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Observations on some new and interesting Algae from Northern India.

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(With 6 figures in the text.)

During his studies of the freshwater algae of Northern India, the author came across a number of new and interesting species. Nearly all the algae which form the subject matter of this paper were collected from Fyzabad District, which lies in the north-east of the United Provinces of Agra and Oudh, between the parallels 26°9′ and 26°50′ north latitude and 81°41′ east longitude. This district is about 300 feets above the sea-level, and has an average annual rainfall of 42 inches, most of which falls in the months of July, August and September.

Most of the forms described in this paper were collected from fields lying fallow during and after the rains, lawns and flower-beds, slowly flowing freshwater streams, and small lakes, known as jhils locally. Some of the species like *Microspora indica* spec. nov., *Cylindrocapsa oedogonioides* Randhawa, *C. scytonemoides* spec. nov. belong to genera which have drawn scant attention from the algologists of this country, and are very rare with the exception of the first mentioned species. So far *Oedogonium* has been regarded as a freshwater genus, but with the description and discovery of *O. terrestris* spec. nov., we have enlarged our concept of this genus so far habitat is concerned.

1. Microspora indica spec. nov.

(Fig. I.)

Vegetative cells 22—27 μ broad and 28—42 μ long. Cell wall conspicuously lamellated, 3—5 μ thick and composed of H-shaped overlapping halves. Two to three celled H-shaped pieces commonly freefloating in water. Chloroplast parietal with dense-cushion-like outgrowths at sides with starch-granules and other food-materials obscuring its structure. No pyrenoids were seen (Fig. I, 1 and 2). Akinetes produced in great abundance. Formed by conversion of ordinary vegetative cells into thick-walled

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bodies which are loaded with starch and stain deep purple with iodine. The protoplasm secretes a reticulum similar to that seen in the zygospores of some species of *Spirogyra* (Fig. I, 3). Akinetes squarish in outline when found insitu in filaments, but globose in outline when liberated by the decay of the outer lamella Fig. I, 4. Whole filaments may be converted into chains of akinetes. Liberated

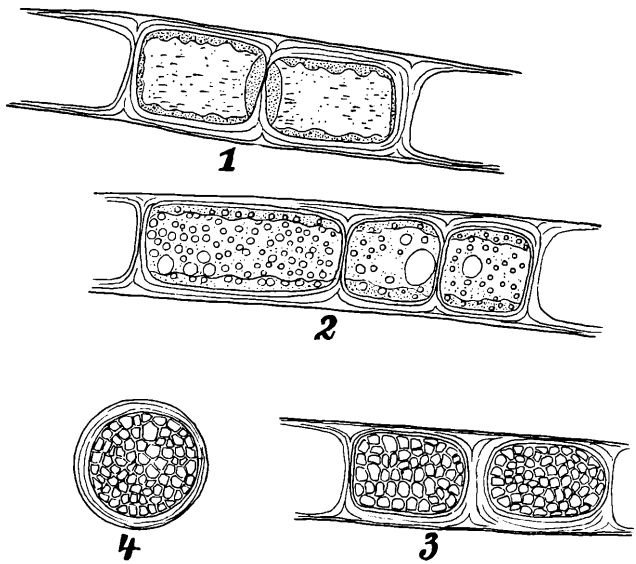

Fig. I. *Microspora indica* spec. nov.

1. Fragment of a filament showing H-shaped and lamellated cell-wall. — 2. A part of a filament showing the structure of chloroplasts. — 3. Shows two akinetes. — 4. A liberated akinete (All × 407).

akinetes which assume a globose spore-like shape are 28—32 μ in diameter, while when found in filaments of the same dimensions as the vegetative cells.

India: Free-floating in light green flocculent mosses in a lake near Milkipur, District Fyzabad, U. P. in November, 1937, and in Tarital Jhil near Gonda in December 1937.

The alga resembles *Microspora amoena* (Kütz.) Rabenhorst in the size of its vegetative cells, but it differs from it in the thicker stratification of its cell walls, and the structure of its peculiar akinetes. When preserved in formalin, the new alga becomes reddish-yellow in colour.

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2. Cylindrocapsa oedogonioides Randhawa.

(Fig. II.)

