

SEVERAL SPECIES OF DACTYLELLA AND DACTYLARIA THAT CAPTURE FREE- LIVING NEMATODES

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(WITH 15 FIGURES)

Owing to their production of colorless pluriseptate conidia on tall colorless conidiophores, six clampless nematode-capturing hyphomycetes, evidently distinct from all previously described related forms of similar predacious character, are herein set forth as new species of *Dactylella* and *Dactylaria*. It is believed that the several species are distributed between the two genera in tolerable conformity with established usage, though as has been pointed out earlier (13: 467), the distinction between a solitary and a capitata sporulating habit is sometimes rather difficult to apply among members of the predacious series. The several new species came to light in agar plate cultures which after being overgrown with *Pythium* mycelium had been further planted with small quantities of decaying vegetable detritus from different localities; the decaying material in each instance supplying not only the nematodes that through rapid multiplication soon infested the agar abundantly but also the fungi by which the animals were subsequently destroyed in large numbers. Occasion is taken, besides, to set

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forth in a provisional way the predacious organs of a related nematode-capturing hyphomycete that so far has not been seen giving rise to reproductive apparatus. Some attention, furthermore, is given to a mucedinous form held referable to *Gonatobotrys simplex* Corda (9), since in its mycelial habit it offers suggestive resemblances to one of the six new species, and in its sporulating habit shows general parallelism more especially with the repeatedly nodose species of *Arthrobotrys* so widely active in the capture of eelworms.

A DACTYLELLA WITH SMALL CONSTRICTING RINGS AND MOSTLY
BISEPTATE OR TRISEPTATE CONIDIA

Several Petri plates of maize meal agar which after being overgrown with mycelium of *Pythium ultimum* Trow had been further planted with small quantities of leaf mold taken from the floor of pine (*Pinus* spp.) woods in Yellowstone National Park on August 18, 1947, became abundantly infested with eelworms during the ensuing weeks. By far the larger number of individual eelworms were conspicuously slender in shape and belonged, according to Dr. G. Steiner, to two species of *Plectus*. On microscopic examination 42 days after the leaf mold had been added the eelworms, especially those of the slender species, were found being killed over a wide area by a strangling hyphomycete differing in appearance from any known form of similar biological habit.

The vegetative mycelium of the hyphomycete came forth here and there from the deposits of opaque detritus to extend sparsely into the transparent agar. It was composed of sparingly branched colorless filaments partitioned at moderate intervals by cross-walls. At somewhat longer intervals the hyphae bore sturdy three-celled rings (FIG. 1, *A*; FIG. 2, *A, a, b*) which like the similar organs of other nematode-strangling forms were usually oriented in a plane perpendicular to the hyphal axis, and consequently were most often seen in edgewise view. The cellular make-up of the rings was better revealed in the occasional specimens that had been pushed sideways through the jostling of vigorous nematodes to be brought conveniently into lateral view (FIG. 1, *B-E; F, a, b*. FIG. 2, *B-E*); though such change in position entails some distortion of the stalk and at times also of the adjacent portion of mycelial filament. As

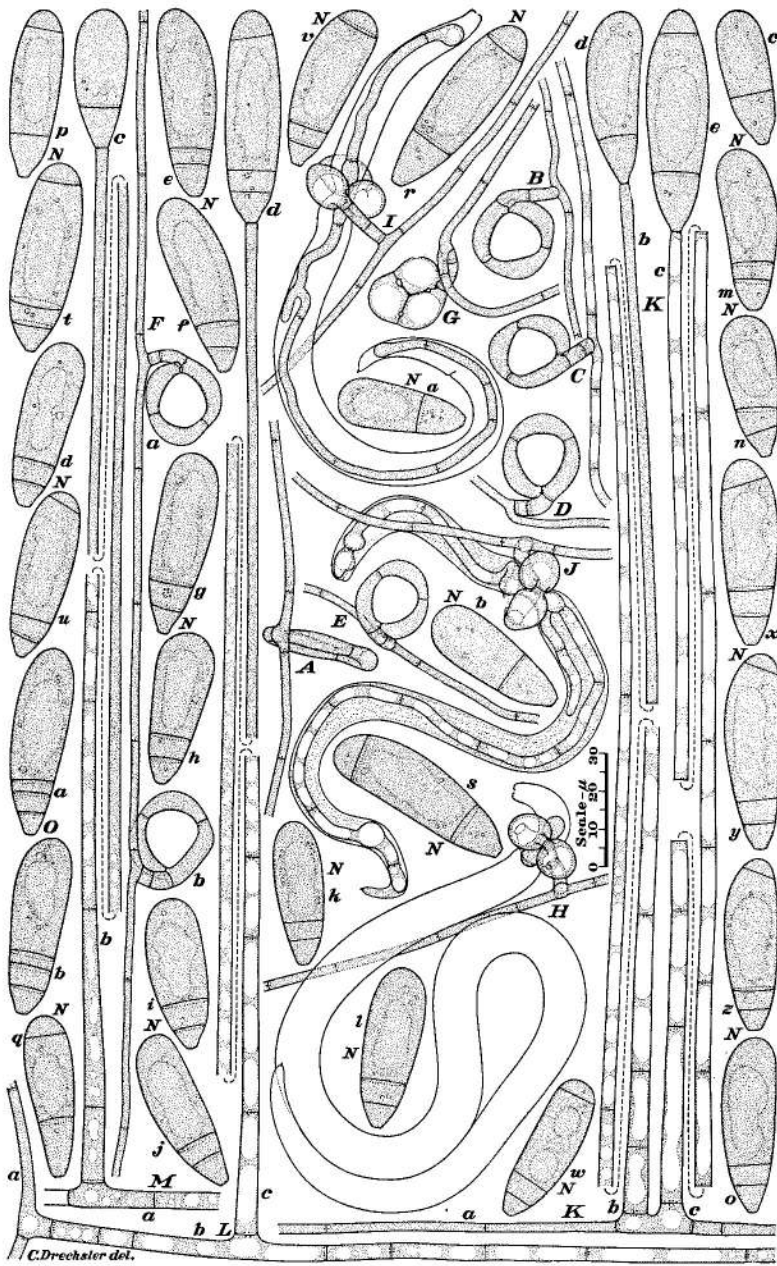


FIG. 1. *Dactylella stenobrocha*.

in other species the stalks were regularly composed of two cells. In relatively short stalks the proximal cell was often shorter than the distal cell (FIG. 1, *C*; *D*; *F*, *a*, *b*), thereby providing similarity to the strangling species I have described earlier under the binomials *Arthrobotrys dactyloides* (12: 482-487), *Dactylella bembicodes* (12: 487-492) and *Dactylaria brochopaga* (12: 514-518). Yet frequently, again, the two cells were of about equal length (FIG. 1, *B*; FIG. 2, *B-E*) somewhat as in my *Dactylella coelobrocha* (19). The rings themselves closely resembled the corresponding organs of *Arthrobotrys dactyloides*, *Dactylella bembicodes* and *Dactylaria brochopaga* in always showing smooth curvature along their rounded triangular inner profile as well as along their more nearly circular outer profile. Their three arcuate cells were never found showing at their inner profile the curious median bulge whereby the aperture of the constricting ring in my *Dactylella doedycoides* (13) and my *Dactylella heterospora* (15) is given a scalloped outline suggestive of trefoil ornamentation. They tapered moderately toward the cross-walls separating them, like the arcuate cells of most nematode-strangling species, and thus did not share the more pronounced taper characteristic of the arcuate cells in *Dactylella coelobrocha*. In general the rings here appeared of smaller and less variable size than those of any nematode-strangling form hitherto described with the exception possibly of my *Trichothecium polybrochum* (12: 535-538). The range of dimensions shown by them would in most allied species include only the constricting rings of small and medium sizes.

