Some clampless hyphomycetes predacious on nematodes and rhizopods.

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With Plates I—VIII.

In continuation of studies on fungi destructive to minute animals in slowly decaying plant materials 2 nematode- capturing hyphomycetes are herein described that seem clearly distinct from any species of similar predacious character hitherto reported as occurring in the United States. They are believed to be distinct also from predacious species described in Great Britain and the Soviet Union, though specimens of foreign origin have not been available for comparison. To set forth the resemblances and differences relevant to their taxonomic treatment the 2 hyphomycetes are illustrated somewhat more fully than is customary, their conidia more especially being figured in sufficient number to provide scope for random selection. Brief accounts are also given of 2 rhizopod-capturing fungi, which, though producing branched conidia of characteristic design, are likewise held to belong in the clampless predacious series whereof *Arthrobotrys oligospora* Fres. would appear to represent the most familiar example. Occasion is taken, further, to note the occurrence of a supplementary phase of reproduction in 2 other members of the series, and to record observations on a novel type of predacious apparatus employed by an unnamed but presumably related fungus.

1. **Dactylaria gampsospora** sp. nov.

Mycelium incoloratum, ramosum; hyphae ejusdem septatae, 1.8—8 μ (saepius 2—6 μ) latae, vulgo in materiis vermiculosis sed interdum etiam in materia animalibus vacua laqueos tenaces arcuatos vel circulares in reticulos fere conjunctos proferentes; hi laquei et reticuli vermiculos nematoideos illaqueantes, integumentum cujusque captivi minute perforantes, tuber mortiferum globosum intrudentes, assumentes hyphas plerumque 2.5—5 μ latas evolventes quae carnem exhauriunt. Hyphae fertiles vulgares incoloratae, erectae, saepius 3—7-septatae, plerumque 150—625 μ altae, basi 5—7 μ latae, apice 2—3 μ latae, ibi aliquot denticulis saepius 3—5 μ longis praeditae et aliquot (vulgo 2—7) conidia in capitulum laxum ferentes; haec conidia incolorata, vulgo fusoidea vel potius curvato-fusoidea, interdum 1—3-septata sed saepissime quadriseptata, medio saepe parum inflata, basi et apice saepe sed non semper fere aequaliter attenuata et rotundata, plerumque 25—76 μ (vulgo 40—70 μ) longa, 7—16 μ (vulgo 9—14 μ) lata. Hyphae fertiles minores interdum ex conidiis abjectis interdum ex hyphis mycelii assurgentes, saepe 1—3-septatae, 75—125 μ altae, basi 4—5 μ, apice 1.2—2 μ latae, ibique denticulis nonnullis 1.5—2 μ longis praeditae et microconidia nonnulla (saepius 5—10) gignentes; microconidia incolorata, continua, elongato-obovoidea, basi attenuata, apice late rotundata, plerumque 10—17 μ longa, 4—6 μ lata. Chlamydosporae dolioformes vel globosae, protoplasmate plus minusve globulifero repletae, plerumque 8—21 μ longae, 6—17 μ latae, in hyphis mycelii saepe abundanter oriundae denique multas catenas induratas efficientes, sed interdum ex reticulis glutinosis ortae et tunc plus minusve glomeratim aggregatae.

Vermiculos nematoideos capiens consumensque habitat in materiis plantarum putrescentibus prope Lake Alfred, Florida, et prope Wauchula, Florida. Typus: National Fungus Collection no. 71640; American Type Culture Collections no. 14446.

Mycelium colorless, composed of branching septate hyphae 1.8—8 μ (often 2—6 μ) long, which give rise in nematode-infested materials and sometimes also in pure culture to many curved or circular adhesive loops that usually become compounded into networks; these loops and networks capturing motile nematodes, then narrowly perforating the integument of each captive and intruding a globose mortiferous bulb from which assimilative hyphae, mostly 2.5—5 μ wide, are extended lengthwise through the interior to appropriate the fleshy contents. Conidiophores of the usual primary type erect, often 3—7-septate, mostly 150—625 μ high, 5—7 μ wide at the base, tapering to a diameter of 2—3 μ at the tip, provided distally with several tooth-like projections often 3—5 μ long on which are borne several (commonly 2—7) conidia in a loose head; these conidia colorless, spindle-shaped with curved axis or arcuately spindle- shaped, sometimes 1—3-septate but most often divided by 4 cross-walls, sometimes noticeably distended in the middle, often though not always tapering proximally and distally in nearly equal measure and then at the base and tip almost equally rounded, 25—76 μ (commonly 40—70 μ) long, 7 to 16 μ (commonly 9—14 μ) in greatest width. Conidiophores of the smaller type arising from detached conidia or from mycelial hyphae, often 1—3-septate, 75—125 μ high, 4—5 μ wide at the base, tapering to a width of 1.2—2 μ at the tip, furnished distally with several tooth-like projections 1.5—2 μ long, and distally bearing several (often 5—10) microconidia; these microconidia colorless, continous, elongate obovoid, tapering toward the base, broadly rounded at the distal end, mostly 10—17 μ long, 4—6 μ in greatest width. Chlamydospores barrel-shaped or globose, filled with more or less globuliferous protoplasm, mostly 8—21 μ long and

6—17 μ wide, often produced abundantly from mycelial hyphae and then arranged in indurated chains, but sometimes formed from adhesive networks and then aggregated in sclerotium-like masses.

Dactylaria gampsospora came to light in several maize-meal-agar plate cultures that after being overgrown with mycelium of *Pythium ultimum* Trow had been further planted with small quantities of mealy detritus sifted from specimens of friable leaf mold collected separately near Wauchula, Florida, on April 15, 1959, and near Lake Alfred, Florida, on April 16, 1959. The adhesive hyphal loops (Pl. I, A—D; E, a, b) and networks (Pl. I, F; G, a, b) which the fungus produced here and there on the sparingly branched mycelial filaments it extended from the deposits of decaying material, appeared generally similar to the retiary apparatus familiar in *Arthrobotrys oligospora* and many other related hyphomycetes. Capture of eelworms by entanglement and adhesion (Pl. I, H—J), narrow perforation of the integument of each captive, intrusion of one or more mortiferous bulbs into each animal, and extension of assimilative hyphae lengthwise through the fleshy interior, ensued without noticeable departure from corresponding development in allied species. After destruction of eelworms had continued for several days asexual reproductive apparatus was formed. The conidiophores, which for the most part ascended erectly from the mycelial filaments, were generally taller than those of allied forms, even the shorter ones (Pl. I, K) among them measuring about 300 μ in height, while the longer individuals rose upward more than 500 or even 600 μ. When the solitary loosely capitate clusters of conidia borne aloft on the erect conidiophore were examined microscopically in uncovered Petri dishes, the spores always appeared markedly collapsed and distorted.

In many instances conidiophores that had become bent over (Pl. II, A) formed conidia on spurs (Pl. II, A, a, b) less than 200 μ from the base, and then after some elongation sometimes produced one or more additional conidia (Pl. II, A, c) in distal positions.

