A NEW TYPE OF LIFE HISTORY IN BRYOPSIS (CHLOROPHYCEAE, CAULERPALES)

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SUMMARY

A *Bryopsis "plumosa"* population from Roscoff appeared to have a heteromorphic life history. Zygotes from the anisogametes grew into filamentous germlings that produced spherical stephanokontic zoids. These stephanokontic zoids grew into new *Bryopsis* plants.

Comparable filamentous germlings produced by a *Bryopsis "plumosa"* population from Zeeland (Netherlands) grew directly into new *Bryopsis* plants.

Crosses between female gametes from the Roscoff population and male gametes from the Zeeland population (and vice versa) produced a fertile offspring. The filamentous germlings, resulting from these crosses however, directly grew into new male or female *Bryopsis* plants.

1. INTRODUCTION

It is a general belief that all *Bryopsis* species have a diplontic life history. The supposedly haploid biflagellate anisogametes are considered to be formed, via meiosis in gametangia, i.e. transformed determinate laterals of the diploid thallus (FRITSCH 1945; IYENGAR 1951; SMITH 1955; CHADEFAUD 1960). Caryological evidence for this type of life history was published by ZINNECKER (1935) and NEUMANN (1969).

Recently, however, HUSTEDE (1964) discovered that in *Bryopsis halymeniae* a Bryopsis-like gamethophytic phase alternates with a Derbesia-like sporophytic phase.

A third type of life history for *Bryopsis* was discovered by the present author in the course of his investigations on the taxonomy of the European species of *Bryopsis*.

2. MATERIAL AND METHODS

A large collection of unialgal *Bryopsis* cultures is maintained by the author on account of his investigations on the taxonomy of the European species of this genus. Vegetative isolates were started from cut-off determinate laterals. Possible algal contaminants were removed by drawing determinate laterals, with a fine needle, through the surface layer of a sterile 2% seawater-agar plate. A slightly modified Erschreiber medium plus EDTA, was used as culture-fluid. Most cultures were kept in a 15 $\pm$1 °C temperature room and exposed, during daily photoperiods of 16 hours, to light intensities of 1600 lux emitted by white fluorescent tubes. Some cultures were exposed to daily photoperiods of 8 hours ("short day conditions"); and to a temperature of 15 $\pm$1 °C.

The present observations were made on vegetative subcultures from isolates from Roscoff (July 1968, Ile de Batz; small intertidal rock pools) and from the province of Zeeland, Netherlands (September 1968, Kattendijke, on stones, upper sublitoral zone). These subcultures were also started from cut-off determinate laterals.

Both collections, though slightly different in morphological details, would be identified as *Bryopsis plumosa* according to the current taxonomic concepts for this genus (see HAMEL 1930; TAYLOR 1957).

Female as well as male plants were isolated from both Roscoff and Zeeland materials.

3. RESULTS

3.1. Bryopsis from Roscoff

After two weeks, subcultures from four different plants (two male and two female) had grown into plants 2½–3½ cm high (*figs. 1* and *2*). These plants were morphologically similar to the original plants from nature. The culture plants were already fertile and had produced gametes, the male gametes in light brown male gametangia, the female gametes in dark green female gametangia. The "ghost" of the emptied gametangia remained incidentally attached to the axis of the plants below the terminal clusters of determinate laterals (*figs. 1* and *2*).

Neither male nor female gametes were able to develop parthenogenetically. Only mixtures of swarms of male (*fig. 3*) and female (*fig. 4*) gametes, produced large numbers of filamentous germlings. After about two months these germlings were about 2–6 mm long and showed no signs of further growth (*figs. 5* and *6*).

