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A NEW SPECIES OF *NOSTOCHOPSIS* (*NOSTOCHOPSIS RADIANS* SP.NOV.)

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(With 2 figures in the text)

THE alga forming the subject of this communication was growing on submerged stones in a shallow stream running in a deep shady valley in the Jog Falls region of Mysore State[1]. It forms hemispherical or subspherical blue-green or olive-green strata, very soft to the touch and attached closely to the substratum. From the surface of each growth numerous long threads project freely into the surrounding water (Fig. 1 A); the maximum width of a stratum, together with these threads, is about 1 cm.

The plant body consists of a system of branched filaments which are not embedded in any mucilage. It can be divided roughly into three regions, viz. (*a*) the small compact basal portion which is attached to the substratum and consists of densely arranged, irregularly curved and profusely branched filaments, (*b*) a large middle region in which the filaments are rather loosely arranged, slightly narrower and less branched, and (*c*) the outermost region of long, unbranched, projecting threads which are much narrower, but of uniform thickness throughout and are almost as long as the rest of the plant body, terminating in a rounded apex. In the middle region the filaments are straight or slightly curved and run more or less radially, but there is no sharp line of demarcation between this and the basal region which gradually merges into the middle one.

The filaments in the basal region and in the older parts of the middle region possess a thin hyaline sheath following the contour of

[1] I am indebted to Professor M. A. Sampathkumaran for the material of this alga.

the cells (Figs. 1 C–F, 2 A and B), but the younger filaments of the middle region (Fig. 1 B) and the outermost freely projecting threads (Fig. 1 G) are altogether devoid of a sheath. The sheath is fairly firm since it retains its cylindrical form after parts of the trichomes have perished (Figs. 1 E, 2 A and B).

There is no definite arrangement of the branches in the basal region, but in the middle region, except in rare cases, they all arise on one side of the main filament. All the branches are true. In the development of a branch the middle part of a cell becomes protruded and cut off by a wall, at first pushing out the enveloping sheath. Usually the latter does not rupture until the protuberance has grown to a certain length. The growth of the branches is apical, though some intercalary division takes place as well. The branch may later secrete a new sheath of its own throughout its length (Fig. 2 A), but this is not always the case. The young branches stand almost at right angles to the cells that bear them (Figs. 1 E, 2 C), but as the branches elongate they bend and take up a more or less radial position with respect to the plant body as a whole.

The colour of the trichomes is blue-green. In the compact basal region the cells are up to 8·4 μ in diameter and usually more or less rounded, sometimes barrel-shaped, with deep constrictions at the joints (Fig. 1 C and D). The surface of contact between the cells is often quite narrow, and in many cases the cells appear connected by obvious processes, resembling protoplasmic connections. When it has been possible to obtain a clear view, however, these processes were seen to be bridged by a delicate septum, and it does not appear that true protoplasmic connections exist in this form. The cells contain a few large granules. In the middle region the cells are much elongated and narrower (up to 6·3 μ in diameter), being more or less barrel-shaped in the inner (Figs. 1 E and F, 2 A and B) and cylindrical, with or without constrictions at the joints, in the outer part (Fig. 2 C). The granules in these cells are slightly smaller than those in the cells of the basal region. The cells of the projecting threads are elongate cylindrical without constrictions at the joints and possess fine granular contents. They are 1·5–3·1 μ in diameter (average about 2·1 μ) and 7–50 μ in length. The majority of the projecting threads are healthy throughout, but some show signs of disintegration as evidenced by the possession of an almost rounded vacuole at each end of the cells and a slight constriction at the septa (Fig. 1 G). At these points the cells eventually split apart.