Although the conidia held aloft in uncovered nematode-infested plate cultures of *Dactylaria gampsospora* appear more severely collapsed than those of related species under like circumstances, they promptly resume their normal contours (Pl. I, L, a—y; Pl. II, B, a—z; C, a—e) when they are placed, together with portions of agar substratum, in a moist preparation under a cover glass. In the curved fusiform shape then revealed they present parallelism with the conidia of *Dactylaria scaphoides* Peach (1952), though further comparison with the description and illustrations of the British fungus discloses noteworthy differences with respect to septation and shape. The difference in septation lies not so much in that the conidia of *D. scaphoides* are divided by 1—3 rather than by 1—4 cross-walls as in their being predominantly biseptate and never quadriseptate, when in marked contrast quadriseptate partitioning predominates strongly among the conidia of *D. gampsospora*. Very probably some relatively short conidia (Pl. I, L, a—e) of *D. gampsospora* are normally triseptate, but the presence of only two (Pl. II, B, j) or three (Pl. II, B, i, y, z) cross-walls in conidia of lengths usual in the species is generally suggestive of immaturity. In many of the shorter triseptate conidia of *D. gampsospora*, as also in virtually all the conidia of *D. scaphoides* figured by Peach, the broadly rounded distal end is easily distinguished from the tapering proximal end; whereas many quadriseptate conidia of *D. gampsospora* taper in very nearly equal measure toward both narrowly rounded ends, with the result that close scrutiny is required to distinguish the base and the tip correctly.

Dactylaria gampsospora was readily isolated by transferring conidia from its tall conidiophores to sterile maize-meal agar. In pure culture on that medium the fungus grows well but often fails to form reproductive apparatus or gives rise to such apparatus only sparingly. The spores produced in pure culture are generally less curved, shorter, smaller, and of more varied shape than those formed on nematode-infested substrata. Among the smaller conidia that become detached in pure cultures are usually some continuous as well as many uniseptate and biseptate specimens (Pl. II, D, a—c).

In germinating on the moist surface of nematode-infested agar plate cultures, detached conidia of *Dactylaria gampsospora*, like those of many related fungi, often become united with one another through vegetative fusion (Pl. I, M, a, b; N, a—c; Pl. II, E, a—c). Many detached conidia (Pl. II, F, a) send up an erect fertile hypha (Pl. II, F, b) and give rise terminally to a secondary conidium (Pl. II, F, c) of similar type. Other detached conidia (Pl. II, G, a) send up an erect hypha (Pl. II, G, b) bearing a number of microconidia (Pl. II, G, c—g), which remain without cross-walls and always are markedly smaller than their parent. Now and then conidiophores (Pl. II, H, a, b) bearing similar microconidia (Pl. II, H, c—i) can be found arising from ordinary mycelial hyphae. Whether of conidial or of mycelial origin the microconidia of *D. gampsospora* are of dimensions somewhat smaller than the dimensions ascribed by Peach to the non-septate secondary conidia of *D. scaphoides*.

Unlike *Dactylaria scaphoides* and many other retiary nematode-capturing hyphomycetes, *D. gampsospora* may form predacious apparatus without the presence of animals or of substances elaborated by animals. When growing in pure culture on maize-meal agar (Pl. III, A) or on potato-dextrose agar (Pl. III, B, C) it puts forth distended branches, which, after describing one or more circular loops, may elongate as ordinary mycelial filaments (Pl. III, A, a—c; B, a, b; C, a—c). Sometimes, however, little (Pl. III, D, a) or no (Pl. III, E) resumption of mycelial growth ensues and many loops may then become anastomosed into entensive networks. Analogous development of predacious apparatus without the presence of animals or animal products has been noted previously in the production of adhesive outgrowths by *Dactylella cionopaga* Drechsler (1950). Furthermore, the several hyphomycetes that in the presence of nematodes habitually form small globose knobs concomitantly with delicate non-constricting rings have sometimes been found producing knobs when growing in pure culture on maize-meal-agar slants.

In pure cultures of *Dactylaria gampsospora* on potato-dextrose agar much of the mycelium gradually becomes indurated, as on that medium longish portions of the main hyphae and of some branches usually are converted into chains of short swollen globuliferous cells (Pl. III, F), or chlamydospores. Similar induration occurs only sparingly in the mycelial hyphae extending through nematode-infested plate cultures. Conversion of the predacious networks into chlamydospores results in sclerotium-like masses (Pl. III, G, H), which, judging from their durable appearance, may enable the fungus to survive long periods of unfavorable weather.

2. **Dactylella parvicollis** sp. nov.

Mycelium incoloratum; hyphae steriles ramosae, mediocriter septatae, plerumque 1.5—3.8 μ latae, hic illic a latere vel in ramulis vulgo 0.5—3.5 μ longis et 2—3.5 μ latis et basi non septo delimitatis tubera tenacia ferentes; haec tubera tenacia globosa vel elongato-ellipsoidea, protoplasmatis limpidi repleta, plerumque 6.5— 11 μ longa, 5.5—9 μ lata, basi semper septo delimitata, interdum alia tubera apice progemminantia etiam rarissime laqueum circularem proferentia, saepe ad vermiculos nematoideos inhaerentia, itaque animalia tenentia, integumentum cujusque captivi minute perforantia, bullam mortiferam intrudentia, hyphas assumentes intus evolventia; hyphae assumentes mox mediocriter septatae, plerumque 2.3—4.5 μ crassae, carnem animalis exhaurientes. Hyphae fertiles incoloratae, erectae, plerumque 130—290 μ longae, basi 3—4.5 μ latae, sursum leniter attenuatae, apice plerumque 1.8—2.2 μ latae, ibique conidium unicum ferentes; conidia incolorata, vulgo fusoidea, apice rotundata, basi attenuata et truncata, plerumque 35—45 μ longa, 8—14 μ lata, quandoque biseptata vel triseptata sed saepissime quadriseptata, post disjunctionem interdum aliud conidium in apice hyphae fertilis erectae circa 130 μ longae basi circa 3.5 μ latae apice circa 1.5 μ latae gerentia, interdum hyphas germinationis circa 2.7 μ latas praecipue basi et apice emittentia, interdum tubera tenacia basi et apice etiam raro in apice hyphae circa 55 μ longae basi circa 2.5 μ latae sursum 1.5 μ latae proferentia.

Vermiculos nematoideos capiens consumensque habitat in materiis plantarum putrescentibus prope Durango, Colorado, et Fort

Collins, Colorado. Typus: Tabulae IV et V American Type Culture Collections no. 14447.

Mycelium colorless; sterile hyphae branched, septate at moderate intervals, mostly 1.5—3.8 μ wide, often (especially in the presence of nematodes) giving rise mostly at intervals of 5—250 μ to adhesive knobs either laterally or on stalks that usually are 0.5—3.5 μ long and 2—3.5 μ wide and are never delimited at the base; adhesive knobs globose or obovoid or prolate ellipsoid, mostly 6.5—11 μ long, 5.5—9 μ wide, always delimited at the base by a septum, usually filled with protoplasm of nearly homogeneous appearance, sometimes producing one or more other knobs distally or even (though only rarely) producing a closed hyphal loop, often holding fast to nematodes, then perforating the integument of each captured animal and intruding a globose mortiferous bulb from which assimilative hyphae are extended through the interior; assimilative hyphae soon becoming septate, mostly 2.3—4.5 μ wide, appıopriating the animal's fleshy contents. Conidiophores colorless, erect, mostly 130—290 μ long, 3—4.5 μ wide at the base, tapering gradually upward, 1.8—2.2 μ wide at the tip whereon is borne a single conidium. Conidia colorless, commonly spindle-shaped, rounded at the tip, narrowly truncate at the base, mostly 35—45 μ long, 8—14 μ in greatest width, sometimes biseptate or triseptate but most often quadriseptate; after disjunction often giving rise singly to another conidium at the tip of an erect germ conidiophore sometimes about 130 μ long, 3.5 μ wide at the base, and 1.5 μ wide distally; often, too, putting forth germ hyphae about 2.7 μ wide, especially at one or both ends; and often, again, producing adhesive knobs at one or both ends or occasionally even on a hyphal stalk sometimes about 55 μ long, 2.5 μ wide below, and 1.5 μ wide at the tip.

