# THE NETHERLANDS' CHAROPHYTA

by

H. D. VERDAM

(Leiden).

The *Charophyta* of the Netherlands have been hitherto almost neglected. As far as I know only the following papers are dealing with the matter:

VAN DEN BOSCH, R. B., in Ned. Kruidk. Archief I, 1846, p. 100, p. 289.
" " " " " " " " " " II, 1851, p. 225.
both preliminary works to
Prodromus Florae Batavae II, 2, 1853, p. 186—189.
DE VRIES, H., Flora van Nederland, in Alg. Statist. v. Ned. I, 8, 1870, p. 39.

A few *Charophyta* from the IJselmeer have been recorded lately:
HOCKE HOOGENBOOM, K. J., in Ned. Kruidk. Archief XVLII, 1937, p. 315—316, p. 327.

In the present paper a list is given of the *Charophyta* collected up to this time in the Netherlands and preserved in the National Herbarium at Leiden (L), the herbarium of the "Nederlandsche Botanische Vereeniging" at Leiden (B) and those of the Universities of Amsterdam (A), Utrecht (U), Groningen (G) and the material of the "Commissie voor onderzoek van het Naardermeer" (N). It is a pleasure to me to express my best thanks to Prof. H. J. LAM for putting the material at my disposal, to the directors of the Institutes mentioned above and to the staff of the Rijksherbarium, Leiden, particularly to Miss Dr. J. TH. KOSTER, who has given me much valuable help. Though it is not my intention to dwell upon a detailed explanation about development, growth, phylogeny, history, etc., some remarks have to be made. The principal literature on these subjects is:

GROVES, J. & BULLOCK—WEBSTER, G. R., The British Charophyta I, 1920, II, 1924. (GROVES)
HY, F., Les Characées de France — Mém. Soc. Bot. de France 3, mém. 26, 1914, p. 1. (HY)

RABENHORST, L., Kryptogamen Flora von Deutschland, Oesterreich und der Schweiz V, 1890—1897 (MIGULA, W.). (MIG.)

ROBINSON, C. B., The Chareae of North America — Bull. New York Bot. Gard. IV, 1905—1907, p. 244. (ROB.)

In general, the subdivision by MIGULA into many forms is considered to be too detailed, as his constant forms may as well be inconstant local forms of one and the same species. However, since I found in the Quackjeswater (a pool) at Voorne near Rockanje nine very well distinguishable forms of *Chara aspera* as described by MIGULA, mixed up with each other, I am convinced that in general he must be right. Afterwards I found in the Herbarium of the "Botanische Vereeniging" a sheet from one place in the island of Texel (HOLKEMA 1868) containing three of the forms collected in the Quackjeswater. These two series have grown respectively under the same conditions and the three forms show the same distinct characters in both habitats. I therefore chiefly followed the subdivision proposed by MIGULA and identified the material as far as I was sure to have the same forms as were described by him. When there was hardly any doubt, the expression: acc. ad (= accedens ad) precedes the name and when I was not sure about the form, only the specific name was given. For comparison principally the rich *Charophyta* collection of the Leiden National Herbarium was used, which for the greater part has been revised by A. BRAUN. As is known the herbarium KÜTZING has been added to this collection, containing the principal Exsiccata collections. Moreover, specimens distributed by W. MIGULA, belonging to the Herbarium of the Utrecht University, have been investigated. BRAUN and KÜTZING have examined and commented many specimens of the material from the Netherlands. In such cases their opinions about the specimens are separately added. In naming the species generally ROBINSON was followed. Only few synonyms are cited, since complete lists of these are to be found in the works of GROVES and MIGULA. As a rule, generic and specific characters used in the keys have not been repeated in the short descriptions of the species.

## Key to the genera

Cells of coronula in two rows, each of five cells; cortex and stipulodes wanting . . . . Subfamily **Nitelleae**

Leaves once or more times furcated, antheridia terminal on the primary ray and secondary rays of the leaf . . . . . **I. Nitella**

Leaves not furcate or furcate so that the mean ray is much more developed than the other one, antheridia lateral on the nodes of the leaf or at the base of the whorl . . . . . **II. Tolypella**

Cells of coronula in a single row of five cells . . . Subfamily Chareae
Stipulodes none, ecorticate, dioecious . . . . . **III. Nitellopsis**
Stipulodes present, sometimes reduced.
Oogonia below the antheridia, ecorticate, monoecious. **IV. Lamprothamnus**
(not found in the Netherlands)
Oogonia between the antheridia, corticate or ecorticate, monoecious . . . .
**V. Lychnothamnus**
(not found in the Netherlands)
Dioecious or monoecious. If monoecious, oogonia above the antheridia; if dioecious, oogonia on the upperside of a leaf-segment, corticate or ecorticate.
**VI. Chara**

## I. NITELLA AGARDH

### Key to the species

Leaves once furcate, ultimate rays 1-celled, coronula deciduous.
Antheridia and oogonia enveloped in mucus.
Feminine leaves not furcate, oospore smooth, tip of leaf pointed . . .
**1. N. syncarpa**
Feminine leaves furcate, oospore oxygyrous, tip of leaf obtuse . . . .
**2. N. capillaris**
Antheridia and oogonia not enveloped in mucus.
Dioecious . . . . . **3. N. opaca**
Monoecious . . . . . **4. N. flexilis**
Leaves once furcate, equal in each whorl, ultimate rays 2—3-celled, coronula persistent. Ultimate rays short, secondary rays usually minute and inconspicuous.
Fertile leaves incurved and crowded . . . . . **5. N. translucens**
Leaves in each whorl of two kinds, smaller accessory leaves being produced above and below the primary leaves, together forming heads. **6. N. hyalina**

**1. Nitella syncarpa** (THUILL.) KG. Phyc. germ., 1845, p. 256 — *Chara syncarpa* THUILL. Flore de Paris ed. II, 1799, p. 473.

*Lit.:* KG. Spec. Alg., 1849, p. 514; Prod. Fl. Bat. II, 2, 1853, p. 188; MIG. l. c. p. 98; HY l. c. p. 8 — *Ill.:* KG. Tab. Phyc. VII, 1857, p. 13, T. 31, fig. II; MIG. l. c. Fig. 28.

Dioecious, 10—20 cm high. Thin, slender and flexible species. Stem thin and often dirty brownish green. Leaves about 6 in a whorl, often two accessory ones, only once bifurcate. Ultimate segments 1-celled, the sterile and male ones 2—4-pointed, the feminine ones usually 1-pointed. The second segment of the leaves of the lower whorl often wanting, in that case oogonia terminal. Cell wall of the leaflets rather thin, hyaline and thickened at the top. Top of the leaflet pointed.

Oogonia 2—3 together, 280—500$\mu$ ($\pm$ 350 $\mu$) long. Antheridia single, 250—325 $\mu$ ($\pm$ 290 $\mu$) in diam.

*Distribution:* Europe.

Formae dissolutae

*Lit.:* MIG. l.c. p. 105.

No heads are formed by the whorls of the leaves.

Groningen: Groningen outside Apoort (B) — Utrecht: Utrecht outside Waardpoort, VAN DER TRAPPEN (B); BERGSMA (B, L, KÜTZING: *Nitella syncarpa*); ex herb. NIJLAND, IV 1843 (B); GEVERS DEYNOOT n. 386 (B), acc. ad Nitellam syncarpam — N. Brabant: Beugen, peat, Unio VII, 1853 (B) — Gelderland: LACOSTE n. 573 (B, L, BRAUN could decide nor to *Nitella capitata* nor to *Nitella syncarpa* by examining only these male specimens, KÜTZING: *Nitella syncarpa*); LACOSTE n. 1080 (B) — N. Holland: Amsterdam, LACOSTE n. 573 (L, KÜTZING: *Nitella syncarpa*).

2. **Nitella capillaris** (KROCKER) GROVES Brit. Char. I, 1920, p. 26 — *Chara capillaris* KROCKER Fl. Siles. III, 1814, p. 62 — *Chara capitata* NEES AB ESENBECK in Denkschr. Bayr. bot. Ges. II, 1818, t. 6, p. 80 — *Nitella capitata* AG. Syst. Alg., 1824, p. 125.

*Lit.:* MIG. l.c. p. 111; HY l.c. p. 7; GROVES I l.c. p. 96 — *Ill.:* MIG. l.c. Fig. 31; HY l.c. Pl. I, fig. 5, 6; GROVES I l.c. Pl. VI.

Dioecious, 10—15 cm high. Usually 1—4 stems (internode of ± 3 cm), furcating when starting from the soil, forming a tuft. Stem slender, bright pale green. Internodes 1—1½ time as long as the leaves. Leaves once furcate. Fertile whorls usually with short leaves forming dense heads. Primary and secondary rays of equal length. Secondary rays 2—4-celled. Oogonia usually 2—3 together, 400—500 μ (± 450 μ) long. Oospore chestnut brown. Antheridium 225 μ in diam.

*Distribution:* Europe, N. Africa, Asia and N. America.

Groningen: Esserweg, ditch, POSTMA 22 IV 1906 (G) — Drente: Assen, pond in the wood, V 1855 (B); Roden—Peize, Zetdiep, 27 V 1855 (B) — Utrecht: Oudwijk near Utrecht, Broers (A) — S. Holland: Boekhorst, pool, 1858 (B).

3. **Nitella opaca** AG. Syst. Alg. 1824, p. 124.

*Lit.:* MIG. l.c. p. 121; HY l.c. p. 9; GROVES I l.c. p. 99. — *Ill.:* MIG. l.c. Fig. 35; HY l.c. Pl. I, fig. 3; GROVES I l.c. Pl. VII.

Dioecious, 15—25 cm high. Stem moderately stout. Internodes 2—4 times as long as the leaves. Leaves once furcate forming more or less dense heads. Secondary rays 1-celled about $^1/_3$ as long as the primary one. Oogonia solitary or geminate 580—700 μ (± 600 μ) long. Oospore dark chestnut brown to black. Antheridia 650—775 μ in diam. (fide GROVES). Can be confounded with *Nitella flexilis*, however, different habitus and antheridia of *N. opaca* larger than those of *N. flexilis* (± 500 μ in diam.).

*Distribution:* Europe, N. Africa, Asia, N. & S. America.

Gelderland: Staverden, Hierderbeek (brook), LACOSTE VII 1855 (L, sterile, BRAUN: *Nitella opaca*) — N. Holland: Naardermeer, POLAK & BUISMAN 13 V 1924 (N), only feminine specimens — Zeeland: Goes, in pools, VAN DEN BOSCH IV 1843 (B, sterile).