Here and there in the cultures where the fungus made its appearance rings were found that had closed emptily (FIG. 1, *G*; FIG. 2, *F*), thereby revealing advantageously the change of the three component cells from an elongated arcuate to an obese orbicular shape. Usually, however, the rings became closed in capturing individual specimens of the two slender species of *Plectus* (FIG. 1, *H-J*. FIG. 2, *G*; *H*, *a*; *I*; *J*) abundantly infesting the agar substratum. In some instances a ring that had closed emptily (FIG. 2, *H*, *b*) was found near one that held a captured nematode, suggesting that disturbance by the struggling captive, or perhaps impact of the animal's body against the flat side of the ring, may have supplied the stimulus that resulted in unprofitable closure. Captured

eelworms were always found indented about equally by all three swollen cells; the ring here manifestly operating in the manner most widely prevalent among nematode-strangling forms rather than in the manner distinctive of *Dactylella coelobrocha*, which commonly grips the animal between the first and second cells. As long as a captured eelworm continued struggling with some vigor, no change was observable near the constricted ring. Once the animal was capable only of feeble movements its integument was penetrated by one or more of the three swollen cells, and into its fleshy body globose protuberances were intruded forward and backward (FIG. 1, H). These protrusions soon grew out distally into assimilative hyphae which finally extended the invasion through virtually the whole length of the captive (FIG. 1, I). Frequently in very slender eelworms only a single assimilative hypha was extended forward and backward from the enveloping ring (FIG. 1, I), but in somewhat stouter animals the median portions usually came to be occupied by two hyphae (FIG. 1, J. FIG. 2, H, a; J). At the anterior end of the animal, as also at its tail end, the assimilative hyphae often showed marked distension in one or two terminal segments (FIG. 1, I, J; FIG. 2, H, I), a type of modification noted previously in *Arthrobotrys dactyloides* and *Dactylella coelobrocha*. During the progress of invasion and for some time afterwards the assimilative hyphae were obscured badly, owing to the globuliferous character of the animal's degenerating contents, but as these contents gradually diminished the assimilative hyphae emerged into view more and more clearly. When the animal's substance was in large part depleted the assimilative hyphae became noticeably vacuolate (FIG. 1, J; FIG. 2, H, J). The vacuoles increased steadily in volume on further reduction of the materials in the eelworm, until finally the hyphal envelopes were no less empty of living protoplasm than the animal's integument surrounding them.

With ample nourishment thus being obtained through expropriation of captured eelworms, the fungus produced conidiophores at variable intervals along the mycelial filaments (FIG. 1, K, a; L, a) on the surface of the agar substratum. The conidiophores (FIG. 1, K, b, c. FIG. 2, K, a; L, a) here consisted of sturdy erect septate hyphae, about 0.5 mm. high, that tapered very gradually toward the tip where each bore a solitary conidium (FIG. 1, K, d, e. FIG. 2,

K, b; L, b). After the conidium had been formed the conidiophore, while still in an erect posture, sometimes lost much (FIG. 3, *A*) or all (FIG. 3, *B*) of its protoplasmic contents. Sometimes, again, it would fall over on the substratum while all (FIG. 1, *L, b*) or some (FIG. 1, *M, a*) of its segments remained alive, and then in many instances would give rise, usually from one of its proximal segments, to a secondary conidiophore (FIG. 1, *L, c; M, b*) which, like its parent, bore a single conidium (FIG. 1, *L, d; M, c*).

The conidia produced by the fungus in nematode-infested agar cultures were regularly of elongated ellipsoidal shape. Many though not all of them were slightly wider in the distal portion than in the proximal portion. Usually the distal end was broadly rounded, whereas the lower half of the spore commonly tapered toward the somewhat rounded truncate base. They were divided variously by cross-walls ranging in number from one to three. In the uniseptate conidia (FIG. 1, *N, a-c; FIG. 2, M, a*), which were relatively infrequent, the septum nearly always delimited a long distal cell from a shorter proximal cell. The biseptate conidia, which were abundant, consisted of two short cells and one long cell; the long cell in some instances (FIG. 1, *N, d-o; FIG. 2, M, b-m*) surmounting the two short ones, and in other instances (FIG. 1, *N, p-s; FIG. 2, M, n, o*) being placed between them. The almost equally numerous triseptate conidia contained three short cells and one long cell; the long cell here most often occurring in penultimate position (FIG. 1, *N, t-z. FIG. 2, M, p-z; N*) between a short apical cell and two short proximal (*i.e.*, basal and parabasal) cells, though sometimes it occupied a terminal position (FIG. 1, *O, a, b*). In mature conidia, as a rule, the large cell contained a rather large elongated vacuole around which subspherical granules were often found scattered a little more thickly than elsewhere in the protoplasm. Conidia after falling on a moist substratum were often found sending up one (FIG. 2, *O, P*) or two (FIG. 2, *Q*) tapering aerial hyphae from any of the small cells. These aerial hyphae were noticeably more slender than ordinary germ hyphae extended by the conidia (FIG. 2, *R*) when immersed in fresh water or in some agar medium.