Dactylella parvicollis came to light in Petri plates of maize-meal agar which after being overgrown with *Pythium* mycelium had been planted with small quantities of mealy detritus sifted from 2 samples of friable forest duff originating in separate localities in Colorado about 400 kilometers apart. One of the samples was taken on July 3, 1958, from woods near Durango, at an elevation of approximately 2000 meters, and the other was collected a few days later in woods extending along the Cache la Poudre River west of Fort Collins. In nematode-infested cultures the fungus arrests attention, owing to the conspicuously close attachment of its adhesive knobs (Pl. IV, A, a—j; B—D: a, b; E—F: a—c; L, a; M, a; Pl. V, C, a; D, a) to their supporting hyphae. Some of its knobs (Pl. IV, A, e; B, b; F, a—c; L, a) may, indeed, be sonsidered sessile or lateral, since they are no less closely attached than the subglobose adhesive branches of *Dactylella lobata* Duddington (1951) or the adhesive protuberances of *Dactylella phymatopaga* Drechsler (1954). Most adhesive knobs of *D. parvicollis*, however, are borne terminally on relatively short yet clearly recognizable stalks (Pl. IV, A, a—d, h—j). Such stalks have never been observed supporting the predacious organs of *D. phymatopaga*, which differ further from the knobs of *D. parvicollis* in their generally more elongate shape and in the granular texture of the protoplasma filling them distally. No stalks of any kind were mentioned in connection with adhesive branches of *D. lobata*, which were set forth as somewhat resembling the adhesive outgrowths of *Dactylella cionopaga* Drechsler (1950). However, in respect to supplementary development some little parallelism with these branches is shown by the predacious knobs of *D. parvicollis*. Thus in aging cultures a knob borne on a mycelial hypha sometimes give rise distally to a second knob, which in turn may give rise to a third, so that a short chain of cells (Pl. IV, G—I; J, a, b; L, b) comes into being, suggestive of the lobate processes usual in Duddington's species. Now and then a knob borne on a mycelial hypha may even produce a small closed loop (Pl. IV, K). When a first knob degenerates the supporting stalk may resume growth and in a somewhat more forward position may then form a second knob (Pl. V, A), which in turn may be superseded by a third. Through such repeated renewal of growth older cultures may show some knobs supported on stalks 2 or 3 times their original length (Pl. V, B).

The capture and invasion of eelworms by *Dactylella parvicollis* proceeds after the manner usual with other knob-bearing clampless hyphomycetes. Individuals of a species of *Plectus* strongly predominant in my cultures struggled vigorously when they were captured and did not usually become seriously disabled until the growing mortiferous bulb stretched almost entirely across the fleshy interior. In a *Plectus* specimen about 200 μ long that was found affixed 35 μ from its anterior end (Pl. IV. M, b) and was there completely severed internally by an intruded bulb, no motion whatever could be observed in the forward third of the animal's body as the bulb began extending backward an assimilative hypha, though at intervals of 1 or 2 minutes very slight movements of the tail were noticeable. The tail movements diminished further during the ensuing 3 hours, during which the assimilative hypha attained a length of 110 μ (Pl. IV, N). The final movement, perceptible through a very slight change in posture of the tail (Pl. IV, O), took place less than 25 minutes later. After an additional interval of 30 minutes, or approximately 4 hours after it was burgeoned forth, the assimilative hypha had advanced well into the narrowing tail of the animal, where spatial limitations prevented further elongation. Invasion of the fleshy interior was thereby completed, since meanwhile a second assimilative hypha, extended forward from the bulb, had reached the frontal profile of the animal. Presumably invasion takes somewhat longer in instances where the captive is affixed only by its head (Pl. IV, P, Q), but should be accomplished more rapidly in instances where the animals is held by two (Pl. IV, R, a, b) or three (Pl. IV, S, a—c) adhesive knobs. When assimilative hyphae extended from separate adhesive organs (Pl. IV, T, a, b) encounter one another they usually cease elongating. After a captive's substance has been absorbed, and as its integument is vanishing from sight (Pl. IV, U), the contents of all assimilative hyphae are gradually withdrawn backward through the mortiferous bulb and adhesive knob into the adjacent mycelium.

A mycelium of *Dactylella parvicollis* that has been nourished for several days through destruction of eelworms usually gives rise to conidial apparatus in small or moderate quantity. The sparsely scattered slender conidiophores (Pl. V, C—D: b; E—G: a) commonly bear aloft a single conidium (Pl. V, C—D: c; E—G: b; J, b). Many of them soon fall over on the moist substratum and from a proximal cell (Pl. V, H, a; I, a) may then put forth a secondary conidiophore (Pl. V, H, b; I, b). Through repetition of such development a tertiary (Pl. V, H, c; I, c) and a quaternary conidiophore (Pl. V, H, d; I, d) may come into being. In some instances a conidiophore (Pl. V, J, a) arises near rather than from its toppled predecessor.

The conidia of *Dactylella brevicollis* (Pl. V, K, a—z; L, a—w) rather closely resemble those of *Dactylella mammillata* Dixon (1952) and *Dactylella lysipaga* Drechsler (1937a) in their slender fusiform shape, their main dimensions, and predominantly quadriseptate partitioning. Like the similar spores of many allied fungi they often give rise to a secondary conidium on a germ conidiophore (Pl. V, M) after they have fallen on a moist substratum; and often, too, they put forth 1 or 2 germ hyphae from polar or lateral positions (Pl. V, N—Q). Some detached conidia, again, produce sessile or short-stalked adhesive knobs mainly in basal or apical positions (Pl. IV, V; W, a, b; Pl. V, R, S). In one observed instance (Pl. IV, W, c) an adhesive knob was borne terminally on a long slender stalk arising laterally from a detached conidium. The stalk may have been initiated here as an erect germ conidiophore, but when half-grown may have been tumbled into a procumbent posture by a large nematode and thus been constrained to serve a vegetative function. In any case, the unusual positional relation of the knob required mention in the diagnosis of the species.

The conidia of *Dactylella parvicollis* seem to differ somewhat markedly in shape from the 11 conidia of *Dactylella lobata* figured by Duddington. Eight of the 11 illustrated spores taper little toward one end, which thus is broadly rounded, but they taper rather strongly toward the other end, which mostly appears narrowly truncate. Despite some lack of bipolar symmetry the conidia of *D. lobata* were characterized as fusiform. They were set forth, further, as being divided by cross-walls into 3—5 cells, and quadricellular partitioning, which is shown in all 11 specimens figured, was held usual among them. The conidia of *D. parvicollis*, in contrast, are most commonly divided into 5 cells, and their generally fusiform shape is modified in smaller measure by bipolar asymmetry.