**4. Nitella flexilis** (L.) AG. Syst. Alg. 1824, p. 124 — *Chara flexilis* L. Sp. Plant. 1753 ex parte, p. 1157.

*Lit.:* Prod. Fl. Bat. II, 2, 1853, p. 188; MIG. l.c. p. 132; HY l.c. p. 10; GROVES I l.c. p. 102; LAKOWITZ, Algenfl. Ostsee 1929, p. 194 — *Ill.:* MIG. l.c. Fig. 37; HY l.c. Pl. I, fig. 2; GROVES I l.c. Pl. VIII.

Monoecious, about 15—30 cm high. Plants forming individual tufts, 10—20 stems grown together starting from the base, brightly deep-green. Stem moderately stout to flexible. Internodes 1½ time as long as the leaves. Whorls consisting of 6—8 straight leaves, fertile ones similar to sterile ones. Leaves once furcate. Primary rays about twice as long as the secondary ones. Secondary rays 2—3, acuminate or slightly mucronate. Oogonia 2—3 together 490—525 $\mu$ ($\pm$ 500 $\mu$) long. Oospore dark reddish brown. Antheridia 240—325 $\mu$ ($\pm$ 300 $\mu$) in diam.

To be distinguished from *N. opaca* by the more graceful habitus and the smaller antheridia.

*Distribution:* Europe, Asia (Kamchatka and Japan), N. & S. America.

Drente: Roden—Peize, canal, 27 V 1855 (B) — Gelderland: Emst near Epe, peatmoor, KOK ANKERSMIT 5 VII 1875 (B); Uddelermeer (lake), LACOSTE 1849 (L, BRAUN: *Nitella flexilis*?); pool, LACOSTE 1849 (B, BRAUN: *Nitella syncarpa* junior flexilis); Vaassen—Apeldoorn, canal, LACOSTE 3 VIII 1854 (L, sterile, BRAUN: *Nitella flexilis*, sed propter sterilitatem incerta); Apeldoorn, Grift, brooklet, LACOSTE VIII 1854 (L, sterile, BRAUN: *Nitella flexilis*) — Utrecht: de Bilt, BONDAM (L); Vinkeveen, LACOSTE 1850 (L, BRAUN: *Nitella flexilis*), LACOSTE V 1850 (B, BRAUN: *Chara flexilis* vera); Achttienhoven, in a boggy pool, LACOSTE 1841 (B); Utrecht—Westbroek, river Vecht, OUDEMANS n. 635, 24 V 1871 (L, U, A, G) — N. Holland: Heemstede (L, KÜTZING: *Nitella exilis* BRAUN); VAN DER TRAPPEN (B, sterile) — Zeeland: Near Goes, in ditches, VAN DEN BOSCH (L) — N. Brabant: Heusden, river Oud Maasje, LACOSTE VIII 1847 (L, KÜTZING: *Nitella flexilis*?); Vught, pond, Muizerik, VAN HOVEN (B) — Limburg: Weert, VERSTRAETEN 27 VII 1905 (G), sterile, acc. ad *Nitellam flexilem;* near Maastricht, FRANQUINET (L, BRAUN: *Nitella flexilis*).

**5. Nitella translucens** (PERS.) AG. Syst. Alg. 1824, p. 124 — *Chara translucens* PERS. Synopsis II, 1807, p. 531.

*Lit.:* Prod. Fl. Bat. II, 2, p. 188; MIG. l.c. p. 140; HY l.c. p. 11; GROVES I l.c. p. 110 — *Ill.:* MIG. l.c. Fig. 39, 40; HY l.c. Pl. I, fig. 9, 19; GROVES I l.c. Pl. XI.

Monoecious. Habitus of sterile plants at first sight resembling that of *Nitellopsis obtusa,* but plant shorter (to 30 cm). Stem stout. Internodes 1½—3 times as long as the leaves. Sterile leaves 4—7, once furcate, primary rays very long, secondary ones minute; fertile leaves in small whorls, closely together, often forming dense heads (fide GROVES). Ultimate rays of the branchlets 2-celled. Oogonia 2—3 together, 475—525 $\mu$ long (fide GROVES). Antheridia 250—375 $\mu$ in diam. (fide GROVES).

*Distribution:* W. Europe, N. Africa (Algiers).

N. Brabant: Vught, pits in moorland, LACOSTE? IX 1847 (L); moorland, VAN HOVEN 1903 (L).

**6. Nitella hyalina** (DC.) AG. Syst. Alg. 1824, p. 126, ex parte — *Chara hyalina* DC. Fl. Fr. V, 1815, p. 247, ex parte.

*Lit.:* MIG. l.c. p. 190; HY l.c. p. 19; GROVES I l.c. p. 127 — *Ill.:* MIG. l.c. Fig. 55, 56; HY l.c. Pl. I, fig. 15; GROVES I l.c. Pl. XVI.

Monoecious. Stem slender. Internodes 2—4 times as long as the leaves. Whorls of usually 8 primary leaves with twice as many shorter secondary ones in two rows; one above, the other below the primary leaves. Leaves together forming heads somewhat stringed at ¼ of the height from below. Primary leaves 2—3 times furcate, secondary leaves of the lower series 1—2 times furcate into 4—6 rays, those of the upper rays usually once furcate into about 5 rays, or simple. Oogonia solitary 500—625 $\mu$ long. Antheridia 350—425 $\mu$ in diam. (fide GROVES).

*Distribution:* W. Europe, Finland, S. Asia, Japan, N. & S. Africa, N. America, Australasia.

Friesland: Drachten, Oudgaasterzanding, GEERTS & RONNER 15 VIII 1905 (A), sterile.

f. $\beta$ **maxima** A. BR.

*Lit.:* MIG. l.c. p. 196 — *Ill.:* MIG. l.c. Fig. 57.

Stem flexible, ± 30 cm long with large heads (2—4 cm in diam.). Leaves often three times furcate to 2 cm long, internodes to 5 cm.

Friesland: Veenwouden, "sanjes", 23 VII 1854 (B).

## II. TOLYPELLA v. LEONHARDI

### Key to the species

Ultimate cell of the rays conical.
Sterile leaves furcate . . . . . 1. **T. intricata**

Sterile leaves simple . . . . . **2. T. prolifera**
Ultimate cell of the rays allantoid.
Sterile leaves simple. Ripe oospore small . . . . . **3. T. glomerata**

**1. Tolypella intricata** (TTENTEP.) v. LEONHARDI in Lotos 1863, p. 32 — *Chara intricata* TRENTEPOHL apud Roth Catalecta botanica Fasc. 1, 1797, p. 125.

*Lit.:* MIG. l.c. p. 214; HY l.c. p. 21; GROVES I l.c. p. 130 — *Ill.:* MIG. l.c. Fig. 61; GROVES I l.c. Pl. XVII.

Monoecious, 15—25 cm high. Stem moderately stout, often much branched. Whorls of two kinds: the sterile and lower fertile ones distant, large and lax, the sterile usually once, the fertile once or twice divided with a variable (often considerable) number of shorter, more slender, usually simple, accessory leaves; the upper fertile whorls forming very large dense heads, with shorter, usually twice divided leaves. Ultimate rays of the leaves 5—7-celled, the cells successively diminishing in length and thickness, so that the ray tapers to the apex. Oogonia 2—4 together at each node, about 300—375 $\mu$ ($\pm$ 350 $\mu$) long. Antheridia 250 $\mu$ in diam.

To be distinguished from *T. prolifera* by the size and the divided sterile leaves.

*Distribution:* W. Europe, N. Africa (Algiers).

Groningen: near Groningen, HOEDEMAKER (G); Zuidlaren, ditches, STRATINGH V 1860 (G) — Gelderland: Lochem, running water near "de Luchte", 21 IV 1860 (B) — Utrecht: Vleuten, GEVERS DEYNOOT IV 1843 (L, KÜTZING: *Nitella polysperma* BRAUN); GEVERS DEYNOOT, herb. LACOSTE (L, BRAUN: *Nitella (Tolypella) intricata, Chara intricata* ROTH *Ch. fasciculata* AMICI, *Ch. polysperma* A. BRAUN olim) — Zeeland: Goes, in ditches, VAN DEN BOSCH n. 120 (L, KÜTZING: *Chara intricata*).

**2. Tolypella prolifera** (A. BR.) v. LEONHARDI in Lotos 1863, p. 57, Oesterr. Arml., 1864, p. 57 — *Chara prolifera* A. BR. in Ann. Sc. Nat. Sér. 2, I, 1834, p. 352.

*Lit.:* Prod. Fl. Bat. II, 2, p. 189; MIG. l.c. p. 203; HY l.c. p. 22; GROVES I l.c. p. 133. — *Ill.:* MIG. l.c. Fig. 59, 60; GROVES I l.c. Pl. XVIII.

Monoecious. Most robust species of this genus (30—40 cm high). Stem very stout, often solitary, much branched. Sterile whorls of about 6—20 simple 3—5-celled leaves, often very unequal, the cells diminishing gradually in length and thickness towards the apex, apical cell rather bluntly conical. Fertile whorls usually in large densely crowded heads. Ultimate rays of the leaves 3—5-celled, the cells usually much diminishing in length and breadth towards the apex; ultimate cells conical, acute or

acuminate, sometimes rather blunt. Oogonia 250—270 $\mu$ ($\pm$ 250 $\mu$) long. Antheridia 190—225 $\mu$ ($\pm$ 200 $\mu$) in diam.

To be distinguished from *T. glomerata* chiefly by the much more robust habitus.

*Distribution:* W. Europe, N. & S. America.

Groningen: near Groningen, VAN HALL (B) — S. Holland: Dordrecht—Willemsdorp, ditch, ALPHERTS & VAN HOVEN IX 1848 (L); near Dordrecht?, VAN HOVEN IX 1848 (B, probably belonging to the preceding specimen; BRAUN: *Nitella prolifera* KG.) — N. Brabant: Zevenbergen—Roodevaart, LACOSTE 23 VII 1860 (B).

**3. Tolypella glomerata** (DESVAUX) v. LEONHARDI in Lotos 1863, p. 129 — *Chara glomerata* DESVAUX in Lois. Not. Fl. Fr. 1810, p. 135.

*Lit.:* MIG. l.c. p. 227; HY l.c. p. 20; GROVES I l.c. p. 135 — *Ill.:* MIG. l.c. Fig. 64; GROVES I l.c. Pl. XIX.

Monoecious, 20—25 cm high. Resembles *T. prolifera* but smaller and more slender and sterile leaves not divided. Stem slender to moderately stout. Sterile whorls consisting of 6—12 elongated simple 3—5-celled leaves, the ultimate cell obtuse. Fertile whorls in dense compound heads of once furcate leaves, ultimate cells obtuse. Oogonia 2—6 together 325—400 $\mu$ ($\pm$ 370 $\mu$) long. Antheridia 220—260 $\mu$ ($\pm$ 250 $\mu$) in diam.

*Distribution:* W. Europe, N. Africa, W. Asia, Australasia.

