

CHARACEÆ

BY

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CHARACEÆ

The Characeæ of Lake Tanganyika are known at present by the report of *Chara zeylanica* from Mtondwe Bay by the GROVES brothers (1907). Although not from this lake, *Chara brachypus* was listed from the Tanganyika Plateau. The present report is based upon a study of thirty-one specimens collected and prepared as dried herbarium mounts by L. VAN MEEL in Lake Tanganyika, its tributaries, and its immediate environs. Seven of these specimens belong to the INSTITUT DES PARCS NATIONAUX DU CONGO BELGE, and the writer is informed that these must be treated elsewhere. After careful study of the available material, the writer divided the specimens into four separate groups. Intergradation could be demonstrated among representatives in each group, but comparable intergradation could not be demonstrated between the separate groups. Three of the four are considered to be species, and have been assigned names on the basis of the published description which fell within the circumscription of each group; while the fourth is construed to be of varietal rank.

A representative specimen from each of the three species is described and illustrated. Variations from this specimen are discussed after each description.

The twenty-four exsiccata specimens discussed in this report are to be retained in the herbarium at Brussels (BR), but where available a duplicate has been retained in the writer's personal herbarium (RDW). Where more than one sheet was found in a packet, the sheets were assigned consecutive letters, a, b, ... etc.; and the particular sheet studied in this work is indicated by these letters, e.g., No. 1925a. These letters were written on the label in pencil.

1. — *Nitella mucronata* (A. BRAUN) MIQUEL.

(Plate I, Fig. 1; Plate II, Fig. 4-9.)

Chara mucronata A. BRAUN (1834 : 351); *Nitella mucronata* (A. BR.) MIQUEL (1840 : 428).

Moderately tall *Nitella*, with somewhat ragged-appearing whorls of branchlets. Whorls 1-2 cm. in diameter with occasional compact heads 5 mm. in diameter amid the branchlets. Plant monœcious, 10-15 cm. in height. Axes ca. 330 μ in diametr. Sterile branchlets (see under fertile branchlets). Dactyls of sterile branchlets (similar to those under fertile). Fertile branchlets 5-6, 2-3 furcated into 3-4 secondary, 2-4

tertiary rays, of which two or more may be occasionally divided into 2 quaternary rays. Both whorls 1-2 cm. in diameter and the small ones 0.5 cm. in diameter are fertile, and aside from size are practically identical. Dactyls of fertile branchlets 2-4, narrowing rather sharply at distal end to the base of the narrowly conical mucro; occasionally appearing to be very much reduced so as to resemble multicellular mucroes. Gametangia without evident mucus; occurring at 1st through 3d branchlet furcations, but most generally at the 2nd furcation; solitary or occasionally geminate. Oogonia lateral at the fertile branchlet nodes, 500 μ long and 392 μ wide; convolutions 7-9, at maturity the upper ends elongating; coronula very small, the fragment found appearing to be 14 μ high and 50 μ wide, but soon deciduous. Oospores amber (not mature), the most nearly mature specimen found being 286 μ long by 271 μ wide and 214 μ thick; striæ of 6 slightly prominent to somewhat blunt ridges; distance between striæ 46-51 μ ; membrane strongly reticulate, the reticulæ 10-12 per fossa, commonly not completely closed. Antheridia 224-238 μ in diameter. (Descr. from No. 1919a.)

Variations seen are not great, the majority of the material consisting of the small-sized ragged-looking specimens described above. On the other hand, No. 145 exhibits well-developed « sterile » whorls 4-5 cm. in diameter; and No. 1927 lacks the small « fertile heads ». Further, No. 1927 is darker green and less spreading than in the described form, but the oospore details are so nearly identical ⁽¹⁾ that it is considered an infraspecific variant. Nos. 1920 and 1752 possess features of *N. microcarpa*. No. 1920 exhibits geminate oogonia, while No. 1752 exhibits aggregate oogonia, and both have numerous of the so-called abbreviated dactyls. The oospores were again quite identical ⁽²⁾ to those of the described specimen.

