The Characeae of Indiana

Fay Kenover Daily

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Butler University
Botanical Studies
(1929-1964)

Edited by

J. E. Potzger
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.

Requests for use of materials, especially figures and tables for use in ecology text books, from the *Butler University Botanical Studies* continue to be granted. For more information, visit www.butler.edu/herbarium.
THE CHARACEAE OF INDIANA

By Fay Kenoyer Daily

This is the third in a proposed series of papers intended to organize the material pertaining to the occurrence and distribution of the Characeae of Indiana and to present a taxonomic treatment of the group.

In the first paper (Daily, 7) only collections which had not been previously reported were cited. In the second paper (Daily, 10) a genus not previously found in the state, *Tolyphila prolifera* Leonh., was given. For the present study, an attempt was made to obtain both reported and unreported specimens extant, and to make further collections. Typic or co-typic specimens were studied whenever possible.

The attempt to obtain previously reported material for study was not so successful as far as those papers citing only generic names were concerned. The majority of such reports were apparently incidental to other studies and probably specimens were not prepared. Generic reports have been published in papers by: J. D. Black (3); Severance Burrage (4); H. Walton Clark (5); Willis DeRyke (11); C. H. Eigenmann (12); B. W. Evermann and H. Walton Clark (13, 14, 15); Shelby D. Gerking (18); L. N. Johnson (21); L. J. King (22); Philip H. Kirsch (23); W. M. Mills (24); D. M. Morris and A. Hale (25); D. M. Mottier (26); C. M. Palmer (27, 29); C. E. Parks (30); W. E. Ricker (32, 33); Will Scott, Ralph Hille and H. T. Spieth (36); J. T. Scovell (37, 38, 39); B. H. Smith (40); and Donald E. Wohlschlag (41). When any of the specimens were found, they have been cited under the specific heading to which they belong in the systematic account, except when the condition of the specimen made specific determination impossible.

Greater success was realized in obtaining collections which are the bases of reports in which specific names were given. The study in which the largest number of specimens was treated is the work by Evermann and Clark (15) on Lake Maxinkuckee and vicinity. Although it was not possible except in a few instances to state definitely that collections found were the bases of the published species because exact collection data were not always given, it is probable that the
TABLE I

The Species of the Characeae from Indiana Arranged Chronologically by Author and According to their Disposition in the Present Study

<table>
<thead>
<tr>
<th>Species</th>
<th>Author/Year</th>
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<tbody>
<tr>
<td>Chara polyphylla</td>
<td>Schneck (35), 1876</td>
</tr>
<tr>
<td>Chara foliifera</td>
<td>Robinson (34), 1896</td>
</tr>
<tr>
<td>Chara foliifera</td>
<td>Evermann &amp; Clark (35), 1896</td>
</tr>
<tr>
<td>Chara gymnopus</td>
<td>Smith (10), 1932</td>
</tr>
<tr>
<td>Chara gymnopus</td>
<td>Palmer (28), 1931</td>
</tr>
<tr>
<td>Chara gymnopus</td>
<td>Daily (7), 1915</td>
</tr>
<tr>
<td>Chara gymnopus</td>
<td>Daily (10), 1950</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Species</th>
<th>Author/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chara fragilis</td>
<td>C. fragilis</td>
</tr>
<tr>
<td>Chara fragilis</td>
<td>C. contraria</td>
</tr>
<tr>
<td>Chara fragilis</td>
<td>C. gymnopus</td>
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<tr>
<td>Chara gymnopus</td>
<td>C. gymnopus</td>
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<tr>
<td>Chara gymnopus</td>
<td>C. gymnopus</td>
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<table>
<thead>
<tr>
<th>Species</th>
<th>Author/Year</th>
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<tbody>
<tr>
<td>Tolypella prolifica</td>
<td>C. globulasis</td>
</tr>
<tr>
<td>Tolypella prolifica</td>
<td>C. contraria</td>
</tr>
<tr>
<td>Tolypella prolifica</td>
<td>C. gymnopus</td>
</tr>
<tr>
<td>Tolypella prolifica</td>
<td>C. gymnopus</td>
</tr>
<tr>
<td>Tolypella prolifica</td>
<td>N. tenuissima</td>
</tr>
<tr>
<td>Tolypella prolifica</td>
<td>N. mucronata</td>
</tr>
<tr>
<td>Tolypella prolifica</td>
<td>N. flexilis</td>
</tr>
<tr>
<td>Tolypella prolifica</td>
<td>N. elegans</td>
</tr>
<tr>
<td>Tolypella prolifica</td>
<td>N. ernabara</td>
</tr>
<tr>
<td>Tolypella prolifica</td>
<td>C. elegans</td>
</tr>
<tr>
<td>Tolypella prolifica</td>
<td>C. Kieneri</td>
</tr>
</tbody>
</table>
material supplied constituted the complete collection extant. J. T. Scovell collected some specimens for this study and included among them might have been specimens reported by him (37) earlier by genus name only. Most of the specimens for the Lake Maxinkuckee study were lodged at the United States National Museum. A few were located at the Chicago Natural History Museum, and all were kindly loaned for study. They were particularly interesting because the largest part of the dried material had been submitted to Dr. C. B. Robinson for identification and the alcoholic collection had been sent to Dr. George T. Moore.

Dr. C. M. Palmer, who wrote on the algae found in Steuben County (28), kindly supplied specimens of the Characeae from that county. The check lists of the algae of Indiana by Palmer (27, 29) covering the period from 1875 to 1928 were very helpful in bibliographic work.

