A note on Cyst formation in *Fritschiella tuberosa* Iyengar.

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With 2 figures in the text.

This remarkable member of Chaetophorales was found growing in fields lying fallow near Tanda, district Fyzabad, U. P. India in the first week of October 1937 — after the close of rains. It was especially abundant on manure heaps in fields, on which it was found growing gregariously in dark green clusters. Later on it was found growing in a drying pond near V. Chandipur tehsil Tanda in the last week of January 1938 mixed with a moss. In October 1938 it was again collected mixed with *Protosiphon botryoides* and *Riccia* sp. from the banks of river Sarju near Fyzabad.

Vegetative Structure.

Early stages of the growth of the alga were not observed. The simplest plants observed showed differentiation into three regions viz. a fan-shaped projecting system, a parenchymatous prostrate system, and an elongated rhizoidal system.

1. Projecting system: This is composed of elongated branches arranged in a fan-like manner. Each cell contains a ulotrichaceous-collar-shaped chloroplast with 2—5 conspicuous pyrenoids. As this part of the thallus is exposed to light, it is usually rich green in colour and serves the function of photosynthesis of food materials. Cells of the projecting system are 4—9 μ broad and 10—30 μ long.

2. Prostrate-Supporting System: The branches of the projecting system arise from the cells of the prostrate supporting

system. In young plants it is composed of a linear row of moniliform cells, uniseriate or biseriate for the most part of their length, with a tendency towards apical expansion into a parenchymatous prostrate layer (Fig. 1, *1*). In more mature plants these cells are considerably swollen, are dark bluish-green in colour and are so much loaded with starch granules that the structure of the chloroplasts is totally obscured. In most cases the cells of this system form the main body of the alga, and are considerably expanded. The whole alga presents the appearance of a prothallus of *Tmesipteris*, if we exclude the branches of the projecting system (Fig. 1, *3*). In some cases the projecting system may be altogether missing thus accentuating the prothallus-like appearance of the alga (Fig. 1, *4*). In mature plants, the filaments of the prostrate system become moniliform in appearance and ramify in all directions like fungal hyphae. The primary function of this part of the thallus is that of storage of food material which is manufactured by the photosynthetic activity of the cells of the projecting system, and later on cells of this part form cysts for the purpose of perennation. Cells of this system are usually seen in tetrads and are 9—18 μ in diameter.

3. Rhizoidal system: Two types of rhizoids are distinguishable in this alga. The more primitive of these are formed by the decay and disintegration of the cell contents and internal cell walls of the lower-most cells of the subterranean prostrate system, as shown in fig. 1, *2* and *4*. These are usually very broad and are branched, and may be called functional rhizoids. The other type of rhizoids seem to be formed by the lengthening of the lowermost basal cell of a plant. Some of the smaller plants show such lengthened basal cells (Fig. 1, *1*). When mature these rhizoids may be 200—380 μ long, have thick walls and may also be branched. Unlike the rhizoids of the specimens described by IYENGAR, the rhizoids of this plant are always unseptate (Fig. 2, *7* and *8*). Possibly these plants are more mature as compared with the South Indian specimens.

Cyst formation.

The main body of a mature plant is composed of the prostrate system which is expanded laterally and whose cells are usually gorged with starch. Its cells are mostly seen in the form of tetrads. Cell-walls of the cells of this system are very thin in early stages (Fig. 1, *2* and *3*). These cells whose main function is storage of food materials in the early stages of the life of the alga, serve the function of perennation when the fields and ponds dry up. In the

material collected from a drying pond in January, 1938 near V. Chandipur, the cell-walls of the cells of the prostrate system were considerably thickened. In the lower-most part where the rhizoids begin, a loose cluster of thick-walled green cysts was seen (Fig. 2, 5).