Vegetative cells are 18—20 μ broad, 12—28 μ long, squarish, rectangular or subrectangular in shape, enclosed in a hyaline lamellose sheath. There is a single massive parietal chloroplast with a single pyrenoid in each cell, and not two as originally described. Oogonia develop from ordinary vegetative cells, by increase in the size of the protoplasmic contents (Fig. II, 1). Oogonia are 44—56 μ broad, 60—70 μ long. Oospores are 26—28 μ in diameter, are enclosed in a thick mucilaginous sheath, and lie loose in the inflated oogonia. An oospore was also seen divided

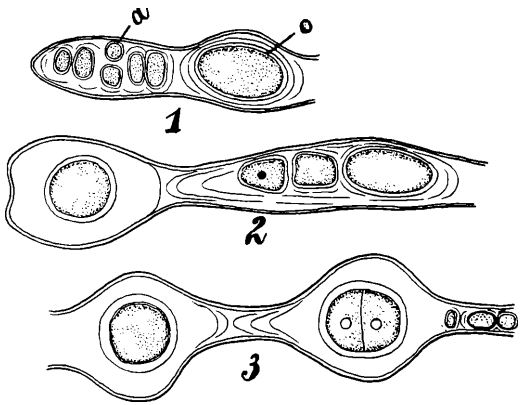

Fig. II. *Cylindrocapsa oedogonioides* Randhawa. 1. A part of a filament showing antheridia (*a*) and an immature oogonium (*o*). — 2. A ripe oospore in an oogonium. — 3. Shows an oospore divided into two cells (All × 407).

into two cells (Fig. II, 2 and 3). Antheridia develop by the division of vegetative cells.

India: Originally collected from a tank at Dasuya, Punjab, in March and April, 1930 and 1931. Subsequently collected from Gonda and Fyzabad districts in the United Provinces from January to March in 1937 and 1938.

3. Cylindrocapsa scytonemoides spec. nov.

(Fig. III.)

Vegetative cells subrectangular to triangular in outline, 24—30 μ broad and 9—26 μ long. Each cell surrounded by a lamellated covering of cellulose 3—4 layers thick glistening white in appearance (Fig. III, 1). In more mature filaments cells irregular in outline. Cells usually loaded with starch, which obscures the

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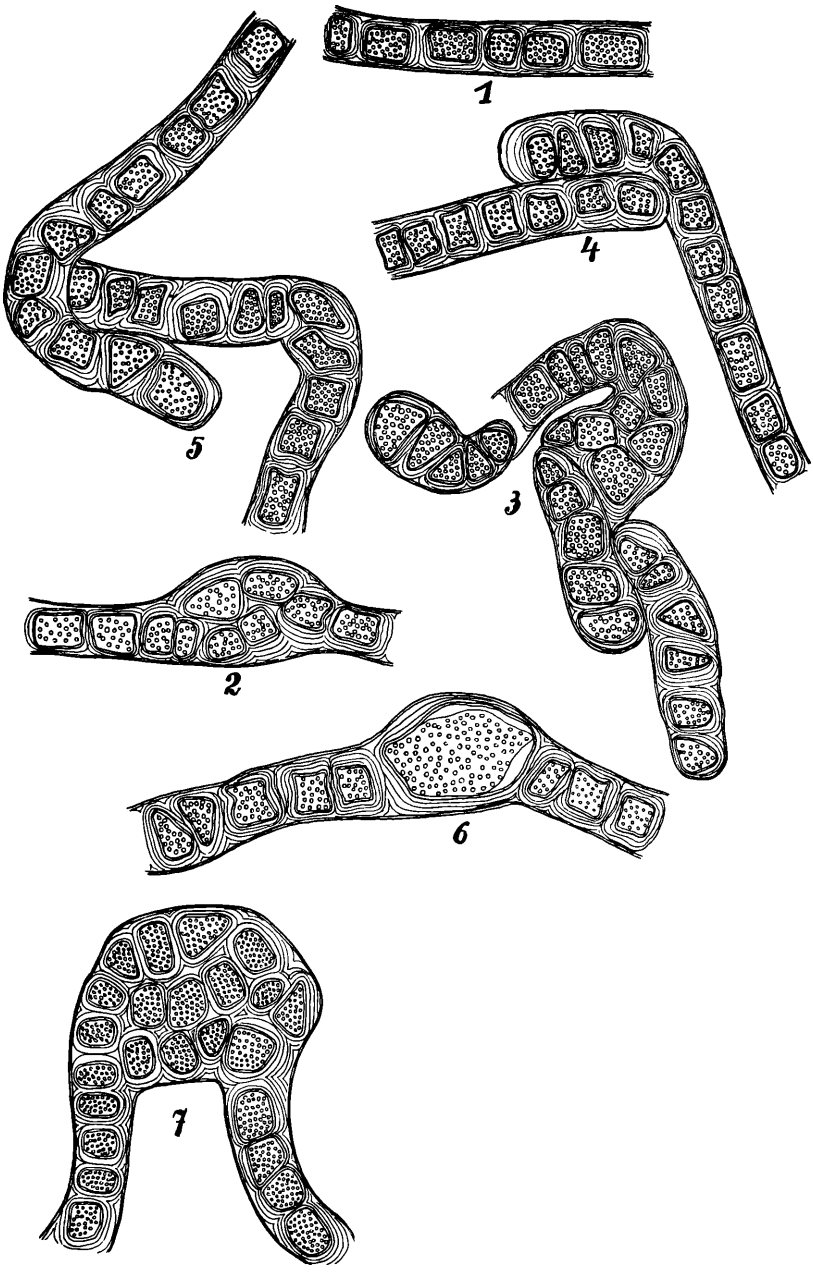