The heterocysts, which are always lateral in position, are formed

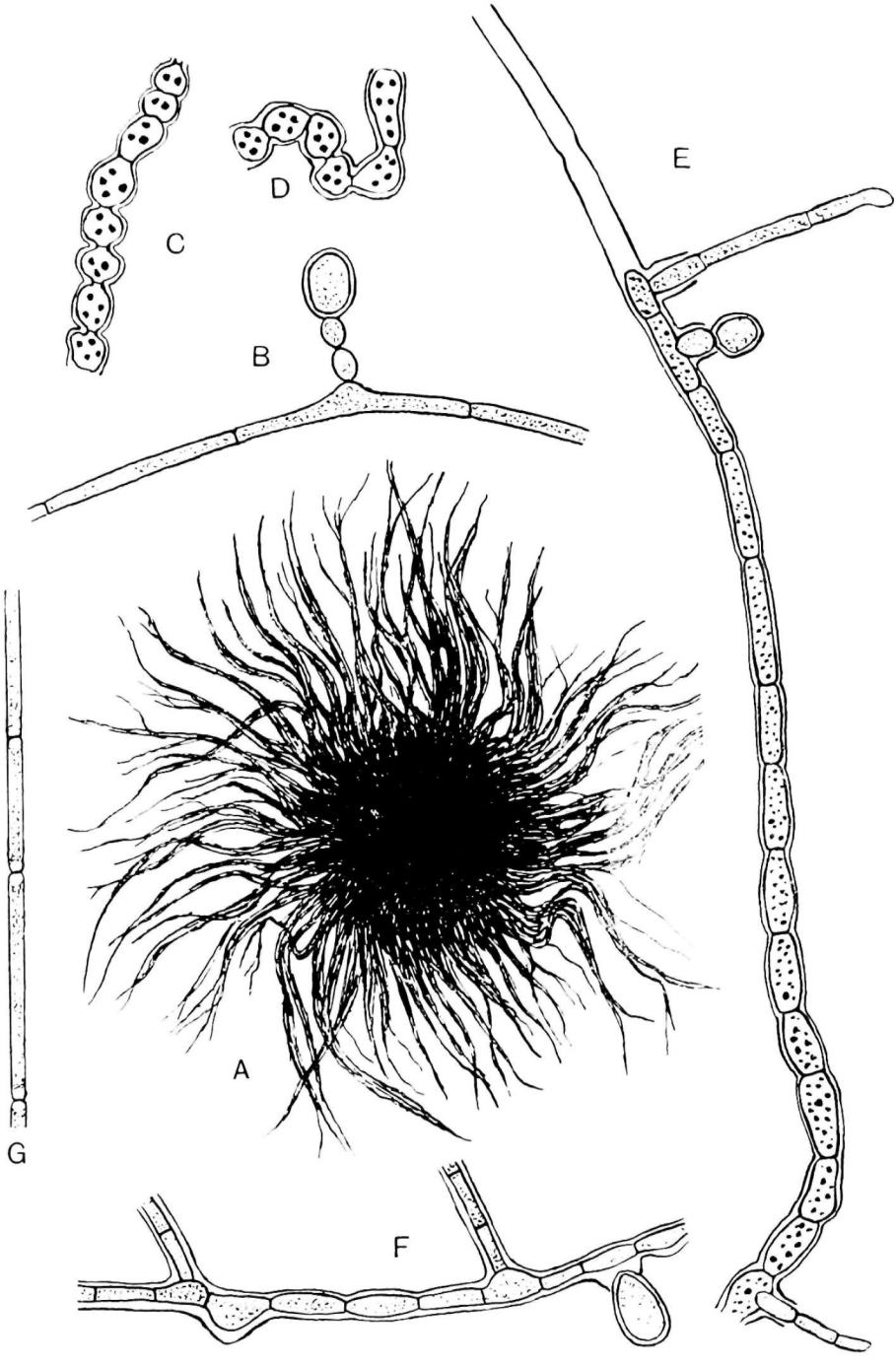

Fig. 1. *Nostochopsis radians* sp.nov. A, stratum showing habit. B, portion of young filament of middle region. C and D, portions of filaments of basal region. E and F, portions of old filaments of middle region. G, portion of projecting thread. (A × 10; B–G × 850.)

only in the basal and middle regions of the stratum, being more numerous in the latter. They are either sessile (Figs. 1 F, 2 F), arising directly from the filaments, or are situated at the end of a one- or two-celled (very rarely three-celled) stalk whose cells are almost spherical (Figs. 1 B and E, 2 B–E). When such heterocysts develop