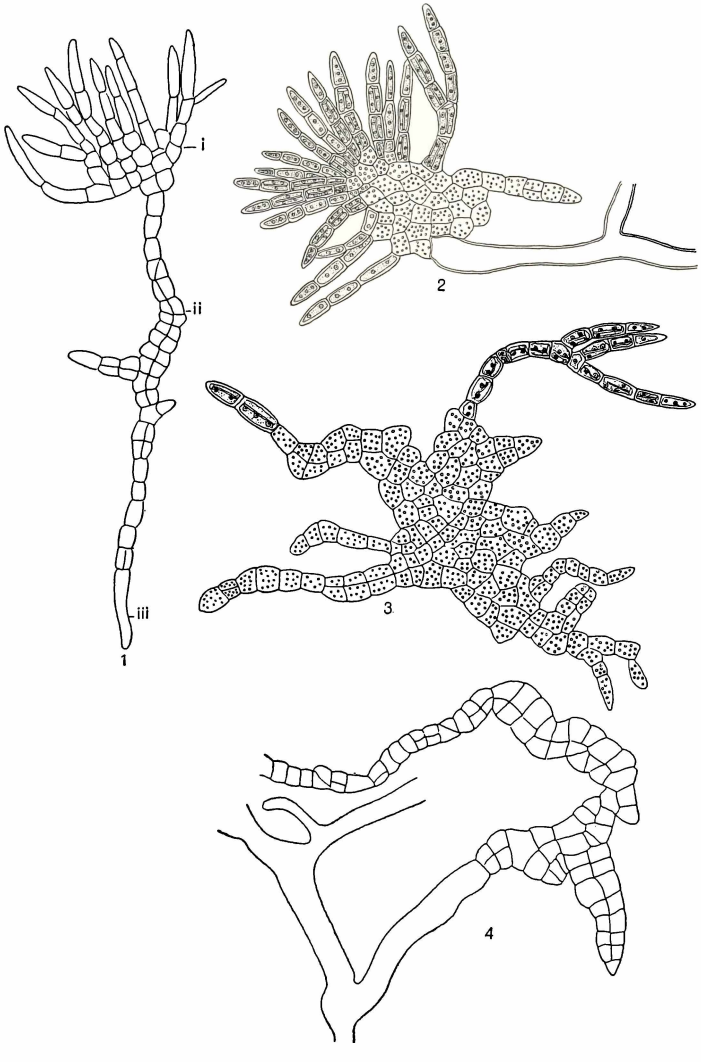

Fig. 1. *Fritschiella tuberosa* Iyengar. 1. A young plant showing the projecting system (I), parenchymatous prostrate system (II), and the rhizoidal cell (III). 2. A plant showing a functional rhizoid formed by the disintegration of lowermost cells. 3. A plant showing prothallus-like prostrate supporting system. 4. A plant in which the projecting filaments are missing. All $\times$ 248.

Cysts 16—20 μ in diameter with thick white mucilaginous walls, which in some cases may be slightly stratified, and resemble those found in the mature plants, were also found scattered in the dried mud (Fig. 2, *6*).

IYENGAR did not observe cysts in the material he collected from Madras and Talguppa in Mysore, but he very rightly surmised that the cells of the prostrate system serve the function of perennation. He writes, "It is probable that the cell clusters of the prostrate system serve as a means of perennation which is prepared long before it becomes actually necessary to meet the danger of sudden desiccation. In fact, as already mentioned above, the alga continues to form these perennating clusters of cells from the very beginning of its life". However his further observations that the "cells themselves with their dense contents and scanty vacuoles appear well-fitted for a resting period without further preparation" donot seem to be well-founded. It is very probable that the South Indian form too produces thick-walled cysts. It is also extremely doubtful if any motile zoospores come out of these thin-walled cells of the prostrate system, though the occurrence of such motile bodies is more likely in the cysts themselves, which germinate in monsoons when there is plenty of water available in the fields and ponds.

It may also be noted that cyst-formation in *Fritschiella* occurs in a very different manner from *Botrydium* and *Protosiphon*. In these coenocytic algae migration of protoplasm takes place from the subaerial balloon-like upper part to the subterranean rhizoidal part. However in *Fritschiella* cysts are formed by the thickening of the cellwalls of the cells of the subterranean prostrate system, and their direct conversion into cysts. The subaerial projecting system decays in *Fritschiella*, while the prostrate system becomes converted into cysts. When scattered in dried soil of ponds and fields it becomes impossible to distinguish between the cysts of *Fritschiella*, *Botrydium*, and *Protosiphon* for all these are rounded thick-walled spore-like bodies with orange-coloured contents.