Fig. III. *Cylindrocapsa scytonemoides* spec. nov.
1. A normal vegetative filament. — 2, 3, 4 and 5. Show different stages in vegetative reproduction. — 6. Shows a part of a filament, with an inflated cell which may be an oogonium. — 7. A part of a filament showing a triseriate arrangement of cells (All × 310).

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structure of the chloroplast which is a massive body completely filling the cell. Vegetative Reproduction: At some points cells divide laterally, filaments becoming biseriate and swollen at such places (Fig. III, 2). The outermost sheath covering the filament bursts, and by repeated cell division, the upper two cells produces 4—6 celled filaments with blunt apices resembling the hormogones of *Myxophyceae*. These hormogone-like filaments often found glued together giving the alga an appearance of a pseudo-branching *Scytonema* or *Tolypothrix* (Fig. III, 3, 4 and 5). However in some cases no such hormogone-like bodies may be formed, and no breaking of the outer wall taking place, though the filaments becoming three-layered (Fig. III, 7). Such cell divisions were commonly found at those parts of filaments which were deeply encrusted with soil particles. Sexual Reproduction. Structures which may possibly be oogonia were seen in some filaments. It was seen that some of the cells become enormously swollen in size, in one case being 54 μ broad and 70 μ long (Fig. III, 6). These cells which seem to serve the function of oogonia, also become loaded with starch, and stain deep blue with iodine. Antheridia not observed.

India: Found entangled in the branches of dried twigs in a slowly-flowing drainage channel near village Mumrezpur, tehsil Tanda, District Fyzabad, U. P., on 12th October, 1937, in the form of dark green tassels.

This alga differs from all the known species of *Cylindrocapsa* in the peculiar manner of its vegetative reproduction, and from *C. involuta* Reinsch, which it resembles in size, in shape and structure of its cells.

4. **Botrydium tuberosum** Iyengar.

(Fig. IV.)

This alga was originally collected and described by Iyengar from the drying sides of rain water pools in Madras in 1923. It was collected by the present author on 25th August, 1937 from some fields lying fallow near Fyzabad. U. P. It was found growing mixed with *Botrydium divisum* Iyengar in irregular sheets many square yards in area, parts of which were deep green to yellowish green in colour.

Cyst-formation. The subaerial part was found empty in most cases, is globose to conical in appearance, and 110—150 μ in diameter. Most of the rhizoids were dichotomously branched and

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contained ripe cysts in their terminal swollen parts. In most cases the subaerial part was found missing while the subterranean part of the alga looks like a potato plant bearing numerous tubers. The ripe cysts are globose to oval in shape, have densely granular contents,

