CHEMICAL BASIS OF SEXUAL APPROACH IN MARINE BROWN ALGAE

Dieter G. Müller
Fachbereich Biologie der Universität Konstanz
D-7750 Konstanz, Federal Republic of Germany

Fusion of gametes is an integral part of the various events summarized under the heading of "sexual reproduction," which is, in turn, one of the major driving forces of evolution. Because of this crucial significance, biologists have been interested for a very long time in learning more about fertilization. As early as 1854, the French pioneer Thuret observed masses of sperm cells aggregating around eggs of Fucus, and a look at the older literature reveals that apparently some marine brown seaweeds are especially suitable for observing fertilization.

The enormous numbers of sperm cells aggregating around a Fucus egg demonstrate immediately and beyond any doubt that there is something that makes the male gametes approach the egg and remain excited in its vicinity until the zygote is formed.

This dramatic happening, which can be easily studied on the North Atlantic coasts, stimulated a number of workers to try to find out what it is that makes the sperm approach the egg. Although all these efforts eventually failed, the British workers Cook et al. came closest to the solution by demonstrating in 1947 that the eggs secrete a highly volatile compound with male-attracting properties.

Unfortunately, further progress was prevented due to the limitations set by the tools of analytical chemistry at that time. No significant new results were reported until, in 1968, the American group of L. Machlis and co-workers identified the first sex attractant in plants. They used interspecific crosses of the aquatic phycomycete Allomyces and identified a sesquiterpene, which they named sirenin, as the signal transmitter between female and
male gametes. At about the same time, I started to rediscover the fine organisms studied by classical marine botanists in the last century. By then, analytical methods had reached a degree of sophistication that gave some hope of successfully handling the minute quantities of substances involved in sexual chemotaxis. Three sex attractants of marine brown algae have now been identified through the cooperative efforts of a group of biochemists and myself. I will now briefly describe the three projects and then give you some information about the current state of our work.

*Ectocarpus siliculosus* is a filamentous brown alga growing in the coastal zones of the North Atlantic and the Mediterranean. There are female and male plants which release motile unicellular gametes into the surrounding sea water. Female cells settle on a substrate and then start to attract male gametes in the vicinity, which accumulate until finally cell fusion takes place. The supernumerary cells lose interest, once the zygote has been formed (Figure 1).

Fortunately, the species can be cultivated in the laboratory. Clonal isolates originating at Naples, Italy, were grown in mass cultures. Female gametes were observed to produce a very characteristic scent, reminiscent of juniper. Suspensions of female gametes were placed in bottles, and purified air was used to flush the volatile substances into a cold trap at -78°C. There, the condensed material could be recovered with solvents and examined by

Figure 1. Mating reaction in *Ectocarpus siliculosus*: motile gametes surrounding single stationary female cells. Lower left: cellular fusion. Lower right: violent reaction of many male cells around one female gamete, which is obscured. Phase contrast, scale unit 2.5 μ.