Groningen: Groningen, ditch outside Apoort, STRATINGH (G), VAN HALL (B).

f. **tenuior** A. BR. in MIG. l.c. p. 232.

Plants about 6 cm high, very slender, grass-like. Internodes to 2 cm long. Leaves of the sterile whorls very long, usually as long as the whole plant (4—5 cm). Heads small, 2—4 mm in diam. Usually 5—6 normal and about 10—12 accessory leaves in one fertile head; inner whorl with some very long leaves (15—20 mm).

Friesland: Takozijl, pier near sluice, VAN DER WERFF n. 42 B, 26 VI 1935 (L); between Kornwerderzand and coast of Friesland, HOCKE HOOGENBOOM n. 146 (29), 3 VII 1934 (B, "Tolypella nidifica" in Ned. Kruidk. Arch. XLVII, 1937, p. 315).

## III. NITELLOPSIS HY

Only species:

**Nitellopsis obtusa** (DESVAUX) J. GROVES in Journ. Bot. 52, 1919, p. 127 — *Chara obtusa* DESVAUX in Lois. Not. Fl. Fr. 1810, p. 136 — *Tolypellopsis stelligera* (BAUER) MIG. l.c. p. 255.

*Lit.:* HY l.c. p. 22; GROVES II l.c. p. 3 — *Ill.:* MIG. l.c. Fig. 70, 71, 72; GROVES II l.c. Pl. XIV.

Dioecious. Tall specimen, to 75 cm high. Stem stout, producing at the lowest nodes rhizoid-like branches, bearing large white much thickened starshaped nodes. Internodes usually equalling the leaves. Whorls consisting of 5—7 straight leaves. Stipulodes absent. Leaves very long, consisting of 2—3 segments, ultimate segment elongated, acuminate or mucronate. Oogonia and antheridia solitary or geminate. Oogonia nearly globular, 1200—1400 $\mu$ long (fide GROVES). Antheridia $\pm$ 1000 $\mu$ in diam. (fide GROVES).

*Distribution:* Europe, N. India.

Utrecht: Vreeland, Wijde Blik, 16 XI 1920; Vinkeveen, Botsholsche plas (fide VAN DER WERFF) — N. Holland: Naardermeer, Spookgat, POLAK & BUISMAN, 3 VII (N) — S. Holland: Noorden, Nieuwkoopsche plassen (pools), VERDAM, 1 VII 1934 (L, only ♀ specimens).

## VI. CHARA L. *)

### Key to the species.

Stem cortex haplostichous, i.e. having a single row of cortical cells to each leaf . . . . . **1. Ch. canescens**

Stem cortex diplostichous, i.e. having two rows of cortical cells to each leaf, a central (primary) one and a lateral (secondary) one.

Tylacanthous, i.e. primary cortical cells more prominent than the secondary, spine-cells at the sides of the cortical cells.

Dioecious . . . . . **2. Ch. tomentosa**

Monoecious.

Oospore with envelopment of lime, more or less incrusted.

Spine-cells wanting or hardly developed, solitary. Posterior bracts rudimentary. Oospore black, not exceeding 700 $\mu$. Plant greenish grey and crumbly when dry . . . . . **3. Ch. contraria**

Spine-cells developed like those of *Chara hispida*. Posterior bracts very short. Oospore brown (sometimes very dark brown to black), usually $\pm$ 700 $\mu$ long . . . . . **4. Ch. aculeolata**

Oospore without envelopment of lime, not incrusted, exceeding 700 $\mu$, black, with strong thorns . . . . . **5. Ch. baltica**

Aulacanthous, i.e. secondary cortical cells more prominent than the primary ones (sometimes equally developed). Spine-cells and papillae (or when they are wanting the isodiametrical cells in the grooves) often pressed by the secondary rows.

Spine-cells or papillae wanting or very short and thick, solitary. Posterior bract-cells hardly developed and only visible as small papillae. **6. Ch. vulgaris**

Spine-cells distinct, often fasciculate anyhow at the top-internodes.

Posterior bract-cells distinctly developed, usually half as long as the anterior ones . . . . . **7. Ch. hispida**

*) All species found as yet in the Netherlands are diplostephanous (*Chara tomentosa* sometimes triplostephanous). Plants monoecious or dioecious. Stem cortex perfect.

Posterior bract-cells very short, less than half as long as the anterior ones . **4. Ch. aculeolata**

Stem cortex triplostichous, i.e. having three rows of cortical cells to each leaf, a central (primary) one and two lateral (secondary) ones.

Dioecious.

Spine-cells developed, usually long and conspicuous. Besides some short posterior bract-cells five long bract-cells at lateral and foreside are developed.

Posterior and anterior bract-cells as long as the lateral ones. Root producing globular bulbils . . . . . **8. Ch. aspera**

Posterior and anterior bract-cells half as long as the lateral ones (when fertile leaves), without bulbils . . . . . **9. Ch. galioides**

Spine-cells wanting, only two anterior bract-cells and one posterior one, rarely two short lateral bract-cells are developed. Stem and branchlets when dried remaining distinctly terete . . . . . **10. Ch. connivens**

Monoecious.

Bract-cells developed round the leaf-segments, spine-cells long . . . . **11. Ch. tenuispina**

Posterior bract-cells not developed or papilliform.

Without spine-cells or papillae, primary and secondary rows equally developed . . . . . **12. Ch. fragilis**

Distinct papillae or spine-cells, primary rows more prominent than the secondary ones . . . . . **13. Ch. verrucosa**

**1. Chara canescens** LOISEL. Nat. Fl. Fr. 1810, p. 139 — *Chara crinita* WALLROTH Ann. bot. 1815, p. 190, T. 3.

*Lit.:* Prod. Fl. Bat. II, 2, 1853, p. 187; MIG. l.c. p. 348; ROB. l.c. p. 262; HY l.c. p. 28; GROVES II l.c. p. 14; LAKOWITZ Alg. Fl. Ostsee 1929, p. 199 — *Ill.:* KG. Tab. Phyc. VII, 1857, p. 27, T. 69 I; MIG. l.c. Fig. 88; GROVES II l.c. Pl. XXVII.

Dioecious, about 15 cm high, dark green, having a single row of cells. Spine-cells so numerous that they are nearly hiding the stem, some solitary ones usually in clusters of 2—5, once to three times as long as the diameter of the stem, usually slender and acuminate. Branchlets 8—10, short, slightly incurved. Segments 5—8 all but the last usually corticate, ultimate segment often scarcely exceeding the subtending bract-cells. Bract-cells well developed, exceeding the oogonium. Stipulodes well developed. Oogonia 450—600 $\mu$ ($\pm$ 525 $\mu$) long. Parthenogenesis. Male plants unknown in the Netherlands.

*Distribution:* Europe, Asia, Africa, N. America (Massachusetts to Long Island).

Formae longispinae

*Lit.:* MIG. l.c. p. 360.

Spine-cells longer than the diameter of the stem.

Friesland: Kornwerderzand, beach near the dike, VAN DER WERFF 3 VII 1934 (L); Takozijl, pier N. side of the sluice, VAN DER WERFF 17 VII 1937 (L), pier near sluice, VAN DER WERFF 26 VI 1935 (L) — N. Holland: IJselmeer, KOOPMANS 7 VIII 1933 (A); Sloten, LACOSTE (L, B); Sloten-Amsterdam, LACOSTE VII 1843 (B, BRAUN: *Chara crinita*); Amsterdam, VAN DEN BOSCH n. 574 (L, KÜTZING: *Chara crinita*); IJselmeer, Bocht van Wervershoof, TINBERGEN 4 IX 1936 (L).

f. γ **laxa** (MIG.)

*Lit.:* MIG. l.c. p. 361.

Slender, elongated, graceful form, 30—40 cm high. Spine-cells scanty, somewhat longer than the diameter of the stem. Top-segment of the leaves hardly longer than the bract-cells. Posterior bract-cells somewhat shorter than the other ones. Oogonia about 500 μ long.

N. Holland: Alkmaar, SURINGAR & ABELEVEN 20 VIII 1871 (B, acc. ad formam *laxam*).

f. λ **compacta** (MIG.)

*Lit.:* MIG. l.c. p. 367.

Small but robust stiff form, 3—7 cm high. Internodes 5—8 mm. Leaves 2—3 mm. Spine-cells densely congested, 1½ times as long as the diameter of the stem, stiff and brittle. Bract-cells longer, often twice as long as the leaf-segments. Oogonia about 250 μ long.

N. Holland: Sloten, LACOSTE (L, acc. ad formam *compactam*).

Formae brevispinae

*Lit.:* MIG. l.c. p. 371.

Spine-cells not as long as the diameter of the stem.

Friesland: Afsluitdijk near coast of Friesland, side of the IJselmeer, VAN DER WERFF 18 VII 1937; Makkumerwaard, VAN DER WERFF 18 VII 1937 (L); Makkum, inland waters at the foot of the dike, VAN DER WERFF 27 VI 1937 (L); Molkwerumerzijl, bottom of the silted sluice, VAN DER WERFF 17 VII 1937 (L); Mirnser Klif, VAN DER WERFF 17 VII 1937 (L); between Blankenham and Blokzijl, washed ashore, VAN DER WERFF 5 VII 1934 (L); Takozijl, pier near sluice, VAN DER WERFF n. 42 B, 26 VI 1935 (L); between Kornwerderzand and coast of Friesland, HOCKE HOOGENBOOM n. 146 (29), 3 VII 1934 (B).

2. **Chara tomentosa** L. Sp. Plant. 1753, p. 1156 — *Chara ceratophylla* WALLROTH (non HALSTED) Ann. bot. 1815, p. 192, t. 5.

*Lit.:* MIG. l.c. p. 386; HY l.c. p. 29, GROVES II l.c. p. 33, LAKOWITZ Alg. Fl. Ostsee 1929, p. 199 — *Ill.:* KG. Tab. Phyc. VII, 1857, p. 29, T. 73 I; MIG. l.c. Fig. 92, 93. GROVES II l.c. Pl. XXXII.

Dioecious, 25—30 cm high, bright to pale green or greyish green,

stiff and brittle. Stem stout and thick to 2 mm in diam., usually diplo- (sometimes triplo-) stichous. Spine-cells scattered on the lower parts of the stem, crowded near the apex, length to 8 mm, obtuse to ovoid, acuminate. Stipulodes similar to the spine-cells. Leaves stout, 6—8 in a whorl, 1—3 cm long, containing 4—6 internodes of which the upper 1—3 are ecorticate and much swollen. Bract-cells 5, broadly ovoid, acuminate, the anterior ones longer than the fructifications. Oogonia about 1000 $\mu$ long. Antheridia about 1400 $\mu$ in diam. (fide GROVES).

*Distribution:* Europe, N. Africa, Asia, tropical and subtropical America from southern Florida and New Mexico through the West Indies and Mexico to Southern Brazil.