The fungus was isolated by removing conidia aseptically from the tall conidiophores to Petri plates of sterile maize meal agar, the

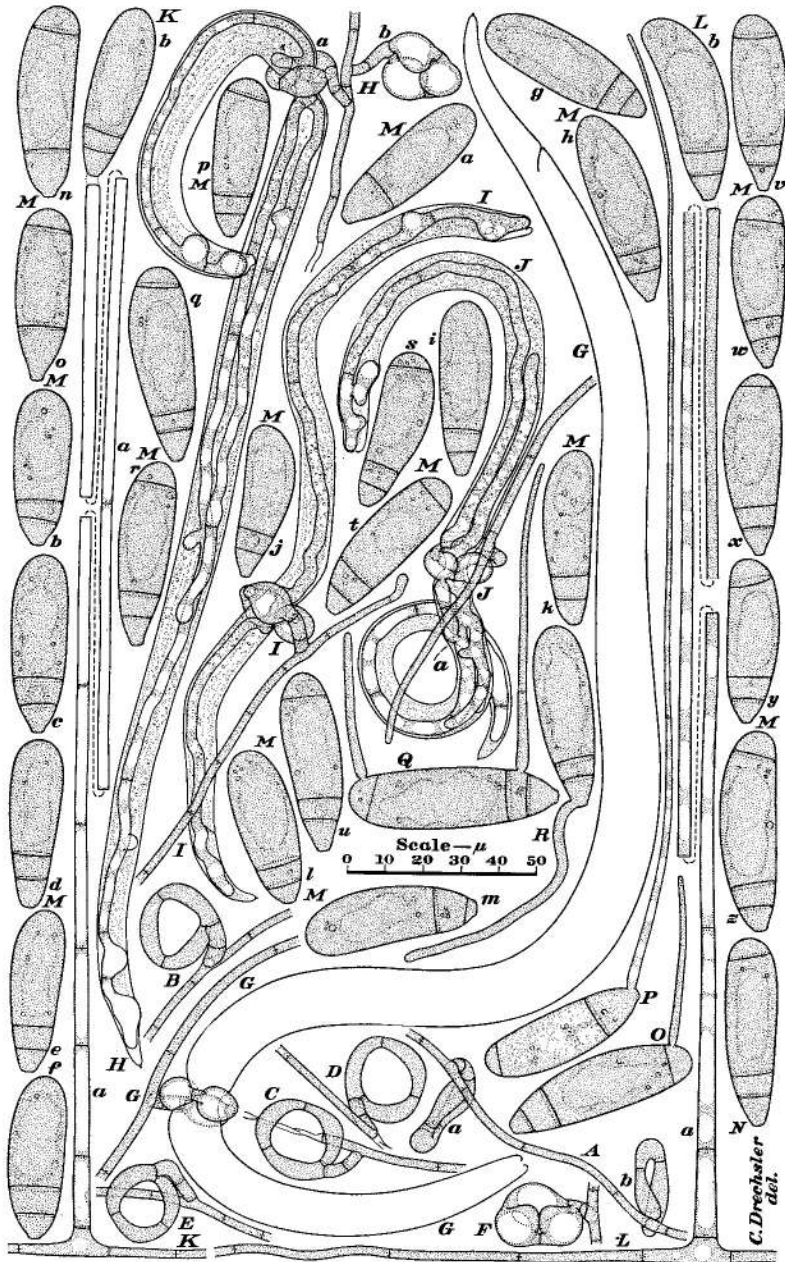


FIG. 2. *Dactylella stenobrocha*.

transfer being accomplished readily by touching the conidia with a small slab of sterile agar held on a flamed platinum spatula. In pure culture on maize meal agar kept at a temperature of 20° C. it grows with moderate rapidity, usually without forming any predacious rings. Predacious rings corresponding accurately both in their cellular make-up and in their relatively small dimensions to those produced in nematode-infested materials have, however, been found present abundantly in pure cultures of the fungus in tubes of maize meal agar that had been stored for over eleven months at a temperature of 5° C. in containers affording some protection against evaporation. As the aging cultures, on microscopical examination, showed no contamination by any bacteria, nor any admixture of other fungi, nor any infestation by animals, it would seem that the new hyphomycete can give rise to predacious rings, even though perhaps only rather slowly, without any chemical or physical stimulus from alien organisms.

Although the fungus sporulates rather freely in pure culture on maize meal agar at temperatures near 20° C., the conidial apparatus produced here differs in dimensions from that formed on nematode-infested substratum. The conidiophores (FIG. 3, *C-E*) are usually much shorter, their height ranging ordinarily from 150 to 250 μ . The conidia likewise are shorter, commonly varying from 30 to 40 μ in length; and as their width is reduced only little, if at all, they are generally of smaller size and plumper shape. Uniseptate conidia (FIG. 3, *F*, *a-o*) are produced more frequently in pure culture, though showing usually the same manner of partitioning into a longer distal cell and a shorter proximal cell that is most prevalent in nematode-infested cultures. Biseptate conidia here, much as in nematode-infested cultures, may have both cross-walls placed toward the basal end (FIG. 3, *G*, *a-h*) or may show a more symmetrical arrangement in having one cross-wall near the basal end and the other near the distal end (FIG. 3, *G*, *i-p*). Tri-septate conidia (FIG. 3, *H*), if formed less frequently than in nematode-infested cultures, usually display similar disposition of cross-walls. The fungus evidently sporulates also at relatively low temperatures, since in pure culture in tubes of maize meal agar stored at 5° C., it showed on examination after eleven and one half months an abundance of new living conidia. These conidia seemed