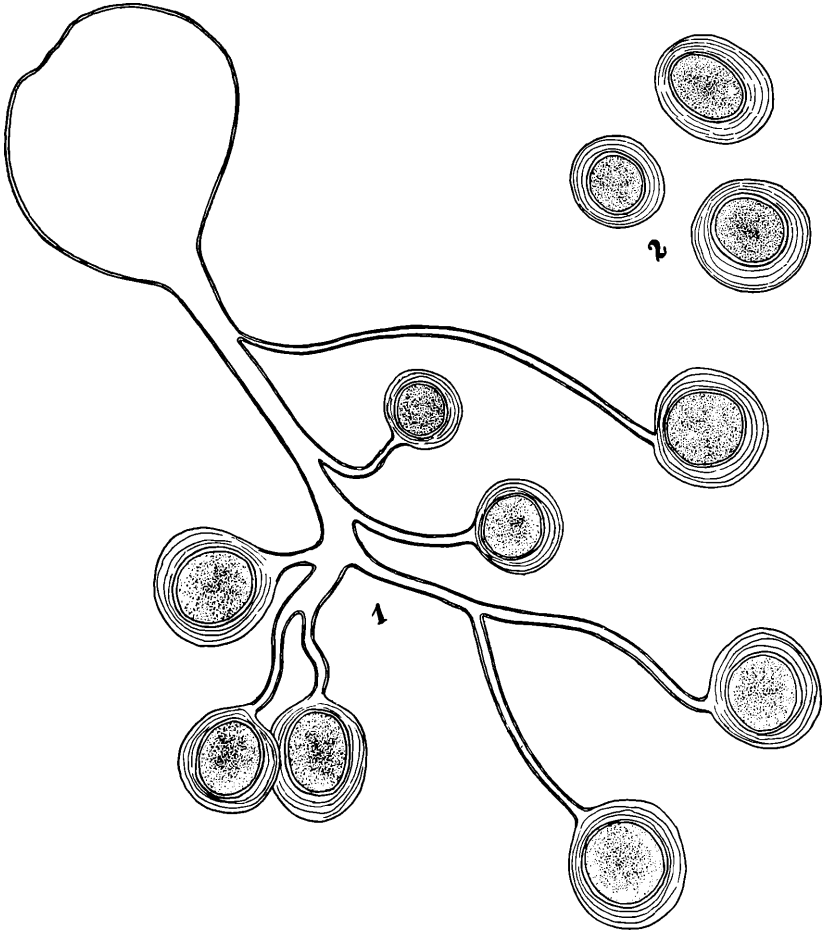

Fig. IV. *Botrydium tuberosum* Iyengar.

1. A complete plant with tuber-like cysts. — 2. Shows detached cysts found in soil (× 310).

and are 36—62 μ in diameter. The rhizoidal walls form the outermost covering of the cysts, while enveloping the cysts is a translucent 4—6 layered covering which may be 8—13 μ in thickness (Fig. IV, 1). Iyengar who probably described only immature specimens, does not figure any such cysts with a lamellated covering. The ripe cysts

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which are oval to globose in shape break off from the fragile rhizoids and may be seen lying loose in the soil in the form of spore-like bodies (Fig. IV, 2).

India: Found growing mixed with *B. divisum* Iyengar in drying fields lying fallow during August, 1937 in Fyzabad, U. P.

5. **Botrydium divisum** Iyengar.

(Fig. V.)

This interesting species of *Botrydium* was found mixed with *B. tuberosum* in a field lying fallow near Fyzabad in August 1937 during monsoon rains. This alga was originally described by Iyengar from Calcutta.

The subaerial part of the thallus is elongated, and is usually dichotomously divided, but in some cases may be even trilobed. The upper part is 140—250 μ broad, and is dark green in colour. The lower part of the alga is hyaline and is prolonged into an unbranched rhizoid.

Iyengar did not observe any cyst-formation in the specimens described by him. He observed as follows in the original description of this species, ,,I searched for possible cysts, but could not find any. The absence may be due to the fact that the soil was still quite moist at the time when I collected the specimens."

The material described here was collected from a drying field, and as was expected cyst formation was seen in some specimens. Unlike the other species of *Botrydium* such as *B. tuberosum* and *B. granulatum* no migration of protoplasm takes place into the subterranean rhizoidal part. The whole protoplasm divides into a number of squarish cysts 9—15 μ in diameter. The cysts in the lower part of the thallus which was covered with soil particles were already thick-walled, those in the middle part had only very thin walls, while those in the upper part were barely differentiated (Fig. V). There is no doubt that the cysts ultimately become rounded in shape, for their squarish outline is due to mutual compression. Cysts observed were immature and hence green in colour, the process of cyst-formation in this alga resembles that of *Protosiphon botryoides* Klebs in which form also the subaerial globose part is usually seen full of rounded red cysts.