The specimens included within this group and identified as *N. mucronata* seem to form a single species population as judged from consideration of the plants themselves. However, if one were to follow the practice in the literature, those specimens with aggregate oogonia and numerous abbreviated dactyls would be considered to be *N. microcarpa* A. BRAUN. This creates and does not solve a problem, and at the present time the writer merely considers the entities studied in this case to fall within one intrafertile population or species.

Specimens seen : Belgian Congo : Albertville : No. 1927, Nov. 7, 1947. « Rivière Tuliki, tributaire de la rivière Lukuga (Nord Albertville). St[at.] 357 ». (BR) (RDW); Fizi No. 1920 and No. 1752, April 16, 1947. « Stat. 245. Rivière Namuntangulu » (BR) (RDW); Tugulu : No. 145, Nov. 16, 1946. « Galerie forestière d'un petit ruisseau. Cuvette rocheuse, pH 7.2 » (BR) (RDW); Rhodesia : Abercorn : No. 1377, Mar. 28, 1947. « Canal d'alimen-

⁽¹⁾ No. 1927. Oospore 329 \times 244 μ , amber; striæ 5-6 and fairly prominent, narrow; membrane strongly reticulate, 10-12 reticulæ per fossa; distance between striæ 51 μ .

⁽²⁾ No. 1752. Oogonium 420 \times 322 μ ; oospore 308 \times 243 μ , striæ 5-6, membrane reticulate; distance between striæ 51 μ ; 10-11 reticulæ per fossa.

tation. Int. Red Loc. Stat. (North Rhodesia) » (BR) (RDW); Tanganyika Territory : M'Tossi : No. 1919, April 2, 1947. « Rivière a M'Tossi (rivière Kajowa) Stat. 220 » (BR) (RDW); Tongo : No. 1918, Aug. 20, 1947. « rivière Katamba. Stat. 347 » (BR).

2. — *Chara zeylanica* KLEIN in WILLDENOW.

(Plate I, Fig. 2-5; Plate II, Fig. 2; Plate III, Fig. 1-3.)

C. zeylanica KLEIN (ined.) in WILLDENOW (1805 b : 185) (descr.); *C. foliolosa* MUHLENBERG (ined.) in WILLDENOW (*ibid.*, 1805 : 185) (descr.); *C. gymnopus ceylonica* (KLEIN in WILLD.) A. BRAUN (1845 : 264) (species not described); *C. gymnopus* A. BRAUN (1867 : 942) (descr.) [= *C. zeylanica*, fide H. and J. GROVES (1911 : 40)]; *C. polyphylla* A. BRAUN (1835 : 70) [= *C. zeylanica*, fide H. and J. GROVES (1911 : 40)].

A moderately tall Charad with whorls 2-3 cm. in diameter. Plants monoecious, 15-45 cm. tall. Axes ca. 550 μ in diameter; regularly triplostichous, with the primary cortical cells generally slightly exceeding the secondary cortical cells in diameter. Spine cells present on youngest internodes only, solitary and scattered, up to 2/3 as long as the diameter of the axis. Stipulodes diplostephanous, those of the upper row nearly twice as long as those of the lower row; with the upper stipulodes 2/3-1 time as long as the diameter of the axis, and generally as long as the basal branchlet internode. Branchlets 8-10 in a whorl, each ca. 1 cm. long, each consisting of 5-9 segments including the ecorticated and shortened basal segment, 3-5 thrice corticated branchlet segments, 1-3 ecorticated segments, and the ecorticated end cell. The basal branchlet segment invariably ecorticate, ca. 2 times as long as wide, slightly inflated, and not obscured by the stipulodes. Bract cells verticillate, well developed at all branchlet nodes, 1-2 times as long as the diameter of the branchlet; the adaxial and abaxial bract cells nearly identical. Those at the first branchlet node quite similar to those at other nodes. Gametangia conjoined, generally at the 2nd and 3rd branchlet nodes, occasionally at 4th; protandrous, and most of the antheridia already lost from this specimen. Bracteoles somewhat exceeding the mature oogonia in length. Oogonia 1070 μ long and 500 μ wide (including the coronula); convolutions 10-11; coronula 286 μ wide and 107 μ high, each cell elongated into a rounded lobe, the lobes divergent. Oospores black, 788 μ long and 393 μ wide; striæ of ca. 11 not prominent ridges; membrane [not clear in this specimen]; distance between striæ 67 μ . Antheridium 322 μ in diameter. (Descr. from No. 884 for vegetative parts, and No. 883 for details of gametangia.)