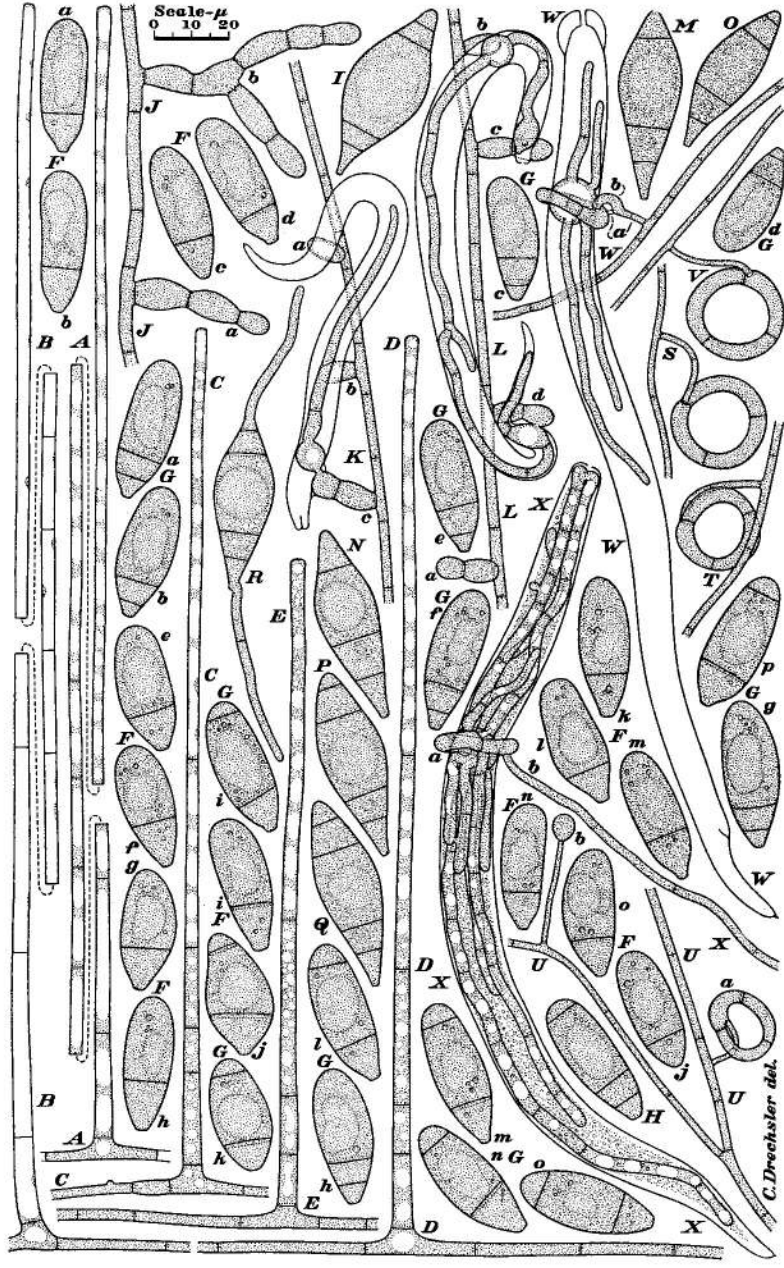


FIG. 3. A-H, *Dactylella stenobrocha*; I, *D. aphrobrocha*; J-R, *D. cionopaga*; S-X, Unnamed Hyphomycete.

generally larger than those produced at 20° C., and were given more frequently to rather pronounced curvature. The conidiophores had a tendency toward production of successive spores following repeated elongation.

Despite the promiscuous variations of its conidia in pure culture, the fungus was never found producing spores that could be regarded as belonging in a different category from the elongated ellipsoidal conidia produced in nematode-infested cultures. It was never observed giving rise to any supplementary reproductive bodies comparable, for example, to the uniseptate allantoid conidia of *Dactylella heterospora*, or to the elongated globuliferous spores of *Dactylella doedycoides*. It has never been seen provided with chlamydospores such as are present abundantly in cultures of *Arthrotrrys oligospora* Fres., nor with distinctive aggregations of enlarged indurated mycelial cells of the sort familiar in cultures of *Dactylella heterospora*, though after several months some of its wider hyphae often appear slightly indurated in that their walls are then thickened and their contents have become partly globulose. While its conidia, in their elongated shape, most nearly resemble the large regularly bisepate conidia of *Dactylella heterospora*, they have never been found produced in submerged positions under the surface of agar substrata, their contour at the base is rounded truncate rather than sharply truncate, and they frequently contain three cross-walls—so frequently, indeed, that the triseptate condition may well be regarded as being typical of the species. In their outward shape they differ markedly from the obese conidia of *Dactylella doedycoides*, as well as from the swollen turbinate conidia of *Dactylella bembicodes*; while their generally greater dimensions and different arrangement of septa distinguish them from the conidia of *Dactylaria brochoþaga*, which are usually borne in capitate clusters rather than singly.

A term having reference to its relatively small constricting rings is deemed suitable as a specific epithet for the fungus.

***Dactylella stenobrocha* sp. nov.**

Mycelium sparsum; hyphis hyalinis, mediocriter septatis, plerumque 1.7–3.7 μ crassis, hic illic ex ramulis bilocularibus (rarius trilocularibus) vulgo 8–14 μ longis et 3–4.5 μ crassis laqueos circulares 20–31 μ (vulgo circa 23 μ) latos proferentibus qui in 3 cellulis arcuatis 14–25 μ (vulgo circa 17 μ) longis

medio 4.4–5.5 μ extremo circa 3 μ crassis consistunt et foramen rotundum vel rotundo-triangulum 11–21.5 μ (vulgo circa 13 μ) latum circumdant; vermiculo nematoideo in laqueum apertum errato omnibus tribus cellulis abrupte se contrahentibus, itaque animal captivum magnopere comprimentibus, mox id trucidantibus, integumentum ejus perforantibus, hyphas intus evolventibus quae carnem exhauriunt; hyphis assumptibus incoloratis, septatis, magnam partem 2–3.5 μ crassis, sed saepe in cellulas 4–8 μ crassas abeuntibus. Hyphae fertiles incoloratae, erectae, vulgo 425–550 μ altae, basi 4.5–6.5 μ crassae, sursum leniter usque 2.5–3 μ attenuatae, 3–10 septatae, apice quandoque leviter latescentes, ibi saepe 3–4.5 μ crassae, unum conidium ferentes; conidiis hyalinis, elongato-ellipsoideis vel late digitiformibus vel interdum aliquantulum clavatis, rectis vel leniter curvatis, basi aliquid rotunde truncatis, apice late rotundatis, vulgo 34–56.5 μ longis, 12.5–16.5 μ crassis, 1–3 septatis, in una grandiore cellula et 1–3 minoribus cellulis consistentibus, grandiore cellula (in uniseptatis sporis plerumque cellula superiore, in pluriseptatis sporis plerumque cellula ultima aut paenultima) vulgo 21–38 μ longa, minoribus cellulis vulgo 3–15 μ longis.

Vermiculos nematoideos diversos praecipue nematoidea gracilia capiens consumensque habitat in humo silvestri in Yellowstone National Park, Wyoming.

Mycelium scanty; vegetative hyphae colorless, septate at moderate intervals, mostly 1.7 to 3.7 μ wide, often especially in presence of nematodes producing mostly underneath and in perpendicular positions approximately circular rings measuring 20 to 31 μ (usually about 23 μ) in outside diameter and composed individually of three arcuate cells 14 to 25 μ (usually about 17 μ) long, 4.4 to 5.5 μ wide in the middle and about 3 μ wide at the ends—the first and third of the cells being united to each other as well as to the distal end of a frequently somewhat curved bicellular (occasionally tricellular) supporting stalk commonly 8 to 14 μ long and 3 to 4.5 μ wide, and all three of the cells having a smooth profile without median protuberance on the side bordering the ring aperture; this aperture being of circular or rounded triangular shape and varying commonly from 11 to 21.5 μ in diameter, most often being about 13 μ wide. After entrance of a nematode into the ring aperture all three arcuate cells abruptly contracting, thereby constricting the animal to death or disabling it, then perforating the integument and extending lengthwise through the body assimilative hyphae for the most part 2 to 3.5 μ wide but often terminating in cells 4 to 8 μ wide. Conidiophores colorless, erect, commonly 425 to 550 μ high, 4.5 to 6.5 μ wide at the base, tapering upward very gradually to a distal width of 2.5 to 3 μ , ultimately becoming divided by 3 to 10 cross-walls, at the apex sometimes widening slightly to a diameter of 3 to 4.5 μ , and bearing there a single conidium. Conidia colorless, elongate elliptical or broadly finger-shaped or sometimes slightly clavate, straight or slightly curved, somewhat rounded truncate at the narrowed base, broadly rounded at the tip, commonly

34 to 56.5 μ long and 12.5 to 16.5 μ wide, divided by 1 to 3 cross-walls into 2 to 4 cells whereof one exceeds the other or others in size, the larger cell (in uniseptate spores usually the distal cell, in pluriseptate spores usually either the apical or the penultimate cell) commonly 21 to 38 μ long, the smaller cells commonly 3 to 15 μ long.