India: Mixed with *Botrydium tuberosum* in a drying field near Fyzabad in August, 1938.

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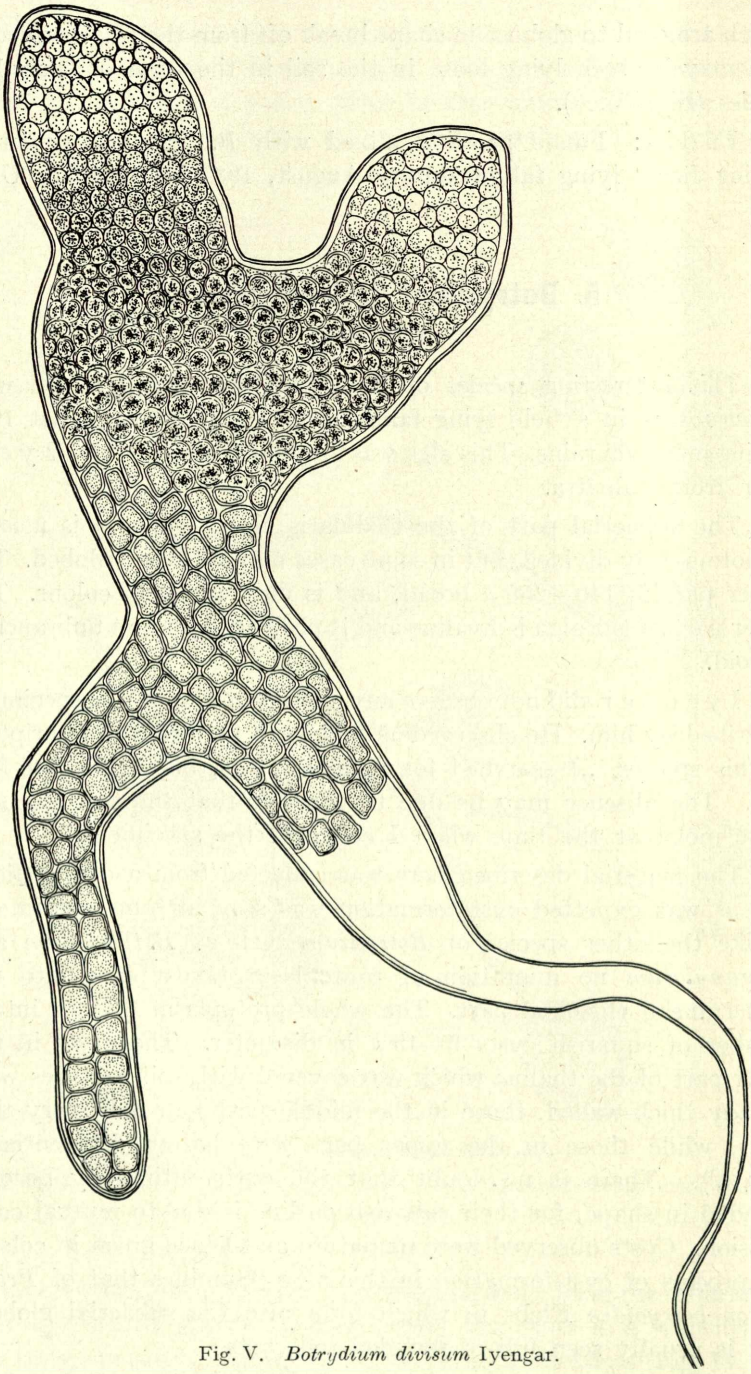

Fig. V. *Botrydium divisum* Iyengar.

A plant with comparatively mature cysts in lower part and immature cysts in middle and upper part (× 310).

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6. Oedogonium terrestris spec. nov.

(Fig. VI.)

So far no terrestrial species of genus *Oedogonium* has been described from any part of the world and as contrasted with genus *Oedocladium* some of whose species are terrestrial, *Oedogonium* is supposed to be a purely terrestrial genus. The author came across a terrestrial species of *Oedogonium* in the first week of August, 1938 which is described here. It was collected growing on sandy soil in thick felt-like sheets, dark green to orange yellow in colour, near the building of the police station at Tanda, district Fyzabad, India. Subsequently this alga was collected in the months of August, September and October growing in lawns and compounds of bungalows at Fyzabad. It is a typically monsoon alga, appearing in early rains and disappearing at the close of rains in October. Ripe spores were found throughout these months as a few sunny days are enough to ripen the spores.

