

Spelaepogon Kashyapi, n. sp., a New Member of the Scytonemataceae.

BY

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With two Figures in the Text.

IN a pond near the Benares Hindu University grounds a beautiful blue-green alga makes its appearance as an epiphyte on *Ceratophyllum* about the end of August every year. It is in luxuriant vegetative growth in

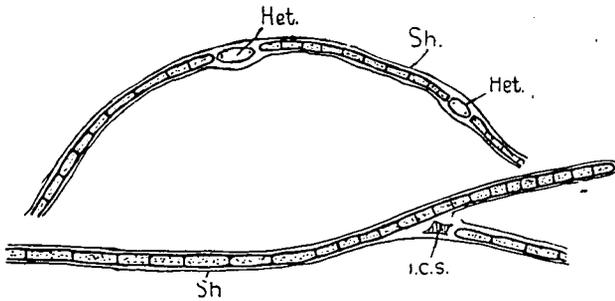
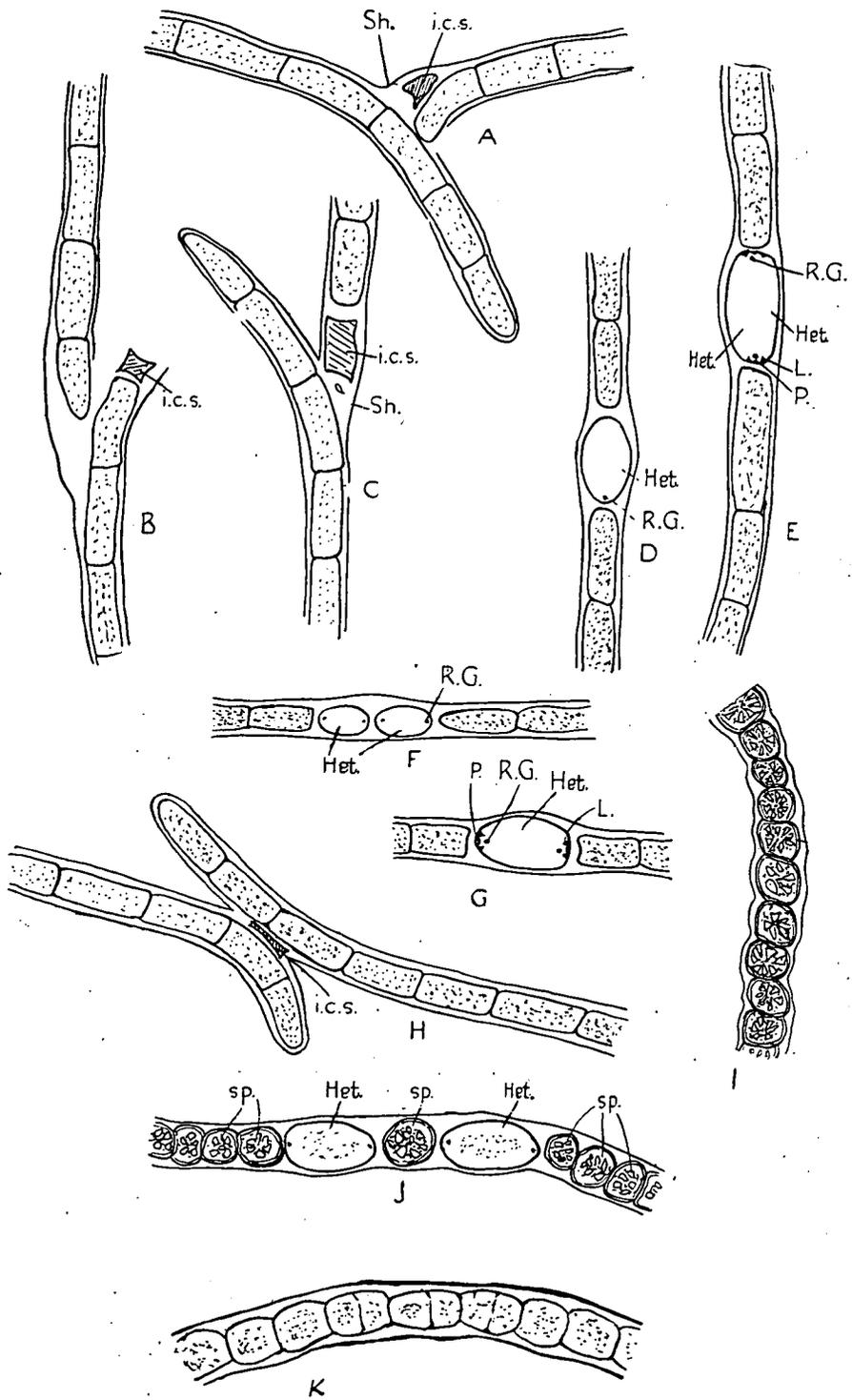


FIG. 1. *Spelaepogon Kashyapi*, n. sp. Two typical filaments. *Het.*, heterocyst; *Sh.*, sheath; *i.c.s.*, intercellular substance. $\times 260$.