As far the author knows, ten papers previous to the present series reported specimens of the Characeae from Indiana by specific name, only five of which were original reports. In Table I can be seen the disposition in the present paper of specimens reported from the state by specific name. Only original reports are included. Subspecies, varieties and forms are not considered in this table; so for a more detailed analysis see the "Systematic Account." Following a line across to "Present Study," one will find whether or not a previously published name has been excluded, changed, substantiated by further collection, and under what name to find it classified in the "Systematic Section" of this study. If a name does not appear in "Present Study," the previous report on that line was based upon a specimen which has not been seen and no other specimen of that species has been found in the state; so it is not included here. Specimens which were not seen are indicated in the table by a question mark. All reports on the same line are considered by the author to belong to the same species listed in "Present Study," except those specimens which were not seen must remain questionable. If the names in previous reports are different from those in "Present Study," they have either been reclassified if specimens were seen, or another name has been used because of its priority. As one progresses across the table from left to right, species not previously reported for the state may be seen below the lowest species listed in preceding columns. In some cases, a new name may appear in a column not found in previous columns,
but must be placed opposite a former report because of reclassification or because of the synonymy of the names.

Fourteen species had been listed for the state before the present series of papers. That number has been reduced to eight by reclassification, reduction to synonymy and exclusion because specimens were not seen. With the addition of eleven more species found in collections formerly unreported or reported by generic name only, the present study recognizes nineteen species collected in Indiana.

About 360 collections made by the author and 135 by others making a total of about 495 collections are treated in this study. Only twenty-seven specimens have been obtained so far to represent the bases for previous reports.

Plate I gives the distribution of the Characeae in Indiana. Each of the first nineteen maps gives the distribution of a single species in the state by county. The last map shows all of the species plotted by county. A dot marks the occurrence of a species in the county where it is placed.

The citation of collections of the Characeae identified to species had appeared in the literature for only four counties before the present series of papers (Gibson, Marshall, Steuben, and Cass). Now fifty-six out of ninety-two counties in the state have collection records. Thirty-six counties remain from which no substantiated records have been obtained.

A large percent of the collections came from the northern part of the state from the lakes of glacial origin, some of which have developed boggy areas. The Characeae abound in this region making it particularly attractive to the collector of this group. Collections from the rest of the state are more often from man-made rather than natural habitats. These include gravel pits, quarry pits, strip mine ponds, drainage ditches, artificial lakes and ponds often connected with fish propagation activities. The natural habitats from the central and southern part of the state include a few lakes such as the old oxbows of the lower Wabash River, bogs, obstructed sinkholes, spring-fed ponds and small lakes, and usually the more sluggish areas of streams.

In the citation of specimens, the following abbreviations are used to indicate the herbaria in which they may be found: BU, Butler University; CM, Chicago Natural History Museum; USM, United States National Museum; HafR, Horn af Rantzien at the Natur-
When it is stated that a species occurs with another in a collection, it is filed under the latter name in the herbarium. Specimens having more than one collector listed with the name of the author last are part of the personal herbarium of the author.

SYSTEMATIC ACCOUNT

Key to the Characeae of Indiana

Coronula composed of two superimposed tiers of five cells each
Antheridia and oogonia lateral at the nodes of the branchlet, oospore terete .......... I. TOLYPELLA
Coronula persistent, sterile branchlets not divided, oospore ca. 368 μ long .......... I. T. prolifera
Antheridia produced terminally on the upper end of a ray where branchlet furcates, oospore laterally flattened ........II. NITELLA

Ultimate rays one-celled
   Dioecious; branchlets simple, once furcate ........ 2. N. opaca

   Monoecious
   Branchlets simple, once furcate
   Ultimate rays acute .......... 3. N. flexilis
   Ultimate rays acuminata .......... 4. N. acuminata

Ultimate rays usually two-celled, not much abbreviated with the ultimate cell short, conical .......... 5. N. tenuiscina
Ultimate rays three-four-celled, unequal in size, some quite abbreviated, forming a two-four cuspidate crown; upper branchlets often with four furcations . 6. N. megacarpa

Coronula composed of five cells in one tier ........ III. CHARA

Stem not corticated
   One series of stipulodes in a circle around stem at the base of a branchlet whorl .......... 7. C. Braunii
Two series of stipulodes in a circle around stem at the base of a branchlet whorl .......... 8. C. Brittonii

Stem corticated
Monoecious
   One series of stipulodes in a circle around stem at the base of a branchlet whorl
Branchlets entirely corticate........9. C. keuhensis
Branchlets (at least some of them) corticate........
........................................................................10. C. hydrophyta
Two series of stipulodes in a circle around stem
at the base of a branchlet whorl
Stem falsely diplostichous (usually only one
secondary cell between primaries, but occasionally
two making the cortex triplostichous in some places,
spines usually single).....................11. C. excelsa
Stem falsely diplostichous and occasionally falsely
haplostichous, spine cells usually single but
occasionally two-together................12. C. Kleneri
Stem diplostichous
Primary cortical cells of stem prominent........
................................................................13. C. contraria
Secondary cortical cells of stem prominent...
................................................................14. C. vulgaris
Stem triplostichous
Cells of stem cortex about equal in size
Branchlet cortication diplostichous
(cortical cells twice the number of bract
cells), branchlets with usually some corticated
internodes, especially the lowest........
..................................................................................15. C. globularis
Branchlet cortication triplostichous,
lowest internode always ecorticate
(sometimes all ecorticate)
Antheridia and oogonia borne at the same
branchlet node...........16. C. zeylonica
Antheridia and oogonia borne at
different nodes............17. C. sejuncta
Primary cells of stem cortex prominent....
..................................................................................18. C. delicatula
Dioecious................19. C. aspera

I. TOLYPELLA A. Br. emend Leonh.
1. TOLYPELLA prolifera Leonh. Lotos 13, p. 57. 1863.
For general description and illustrations see Daily (8 and 10).
The size range of oospores in Indiana material is 300-375 μ long,
275-315 μ broad.

For further citation of specimens see Daily (10). In this study, a collection was reported from Steuben County.

