Synchytrium Brownii, a new species with sexual reproduction.

By John S. Karling.

In 1945 Cook reported the occurence of *Synchytrium fulgens* on *Oenothera laciniata* at Baton Rouge, La., and in 1953 and 1954 the author collected the same fungus in the same locality where it is very abundant in the spring of the year. However, a careful study of these collections of living material as well as of Cook's fixed and stained preparations has shown that this species is not *S. fulgens*. Its initial thallus or cell functions as a prosorus and gives rise to a sorus of sporangia. In this respect it differs markedly from *S. fulgens* and belongs in a different subgenus. In view of this and the fact that it is the only other long-cycled species known to occur on members of the *Onagraceae* which has distinctive characteristics, it is regarded as a new species and named *S. brownii* *).

Synchytrium brownii sp. nov.

Prosoris ovalibus, 65—108 ⇌ 79—138 μ, subsphaericis vel sphaericis; 82—132 μ; parietibus 2.8—3.6 μ crassis, hyalinis. Soris ovalibus, 72—84 ⇌ 78—108 μ, subsphaericis, 67—106 μ; parietibus 2.4—3 μ crassis, hyalinis. Sporangiis numerosis, polyedricis, 32—78 μ; parietibus levibus, hyalinis, intus citrino-flavis. Zoosporis oblongis, ovalibus vel sphaericis, 3.8—4.3 μ, flagello 12.7—14 μ longo. Sporis perdurantibus ovalibus, 33—50 ⇌ 61—82 μ, subsphaericis, 42—70 μ; parietibus 3.6—4.2 μ crassis, fuscis.

Prosori up to 5 in a cell when young, usually solitary when mature, occasionally 2 to 3 in a cell, oval, 65—108 ⇌ 79—138 μ, subspherical to spherical, 82—132 μ, with a 2.8—3.6 μ thick, hyaline wall. Sori predominantly oval, 72—84 ⇌ 78—108 μ, subspherical, 67—106 μ, with a 2.4—3 μ thick, hyaline wall. Sporangia numerous, predominantly polyhedral, 32—78 μ in greatest diam., with a thin hyaline wall, and yellowish-orange, finely granular content. Zoospores oblong to oval or spherical, 3.8—4.2 μ diam., with one large and usually a second smaller, yellowish-orange refractive globule; whip-lash flagellum 12.7—14 μ long. Resting spores usually solitary,

*) This study has been supported by a grant-in-aid from the National Science Foundation.

Synchytrium brownii is named after Dr. Clair A. Brown, Department of Botany, Louisiana State University, in appreciation of his enthusiastic help in collecting species of *Synchytrium*.

occasionally up to 4 in a cell, oval, 33—50 ⇌ 61—82 μ, subspherical, 42—70 μ, with a 3.6—4.2 μ thick, brown wall and coarsely granular content; usually enveloped by a 2—6 μ thick layer of residue; functioning as a prosorus in germination.

Sporangial and resting spore galls not usually raised and conspicuous as distinct entities, abundant on both surface of leaves, petioles and stems, usually aggregated and confluent, composite and multicellular, often compound, usually embedded in host tissue. Sporangial galls yellowish-orange, occasionally raised slightly above surface of leaf, 110—120 μ high by 132—145 μ broad; embedded galls, 120—180 ⇌ 200—300 μ diam. Resting spore galls greyish- to reddish-brown, 84—90 ⇌ 102—130 μ.

On leaves, petioles, stems, flowers and fruits of *Oenothera laciniata,* Louisiana, Texas, and Virginia and *O. biennis,* Indiana.

The above dimensions of the galls, sori and sporangia are considerably larger than those given by Cook (1945 A), and careful measurements of these structures in his slides indicates that his measurements are incorrect. It is surprising that he overlooked the prosori because they are quite conspicuous in his slides, and his (1945 B) fig. 3 D shows an empty collapsed prosorus in the base of the infected cell. When mature living sorangial galls are dissected carefully the prosorus comes out readily as an empty oval, subspherical or spherical vesicle attached to the sorus of sporangia. The walls of the prosorus and sorus give a positive cellulose reaction when tested with chloroiodide of zinc.