Variations are marked among the specimens seen. In size the plants range from large ones 45 cm. in height (No. 884) through smaller ones 15-20 cm. (No. 329) and 10 cm. (No. 1922) to extremely small and compact fertile specimens 2-4 cm. tall (No. 1921 and 1926). The ecorticated basal branchlet segments

vary from 1 (No. 1585) to 2 (No. 329) to 3 (No. 1926), and from 4-10 (No. 07626) ⁽³⁾ times as long as the diameter of the branchlets. The bract cells vary from 1/4 (No. 1926) to 1-2 times as long as the diameter of the branchlets (No. 1921). Multicellular bulbils are found in a very few cases, e.g., No. 1926.

On the basis of general size and elongation of axial internodes alone, the specimens fall into four general forms which include the normal form (No. 883, 884, and 329); the large lax form (No. 996, 1153, 1585); the small but typically-constructed specimens (No. 1922, 1926b, and 1926c); and the very small and condensed specimens (No. 1921, 1926a, and 1926d).

Specimens seen : Belgian Congo : Albertville : No. 1921 and 1926, Oct. 24, 1946. « Plage vaseuse » and one indicated as « profondeur 75 cm. » (BR) (RDW); m'Vua : No. 1153, Mar. 12, 1947. « dragage dans la baie, St[at.] 166 » (BR) (RDW); Tanganyika Territory : Karema : No. 329, Dec. 22, 1946. « Baie, dragage à 400 m. de la rive prof[ondeur] 4 m. » (BR) (RDW); *ibid.* No. 883 and 884, Feb. 15, 1947. « Estuaire riv. Ifume, Stat. 124 » (BR) (RDW, not 883); Lagosa : No. 1585, Apr. 14, 1947. « Baie de Lagosa, dragage » another collection indicated as « dragage dans la baie, 6 m. de profondeur. St[at.] 232 » (BR); Malagarasi : No. 996, Feb. 25, 1947. « Delta de la riv. Malagarasi, le long des rives de l'estuaire. » (BR) (RDW); m'Samba : No. 1922, Mar. 23, 1947. « Mare sur la plage. Stat. 187 » (BR) (RDW).

It should be noted that the general nature of the described specimen approaches closely NORDSTEDT's (1882) entry for *C. gymnopus* var. *ceylonica*. This taxon has been treated as *C. zeylanica* var. *typica* ZANEVELD (1940 : 208). Under the 1950 edition of the Botanical Code, such usage is illegitimate, and the name must appear as *C. zeylanica* var. *zeylanica*. As noted later in the discussion, these specimens are remarkably similar to local collections of *C. brachypus*, the only distinguishing feature being the presence of cortication on the basal branchlet internodal cell.

3. — *Chara brachypus* A. BRAUN.

(Plate I, Fig. 6; Plate II, Fig. 3; Plate III, Fig. 4-6.)

C. setosa KLEIN (ined.) in WILLDENOW (1805 a : 58) [= *C. brachypus* p.p., fide BRAUN (1867 : 939) who considered *C. setosa* a nom. ambig.]; *C. setigera* KLEIN (ined.) listed by BRAUN (1867 : 939); *C. setacea* WILLDENOW (1805 a : fig. 1) [non CHEVALLIER (1827 : 126)] [= *C. fragilis*, fide MIGULA (1897 : 723)] apparently is merely a typographical error for *C. setosa* KL. in WILLD. — ZANEVELD (1940 : 200) emphasizes this problem of nomenclature, i.e., *C. setosa* vs. *C. brachypus*, and under the present Code, BRAUN's argument that WILLDENOW confounded *C. zeylanica* and *C. setosa* needs to be solved by the type method.

