

Two additional species of *Dactylella* parasitic on *Pythium* oospores.

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With Plates IX—XI.

In earlier papers (Drechsler, 1938, 1943, 1952) five hyphomycetes, including a fungus identified as *Trinacrium tenuis* Riess (Fresenius, 1852) and four allied species I described under the binomials *Dactylella spermatophaga*, *D. helminthodes*, *Trichothecium arrhenopum*, and *T. polycetum*, were set forth as being habitually parasitic on *Pythium* oospores. That more than a few other fungi of like parasitic character occur widely in the United States has become evident from further observations on relatively old maize-meal-agar plate cultures prepared for the isolation of root-rotting phycomycetes, as well as from continued inspection of aging plate cultures, which, after being occupied by *Pythium* mycelium, had been inoculated with small quantities of slowly decaying plant material. Unfortunately the mucedinaeous oospore parasites very often will not form conidia or other reproductive parts. Sterile development would seem much more prevalent among them than among the clampless nematode-capturing hyphomycetes to which they appear rather closely related. Two kinds of triseptate conidia, however, have come to light in sufficient quantity to permit recognition of 2 oospore-destroying fungi as new members of the genus *Dactylella*.

1. *Dactylella anisomeres* spec. nov.

Hyphae steriles filiformes, ramosae, incoloratae vel interdum leviter fumidae, plerumque 1—3.5 μ crassae, hic illic appressoria vulgo 4—6 μ crassa ad oosporas Pythii stricte apponentes, uno vel duobis tubulis circa 1 μ latis murum perforantes, partem interiorum cellulis valde globuliferis globosis vel multangulis 2—7 μ latis crebre complentes; hyphae fertiles erectae, incoloratae, primo simplices et continuatae, mox 1—4-septatae, saepius 45—85 μ altae, basi 2—4 μ crassae, apice plerumque 1.1—1.5 μ crassae, ibi unum conidium ferentes, postea cadentes denique saepe aliam hypham fertilem proferentes; conidia incolorata, cylindracea vel interdum elongato-fusoida, apice rotundata, basi aliquid attenuata, plerumque 20—43 μ longa, 3.5—4.5 μ lata, 1—5-septata, vulgo 3-septata, infima cellula et summa cellula sporae triseptatae inter se vulgo pariles sed untraque saepissime longior quam paenultima vel antepaenultima cellula.

Oosporas specierum Pythii (interdum etiam protozoa testacea) interficiens habitat in materiis plantarum putrescentibus in Colorado et Florida et Wisconsin. Typus: Tabula VIII, A—J, M, N.

Sterile hyphae filamentous, branched, colorless or sometimes of a slightly smoky tinge, mostly 1 to 3.5 μ wide, here and there in close contact with *Pythium* oogonia and oospores forming appressoria mostly 4 to 6 μ wide, then extending through oogonial and oospore walls 1 or 2 tubes about 1 μ wide, and filling the oospore chamber with subspherical or polygonal globuliferous assimilative cells mostly 2 to 7 μ wide; conidiophores erect, colorless, at first unbranched and continuous, later divided by 1 to 4 cross-walls, usually 45—85 μ high, 2 to 4 μ wide at the base, 1.1 to 1.5 μ wide at the tip, bearing terminally a single conidium, then after toppling over often giving rise to another conidiophore and thus initiating development of several conidiophores one after another; conidia colorless, cylindrical or sometimes elongated spindle-shaped, rounded at the tip, often tapering somewhat toward the base, mostly 20 to 43 μ long and 3.5 to 4.5 μ in greatest width, divided by 1 to 5 cross-walls but most often divided by 3 cross-walls in such wise that the basal and apical cells are of nearly equal dimensions and noticeably exceed in length either of the 2 median cells.

Dactylella anisomeres developed most abundantly in some maize-meal-agar plate cultures which after being overgrown with *Pythium butleri* Subr. had been further planted with small quantities of leaf mold collected in July 1958 in woods near Fort Collins, Colorado, at an elevation of approximately 2000 meters. Owing presumably to the digestive activity of some contaminating microorganisms nearly all the oogonial envelopes of *P. butleri* had vanished when the cultures were 80 days old, leaving the oospores exposed directly to attack. The appressoria by which attack was initiated bore some resemblance to antheridia, though they were smaller and less conspicuously modified than the antheridium-like appressoria of *D. arrhenopum*. Often only a single appressorium became fastened on an individual oospore and only a single infection tube was extended through the thick oospore wall (Pl. IX, A, a, b; B), but occasionally 2 appressoria became affixed in positions close together, each of them intruding a separate infection tube (Pl. IX, C). Now and then 2 infection tubes were extended through the oospore wall from a single haustorium (P. IX, D). The ensuing invasion of the protoplasmic interior, as a rule, was markedly thorough, for in most instances the chamber of the oospore became compactly crowded with globuliferous assimilative cells. The haustorial mass presented often a scalloped outline (Pl. IX, B, C) as its peripheral cells bulged outward into the zone left largely unoccupied after gradual digestion of a thick inner layer of the oospore wall.