Capturing and consuming different nematodes, especially nematodes of slender body shape, it occurs in leaf mold in Yellowstone National Park, Wyoming.

A DACTYLELLA PRODUCING LONG-STALKED CONSTRICTING RINGS
AND QUADRISEPTATE CONIDIA

Six years ago a nematode-strangling fungus resembling *Dactylella bembicodes* in the general appearance of its tall conidiophores and solitary conidia was found developing meagerly in a maize-meal-agar plate culture which after being overgrown with mycelium of my *Pythium salpingophorum* had been further planted with a small quantity of leaf mold gathered in a deciduous wood near Fairfax, Virginia, on November 10, 1942. The fungus arrested attention because its conidia, though of broadly fusiform shape much like those of *D. bembicodes*, were nearly always divided by four rather than by three cross-walls (FIG. 3, I). As *Dactylella coelobrocha* had not then been discovered the quadrisepate condition was quite alien to the conidia of any nematode-strangling hyphomycete known at the time. It was noted, moreover, that the stalks bearing the constricting rings were in general a little longer than in *D. bembicodes*. To determine whether the observed differences came about as variations of *D. bembicodes* or derived from a separate species, attempts were made to isolate the fungus by removing its conidia to a sterile agar medium. These attempts failed owing to the unfortunate circumstance that the rather small number of conidiophores available were closely intermingled with taller sporangio-phores of a species of *Mucor*. Every lot of conidia removed was in some measure mixed with small spores of the *Mucor*. In all cultures planted with the mixture, the rapidly growing *Mucor* quickly overwhelmed the hyphomycete.

Early in 1948 the same fungus developed abundantly in more than a dozen maize-meal-agar plate cultures which, after being perme-

ated with mycelium of *Pythium debaryanum* Hesse, had been further planted with small quantities of leaf mold kindly gathered by Dr. E. B. Toole in woods consisting mainly of pine (*Pinus*) and oak (*Quercus*) trees near Greensboro, North Carolina, on December 29, 1947. From the lofty conidiophores sent up in scattered positions over extensive tracts of substratum in these cultures, conidia of the fungus were readily transferred to sterile agar without admixture of any alien organism. Ample opportunity was thus provided for comparing the fungus, in pure as well as in nematode-infested cultures, with all known hyphomycetes of similar predacious habit, apart from *Trichothecium polybrochum*, which has not been seen again since it was first encountered in 1933. The fungus from North Carolina was soon revealed as differing decisively from *Dactylella bembicodes* and *Dactylella coelobrocha*. Through its disclosure as a separate species the number of distinct mucedinous forms known to utilize constricting rings in their capture of eelworms is increased to nine.

When sizable portions are cut from pure cultures of the new *Dactylella* and placed on nematode-infested agar in Petri dishes, mycelial filaments grow out somewhat sparingly in all directions from the transferred material into the surrounding medium. While the mycelium developed by the fungus in pure culture on maize meal agar is regularly free of predacious organs, the hyphae extended into nematode-infested agar promptly give rise to constricting rings at somewhat variable intervals. These rings, much as in allied species, are commonly formed in planes perpendicular or nearly perpendicular to the mycelial filament bearing them (FIG. 4, *A*; *B*, *a*. FIG. 5, *A*). Some of them, on being jostled vigorously by robust eelworms, are turned sideways in noticeable measure (FIG. 4, *B*, *b*; *C*, *a*, *b*; *D*; *E*. FIG. 5, *B*), and a few are turned flatwise (FIG. 4, *F-H*; *I*, *a*, *b*. FIG. 5, *C-H*) so that their cellular make-up is conveniently exposed to view. On several occasions it was possible to observe progressive steps in the development of predacious rings oriented flatwise in slabs of nematode-infested agar mounted on a microscope slide under a cover glass. The developing organ in each instance first became recognizable as a circinate curved lateral branch delimited by a basal septum from the frequently somewhat narrower parent hypha (FIG. 5, *I*, *a*), and filled with

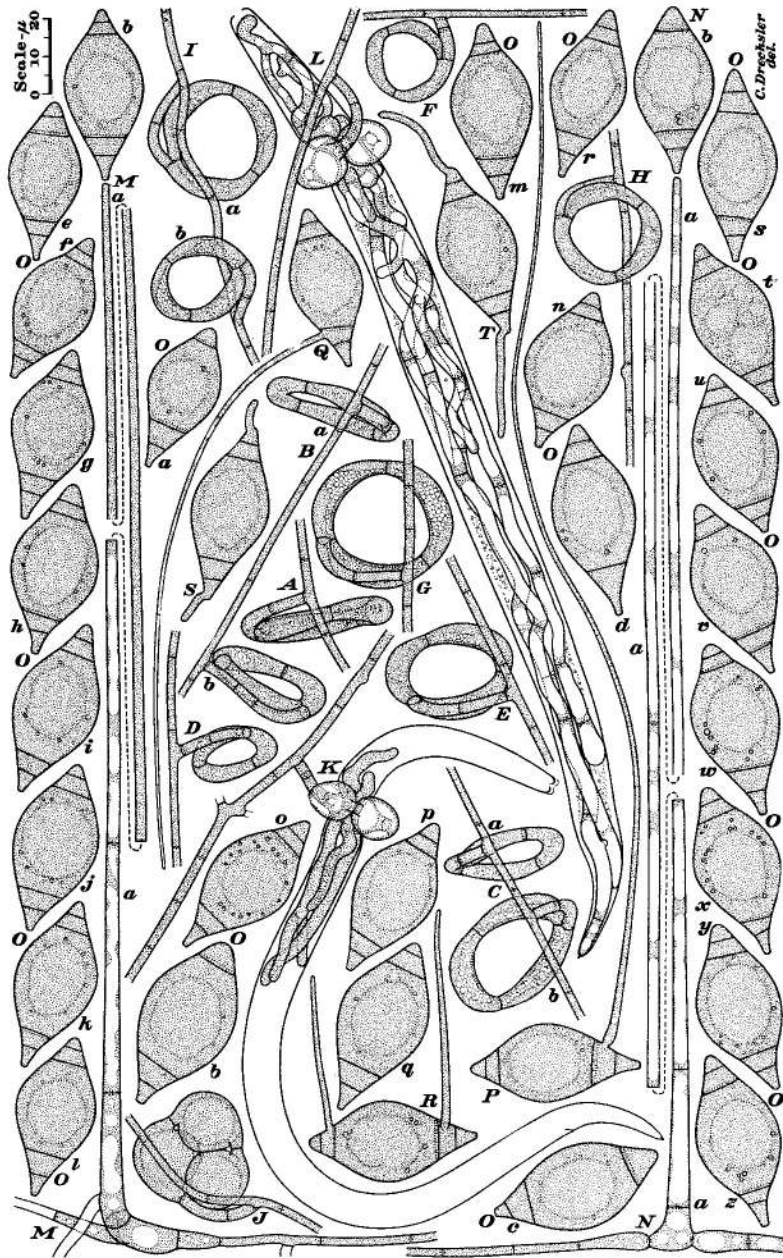


FIG. 4. *Dactylella aphrobrocha*.