II. NITELLA Ag. emend, A. Br.

2. NITELLA OPACA (Ag. ex Bruz.) Ag. Syst. Alg., p. 124. 1824.

For a general description and illustrations see Daily (6). A more nearly exact description of some characteristics found in Indiana plants is: ripe oospores chestnut brown, ca. 420 μ long, ca. 367 μ broad, with 7 ridges; outer oospore membrane red brown, translucent, with warty protuberances; antheridia as large as 682 μ in diameter.

Apparently only one collection of this species in Indiana has been made so far. This was found in Wayne County by L. J. King. For the complete specimen citation see Daily (7). This report for Indiana was also cited by Wood (42).


Habit spreading, fairly stout; monoecious; fertile and sterile branchlets usually 6-8 at a node, similar except in capitulate forms in which fertile branchlets may be more or less condensed; branchlets with one furcation at which usually 2 and sometimes either 1 or 3 ultimate rays may be produced; oogonia 1-3 at a node; oospores red-brown to black, 420-580 μ in length, 400-495 μ in width with ca. 7 prominent ridges; outer oospore membrane smooth or scabrous with wart-like protuberances; antheridia ca. 504-630 μ in diameter.

NITELLA FLEXILIS (L. pro parte) Ag. var. flexilis
Plate II-A

That part of the taxon containing the type specimen for the species belongs here. The type specimen has not been seen by the
author, but those plants having branchlets of a whorl similar in size, fertile branchlets not reduced to form a head, and branchlets once-furcate and bearing usually 2 or 3 ultimate rays are usually considered typical of the species.


See Daily (7) for further citation of specimens. In that study, specimens were reported from Marion and Steuben Counties. This report was also cited by Wood (42).


Plate II-B

Differing from the type in having fertile branchlets somewhat reduced in size and more or less unequal in length produced in more or less condensed clusters particularly at the top of the plant. Ultimate rays are frequently produced singly at a furcation rather than in the typical numbers of 2 or 3.

The author agrees with Groves and Bullock-Webster (19, Vol. 2, p. 107) that *Nitella flexilis* var. *subcapitata* is distinct from *Nitella flexilis* var. *nidifica*. The latter differs chiefly in having a more extreme reduction of the size of fertile whorls. There are other differentiating characteristics.

This variety has not been previously reported for the state. It is possible, however, that the specimens from Lake Maxinkuckee, Marshall County, reported by Evermann and Clark (15) and cited
by Palmer (27) under the name, *Nitella monodactyla* A. Br., belonged in this group. Later in the Evermann and Clark work, the collections are again discussed under the heading, *Nitella sp.*, and it is revealed that the material examined by Dr. C. B. Robinson was sterile. It may have been an error that the earlier heading of *N. monodactyla* was included as Dr. Robinson did not commit himself definitely to this diagnosis because of the sterility of the material. Apparently none of the material is preserved. However, more recent collections from the Outlet of Lake Maxinkuckee possibly may be the same if the Nitella were maintained or reoccurred in that location during the intervening years. Since this material is fertile, it is referable to *N. flexilis* var. *subcapitata* which might possibly be confused with *N. monodactyla* if sterile. Mr. Russell Fisher of Culver, Indiana, recalled the collection of Nitella in the Outlet during the Lake Maxinkuckee Survey by Evermann and Clark for he accompanied the collectors then, and made possible the present collections there.


Habit spreading and often diffusely branched; plants usually ca. 20-25 cm. high; stem ca. 1000 μ in diameter, sterile branchlets slightly smaller; monoecious; sterile whorls slightly to far exceeding the fertile whorls (i.e. sterile whorls lax, long; fertile whorls more or less condensed, borne on a peduncle of varying length located in the axils of the sterile whorls); branchlets 6-8 at a node, similar, once-divided into 2-4 one-celled terminal rays which gradually taper to a point; fruiting bodies not enveloped in jelly; oogonia 1-3 at a node; coronulae short, persistent; oospores usually with 7 ridges, spherical, reddish-brown; membrane light brown, translucent, with raised elevations or granular (granules may be arranged reticulately in mature oospores, scattered or not present in immature oospores); antheridia ca. 320 μ in diameter.

Present collections of this species in Indiana apparently belong to this variety.

See Nitella subglomerata (as synonym) in Daily (6) for general description and illustrations. In Indiana specimens, the sterile branchlets are not greatly overtopping the fertile ones, sterile branchlets are up to ca. 4.5 cm. long with primary rays ca. \( \frac{3}{4} \) the total length of the branchlet, fertile whorls are borne on a peduncle and consist of branchlets ca. 3.5 mm. long with primary rays ca. 1/2-2/3 the total length of the branchlet. Oospores are 300-315 \( \mu \) long, 255-263 \( \mu \) broad, red-brown; membrane of mature oospores has granulate reticulation; antheridia are up to 300 \( \mu \) in diameter.

Apparently not cited for the state until the present report.


Habit small compact, internodes ca. 2.5 times the length of the branchlets; monoecious; whorls of usually 6 short, compact branchlets; branchlets usually 3 times furcate (4); primary rays 1/3-2/5 the entire length of the branchlet; usually 6 or 7 secondary rays at the first furcation, usually 4-6 tertiary rays at the second furcation; some tertiary rays again furcate producing usually 3-5 quaternary rays; quaternary rays sometimes producing 3-4 quinary rays; ultimate rays 2-celled with the ultimate cell acuminate, slender; fruiting bodies in all but the first furcation of the branchlet, solitary; oospores usually 200-250 \( \mu \) long (up to 265-315 \( \mu \) in var. compacta) 235-290 \( \mu \) broad, with 7-9 ridges, brown; outer oospore membrane red-brown, with beaded reticulation; antheridia up to 265 \( \mu \) in diameter.


See Nitella tenissima in Daily (10) for illustration.