Thus amply nourished through destruction of oospores the Colorado fungus gave rise from some of its procumbent hyphae (Pl. IX,

E—G: a; H, a, b; I, a) to scattered erect conidiophores (Pl. IX, E—G: b), each bearing terminally a single conidium (Pl. IX, E, c), which, as a rule, soon fell off. After the denuded conidiophores had toppled onto the moist substratum (Pl. IX, H, c; I, b) they often resumed development in the manner familiar among related nematode-capturing fungi by putting forth new conidiophores sometimes from subapical (Pl. IX, H, d) but more commoly from basal (Pl. IX, I, c, d) positions.

The conidia of the Colorado fungus (Pl. IX, E, c; J, a—x) recalled those of the widely distributed nematode-strangling *Dactylaria brochopaga* Drechsler (1937) owing to their usual unequal division by 3 cross-walls into 2 rather short median segments and 2 longer end segments (Pl. IX, E, c; J, a, c, d, f—x). The dimensional inequality, which suggested for the fungus an epithet compounded of 2 words (*ἄνισος*, *μέρος*) meaning “unequal” and “part”, respectively, was in some instances rather slight (Pl. IX, J, w, x) and in other instances where each end segment exceeded in length the 2 median segments combined (Pl. IX, J, c, i), was conspicuous. Some few detached conidia contained only 2 cross-walls (Pl. IX, J, b) while others contained as many as five (Pl. IX, J, e). On moist agar substratum detached conidia readily anastomosed either with a hypha (Pl. IX, M) or with another conidium (Pl. IX, N).

Owing to close resemblance with respect to conidial morphology (Pl. IX, K, a—e) *Dactylella anisomeres* was readily recognized in a fungus found destroying oospores of *Pythium debaryanum* Hesse in several maize-meal-agar plate cultures to which had been added, 3 months earlier, small quantities of decaying plant detritus taken from a roadside near Lake Alfred, Florida, on April 16, 1959. General agreement in manner of attack and in conidial morphology (Pl. IX, L, a—c) gave ample reason for recognizing the species also in a fungus observed destroying large numbers of oospores of *P. debaryanum* in a plate culture that had been planted 80 days earlier with a small quantity of leaf mold gathered in woods near Park Falls, Wisconsin, late in November 1957. Apart from its parasitism on oospores, *D. anisomeres* in all cultures was destructive on a small scale to various rhizopods. Animals of the testaceous genus *Euglypha* were most often attacked. In a culture prepared with leaf mold from Colorado robust individuals also of a *Pelomyxa* were invaded and expropriated of their substance.

2. *Dactylella stenocrepis* spec. nov.

Hyphae steriles filiformes, ramosae, incoloratae, parce vel modice septatae, plerumque 0.8—2.2 μ crassae, hic illic appressoria aliquid clavata et 1.5—3 μ lata ad oogonia et oosporas *Pythii* apponentes,

membranam oogonii et murum oosporae anguste perforantes, haustorium intus evolventes; haustorium ramosum, ex parte in tumentis 3—5.5 μ latis consistens; hyphae fertiles erectae, incoloratae, saepius 55—90 μ altae, basi vulgo 2—3 μ latae, apice 1.7—2 μ latae, primo simplices et continuae, mox 1—4-septatae, unum conidium ferentes, postea cadentes et saepe aliam hypham fertilem proferentes; conidia incolorata, fusiformia vel siliquiformia, recta vel leviter curvata, apice rotundata, ad basin saepius aliquid attenuata, plerumque 29—46 μ longa, 4.6—7.8 μ lata, interdum 1- vel 2-septata sed vulgo 3 septis in 4 cellulas divisa.

