

Freshwater algae of Southern Africa. II. *Triplastrum spinulosum* from the Transvaal

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ABSTRACT

The presence of *Triplastrum spinulosum* (Kisselev) Gauthier-Lièvre (Desmidiaceae) in South Africa is reported for the first time. The characters of *T. spinulosum* varieties *spinulosum*, *indicum* (Iyengar & Ramanathan) Gauthier-Lièvre and *africanum* Gauthier-Lièvre were found to be exhibited by specimens collected at Ottosdal in the south-western Transvaal. The differences among specimens of the populations studied are ascribed to variation within one variable species and therefore the varieties *indicum* and *africanum* are relegated to synonymy.

RESUME

ALGUES DULCICOLES D'AFRIQUE AUSTRALE. II. TRIPLASTRUM SPINULOSUM DU TRANSVAAL

La présence de *Triplastrum spinulosum* (Kisselev) Gauthier-Lièvre (Desmidiaceae) en Afrique du Sud est signalée pour la première fois. On a constaté que les caractéristiques des variétés *spinulosum*, *indicum* (Iyengar & Ramanathan) Gauthier-Lièvre et *africanum* Gauthier-Lièvre de l'espèce *T. spinulosum* se rencontrent dans les spécimens récoltés à Ottosdal dans le sud-ouest du Transvaal. Les différences entre spécimens des populations étudiées sont attribuées à la variation intraspécifique d'une espèce variable et les variétés *indicum* et *africanum* sont dès lors placées en synonymie.

INTRODUCTION

Samples containing *Triplastrum spinulosum* were collected by the author during April 1972 and February 1975 from a small pan 16 km east of Ottosdal in the south-western Transvaal and by Mr G. Germis-huizen, Botanical Research Institute, Pretoria, during February 1974 from a small pool on the banks of the Nyl River on the farm Mosdene near Naboomspruit, central Transvaal.

Both habitats contain water during the rainy season, but may dry up partially or completely during the dry season (winter). During December 1974, which was an exceptionally dry summer, the Ottosdal pan was completely dry.

The hydrogen-ion concentration and the temperature of the water at the time of collection were pH 7,7 and 24°C, and pH 7,5 and 27°C for April 1972 and February 1975 respectively at Ottosdal and pH 6,1 and 26°C at Mosdene.

METHODS

The material was preserved with 4% formalin. Slides were made by mounting a sample droplet in a drop of glycerine. The methods used for the drawings and photomicrographs were the same as those given in the first paper of this series (Claassen, 1973).

OBSERVATIONS AND DISCUSSION

Iyengar and Ramanathan (1942) found a desmid in material collected during December 1940 in a paddy field near Madras, South India, which resembled the species *Triploceras abbreviatum* Turner (Krieger, 1937; Turner, 1892) and *Triploceras simplex* Allorge (Krieger, 1937). One of the main characters of the genus *Triploceras* Bailey is the presence of numerous whorls of knotlike projections (verrucae). As this character was lacking in both Turner's and Allorge's species as well as in their own taxon, Iyengar and Ramanathan (1942) decided to establish the new genus *Triplastrum* to accommodate these taxa, the constituent species being *Triplastrum indicum* Iyengar & Ramanathan, the desmid collected near Madras, *Triplastrum abbreviatum* (Turner) Iyengar & Ramanathan and *Triplastrum simplex* (Allorge) Iyengar & Ramanathan. However, they were unaware of the existence of *Triploceras spinulosum* Kisselev (Krieger,

1937), the description of which was based on a single specimen collected in Turkestan in 1930. *Triploceras spinulosum* closely resembles *Triplastrum indicum* and in 1960 Gauthier-Lièvre reduced the latter to a variety of the former, thus *Triplastrum spinulosum* (Kisselev) Gauthier-Lièvre var. *indicum* (Iyengar & Ramanathan) Gauthier-Lièvre.

