FRITSCHIELLA, A NEW TERRESTRIAL MEMBER OF THE CHAETOPHORACEAE

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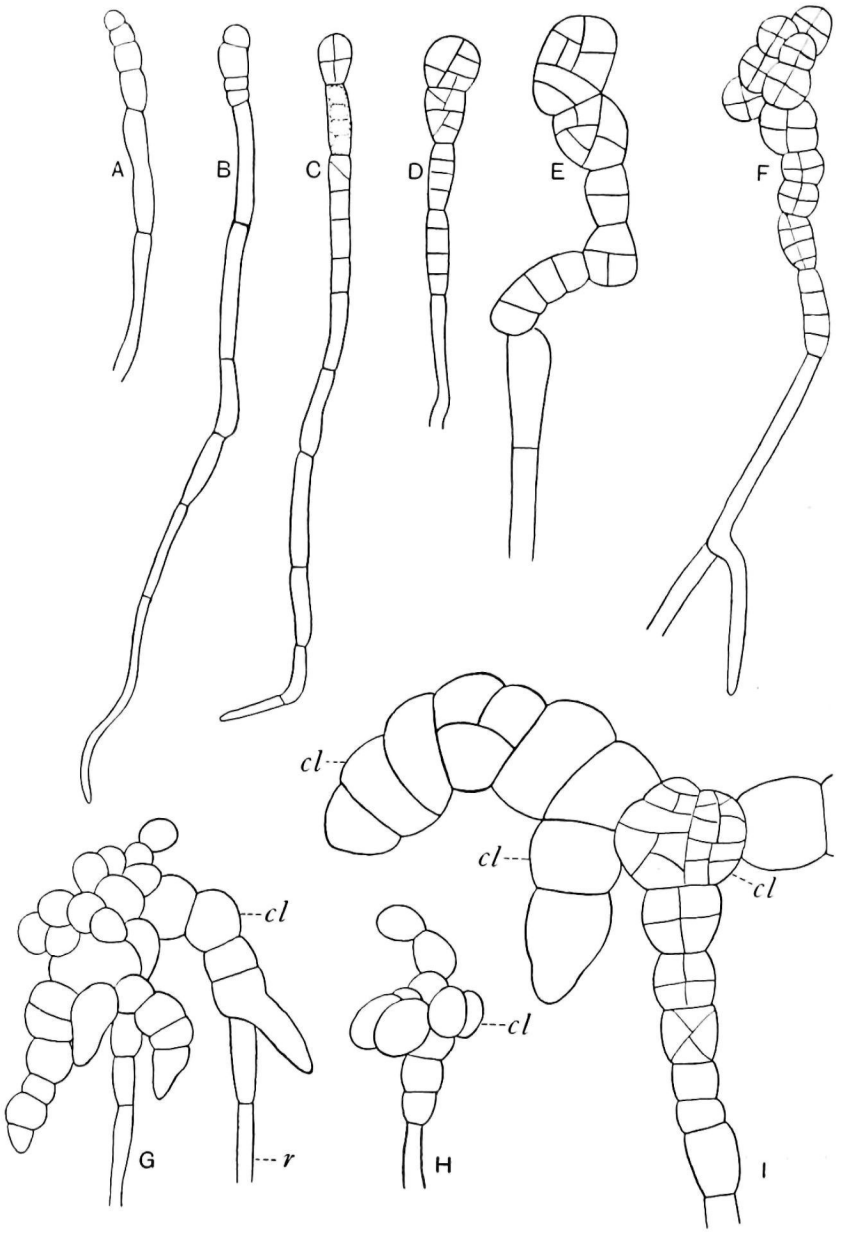
(With Plate XIII and 2 figures in the text)