Affinities: This alga resembles *Fritschiella tuberosa* IYENGAR in most features but differs from it in the presence of unseptate rhizoids. Further observations on more mature specimens of the South Indian species are desirable to show whether rhizoids in mature plants are also septate. However as at present described, the possession of septate rhizoids seems to be a prominent characteristic of the South Indian species, while the North Indian form has distinctly unseptate rhizoids.

Habit: Found growing gregariously on manure heaps, and in highly manured fields and ponds in Tanda district Fyzabad, United Provinces, India from October 1937 to January 1938 and from September to November, 1938 in pure growths or mixed with *Protosiphon botryoides* and *Riccia.*

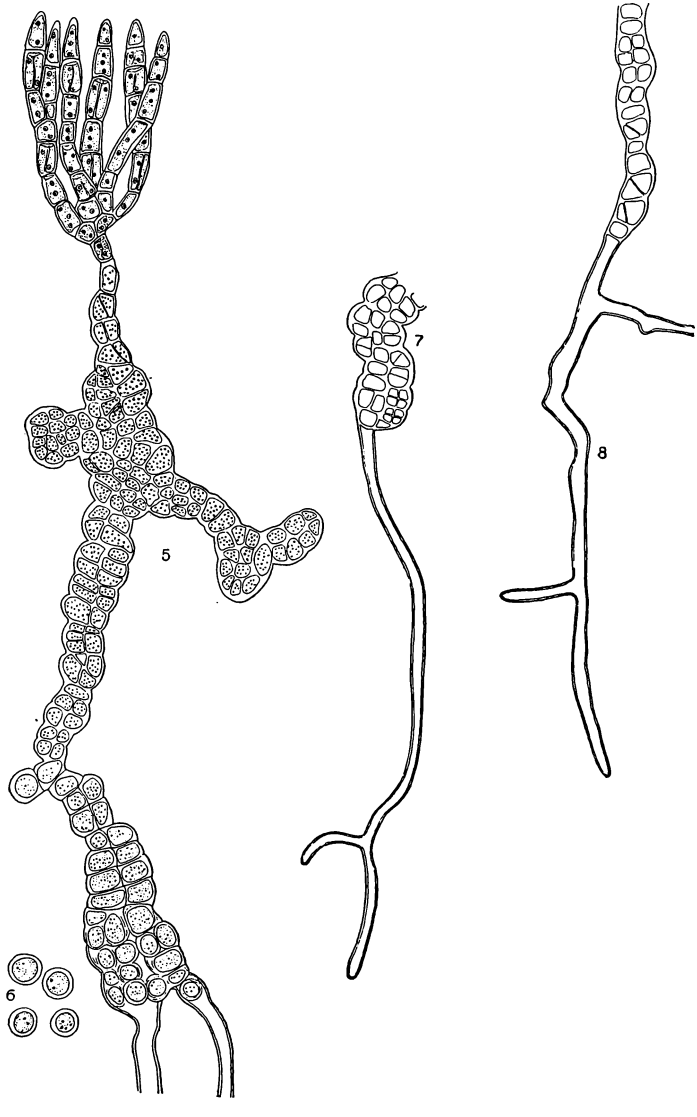

Fig. 2. *Fritschiella tuberosa* Iyengar. 5. A mature plant showing the conversion of cells of the prostrate system into cysts. 6. Some cysts found loose in the soil. 7. and 8. Show rhizoids. All ×248.

Significance of *Fritschiella.*

The starch-gorged cells of the prothalli of certain ferns look very similar to the cells of the prostrate system of *Fritschiella.* In early stages this alga resembles the prothalli of Schizaea. The amphibious habit coupled with its prothallus-like appearance give peculiar significance to this alga. Most probably this alga is one of the survivors out of the pioneers which played a great role in the conquest of land when the great landward movement took place. Very probably the first land plants originated and evolved from humble ancestors like *Fritschiella,* and not from massive sea weeds which were too specialised and over-developed, and lacked the plasticity which alone could have ensured success in a new environment.

References.

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