Gauthier-Lièvre (1960) also described a new variety based on material collected in Africa, namely *Triplastrum spinulosum* var. *africanum*. The name of this new variety proposed by Gauthier-Lièvre was not validly published, however, since it was not accompanied by a Latin description or diagnosis as stipulated by Article 36 of the International Code of Botanical Nomenclature (Stafleu, 1972).

Turner (1892) described the apices of *Triploceras abbreviatum* as three- or four-lobed. Iyengar and Ramanathan (1942) incorporated this into their description of the genus *Triplastrum*. Krieger (1937) mentioned only three-lobed apices in his description of *Triploceras abbreviatum* Turner, and Gauthier-Lièvre mentioned only three-lobed apices in her description of the genus *Triplastrum*. In the material collected in the Transvaal the Ottosdal specimens have either three-lobed apices (Figs 1-3, 16 - upper cell, 17-22, 31, 32, 33 - cell on left, 34-38) or four-lobed apices (Figs 4, 9, 16 - lower cell, 25, 33 - cell on right) while some specimens have one semicell with a three-lobed apex and the other semicell with a four-lobed apex (Figs 10, 11, 26-28, 39). The Mosdene specimens have only four-lobed apices (Figs 5-8, 14).

Gauthier-Lièvre (1960) described *Triplastrum spinulosum* var. *spinulosum* as having weakly dilated apices, divided into three hardly divergent lobes which are bi-, tri- or quadridentate. Krieger's figure of this variety (1937, Pl. 53, Fig. 7), one of Gauthier-Lièvre's figures of her var. *africanum* (1960, Fig. 2t, cell on left), and Figs 1 and 13 (upper semicell) in the present paper as well as some of the specimens with four-lobed apices (Figs 7, 8, 14) resemble one another in that the apices are weakly dilated, and the polar lobes hardly divergent and bi- or tridentate and seldom quadridentate (Fig. 13).

According to Gauthier-Lièvre (1960), *Triplastrum spinulosum* var. *indicum* differs from the typical variety in its larger dimensions and longer more divergent polar lobes. Iyengar and Ramanathan's figures for

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this variety agree with Figs 2 (lower semicell) and 17 (cell on left) of the present paper as well as with some of the cells with four-lobed apices (Figs 4-6). The dimensions of these cells overlap both those of the type and var. *indicum*.

Triplastrum spinulosum var. *africanum* (Gauthier-Lièvre, 1960) differs from the typical variety in that the cells are slightly narrower below the apices and the polar lobes are strongly divergent, bidenticulate and seldom tridenticulate. The majority of the Ottosdal specimens (Figs 2 - upper semicell, 3, 19-22, 31, 32, 34-38) agree with Gauthier-Lièvre's figures for this taxon (1960, Figs 2q-t), but bidenticulate and tridenticulate polar lobes are approximately equal.

Iyengar and Ramanathan (1942) observed two chloroplasts each with a central pyrenoid in each semicell. Gauthier-Lièvre (1960) reported 1 or 2 pyrenoids per semicell for the type and 1-3 pyrenoids for her var. *africanum*. In the material collected in Transvaal, the majority of the specimens observed had two chloroplasts per semicell (Figs 1, 2, 4-8, 11, 12, 14, 19, 21, 23, 24, 26-28, 31, 32, 41), some had three chloroplasts per semicell (Figs 9, 25) or one semicell contained two chloroplasts and the other three (Figs 3, 20, 22). Each of these chloroplasts contained a central pyrenoid. Only a few specimens were observed in which the delineation of the chloroplasts was indistinct and there appeared to be only one chloroplast per semicell, but each contained two pyrenoids.

In the Ottosdal material one specimen (Figs 9, 25) was found which was considerably larger than the others: length without spines 141 μm , with spines 144 μm ; maximum width 14 μm ; width of isthmus 11 μm ; width of apices 17-18, 5 μm . If this specimen is also taken into consideration, the dimensions of the Transvaal specimens overlap those of Gauthier-Lièvre's three varieties of *Triplastrum spinulosum*. The dimensions of the other Transvaal specimens are as follows:

	<i>Ottosdal</i>	<i>Mosdene</i>
length without spines	61-97 μm	56-66 μm
length with spines...	63-102,5 μm	59-68 μm
maximum width.....	9-11 μm	9,3-10 μm
width of isthmus....	8,5-10,5 μm	8,8-9,3 μm
width of apex.....	11-18 μm	10,5-14 μm

Zygospores, found in the Ottosdal material collected during April 1972 (Figs 17, 18, 34-39), resemble those found by Iyengar and Ramanathan (1942) but are slightly smaller. The dimensions are 34-38 \times 36-40 μm .