This variety has been characterized by its small size and the very compact nature of the branchlets, which are usually only ca. 1-3 mm. long in Indiana specimens. Some oospores are larger than the previously given range.
All collections of this species so far made in Indiana seem to fit
the description for var. compacta.

Included here are the specimens from Marshall County which
probably are the basis of the report by Evermann and Clark (15)
whose study was also cited by Palmer (27) in which \textit{Nitella tenuissima}
was found in Lake Maxinkuckee and "common in Lost Lake."
Also included is the specimen which is the basis of the report of
Evermann and Clark (15) cited also by Palmer (27) of \textit{N. batracho-
sperma} from Lake Maxinkuckee, Marshall County. Included also is
the specimen which is the basis of the report by Palmer (28) for
Steuben County cited as follows: "\textit{Nitella tenuissima} Kitz.; Bass L., July."

Specimens seen: KOSCIUSKO COUNTY: Shallow water
near shore, marl bottom, Dewart Lake, M. S. Marble 8, Aug., 1946
(EC, BU); in shallow water on bottom of a recently excavated chan-
nel, southeast border of Chapman Lake, R. C. Friesner 23168, Sept.
24, 1949, 32207, Oct. 8, 1949 (BU); on turf in shallow water, Lake
Wawasee, near Johnson's Hotel, \textit{W. A. & F. K. Daily} 199, July 23,
1950 (CM, Hafr, BU); on turf, shallow water, Lake Wawasee,
west of Johnson's Hotel, \textit{W. A. & F. K. Daily} 234, 235 with \textit{C. con-
traria}, July 26, 1950 (CM, BU). MARSHALL COUNTY: Muddy
bottom, north end of Lost Lake, \textit{B. W. Evermann} 1574 (570), Sept.
1900 (USM, BU) (Probably the basis of the report of Evermann
and Clark, 15, and Palmer, 27); not seen in habitat—found among
material from Lost Lake, \textit{B. W. Evermann} 1576 (578), about Sept.
19, 1900 (USM, BU) (the basis of the report in Evermann and
Clark, 15, and Palmer, 27, of \textit{N. batrachosperma}); common near
shore, Lake Maxinkuckee, \textit{B. W. Evermann} 1578 (608), Oct. 12,
1900 (USM, BU) (Possibly the basis of the report in Evermann
and Clark, 15, and Palmer, 27).

STEUBEN COUNTY: Shallow water near bank attached to bottom in groups, Bass Lake, \textit{C. M. Palmer} 1007, July 28, 1933 (BU) (The basis of the report by Palmer,
28); in tufts on marl bottom, shallow water ca. 1 ft. deep, Green

(Description).
Habit robust, spreading; branchlets usually 5-6 in a whorl, 3-4 times furcate with usually 5 secondary rays at the first furcation, 2 or 3 at the second furcation, 2 or 3 at the third furcation, and 2-4 at the fourth furcation when it occurs in some of the quaternary rays; ultimate rays usually 2-celled, but also 3-celled (4), variable in size from very short to quite long; ultimate cell conical and mucronate; oogonia in all furcations of the branchlets except the last one especially when a crown of short ultimate rays are produced; corona of the oogonium short; oospores usually 370-400 μ long, ca. 318-368 μ broad, with 6 or 7 ridges; outer oospore membrane with granules connected by reticulation; antheridia ca. 265 μ in diameter. (Although the oospores do not reach the proper size in two collections, they are probably immature judging from color and difficulty in removing from the plant, otherwise Indiana collections agree in essential characteristics with a co-typic collection seen by the author.)

Specimens which probably form the bases of the report of *Nitella mucronata* from Marshall County in Evermann and Clark (IS) whose record was cited by Palmer (27) were redetermined *Nitella megacarpa* T. F. Allen. Two locations were cited by Evermann and Clark. They state, "A delicate species growing in the muddy bottom of Lost Lake. One of the most attractive species of the region. Abundant at Bass Lake."

Specimens seen: MARSHALL COUNTY: B. W. Evermann 1571 (374), Aug. 13, 1900 (? (USM, BU); B. W. Evermann 1583 (708) (USM, BU) (no collection data accompanied this but it possibly is the basis for the report for Lost Lake in Evermann and Clark, 15, and Palmer, 27, as the determination *N. mucronata* was on the specimen.) PORTER COUNTY: Dredged collection, Moss Lake, ½ mi. west of Lake Wauhob near Valparaiso, W. A. & F. K. Daily 365, Aug. 30, 1951 (BU). STARKE COUNTY: Bass Lake, H. W. Clark & B. W. Evermann 132, Aug. 14, 1906 (CM, USM, BU) (probably the basis of the report in Evermann and Clark, 15, for *N. mucronata* for Bass Lake as this determination was with the specimen).
III. CHARA (Vaill.) Loenh.

7. CHARA BRAUNII Gmel. Fl. Bad. Alsat. 4:646. 1826. (As a synonym, Chara coronata Ziz.)

See Chara coronata in Daily (6) for general description and illustrations.

Because of intergradation in this species, it is difficult to exactly distinguish the varieties as established, so that use of varietal names is unsatisfactory. In Indiana specimens, there is a great variation in habit from short and tufted to elongate, in stipulodes from very short and slender to long and broad, in bract cells from unilateral to verticillate, in oospore length from 500-578 μ. The number of ridges on the oospore is usually 9, however, and the bracteoles and anterior bract cells are usually longer than the oogonia. If limited to a consideration of the last two characteristics and oospore length, Indiana plants are all referable to var. Schweinitzii, but the range of other characteristics is not encompassed in this category. Varietal names are, therefore, not considered in this species for the present.


For further citation of specimens see Daily (7) under the name, Chara coronata Ziz. In that study, collections were reported from Martin and Porter Counties.