A rather small Charad with branchlet whorls curving upward so as to form a terminal brush 2-3 cm. long at the apex of the plant. Lower branchlets tending to abscize at the 1st (sometimes the 2nd) branchlet node in such a way as to

⁽³⁾ The specimen No. 07626 is the property of the « INSTITUT DES PARCS NATIONAUX DU CONGO BELGE ».

leave the node studded with the whorl of short stumps. Plants monoecious, 9-11 cm. in height. Axes ca. 450 μ in diameter; cortication triplostichous, rather strongly tylacanthous in younger internodes but becoming almost æquistriate in older internodes. Spine cells present only on younger internodes, solitary and scattered, about 1/5 as long as the diameter of the axis. Stipulodes diplostephanous, those of the upper tier slightly longer than those of the lower, the upper ones about as long as the diameter of the axis. Branchlets 8-14 (or more) in a whorl, the number becoming reduced to 7-8 in older whorls; branchlets about 1 cm. long, each consists of 8-10 segments including the corticated but uniquely-colored and shortened basal segment, 4-7 thrice corticated branchlet segments, 1-2 ecorticated segments, and an ecorticated end cell. The basal branchlet segment corticated in a manner similar to the other segments, but only in one direction so that no band encircles center of this segment, commonly somewhat lighter in color. This basal branchlet segment 1-2 times as long as broad, commonly somewhat inflated and regularly incurved. In some whorls of this plant the basal branchlet segments are totally ecorticate! Bract cells well developed, nearly radiate, 1-2 times as long as the diameter of the branchlet; the adaxial ones somewhat longer than the abaxial ones; those at the first branchlet node much reduced, generally 1/4-1/3 as long as the diameter of the branchlet, but otherwise similar to bract cells at other nodes. Gametangia conjoined, occurring at 1st through 3d nodes, occasionally to 6th, quite commonly at 1st node; protandrous, the specimen having lost most of the antheridia. Bracteoles equal to or somewhat exceeding the oogonia in length. Oogonium 1010 μ long and 752 μ wide; convolutions 10-11; coronula 243 μ wide and 107 μ high, the individual cells erect, thus the coronula connivent and not divergent. Oospore black at maturity, 710 μ long and 535 μ wide; striæ of 9-10 low ridges; distance between striæ 68 μ ; membrane (not clearly marked). Antheridium 430 μ in diameter. (Descr. from No. 860b.)

Only four collections are included in this group, and the variation among the specimens is rather slight. One strongly bleached specimen (No. 860c) is otherwise quite typical. All exhibit the tendency for abscission of the branchlets at the 1st branchlet node leaving a ring of stumps at lower axial nodes. No. 1923 is a diffuse specimen which probably belongs here.

Specimens seen : Belgian Congo : Albertville : No. 1923, July 17, 1947. « Sud d'Albertville, mare au camp Jacques. Station 334 » (BR) (RDW) [a doubtful determination]; Tembwe : No. 860, Feb. 12, 1947. « étange. Stat. 119 » (BR) (RDW) [also under the same collection number, but indicated by the writer as « c, » is a strongly bleached specimen]; Tanganyika Territory : Lagosa : No. 264, Dec. 13, 1946. « petite mare sur la plage. St[at.] 9 » (BR).

var. *tanganyikæ* var. nov.

(Plate I, Fig. 7-9; Plate II, Fig. 1; Plate III, Fig. 7-11.)

Haec varietas a specie differt lobis coronularibus valde divergentibus, radiis non abscissis, bracteis tenuioribus ut verticilli radiorum normaliter spines-centes non videantur. [This variety differs from the species in having strongly divergent coronular lobes, the failure of the branchlets to abscize, and the slimmer bract cells which, as a result, give no spiny appearance to the branchlet whorls.]⁽⁴⁾