When all the characters found in the Transvaal specimens were taken into consideration it was decided that the specimens studied belonged to one species, namely *Triplastrum spinulosum* and that the two varieties *indicum* and *africanum* should be regarded as synonyms.

The two varieties are thus placed into synonymy and the circumscription of the species is amplified.

***Triplastrum spinulosum* (Kisselev) Gauthier-Lièvre** in *Revue Algol.*, 5, 1960, p. 64.

Syn.: *Triploceras spinulosum* Kisselev in *Trans. Uzbekistan Inst. Tropic. Med.* 1, 1930, p. 50, Pl. 4, Fig. 5; Krieger in *Rabenhorst's Kryptogamenflora* 13(1), 1937, p. 449, Pl. 53, Fig. 7.

Triplastrum indicum Iyengar & Ramanathan in *J. Indian Bot. Soc.*, 21, 1942, p. 228, Figs 1-5. *T. spinulosum* (Kisselev) Gauthier-Lièvre var. *indicum* (Iyengar & Ramanathan) Gauthier-Lièvre in *Revue Algol.*, 5, 1960, p. 64. - var. *africanum* Gauthier-Lièvre, l.c. Pl. 64, Fig. 2, q-t, non rite publ.

DIAGNOSIS

Cellulae parvae, circiter 6-10-plo longiores quam latiores, in medio leviter at manifeste constrictae; semicellulae rectae, cylindricae, lateribus paene parallelis vel leviter a basi paene usque ad apicem attenuatis, apices aliquatenus inflati, trilobi vel quadrilobi; qui lobi singuli 2-4 spinas breves ferunt; cellulae paries incolor, pori perparvuli. Chloroplasti axiales bini vel terni in semicellulis singulis, in seriem mediam dispositi, quorum unicuique laminae radiantes vel stellatae cum pyrenoide medio. Zygospora sphaerica (-subsphaerica) pariete spisso, margine crenato. Longitudo sine spinis 56-99, 5 (141) μm , cum spinis 59-105 (144) μm ; latitudo ad basim semicellulae 9-14 μm ; isthmi latitudo 8, 5-12 μm ; apicis latitudo 11-18 (18,5) μm ; zygospora 36-42 \times 38-42 μm .

Cells small, about 6-10 times longer than broad, with a slight but well-defined median constriction; semicells straight, cylindrical, with sides nearly parallel or slightly attenuated from base to just below the apex; apices more or less inflated, three- or four-lobed, lobes slightly to strongly divergent, each lobe bearing 2-4 short spines; cell wall colourless, pores minute. Chloroplasts axial, 1 (?) or 2-3 in each semicell, arranged in a median series, each chloroplast with radiating plates (stellate) and a central pyrenoid. Zygospora spherical to subspherical, thick-walled, margin crenate. Length without spines 56-99,5 (141) μm , with spines 59-105 (144) μm ; maximum width near base of semicell 9-14 μm ; width of isthmus 8,5-12 μm ; width of apices 11-18 (18,5) μm ; zygospora 38-42 \times 36-42 μm .

The geographical distribution of this species is:

ASIA.—Turkestan (in a rice-swamp near Weliko-Alexewskoje). India (in a paddy field near Madras, December).

AFRICA.—Sudan (in a swamp of the River Niger near Gao, December). French Equatorial Africa (Ubangi-Shari, February). Uganda (in a swamp on the road from Masaka to Kampala, August). Transvaal (in a small pool on the banks of the Nyl River near Naboomspruit, February; in a small pan near Ottosdal, February and April).