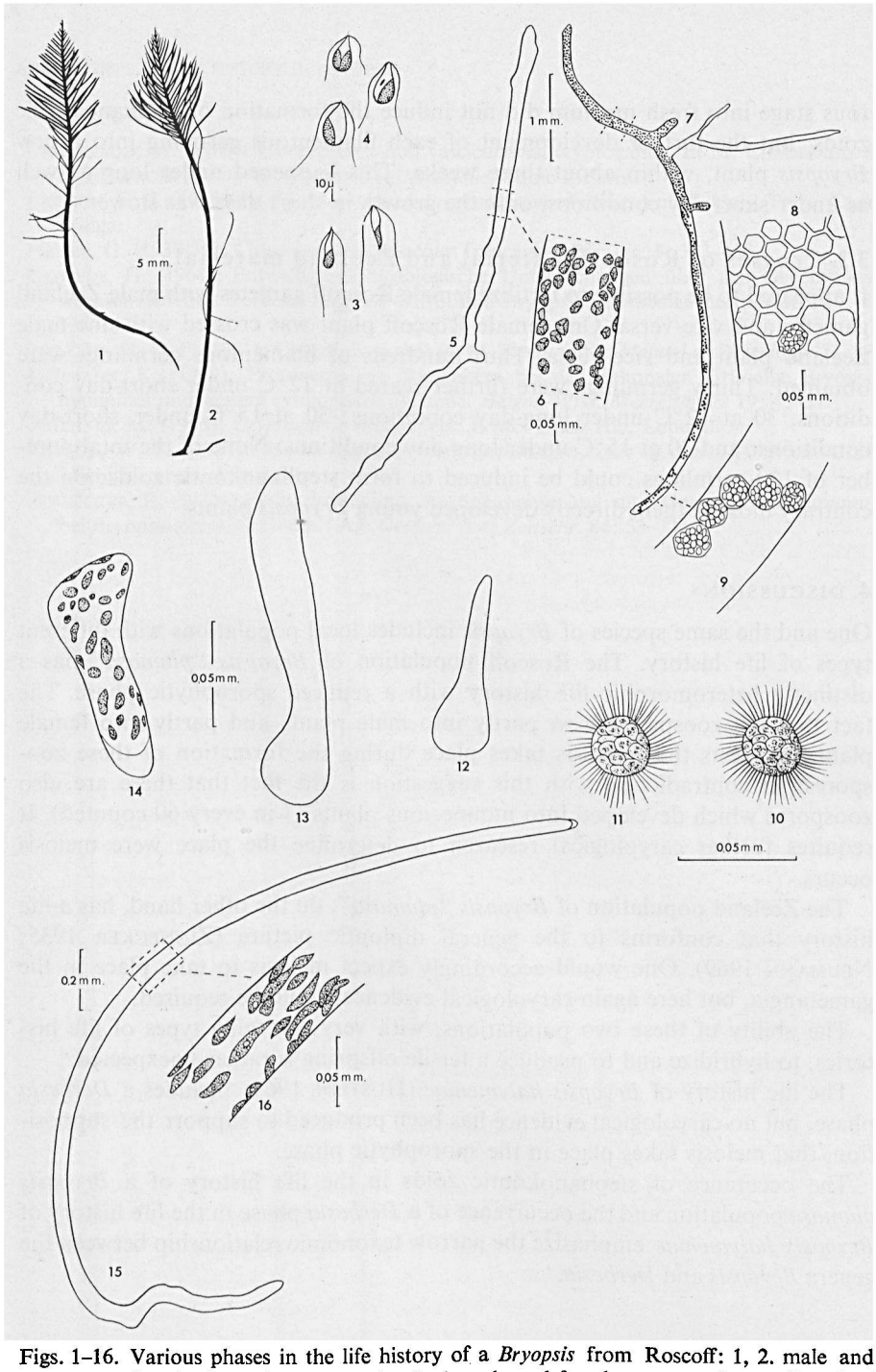
However, after transfer into fresh medium, the filamentous germlings started to divide their contents into numerous spherical stephanokontic zoids, with a diameter of 25–30 μ (*figs. 7, 8* and *9*). Transfer into fresh medium and short day conditions induced the formation of zoids within two or three weeks. Each motile stephanokontic zoid contained a large number of chloroplasts (*figs. 10* and *11*). Most zoids had attached within ten hours to the wall of the cultural tubes and to the emptied fllamentous stage (the emptied zoidangium).

Within a few days the attached zoids developed an initial rhizoidal attached part and an erect axis (*figs. 15* and *16*). Very young stages consisted of a spherical part – corresponding with the form of the attached zoid – from which grew a short germination tube (*figs. 12, 13* and *14*).

The germinated stephanokontic zoids grew within two weeks into new fertile *Bryopsis* plants. It was not possible to divide the offspring of the stephanokontic zoids, produced by one filamentous germling, into male and female plants, because at least part of them are both male and female.

3.2. Bryopsis from Zeeland

This material in cultures roughly gave the same results as the Roscoff material up to the filamentous germlings grown from the zygotes. Transfer of this filamen-



Figs. 1–16. Various phases in the life history of a *Bryopsis* from Roscoff: 1, 2. male and female plant after two weeks; 3, 4. male and female gametes; 5. germling rised from zygote; 6. detail of germling; 7. zoidangium; 8, 9. details of zoidangium; 10, 11. stephanokontic zoids; 12, 13, 14. very young stages just now rised from zoids; 15. young *Bryopsis* plant; 16. detail of young plant.

tous stage into fresh medium did not induce the formation of stephanokontic zoids, but the further development of each filamentous germling into a new *Bryopsis* plant, within about three weeks. This happened under long as well as under short day conditions, only the growth in short days was slower.

3.3. Crosses of Roscoff material and Zeeland material

It appeared to be possible to fertilize female Roscoff gametes with male Zeeland gametes and vice versa. One female Roscoff plant was crossed with one male Zeeland plant and vice versa. Thus hundreds of filamentous germlings were obtained. Thirty germlings were further reared at 12 °C under short-day conditions, 30 at 12 °C under long-day conditions; 30 at 15 °C under short-day conditions; and 30 at 15 °C under long-day conditions. None of the total number of 120 germlings could be induced to form stephanokontic zoids; on the contrary most of them directly developed young *Bryopsis* plants.

4. DISCUSSION

One and the same species of *Bryopsis* includes local populations with different types of life history. The Roscoff population of *Bryopsis "plumosa"* has a distinctly heteromorphic life history with a reduced sporophytic phase. The fact that the zoospores grow partly into male plants and partly into female plants, suggests that meiosis takes place during the formation of these zoospores. In contradiction with this suggestion is the fact that there are also zoospores which developed into monoecious plants (7 in every 60 counted). It requires further caryological research to determine the place were meiosis occurs.

The Zeeland population of *Bryopsis "plumosa"*, on the other hand, has a life history that conforms to the general diplontic picture (ZINNECKER 1935; NEUMANN 1969). One would accordingly expect meiosis to take place in the gametangia, but here again caryological evidence would be required.

The ability of these two populations, with very diverging types of life histories, to hybridize and to produce a fertile offspring is rather unexpected.

The life history of *Bryopsis halymeniae* (HUSTEDE 1964) includes a *Derbesia* phase, but no caryological evidence has been produced to support the supposition, that meiosis takes place in the sporophytic phase.

The occurence of stephanokontic zoids in the life history of a *Bryopsis plumosa* population and the occurrence of a *Derbesia* phase in the life history of *Bryopsis halymeniae* emphasize the narrow taxonomic relationship between the genera *Bryopsis* and *Derbesia*.

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