Plate II-D

Habit short and compact, usually not more than 2 cm. in height with branchlet whorls overlapping; monoecious, but antheridia and oogonia usually at different nodes of the branchlet; stem and branchlets entirely ecorticate; stipulodes in 2 series in a circle around the stem, quite long and narrow, upper series ca. 636-1,166 μ long, lower series 636-1,590 μ long; branchlets usually bearing 2 or 3 nodes having long bracts and bracteoles, followed by a 2-celled tip; oospores 682-782 μ long, black, having 15 ridges; antheridia 263-318 μ in diameter.

See Daily (7) for citation of specimens. In that study, reports were made for Randolph and LaPorte Counties. These are the specimens cited by Friesner and Potzger (16 and 17).

Apparently previously to the Indiana collections, this species had been known only from the type collection which has been examined by the author. Indiana material is very similar.

Specimens may be found at Harvard University, U. S. National Museum, New York Botanical Garden, Chicago Natural History Museum, and Butler University. These were collected from Randolph County. La Porte County specimens are at Butler University.

Plate II-E

Habit short, compact; monoecious; stem cortication diplostichous, primary cortical cells usually prominent, irregular with secondary cells sometimes produced on both sides of node, but extending only a short distance; spine cells variable, from papillae to ca. 900 μ in length; stipules in a single series in a circle around the stem, up to twice the number of the branchlets, from ca. 800-1,325 μ in length; branchlets usually 8-10 in a whorl of 5 or 6 entirely ecorcitate segments; bract cells usually longer than the oogonia; bracteoles similar to the bracts; oospores black, from 345-450 μ in length, 265-290 μ broad, with 9-11 ridges; antheridia up to ca. 300 μ in diameter.

Included here is the specimen reported by Palmer (28) from Steuben County as, "Chara delicatula var. annulata (Wallman) G. and B. W.; Crooked L., Sept. A small form growing in shallow water along the shore line."

Indiana material is very similar to the specimen of Chara keukensis borrowed from the New York Botanical Garden for which the citation follows: Phycotecta Boreali Americana, Collins, Holdén & Setchell 1491, Lake Kenca, N. Y., collected by T. F. Allen, determined by C. B. Robinson.


For further citation of specimens see Daily (7) under the name, Chara gymnoptysis. As varietal names were avoided in that study and since this species seemed more consistently arranged as a variety of Chara gymnoptysis, only that name appeared. It is possible that further collections may produce substantiating evidence supporting Allen's original conviction that this should be considered a variety of C. gymnoptysis (C. fibrosa Ag. ex Bruz. has precedence over C. gymnoptysis according to Zaneveld, 43).

Specimens were reported in Daily (7) from Cass, Lake, and LaForté Counties. A specimen also reported in that study from Morgan County must be included with C. hydroptysis.

No specimens were seen to support the report of Chara gymnoptysis in Evermann and Clark (15) and Palmer (27).

Habit compact or extended; monoecious; stem essentially diplostichous, sometimes partially triplostichous by development of secondary cortical cells on both sides of the node, but some extending only a short distance, primary cells prominent; spine cells papillate to very long, branchlets partially diplostically corticated with the lowest segment ecoricate and tipped by usually 2 or 3 ecoricate segments, the last surrounded by a tuft of long bract cells, occasionally some of the branchlets entirely ecoricate; bracts and bracteoles quite long; stipulodes in a single series in a circle around the stem, quite long; antheridia and oogonia solitary and together at the lowest nodes of the branchlets.

There is considerable variation in this group and the limits of present varieties seem to overlap. However, Indiana plants collected so far possibly are all referable to the following variety:


Plate II-F

Ca. 8-10 branchlets per whorl; usually 5 or 6 segments per branchlet; stipulodes 500-1,200 μ long; spine cells from papillate to ca. 950 μ in length; oospores (371 μ long, brown, immature?) 424-477 μ in length, 265-292 μ broad, black, with (10) 11-13 ridges; antheridia up to ca. 265 μ in diameter.

Included here is the plant reported in Daily (7) as C. gymnopus from Morgan County. The infrequent production of corticated branchlet segments and their transparency caused difficulty in identification.

pool's edge, Jewel Lake, Bethany Park, near Martinsville, W. A. & F. K. Daily 37, Sept. 20, 1942 (BU) (Reported in Daily, 7, as C. gymnopolis).

For further citation of specimens see Daily (7). In that study, collections were reported from Lake, Porter and Wayne Counties.


Plate II-G

Habit similar to C. contraria but more slender and spinescent; monoeocious; branchlets usually 7-8 at a verticel, having 3 or 4 doubly corticated internodes and 2 or 3 eocorticate cells at the tip; stem cortex diplostichous but irregular often producing an additional short secondary cell or having the ends of secondary cells overlapping so that the cortex is occasionally tripllostichous; spine cells underdeveloped up to very long found sometimes on the same stem internode; stipulodes variable in size and shape at the same verticel, in 2 series in a circle around the stem at the base of a branchlet whorl; bracteoles and anterior bracts usually slender and exceeding the oogonia; posterior bracts much shorter, variable, sometimes as short as in C. contraria but usually longer and more slender; oogonia with elongated neck and short coronula; oospores black, 685 μ long and 370 μ broad with 15 or 16 ridges; antheridia up to 370 μ in diameter.

Indiana material seems essentially the same as the cotypic material seen by the author. This species apparently has not been reported for the state previously.


STEUBEN COUNTY: Shallow water, Silver Lake, ca. 3 mi. west of Angola on U. S. Rd. 20, W. A. & F. K. Daily 331 and 336 with C. contraria, June 20, 1951 (BU).


See Daily (9) for description and illustrations.

Some interesting observations concerning the occurrence of forked anterior bract and bracteole cells as well as other forked processes in Chara have come to the author's notice since publication of the
species, *Chara Kieneri*. G. O. Allen (1) reported bifid bracteoles and bract cells in a plant referred to *Chara aspera*. Material kindly supplied by Dr. Allen proved to have also divided spine cells. Other material awaits further data for reporting. The question must be considered whether these occurrences should be construed in all cases as abnormalities or if they are taxonomically significant.