It seems that this species is very rare and that usually only a few specimens are found in samples collected. In the samples collected near Ottosdal during April 1972, however, it was fairly abundant.

As could be expected in a fairly large population anomalous specimens were also found. In the Ottosdal material one specimen was found where, in each semicell, one of the polar lobes was under-developed, without spines and somewhat subapical (Figs 12, 41). In another specimen only one of the semicells was like this (Fig. 13, lower semicell). Several asymmetrical cells were found (Figs 11, 29, 40) and one very narrow semicell was observed (Fig. 30). The most anomalous specimen was a single semicell with a prominent basal inflation encircled by a whorl of eight lobes similar to the polar lobes (Figs 15, 42-44). In the Mosdene material one anomalous specimen was found with the polar lobes of one semicell undeveloped (Fig. 14).

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UITTREKSEL

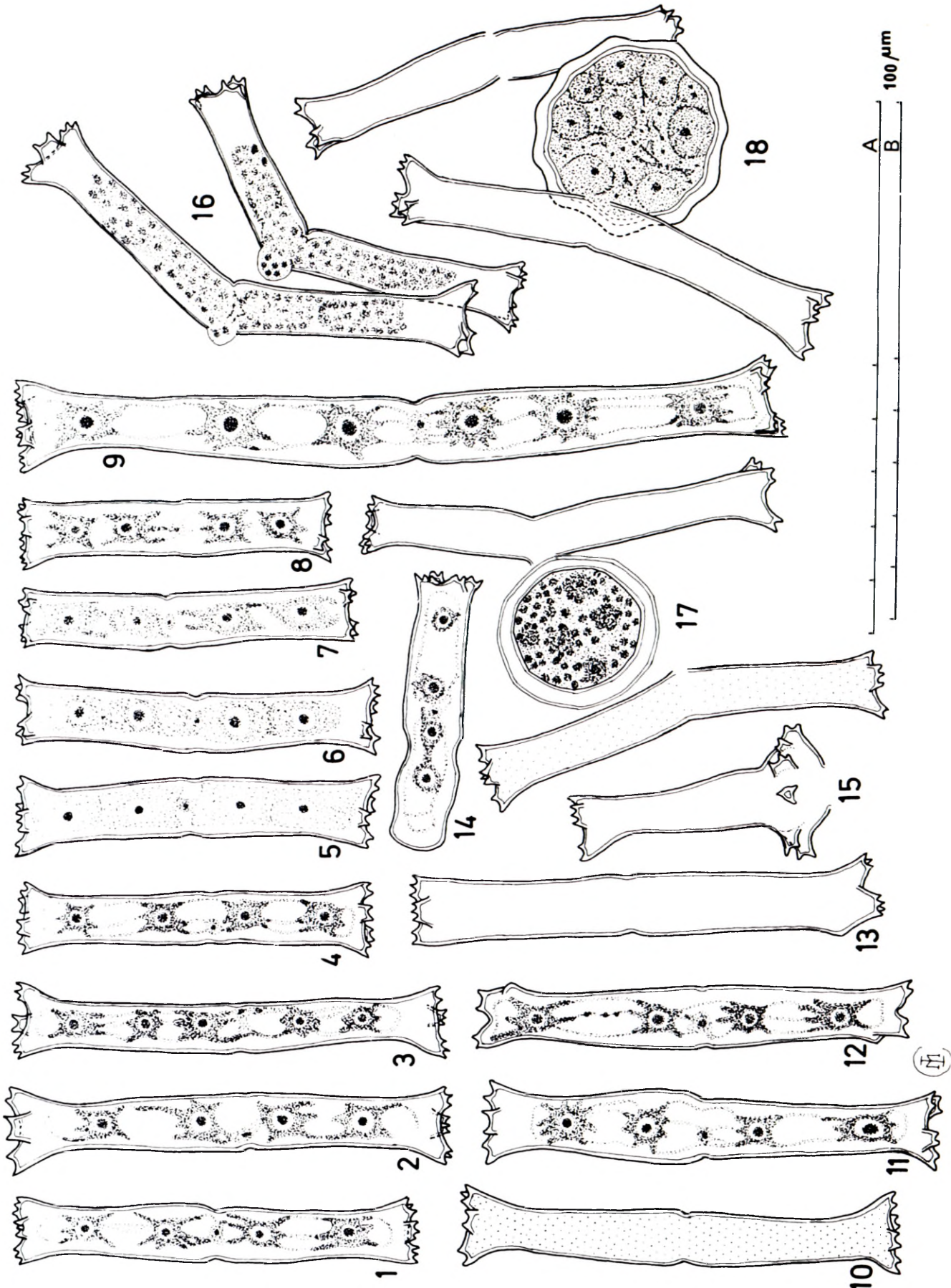
Triplastrum spinulosum (Kisselev) Gauthier-Lièvre (*Desmidiaceae*) is vir die eerste keer in Suid-Afrika aangetref. Daar is gevind dat verteenwoordigers

