bates,* July 10, 1894; Watts lake, *Elda Walker 42,* July 17, 1912; Hackberry lake, *E. Palmatier* and *T. R. Porter,* June 11, 1936; lake bottom 3 ft. deep, Hackberry lake, *E. Palmatier* and *T. R. Porter,* Kiener Herb. no. *13779,* June 13, 1936. HALL COUNTY: gravel pit pond, near Grand Island, *Walter Kiener 15159,* Aug. 28, 1943. HAMILTON COUNTY: submerged in sandpit lake, Platte river near Phillips, *Walter Kiener 14852* (two portions mounted separately—one dried from formalin, the other dried from the natural state), *14857,* July 30, 1943; with *C. contraria* A. Br. submerged in sandpit lake, Platte river near Phillips, *Walter Kiener 14855,* July 30, 1943. HOLT COUNTY: Chambers, *George Herzog,* 1929. KEITH COUNTY: gravel pit pond, Kingsley Dam, *Walter Kiener 15494,* Sept. 13, 1943; dried up pool, west of Keystone, *Walter Kiener 15704,* Sept. 24, 1943; sandhill pond, Kingsley Dam, 9 mi. north, *Walter Kiener 16080, 16081, 16088,* Oct. 27, 1943; probably *C. fragilis* Desv., sandhill pond, Kingsley Dam, 9 mi. north, *Walter Kiener 16082,* Oct. 27, 1943. THOMAS COUNTY: Dismal river, *H. J. Webber 6523 (No. 6),* July 13, 1889. WEBSTER COUNTY: Red Cloud, *John M. Bates,* July, 1905.

11. CHARA VERRUCOSA Itzig. Bot. Zeit. 8: 338. 1850.

Plate IV-C.

Habit similar to *Chara fragilis* Desv. but smaller and more rigid; about 7 branchlets in a whorl; monoecious; stem triplostichous with the primary cells larger and more prominent than the secondary, secondary cells sometimes irregular; spine cells papilliform up to short cells about 0.08 to 0.13 mm. long, pointed, stipulodes in two series, upper 0.21 mm. long, lower about 0.08 mm.; lowest internode of branchlet diplostichous; tip of branchlet of 1-3 ecorticate cells; bracteoles a little longer than oogonia; posterior bract cells papilliform; no mature oogonia or antheridia seen but according to Robinson (20),



IV-A IV-B IV-C

IV-A. CHARA FOETIDA A. Br. 1. Portion of plant, natural size. 2. Portion of stem cortex. 3. Portion of plant, natural size. 4. Portion of transverse section of stem. 5. Portion of transverse section of stem. 6. Basal portion of branchlet. 7. Basal portion of a branchlet.

IV-B. CHARA FRAGILIS Desv. (Rearranged and reproduced from Woods, 23, Pl. XXXV.) 1. Portion of plant, one-half natural size. 2. The base of a verticel with one branchlet showing a few basal internodes. 2a. The remainder of the branchlet shown in fig. 1. 3. Oogonium containing oospore. 4. Portion of a transverse section of a stem.

IV-C. CHARA VERRUCOSA Itzig. 1. Portion of stem cortex. 2. Portion of plant, natural size. 3. Fertile branchlet.

"oospores 0.63-0.8 mm. long, 0.47-0.6 mm. wide with 11-13 striae; antheridia 0.35-0.56 mm. in diameter."

Specimens seen: CHERRY COUNTY: with *Chara fragilis* Desv. in Wood Lake, *J. M. Bates 1145,* Aug. 13, 1898; "Phalaris" lake, *Elda R. Walker 37,* July 15, 1912.

12. CHARA ASPERA Willd. Ges. Naturf. Fr. Berlin Mag. 3: 298. 1809.

Plate V-A.