It was arranged by Dr. J. E. Potzger for specimens of *Chara Kieneri* to be collected from the same location in Michigan for two successive years and the characteristic of forked bracteoles and anterior bract cells was constant in both collections.

Although forked processes may be infrequent on a plant of *Chara Kieneri*, the general habit, accompanied by the extremely irregular cortex, and the occasionally geminate spine cells are enough to stimulate a search usually rewarded by finding some of the forked members, and to differentiate the plant from *Chara excelsa* with which it is most closely allied.


See Daily (6) for description and illustrations.

Since there are many intergrading forms in this taxon, it is very difficult to differentiate the varieties moniliformis and hispidula as is sometimes done on the basis of short and long spine cells respectively; so these varietal names are not employed here.

Included here are the specimens reported in Evermann and Clark (15) for Lake Maxinkuckee, Marshall County, whose study was also cited in Palmer (27). Evermann and Clark reported, "This is the most common Chara in the lake, forming extensive meadows over the bottom... . . . According to Dr. Robinson, 'this is a very polymorphic form, several of our specimens representing the common American form, a few being more robust and heavily encrusted, others usually slender and another form with very short whorls. Again, one specimen was peculiar in appearing, through hypertrophy of the secondary rows of cortex, to be triply corticated.'" Further in the work they said, "It forms a covering over most of the bottom of Outlet Bay out from Long Point, and, indeed, almost everywhere in the lake where bottom and depth are favorable."

Also included here are the specimens probably indicated in the manuscript by J. T. Scovell (39) on Twin Lakes, Marshall County, to be found in the Indiana Historical Section of the Indiana State Library. They were referred to by genus name only from "The Dam" of Twin Lakes, Treighbaum Lake and Pretty Lake.

One specimen constituting the basis of the report by R. C. Friesner and J. E. Potager (17) from Randolph County is included here. Another was reported by Daily (7).

The specimen reported by Palmer (28) from Bass Lake, Steuben County, as Cha ra fragilis is also included here.


MARION COUNTY: Pool 8, Riverside Fish Hatcheries, Camellia Kenoyer, W. A. & F. K. Daily 128, Sept. 2, 1946 (BU); near shore of gravel pit pond, Standard Material Co., 4100 E. 56th St., Indianapolis, W. A. & F. K. Daily 341 (CM, HaifR, BU), 342 and 343 (BU), July 14, 1951; pond, Holliday Park, Indianapolis, W. A. & F. K. Daily 371, Feb. 9, 1952 (CM, BU). MARSHALL COUNTY: Grew in laboratory of J. T. Scovell Sept., 1903-Sept., 1904, originally from Lake Maxinkuckee, J. T. Scovell (3-11), Sept. 1903 (USM, BU) (Probably the basis of the report in Evermann and Clark, 15, and Palmer, 28); "The Dam" of Twin Lakes, J. T. Scovell (3-12), July 6, 1904 (USM, BU) (Probably the basis for the report of Chara in Scovell, 39); in ca. 3 ft. of water, Meyer's Lake, J. T. Scovell (3-6), July 7, 1904 (USM, BU); 3-6 ft. of water, Treighbaum Lake, J. T. Scovell (3-10), July 8, 1904 (USM, BU) (Probably the basis of the report of Chara in Scovell, 39); Pretty Lake, J. T. Scovell (3-14, 3-14x, 3-14xx) with C. globularis, July 21, 1904 (USM, BU) (Probably the basis of the report of Chara in Scovell, 39); 11 ft. of water on south end of lake bar north of the Maxinkuckee line, Lake Maxinkuckee, J. T. Scovell (3-21), July 30, 1904 (USM, BU) (Probably the basis of the report in Evermann and Clark, 15, and Palmer 27); 10-12 ft. of water, east lake bar, dark marl mud, just north of the Maxinkuckee line, J. T. Scovell (3-23), July 30, 1904 (USM, BU) (Probably the basis of the report in Evermann and Clark, 15, and Palmer, 27); 8 ft. of water, dark marl mud, west side of Long Point bar on the Maxinkuckee line, J. T. Scovell (3-22), July 30, 1904 (USM, BU) (Probably the basis of the report in Evermann and Clark, 15, and Palmer, 27); shallow water near the Point, Lake Maxinkuckee, J. T. Scovell 8A and 8B


For further citation of specimens see Daily (7). In that study, collections were reported from Bartholomew, Cass, DeKalb, Elkhart, Fulton, Hancock, Jasper, Kosciusko, Lagrange, Lake, Marion, Marshall, Noble, Porter, Putnam, Randolph, Shelby, Steuben, Wayne, and Whitley Counties.

No specimens were seen to support the report in B. H. Smith (40) for Vigo County.


See Daily (6) for description and illustrations under the name C. foetida.

A small condensed form found in Indiana bogs and in shallow water is apparently similar to British collections mentioned in Groves and Bullock-Webster (19) as belonging to C. foetida var. condensata Breb. (C. coarctata Wallman) or as arranged in A. Braun's classical treatment—subinermis, macroptila, condensata. Some plants are as small as 4 cm. in height. They have long anterior bracts, somewhat shorter bracteoles, and short spine cells, stipulodes and posterior bract cells. In some collections, there is a tendency to produce entirely eocorticate branchlets in the lower whorls. These branchlets, however, are sterile and not differentiated into nodes and internodes. Because of intergradation in this species, this variety is considered by the author of little taxonomic significance and so is not employed here.

Specimens from Randolph County in Daily (7) under the name of C. foetida are the bases of the report by Friesner and Putzger (17) for that county.

Specimens seen: CARROLL COUNTY: Bog, between Rd. 25 and Wabash River, 1 mi. northeast of Delphi, R. C. Friesner 20356, June 8, 1946 (BU). CASS COUNTY: Springy place on marly flat near northeast corner of Peabody Bog, ca. 3.5 mi. northeast of
Hoovers, R. C. Friesner 20602, 20603, June 22, 1946 (BU).