Dactylella brevicollis was readily isolated by transferring its conidia from their supporting hyphae to sterile maize-meal agar. In pure culture on this medium the fungus forms a delicate colorless mycelium generally devoid of predacious organs and usually also of conidial apparatus.

3. **Tridentaria glossopaga** sp. nov.

Mycelium parce pansum; hyphae steriles incoloratae, parce ramosae, mediocriter septatae, plerumque 1.2—1.5 μ latae, hic illic tuberibus tenacibus praeditae; tubera tenacia ovoidea vel elongato-ellipsoidea vel lingulata, basi semper septo limitata, vulgo 3—3.5 μ longa, 2—2.5 μ lata, saepius ad rhizopoda testacea inhaerentia, animalia ita tenentia, mox apice crescentia, itaque captivos penetrantia et hyphas intus evolentia quae carnem exhauriunt. Hyphae fertiles erectae, incoloratae, interdum 110—150 μ altae, basi 3—4 μ latae, sursum leniter attenuatae, apice 1—1.3 μ latae, ibi unum conidium ferentes. Conidia incolorata, vulgo ex 4 quandoque ex 5 partibus ad instar fuscinae composita: pars infera quae hastilem facit clavata, uniseptata, plerumque 12—15 μ longa, basi circa 1 μ lata, sursum leniter latescens, apice saepe 2.8—3.5 μ lata, ibi vulgo 3 rarius 4 dentes ferens; imdentes primo fasciculat conferti, postea praecipue post disjunctionem divaricati, graciliter digitiformes, plerumque 21—45 μ longi, prope basim 2.2—3 μ lati, sursum attenuati, apice circa 1.2 μ lati, interdum uniseptati vel biseptati sed vulgo 3—5 septis in 4—6 cellulas divisi.

Euglypham levem capiens consumensque habitat in foliis arborum (Aceris, Betulae, Ulmi) putrescentibus prope Park Falls, Wisconsin. Typus: Tabula VI.

Mycelium sparse in mixed cultures on agar substratum; vegetative hyphae colorless, sparingly branched, septate at moderate intervals, mostly 1.2—1.5 μ wide, here and there bearing adhesive protuberances; these protuberances somewhat egg-shaped or prolate ellipsoidal, often with tongue-like profile, always delimited at the base by a septum, commonly 3—3.5 μ long, 2—2.5 μ wide, often adhering by the tip to testaceous rhizopods, thereby holding fast the animals, then elongating distally, thus penetrating into the captives and forming assimilative hyphae internally which appropriate the fleshy contents. Conidiophores erect, colorless, often 110—150 μ high, 3—4 μ wide at the base, tapering gradually upward, 1—1.3 μ wide at the tip whereon is borne a single conidium. Conidia colorless, consisting usually of 4 (less often of 5) parts in trident-like arrangement:

the basal trunk corresponding to the shaft of a trident being club-shaped, uniseptate, usually 12—15 μ long, about 1 μ thick at the proximal end, widening gradually upward to a diameter of 2.8—3.5 μ near the bluntly rounded tip whereon are borne usually 3 (less often 4) prongs in isogonal arrangement; the prongs at first extending upward close together in a terminal sheaf, but later (and especially after abjunction of the spore) usually divaricate, slenderly finger-shaped, mostly 21—45 μ long, 2.2—3 μ in greatest width often 2—8 μ above the basal attachment, tapering upward gradually, 1.2 μ wide at the tip, sometimes containing only 1 or 2 cross-walls but commonly divided ed by 3—5 cross-walls into 4—6 cells.

Tridentaria glossopaga was found in a maize-meal-agar plate culture which after being overgrown with *Pythium* mycelium had been planted with a small quantity of friable leaf mold taken from woods in northern Wisconsin on November 15, 1957. The fungus shows noteworthy parallelism with *Dactylella parvicollis* in producing sessile adhesive knobs. However, while in *D. parvicollis* only about one-third of the predacious knobs are approximately sessile, the others being borne on short yet recognizable stalks, in *T. glossopaga* all adhesive knobs (Pl. VI, A, a—c; B, a, b; C, a; D, a; E, a, b; F, a, b; G) are sessile, being delimited basally by a septum rather accurately in alignment with the membrane of the parent hypha. Among the clamp-less nematode-capturing hyphomycetes similar development of adhesive knobs in consistently sessile positions has been observed only in *Dactylella phymatopaga*. The predacious organs of *T. glossopaga* further resemble those of *D. phymatopaga* in their elongate shape, theough differing in their generally smaller dimensions as well as in the much more nearly uniform texture of their protoplasmic contents. They appear somewhat wider and shorter than the finger-shaped adhesive protuberances by means of which the apparently related *Pedilospora dactylopaga* Drechsler (1934) captures various testaceous rhizopods, but are narrower and shorter than the sessile globose adhesive knobs used in capturing amoebae by *Dactylella tylopaga* Drechsler (1935) and by an unnamed sterile septate fungi I reported earlier (Drechsler, 1954).

The adhesive protuberance of *Tridentaria glossopaga*, much like that of *Pedilospora dactylopaga*, grows out distally at full width into the protoplast of a captured animal. As a result the predacious organ, together with its prolongation, usually appears as a continuous branch that enters the aperture of the animal's testa (Pl. VI, E, c). Evidently the invading branch ramifies haphazardly through the granular protoplasm to form an assimilative system that in large part is only indistinctly discernible. During the later stages in the expropriation of the animal's contents the assimilative system becomes emptied progressively and vanishes from sight.

In producing adhesive protuberances *Tridentaria glossopaga* differs conspicuously from 2 congeneric fungi, *T. carnivora* Drechsler (1937b) and *T. implicans* Drechsler (1940), neither of which forms recognizable predacious organs preliminary to capturing prey. *T. glossopaga* is readily distinguished from both congeners also by its reproductive apparatus. Its conidiophores, whether arising (Pl. VI, E, d; F, c) from a mycelial filament or from (Pl. VI, F, e) a proximal segment (Pl. VI, F, d) of an older, toppled conidiophore, are about twice as tall as those of *T. carnivora*, but differ little in stature or width from those of *T. implicans*. In its conidia, as also in the conidia of *T. implicans*, all distal parts corresponding to the prongs of a trident arise alike in isogonic arrangement from the distal end of the two-celled basal trunk; whereas in the conidia of *T. carnivora* one of the prongs is a direct prolongation of the basal trunk, while the other two prongs usually present arise through dichotomy of a very short lateral spur. Among the predominantly three-pronged conidia of *T. glossopaga* (Pl. VI, H—N) are usually intermixed some four-pronged spores (Pl. VI, O, P); whereas in *T. carnivora* and *T. implicans* departure from the usual tridentate conidial make-up is displayed mainly in a scanty admixture of two-pronged spores. The conidia of *T. glossopaga* appear rather spindly and long-stemmed when compared with those of *T. implicans*, though on the average the width of their prongs is only about 1.6 μ less, and the length of their basal trunk only about 3.5 μ greater, than the corresponding dimension of the latter species.

4. **Triposporina quadridens** sp. nov.