wat naby *Ottosdal* in die suid-westelike Transvaal versamel is die kenmerke van *T. spinulosum* variëteite *spinulosum*, *indicum* (Iyengar & Ramanathan) Gauthier-Lièvre en *africanum* Gauthier-Lièvre weerspieël. Verskille tussen verteenwoordigers van hierdie populasie word as variasie in dieselfde takson aanvaar en die variëteite *indicum* en *africanum* word dus as sinonieme beskou.

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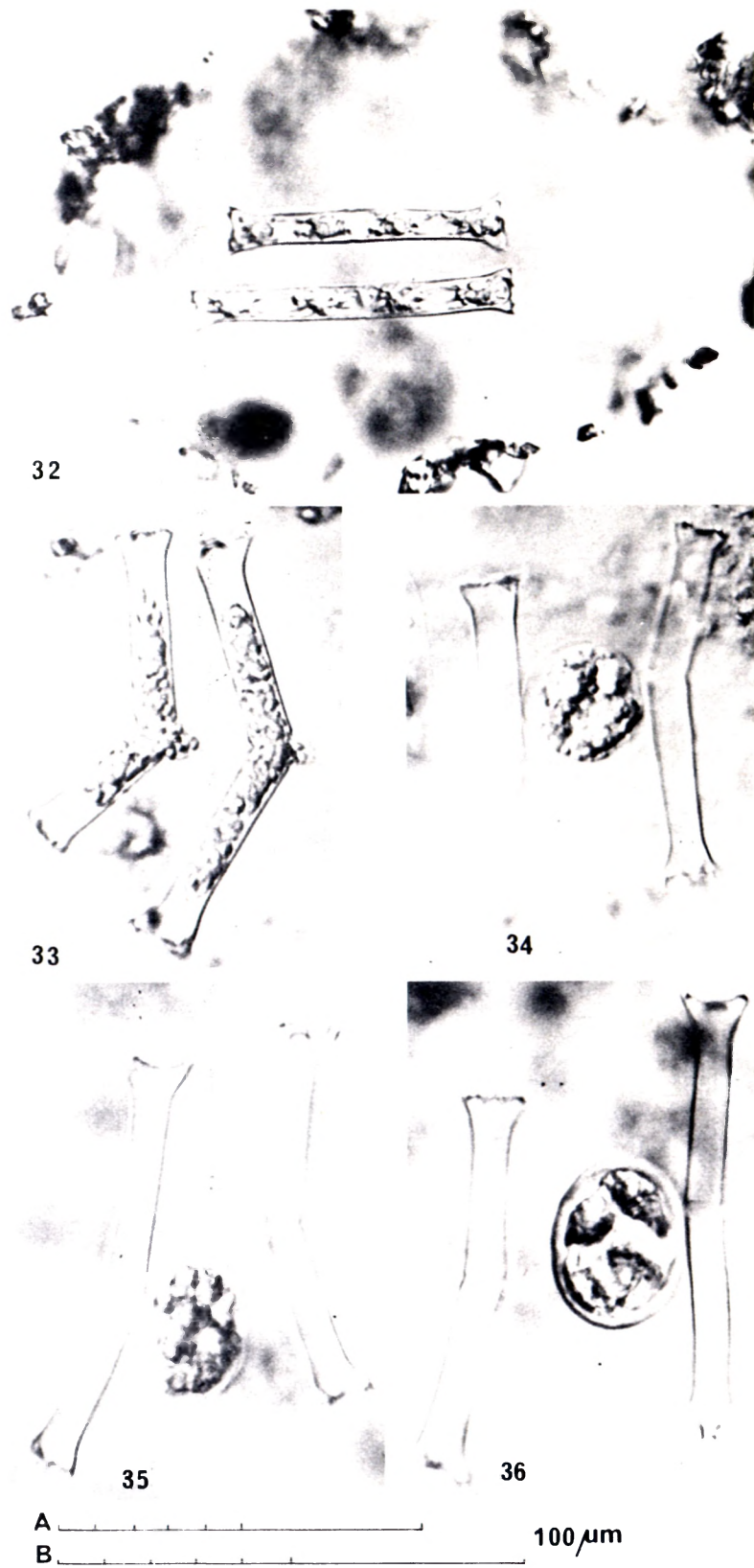
* The original spelling of the name of this genus by its authors was *Ichthyocercus* (West, W. & G. S. West, 1897, *Welwitsch's African freshwater Algae, J. Bot.*, 35: 80).



