

Indian Chytrids. II. *Olpidium indicum* sp. nov. *)

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(24 text-figures).

In 1963 while participating as a mycologist in the UNESCO-sponsored International Indian Ocean Expedition the author isolated numerous chytrids from soil, pools and lakes in various parts of India. Some of the monocentric eucarpic species were described in an earlier paper (Karling, 1964 a). In addition to these, a large *Olpidium* species was found which parasitized the thalli and sporangia of *Phlyctorhiza variabilis* and the sporangia of *Rhizophlyctis fuscis* Karling (1964 b). These hosts had been isolated from soil at the edge of a slightly brackish pool at Mandapam Camp, Rhamnad District, and grown on bleached corn leaves in tap water whose salt content varied from 0.3 to 1.0 per cent. Under such conditions they became so abundantly parasitized by the *Olpidium* species that after two weeks it was difficult to find any thalli which were not attacked. Subsequently, it was found in isolates of the same hosts from soil in dry rice paddies 10 and 51 kilometers south of Madurai along the Rhamnad Road where the soil is non-brackish.

The sporangia of the parasite vary markedly in size and shape, depending to some degree on the number present in a host cell, but when they occur singly in a large sporangium of *Rhizophlyctis fuscis* they may fill it and attain a diameter of 150 μ , the largest size reported so far for any species of *Olpidium*. Such large sporangia of the parasite may develop exit tubes which vary from 8 to 12 μ in diameter and 28 to 48 μ in length. The hyaline to light amber resting spores develop by the contraction of the thallus content (fig. 14—16) and its investment by a fairly thick wall. As a result, the spores occupy only a portion of the thallus in which they develop and are usually enveloped by a thin hyaline membrane as in *Olpidium allocytos* Karling (1948) and other species. No evidence of fusion of

*) This study was supported by the U. S. Program in Biology, International Indian Ocean Expedition and conducted at the Central Marine Fisheries Research Institute, Mandapam Camp. I am very grateful to Dr. S. Jones, Director of the Institute for research facilities and assistance and to Dr. Eric Silas for collecting numerous soil samples near the southern tip of India.

gametes prior to resting spore development, such as Sahitya nce (1962) found in *Pleotrachelus*, has been observed so far. Occasional biflagellate zoospores (fig. 2) may occur, but these appear to be the result of unequal cleavage instead of fused gametes.

Although the Indian species of *Olpidium* occurred so abundantly in the hosts mentioned above, it appears to have a limited host range. Other aquatic fungi such as, *Catenaria anguillulae*, *Nowakowskiella elegans*, *N. ramosa*, *Karlingia rosea* and *Pythium* spp. were abundant in the parasitized cultures of *P. variabilis* and *Rhizophlyctis fuscis*, but none of these were attacked during the course of this study. Subsequent attempts to infect these and other aquatic fungi with *O. indianum* in the laboratory at Purdue University were unsuccessful. However, the sporangia and resting spores of *Allomyces arbuscula* and the resting sporangia of *Physoderma pluriannulata* on *Kundmannia sicula* became densely infected when these fungi were added to a parasitized culture of *P. variabilis*. In these additional hosts also, a single to several parasites occurred in the host cells, and the exit canals were usually quite long and contorted.

***Olpidium indicum* sp. nov.**

Fungus parasiticus, sporangiis hyalinis, laevibus, sphaericis, 30–150 μ , ovalibus, 22–40 \times 38–60 μ , oblongatis, 20–30 \times 40–52 μ , hemisphaericis aut angularibus; tubulum exeuntibus 5–12 \times 8–48 μ . Zoosporis sphaericis, 3–4 μ singulis globulis refringentibus instructis; flagello 18–22 μ longo. Sporis perdurantibus laevibus, sphaericis, 12–28 μ , ovalibus, 8–12 \times 15–20 μ , granulis globulis refractivis numerosis dense instructis; zoosporis germinatione ortis.

Sporangia 1 to 18 in a host cell and filling it partly or completely, hyaline, smooth, spherical, 30–150 μ , ovoid, 22–40 \times 38–60 μ , oblong, 20–30 \times 40–52 μ , hemispherical to polyhedral when 2 and a large number, respectively, fill a host cell. Exit tubes usually solitary, rarely 2 per sporangium, 5–12 μ in diameter by 8–48 μ in length, penetrating and cracking the host wall locally. Zoospores numerous, spherical, 3–4 μ , with a hyaline, brilliantly refractive globule and an 18–22 μ long flagellum; remaining spherical throughout motile period. Resting spores, 1 to 25 in a host cell, spherical, 12–18 μ , ovoid, 8–12 \times 15–20 μ , with a hyaline to light amber, smooth wall, 1–8 to 3.2 μ thick, and containing 1 to several large refractive globules; formed by contraction of thallus content and lying in a hyaline vesicle; forming zoospores directly in germination and discharging them through a broad exit tube.