HENRY COUNTY: Running water, small stream flowing from springy place in east bank of Blue River Valley, ca. 2.5 mi. north and 1 mi. east of Knightstown, R. C. Friesner 22457, Sept. 6, 1948 (BU); by railroad east of Knightstown, Rd. 43, Joanna Jones, June 23, 1950 (BU).


LAGRANGE COUNTY: Stagnant water near spring, Pigeon River, Winona H. Welch 9092, 9093, Aug. 31, 1941 (DU, BU).


MARSHALL COUNTY: Maxinkuckee Gun Club and Fish Hatchery, 2 mi. northwest of Culver, W. A. & F. K. Daily 92 in drainage ditch from above pond, 93 in pond, July 1, 1946 (CM, HaFR, BU); pond with sand and gravel bottom, Old Zeckiel Gravel Pit, near outlet of Lost Lake, Russell Fisher 1, July 19, 1946 (BU).

MARSHALL COUNTY: Pond caused by dredging Yellow River, third bridge downstream including bridge north of Burr Oak, Russell Fisher pbg. 2 with C. globularis, July 9, 1946 (BU).

PUTNAM COUNTY: 3 mi. south of Greencastle in lake at Linedale, Winona H. Welch 9465, May 17, 1949 (DU, BU).

RANDOLPH COUNTY: Gravel excavation along road 0.5 mi. north and 0.7 mi. west of Huntsville, R. C. Friesner 19230 in small stream fed by pool, 19231 floating in pool, July 14, 1945 (BU).

STEARKE COUNTY: Pond caused by dredging Yellow River, third bridge downstream including bridge north of Burr Oak, Russell Fisher pbg. 2 with C. globularis, July 9, 1946 (BU).

STEUBEN COUNTY: Bledsoe’s Beach, Lake James, W. A. & F. K. Daily 163, Sept. 10, 1947 (BU); marl pit on north side of road ca. 1 mi. from Fremont, ca. 2 mi. from intersection of Rds. 27 and 12, W. A. & F. K. Daily 291, June 17, 1951 (CM, HaFR, GOA, BU); northwest end, Lake Gage, W. A. & F. K. Daily 304, June 18, 1951 (BU); along shore in shallow water, east side of Lime Lake, W. A. & F. K. Daily 305, June 18, 1951 (CM, HaFR, GOA, BU).

WAYNE COUNTY: Very dense growth in shallow water, Clear Creek, Lawrence J. King 2575, Sept., 1945 (EC, CM, BU).

For further citation of specimens see Daily (7) under the name, C. foetida A. Br. In that study, specimens were reported from Carroll, Kosciusko, LaGrange, Lake, Randolph, St. Joseph, Tippecanoe and Wayne Counties.

No specimens were seen to support the report of Evermann and Clark (15) under the name of C. foetida and C. vulgaris from Lake
Maxinkuckee, Marshall County. The only reference to distribution in Lake Maxinkuckee is, "Represented in our collection by numerous examples." At least some of the material was not fruiting and may not have been preserved for this reason. Evermann and Clark's report of *C. vulgaris* was also cited by Palmer (27).


See *Chara fragilis* in Daily (6) for general description and illustrations. In Indiana specimens the ridges on the oospores range from 9-15. The oospores are ca. 480-690 μ long and dark brown to black.

Included here are: the specimen probably referred to by genus name only in Evermann and Clark (13) and also cited by Palmer (29) from Lake Cicott, Cass County; possibly the specimens to support the report of *C. fragilis* from Long Point near Scovell's and "occasional in the lake," Lake Maxinkuckee, Marshall County, reported by Evermann and Clark (15) whose study was also cited by Palmer (27); also probably some of the specimens referred to by genus name only in Scovell (39) for Treighbaum and Pretty Lakes in Marshall County.


For further citation of specimens see Daily (7) under the name of Chara fragilis Desv. In that study, specimens were reported from Bartholomew, Decatur, Hamilton, Marion, Noble, Shelby, Steuben, Union and Wayne Counties.

No specimens were seen to support the report in Smith (40) for Clay County or Palmer (28) for bog near Hogback Lake in Steuben County.


Habit flexible to rigid; upper stem internodes shorter than branchlets; lower whorls remote, ca. 10-14 branchlets in a whorl; branchlets with 6-13 nodes; monoecious; stem cortex regularly triplostichous, cells about equal in diameter; spine cells borne singly, long; stipules in two series, long, slender, sharply pointed, variable in length; lowest branchlet internode corycitate, variable in length; next lowest branchlet internode triplostichous (or as in f. inconstans some
branchlets may be entirely ecorticate) first branchlet node may or
cannot be fertile; number of branchlet internodes corticated vari­
able; bracts and bracteoles quite variable (in f. Humboldtiana rather
long, in f. Michauxii short); oospores usually having 13 or 14
ridges, ca. 525-735 μ long, black; oospore membrane dark brown with
granules; antheridia ca. 370-480 μ in diameter.

See Daily (6) for illustrations.

Key to the Forms Found in Indiana

Lowest node of the branchlet usually fertile, bracts similar
to the others
Branchlet nodes 8-10, oospore ca. 580-689 μ long, all
branchlets with at least some internodes corticated.

Branchlet nodes 6-7, oospore ca. 525 μ long, at least
some of branchlets entirely ecorticate, particularly
those of the lowest stem nodes.

Lowest node of the branchlet usually sterile, bracts similar
to the others
Branchlet nodes 10-12, oospore ca. 636-689 μ long,
plant large, bracts particularly at sterile nodes very
minute

Branchlet nodes 12 or 13, oospore ca. 700-735 μ long, bracts
longer than in f. Michauxii

Chara zevaliana f. macilenta nov. comb. (As synonym for
Chara gymnopus var. macilenta A. Br. ex Braun and Nordstedt.
Berlin, 1882, p. 192, Taf. VII, Fig. 271. 1883).