protoplasm of nearly homogeneous consistency. Two cross-walls soon appeared in the proximal portion of the branch to delimit the two segments destined to make up the stalk. As the tip of the recurving branch approached the farther septum a spur grew out from the distal end of the second stalk cell to meet it (FIG. 5, *I, b*). The spur often attained a length of 3 or 4 μ before its tip encountered the tip of the branch (FIG. 5, *I, c*). At about the same time another cross-wall was formed to delimit the proximal arcuate segment of the ring that came into being as the juxtaposed tips fused broadly (FIG. 5, *I, d*). Later a second connection was established through hyphal fusion between the basal end of the proximal arcuate segment and the portion of the ring that had originated as a lateral spur. The continuity of both anastomosing connections eventually was modified through the formation of a cross-wall in each; one of the cross-walls being laid down in a position corresponding to the base of the lateral spur, whereas the other was laid down midway in the second connection. With the deposition meanwhile of another cross-wall midway between the distal end of the first arcuate segment and the septum formed at what had been the base of the lateral spur, the second and third arcuate segments were delimited from one another, thereby completing the cell divisions required in putting forth a constricting ring of usual structure (FIG. 5, *I, e*).

Departure from the usual cellular structure is observable now and then in instances where the stalk consists of three (FIG. 4, *B, b*; FIG. 5, *J*) rather than two cells. These three-celled stalks commonly exceed in length the arcuate segments of the rings supported by them, whereas the bicellular stalks are most often a little shorter than the associated arcuate segments. However, even the bicellular stalks must be considered relatively long in comparison with those of most allied species, being about equal in length to the rangy stalks of *Dactylella doedycoides* and *Dactylella heterospora*. The arcuate cells in the present fungus lack the median bulge whereby the aperture of the rings in *Dactylella doedycoides* and *Dactylella heterospora* is given a scalloped outline suggestive of trefoil ornamentation. They taper toward their delimiting septa in about the same measure as the homologous cells of all other known nematode-strangling forms apart from *Dactylella coelobrocha*. Apparently the arcuate cells acquire their definitive shape together with their

contractile power during their later stages of development. During these later stages (FIG. 5, *I, d, e*) they increase perceptibly in length as the ring enlarges, while their thickness near the septa increases in about the same proportion. In their median region, however, they undergo more pronounced widening, so that their width here often comes to be twice that of the stalk cells with which they had formed earlier a branch of fairly uniform diameter. Distinctive changes take place also in their internal structure. Arcuate cells capable of contraction show along the inner side bordering the ring aperture a rather thin layer of protoplasmic material having a characteristic dense appearance. Material of similarly dense consistency is likewise present in a layer of more variable thickness along the outer side. Between the two dense layers is an irregular elongated region filled with rather faintly visible globules which collectively offer a somewhat foamy appearance when the ring is viewed flatwise. When the ring is viewed edgewise in its normal perpendicular posture the arcuate cells appear as if they were marked by a series of curved transverse striations (FIG. 4, *A*). Presumably the globuliferous core here corresponds to the elongated vacuole or vacuole-like part displayed by the arcuate cells of *Dactylella coelobrocha*.

In nematode-infested cultures predacious organs may be found here and there that have closed emptily (FIG. 4, *J*), thus showing conveniently the pronounced contraction undergone by the three component cells in changing from an arcuate to an orbicular shape. Ordinarily, of course, closure of the organ results in the capture of a nematode; the animal being gripped most often at its anterior end (FIG. 4, *K; L; FIG. 5, K-M*), though occasionally it is held by the tail end (FIG. 5, *N*). All three swollen cells of the closed ring are indented broadly and deeply into the yielding body of the eelworm. After the captive's struggles have become feebler, presumably from exhaustion, its integument is narrowly perforated in two or three places by slender protuberances from the swollen cells. Each protuberance, on reaching the fleshy interior, widens markedly (FIG. 5, *K*) to become recognizable as an assimilative hypha (FIG. 4, *K*). The several assimilative hyphae elongate until the animal's body is invaded from head to tail (FIG. 4, *L; FIG. 5, L, N*). During their period of active growth the assimilative hyphae show only

rather scanty septation, but since they continue to form cross-walls for some time after growth ceases, they eventually are divided into segments mostly 10 to 50 μ long. In some instances the main assimilative filaments bear a moderate number of branches and spurs (FIG. 5, *M*), but in other instances, again, branching is infrequent (FIG. 4, *L*; FIG. 5, *N*), or even wholly absent (FIG. 5, *L*). Hyphal fusions between assimilative hyphal elements are to be found occasionally (FIG. 5, *M*). Although now and then an assimilative hypha terminates in a noticeably expanded cell (FIG. 4, *L*), this sort of modification would seem hardly frequent enough to be regarded as a characteristic feature of the species.

The assimilative hyphae in their progressive invasion of a captured eelworm bring about globulose degeneration of its fleshy substance, and thereby are badly obscured from view, especially if the animal's body is relatively stout. After the globulose materials have been largely absorbed by them, the hyphae become more clearly visible. On further depletion of the animal's substance, vacuoles make their appearance in the hyphal segments (FIG. 4, *L*; FIG. 5, *N*). With continued enlargement of these vacuoles, the protoplasmic contents of the assimilative hyphae are steadily withdrawn backward into the mycelial filament bearing the predacious organ, until ultimately the hyphal envelopes, like the collapsing integument surrounding them, are left entirely empty. The transfer of hyphal contents backward into the mycelial filament is sometimes accomplished by way of the stalk on which the constricting ring was produced (FIG. 4, *L*). Often, however, the original stalk degenerates (FIG. 5, *M, a*; *N, a*), very probably as the result of injury sustained from the violent struggles of the captured eelworm. Where such degeneration occurs a new hyphal element is produced to provide a passageway for the backward movement of fungus protoplasm. Usually the new hyphal element (FIG. 5, *M, b*) connects the mycelial filament with one or another of the three swollen cells. Somewhat rarely, where the swollen cells have all suffered some injury, the new connection may be established directly between the mycelial filament and the proximal hyphal cell within the animal (FIG. 5, *N, b*). In its ready development of new hyphal connections the fungus shows obvious similarity to *Dactylella doedycoides* and *Dactylella heterospora*, which, as has been noted, likewise bear