A moderately large Charad with branchlets commonly curved upward so as to form a terminal brush 2-4 cm. long. The lower branchlets not tending to abscize as in the specimens of *C. brachypus*. Plant monoecious, 9-11 cm. in height. No detectable lime when treated with dilute hydrochloric acid. Axes ca. 500 μ in diameter; triplostichous, very slightly tylacanthous though somewhat irregular through the unequal elongation of the secondary cortical cells. Spine cells absent, or obscure, on youngest internodes. Stipulodes diplostephanous, those of the upper tier somewhat longer than those of the lower; uppers $3/4-1\ 1/2$ times as long as the diameter of the axis; shorter than to as long as the basal branchlet segment. Branchlets 9-11 in a whorl, about 1 cm. long, not spreading; each consisting of 6-8 segments including the corticated but uniquely colored and shortened basal segment, 2-6 thrice corticated segments, 1-3 ecorticated segments, and an end cell. The basal branchlet segment much shorter than other branchlet segments, 1-5 times as long as broad, occasionally somewhat inflated, cortication similar to that of the other segments but only from one direction (so that no central banded line occurs), the cortication generally somewhat less green than other cells; occasionally the segment is totally ecorticated. Occasionally one or more branchlets in a whorl or even an entire lower whorl of branchlets may consist of ecorticated branchlets. These ecorticated branchlets differ from normal branchlets in having no nodes, bract cells, nor reduced basal segment. In somewhat younger, more terminal whorls, the occasional ecorticated branchlets generally have a few nodes with bract cells, and with the shortened lower internodal cell. In upper whorls, the branchlets are corticated in the normal manner, and have nodes, bract cells, and the reduced basal internodal segment. Bract cells well developed, long and slender, radiate, about as long as the diameter of the branchlet, the abaxial ones in some cases shortened to $1/2$ the length of the adaxial ones; those of the 1st branchlet node often reduced to $1/4-1/2$ as long as the other bract cells. On totally ecorticated branchlets nodes and bract cells are generally entirely lacking. Gametangia conjoined, occurring regularly at the 1st branchlet node, and commonly on the 2nd through 4th nodes. Bracteoles $1-1\ 1/2$ times as long as the oogonia seen. Oogonium (only immature specimens seen) 824 μ long and 480 μ wide (including coronula); convolutions 10-11;

⁽⁴⁾ The Latin description has been graciously provided by Dr. HANNAH CROASDALE.

coronula 214 μ wide and 107 μ high, the individual cells prolonged into rounded lobes, the lobes of the coronular cells strongly divergent. Oospores (probably blackish at maturity, but no mature ones seen), a fairly mature (brown) specimen measured 572 μ long and 358 μ wide; striæ apparently 9-10; distance between striæ 61.2 μ and 64.5 μ ; membrane very finely and regularly granulate. Antheridium 300 μ in diameter. (Descr. from No. 1925a.)

Variation is rather considerable among the specimens seen. The size ranges from moderate ones as described (11 cm. tall) to compact, fertile specimens 3-4 cm. tall (No. 1928b). The number of corticated branchlet segments varies within whorls of a given specimen, but No. 608 exhibits a higher proportion of ecorticated branchlets than most specimens. Among the whorls of this specimen is exhibited a nice gradation from ecorticated lower whorls without nodes or bract cells to upper whorls which are perfectly normal. No. 999 is a very bleached specimen which has branchlets regularly with only 1-2 corticated segments, but in other respects is quite typical of the group. No. 1923 is a lax specimen which has been referred to the typical form of *C. brachypus* in absence of other essential distinguishing characters because of the manner of abscission of the branchlets at the 1st branchlet nodes. Collections No. 508 and 509 appear quite unique. These are small and exhibit a preponderance of totally ecorticated sterile branchlets without nodes or bract cells. The upper whorls, however, exhibit nodes and bract cells, and the very young internodes exhibit normal cortication of this group. Because of the range of variation already pointed out for specimen No. 608, these two collections can be seen to be merely immature specimens of the same species. At axial nodes where the branchlets are predominately ecorticate, the stipulodes tend to become reduced to short, blunt ones reminiscent of those of *C. vulgaris*.