Figs 1-18.—Drawings of *Triplastrum spinulosum*. 1, cell with three-lobed apices, lobes tridenticulate; 2, cell with three-lobed apices, lobes bi- or tridenticulate; 3, cell with one semicell containing three chloroplasts and the other semicell two; 4-8, cells with four-lobed apices, lobes bi- or tridenticulate; 9, large specimen with four-lobed apices, lobes tridenticulate, each semicell with three chloroplasts; 10, cell with one three-lobed and one four-lobed apex, lobes bi- or tridenticulate; 11, asymmetrical cell with one three-lobed and one four-lobed apex, lobes bidenticulate; 12, anomalous cell with one polar lobe in each semicell under-developed, without spines and slightly subapical, normal lobes bidenticulate; 13, anomalous cell with one polar lobe in one semicell under-developed, without spines and slightly subapical, normal lobes bi-, tri- or quadridenticulate; 14, anomalous cell with polar lobes of one semicell undeveloped; 15, anomalous semicell with a prominent basal inflation encircled by a whorl of eight lobes; 16, conjugating cells showing protuberances; 17, conjugating cells with young zygospore; 18, conjugating cells with mature zygospore. (Figs 1-4, 9-12 and 15-17: scale B. Figs 5-8, 13, 14 and 18: scale A).



FIGS 19–31.—Photomicrographs of *Triplastrum spinulosum*. 19, 21, cells with three-lobed apices and two chloroplasts per semicell; 20, 22, cells with three-lobed apices, one semicell with two chloroplasts and the other semicell with three; 23, 24, cells with four-lobed apices; 25, large specimen with four-lobed apices and each semicell with three chloroplasts; 26–28, cells each with the upper apex four-lobed and the lower apex three-lobed; 29, asymmetrical cell with upper semicell broader than lower semicell; 30, abnormally narrow semicell; 31, two cells after division remaining attached to each other. (c, chloroplast; p, pyrenoid; n, nucleus).



FIGS 32-36.—Photomicrographs of *Triplastrum spinulosum* 32, two cells just before conjugation, the dirt particles represent the margin of the mucilaginous envelope; 33, conjugating cells showing protuberances; 34, conjugating cells with young zygospore; 35, 36, further stages in development of zygospore. (Fig. 32: scale A. Figs. 33-36: scale B).



FIGS 37-44.—Photomicrographs of *Triplastrum spinulosum*. 37, immature zygospore showing crenate margin; 38, 39, mature zygospores; 40, asymmetrical cell; 41, anomalous cell with one polar lobe in each semicell under-developed, without spines and slightly subapical; 42-44, anomalous semicell with a prominent basal inflation encircled by a whorl of eight lobes, photographed at various focussing adjustments.