Formae isoptilae

*Lit.:* MIG. l.c. p. 397.

Bract-cells developed equally round the leaf-segments.

N. Holland: Amsterdam, in ditches, OUDEMANS VI 1872 (U).

3. **Chara contraria** A. BR. in KG. Phyc. germ. 1845, p. 258; KG. Spec. Alg. 1849, p. 523.

*Lit.:* Prod. Fl. Bat. II, 2, 1853, p. 187; MIG. l.c. p. 432; ROB. l.c. p. 265; HY l.c. p. 33; GROVES II l.c. p. 36 — *Ill.:* KG. Tab. Phyc. VII, 1857, p. 24, 25, T. 59, 61; MIG. l.c. Fig. 99, 100; GROVES II l.c. Pl. XXXIII.

Monoecious, 10—30 cm high, usually greyish green. Internodes 2—4 times as long as the leaves. Cortex regularly diplostichous, the primary series more prominent than the secondary. Spine-cells solitary, conspicuous only on the upper internodes, on the mature internodes ranging to small papillae. Stipulodes small. Leaves 6—8 in a whorl, incurved, to 3 cm long. Anterior bract-cells equalling or exceeding the fructifications, posterior ones reduced to papillae or wanting. Antheridia and oogonia also at ecorticate segments. Oogonia 500—1000 $\mu$ ($\pm$ 700 $\mu$) long. Nucleus 300—700 $\mu \times$ 175—440 $\mu$. Antheridia 240—350 $\mu$ ($\pm$ 300 $\mu$) in diam.

Resembling *Chara vulgaris*. However, except the individual characteristics (size of the ripe nucleus) the habitus of *Chara contraria* is more slender, flexible and graceful than the more robust *Chara vulgaris*. The stem of *Chara contraria* is narrower but more firm and solid than that of *Chara vulgaris* and very crumbly, when dry.

*Distribution:* Europe, Africa, Asia, Australasia, N. America.

N. Holland: Texel, Binnen Mui, MEEUSE 10 VI 1937 (L); Rozewater near Zandvoort, dunes, BUSE (BRAUN: *Chara foetida*, acc. ad *Charam contrariam*) — S. Holland: near 's-Gravenhage, Waalsdorp, VAN HALL 16 VII 1834 (B); Waalsdorp 26 VII 1854 (B).

Formae microteles

*Lit.:* MIG. l.c. p. 443.

Ecorticate top-segment (usually 2—3 cells) shorter or not much longer than the last corticate segment.

Utrecht: near Utrecht, GEVERS DEYNOOT n. 388 (B).

Formae macroteles

*Lit.:* MIG. l.c. p. 452.

Ecorticate top-segment (usually 3—5 cells) always considerable, often much longer than the last corticate segment.

Friesland: Schiermonnikoog, HOLKEMA 14 V 1868 (B) — S. Holland: Hoek van Holland, S. VI 1879 (B).

f. λ **macroptila** MIG. l.c. p. 453

At first sight looking like a *Chara vulgaris*. About 9 cm high. Internodes at the base 2—3 times as long as the leaves, at the top half as long as the leaves. Cortex normal. Spine-cells badly developed. Leaves 1—2 cm long, 2—3 fertile nodes, 2 corticate, 1 naked. The naked tip usually 3-celled, the first cell somewhat swollen and broader than the corticate nodes, 3—6 times as long as the corticate part of the leaf. Bract-cells longer than the fructifications.

Gelderland: Hoophuizen, mouth of brook, VAN DER WERFF n. 8A, 15 VII 1937 (L); IJselmeer, Hoophuizen, in front of mouth of brook, VAN DER WERFF n. 8B, 15 VII 1937 (L).

f. ν **capillacea** MIG. l.c. p. 455.

Slender and fine about 13 cm high. Internodes longer than the leaves, suddenly shortened at the top. Leaves very fine and characterised by the uncommonly long uncorticated end. Leaves consisting of 3—4 segments, the first 2—3 corticated and fertile, top-segment 3—4 celled to about 3 cm long; the corticated segments together about 3 mm long.

Friesland: Kornwerderzand, beach near the dike, VAN DER WERFF 3 VII 1934 (L); Molkwerumerzijl, bottom of the silted sluice, VAN DER WERFF 17 VII 1937 (L); between Kornwerderzand and coast of Friesland, HOCKE HOOGENBOOM n. 126 (29), 3 VII 1934 (B, „Chara fragilis" in Ned. Kruidk. Arch. XLVII, 1935, p. 316) — Gelderland: Hoophuizen, IJselmeer, brooklet, VAN DER WERFF 15 VII 1937 (L, acc. ad formam *capillaceam*).

var. **hispidula** A. BR. in MIG. l.c. p. 457.

Distinct spine-cells visible with the naked eye, robust specimins, stipulodes better developed, leaves and bract-cells more prominent.

Formae microteles

*Lit.:* MIG. l.c. p. 458.

Ecorticate top-segment shorter, sometimes equalling the last corticate segment.

N. Holland: Muiderberg, LACOSTE (L, „Chara hispida" in Prod. Fl. Bat. II, 2, 1853, p. 187; KÜTZING: *Chara stricta,* BRAUN: *Chara contraria* var. *hispidula*)

**4. Chara aculeolata** KG. in Reich. Fl. germ. exc. II, 1832, p. 843 — *Chara papillosa* KG. in Flora II, 1834, p. 707 — *Chara intermedia* A. BR. in Fl. Krypt. bad. ined.

*Lit.:* MIG. l.c. p. 488; ROB. l.c. p. 267; GROVES II l.c. p. 33, 42, 47, 49, 50 — *Ill.:* KG. Tab. Phyc. VII, 1857, p. 27, 28, T. 67 II, 70 I; MIG. l.c. Fig. 110, 111, 112, 113.

Monoecious. Very variable species usually looking like an intermediary form between *Chara contraria* and *Chara hispida,* 5—25 cm high, usually 20 cm, in habitus for the greater part resembling *Ch. hispida,* shorter forms forming tufts. Stem to 2 mm in diam. Primary cortex rows not distinctly prominent, to the aspect of the cortex like that of *Ch. hispida.* Stipulodes conspicuous. Spine-cells from quite short and scarce (like papillae) to well developed and dense at least at the top-internodes, sometimes wanting at the lower internodes. Leaves 7—10 in a whorl. Segments 5—7, usually 6 (3 fertile). The ecorticate top-segment of very different form and length. Bractcells all developed, sprucefir-like and rigidly patent, posterior ones shorter. Oogonia 500—1200 $\mu$ ($\pm$ 900 $\mu$) long; nucleus 450—850 $\mu$ ($\pm$ 700 $\mu$) long. Antheridia 230—475 $\mu$ ($\pm$ 375 $\mu$) in diam.

Resembling *Chara contraria,* but *Ch. contraria* has a nucleus not exceeding 700 $\mu$ (*Chara aculeolata* having a nucleus usually exceeding 680 $\mu$) and when dried, *Ch. aculeolata* is not crumbly like *Ch. contraria.* Habitus more robust. At first sight to be distinguished from *Ch. hispida* by the usually less rigid and robust habitus. The posterior bract-cells of *Ch. aculeolata* are less developed than those of *Ch. hispida.* Top-segment of the leaves of *Ch. aculeolata* often ecorticate, long and swollen.

*Distribution:* Europe, N. & S. America.

Formae papillosae

*Lit.:* MIG. l.c. p. 497.

Stem with small papillae, usually only twice as long as broad.

N. Holland: Texel, Binnen Mui, MEEUSE 10 VI 1937 (L); Sloten, in ditches of the Haarlemmermeer, LACOSTE VI 1847 (L); Zeeland: Duiveland, DOZY (L).

f. α **elongata** (A. BR.)

*Lit.:* MIG. l.c. p. 497.

The largest of all forms (exceeding 40—60 cm, diameter of the stem 2 mm). Habitus like that of *Ch. hispida*. The top-segment is usually one-celled and ecorticate, short, often hardly longer than the bract-cells of the last segment.

N. Holland: in the Alloo in Texel, between Koog—Westen, HOLKEMA 16 VIII 1868 (B).

F o r m a e a c u l e o l a t a e

*Lit.:* MIG. l.c. p. 503.

Stem with distinct spine-cells, partly solitary, partly crowded, moretimes longer than broad.

Utrecht: Vinkeveen, Botsholsche plas, VAN DER WERFF 29 X 1937 (L).

In literature there is no agreement about the nomenclature nor about the limitations of this species. KÜTZING distinguished two species: *Chara aculeolata* (in REICHENBACH Flor. germ. exc. II, 1832 add. p. 843, Phyc. gen. 1843, p. 320, Tab. Phyc. VII, 1857, p. 27, T. 67 II, type from Tennstaedt) and *Chara papillosa* (in Flora II, 1834, p. 707; Tab. Phyc. l.c. p. 28, T. 70 I, type from Mansfeld). GROVES concludes on the ground of the Exsiccata of REICHENBACH (n. 426) to transfer the species *Ch. aculeolata* to *Ch. polycantha* A. BR., whereas MIGULA l.c. p. 488, 489 transfers *Ch. aculeolata* as well as *Ch. papillosa* to *Ch. intermedia* A. BR. According to GROVES II l.c. p. 50 the REICHENBACH Exsiccata n. 426 should be a weak sterile form of *Chara polyacantha*. The REICHENBACH Exsiccata n. 426, that was kindly sent us on loan by the Botan. Museum, Berlin, is fertile and as well developed as the sterile type specimen from Tennstaedt. However, both fertile and sterile specimens of this *Chara aculeolata* KG. do not show much resemblance to *Chara polyacantha*. In any case they are clearly to be distinguished from *Chara polyacantha*.

Now it appears that *Ch. intermedia* A. BR. is a synonym of *Ch. papillosa* KG., among others from the letter written by A. BRAUN to KÜTZING concerning the specimens of the type collection (Mansfelder See). At present the type collection of *Chara papillosa* KG. is preserved in the National Herbarium, Leiden. The letter mentioned above is copied here:

**Chara papillosa** KÜTZING.

Diese Pflanze bildet wirklich eine besondere Species (Unterart der Ch. foetida nach meiner Zusammenstellung der Arten), die zwischen Ch. vulgaris und hispida im Habitus und der Grösse der Samen die Mitte hält, in der Berindung aber mit

meiner Ch. contraria übereinstimmt. Ich habe sie, ehe ich Ihre Pflanzen kennte (in dem schon seit mehreren Jahre gedruckten Anfang der Fl. bad. crypt.) Ch. intermedia genannt. Die mir ehemals bekannten wenigen Formen sind jedoch ziemlich abweichend von der Ihrigen, in welcher ich einen neuen Form dieser, wie mir scheint, äusserst seltenen Art kennen lerne, nämlich meinen forma macroteles condensata.