Specimens seen : Belgian Congo : m'Toa : No. 1928, Jan. 30, 1947. « flaque d'eau sur la rive du lac. Station 99 » (BR) (RDW); Tanganyika Territory : Malagarasi : No. 999, Feb. 24, 1947. « Malagarasi riv., marais sur lange de terre. Estuaire. Stat. 744 » (BR); Ujiji : No. 508 and 509, Jan. 9, 1947. « Marais. Stat. 58 » (BR) (RDW) : Urundi : Rumonge : No. 608 and 1925, Jan. 23, 1947. « mare sur plage. Stat. 81 » (BR) (RDW). (No. 1925a (BR) Holotype). These were determined as *C. pseudo-brachypus* prox. by the writer in 1954.

In differentiating this group of specimens from those which were clearly *C. brachypus*, the features of significance are the (1) divergent coronular lobes, (2) the failure of the branchlets to abscize, and (3) the finer bract cells which give little or no spiny appearance to the branchlet whorls. These features occurred in all the specimens construed to be var. *tanganyikæ* and not in those considered as typical *C. brachypus*. Since no mixing of these features was detected, it seems probable that two distinct though similar populations may be represented. However, the close similarity of the two groups suggests that more critical

statistical analysis of specimens in this lake would reveal that the two forms intergrade into one species. The writer originally considered this group to constitute a distinct species, and he identified the specimens (BR) tentatively as « *Chara pseudo-brachypus* J. GR. et STEPH. (prox.) ». He has not had the opportunity to compare them with holotype material, but G. O. ALLEN of England has seen the types. He graciously inspected bits of No. 1925a, and has informed the writer that they are doubtless those of *C. brachypus* and not *C. pseudo-brachypus*. Until the present writer has had an opportunity to inspect further specimens, he assigns these specimens to the varietal status.

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PLATE I

PLATE I

EXPLANATION OF PLATE I.

Habit sketches of species of Characeæ found in Lake Tanganyika and environs, 1946-1947.

FIG. 1. — *Nitella mucronata* (A. BRAUN) MIQUEL (after No. 145). $\times 0,48$.

FIG. 2-5. — *Chara zeylanica* KLEIN in WILLDENOW. Series demonstrates variation from tiny to large fertile forms. Fig. 2 : No. 1926 *a*. Fig. 3 : No. 1921 *a*. Fig. 4 : No. 884 *a*. Fig. 5 : No. 1922 *a*. $\times 0,48$.

FIG. 6. — *Chara brachypus* A. BRAUN (No. 860). $\times 0,48$.

FIG. 7-9. — *Chara brachypus* var. *tanganyikae* nov. var. Fig. 7 : No. 1925 *b*. Fig. 8 : No. 608. Fig. 9 : No. 1928. $\times 0,48$.