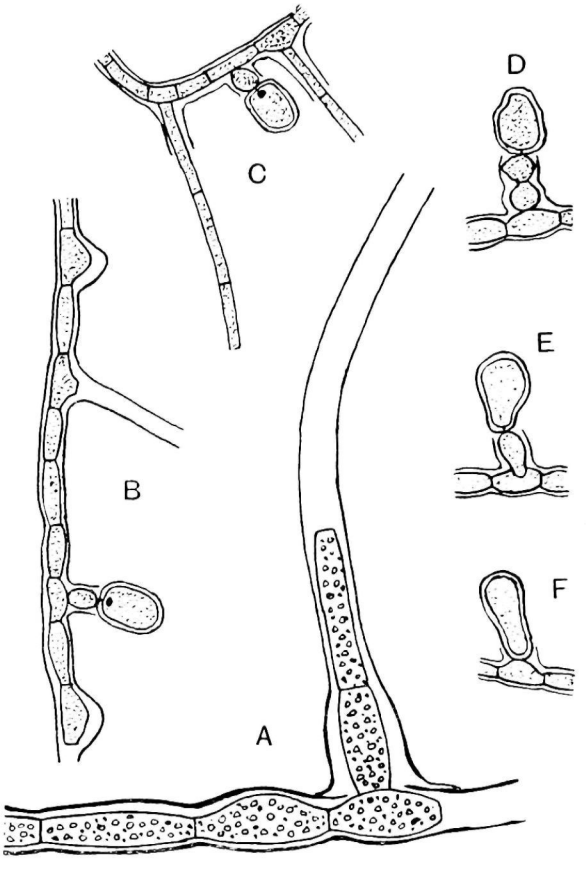

Fig. 2. *Nostochopsis radians* sp.nov. A and B, portions of old filaments of middle region. C, portion of filament from the outer part of middle region. D–F, portions of filaments with lateral heterocysts. (A × 1820; B–F × 850.)

upon a sheathed trichome the sheath of the latter invariably surrounds the stalk cells (Figs. 1 E, 2 B–E), but when the naked trichomes of the middle region bear stalked heterocysts the stalk may or may not be surrounded by a sheath (Fig. 1 B). The latter is secreted around the stalk cells of the heterocysts and the cell of the main filament upon which the heterocyst is borne, and also sometimes around one or two

adjacent cells in either direction. In no case does the sheath envelope the heterocyst. The heterocysts are usually unilateral, being formed on the same side of the filaments as the branches (Figs. 1 E, 2 B and C). They develop in the same way as the latter, usually arising from the middle of the cell that bears them; very occasionally they are placed a little on one side. They are usually ellipsoidal, ovate or obovate in shape and measure 4–9 μ in breadth and 6–15 μ in length. They have yellowish contents, sometimes including refractive granules.

Spores and hormogones have not been observed.

On account of its true branching, its general habit and the presence of lateral heterocysts, the alga above described must be referred to the Nostochopsidaceae of Geitler in which he includes the genera *Mastigocoleus*, *Nostochopsis*, *Myxoderma* and *Mastigocoleopsis*. It has no resemblance with *Mastigocoleus* except in the occasional presence of a thin firm sheath; it differs from *Myxoderma* in habit, in the mode of arrangement of the filaments within the plant body and in the presence of a thin firm sheath. On the other hand it resembles *Nostochopsis* in its attached mode of growth, in the radial arrangement of the filaments, in the form of the cells, and in the presence of both sessile and stalked lateral heterocysts. It does not, however, completely agree with any of the described species of this genus.