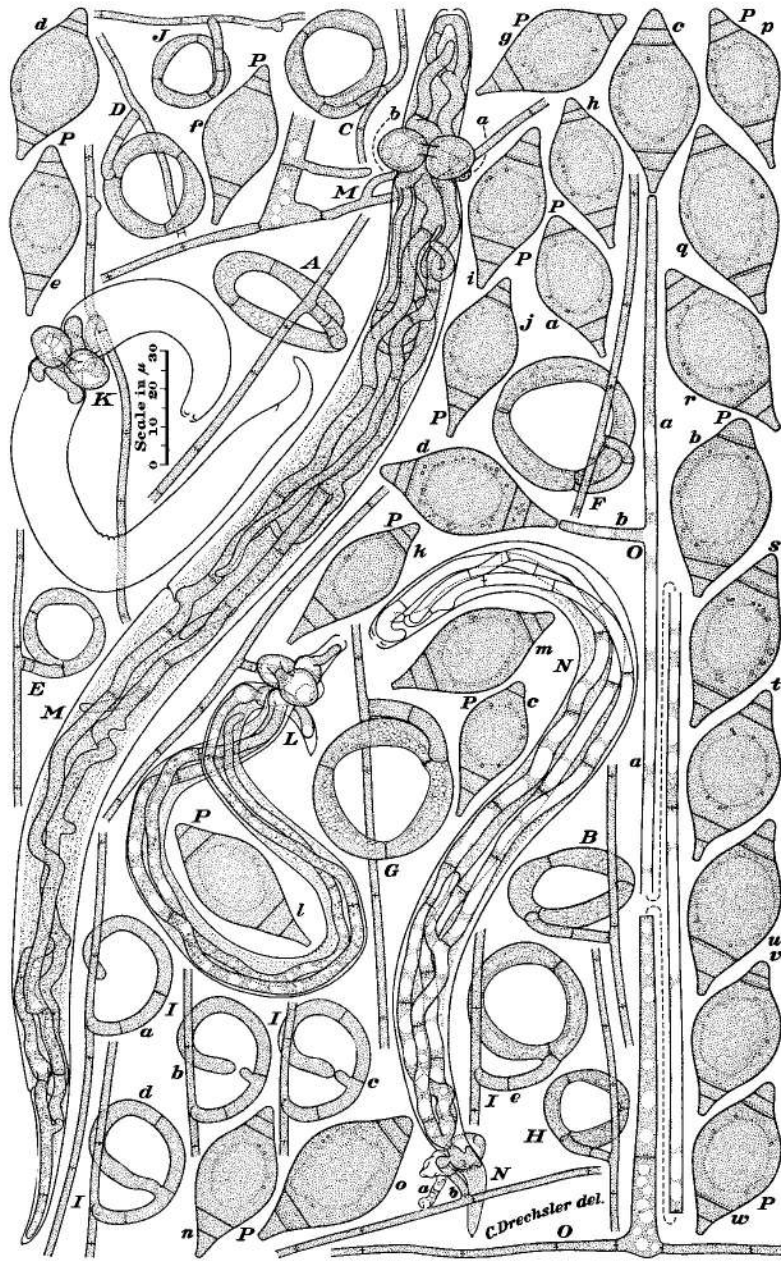


FIG. 5. *Dactylella aphrobrocha*.

their predacious rings on relatively long stalks easily injured by violent struggles of captured eelworms.

The scattered erect conidiophores sent up by the fungus from hyphae prostrate on nematode-infested substrata resemble those of *Dactylella bembicodes* in their stature and gradual upward tapering (FIG. 4, *M, a*; *N, a*). As a rule they give rise terminally to a single conidium (FIG. 4, *M, b*; *N, b*), but now and then a conidiophore (FIG. 5, *O, a*) will put forth a lateral branch (FIG. 5, *O, b*) some distance below the tip, and thus is enabled to form two conidia (FIG. 5, *O, c, d*). Although on the whole the conidia here are somewhat longer and wider than those of *Dactylella bembicodes*, and in general appear to have their greatest width rather more accurately midway between base and apex, the differences in size and shape they present in comparison with the widely distributed constricting species made known earlier are not very pronounced. In some instances they contain three cross-walls, which often delimit a small apical cell, a large ventricose penultimate cell, a small parabasal cell, and a small basal cell (FIG. 4, *O, a-c*; FIG. 5, *P, a-c*), thus bringing about the usual cellular arrangement found in spores of *Dactylella bembicodes*. Often again, however, in triseptate conidia it is the parabasal cell that is large and ventricose, while the penultimate cell, as also the apical and basal cells, will be relatively small (FIG. 4, *O, d*). Although triseptate conidia are formed rather abundantly in pure culture on maize meal agar, by far the greater number of conidia produced by the fungus in nematode-infested cultures are symmetrically quadrisepate (FIG. 4, *O, e-s*; FIG. 5, *P, d-w*); a massive ventricose cell with a large vacuole being found in median position between two smaller proximal (basal and parabasal) cells below and two smaller distal (penultimate and apical) cells above. As conidia with more than four cross-walls are virtually unknown here, the quadrisepate condition may safely be regarded as being definitive in mature spores, whereas the positions of the cross-walls in many triseptate specimens taken from actively sporulating nematode-infested cultures give ample reason for suspecting that had no disturbance intervened a fourth transverse partition would have been formed. Accordingly the data on conidial dimensions given in the diagnosis were derived, much as in the case of *Dactylella coelobrocha*, mainly from quadri-

septate specimens taken at random in mounts prepared from abundantly sporulating nematode-infested agar plate cultures. One hundred measurements for length, expressed in the nearest integral number of microns, showed a distribution as follows: 41 μ , 1; 42 μ , 2; 43 μ , 1; 44 μ , 15; 45 μ , 13; 46 μ , 21; 47 μ , 17; 48 μ , 11; 49 μ , 6; 50 μ , 3; 51 μ , 6; 52 μ , 2; 54 μ , 1; 55 μ , 1. The measurements for greatest width, relating to the same 100 conidia, were distributed thus: 17 μ , 1; 18 μ , 1; 19 μ , 7; 20 μ , 7; 21 μ , 21; 22 μ , 22; 23 μ , 25; 24 μ , 12; 25 μ , 3; 26 μ , 1; while the median cells of the 100 specimens gave values for length as follows: 23 μ , 2; 24 μ , 1; 25 μ , 7; 26 μ , 20; 27 μ , 25; 28 μ , 23; 29 μ , 14; 30 μ , 6; 31 μ , 1; 34 μ , 1. Although the conidia here are substantially shorter than those of *Dactylella coelobrocha*, the two species show rather little difference with respect to the lengths of the parabasal, median, and penultimate cells. Manifestly the conidia of *Dactylella coelobrocha* owe their greater length, as also their markedly different appearance, to their characteristically protracted basal and apical cells, which are conspicuously longer than the concomitant parabasal and penultimate cells, respectively. Often the conidia of the present fungus, while still borne aloft on the conidiophores, will put forth a slender aerial hypha, usually from the small parabasal cell (FIG. 4, P, Q), but sometimes also from the small penultimate cell (FIG. 4, R). In general these aerial hyphae resemble the slender outgrowths extended by the conidia of *Dactylella coelobrocha*, but are perhaps somewhat less rigid. As in related species they seem to be produced more profusely under warm than under cool conditions. When mature conidia fall on a moist substratum or are shallowly immersed in water, they germinate in commonplace manner by putting forth a germ hypha from the small apical cell and from the small basal cell (FIG. 4, S, T).