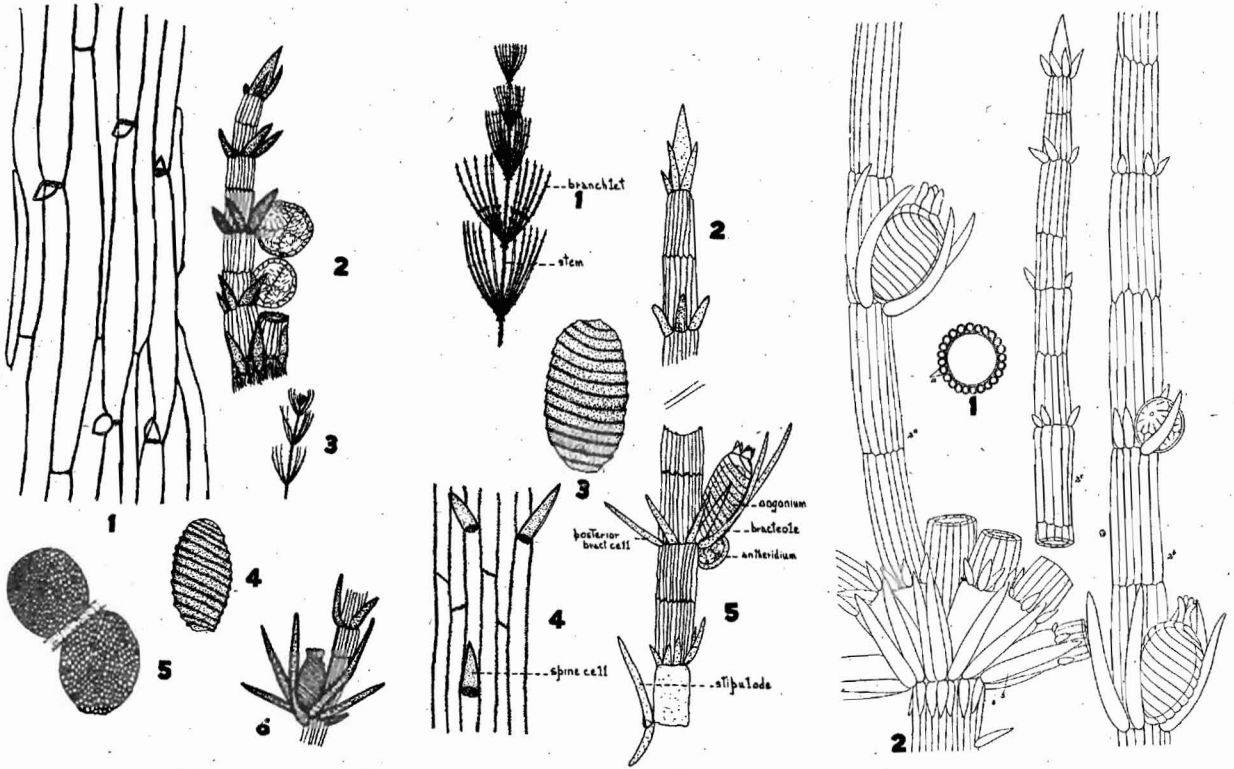
Habit small, about 4 cm. high, resembling *Chara fragilis* Desv.; slightly incrusted; almost spherical bulblets; about 7 branchlets at node with 5 segments each; dioecious; stem unevenly triplostichous appearing diplostichous at times, sometimes secondary cell ends overlap a considerable distance, other irregularities also occur such as secondary cells developed in only one direction from node or developed only a short distance in both directions, size of cells variable also; spine cells papilliform to 0.2 mm. long, sharply pointed; 2 series of well developed stipulodes, upper row about 0.32 mm. at a mature node, lower about 0.16 mm., both quite variable from node to node and at the same node; branchlet diplostichous, tip of branchlet made up of 1-2 short uncorticated cells; bracteoles apparently considerably longer on female plant than on male plant, 0.7-1.0 mm. long, 0.08-0.12 mm. wide on female, 0.43 mm. long and about 0.08 wide on male, variable; posterior bract cells also apparently larger on female than on male, 0.16 mm. long and 0.05-0.08 mm. wide on male, 0.27-0.56 mm. long and about 0.08 mm. wide on female; oospores with 13 ridges, 0.43-0.45 mm. long and about 0.27 mm. wide., black; antheridia about 0.53 mm. in diameter; only immature ones seen.