The filaments are unbranched and there is no gelatinization of walls. These characters preclude any relationship of this alga with *Oedocladium*. Vegetative cells in the subaerial part are 14—17 μ broad and 24—32 μ long while in the subterranean part, these are much thinner and are greatly elongated being 6—8 μ broad, and 26—70 μ long. No specialized rhizoids were seen, and on the contrary the subterranean elongated cells which are mostly hyaline or contain very much attenuated chloroplasts serve the function of rhizoids (Fig. V, 2).

This species is monoecious macrandrous. Oogonia are 30—42 μ in diameter, and are operculate. Oospores which are dark chocolate brown in colour are 26—32 μ in diameter, and do not completely fill the oogonia. Ospores are globose, and spore-wall is smooth. Antheridia are 4—6 in number, are 11—14 μ broad and 6—10 μ long are found both below and over the oogonia, and each contains a single sperm (Fig. V, 1, 2 and 3).

This species differs from all the known species of *Oedogonium* in its terrestrial habitat. The nearest related species is *Oedogonium crispum* (Hass.) Wittr. var. *hawaiense* Nordstedt which it resembles in its monoecious nature and other characters, but from which it differs in its broader oogonia, and its peculiar habitat.

Following is in brief a diagnosis of this species:

Oedogonium terrestris spec. nov. — Vegetative cells 6—8 $\mu \times$ 26—70 μ in subterranean part, and 14—17 $\mu \times$ 24—30 μ in subaerial part. Monoecious, macrandrous, oogonium single,

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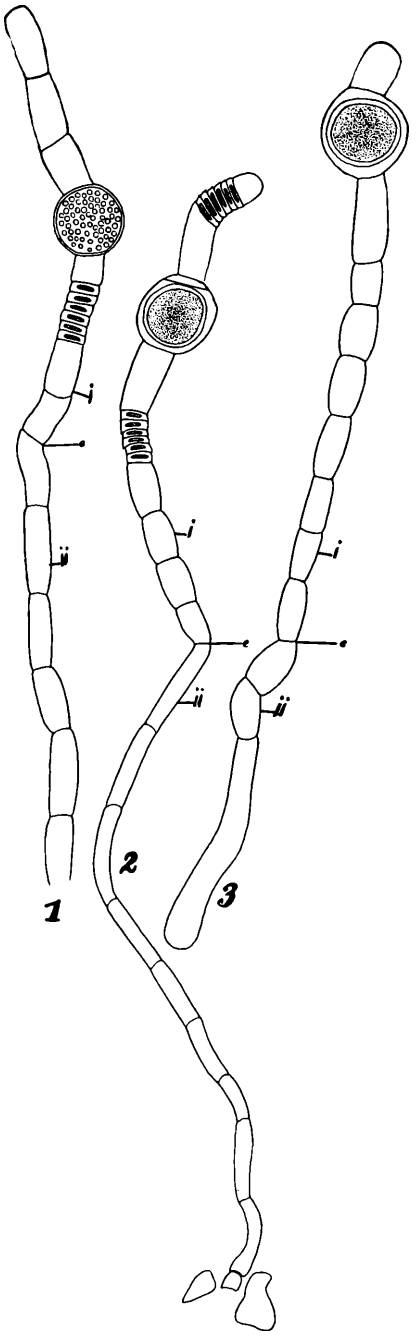

Fig. VI.

Oedogonium terrestris spec. nov.

1. A filament showing an oogonium and antheridia.

2 and 3 show ripe oospores. Line marked "e" shows the level of earth, part marked is subaerial and part marked is subterranean (All × 310).

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intercalary, globose, operculate, division superior, oospore globose, not filling the oogonium, spore-wall smooth; antheridium 4—6 epigynous or hypogynous, sperms single, basal cell elongate. Oogonium 30—42 μ, oospore 26—32 μ, antheridium 11—14 $\mu \times$ 6—10 μ.

India: Growing on sandy soil of lawns, gardens and compounds of houses at Tanda and Fyzabad, U. P., from August to October, 1938.

Conclusion.

The author is grateful to Dr. L. H. Tiffany for his kindness in examining the samples of *Oedogonium terrestris* and communicating his valuable suggestions.

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