Mit Ch. ceratophylla hat die papillosa keinen Verwandtschaft, da sie monoecisch ist, ceratoph. aber diöcisch. A. Br. 1840.

Specimens belonging to *Ch. aculeolata, Ch. papillosa* as well as intermediary forms have been identified well by BRAUN as *Ch. intermedia* A. BR. So MIGULA was right in uniting *Ch. aculeolata, Ch. papillosa* and *Ch. intermedia.* According to the Rules of Nomenclature the name of this species has to be *Ch. aculeolata* KG.

**5. Chara baltica** (HARTM.) FRIES in Aspegr. Försök till Bleh. Flor. 1823, p. 13 — *Chara hispida* var. *baltica* HARTMAN Skand. Fl. 1820, p. 376.

*Lit.:* MIG. l.c. p. 515; ROB. l.c. p. 267; HY l.c. p. 35; GROVES II l.c. p. 44; LAKOWITZ Alg. Fl. Ostsee 1929, p. 200 — *Ill.:* KG. Tab. Phyc. VII, 1857, p. 26, T. 63 II, 64 I; MIG. l.c. Fig. 114, 115; GROVES II l.c. Pl. XXXVI.

Monoecious, dark green, incrustation not visible. The lower nodes swollen, root bulbs with storefood. Cortex regularly diplostichous, the primary cortical cells slightly larger and more prominent. Spine-cells rather dense, solitary or many together, stout and acuminate. Stipulodes well developed. Leaves 8—11 in a whorl. Segments 5—7 (top-segment ecorticate, sometimes also the preceeding one). Bract-cells all developed. Oogonia ± 1000 $\mu$. Antheridia 500—600 $\mu$ in diam. (fide GROVES).

*Distribution:* England, Sweden, Finland, Denmark, N. W. Germany, N. America (Greenland), S. America (Bolivia).

F o r m a e m a j o r e s

*Lit.:* MIG. l.c. p. 528.

Robust forms of middle size with long internodes and relatively short leaves, 8—9 in a whorl.

f. $\zeta$ **typica** MIG. l.c. p. 528.

Moderately robust to 30 cm high, with thick short leaves. Stem 1 mm in diam. Internodes 3—4 times as long as the leaves. Cortex normal, cortical cells with thick walls. Spine-cells scattered at the lower internodes, dense at the upper ones, equalling the diameter of the stem or longer. Stipulodes well developed, visible with the naked eye. Leaves 8 in a whorl to 2 cm. Segments 5—6 (3—4 fertile) top-segment ecorticate (2—3-cells) exceeding in length the preceding corticate segment. Bract-cells small, stiff and acuminate, the lateral ones exceeding the oogonia,

the anterior ones shorter. Oogonia 360—550 $\mu$ ($\pm$ 500 $\mu$) long. Antheridia 225—300 $\mu$ ($\pm$ 250 $\mu$) in diam.

N. Holland: between Amsterdam and Sloten, Sloterweg, LACOSTE IX 1853 (L, acc. ad formam *typicam*).

6. **Chara vulgaris** L. Sp. Plant. 1753, p. 1156, emend. WALLROTH.

*Lit.:* Prod. Fl. Bat. II, 2, 1853, p. 187; MIG. l.c. p. 554; ROB. l.c. p. 269; HY l.c. p. 30; GROVES II l.c. p. 18 — *Ill.:* KG. Tab. Phyc. VII, 1857, p. 24, 25, T. 58, 59 II, 60, 72 II; MIG. l.c. Fig. 122; GROVES II l.c. Pl. XXVIII.

Monoecious, 10—50 cm high. Habitus variable, bright, pale or brownish green. Stem to 1.2 mm in diam., moderately stout, cortex double; secondary cortical rows somewhat wider and more prominent than the primary ones. Spine-cells solitary, more or less obtuse, papilliform or nearly wanting. Leaves incurved, spreading or recurved, 6—11 in a whorl, to 3 cm long, containing 3—5 corticate segments and an incorticate 2—3-celled leaf tip. Anterior bract-cells different in length, sometimes shorter, sometimes much longer than the oogonia. Posterior bract-cells small or wanting. Oogonia to 800 $\mu$ long. Antheridia to 500 $\mu$ in diam.

Almost cosmopolitan species (in the extreme North of Europe wanting).

F o r m a e s u b i n e r m e s

*Lit.:* MIG. l.c. p. 566.

Papillae extremely small, smaller than the stipulodes. Oospore brown.

Friesland: Kornwerd, IJselmeer, VAN DER WERFF 18 VII 1937 (L); near Sneek, BERGSMA (B); Makkumerwaard, VAN DER WERFF 18 VII 1937 (L); Makkum, outside the Waard, VAN DER WERFF 27 VI 1937 (L); Makkum, inland water-way near the dike, VAN DER WERFF 27 VI 1937 (L) — Utrecht: Maarssen, WENT 1882 (U); near Utrecht, GEVERS DEYNOOT n. 387 (B) — N. Holland: Sloten, ditches in Haarlemmermeer, LACOSTE (B) — S. Holland: Kagermeer, COOL 4 VII 1921 (L); Wassenaar, STEKHOVEN n. 999 and n. 1000 (B); near 's-Gravenhage, VRIJDAG ZIJNEN (U); near Rotterdam, OUDEMANS 1850 (B, A, BRAUN: *Chara foetida*), OUDEMANS V 1850 (B, BRAUN: *Chara foetida* A. BR., *Chara vulgaris* auct. ex parte) — Zeeland: Goes, in ditches, VAN DEN BOSCH (B); Kloetinge-Kapelle, ditch, LACOSTE IV 1839 (L).

f. $\alpha$ **normalis** MIG. l.c. p. 566.

About 30 cm high, slender form. Spine-cells small and scanty. Leaves 7—8 in a whorl, half as long as the internodes, somewhat curved

upwards, 3 corticate fertile bract-cells and one ecorticate top-segment (3 cells) as long as the corticate part of the leaf. Posterior bract-cells very small (only papillae). Anterior and side bract-cells about twice as long as the oogonia. Ripe oospores bright chestnut coloured, 480 $\mu$ long.

S. Holland: Waalsdorp, ditches in the dunes, VRIJDAG ZIJNEN (B).

f. $\beta$ **longibracteata** (KG.)

*Lit.:* KG. in REICHENB. Fl. exc. 1832, p. 843; MIG. l.c. p. 567 — *Ill.:* KG. Tab. Phyc. VII, 1857, p. 25, T. 60 I; MIG. l.c. Fig. 123; GROVES II l.c. Pl. XXIX, 3.

About 40 cm high. Stem moderately stout. Cortex regular. Spine-cells short to rudimentary, appressed. Leaf-segments elongated, the ultimate 2—3 ecorticate, usually forming flagelliform ends. Anterior and side bract-cells very long to 10 times as long as the oogonium.

Friesland: St. Jacobi Parochie, VAN HALL 15 VII 1829 (B); Makkumerwaard, VAN DER WERFF 18 VII 1937 (L); Molkwerumerzijl, bottom of the silted sluice, VAN DER WERFF 17 VII 1937 (L); Mirnser Klif, VAN DER WERFF 17 VII 1937 (L); Takozijl, pier of N. side of the sluice, VAN DER WERFF 17 VII 1937 (L) — Groningen: Euvelgunne, POSTMA 13 VI 1905 (G); Esserweg, POSTMA 8 VII 1906 (G); Oostwolde, ditch in peatmoor, POSTMA 27 VI 1906 (G); Groningen, outside Apoort, STRATINGH (G) — Overijsel: Kampen, ditches, BONDAM VIII 1847 (L, KÜTZING: *Chara vulgaris* var. *longibracteata*); Vollenhoven, ditches between sea and dike, JANSEN & WACHTER (Unio) VII 1928 (L) — Gelderland: Berkel, trench in hayfield, 13 VII 1859 (B) — Utrecht: Eembrug-Bunschoten, ditches in peatmoor, WENCK V 1845 (L); Utrecht, NIJLAND? 1869 (L), LACOSTE (B, BRAUN: *Chara polysperma* est forma *Charae foetidae*); near Koningslust, BROERS (A) — N. Holland: Amsterdam, ditches in brackish claysoil, OUDEMANS n. 842 1 VI 1872 (L, B, G, U, A); IJselmeer, Bocht van Wervershoof, TINBERGEN 29 VIII 1936 (L); Amsterdam, J. W. MOLL 1 VI 1872 (G); Amsterdam, LACOSTE (L); Zandvoort, valley in the dunes near Rozewater, BUSE (L, BRAUN: *Chara foetida*); Zandvoort, VAN DER TRAPPEN (L, mixed up with one piece of the *subhispidae* group, BRAUN: *Chara foetida* cum var. *subhispida*); Halfweg near Haarlem, LACOSTE VIII 1855 (L, BRAUN: *Chara foetida* A. BR.); Sloten, in Haarlemmermeerpolder, LACOSTE IX 1853 (L, mixed up with *Chara fragilis*, BRAUN: *Chara foetida* A. BR.); Sloten, ditches in Haarlemmermeer, LACOSTE n. 1901 (B, mixed up with a form of the *subhispidae* group); Haarlem, SPLITGERBER (B); Haarlemmerhout, SPLITGERBER VI (B) — S. Holland: near Leiden, DOZY (L, KÜTZING: *Chara vulgaris* WALLR.); Leiden, STEKHOVEN? (L); Waalsdorp, ditch, VRIJDAG

ZIJNEN (U, mixed up with a form of the *paragymnophyllae* group); Waalsdorp, VRIJDAG ZIJNEN (A); near 's-Gravenhage, G. BISSCHOP (L, BRAUN: *Chara foetida,* forma *subinermis, longibracteata, elongata*); Loosduinen, ditch near 's-Gravenhage. VRIJDAG ZIJNEN (B. BRAUN: *Chara foetida* acc. ad var. *subhispidam*); Lekmond, little creeks of the Lek, VAN HALL 28 VII 1832 (B); Rotterdam, puddle in sand, JONGMANS & WACHTER 10 X 1937 — Zeeland: Zierikzee—Nieuwerkerk, brackish ditches, DOZY (B); Zuid-Beveland, VAN DEN BOSCH (L); Axel, ditches, WALRAVEN XII 1855 (L, BRAUN: *Chara foetida* f. *longibract. elongata, Ch. longibract.* K.); Hoek, in pits in a boggy field, WALRAVEN 29 VII 1854 (L, BRAUN: *Chara foetida*); St. Fenabtsdorp, VAN DEN BOSCH IV 1840 (L, BRAUN: *Chara foetida* forma *longibract. elongata, Ch. longibract.* K!) — N. Brabant: Empelsche dijk, ditch in a clayish soil, LACOSTE IX 1847 (L, KÜTZING: *Ch. vulgaris*); 's-Hertogenbosch, LACOSTE XI 1847 (B).

f. **polysperma** (KG.) — *Chara polysperma* KG. Phyc. germ. 1843, p. 258.