Included here are the specimens probably the basis of the report
by Evermann and Clark (15) under the general heading Chara folio­
loosa Muhlenberg and Willdenow, "On the shore of Lake Maxin­
kuckee on the west side by Winfield's." Farther along in this same
treatment, they state, "Various modifications or subspecies of this
form, such as Chara foliolosa macilenta, . . . are to be found along
the shores of Lost Lake." The general heading Chara foliolosa was
also cited by Palmer (27).

Included here also is a specimen probably the basis of the report
by genus name only in H. W. Clark (5) and C. M. Palmer (27) for
Winona (Eagle) Lake, Kosciusko County.

For further citation of specimens, see Chara gymnosus in Daily (7). In that study, the specimens reported for Cass and Lake Counties belong to this form.


Specimen seen: STARKE COUNTY: In ca. 6 in. of water, Bass Lake, W. A. & F. K. Daily 125, July 6, 1946 (BU).


Included here are the specimens probably the basis for the report by genus name only in the manuscript on Twin Lakes, Marshall County, by J. T. Scovell (39).


For further citation of specimens see Chara gymnopus in Daily (7). In that study, specimens reported from Jefferson, Noble and Whiteley Counties belong to this form.


For further citation of specimens, see Chara gymnopus A. Br. in Daily (7). In that study specimens reported from Bartholomew County belong to this form.

No specimens were seen to support the following reports: C. polyphylla from Wabash River, Gibson County, reported by J. Schneck (35) and C. M. Palmer (27); C. foliolosa, “alcoholic specimen in bottle marked Sp. 4” and “extending from Long Point down to about

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Farrar’s,” reported from Marshall County by B. W. Evermann and H. W. Clark (15); *C. foliolar conjugens* from Lost Lake, Marshall County, reported by B. W. Evermann and H. W. Clark (15).


For general description and illustrations see Daily (6). In Indiana specimens the oospores are 735-848 μ long; 500-636 μ wide with 11 or 12 ridges; antheridia ca. 370 μ in diameter.

TON COUNTY: In sinkhole on south side of Rd. 56, ca. 4½ mi. southwest of Salem, C. C. Doan 63468, Aug. 21, 1945 (BU).

For further citation of specimens see Daily (7). In that study, collections were reported from Porter, Spencer, Steuben and Sullivan Counties.

18. CHARA DELICATULA Ag. Syst. Alg.-., p. 130. 1824. (non Desv.) (As synonym, C. verrucosa Itzig.)

For general description and illustrations see Daily (6) under Chara verrucosa. Indiana specimens have: upper series of stipulodes variable in size, lower slightly developed; coronula of oogonium connivent; oospores ca. 635-685 μ in length, 400-480 μ broad with 12-14 ridges; antheridia ca. 420-470 μ in diameter.

Included here is a specimen probably the basis of the report of Chara subverrucosa A. Br. by Evermann and Clark (15) and also cited by Palmer (27) from Lake Maxinkuckee, Marshall County. The report by Evermann and Clark states that it is “occasional in the lake, represented in the collection by several specimens.” Only one was seen. It is difficult to classify this specimen as the prominence of the primary cortical cells is variable; however, the author believes it belongs here.

Specimens seen: MARSHALL COUNTY: Lake Maxinkuckee, J. T. Scovell (3-20A) with C. contraria, Aug. 2, 1904 (USM, BU) (Probably the basis for the report of C. subverrucosa in Evermann and Clark, 15, whose study was also cited by Palmer, 27); shallow water, muck bottom, Old Outlet Bed, Lake Maxinkuckee, Russell Fisher, July 8, 1946 (BU). NOBLE COUNTY: Tippecanoe (Big Lake), J. T. Scovell (2-9), Sept. 3, 1904 (USM, BU).


For further citation of specimens see Daily (7) under the name Chara verrucosa. In that study, one specimen was reported from Noble County.


Habit small, not over 30 cm. in height (var. Macoumi usually only a few centimeters in height), slender, producing bulbils at the rhizoidal portion; dioecious; branchlets usually 6-8 at a node having 5-8 segments, the lower ones diplostichous, the upper 1 or 2 ecorticate and usually short; stem cortex irregularly triplostichous, appearing
at times diplostichous because secondary cells developed in one direction or developed only a short distance in both directions from a node, cells variable in diameter, primary usually prominent; spine cells papiliform and blunt to ca. 200 μ long and pointed; stipulodes in 2 series in a circle around the stem, usually well developed but variable even at the same stem node; bracteoles and bracts variable in size; oospore black with 12-15 ridges, usually 400-650 μ long; antheridia ca. 500 μ in diameter.


For illustrations see Daily (6) under Chara aspera.

The present collections of this species from Indiana are probably all referable to this variety, which differs from the type chiefly by its relatively small stature and in having stipulodes and spine cells reduced in size.

As the type material was immature, the number of ridges of the oospore is usually given as probably 8-10. The author saw no oospores in the type material which could be used as a basis for size or number of ridges with certainty. Ripe oospores are usually apparently scarce in collections as is the case in Indiana. From the immature material at hand, though, it would appear that oospores would at least have as many as 12-13 ridges. A specimen from Nebraska otherwise referable to this variety had 13 ridges, was black and appeared to be similar to the oospore usual for the species. (Fish ponds, Rock Creek Hatchery, Dundy County, Nebraska, Walter Kiener 1950, Aug. 3, 1945).

Included here are the specimens which are probably the bases of the report of Chara by J. T. Scovell (39) for Pretty Lake, Marshall County.


For further citation of specimens see *Daily* (7). In that study, a specimen was reported for Kosciusko County.

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Butler University