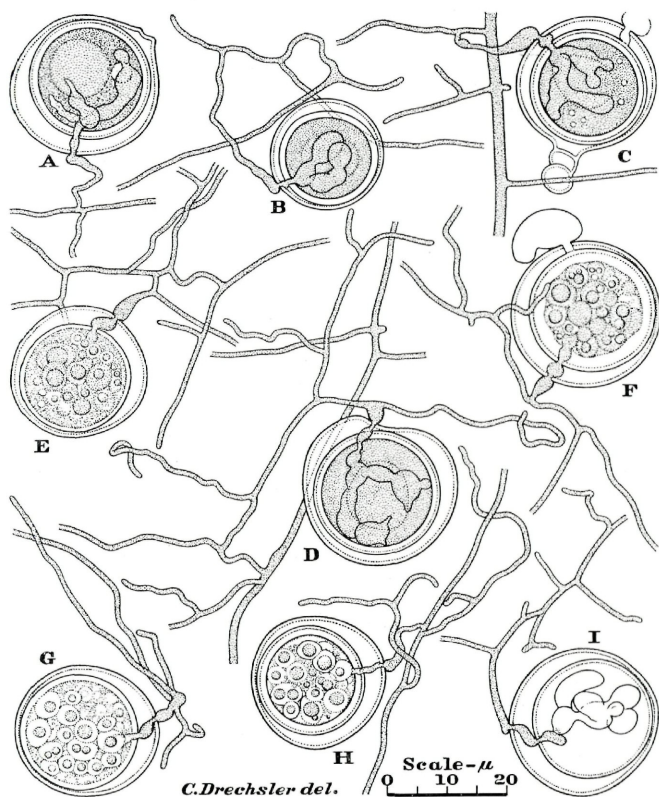
Oosporas specierum *Pythii* interficiens habitat in materiis plantarum putrescentibus prope Saint Petersburg, Florida. Typus: Tabulae IX et X.

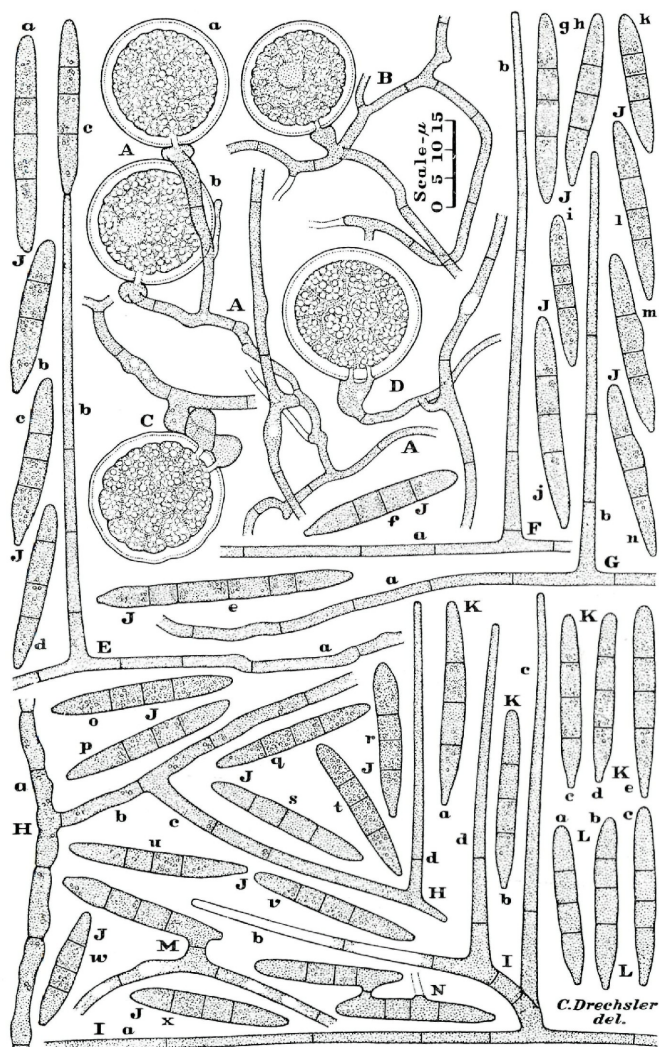
Sterile hyphae filamentous, branched, colorless, sparingly or moderately septate, mostly 0.8 to 2.2 μ wide, producing in contact with oogonia or oospores of various *Pythium* species somewhat clavate appressoria mostly 1.5 to 3 μ wide, from each of which a narrow infection tube is extended through oogonial envelope and oospore wall to invade the interior by forming a branched haustorium with lobulate swellings 3 to 5.5 μ wide; conidiophores erect, colorless, mostly 55 to 90 μ high, commonly 2 to 3 μ wide at the base, 1.7 to 2 μ wide at the tip, at first continuous and unbranched, later becoming 1- to 4-septate, bearing terminally a single conidium, after toppling over often giving rise to a new conidiophore, thereby in many instances initiating development of several conidiophores one after another; conidia colorless, spindle-shaped or pod-shaped, rounded at the tip, often prolonged somewhat narrowly at the base, straight or slightly curved, mostly 29 to 46 μ long, 4.6 to 7.8 μ in greatest width, sometimes uniseptate or biseptate but at maturity usually divided by 3 cross-walls into 4 cells not markedly differing in length.

