ON SOMATIC DIVISION, REDUCTION DIVISION, AUXOSPORE FORMATION AND SEX DIFFERENTIATION IN *NAVICULA HALOPHILA* (GRUNOW) CLEVE

Navicula halophila occurs in good quantity at Madras. The life-history of the Diatom was studied by the author with the help of laboratory cultures. Special attention was devoted to its auxospore-formation and the nuclear details connected with the process.

Somatic division takes place in the usual manner, the chromosomes being arranged in a ring around the spindle at metaphase as is characteristic of Diatoms. The chromosome number appears to be 48-52 (2 *n*). After cytokinesis, two new valves are secreted by the daughter protoplasts inside the old valves.

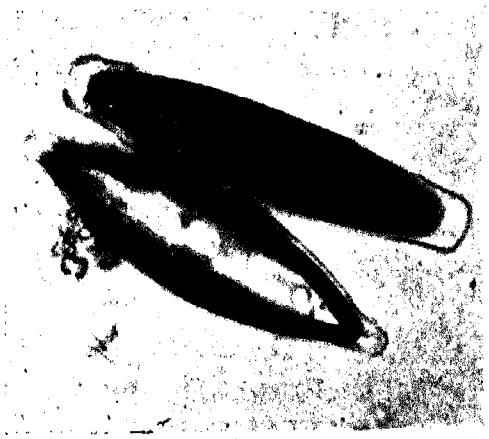
During auxospore-formation two cells come near each other (Fig. 1) and secrete a common mucilaginous envelope. The nucleus of each cell divides meiotically and forms two nuclei. All the stages of the meiotic division were observed. The haploid number of chromosome appears to be 24-26. The contents of each cell then divides into two protoplasts, each protoplast receiving one haploid nucleus. The haploid nucleus in each daughter-protoplast undergoes the second division and forms two nuclei. Of these two nuclei in each daughter-protoplast, one degenerates and the other remains functional, so that ultimately, each daughter-protoplast (gamete) has one single haploid nucleus. Finally two gametes are organised in each of the conjugating cells (Fig. 4).

The two gametes of one of the cells escape out of the valves and fuse with the two gametes of the other cell. The latter gametes remain passive and do not move out of the parent valves. Both the zygotes are formed in the latter cell (Fig. 5).

The zygotes (auxospores) germinate after a few hours of rest and form two new Diatom cells (Fig. 6). The two gametic nuclei inside each auxospore do not fuse for a long time and fuse only after the auxospore has reached its full size.

The nuclear details connected with auxospore-formation among the Pennate Diatoms have been recorded only in a few forms (*Cymbella lanceolata*, Geitler 1927 *a*; *Cocconeis placentula*, Geitler 1927*b*; *Nitzschia subtilis*, Geitler 1928; *Synedra ulna*, Geitler 1939; *Rhoicosphenia curvata*, Cholnoky 1927; *Anomœoneis sculpta*, Cholonoky 1928; *Cymbella cistula*, Cholnoky 1933; and *Gomphonema geminatum*, Meyer 1929). But nothing is known regarding the nuclear details connected with auxospore-formation in the very common genus, *Navicula*, though auxospore-formation has been previously recorded in the genus [*Navicula Grevillei* (Smith 1856); *N. serians* and *N. rhomboides* (Carter 1865); *N. cuspidata* var. *ambigua* and *N. elliptica* (Pfitzer 1871); *N. viridula* and *N. scopulorum*, (Karsten 1896); *N. crucigera* (Karsten 1897); *N. didyma*, *N. ramosissima*, *N. directa*, *N. subtilis* and *N. pygmæa* (Karsten 1899); and *N. seminulum* (Geitler 1932)]. In the present form the author was able to follow all the details of the nuclear changes connected with the auxospore-formation. This appears to be the first complete account of the nuclear changes connected with auxospore-formation in this genus.