To 30 cm high. Stem slender and graceful. Plant bright green to dark green. Branchlets 7—9 in a whorl, nearly perpendicularly (± 80°) patent. Tip of the leaves very slender, slightly curved up. Segments short, each segment with a pair of oogonia and antheridia in the upper whorls too, giving the plant a very dotted aspect. Bract-cells shorter than or equalling the oogonia. Oogonia globose to ovoid, white to yellow brownish 600—750 $\mu$ (± 700 $\mu$) long.

Friesland: near Sneek, BERGSMA (B) — Overijsel: Kampen, in a ditch (L) — Utrecht: Utrecht, VAN DER TRAPPEN (L, KÜTZING: *Chara polysperma* KG.), BEINZ 1869 (B) — N. Holland: Texel, VAN EEDEN VIII 1867 (B), HUIZINGA VIII 1867 (B); Sloten, Haarlemmermeerpolder, LACOSTE IX 1853 (L, BRAUN: *Chara polysperma* KG. ist eine *Chara foetida brevibracteata*); Sloten, ditches in Haarlemmermeer, LACOSTE VI 1847 (B), LACOSTE (L, BRAUN: *Chara foetida* forma *brevibract. munda, Ch. punctata* LEBEL); Heemstede (L).

f. **seminuda** (KG.) — *Chara seminuda* KG. Tab. Phyc. VII, 1857, p. 24, T. 59 II — *Chara stricta* KG. Spec. Alg. 1849, p. 524.

To 30 cm high. Stem relatively thick, with very prominent primary rows. Plant greenish grey. Papillae very small and only visible when magnified, at the upper internodes. Leaves naked except one or two segments. Anterior bract-cells very well developed (to 3 mm long), posterior ones not developed.

N. Holland: Texel, ditch near Binnen Mui J 4, 23, 23, MEEUSE n. 184 19 VIII 1937 (L); Bentveld near Haarlem, VAN HALL (B, sterile)

— S. Holland: Oegstgeest, ditch, herb. PERIN IV (B, sterile, BRAUN: *Chara foetida* forma *major stricta, Ch. funicularis* THUILL.); Oegstgeest, Morschebelsche polder, STEKHOVEN n. 999 5 V 1833 (B, sterile, BRAUN: *Chara foetida* forma *major stricta, Ch. funicularis* THUILL.).

F o r m a e s u b h i s p i d a e

*Lit.:* MIG. l.c. p. 575.

Papillae usually visible with the naked eye, longer than the stipulodes, about as long as the diameter of the stem. Oospore brown.

Overijsel: Kampen, ditches (L) — N. Holland: Zandvoort, LACOSTE (L); Langerak, Haarlemmerduinen, dunes 13 VI 1883 (B); Leiden, ditches, OUDEMANS & MOLKENBOER n. 122, VII 1847 (L), in ditches outside Marepoort, OUDEMANS VII 1847 (B, BRAUN: *Chara foetida* var. *subhispida*); Wassenaar, ditch, STEKHOVEN n. 1000, 24 II 1833 (B, 2 plants, which BRAUN identified as A. *Chara foetida subhispida,* B. *Chara hispida*).

F o r m a e p a r a g y m n o p h y l l a e

*Lit.:* MIG. l.c. p. 603.

Leaves usually with less than two corticate segments.

Overijsel: Bathmen, pools in the moor, Unit. 1850 (B) — Gelderland: Zuid Loo, ditches, ABELEVEN (B) — S. Holland: Oegstgeest, STEKHOVEN (B); Waalsdorp, ditch, VRIJDAG ZIJNEN (U) — N. Brabant: Akersloot, ditch near Limmen, VAN GOOR 7 V 1919 (L).

**7. Chara hispida** L. Sp. Plant. 1753, p. 1153, ex parte.

*Lit.:* Prod. Fl. Bat. II, 2, 1853, p. 187; MIG. l.c. p. 624; ROB l.c. p. 269; GROVES II l.c. p. 29 — *Ill.:* KG. Tab. Phyc. VII, 1857, p. 26, 27, T. 65, 67 I; MIG. l.c. Fig. 130, 131; GROVES II l.c. Pl. XXXI.

Monoecious. Most robust species, to 70 cm, stem stout and stiff. Primary and secondary rows of the cortex equally developed, cells often tapering to the top. Sometimes cortex-cells forming a loop, whereas the internode is partly naked. Spine-cells in the furrows solitary, geminate (side by side) or by three, stiff and acuminate, usually wanting at the lower internodes. Stipulodes well developed. Leaves stiffly patent, long and incurved. Anterior bract-cells elongated longer than the oogonium, posterior ones shorter. Oogonia solitary 600—1000 $\mu$ ($\pm$ 750 $\mu$) long. Antheridia solitary 225—450 $\mu$ ($\pm$ 350 $\mu$) in diam.

*Distribution:* Europe, Asia (Siberia), N. Africa.

F o r m a e m a c r a c a n t h a e

*Lit.:* MIG. l.c. p. 631.

Spine-cells as long as or longer than the diameter of the stem.

Utrecht: Eembrug—Bunschoten, briny ditches, WENCK (L) —

N. Holland: Muiderberg, LACOSTE (L, KÜTZING: *Chara hispida*); Sloten, ditches in Haarlemmermeer, LACOSTE VI 1847 (B) — S. Holland: Leiden, MOLKENBOER VI 1836 (L, KÜTZING: *Chara hispida*) — N. Brabant: Hooge Zwaluwe—Wagenberg, Herb. W. F. VAN HALL 3 VI 1926 (L).

f. *α* **typica** MIG. l.c. p. 631.

Robust form, to 65 cm long. Internodes very long, to 13 cm. Older internodes having irregular cortex. Spine-cells at the lower internodes scanty, at the upper ones usually fasciculated. Whorls of about 10 leaves, each leaf consisting of 4 corticate (3 fertile) segments and one naked tip of 3—4 cells. Anterior bract-cells twice as long as the oogonia, the posterior comparatively diminishing to the lower internodes.

Gelderland: Sandberg, marsh near the Waterline, LACOSTE VI 1845 (B) — Utrecht: Haastrecht, in ditches, PULLE, DE VRIES & UITTIEN VII 1924 (U) — N. Holland: Texel, pools behind de Hoorn, HOLKEMA 23 VI 1868 (B); near Zandvoort, valley in the dunes, VAN DER TRAPPEN (B); Haarlem, VAN HALL (mixed up with *Chara vulgaris* L. *subinermes* and *Chara vulgaris* L. *subinermes* forma *normalis* (MIG.)); Haarlem, ditch near Mariënberg, OUDEMANS n. 648 6 VI 1871 (B, G, U, A) — S. Holland, Noorden, Nieuwkoopsche plassen, VERDAM 1 VII 1934 (L); Leimuiden, 5 VII 1882 (B, mixed up with *Chara fragilis* DESV. *mikroptilae*); Boekhorst, pond, summer 1859 (B); near 's-Gravenhage, ditches in peat, VRIJDAG ZIJNEN (B); Naaldwijk, VAN DER TRAPPEN (B, BRAUN: *Chara hispida*); Rockanje, Voorne Quackjeswater, VERDAM 17 VI 1934 (L) — Zeeland: near Hulst, ditches, VAN DEN BOSCH VI 1845 (B).

f. *β* **robustior** MIG. l.c. p. 632.

Very robust, to 60 cm high, forming sprucefir-like tufts. Stem 2 mm in diam., rough and crumbly. Internodes about 4 cm long, leaves thick, about 2 cm long. Very spiny; many spines at the older internodes. Spine-cells as long as the diameter of the stem. Stipulodes developed. Leaves containing 5 corticate (3—4 fertile) segments and an ecorticate leaf-tip of 2—3 cells. Bract-cells developed around, shorter but thicker than the spine-cells; posterior ones shorter, anterior ones slightly longer than the oogonium. Much incrusted.

N. Holland: Sloten, Haarlemmermeer, LACOSTE VI 1847 (L, acc. ad formam *robustiorem*).

f. *ε* **submunda** MIG. l.c. p. 633.

Plants green with greyish bloom. Robust, slightly incrusted form, about 20 cm high. Spine-cells as long as the diameter of the stem, usually solitary, sometimes geminate. Stipulodes well developed. Leaves containing 4 corticate (3—4 fertile) much swollen segments and 3 naked

ultimate cells; ecorticate part as long as a corticate leaf-segment.

N. Holland: Muiderberg, ditches, LACOSTE VI 1847 (L).

F o r m a e m i c r a c a n t h a e

*Lit.:* MIG. l.c. p. 636.

Spine-cells shorter than the diameter of the stem.

S. Holland: Waalsdorp, well in dune valley, STEKHOVEN 7 V 1833 (B, BRAUN: *Chara hispida* auct. forma *subinermis*).

8. **Chara aspera** WILLD. Mag. Ges. Nat. Fr. Berlin III, 1809, p. 298.

*Lit.:* Prod. Fl. Bat. II, 2, 1853, p. 186; MIG. l.c. p. 653; ROB. l.c. p. 281; GROVES II l.c. p. 51; Lakowitz Alg. Fl. Ostsee 1929, p. 202 — *Ill.:* KG. Tab. Phyc. VII, 1857, p. 21, T. 51 II c and g, 52; MIG. l.c. Fig. 134, 135; GROVES II l.c. Pl. XXXIX.

Dioecious, to 20 cm high. Tender, graceful form, dull or pale green. Stem slender, thread-like and internodes long. Spine-cells variable, usually well developed and frequent, solitary, 2—5 together or bulbously based. Stipulodes developed well, base often bulbous. Leaves 7—10 in a whorl, slender and rather weak. Bract-cells all developed, anterior ones long. Production of spherical 1-celled whitish root-bulbils, 1 mm in diam. Oogonia at the lowest 2—3 segments, solitary, 275—700 $\mu$ ($\pm$ 375 $\mu$) long. Antheridia solitary, 250—450 $\mu$ ($\pm$ 350 $\mu$) in diam.

*Distribution:* Europe, Central Asia, N.W. Africa, N. America. Not known from the Southern Hemisphere.

F o r m a e l o n g i s p i n a e

*Lit.:* MIG. l.c. p. 661.

Spine-cells at least at some internodes as long as or longer than the diameter of the stem.

Utrecht: Vinkeveen, Botsholsche plas, VAN DER WERFF 29 X 1937 (L, sterile).

f. $\alpha$ **longispina** MIG. l.c. p. 661.

Brownish green plant, 15—25 cm high. Internodes 2 cm. Spine-cells solitary, twice to more times as long as the diameter of the stem. Whorl of 7—8 leaves, lower part incurved to the stem, upper part recurved outwards. Segments usually 7 (3—4 fertile).