September, when it covers up and totally conceals the branches and leaves of *Ceratophyllum*. It appears in small slimy and woolly tufts of a dirty bluish-green colour; arising from a basal tangle, these encircle and twine round the aerial and submerged parts of the substratum. The filaments are delicate and enclosed in a thick lamellose sheath which is quite hyaline. During the early part of October the alga forms spores.

The filaments.

The filaments are free and measure up to 5 or 6 mm. in length. The trichomes are dirty green or bluish-green and slightly constricted at the joints. The cells are two to four times as long as broad ($5-6 \mu$ thick; $7-24 \mu$ long) with coarsely granular contents (Fig. 1), and the dissepiments are generally very distinct. The majority of the filaments are curved, but some are quite straight. Some are simple, others are provided with pseudo-



branches, as in the case of *Plectonema*. The formation of pseudo-branches is initiated by the excretion of biconcave discs of intercellular substance between two adjoining cells. At a level with one of the biconcave discs the mucilage sheath swells up and one portion of the filament grows out into a short pseudo-branch (Fig. 2, A, C). In some cases both portions of the filament grow out in opposite directions to form two pseudo-branches (Fig. 2, H). The intercellular substance is often left within the sheath of the main filament, but in some cases it is carried up on the top of the new branch (Fig. 2, B). All the branches are of the same thickness.

The sheath.

The mucilage sheath is quite hyaline, often lamellose and more or less uniformly thickened, about $2\ \mu$ thick. It is quite firm, since it has been found to retain its cylindrical shape even when a number of cells invested by it have completely died out at the end of a trichome. It contains cellulose, as it gives a slightly blue colour with zinc chloriodide, as has been shown by Lemaire (5) for certain Scytonemataceae.

Heterocysts.

The filament is bulged out wherever there is a heterocyst (Fig. 1). Ordinarily one to four heterocysts are seen at regular intervals along the length of the filament, but it is rare for two heterocysts to lie side by side at one point (Fig. 2, F). The young heterocysts have pale yellow granular contents, but when mature they are devoid of contents and completely hyaline. A bright highly refractive granule, situated opposite one or both of the end-walls, as described in *Anabaena* by Fritsch (1) and in *Campylo-nema Lahorensis* by Ghose (2) (see also West (4)), has been observed in practically all the heterocysts (Fig. 2, D-G). The two lip-like prominences reported to develop internally on each side of the pore by Fritsch (1) have also been observed in a few cases (Fig. 2, E and G). The heterocysts are ellipsoid or ovoid in shape and are 11 to $20\ \mu$ long and 5 to $10\ \mu$ broad.

Multiplication.

Multiplication is mostly effected by means of long hormogones which are generally produced by the secretion of an intercellular substance of dark green colour between two adjoining cells, similar to that formed in connexion with the production of pseudo-branches. This intercellular substance

FIG. 2. *Spelaopogon Kashyapi*, n. sp. A, B, C, and H, four filaments, showing pseudo-branches formed in connexion with biconcave discs of intercellular substance (*i.c.s.*); *Sh.*, sheath; D-G, portions of filaments with heterocysts (*Het.*); E and G, each showing a single heterocyst with a bright refractive granule (*R.G.*) opposite each of the two end-walls, and a lip-like prominence (*L.*) developed internally on each side of the pore (*P.*); in D the heterocyst contains only one refractive granule; F shows a pair of heterocysts; I, part of a chain of spores with granular contents; J, filament showing a chain of spores (*sp.*) interrupted by two heterocysts (*Het.*), K, filament showing division of cells before the formation of spores. $\times 490$.

either takes the form of a biconcave disc (Fig. 2, B, *i.c.s.*) or a thick rectangular pad with concave ends (Fig. 2, C, *i.c.s.*). Hormogones are also formed by the dying of occasional vegetative cells. The hormogones are fragments of the ordinary trichomes, consisting of many cells, and grow into mature filaments by repeated division of their cells.