Parasitic in the thalli and sporangia of *Phlyctothiza variabilis* and *Rhizophlyctis fuscis*, Rhamnad District, Madras State. Type spec. slide, PU, no. 103.

The life cycle and development of *O. indicum* are basically

similar to those of other known species of the genus, and it is not essential that they be described in detail. They are illustrated fully in figures 1 to 21, and the descriptive legends of the figures are sufficient for an understanding of the developmental stages.

Rhizophlyctis fuscis is a species whose sporangia develop an unusually thick, up to 8 μ , reddish-brown wall, but the exit tube of *O. indicum* readily cracks this wall locally and penetrates to the outside as shown in fig. 13. Likewise, the relatively thick-walled sporangia of polycentric strains of *Phylectorhiza variabilis* Karling (1951) and resting sporangia of *Allomyces arbuscula* and *Physoderma pluriannulata* are penetrated in the same manner.

So far only two members of the family *Olpidiaceae* has been reported from India as far as I am aware. Thirumalachar (1942) reported *Olpidium uredinis* as a parasite of the uredospores of *Hemileia canthii*, and Lacy reported *Olpidium entophyllum* in *Spirogyra* from Patna in 1955. However, during the course of this study several members of this family were found in India in addition to *O. indicum*. These include the following species:

Olpidium gregarium (Nowakowski) Schroeter, 1885. Cohn, Krypt. — Fl. Schlesiens 3 (1): 182.

Chytridium gregarium Nowakowski, 1876, Cohn, Beitr. Biol. Pflanz. 2: 77.

Parasitic in rotifer eggs. This species occurs commonly as a parasite of rotifer eggs, and this is the first report of its occurrence in India so far as I know. It was found frequently in rotifer eggs in the cultures which contained *O. indianum* from Mandapman Camp.

Olpidium entophyllum (Braun) Rabenhorst, 1868. Flora Europ. Algarum 3: 283.

Chytridium entophyllum Braun, 1856. Monatsber. Berlin Akad. 1856: 589.

Parasitic in *Spirogyra* sp. This species occurred in a large species of *Spirogyra* which was collected in a freshwater lake about 4 kilometers west of Uchippuli in the Rhamnad district.

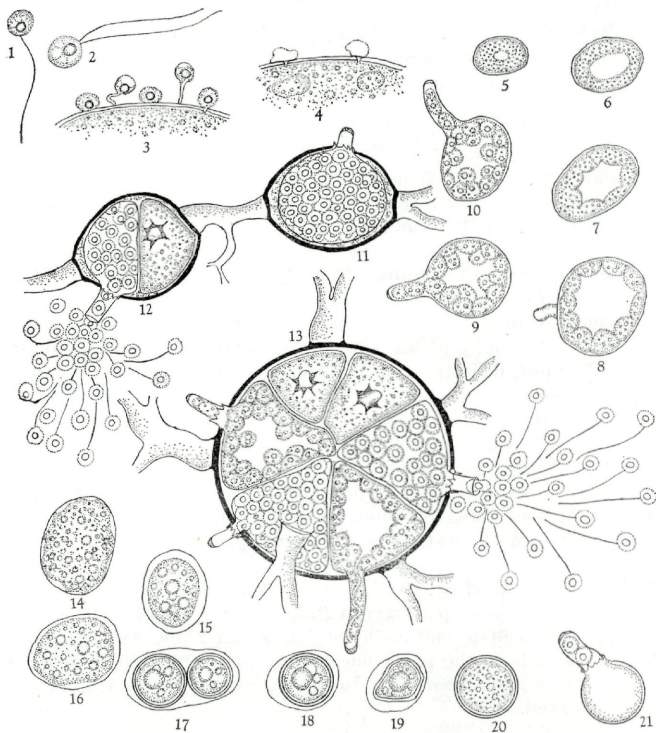
Olpidium allomycetos Karling, 1948. Amer. J. Bot. **35**: 503—510, fig. 1—32.

Parasitic in *Allomyces arbuscula* which was isolated from dry soil along the Rhamnad Road near Valantaravai, Rhamnad District, Madras State.

Rozella allomycis Foust, 1937. J. Elisha Mitchell Sci. Soc. **53**: 198, pls. 22, 23.