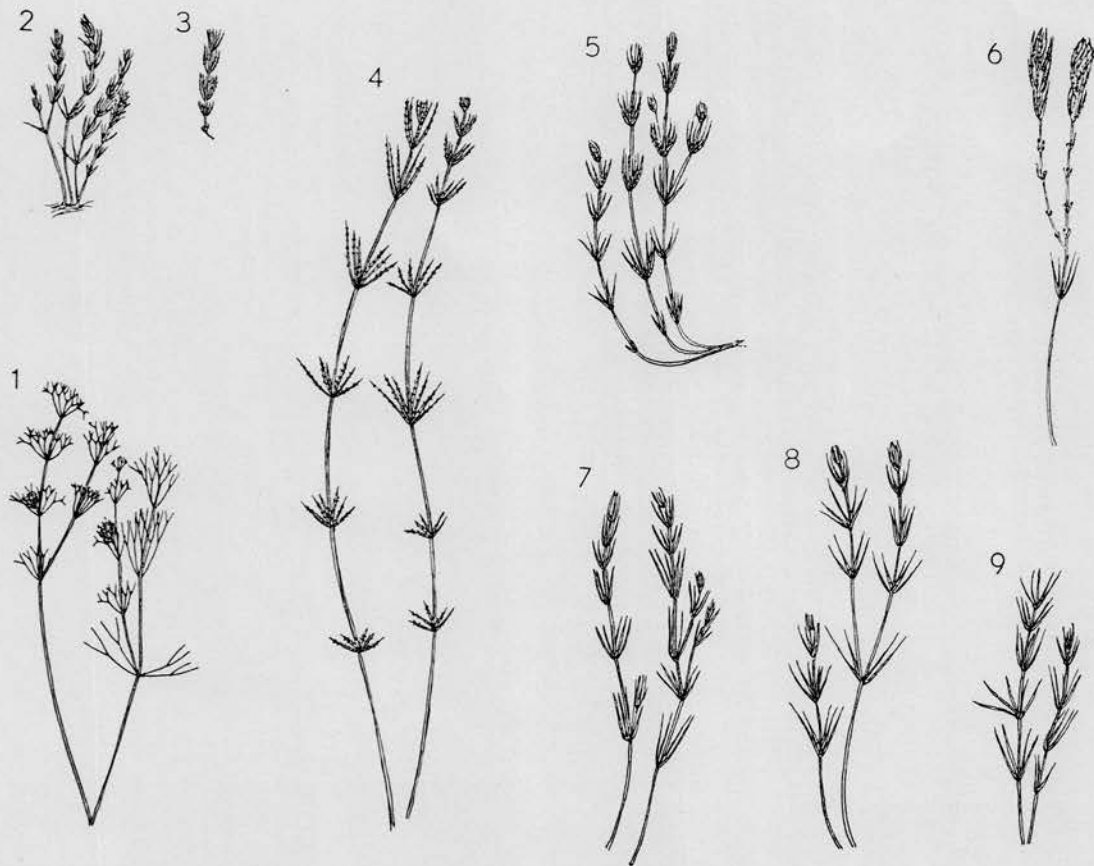


PLATE II

PLATE II

EXPLANATION OF PLATE II.

Details of certain Characeæ of Lake Tanganyika. Figures 1-8 drawn with the aid of a camera lucida. Figure 9 sketched as seen with $\times 30$ stereoscopic microscope.

FIG. 1. — *Chara brachypus* var. *tanganyikae* nov. var. Oogonium (No. 1925 a), slightly immature. $\times 72$.

FIG. 2. — *Chara zeylanica* KLEIN in WILLDENOW. Oogonium (No. 883). $\times 72$.

FIG. 3. — *Chara brachypus* A. BRAUN. Oogonium (No. 860). $\times 72$.

FIG. 4-9. — *Nitella mucronata* (A. BRAUN) MIQUEL. Fig. 4. Oogonium (No. 1919 a). $\times 72$. Fig. 5-8. Apices of branchlets (No. 1752) showing progressive modification of the terminal cells forming mucronate crown at one extreme and abbreviated dactyls at the other. Fig. 9. Fertile branchlet (No. 1752).