Mycelium parvum; hyphae steriles incoloratae, ramosae, circa 2 μ latae, saepe per aperturam rhizopodi testacei ramum promittentes qui protinus aliquot (3—5) lobos 3—6 μ latos efficientes, aperturam obturantes, ita animal tenentes, tunc ramos assumentes intus evolvens qui protoplasma exhauriunt. Hyphae fertiles incoloratae, simplices, erectae, vulgo continuae, interdem 10—12 μ altae, circa 1.8 μ latae, unum conidium ferentes. Conidia incolorata, aliquid filiformia, sursum deinceps bis late bifurca, itaque in 1 trunco et 2 ramis primariis et 4 ramis secondariis consistentia: truncus erectus, saepius 45—60 μ longus, basi circa 1.8 μ latus, sursum latescens, apice 5—6 μ latus, plerumque 5—7 septis in 6—8 cellulas divisus; rami primarii leviter ascendentes, 6—11 μ longi, 4.5—6 μ lati, interdum in 2 cellulis sed saepissime in 1 cellula constans; rami secundarii leviter ascendentes, 20—34 μ longi, basi 4—5.5 μ lati, sursum attenuati, prope apicem rotundam saepe 1.5—2 μ lati, interdum bicellulares sed plerumque in 3 vel 4 cellulas divisi.

Euglypham levem capiens consumensque habitat in materiis plantarum putrescentibus prope Lake Alfred, Florida, Typus: Tabulae VII et VIII.

Mycelium sparse in mixed culture on agar substratum; sterile hyphae colorless, branched, about 2 μ wide, often capturing a testaceous rhizopod by entending a branch into its aperture and immediately within forming several (often 3 or 4) lobes 3—6 μ wide, then invading the interior with assimilative hyphae which appropriate the protoplasmic contents. Conidiophores colorless, simple, erect, continuous, often 10—12 μ high, about 1.8 μ wide, bearing a single conidium. Conidia colorless, somewhat filamentous, distally branched dichotomously twice in succession, hence composed of a basal trunk together with 2 primary and 4 secondary branches: the basal trunk erect, mostly 45—60 μ long, about 1.8 μ thick at the proximal end, widening upward to a distal diameter of 5—6 μ, usually divided by 5—7 crosswalls into 6—8 segments; the primary branches ascending at a rather low angle, often 6—11 μ long, 4.5—6 μ wide, mostly unicellular but sometimes bicellular; the secondary branches similarly ascending at a low angle, often 20—34 μ long, 4—5.5 μ wide at the base, tapering upward to a diameter of 1.5—2 μ near the rounded tip, sometimes 2-celled but usually divided into 3 or 4 cells.

Triposporina quadridens developed in a maize-meal-agar plate culture, which, after being overgrown by *Pythium ultimum*, had been planted with a small quantity of decaying herbaceous material taken from a grassy area in central Florida on April 12, 1959. The mycelium of the fungus was not furnished with readily recognizable predacious organs, though it is possible that some slight distentions observed here and there on the hyphae (Pl. VII, A) may have been adapted for capture of prey. Captured specimens of *Euglypha levis* (Pl. VII, A, a; B) were found tethered to the hypha by a short branch, their escape during the period they remained alive being prevented manifestly by the compact mass of swollen lobes formed immediately within the aperture. In its manner of taking prey the fungus displayed close parallelism with *Dactylella passalopaga* Drechsler (1936).

The conidiophores (Pl. VII, A, b) of *Triposporina quadridens* are much shorter than those of *Dactylella passalopaga* or *Tridentaria implicans*. In their dimensions they greatly resemble the conidiophores of the oospore-destroying hyphomycete I referred (Drechsler, 1938) to *Trinacrium subtile* Fresenius (1852). The solitary conidia (Pl. VII, A, c; C; Pl. VIII, A—G) they bear resemble those of *D. passalopaga* in their somewhat distended filamentous character. Owing to further similarity provided in their dichotomous branching they resemble even more strongly the conidia of *T. subtile*. Yet as the conidia of the Florida fungus regularly branch dichotomously twice rather than only once, they have 5 instead of 3 free extremities, and thus do not accurately conform in a numerical sense to the requirement that might be held implied in the generic name invented by Fresenius. Since repeated dichotomous branching is characteristic also of the conidia produced by *Triposporina aphanopaga* Drechsler (1937 a), the fungus is presented as a congener of that weakly predacious species. The postural relations of the 4 divergent conidial branches are originally much the same in *T. quadridens* (Pl. VII, A, c; C) as in *T. aphanopaga*, but while the compact spores of *T. aphanopaga* incur very little change of shape when they are brought into a moist preparation under a cover glass, the outspreading spores of *T. quadridens* often become markedly flattened (Pl. VII, D; Pl. VIII, A—G) in covered mounts, thereby displaying more clearly their cellular make-up.

5. In a maize-meal-agar plate which after being overgrown by *Pythium debaryanum* Hesse had been planted with a small quantity of friable leaf mold collected near Salisbury, Maryland, on November 21, 1951, some triseptate conidia (Pl. II, I, a) were found 30 days later to have extended a germ hypha (Pl. II, I, b) bearing one (Pl. II, I, c) or more constricting rings and a single somewhat tapering conidiophore (Pl. II, I, d) about 55 μ high, 3.5 μ wide at the base and 1.2 μ wide at the tip. When such a conidiophore toppled over on to the substratum it sometimes gave rise from a basal position to another conidiophore of like dimensions (Pl. II, I, e). On their axial tips and on the equally narrow tips of several subterminal spurs commonly 2.5—4 μ long, the conidiophores bore 4—8 clavate microconidia (Pl. II, I, f—k) 12—20 μ long and 4.5—7 μ in greatest width. These microconidia, unlike the homologous spores of *Dactylaria gampsospora*, were regularly divided by single cross-walls, which usually appeared in a position somewhat closer to the broadly rounded apices than to the narrowed truncate bases. From its constricting rings, simple sturdy primary conidiophores, and large turbinate triseptate primary conidia (Pl. II, J), the fungus here concerned was readily identified as *Dactylella bembicodes* Drechsler (1937 a).

6. Development of microconidia was found proceeding from some few quadriseptate conidia (Pl. II, K, a) in a maize-meal-agar plate culture that had been planted 106 days earlier with pinches of forest duff collected near Durango, Colorado, on July 3, 1958. In view of the many similar conidia (Pl. II, L, a, b) that nearby were held aloft on tall conidiophores having a visible mycelial connection with scalariform networks (Pl. II, M), the supplementary reproductive phase here was referred without diffiuclty to *Dactylella gephyropaga* Drechsler (1937 a). The parent conidium (Pl. II, K, a) in several observed instances evidently first put forth a prostrate germ hyphae (Pl. II, K, b), which soon gave rise proximally to 1 or 2 tapering conidiophores (Pl. II, K, c) about 90 μ long, 4 μ wide at the base, and 1 μ wide at the tip. These conidiophores bore on the axial tip and on the tips of primary

(Pl. II, K, d) and secondary branches sometimes as much as 32 μ long, usually 2 to 6 colorless, prolate ellipsoidal or spindle-shaped microconidia (Pl. II, K, e—i), mostly 22—30 μ long and 5—6.8 μ in greatest width. A median cross-wall divided each microconidium into 2 cells of very nearly equal size and length.