Parasitic in *Allomyces arbuscula*. This host was isolated on hemp seed from soil in a slightly brackish pond 8 kilometers north of Man-

dapam Camp along the Rhamnad Road, and within a few days it became so heavily parasitized that nearly all of thalli were killed. The zoosporangial phase of the parasite occasionally caused septation of the hyphae and incipient zoosporangia of the host, as described by Foust, but only rarely did it induce slight cell enlargement. The re-



Figs. 1—21. *Olpidium indicum*. Fig. 1. Normale Zoospore, Fig. 2. Abnormal biflagellate zoospore. Fig. 3. Multiple infection of host cell, Fig. 4. Young parasites in host protoplasm. Figs. 5—7. Development of thallus. Figs. 7—10. Stages in cleavage and zoosporogenesis. Fig. 11. Ovoid sporangium in thick-walled sporangium of *Phlyctorhiza variabilis*. Fig. 12. Two almost hemispherical sporangia in same host. Fig. 13. Median view of large sporangium of *Rhizophlyctis fuscis* with six polyhedral sporangia of *O. indicum* in various stages of development and dehiscence. Figs. 14—16. Stages in contraction of thallus content to form resting spores. Fig. 17. Thallus with 2 resting spores. Figs. 18—20. Mature resting spores. Fig. 21. Germination of resting spore.

sting spore phase, on the other hand, caused considerable cell enlargement, particularly when several spores were present in a cell. In some sporangia and hyphal cells of the host as many as 12 resting spores were present.

Rozella cladochytrii Karling, 1941, Torreyia 41: 105; 1942 a, Amer. J. Bot. **29**: 25, figs. 1—24.

Parasitic in *Nowakowskiella ramosa* and *N. elegans*, isolated on bleached corn leaves from a freshwater lake approximately 4 kilometers west of Uchippuli, Rhamnad District.

Rozella rhizophlyctii Karling, 1942, Amer. J. Bot. **29**: 32, figs 37—47.

Parasitic in the sporangia of *Karlingia rosea* which was isolated on bleached corn leaves from soil at the edge of a brackish ditch on Mandapam Camp, Rhamnad District.

Rozella laevis Karling, 1942, Mycologia **34**: 201; 1944, Mycologia 36: 638, figs. 1—19.

Parasitic in the sporangia and hyphae of *Pythium* sp. causing marked hypertrophy of the host cells, Mandapam Camp, Madras State, Jodhpur, Rajasthan State, Calcutta, Bengal State and Munnar, Kerala State.

One of the hosts of this parasite was isolated on corn leaves from brackish soil in a dry ditch and cultured in brackish tap water at Mandapam Camp. Apparently, the resting spores of the parasite were present in the brackish soil with the zoospores of the host. Subsequently, it was found in numerous non-brackish soil collections as noted above, and appears to be a common parasite in India.

Rozella sp. Karling, 1947, Amer. J. Bot. 34: 31, figs. 44—48.

Parasitic in the sporangia of *Phlyctorhiza variabilis*, Mandapam Camp, Madras State and Jodhpur, Rajasthan State. Apparently, the Indian parasite is the same one which the author (1947) found in America because it conforms closely with it. So far no resting have been observed.

Summary.

Olpidium indianum sp. nov. is a virulent parasite of *Phlyctorhiza variabilis* Karling and *Rhizophlyctis fuscis* which occur in the brackish soil at Mandapam Camp, Madras State, and non-brackish soil in other parts of India. It is characterized by unusually large sporangia with long or short exit tubes, minute spherical zoospores which contain a hyaline, brilliantly refractive globule, and resting spores which are formed by the contraction of the thallus content and its

investment by a relatively thick, hyaline wall. These spores function as sporangia in germination. Other members of the family Olpidiaceae found in India include *Olpidium gregarium* (Nowakowski) Schroeter, *O. entophyllum* (Braun) Rabenhorst, *O. allomyces* Karling, *Rozella allomyces* Foust, *R. cladochytrii* Karling, *R. rhizophlyctii* Karling and *R. laevis* Karling which parasitized, respectively, rotifer eggs, *Spirogyra* sp., *Allomyces arbuscula*, *Nowakowskiella ramosa* and *N. elegans*, *Karlingia rosea* and *Pythium* spp.

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Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Sydowia](#)

Jahr/Year: 1964

Band/Volume: [17](#)

Autor(en)/Author(s): Karling John S.

Artikel/Article: [Indian Chytrids. II. Olpidium indicum sp.nov. 302-307](#)