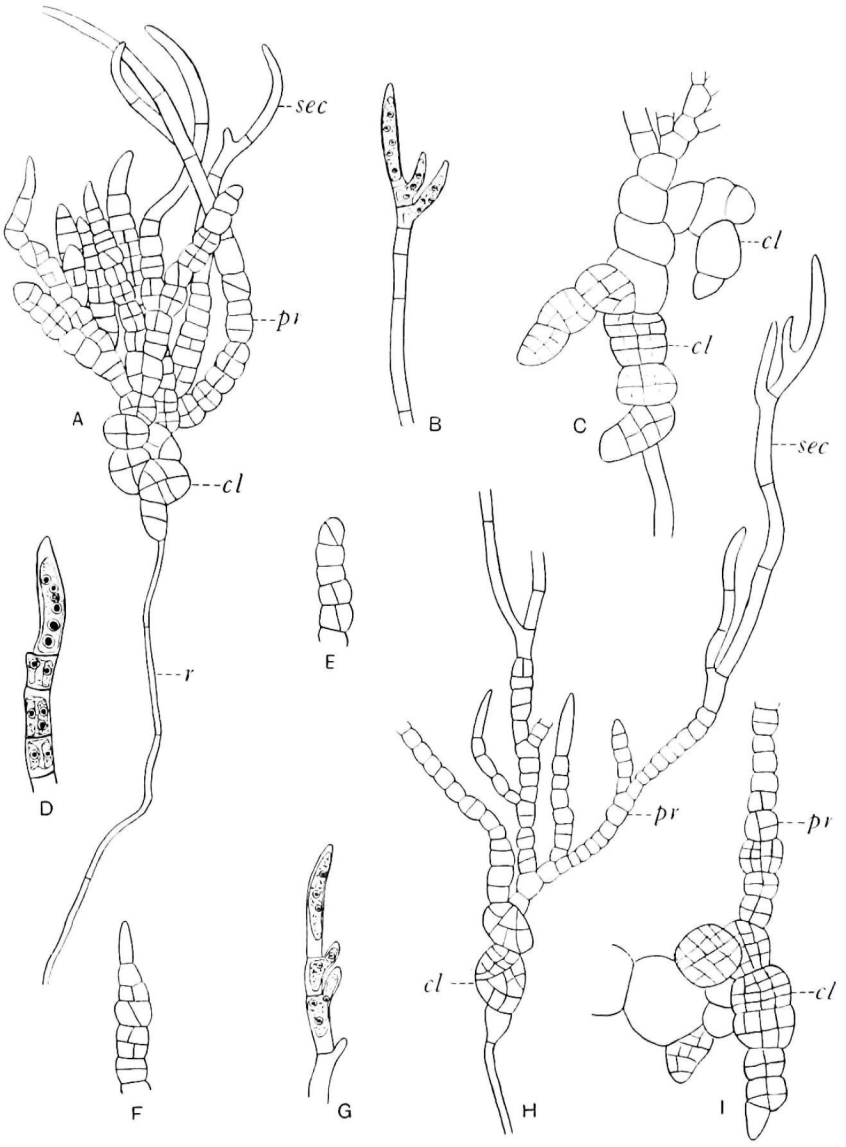
This alga was growing more or less gregariously, together with *Protosiphon botryoides* or *Botrydium tuberosum*, on the moist silt of drying rain-water pools at Madras and occurred in a similar situation, together with *Botrydium tuberosum*, at Talguppa in the Mysore Province. The alga has been repeatedly observed in Madras in different years, when the pools were drying up after the north-east monsoon.

At first sight the alga recalls a dense growth of *Stigeoclonium*, but careful examination shows that it possesses a complicated structure which is much more specialised than that of the latter genus. The mature plant consists of (1) a *rhizoidal system*, penetrating the substratum and comprising one or more downwardly directed rhizoid-like filaments made up of much elongated colourless cells with very scanty contents and sometimes with a few branches (Text-fig. 2, *A*, Text-fig. 1, *F*); (2) a *prostrate system* composed of a number of rounded or irregular swollen clusters of cells with dense contents and thin walls, the whole forming an irregular system with short congested branches (Text-fig. 2, *A*, *C*, *H*, *cl*); (3) a *primary projecting system*, arising from the prostrate system and consisting of a number of upright short-celled branched threads (Text-fig. 2, *A*, *H*, *pr*); and (4) a *secondary projecting system* composed of somewhat elongate branches having longer cells with bright green contents (Text-fig. 2, *A*, *H*, *sec*). In the natural habitat only the secondary projecting system arises as a tuft above the surface of the substratum, the remaining portions of the alga being situated on a level with or slightly beneath the surface of the soil.

The development of the mature structure. As far as can be made out from preserved material, the alga seems to develop in the following manner. In the youngest stage it appears as an unbranched erect



Text-fig. 1. *Fritschiella tuberosa* sp.n. *A–F*, various stages of growth of the young plants. *G–I*, plants with only the rhizoidal and prostrate systems of clustered cells developed; in *G* a side branch is forming a second rhizoid. *cl*, clusters of cells belonging to the prostrate system; *r*, rhizoid. *E* ×600; *I* ×800; the rest ×400.