S. Holland: Voorne, Quackjeswater, VERDAM 17 VI 1934 (L).

f. $\zeta$ **gracilis** MIG. l.c. p. 664.

Graceful, bright green plant, 20—30 cm high, much branched, having fresh from the water a prickly aspect caused by the sprucefir-like patent leaves. Stem fine, threadlike, smooth and shiny. Spine-cells scattered at the upper internodes, at the lower usually wanting, somewhat longer

than the diameter of the stem. Whorl of 8 leaves each having 8 segments (3 fertile).

S. Holland: Voorne, Quackjeswater, VERDAM 17 VI 1934 (L).

f. ι **brachyphylla** MIG. l.c. p. 666.

Distinct form, about 20 cm high, greenish yellow. Internodes 2—3 cm, 4—6 times as long as the leaves. Stipulodes well developed. Leaves 4—5 mm long, 7—8 in a whorl, incurved and congested, forming a globule. Segments 7—8 (2—3 fertile), top-segment (1—2 cells) naked, very pointed.

N. Holland: Texel, near de Hoorn, HOLKEMA 23 VI 1868 (B) — S. Holland: Voorne, Quackjeswater, VERDAM 17 VI 1934 (L).

f. κ **caespitosa** MIG. l.c. p. 667.

15—20 cm high, much branched at the lower internodes. Internodes about 2 cm long. Leaves 7 in a whorl; the upper whorls 5 mm long, the middle internodes 9—12 mm long, increasing in length from the upper to the lower whorls. Segments 6—7 (2 fertile), top-segment (1—2 cells) naked, very short. Bract-cells very short.

S. Holland: Voorne, Quackjeswater, VERDAM 17 VI 1934 (L).

f. μ **tenuispina** MIG. l.c. p. 668.

An intermediary form between forma *brachyphylla* and forma *caespitosa*. About 20 cm high. Internodes 1—2 cm long. Characteristic are the spine-cells, 3—4 times as long as the diameter of the stem, sometimes in pairs, slightly curved, bulbously swollen at base. Leaves 8 in a whorl, segments 7 (2 fertile). Bract-cells long.

N. Holland: Texel, Geul, MEEUSE 8 VI 1937 (L) — S. Holland: Voorne, Quackjeswater, VERDAM 17 VI 1934 (L).

f. ν **stagnalis** MIG. l.c. p. 668.

Bright green plant, 15—20 cm high, much branched. Internodes of one plant of very unequal length, varying from 0.5 to 3 cm. Leaves 7—8 in a whorl, different in length in one whorl; length about 8 mm. Segments 7 (1 fertile).

Friesland: Veenwouden, pools, SPREE? 23 VII 1854 (B, mixed up with *Chara fragilis* DESVAUX and *Nitella hyalina* (DC.) AG.) — N. Holland: Terschelling, Doodemanskisten, HOLKEMA 27 VIII 1869 (B) — S. Holland: Voorne, Quackjeswater, VERDAM 17 VI 1934 (L).

f. ξ **tenuifolia**, MIG. l.c. p. 669.

Bright green plant, hardly 15 cm high. Internodes to 2.5 cm long. Spine-cells solitary, twice as long as the diameter of the stem. Stipulodes short (1/3 of the length of the spine-cells). Leaves 7—8 in a whorl; characteristic are the 5 very long ecorticate segments and a naked very

short top-segment, 2 fertile segments. Bract-cells developed only when fertile.

N. Holland: Texel, pools in the dunes behind de Hoorn, HOLKEMA 23 VI 1868 (B); Texel, HOLKEMA 16 VII 1868 (B) — S. Holland: Voorne, Quackjeswater, VERDAM 17 VI 1934 (L).

f. *o* **macrostephana,** MIG. l.c. p. 670.

Dirty green plant giving a downy aspect, to 20 cm high. Internodes to 2 cm, fine. Spine-cells to four times as long as the diameter of the stem, solitary. Stipulodes well developed, upper ones often much longer than the spine-cells. Leaves 6—8 in a whorl, in the upper whorls already well developed, patent like the leaves of a palm. Segments 6 (2 fertile). Bract-cells around very well developed and thus giving a downy aspect to the plant.

N. Holland: Texel, pools in the dunes behind de Hoorn, HOLKEMA 23 VI 1868 (B) — S. Holland: Voorne, Quackjeswater, VERDAM 17 VI 1934 (L).

f. $\pi$ **streptophylla** MIG. l.c. p. 670.

*Lit.:* LAKOWITZ l.c. p. 202.

Small, bright green form to 10 cm high, has come resemblance to forma *tenuifolia,* but forma *streptophylla* is much smaller. Internodes 1—1.5 cm, usually shorter than the leaves. Stipulodes well developed. Leaves 6 in a whorl, about 12 mm long, stiff and somewhat torted. Segments 6 corticate and one ecorticate. Plants only found sterile in the Netherlands (MIGULA saw only sterile plants too).

Groningen: Harendermolen, shallow water, VAN HALL 9 VI 1858 (B) — N. Holland: Texel, between Koog and Nieuwe Aanleg, HOLKEMA 16 VII 1868 (B), Alloo, between Koog and Nieuwe Aanleg, HOLKEMA 16 VII 1868 (B) — S. Holland: Voorne, Quackjeswater, VERDAM 17 VI 1934 (L) — N. Brabant: Budel, LACOSTE VIII 1874 (B).

Formae brevispinae

*Lit.:* MIG. l.c. p. 674.

Spine-cells shorter than the diameter of the stem, sometimes nearly visible.

Friesland: Veenwouden, SPREE 23 VII 1854 (B) — Groningen: Groningen, Apoort (G) — Overijsel: Kampernieuwstad, reed-land, IJsselmeer, VAN DER WERFF 15 VII 1937 (L) — Utrecht: Zeist, KRAEPELIEN n. 388 (B); Achttienhoven, LACOSTE (B); Jutphaas (L, acc. ad formam *vulgarem* MIG.) — N. Holland: Vlieland, DE VRIES VIII 1937 (L); Naardermeer, POLAK & BUISMAN (N) — S. Holland: Naaldwijk, ditch and pool, VAN DER TRAPPEN (B, BRAUN, *Chara aspera*).

**9. Chara galioides** DC. in Catal. horti Monspel. 1813, p. 93.

*Lit.:* MIG. l.c. p. 685; HY l.c. p. 40; GROVES II l.c. p. 57 — *Ill.:* MIG. l.c. Fig. 137, 138; HY l.c. Pl. III, fig. 59.

Dioecious, to 25 cm high. Stem moderately stout, diameter 1.5 mm. Internodes 2—3 cm long. Cortex irregularly triplostichous. Spine-cells variable in number and form. Stipulodes well developed. Leaves 6—8 in a whorl, about 2 cm long. Segment 4—7 corticate, top-segment ecorticate, 3-all segments fertile. Nodes thick and filled up with storefood, increasing in size to the lower nodes and there forming bulbs to 2.5 mm. in diam. Anterior bract-cells twice as long as the fructifications, posterior ones not developed. Oogonia ± 900 $\mu$ long. Antheridia ± 1000 $\mu$ in diam. (fide GROVES).

To be distinguished from *Chara aspera* by the size of the whole plant, especially of the antheridia and the lack of bulbils.

*Distribution:* Schleswig Holstein, France, Spain, Italy, N. Africa.

S. Holland: Voorne, Branddijk pool, DE LEEUW 13 VI 1934 (L, only feminine specimen).

**10. Chara connivens** A. BR. in Flora XVIII, 1, 1835, p. 73.

*Lit.:* MIG. l.c. p. 703; HY l.c. p. 41; GROVES II l.c. p. 57; LAKOWITZ Alg. Fl. Ostsee 1929, p. 203 — *Ill.:* KG. Tab. Phyc. VII, 1857, p. 26, T. 63 I; MIG. l.c. Fig. 142, 143; GROVES II l.c. Pl. XLI.

Dioecious. Much variable species, pale green. Stem graceful and glossy, more rigid than that of *Ch. aspera*. Cortex even and round also when dry. Spine-cells as well as stipulodes rudimentary. Leaves 6—9 in a whorl, distinctly connivent to the stem, evenly corticate and terete. When dried leaves somewhat curled, 8—9 segments, upper ones 1—2 ecorticate. Bract-cells shorter than the fructification. Oogonia solitary at the lowest 2—3 segments, ± 750 $\mu$ long. Antheridia 600—700 $\mu$ in diam. (fide GROVES).

*Distribution:* W. Europe, N. Africa.

Friesland: Afsluitdijk near coast of Friesland, side of the IJsselmeer, VAN DER WERFF 18 VII 1937 (L).

f. $\alpha$ **major** MIG. l.c. p. 709.

Robust form, 20—25 cm high. Stem 0.6 mm in diam. Internodes at the lower part of the stem 3—4 cm long, at the upper part 1—2 cm long. Stipulodes much reduced. Leaves about 1 cm long, 8 in a whorl. Segments 7—9, top-segment naked, broad at the base. First 3—4 segments fertile. The two leaflets pressed to the antheridia and very small. Leaflets of female specimens 5, halfs as long as the oogonia.

Friesland: Makkum, inland water-ways at the foot of the dike, VAN DER WERFF 27 VI 1937 (L, acc. ad formam *majorem*).

f. $\beta$ **laxa** MIG. l.c. p. 710.

Slender and short form, about 25 cm high. Stem filiform and when dry, solid, terete and glossy. When dried, stem and leaves curled and fragile. Internodes very long, 4—6 cm. Spine-cells wanting, stipulodes minute. Leaves 8 in a whorl. Segments 8—9 (one naked). Oogonia $\pm$ 480 $\mu$ long. Antheridia 250—500$\mu$ ($\pm$ 350 $\mu$) in diam.

N. Holland: IJselmeer, Bocht van Wervershoof, TINBERGEN 29 VIII 1936 (L).

f. $\gamma$ **gracilescens** MIG. l.c. p. 711.

Slender form, about 15 cm high. Stem slightly curved. Internodes at the lower part 3—4 cm, at the upper part 1—2 cm, irregularly long at one and the same stem. Stipulodes minute, developed as warts. Leaves 7—8 in a whorl, fine, about 1 cm long, at female specimens straight, at male specimens incurved to the stem. Segments about 7 (one naked top-cell).

Friesland: Afsluitdijk, near coast of Friesland, side of the IJselmeer, VAN DER WERFF 18 VII 1937 (L); Mirnser Klif, VAN DER WERFF 17 VII 1937 (L); Harderwijk, Essenburg, BONDAM VII 1866 (B). All acc. ad formam *gracilescentem*.

f. $\delta$ **longifolia**, MIG. l.c. p. 711.