7. The same small sample of partly decayed herbaceous material that in one maize-meal-agar plate culture yielded *Triposporina quadridens*, provided in another such culture some meager development of a clampless septate fungus which captured nematodes by means of a predacious device different from any hitherto made known. The sparse mycelium of the fungus occupied an area of only 2 or 3 square millimeters, and consisted of sparingly branched filamentous hyphae about 1.8 μ wide. Here and there along these hyphae captive nematodes, about 10 μ wide, were held tightly encircled by a helicoid hyphal coil of 3 close turns (Pl. II, N), which in some instances was attached to a short branch about 3.5 μ wide. As the coiled hyphae measured about 5 μ in width while the several turns had an outer diameter of approximately 15 μ, the animals were constricted locally to a width of about 5 μ. None of the hyphal coils were seen in any formative stage, so that it remains uncertain whether they came into being through spiral elongation of a branch 5 μ wide in the beginning, or originated by convolvement of a more slender branch that subsequently increased in thickness. One or two cross-walls were visible in some of the coils, and in all instances the tip of the convolved branch was rather bluntly rounded. Assimilative hyphae, mostly 2.2—3.8 μ wide, which extended lengthwise through each animal, gradually appropriated its fleshy substance.

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Explanation of plates I—VIII.

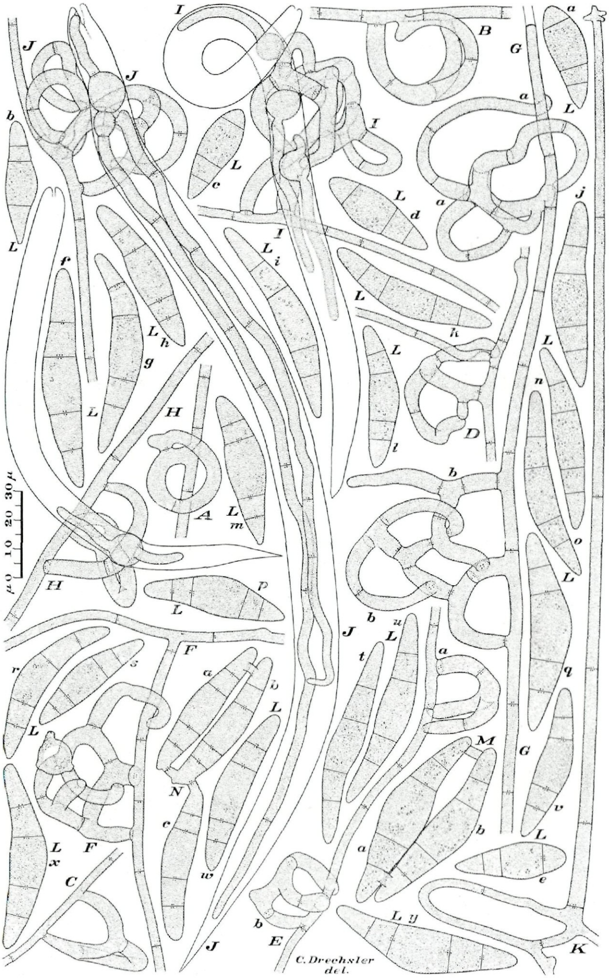
Plate I. *Dactylaria gampsospora* in nematode-infested maize-meal-agar culture, drawn at a uniform magnification with the aid of a camera lucida; × 500. A—D, Portions of hyphae, each showing an early stage in the production of an adhesive network. E, Hyphae bearing 2 small adhesive networks, a and b. F, Portion of mycelium with a larger adhesive network. G, Portion of hypha with 2 networks, a and b. H, Portion of hypha bearing a small network from which a mortiferous bulb has grown into a captured eelworm and is extending 2 assimilative hyphae. I, Portion of hypha bearing an adhesive network that has intruded into a captured nematode 3 mortiferous bulbs from which assimilative hyphae are being extended. J, Portion of hypha bearing an adhesive network that has intruded into a captured eelworm a mortiferous bulb from which assimilative hyphae have been extended lengthwise through the animal. K, Denuded conidiophore with 4 sterigmatic spurs at its tip. L, Detached conidia, a—y, showing usual variations in size, shape, and septation. M, Two conidia, a and b, united by germ tubes at the ends. N, Three conidia, a—c, united by germ tubes.

Plate II. Several predacious hyphomycetes which in all parts except D developed in nematode-infested maize-meal-agar plate cultures; drawn at a uniform magnification with the aid of a camera lucida; × 500. A, Conidiophore of *Dactylella gampsospora* that after forming 2 conidia on the spurs a and b, elongated laterally and on a new tip, c, is producing a third conidium. B(a—z), C(a—e), Detached conidia of *D. gampsospora* showing usual variations in size and shape. D, Undersized conidia, a—c, of *D. gampsospora* from a pure Petri-plate culture of maize-meal-agar 12 days after inoculation. E. Three conidia, a—c, of *D. gampsospora,* which are united by 2 germ tubes; a third germ tube is elongating unimpeded. F, Conidium, a, of *D. gampsospora,* which has sent up a germ conidiophore, b, bearing a large secondary conidium, c. G, Conidium, a, of *D. gampsospora,* which has sent up a germ conidiophore, b, bearing at the tip several denticulations from which microconidia, c—g, have become detached. H, A mycelial hypha of *D. gampsospora* with 2 slender conidiophores, a and b, each bearing at the tip small denticulations from which microconidia, c—i, have become detached. I, Conidium, a, of *Dactylella bembicodes,* that has put forth a germ hypha, b, bearing both a constricting ring, c, and a toppled conidiophore, d, from which a secondary conidiophore, e, bearing 3 microconidia, f—h, has grown out; i—k, three detached microconidia of *D. bembicodes.* J, Accompanying detached conidium of *D. bembicodes.* K, Conidium, a, of *Dactylella gephyropaga* that has put forth a germ hypha, b, from which has been extended a conidiophore, c, denuded at its tip but supporting a ramified branch, d, whereon 4 microconidia, e—h, are borne; i, accompanying detached microconidium. L, Two accompanying conidia, a and b, of *D. gephyropaga.* M, Concomitant predacious network of *D. gephyropaga.* N, Septate clampless fungus that has entensively invaded a nematode which it captured by means of a helicoid hyphal coil of 3 turns.

Plate III. *Dactylaria gampsospora* drawn at a uniform magnification with the aid of a camera lucida; ×500. A, Predacious apparatus found in pure culture of fungus on Petri plate of maize-meal agar 8 days after inoculation; a—c, unmodified hyphal prolongations. B—E, Predacious apparatus found in pure culture of fungus on Petri plates of potato-dextrose agar 17 days after inoculation; a—c, unmodified hyphal prolongations. F. Mycelium with many indurated cells, or chlamydospores, produced in pure culture on Petri plates of potato-dextrose agar within 20 days after inoculation. G, H, Portions of hyphae bearing sclerotioid masses resulting from induration of predacious networks; found in nematode-infested maize-meal-agar plate culture 50 days after addition of mealy plant detritus.

