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*CAULERPA*

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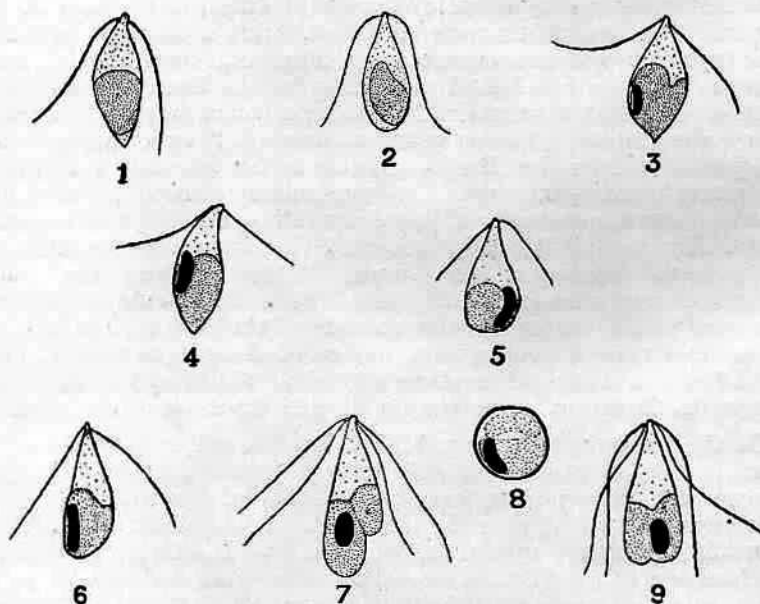
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UNTIL very recently the only method of reproduction known in *Caulerpa* was by vegetative reproduction. Dostal<sup>1</sup> in 1928 observed elongated papillae on the assimilators of *Caulerpa prolifera*. Later on in 1929 he<sup>2</sup> observed the contents of the assimilators in this *Caulerpa* issuing out as a mass of mucilaginous matter containing a large number of biciliate swimmers. In the same year Schussnig<sup>7</sup> also observed the phenomenon in the same species. But they were not able to decide whether the swimmers were zoospores or gametes. Since then a few other authors also have observed the phenomenon in some other species. In 1932 Ernst<sup>4</sup> found in *Caulerpa clavifera* and some other species biciliated swimmers of two sizes. Since the swimmers were of two different sizes, he concluded that they were gametes and that their conjugation would be anisogamous. He found these two types of swimmers in different plants and so suggested that the plants were dioecious. But actual conjugation of the gametes was not observed by him. The writer, in 1933, observed at Krushadi Island near Pamban in South India, the formation of biciliate swimmers in *Caulerpa racemosa* var. *uvifera* Weber von Bosse. These swimmers were of two sizes, and as suggested earlier by Ernst, proved to be gametes and were conjugating anisogamously. A preliminary account of the writer's observations was published by him<sup>5</sup> in the same year. In 1937 Miyake and Kunieda<sup>6</sup> observed the formation of gametes in *Caulerpa brachypus* in Japan. They found that the conjugation was anisogamous. These two authors evidently were not aware of the writer's earlier record<sup>5</sup> of the conjugation of the gametes in *Caulerpa* and so have not referred to it in their paper. The details of their observation regarding the gametes and the conjugation, however, agree very well with those of the writer.

In the preliminary note published by the writer in 1933<sup>5</sup> only the occurrence of the gametes and their conjugation in the *Caulerpa* was recorded. The publication of the details of the writer's observations was postponed with the idea of amplifying them by further observations on more species in the locality. He therefore visited the island on three different occasions after that and examined a large number of specimens of different species of *Caulerpa* to find out if any gametes were being formed, but without success. He sees no point in delaying the publication of his original observations and drawings any further and so gives them here below.

5292

The assimilators in a few specimens of *Caulerpa racemosa* var. *wifera* Weber von Bosse showed a reticulate appearance caused by the accumulation of the protoplasm in a net-like manner inside. The colour of these assimilators with the net-like appearance was slightly yellowish-green. The specimens were kept in fresh sea-water in a glass vessel and watched for a long time for the formation of the papillæ on the surface of the assimilators and for the escape of the contents as motile spores. Though they were watched for a long time, the formation of the papillæ and the escape of any motile spores were not seen. The contents of some of these assimilators, when examined, showed a large number of rounded green bodies exhibiting a slight movement inside. A careful examination under higher magnification showed a large number of spores actively moving inside. As the writer's stay on the island had to be very brief, he could not wait and follow the development of the papillæ and the escape of the swarm spores. Portions of these assimilators were therefore cut and placed in fresh sea-water in glass vessels. Immediately, the contents of the assimilators slowly escaped from the cut end as a thick brownish-green viscous liquid and settled at the bottom of the water in the dish. A drop of this dark liquid, when mounted on a slide and examined under the microscope, showed a large number of biciliate swimmers actively moving in it. These after a short time began to fuse with each other in pairs. The



TEXT-FIGS. 1-9. Gametes of *Caulerpa racemosa* var. *wifera*

Figs. 1-6. Gametes showing various shapes. Figs. 7 & 9. Anisogamous conjugation. Fig. 8. Zygote. (All Figs.  $\times 2150$ .)

conjugation was anisogamous, one of the gametes being larger than the other. The gametes were spindle-shaped to pear-shaped with the posterior end either rounded or pointed. The eyespot is somewhat median in the spindle-shaped ones (Text-figs. 3 and 4) and more towards the posterior end in the pear-shaped ones (Text-figs. 5 and 6). The two cilia are slightly longer than the body of the gamete. A small papilla is seen at the anterior end. Of the two conjugating gametes, only the female gamete possesses an eyespot while the male does not show it (Text-figs. 7 and 9). The female gamete measures  $2.6-2.9 \mu$  broad and  $7.0-8.25 \mu$  long and the male gamete  $2.3-2.6 \mu$  broad and  $6.5-7.6 \mu$  long. After conjugation the zygote loses its cilia and becomes round and covers itself with a wall (Text-fig. 8). The further development of the zygote could not be followed.

Schussnig<sup>8</sup> in a recent paper has given an account of the cytology of the swarmer formation in *Caulerpa prolifera*. He found reduction division taking place during the formation of the swarmers and concludes that the plants are diploid and the swarmers haploid. It is very probable that the plants in *C. clavifera* and in *C. racemosa* var. *wifera* are also diploid and that reduction takes place during gamete formation. From the fact that Ernst<sup>4</sup> found gametes of two sizes in different individuals in *C. clavifera* and other species and Iyengar<sup>5</sup> observed anisogamous conjugation in *C. racemosa* var. *wifera*, Schussnig<sup>8</sup> assumes that the plants (diploid) in *Caulerpa prolifera* are of two kinds, one kind forming male gametes and the other female gametes, reduction division taking place in each kind just before gamete formation. He therefore considers that *Caulerpa prolifera* is diploid dioecious. But it must be mentioned here that in the present alga (*C. racemosa* var. *wifera*) the conjugating gametes were found in the liquid which oozed out of the cut end of a branch of a single plant. This shows that the plant is not dioecious but monoecious and further that the conjugation takes place between the gametes formed by the same individual. *C. racemosa* var. *wifera* is therefore monoecious while *C. clavifera* and the other species studied by Ernst<sup>4</sup> are dioecious. Schussnig<sup>8</sup> assumes that the plants in *C. prolifera* are diploid dioecious. They are diploid alright. But whether they are really dioecious or monoecious can be decided only after observing the gamete formation in the alga, since the plant in one of the species of the genus, viz., *C. racemosa* var. *wifera*, appears to be definitely monoecious.

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