Text-fig. 2. *Fritschiella tuberosa* sp.n. *A*, a small mature plant with a single rhizoid. *C*, portion of a mature plant. *B*, *D*, *G*, parts of branches belonging to the secondary projecting system. *E*, *F*, portions of the primary projecting system. *H*, part of a plant showing all the various systems. *I*, a portion of a prostrate system with a branch of the primary projecting system. *cl*, cluster of cells of the prostrate system; *r*, rhizoid; *pr*, primary projecting branches; *sec*, secondary projecting branches. *D* ×500; the rest ×350.

filament composed of a few cells and probably largely buried in the substratum. The uppermost cells are somewhat wider with richer contents and form a linear row of four cells (Text-fig. 1, *A*, *B*). The lower cells are elongate and form a rhizoid which, as mentioned above, may branch once or twice or remain unbranched. Earlier stages than this were not observed.

Each of the four cells terminating this primary filament enlarges and divides into four; the division of the lower cells is generally transverse, while in the upper ones transverse, longitudinal and diagonal divisions are seen (Text-fig. 1, *C–E*). The resulting cells continue to divide in all directions, though mainly along planes at right angles to one another, so that ultimately an irregular group of rounded cell clusters is formed, each cluster being the result of the continuous division of one of the four original cells or of one of their products (Text-fig. 1, *D–F*). In many of these clusters localised growth occurs, so that new clusters are budded out laterally or the whole grows out to one side, usually in a slightly downward direction (Text-fig. 1, *G–I*, Text-fig. 2, *C*, *I*; Pl. XIII, 1, 3, 5–9). In the latter case the end cell grows out into a long rhizoid (Text-fig. 1, *G*; Pl. XIII, 1, 5). Sometimes a number of rhizoids are formed in this way. In many cases, however, downward growth of the clusters does not occur and then the entire plant has only the single original rhizoid (Text-fig. 2, *A*, *C*, *H*; Pl. XIII, 3, 6, 9).

From some of these rounded clusters of cells, representing the *prostrate system* of the alga, but usually from the uppermost ones, a number of filaments grow upwards. These, forming the *primary projecting system*, are composed of short cells whose length and breadth are very nearly equal (Text-fig. 2, *A*, *H*, *I* [*pr*], *E*, *F*; Pl. XIII, 1–7), and which have fairly dense contents. Division in these threads mostly takes place transversely, though occasional longitudinal, cross-wise, or diagonal division may occur (Text-fig. 2, *E*, *F*). Rounded clusters, like those seen in the prostrate system, are, however, never formed. The primary branches show considerable ramification, all the threads growing upwards.

From the upper ends of these primary branches then arise a number of secondary branches (*secondary projecting system*), composed below of much elongated cells with scanty contents and above of comparatively shorter cells with dense bright green contents. The latter, with the exception of the terminal cell, generally grow out laterally into a short branch usually not separated by a septum from the parent cell, though occasionally a septum may be formed

(Text-fig. 2, *A*, *H* [*sec*], *B*, *D*, *G*; Pl. XIII, 2); these branches have a broad conical apex. No hairs of any kind are formed on any of the branches.

In the cells of the secondary projecting system a curved plate-shaped chloroplast with 2–8 pyrenoids is well seen (Text-fig. 2, *B*, *D*, *G*). But in those of the primary projecting and the prostrate systems the contents are very dense and the chloroplast is not clearly recognisable. The pyrenoids in these latter cells are smaller and fewer in number (usually 2–4) than in those of the secondary projecting system. All the cells have a single nucleus. The walls are in no way thickened.

In the material it was not unusual to find plants lacking the secondary system, or possessing only the prostrate and rhizoidal systems (Pl. XIII, 5); such plants represent immature stages which have yet to complete their full growth. Very often one or other of the four systems is especially prominently differentiated. The prostrate system varies very much in the extent of its development. In young plants it is generally small, but it gradually increases in size as the plant grows older, well-grown specimens invariably showing a very well-developed prostrate system.

The rounded clusters of cells constituting the prostrate system and composed of small cells with thin walls and dense contents are very peculiar and hitherto quite unknown among Chaetophoraceae. Their exact function is not clearly established. They remind one to some extent of the swollen upper portions of a *Schizomeris* filament before the walls break down and the contents escape as zoospores. It is probable that they serve for the perennation of the alga during the long dry season.