Plate IV. *Dactylella parvicollis* in nematode-infested maize-meal-agar plate cultures 39—65 days old; drawn at a uniform magnification with the aid of a camera lucida; ×500. A, Portions of hyphae, a—j, each bearing an adhesive knob. B—D, Portions of hyphae that bear 2 adhesive knobs, a and b. E, F, Portions of hyphae bearing 3 adhesive knobs, a—c, each. G—I, Portions of hyphae bearing 2 catenated adhesive cells each; in I the second cell is budding forth a third. J, Portion of hypha bearing 2 adhesive chains, a and b, each composed of 2 globose knob-cells. K, Portion of hyphae bearing an adhesive knob from which a closed hyphal loop has been extended. L, Portion of hypha bearing a predacious knob, a, and a chain, b, of 3 adhesive knob-cells. M, Portion of hypha bearing 2 adhesive knobs, a and b; the knob b has captured an eelworm (*Plectus* sp.) and intruded a mortiferous bulb from which an assimilative hypha is being extended. N, Same captured animal that is shown in M, b, but drawn 3 hours later. O, Posterior portion of same captive shown in N, but drawn 25 minutes later when all movement had ceased. P, Portion of hypha bearing on a relatively long stalk an adhesive knob from which a mortiferous bulb and an assimilative hypha have been extended into a captured eelworm (*Plectus* sp.). Q, Captured eelworm (*Plectus* sp.) extensively invaded from an adhesive knob that now is attached to the parent hypha not only by its short stalk, but also by a longer supplementary filamentous connection. R, Portion of hypha bearing 2 adhesive knobs, a and b, both of which have invaded the same eelworm (*Plectus* sp.). S, Portion of hypha with 3 adhesive knobs, a—c, participating in capture of an eelworm (*Plectus* sp.); knob a has just penetrated the animal's integument, while knobs b and c have each intruded a mortiferous bulb from which assimilative hyphae are being extended. T, An eelworm (*Plectus* sp.) extensively invaded from 2 adhesive knobs, a and b, borne on separate hyphae. U, Captured eelworm whose fleshy contents have been wholly appropriated by an assimilative hypha, which now is mostly empty. V, Detached conidium with an adhesive knob at each end. W, Detached conidium with an adhesive knob, a and b, at each end and bearing a long slender stalk surmounted by an adhesive knob, c.

Plate V. *Dactylella parvicollis* in nematode-infested maize-meal-agar plate cultures 39—65 days old; drawn at a uniform magnification with the aid of a camera lucida; ×500. A, B, Portions of hyphae each bearing an adhesive knob on a prolongation of a stalk that originally supported an earlier knob. C, D, Portions of hyphae, each bearing an adhesive knob, a, and a conidiophore, b, with a conidium, c. E—G, Portions of hyphae from each of which arises a conidiophore, a, surmounted by a conidium, b. H, I, Portions of hyphae, a, from each of which was extended a primary conidiophore, b, that after toppling on to the substratum has put forth a secondary conidiophore, c, wherefrom in turn a tertiary conidiophore, d, was produced. J, Remnant of a toppled conidiophore near which was extended a new conidiophore, a, bearing a conidium, b.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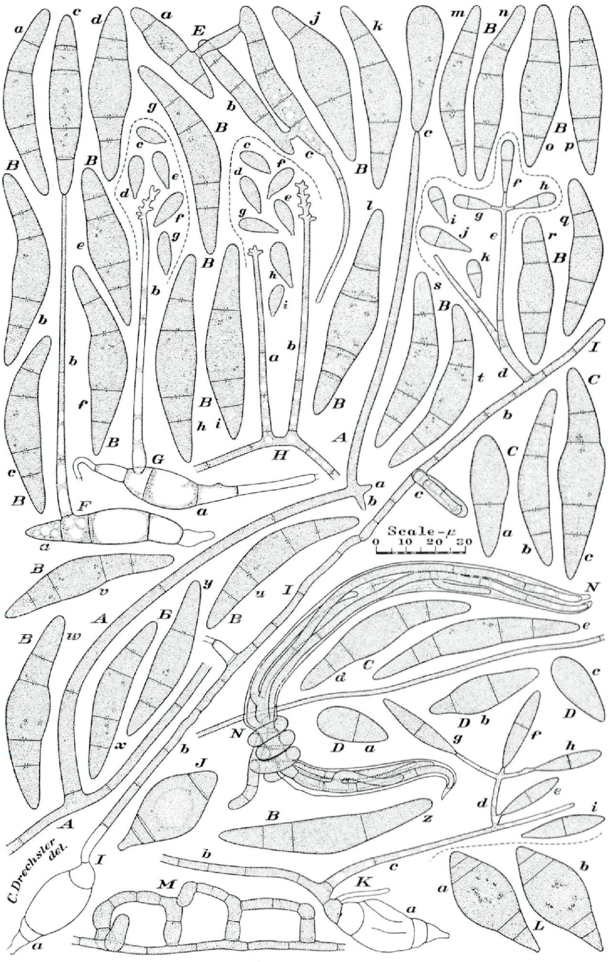
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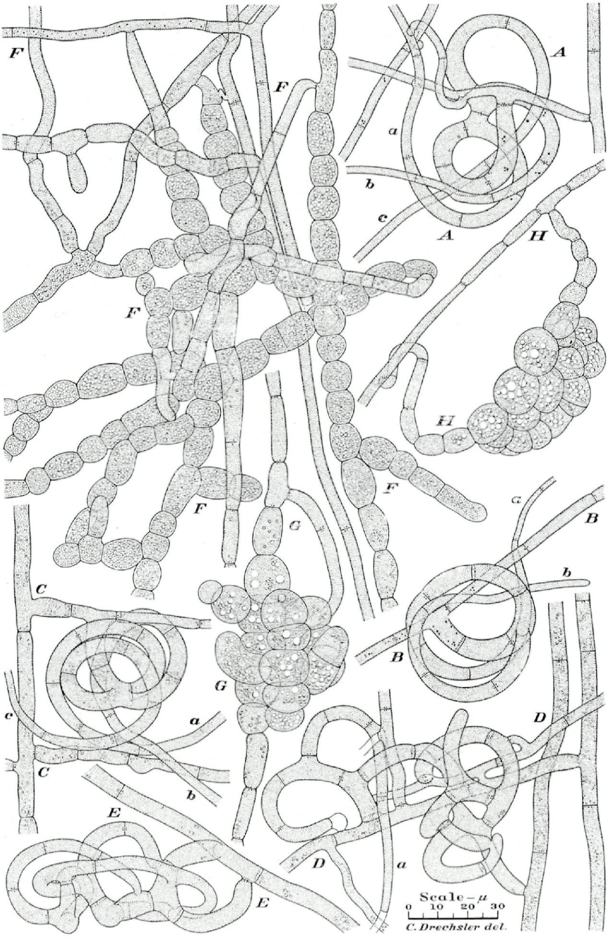
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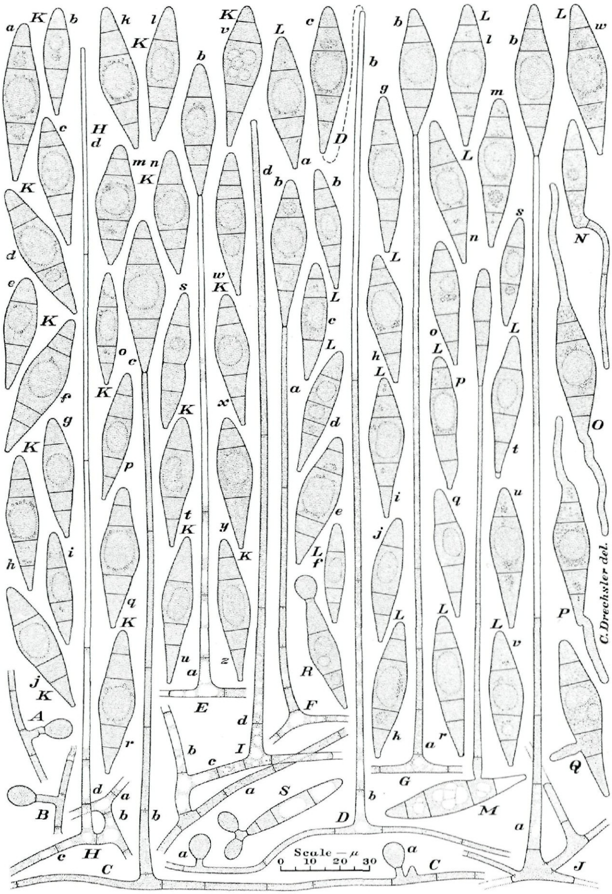
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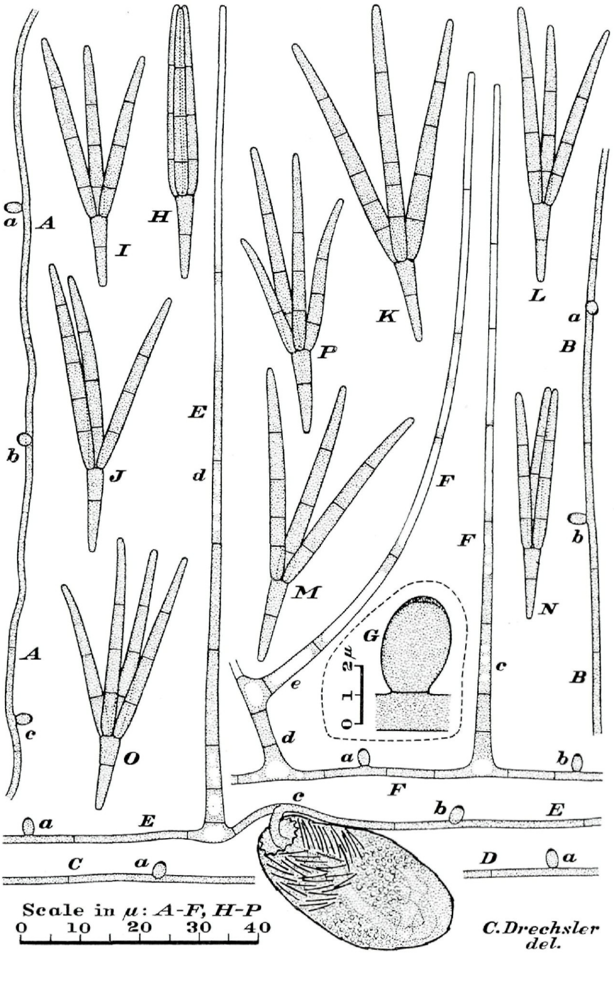
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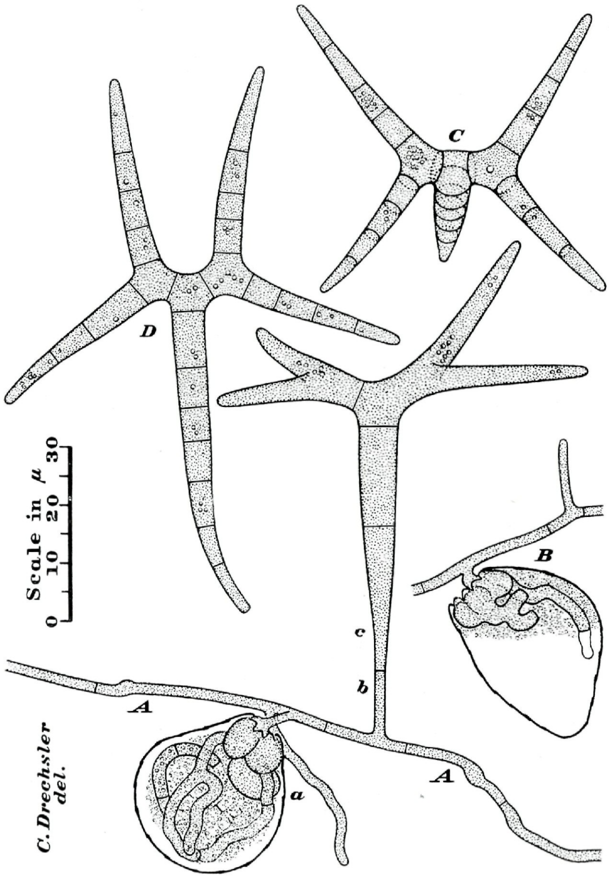
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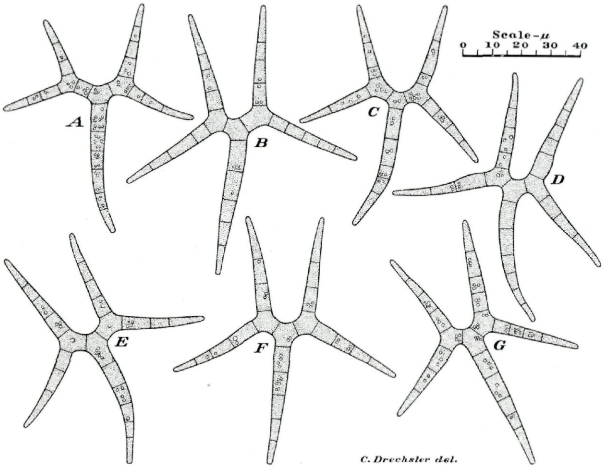
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K(a-z), L(a-w), Detached conidia showing usual variations in size and shape. M, Detached conidium that has sent up a germ conidiophore bearing a young secondary conidium. N—Q, Conidia germinating by emission of 1 or 2 germ tubes. R, Conidium provided with an adhesive knob at one end. S, Conidium with 2 adhesive knobs at one end.

