

## THE GENUS TEMNOGAMETUM.

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The genus *Temnogametum* was established by W. and G. S. West in 1897 to include those species of the *Zygnemaceae* with vegetative cells and chromatophores similar to those of *Mougeotia*, but in which the gametangia are clearly differentiated from the vegetative cells prior to conjugation.

Czurda\* has called attention to the well known fact that conjugation always occurs between youthful cells, and he therefore concludes that the lengths of conjugating cells (gametangia) are of no significance. Such cells would probably elongate the same as vegetative cells were it not for the organization of gametes and subsequent conjugation. In the one species of *Temnogametum* that I have seen there is abundant evidence that the gametangia do not elongate when conjugation fails. Furthermore these short cells are not to be identified with the occasional or rare short cells that every experienced collector has seen in field collections and which Czurda figures from his clone cultures.

A second reason advanced by Czurda for not recognizing *Temnogametum* as distinct from *Mougeotia* is his claim that lateral conjugation is the same in both genera. What I have described and figured as "aplanospores" in the paper on "The Genus *Mougeotia*"† he interprets as zygospores formed by lateral conjugation. This interpretation rests on an observation of a case of lateral conjugation in a clone approaching *M. viridis* in form. I do not question this observation, but I have watched the formation of these spores in several other species, and particularly in *M. prona*, where I had essentially a pure culture in a small spring near Cold Spring Harbor, L. I. No other algae were present except a few species of desmids. For six weeks I made collections at frequent intervals and examined them in the living condition, and had them developing in glass dishes in the laboratory. During that period I examined

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\*Czurda, Viktor. Zur Morphologie und Systematik der Zygnemalen. Beih. zum Bot. Cent. 48: 2; 238. 1931.

†Ohio Journal of Science, 26: 311-338. 1926.

several thousand spores in all stages of development with this particular point in mind, but I never saw the nucleus divide nor any suggestion of a division of the cytoplasm and formation of a dividing wall.

But even granting that the "aplanospores" figured by Wittrock, Borge, West, and myself are in reality zygotes formed by the union of two partially developed gametes, the whole process is quite different from that which takes place in *Temnogametum*. In *Mougeotia* the contents of a long vegetative cell contracts to the middle of the cell leaving behind a certain amount of cytoplasmic residues. Cross walls are then formed separating this median cell (sporangium) from the two non-living ends of the cell. Czurda thinks this follows a division of the protoplasm and that the median cell is the result of a subsequent union.

In *Temnogametum*, on the other hand, two adjoining vegetative cells cut off gametangia adjacent to one another with a primary cell wall separating them. The vegetative cells on either side of the pair of gametangia remain alive, and the gametangia accumulate foods and become very dense as compared with the vegetative cells from which they were cut off. Then the primary separation wall is dissolved and the two gametes formed from two distinct vegetative cells unite and form a zygote. Surely this is a very different process from that which occurred in Czurda's clone culture of *M. (?) viridis*.

For these reasons I cannot accept Czurda's proposal to merge the species of *Temnogametum* with *Mougeotia*. I agree that they are evidently closely related, but are sufficiently distinct, morphologically and physiologically, to merit separation in different genera.

At present only three species are known: one from Welwitsch's collections in Africa, one from Ule's collections in Southern Brazil, and a third from Thaxter's collections on the Island of Trinidad. Thus far the species are tropical or subtropical in their occurrence.

The genus and species may be defined as follows:

*Temnogametum* W. & G. S. West, 1897.

Vegetative cells cylindrical, 2 to 25 diameters long; chromatophore an axile plate containing several or many pyrenoids; isogamous gametangia distinct and cut off from the ends of vegetative cells; conjugation scalariform or lateral, resulting in the formation of two

types of zygospores. Aplanospores and parthenospores also formed in some of the non-conjugating short cells. In none of the collections thus far seen has there been a separation of the spore wall and sporangium into distinct layers.