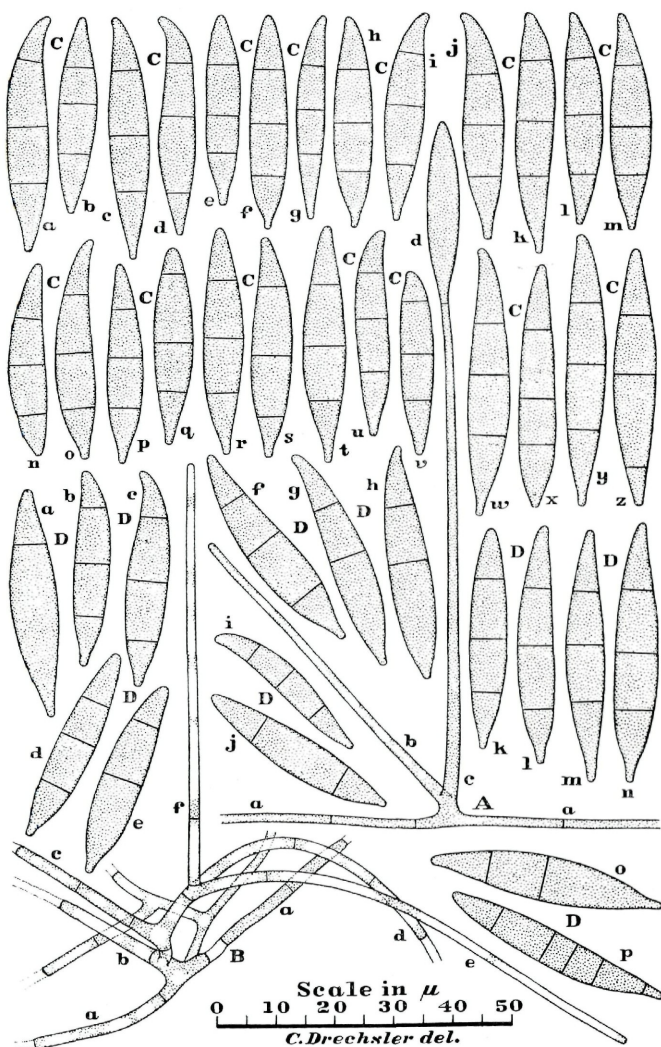
Dactylella stenocrepis was observed in several maize-meal-agar plate cultures which after overgrown by *Pythium butleri* had been planted with small quantities of decaying plant detritus gathered in 2 locations on a roadside close to Tampa Bay on April 15, 1959. When the cultures were 2 months old the fungus had extended its mycelium through the agar substratum and was continually active in the destruction of dormant oospores. Its mycelium consisted mainly of submerged hyphae, about 0.9 μ wide, which followed rather irregular courses with frequent haphazard changes in direction. In these slender filaments, much as in the similarly delicate exploratory filaments of *Trichothecium arrhenopum*, the presence of septa could not be determined, except for some retaining walls at the boundaries between living and empty portions of hyphae. Wherever one of the slender filaments encountered an oogonium or oospore it underwent noticeable distention in forming an appressorium of the type found in *Dactylella spermatophaga*. From the

tip of each appressorium a protrusion, approximately $0.6\ \mu$ in diameter, grew through the oogonial envelope and then widened slightly (Pl. X, A, B) or somewhat pronouncedly (Pl. X, C—G) before pushing through the oospore wall as a delicate infection tube. On reaching the interior the infection tube widened and extended 2 or 3 lobate assimilative branches into the parietal layer of protoplasm (Pl. X, A, B). As the branches elongated in forming rounded subsidiary lobes (Pl. X, C) and somewhat tapering protrusions (Pl. X, D) the parietal layer gradually lost its granular character. The boundary of the reserve globule became irregular and indistinct while the refringent body faded from sight. After the internal organization characteristic of the dormant oospores had been wholly obliterated the lobes of the haustorium in many instances appeared confusingly intermixed with disorganized host contents (Pl. X, E—H). In later stages when all digestible host materials, including a thick inner layer of the oospore wall, had been assimilated, the empty membrane of the haustorium could often be distinguished within the nearly empty chamber of the spore (Pl. X, I).