Algae like *Botrydium*, *Protosiphon* and *Fritschiella* growing on the moist earth of drying pools are always in danger of rapid desiccation, and must be able to meet this contingency in some fashion. As long as the soil is moist they grow and increase in size. When conditions of desiccation set in, the contents of *Botrydium* and *Protosiphon* recede into the underground portions of these plants and form cysts which rest unharmed until the next rainy season. The new plants arise from the contents of the cysts either directly or indirectly by the formation of motile spores. In the case of *Botrydium* and *Protosiphon* the protoplasmic contents can readily migrate into the underground portions as a result of the coenocytic structure. But in the case of *Fritschiella* the septate structure of the alga renders such a migration impossible. 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, so that they may be available for an emergency at any stage of its existence. The cells themselves with their dense contents and scanty vacuoles appear well fitted for a resting period without further preparation. No special thickening of the walls has been observed, though the outer wall of each cluster was decidedly thicker than the walls between adjacent cells of the cluster. The thin walls of the individual cells of each cluster will facilitate the escape of motile spores, if such, as seems probable, should be formed in these cells when the rainy season commences.

The clusters of cells show a certain remote resemblance to the appearance obtained during the early stages of palmella formation in certain species of *Stigeoclonium*. But in a terrestrial alga like *Fritschiella* the growth of cells, isolated during palmella formation, will lead to a dense growth of new plants at one place. The rather uniformly distributed, though gregarious, growth of the alga on the bed of the pool and the absence of any dense clusters suggest zoospore formation rather than development from a palmella stage.

Numerous plants were carefully examined for empty cells from which motile spores could have escaped, but no such cells were found either in the prostrate or in the projecting systems. It can hardly be doubted that when the soil dries up the projecting system perishes, so that this system is probably purely assimilatory in function, affording an interesting instance of division of labour among the Chaetophoraceae.

In the absence of knowledge of the motile stages of the alga, it is not easy to decide its systematic position. The general appearance of the uppermost branches (secondary projecting system) and of their cells and to some extent also that of the primary projecting system much resemble *Stigeoclonium*. In the possession of rhizoid-like filaments and the terrestrial habit there is similarity to *Iwanoffia* Pascher[1] (*Stigeoclonium terrestre* Iwanoff). It differs markedly from *Iwanoffia*, *Stigeoclonium* and all the other members of the Chaetophoraceae in its special habit, in the formation of a prostrate system composed of clusters of cells that probably perennate and in the high specialisation of its thallus into rhizoidal, prostrate, primary and secondary projecting systems. The alga may therefore be regarded as

[1] A. Pascher, *Bibl. Bot.* **67**, 63. 1907.

IYENGAR—*FRITSCHIELLA*

the type of a new genus of Chaetophoraceae allied to *Iwanoffia* and *Stigeoclonium* which I shall call:

Fritschiella gen.nov.

Thallus terrestrial, branched above and attached to the soil by means of colourless septate rhizoids, with a number of irregularly rounded clusters of small cells with dense contents and thin walls forming a crowded prostrate system probably serving for purposes of perennation, and a projecting system composed of a lower portion consisting of very short cells and an upper portion consisting of elongate cells, bearing some branches; setae absent; zoospores and gametes not observed.

Fritschiella tuberosa sp.n. (Text-figs. 1 & 2; Pl. XIII).

Characters same as for the genus; cells of the upper branches 6–10μ broad and 3–8 times as long as broad, those of the lower branches 7–11μ broad and 5–10μ long; perennating clusters of the prostrate system about 18–40μ in diameter; rhizoidal filaments 4–8μ broad; plants without the rhizoids about 250–600μ high.

Habitat. On moist silt on the bed of drying rain-water pools at Madras, and Talguppa in Mysore Province, India.

In conclusion the writer wishes to express his indebtedness to Prof. F. E. Fritsch, F.R.S. for his guidance and help in preparing this paper.

EXPLANATION OF PLATE XIII

Fritschiella tuberosa sp.n.

1, 3, 4, 6, plants showing habit; 2, primary and secondary projecting systems; 5, young plant with only prostrate and rhizoidal systems developed, with a branch of the primary projecting system beginning to form; 7, 8, a portion of 4 enlarged; 9, a portion of 6 enlarged. *cl* and *d*, prostrate system; *pr*, primary projecting system; *sec*, secondary projecting system; *r*, rhizoid. 7, 9 ×about 200; 8 ×about 350; the rest ×about 100.

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