Specimen seen: CHERRY COUNTY: Big Alkali lake, *Elda R. Walker 36,* July 15, 1912.

13. CHARA GYMNOPUS A. Br. Uebersicht der Schweizerischen Characeen, Neue Denkschr. d. allgemeinen Sehweiz. Ges. f. d. gesammten Naturw. 10: 13. 1849. char. emend.

Plate V-B.

Habit usually lax and flexible; upper stem internodes shorter than branchlets; lower whorls remote, about 10 branchlets in a whorl, having 9-10 segments; monoecious; rather regularly triplostichous, cells about equal; spine cells borne singly, long; stipulodes in two



V-A V-B V-C

V-A. CHARA ASPERA Willd. 1. Portion of stem cortex. 2. Fertile branchlet of male plant showing portion of stipular whorl. 3. Portion of female plant, natural size. 4. Oospore. 5. Bulblets. 6. Portion of branchlet from female plant.

V-B. CHARA GYMNOPUS A. Br. 1. Portion of plant, natural size. 2. Tip of branchlet. 3. Oospore. 4. Portion of stem cortex. 5. Basal portion of branchlet.

V-C. CHARA SEJUNCTA A. Br. (Rearranged and reproduced from Woods, 23, Pl. XXXVI.) 1. Transverse section of the stem. 2. Basal portion of fertile verticel showing successive portions of a branchlet from the base upward in figs. 2a, 2b, 2c.

series, long, slender, sharply pointed, variable in length, upper series about 0.64-0.85 mm. long, lower about 0.32 mm. long; lowest branchlet internode uncorticated, variable in length but about as long as broad—covered by upper row of stipulodes; next lowest internode triplostichous; first branchlet node may be fertile; tip of branchlet bears one uncorticated short cell; bracteoles about as long as fruit; posterior bract cells about one-half as long as fruit at fertile node; short bracts produced all around branchlet at sterile nodes; bracteoles and bract cells at first branchlet node similar to rest; oospores with 13 or 14 ridges, about 0.61 mm. long, black; membrane dark brown, with granules; antheridia on specimen studied probably immature, 0.27 mm. in diameter.

Some authors divide this species into subspecies, but confusing intermediates occur, so none are mentioned at this time.

Specimen seen: DODGE COUNTY: submerged in sandpit lakes at Fremont, *Walter Kicner 14795,* July 23, 1943.

14. CHARA SEJUNCTA A. Br. in pl. Lindh. (Boston Journ. of Nat Hist. 5: 263. 1845.) p. 56. Monatsber. d. Bul. Akad. 1858.

Plate V-C.

Habit similar to *Chara gymnopus* A. Br.; 8-10 branchlets with about 10 segments each; monoecious, but antheridia and oogonia borne on different branchlet nodes; the stem regularly triplostichous, the cells about equal in diameter; spine cells short and sharply pointed; two series of well developed stipulodes, the upper row about 0.8 mm. long, the lower about 0.2 mm. long; the upper row of stipulodes almost conceals the uncorticated lowest branchlet internodes; next to the lowest branchlet internode triplostichous: one short uncorticated cell surrounded by several sharply-pointed bract-cells is found at the tip of the branchlet; bracteoles about as long as oogonia; posterior bract cells papilliform. In the portion of the specimen studied, no mature antheridia or oogonia were found, but according to Woods (23) oospores are 0.63 x 0.36 mm.; antheridia 0.36-0.38 mm. in diameter.

Robinson (20) cited illustration in Woods (23) Pl. 36.

Specimen seen: KEARNEY COUNTY: Minden, *H. Hapeman,* Sept. 7, 1891 (probably the basis of the reports by the Nebraska Bot. Surv. III (13), "*Chara sejuncta* A. Br. Minden. (3365)"; Woods, 23, "*Chara sejuncta* A. Br. Minden".).

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