Particularly significant in this species is the occasional fusion of isomorphic gametes. To date such fusions have been observed only on two occasions, and it is not known what conditions are essential to fusion. It is quite possible that the gametes are facultative as in *S. fulgens,* and unless they fuse they infect the host as zoospores. The sexual phase of *S. brownii* is being investigated and will be described in another publication.

The symptoms produced on the host plant and the general macroscopic appearance of *S. brownii* are very similar to those of *S. fulgens.* Also, as its galls dehisce the sporangia may be dispersed on the surface of the host around the galls as in *S. fulgens.* From these standpoints it is not surprising that Cook mistook *S. brownii* for *S. fulgens.* These striking similarities as well as the wide distribution of *S. brownii* and its ability to infect several different hosts under greenhouse conditions have raised the question in the author's mind of the possibility that *S. fulgens* also develops a prosorus. In that event the two species are identical. However, Kusano's intensive studies on *S. fulgens* appear to have been carefully made, and in the author's opinion if a prosorus is present he would have seen it.

Also, his textfig. 19 shows the initial thallus as developing directly into a sorus of sporangia. Nevertheless, the author believes that the question of the presence or absence of a prosorus in *S. fulgens* as well as in a larger number of other species needs further investigation because he has found it to occur in a great many species of *Synchytrium*. Because of the wide distribution of *S. brownii* and its similarity to *S. fulgens* it is quite likely that some of the collections labeled *S. fulgens* on *Oenothera biennis* in herbaria in the U.S.A. may relate to *S. brownii*. Obviously, all of these collections must be restudied to solve this question, and it is apparent that collectors are no longer justified in labeling every *Synchytrium* member which they find on *Oenothera* species as *S. fulgens*.

Cross inoculation experiments with *S. brownii* in progress at Purdue University indicate that it may infect a number of *Oenothera* species and varieties. Also, evidence is being found of the existence of biological races of this species in various parts of the U.S.A. This problem is under intensive investigation by one of my graduate students, and the results will be presented in another publication.

So far only a few germinating resting spores have been found and these were from the Indiana collection on *O. biennis*. However, as noted above they functioned as a prosorus in the process, giving rise to a superficial sorus of sporangia. Thus the life cycle of *S. brownii* is identical to that of *S. (Micromyces) zygogonii, S. (Micromyces) longispinosus* and *S. (Micromyces) laevis* and this species is accordingly, classified in the subgenus *Microsynchytrium*. The latter three aquatic parasites of algae were removed from the genus *Micromyces* and incorporated by the author (1953) in a new subgenus, *Microsynchytrium,* of *Synchytrium* because of the similarity of their life cycles to those of *Synchytrium* species. The establishment of this subgenus appears to be amply justified by the discovery of *S. brownii* and its complete cycle of development. *Synchytrium brownii* is the first terrestrial species to be assigned to this subgenus, but others will probably be found to belong here when they are fully known.

In connection with Cook's failure to recognize *S. brownii* as a distinct and separate species from *S. fulgens* it may be noted that he overlooked also the presence of a prosorus in the life cycles in his *S. chiltonii* on *Stellaria media* and *S. cerastii* on *Cerastium viscosum*. *Synchytrium chiltonii* has been collected by the author on *Stellaria media* at Baton Rouge, La., College Station, Texas, Richmond, Va. and Washington, D. C. A cytological study of its life cycle has shown that it develops a prosorus in the apex of the infected cell like *S. stellariae* and is otherwise similar to it. Therefore, the author believes that Cook's *S. chiltonii* is the same as *S. stellariae* which Fuckel

described in 1869 and should be listed as a synonym of the latter species. In inoculation experiments the author has been successful in infecting a few plants of *Cerastium vulgatum* with *S. stellariae* (*S. chiltonii*) from Baton Rouge. *Arenaria serpyllifolia* and *Cerastium viscosum*, however, were not infected. Cook's *Synchytrium cerastii* on *C. viscosum* develops a prosorus as in *S. stellariae* but it appears to be a different species or possibly a variety or race of the latter. It will infect seedlings of *Cerastium vulgatum* but not those of *Stellaria media*.

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