The procumbent hyphae (Pl. XI, A, a; B, a) from which arise the conidiophores (Pl. XI, A, b; B, b) of *Dactylella stenocrepis* commonly measure 1.5 to $2.2\ \mu$ in diameter and are thus noticeably coarser than the very slender filaments most active in destroying oospores. In this species, as in many congeneric fungi, a conidiophore that has fulfilled its function soon topples and then often gives rise, mostly from a proximal position, to a new conidiophore (Pl. XI, A, c), which like its parent bears a single conidium (Pl. XI, A, c). Through repetition of such development a series of conidiophores often are produced one after another (Pl. XI, B, c—f), the later ones arising amid a disorderly array of their fallen predecessors. It is of some taxonomic moment that sporulation takes place aloft on well developed erect conidiophores, since the conidia (Pl. XI, C, a—z; D, a—p), even if in lesser degree than those of *D. spermatophaga*, are in general appearance suggestive of *Fusarium*. The triseptate condition predominates in mature conidia (Pl. XI, C, a—z; D, b—d, f, i, k—n), yet specimens with 2 cross-walls (Pl. XI, D, e, g, h, j, o) are readily found, and occasionally specimens with only 1 cross-wall (Pl. XI, D, a) or with as many as 5 cross-walls (Pl. XI, D, p) come under observation. While in some conidia the proximal and distal ends are nearly alike, in many others the tip shows a more or less abrupt curvature not observable at the basal end. The basal end, however, has some distinctiveness in often being prolonged rather narrowly — a feature signalized in the epithet compounded of 2 words (στενός, κρηπίς) meaning “narrow” and “boot” or “lower part”, respectively.







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Explanation of Plate IX—XI.

Plate IX. *Dactylella anisomeres*, drawn at a uniform magnification from living material that developed in maize-meal-agar plate cultures to which had been added leaf mold from northern Colorado (A—J, M, N), from Florida (K), and from northern Wisconsin (L); $\times 1000$. A, Portion of mycelium with 2 parasitized oospores, a and b, of *Pythium butleri* free of their oogonial envelopes. B—D, Portions of mycelium, each with a parasitized oospore of *P. butleri* free of its oogonial envelope. E, Procumbent hypha, a, from which has been sent up a conidiophore, b, bearing a conidium, c. F, G, Portions of procumbent hyphae, a, each with a denuded conidiophore, b. H, Procumbent hypha, a, with a branch, b, bearing a toppled conidiophore, c, from which has been sent up distally a secondary conidiophore, d. I, Procumbent hypha, a, with a toppled conidiophore, b, from which 2 secondary conidiophores, c and d, have been extended. J (a—x), K (a—e), L (a—c). Detached conidia showing usual variations in size, shape, and septation. M, Conidium that has become fused with a hypha. N, Two conidia that have become united through vegetative fusion.

Plate X. *Dactylella stenocrepis*, drawn at a uniform magnification from living material in maize-meal-agar plate cultures 57 to 65 days old; $\times 1000$. A—D, Portions of mycelium, each with an appressorium that after penetrating an oogonial envelope of *Pythium ultimum* has also penetrated the wall of the contained oospore and is extending a branched lobulate haustorium into its protoplasmic contents. E—H, Portions of mycelium, each with an appressorium affixed to an oogonial envelope of *P. ultimum* wherein is contained an oospore in somewhat advanced stage of invasion. I, Portion of mycelium with an appressorium attached to an oogonial envelope of *P. ultimum* that surrounds an oospore wall containing the membranous remains of the haustorium that assimilated the protoplasmic contents.

Plate XI. *Dactylella stenocrepis*, drawn at a uniform magnification from living material in maize-meal-agar plate cultures 57 to 65 days old; $\times 1000$. A, Procumbent hypha, a, that has sent up a conidiophore, b, which after toppling over has put forth a secondary conidiophore, c, bearing a young unseptate conidium, d. B, Procumbent hypha, a, that has sent up a conidiophore, b, which after toppling over gave rise to a secondary conidiophore, c, thereby initiating production successively of other conidiophores, d—f, all shown in a denuded state. C (a—z), D (a—p), Detached conidia showing usual variations in shape, size, and septation.

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