It differs from *N. lobatus* Wood in the much smaller solid thallus, in the absence of special unseptate branches ((2), Fig. 358) and in the ends of the ultimate branches never being club-shaped ((2), Fig. 358 and (1), Pl. VII, figs. 3 and 5). It contrasts with *N. Wichmannii* Weber van Bosse in the absence of well-marked zonation in the stratum and of intercalary heterocysts ((2), Figs. 359*b* and 360). From both these species it further differs in the profuse branching of the central region of the plant body and the unbranched character of the peripheral threads ((2), Figs. 357 and 359*b*), as well as in the narrow width of the latter and their greatly elongated cells. Finally it differs from *N. Hansgirgi* Schmidle in the blue-green or olive-green colour, in the absence of the intercalary meristematic zone described by Schmidle ((3), p. 179) and the consequent absence of tapering or club-shaped apices on the ultimate branches, in the lack of intercalary heterocysts and in its aquatic habitat.

This alga further differs from all the described species of *Nostochopsis* in not possessing a *Nostoc*-like habit[1], in the presence of a

[1] An examination of herbarium specimens of *N. lobatus* Wood at the Natural History Museums of London and Vienna and at the Botanical Gardens of Brussels and Geneva shows that the habit of this alga is always exactly like that of a *Nostoc* (cf. (5), p. 126 and (1), Pl. VII, figs. 1 and 2).

distinct firm sheath on some of the filaments[1], and in the unbranched character of the peripheral threads which become almost as long as the rest of the plant body. These differences are well marked and distinctive, but they are scarcely sufficient to warrant the establishment of a new genus. The retention of *Myxoderma*, which differs only in habit from *Nostochopsis*, also appears open to question.

The alga is therefore to be regarded as a new species of *Nostochopsis* to be named *N. radians*.

DIAGNOSIS

Stratum hemispherical or subspherical, not embedded in mucilage but soft to the touch; blue-green or olive-green; consisting of three regions, viz. (*a*) a small compact base attached to the substratum and composed of densely arranged, irregularly curved and profusely branched filaments, (*b*) a large middle region with rather loosely arranged, straight or slightly curved, somewhat narrower and less branched filaments running more or less radially, and (*c*) an outermost region, almost as long as the rest of the plant body, composed of unbranched narrow projecting threads of uniform thickness. Middle and basal regions gradually merging into one another. Filaments in the basal region and in the older parts of the middle region possessing thin, firm and hyaline sheaths.

Branches true, irregularly arranged in the basal region but generally unilateral in the middle region; when young placed perpendicular to the main filament, but later bending to take up a more or less radial position with respect to the plant body as a whole.

Trichomes blue-green. Cells in basal region usually more or less rounded, sometimes barrel-shaped, with deep constrictions at the joints; much elongated and more or less barrel-shaped in the inner and cylindrical with or without constrictions at the joints in the outer part of the middle region. Cells of projecting threads elongate cylindrical with or without constrictions at the joints.

Heterocysts lateral; usually ellipsoidal, ovate or obovate in shape; formed only in the basal and middle regions of the stratum; either

[1] Wood ((5), p. 126), who established *Nostochopsis* and described *N. lobatus*, writes "No sheaths are anywhere visible." The sheath shown by Bornet and Grunow ((1), Pl. VII, fig. 4) in *Mazaea rivularioides* Born. et Grun., which is now regarded as *Nostochopsis lobatus*, does not appear to be of the firm character found in the alga here described. Figures of *N. lobatus* drawn by later workers do not show any sheath. Similarly no sheath is shown by the figures of *N. Wichmannii* drawn by Weber van Bosse ((4) Fig. 9) and Frémy ((2), Fig. 360). Schmidle (3) has described the presence of a sheath in older filaments of *N. Hansgirgi*, but here again it is more or less mucilaginous and not firm.

sessile or situated at the apices of one- or two-celled (very rarely three-celled) stalks; usually arising on the same side of the filaments as the branches.

Maximum thickness of the thallus 1 cm. Diameter of the cells (*a*) in the basal region up to 8·4 μ, (*b*) in the middle region up to 6·3 μ, (*c*) in the projecting threads 1·5–3·1 μ (average about 2·1 μ), length 7–50 μ. Heterocysts, diam. 4–9 μ, long. 6–15 μ.

On stones in a shallow stream in the Jog Falls region of Mysore State, India.

The author wishes, in conclusion, to express his great indebtedness to Professor F. E. Fritsch, F.R.S., for his guidance and criticism.

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