Again, in the Pennate Diatoms, previously, both isogamous conjugation [*e.g.*, *Rhopalodia gibba* (Klebahn 1896); *Epithemia zebra* var. *saxonica* and *Denticula Vanheurckii* (Geitler 1932)] and anisogamous conjugation [*e.g.*, *Cymbella lanceolata* (Geitler 1927*a*); *Nitzschia subtilis* (Geitler 1928); *Gomphonema parvulum* var. *micropus* (Geitler 1932)] have been recorded. In the former the gametes of both the cells are equally active and as a result, the two zygotes are formed between the two pairing cells. In the latter type of conjugation, of the two gametes that are formed in each pairing cell, one is active and motile,



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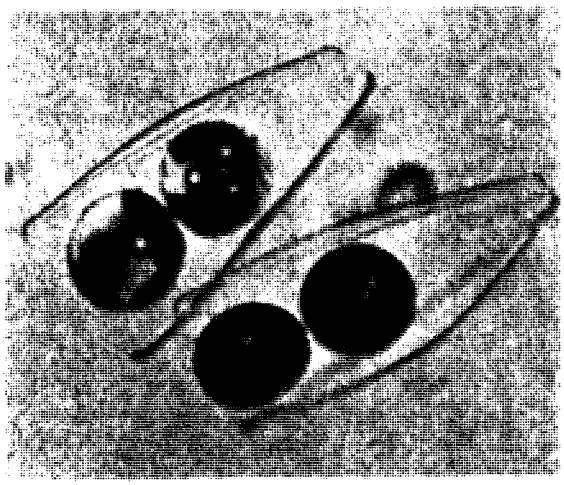

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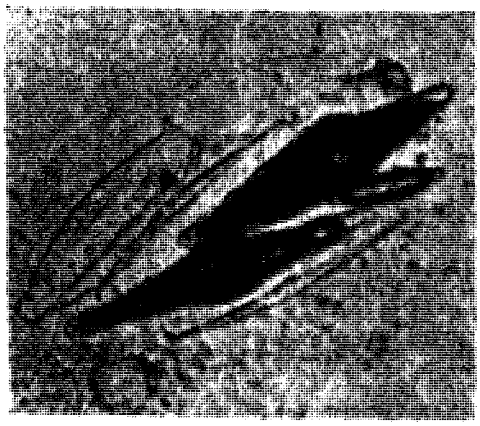

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FIG. 1. Two cells just come near each other (living material) × 650.

FIG. 2. Synizesis × 1500.

FIG. 3. Diakinesis. × 1500.

FIG. 4. Two gametes in each one of the pairing cells ready for conjugation (living material) × 500.

FIG. 5. Two zygotes (auxospores) inside the valves of one of the conjugating cells (female) (living material). × 500.

FIG. 6. Two zygotes (auxospores) germinating. Note the two auxospores are seen inside the valves of one of the conjugating cells (female). × 350.

while the other is passive. During conjugation, the active gamete of one cell passes over to the opposite cell and fuses with its passive gamete and the active gamete of the latter cell behaves in a like manner and fuses with the passive gamete of the former cell. As a result of this a zygote is formed in each of the two conjugating cells. Geitler (1935, page 154) with reference to this phenomenon states that "the physiologically anisogamous behaviour involved in the formation of two gametes permits the interpretation that each mother-cell forms two gametes of opposite sex, a male motile gamete and a female non-motile gamete. The mother-cells themselves may, accordingly, be regarded as hermaphroditic and the entire behaviour would, from this view-point, correspond to that involved in the conjugation of the Ciliates. So far as we know, sex determination occurs phenotypically in all cases hitherto investigated. A sex chromosome mechanism has not been observed nor can it be expected."

In the case of the present Diatom, the conjugation is anisogamous, but, the anisogamy observed here is quite different from those recorded previously among the Pennales. Here, of the two gametes that are formed in each cell, instead of one of them being active and the other passive, *both* the gametes of one cell are active (i.e., physiologically male), while *both* the gametes of the other cell are passive (i.e., physiologically female), with the result that both the zygotes are formed in the latter cell, unlike in the previously recorded cases, where a zygote is formed in each of the two cells. The mother-cells in the form under investigation (*Navicula halophila*), therefore, should be regarded as dioecious, i.e., as either male or female and not as monoecious (hermaphroditic) as in the previously recorded cases.

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