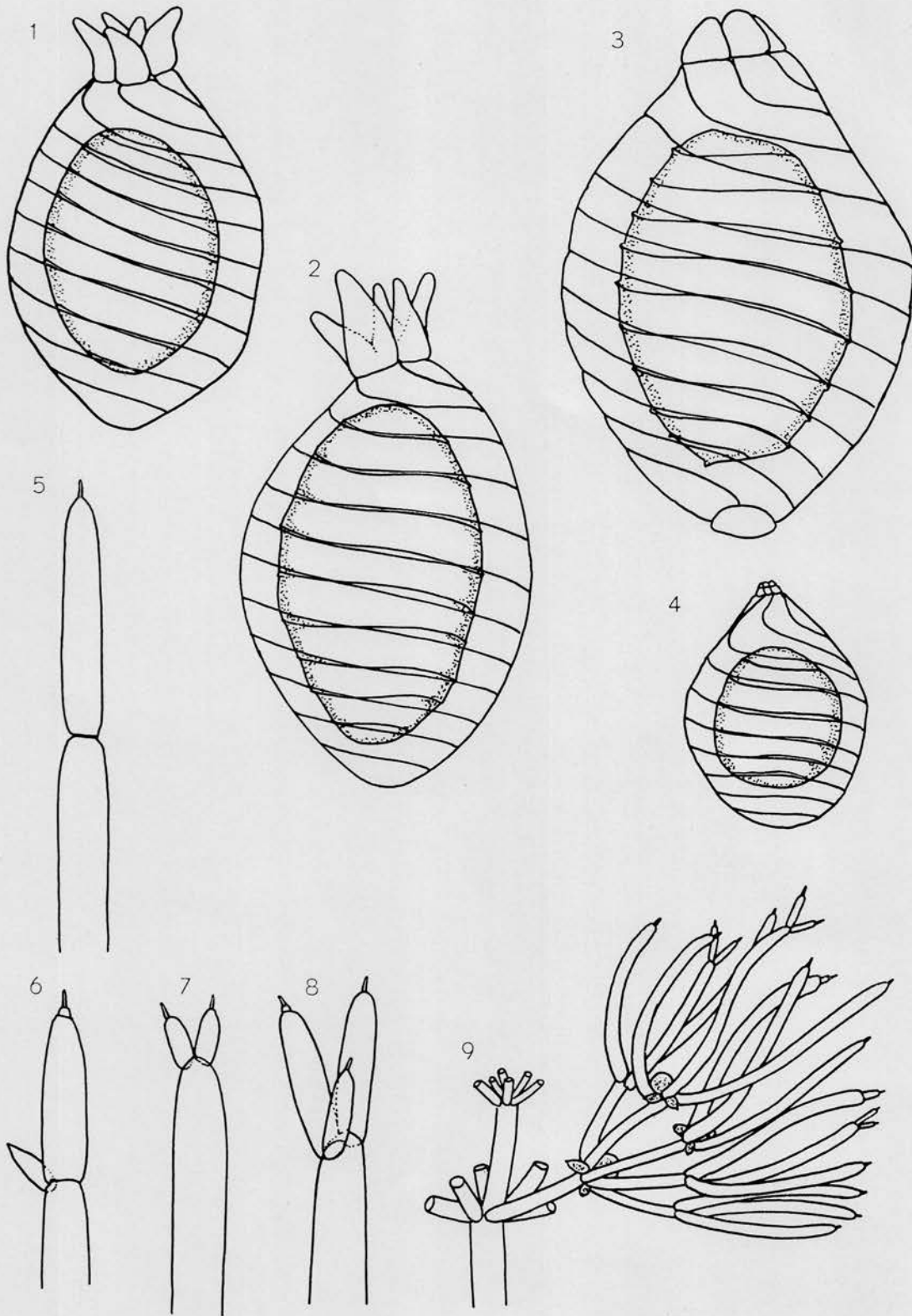


PLATE III

PLATE III

PLATE III

PLATE III

PLATE III

PLATE III

EXPLANATION OF PLATE III.

Details of the species of *Chara* of Lake Tanganyika. All figures sketched as the structures were seen under $\times 30$ stereoscopic microscope.

FIG. 1-3. — *Chara zeylanica* KLEIN in WILLDENOW. Fig. 1. Branchlet showing naked basal branchlet cell (No. 883). Fig. 2. Fertile branchlet node with conjoined gametangia (No. 883). Fig. 3. Axial node showing stipulodes, spine cells, bract cells of branchlets, and the naked basal branchlet internodal cells (No. 884).

FIG. 4-6. — *Chara brachypus* A. BRAUN. Fig. 4. Fertile branchlet (No. 860). Fig. 5. Axial node showing stipulodes, spine cells, bract cells of the branchlets, and the corticated but reduced basal branchlet internodal cells (No. 860 *b*). Fig. 6. Axial node from the lower portion of axis to show stumps where abscission of branchlets has occurred at the first and second branchlet nodes (No. 860 *b*).

FIG. 7-11. — *Chara brachypus* var. *tanganyikæ* nov. var. Fig. 7. Variations in branchlets found on a single specimen, the two left ones having nodes with bract cells together with some cortication; while the one on the right is totally ecorticate, lacks bract cells and nodes, and the cells are about equal in size and shape instead of exhibiting a reduced basal branchlet cell. Fig. 8, 9. Axial nodes from a single specimen (No. 07625 *a*). Figure 8 from an upper node and figure 9 from a lower node. Fig. 10, 11. Axial nodes from rather normal specimen (No. 608).