1. *T. heterosporum* W. & G. S. West, 1897. African Freshwater Algae, Jour. Bot. 35: 37. Pl. 370, Figs. 5-9; G. S. West, Algae, pp. 340-341, Fig. 212. 1916; Czurda, Zygnemales; Süßwasserflora Mitteleuropas; 9: 98. 1932.

Diameter vegetative cells  $14.5-17\mu$ , length 6-12 diameters, chromatophore with 1-6 (usually 5) small globular pyrenoids arranged in a single row; gametangia  $22-40\mu$  in length; zygospores, formed by scalariform conjugation cruciate with convex sides and truncate angles, occupying the gametangia and tube,  $39-50\mu \times 48-59\mu$ ; zygospores formed by lateral conjugation obliquely ovoid with truncate ends occupying the united gametangia  $20-26\mu \times 61-67\mu$ ; spore wall smooth, colorless. Plate I, Figures 9-13.

Morro de Lopollo, Angola, Africa, Feb., 1860. Welwitsch.

2. *T. uleana* (Moebius) Wille, 1909. Pflanzenfamilien, Nachtrage zum 1 Teil, 2 abt., page 13, Fig. 3; Moebius, Ueber einige brasilianische Algen, Hedwigia 34: 175-177, Pl. II, Figs. 1-10. 1895. Czurda, Zygnemales; Süßwasserflora Mitteleuropas; 9: 97. 1932.

Diameter vegetative cells  $10-12\mu$ , length 6-10 diameters, at time of conjugating elongating to 20-25 diameters, cell sap purple; chromatophore an axile plate with usually four pyrenoids; gametangia  $20-30\mu$  long; zygospores usually formed by lateral conjugation, obliquely ovoid to ovoid,  $20-40\mu \times 40-60\mu$ ; the less frequent zygospores formed by scalariform conjugation cruciate-quadrangle with truncate angles  $25-40\mu \times 30-50\mu$ ; spore wall smooth and colorless (spore dimensions estimated from Moebius figures). Aplanospores formed in the short cells rarely. Plate I, Figures 1-8.

Agulhas Negras (alt. 2,500 m.), near Itajahy, Southeastern Brazil, March, 1894. E. Ule.

*Temnogametum thaxteri* sp. nov.

Diameter vegetative cells  $39-45\mu \times 220-360\mu$  ( $-510\mu$ ), (5-10 diameters long), cell sap purple, chromatophore with 30 to 120 pyrenoids, gametangia  $36-90\mu$  long; zygospores formed only by scalariform conjugation, quadrangular ovoid with truncate or rounded corners  $60-75\mu$  ( $-100\mu$ )  $\times 90-120\mu$ ; occasionally formed in pairs by union of two pairs of gametangia, each zygospore being somewhat narrower and longer; zygospore wall thick, smooth and colorless; aplanospores may develop within the short cells, which become more or less enlarged, ovoid, about  $60\mu \times 75\mu$ , with wall similar to that of the zygospores. Plate I, Figures 14-20.

Sandy pools in Aripo Savanna, Cumuto Station, Trinidad, B. W. I., April 10, 1913. R. Thaxter.

## EXPLANATION OF PLATE.

- Figs. 1-5. *Temnogametum uleana*. Stages in the formation of zygospores by lateral conjugation. After Moebius.
- Figs. 6-8. *T. uleana*. Zygospores formed by scalariform conjugation. After Moebius.
- Figs. 9-13. *T. heterosporum*. Lateral and scalariform conjugation. After West.
- Fig. 14. *T. thaxteri*. Paired zygospores formed by scalariform conjugation of paired gametes.
- Fig. 15. *T. thaxteri*. Aplanospore formed from a single gamete.
- Fig. 16. *T. thaxteri*. Paired gametangia, each cut off from adjoining vegetative cells. Note increased number of pyrenoids, and their enlargement due to starch accumulation.
- Fig. 17. *T. thaxteri*. Vegetative cell and parthenospore.
- Figs. 18-20. *T. thaxteri*. Variations in form of zygospores. In Figure 19 the enlarged and crowded pyrenoids are shown. In Figure 20 a pair of gametes in two filaments have united, the unpaired gamete has formed an aplanospore.