Very slack form, about 15 cm high with very long leaves. Stem 0.6 mm in diam., slack and flexible, sunken and flat when dry. Internodes at the lower part 4 cm long, gradually diminishing to 1 cm at the upper part. Stipulodes minute. Leaves 8 in a whorl, very long, 2.5—5 cm, usually about 3 cm long, fine and slender, curved. Segments 9—13 (one naked top-cell). Leaflets short.

Friesland: Takozijl, pier N. side of the sluice, VAN DER WERFF 17 VII 1937 (L, acc. ad formam *longifoliam*).

f. $\varepsilon$ **minor** MIG. l.c. p. 712.

Small form about 6 cm high, glabrous. Stem about 0.5 mm in diam., hard, round and glossy. Internodes 2—20 mm, usually 10 mm long. Stipulodes developed as small warts. Leaves 7 in a whorl, straight or somewhat incurved, stiff and naked, 3—20 mm, usually about 10 mm long. Segments 7 (one naked top-cell), 1-celled and small at the relatively thick last corticate segment.

Friesland: Afsluitdijk near coast of Friesland, side of the IJselmeer, VAN DER WERFF 18 VII 1937 (L); Kornwerd, coast of the IJselmeer, VAN DER WERFF 18 VII 1937 (L); Makkumerwaard, VAN DER WERFF

18 VII 1937 (L) — Gelderland: Wisselsche veenen, peatmoors, KOK ANKERSMIT 1 VII 1876 (B). All acc. ad formam *minorem*.

**11. Chara tenuispina** A. BR. in Flora XVIII, 1, 1835, p. 68.

*Lit.:* MIG. l.c. p. 715 — *Ill.:* MIG. l.c. Fig. 145.

Monoecious and therefore and by the long spine-cells immediately to be distinguished from the other triplostichous species. 25 cm high. Stem slender, corrugated. Cortex not quite regular. Spine-cells long and fine. Stipulodes developed. Leaves 9—10 in a whorl, to 1.5 cm long. Segments 6—8 (the last 1—2 naked). Anterior bract-cells twice as long as or longer than the oogonia, posterior ones half as long as the oogonia. Oogonia 650—800 $\mu$ long. Antheridia 250—300 $\mu$ in diam. (fide MIG.).

*Distribution:* Germany, Austria, Switzerland.

f. $\alpha$ **major** MIG. l.c. p. 721.

*Ill.:* MIG. l.c. Fig. 144.

Long stretched form about 50 cm, ramifications few. Internodes to 7 cm, leaves to 2.5 cm and bract-cells $\pm$ 2 mm long. Cortex normal, spine-cells sparse, fine and long. Cortex of the leaves sometimes unequal, sometimes all segments but one corticated, sometimes 2—4 ecorticate; bract-cells developed. Oogonia $\pm$ 700 $\mu$ long. Antheridia $\pm$ 250 $\mu$ in diam.

N. Holland: Texel, valley in the dunes of Schapebroek, MEEUSE 8 VI 1937 (L) — Presumably Zeeland, VAN DEN BOSCH VI 1842 (B).

**12. Chara fragilis** DESVAUX in Lois. Not. Fl. Fr. 1810, p. 137.

*Lit.:* Prod. Fl. Bat. II, 2, 1853, p. 186; MIG. l.c. p. 722; ROB. l.c. p. 279; HY l.c. p. 42; GROVES II l.c. p. 61; LAKOWITZ Alg. Fl. Ostsee 1929, p. 203 — *Ill.:* KG. Tab. Phyc. VII, 1857, p. 22, 23, T. 54, 55, 56; MIG. l.c. Fig. 146, 147.

Monoecious, polymorphic and variably high, usually 20—40 cm high, slightly incrusted. Stem rather slender and graceful, finely striped. Internodes equalling or exceeding the leaves. Regularly triplostichous, corticated, primary and secondary cells equally broad and prominent, never bearing spine-cells or papillae. Stipulodes irregularly developed, usually rudimentary. Leaves 6—9 in a whorl, fine and brittle. Segments 5—8 corticated; leaf-tip ecorticate (1—2 celled). Posterior bract-cells always wanting, anterior ones usually extant though short. Oogonia 500—700 $\mu$ ($\pm$ 600 $\mu$) long. Antheridia $\pm$ 250 $\mu$ in diam., brightly red with distinct markings on the shields.

Resembling *Ch. verrucosa*, however, *Ch. verrucosa* forms distinct tufts, the leaves are usually exceeding the length of the internodes and at least the upper row of stipulodes is well developed.

*Distribution:* Almost cosmopolitan species (not in W. Indies).

N. Holland: Amsterdam, LACOSTE (B) — S. Holland: Wassenaar, ditch in Persijnpan, STEKHOVEN 22 II 1933 (B, sterile).

Formae mikroptilae

*Lit.:* MIG. l.c. p. 729.

Bract-cells equalling or shorter than the ripe oogonium. Stipulodes hardly developed.

Friesland: Jorwerd, LAMBERS 11 VIII 1924 (U) — Utrecht: Driebergen, along railway — N. Holland: Amsterdam, ditches, LACOSTE (B); Sloten, Haarlemmermeerpolder, LACOSTE IX 1853 — S. Holland: Nieuwland near 's-Gravezande (KÜTZING: *Chara aspera*).

f. β **Hedwigii** (AG.) MIG. in BRUZELIUS Obs. Char., 1824, p. 7, 21.

*Lit.:* KG. Tab. Phyc. VII, 1857, p. 23; MIG. l.c. p. 730; GROVES II l.c. p. 64 — *Ill.:* KG. l.c. T. 55 I; GROVES II l.c. Pl. XLIII.

Very long stretched with extremely long leaves, strong form, the largest of *Ch. fragilis* (40—70 cm), pale soft green. Stem slack, not solid as usual for *Ch. fragilis* and therefore flat, when dried. Internodes 3—6 cm. Cortex normal. Stipulodes like terete papillae. Leaves 2—4 cm, 7 in a whorl, firm, at the lower and middle internodes widely patent, not curved. Bract-cells of sterile leaves not developed, of fertile leaves shorter than the oogonia.

Friesland: St. Jacobi Parochie, VAN HALL 15 VII 1829 (B) — Gelderland: Berkel near Boevenbrug, trench in hayfield, 13 VII 1859 (B, mixed up with *Chara vulgaris*); Ankelaar, KOK ANKERSMIT IX 1873 (B); Loo-Ankelaar, ditch, KOK ANKERSMIT IX 1873 (B, sterile); Apeldoorn, KOK ANKERSMIT 1873 (B, sterile); Apeldoorn, peatpits in Dalhoven, KOK ANKERSMIT 4 IX 1875 (B); Apeldoorn, peatpits on "de Beemte", KOK ANKERSMIT 4 IX 1875 (B) — N. Holland: Terschelling, HOLKEMA 27 VIII 1869; Osdorp near Amsterdam, brackish ditch, LACOSTE IX 1849 (L, B) — S. Holland: Waalsdorp, ditches in the dunes, VRIJDAG ZIJNEN (B, mixed up with *Chara vulgaris* L. *subinermis* A. BR. forma *normalis* (MIG.), BRAUN: *Chara fragilis* and *Chara foetida*).

Formae makroptilae

*Lit.:* MIG. l.c. p. 742.

All bract-cells exceeding the ripe oogonium. Upper stipulodes developed, the lower row hardly or not developed.

Friesland: Veenwouden, SPREE? 3 VIII 1851 (B), summer 1852 (B), 24 VII 1854 (B), ditch, 24 VII 1854 (B) — Groningen: ditches outside Groningen, STOLZ (B) — Gelderland: Epe, S. 1864 (B); Wissel, peatmoors, BOERLAGE 1890 (B); Lochem, pond in Sterrebosch, OUDEMANS VII 1875 (B); Nijkerk, peatmoor near Hoevelaken, STOLZ (L); Hoeve-

laken near Nijkerk, STOLZ 1870 (B) — Utrecht: Achttienhoven, BEINZ (B); pits in peat, BEINZ 1871 (B); LACOSTE (B, BRAUN: *Chara fragilis longibracteata* confirmis obsita); Maartensdijk, LACOSTE VI 1841 (L, KÜTZING: *Chara pulchella*); VAN DEN BOSCH (B, BRAUN: *Chara fragilis* var. *longibracteata* A. BRAUN); Jutphaas, VAN DER TRAPPEN? (L); Vinkeveen, LACOSTE V 1850 (L) — N. Holland: Vlieland, DE VRIES VIII 1937 (L); Halfweg near Haarlem, Herb. MOLKENBOER (B) — S. Holland: Boekhorst, pond, 29 VIII 1859 (L); Hazerswoude, Rietveldsche Polder, STEKHOVEN 9 IX 1833 (B, BRAUN: *Chara fragilis* var. *verrucosa longibracteata*); Hazerswoude (B, BRAUN: *Chara fragilis* var. *verrucosa longibracteata*); Leiden, DOZY (L) — N. Brabant: Eindhoven, ditches, Herb. FORSTEN (B, BRAUN: *Chara foetida*).

**13. Chara verrucosa** ITZIGSOHN in Bot. Zeit. 8, 1850, p. 338 — *Chara delicatula* AG. Syst. Alg. 1824, p. 130 (non DESV.).

*Lit.:* MIG. l.c. p. 752; ROB. l.c. p. 280; GROVES II l.c. p. 65 — *Ill.:* MIG. l.c. Fig. 148; GROVES II l.c. Pl. XLIV.

Monoecious, about 10 cm high, more concentrated than *Ch. fragilis*, forming tufts. Stem thin, hard and terete. Internodes shorter than the leaves. Cortex triplostichous; primary cortical cells wider than the secondary ones. Cortical node-cells sufficiently conspicuous, forming papillae. Stipulodes of the upper whorl well developed, those in the lower always shorter. Leaves 7—8 in a whorl, tall, stiffly straight, patent. Segments 8—9, 3-celled leaf-tip ecorticate; only the first two segments fertile. Anterior bract-cells hardly developed, posterior bract-cells not developed, or reduced to mere papillae. Oogonia 500—760 $\mu$ ($\pm$ 600 $\mu$) long. Antheridia $\pm$ 350 $\mu$ in diam.

To be distinguished from *Ch. fragilis* by the habitus, the internodes (shorter than the leaves), the cortex, the cortex-papillae, and the hardly extant bract-cells.

*Distribution:* Europe, Asia Minor, S. Africa, N. America.

Groningen: Noordlaren, HAVINGA 9 VII 1916 (G); Eelderweg, POSTMA 18 V 1905 (G) — N. Holland: Terschelling, Doodemanskisten, KOSTER n. 159 13 VII 1937 (L); Wisselsche veenen, U. I. (BOERLAGE) 1890 (B); Vinkeveen, Botsholsche plas, VAN DER WERFF 29 X 1937 (L).