At times the whole of a filament forms spores, which occur in long chains, in rare cases interrupted by heterocysts (Fig. 2, I, J). There are no biconcave discs between the spores, such as are described by Borzi in *Tolypothrix Wartmannia* ('Nuov. Giorn. Bot. Ital.', xi, 1879). The spores have a thick smooth outer and a thin inner membrane, and are about 5 to 7 μ broad and 3 to 7 μ long. They are more or less spherical in shape, but are sometimes so closely packed that the adjacent walls are flattened as a result of pressure from both sides. The sheath is sometimes slightly constricted between the spores (Fig. 2, I). The contents of the spores appear divided up into irregular fragments and also include a few small granules (Fig. 2, I). Prior to the formation of spores the vegetative cells divide repeatedly (Fig. 2, K), the products enlarging and rounding off whilst the wall becomes thickened. Meanwhile the granular appearance of the cytoplasm disappears and the contents of the spore divide up into numerous fragments arranged more or less in a radial manner. The ejection and germination of the spores has so far not been observed.

Systematic.

This alga is evidently a member of the Scytonemataceae. It cannot be referred to *Plectonema* on account of the presence of heterocysts, although it resembles species of this genus in the general characters of its pseudo-branches. It differs from *Tolypothrix* in the absence of heterocysts at the points of ramification. From *Campylonema* it differs in the absence of the characteristic crescentic shape of the filaments and of the geminate pseudo-branches which have been described by Ghose (2) in *Campylonema Lahorensis*. It contrasts with *Scytonema* in the fact that the branches are single, except in very rare cases when two pseudo-branches arise from the same place but grow in opposite directions (Fig. 2, H), but the typical geminate branching of *Scytonema* is totally absent. It also differs from Borzi's *Seguenzaea* (see Geitler (6), p. 252) in having filaments of one kind only, which are not united to form thick bundles, and in the absence of paired pseudo-branches and gonidia.

The alga, however, resembles Borzi's *Spelaeopogon* (see Geitler (6), p. 250), especially in the formation of pseudo-branches not related to the heterocysts. It stands nearest to *Spelaeopogon Cavarae*, Borzi, in (i) the dirty bluish-green colour of the thallus, (ii) the presence of few intercalary heterocysts, (iii) the thick lamellose sheaths, and (iv) the formation of resting spores in chains. At the same time it differs from this species in (a) the

presence of biconcave discs of intercellular substance, (b) the narrower dimensions and the cells being two to four times as long as broad and not isodiametric and rounded, and (c) the production of hormogones instead of hormocysts. Another difference lies in the aquatic habitat, whilst the three species of *Spelaeopogon* described by Borzi are all terrestrial. But this point is not of any great importance, as *Tolyptothrix* also includes both aquatic and terrestrial species. Again, the absence of hormocysts (i. e. short hormogones completely enclosed in a thick-walled and stratified sheath) does not give sufficient ground for its separation as a distinct genus.

The alga above described may thus be regarded as a new species of *Spelaeopogon*.

Spelaeopogon Kashyapi,¹ sp. nov.

Thallus forming small, slimy, woolly tufts of a dirty bluish-green colour; sheath conspicuous, hyaline, thick, and firm, often lamellose; filaments straight or slightly curved, 5-6 mm. in length, bulged out opposite the heterocysts; trichomes 5-6 μ in diameter, slightly constricted at the joints, simple but generally with pseudo-branches; the latter given off singly in connexion with biconcave discs of intercellular substance; cells 2-4 times as long as broad, transverse walls distinct; heterocysts few, at considerable intervals throughout the whole length of the filament, ellipsoid or ovoid, 11-20 μ long and 5-10 μ broad; hormogones long, enclosed by the parent sheath; spores in chains, rarely interrupted by heterocysts, about 5-7 μ broad and 3-7 μ long, with thick smooth episporium, contents divided up into fragments which are radially arranged.

Habitat. Benares, India, in one of the ponds near the Hindu University, on branches and leaves of *Ceratophyllum*; August to October.

In conclusion, it is a pleasure to thank Professor F. E. Fritsch for his valuable suggestions and criticism and for kindly revising the manuscript. I am also indebted to Dr. S. L. Ghose, of the University of Rangoon, for his generous help during the preparation of this paper and for kindly lending me some material of *Campylonema Lahoreense*. My thanks are also due to Professor Shiv Ram Kashyap for the interest which he took in the work, and to the authorities of the Benares Hindu University for the facilities provided for research.

¹ Named after my esteemed teacher Rai Sahib Professor Shiv Ram Kashyap, of the University of the Panjab.

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