Plate VI. *Tridentaria glossopaga* in maize-meal-agar plate culture 20—28 days after addition of Wisconsin leaf mold; all parts except G drawn with the aid of a camera lucida at a uniform magnification and reduced to ×1000. A, B, Portions of hyphae bearing three (a—c) and two adhesive knobs (a, b), respectively. C, D, Portions of hyphae which each bear an adhesive knob, a. E, Portion of hypha bearing 2 adhesive knobs, a and b; c, a knob that after capturing a specimen of *Euglypha levis* has elongated and thus grown into the aperture of the captive; d, a denuded conidiophore. F, Portion of hypha bearing 2 adhesive knobs, a and b, as well as a denuded conidiophore, c; another conidiophore, d, borne on it gave rise laterally to a secondary conidiophore, e. G, Profile view of adhesive knob, ×5000. H. Conidium with prongs folded close together. I—N, Detached conidia with 3 prongs somewhat spread out. O, P, Detached conidia with 4 prongs somewhat spread apart.

Plate VII. *Triposporina quadridens* in maize-meal-agar plate culture 48 days after addition of decaying plant material; drawn at a uniform magnification with the aid of a camera lucida; ×1000. A, Portion of hypha with a captured specimen of *Euglypha levis*, a, and a short conidiophore, b, bearing an immature conidium, c. B, Portion of hypha with a captured specimen of *E. levis* that has been largely expropriated of its protoplasm. C, Fully developed conidium shown in somewhat oblique top view. D, Conidium in flattened condition, as usually seen under a cover-glass.

Plate VIII. *Triposporina quadridens* in maize-meal-agar plate culture 48 days after addition of decaying plant material; drawn at a uniform magnification with the aid of a camera lucida; ×500. A—G. Fully developed conidia in flattened condition, as usually seen in a moist microscope mount under a cover-glass.