In recalling the globuliferous core of its contractile arcuate cells a term compounded of two words meaning "foam" and "noose," respectively, may serve as a suitable specific epithet for the fungus.

***Dactylella aphrobrocha* sp. nov.**

Mycelium sparsum; hyphis hyalinis, septatis, plerumque 1.7–3.7 μ crassis, hic illic ex ramulis bilocularibus (raro trilocularibus) vulgo 11–28 μ longis et 2.4–4.7 μ crassis laqueos circulares 20–38 μ latos proferentibus qui in 3

cellulis arcuatis consistunt et foramen rotundum vel rotundo-triangulum 12–27 μ latum circumdant; cellulis arcuatis 15–37 μ longis, medio 4–8.6 μ crassis, extremo 2.4–4.7 μ crassis, denso eorum protoplasmate circum lacunam centram elongatam globuliferam disposito; vermiculo nematoideo in laqueum apertum introito omnibus tribus cellulis abrupte se contrahentibus, animal magnopere comprimentibus, id ita necantibus, integumentum ejus perforantibus, hyphas intus evolventibus quae carnem exhauriunt; hyphis assumptibus mox mediocriter septatis, saepius plus minusve ramosis, maximam partem 2–5 μ crassis sed interdum in cellulis usque 7 μ crassis abeuntibus, quandoque inter se conjunctis. Hyphae fertiles incoloratae, erectae, saepe 450–525 μ altae, basi 6–7 μ crassae, sursum leniter attenuatae, apice circa 2 μ crassae, ibi unum conidium ferentes, quandoque ramo brevi subter apicem praeditae denique aliud conidium gignentes; conidiis incoloratis, plerumque late fusiformibus, 2–4 septatis, saepissime quadriseptatis, tum plerumque ex toto 41–55 μ (saepius circa 46.7 μ) longis et 17–26 μ (saepius circa 21.9 μ) crassis, cellula infima 4.2–9.1 μ (saepius circa 6.2 μ) longa, cellula secunda 3.2–7.6 μ (saepius circa 5 μ) longa, cellula media 22.8–34 μ (saepius circa 27.3 μ) longa, cellula paenultima 2.6–6.5 μ (saepius circa 4.1 μ) longa, cellula summa 1.8–6 μ (saepius circa 4.1 μ) longa; cellula secunda interdum etiam rarius cellula paenultima appendicem filiformem ad pares angulos emittente, appendice incolorata, recta vel curvata, continua vel 1–2 septata, 40–300 μ longa, basi 1.8–2.5 μ crassa, sursum attenuata, apice circa 0.8 μ crassa.

Vermiculos nematoideos varios capiens consumensque habitat in humo silvestri prope Greensboro, North Carolina.

Mycelium scanty, spreading; vegetative hyphae colorless, septate, mostly 1.7 to 3.7 μ wide, often, especially in presence of nematodes, giving rise on curving stalks to circular rings in usually perpendicular positions; the stalks, commonly 11 to 28 μ long and 2.4 to 4.7 μ wide, consisting usually of two cells but occasionally composed of three cells; the rings, commonly 20 to 38 μ in outside diameter and surrounding a circular or rounded triangular aperture 12 to 27 μ wide, being consistently composed of three arcuate segments; the arcuate cells usually 15 to 37 μ long, 4 to 8.6 μ wide in the middle and 2.4 to 4.7 μ wide at the ends, containing dense homogeneous protoplasm in a parietal layer surrounding a central elongated lacuna filled with numerous globules—the first and third of the cells being united to one another as well as to the distal end of the stalk, and all the cells lacking a median protrusion on the inner side; on entrance of a nematode into the aperture the arcuate cells contracting abruptly, all three indenting the animal broadly and deeply, thereby strongly constricting it and soon disabling it, then perforating its integument to extend lengthwise through its body assimilative hyphae that appropriate the fleshy contents; the assimilative hyphae for the most part 2 to 5 μ wide but sometimes terminating in cells up to 7 μ in width. Conidiophores colorless, erect, often 450 to 525 μ high, 6 to 7 μ wide at the base, tapering

gradually upward, about $2\ \mu$ wide at the tip, there bearing a single conidium, and sometimes bearing another conidium on a short branch given off a little below the tip. Conidia colorless, usually broadly spindle-shaped, sometimes 2- or 3-septate, but most often divided by four cross-walls in such wise that the middle cell is much larger than the others—then mostly 41 to $55\ \mu$ (average $46.7\ \mu$) long and 17 to $26\ \mu$ (average $21.9\ \mu$) wide, with the basal cell measuring often 4.2 to $9.1\ \mu$ (average $6.2\ \mu$) in length, the parabasal cell 3.2 to $7.6\ \mu$ (average $5\ \mu$), the median cell 22.8 to $34\ \mu$ (average $27.3\ \mu$), the penultimate cell 2.6 to $6.5\ \mu$ (average $4.1\ \mu$), and the apical cell 1.8 to $6\ \mu$ (average $4.1\ \mu$); the small parabasal cell, and occasionally also the small penultimate cell, under some conditions putting forth at a right angle with the spore axis an aerial hyphal appendage; the appendage being colorless, straight or flexuous, 40 to $300\ \mu$ long, 1.8 to $2.5\ \mu$ wide at the base, tapering gradually to a width of $0.8\ \mu$ at the tip, continuous or divided in the broader proximal portion by one or two cross-walls.

Capturing eelworms of different species it occurs in leaf mold in woods near Greensboro, North Carolina.

A DACTYLELLA WITH ADHESIVE COLUMNAR OUTGROWTHS THAT
SOMETIMES UNITE TO FORM IRREGULAR MESHES

In some maize-meal-agar plate cultures which after having been overgrown with *Pythium* mycelium had been further planted with leaf mold collected in deciduous woods near Butternut, Wisconsin, in September 1938, there appeared among various other nematode-capturing hyphomycetes a *Dactylella* that in a general way resembled *D. gephyropaga*, yet with respect to several phases of morphology differed rather markedly from that species. Its mycelial hyphae bore columnar outgrowths that not infrequently were composed of three or more cells (FIG. 3, *J*, *a*, *b*), though most often they consisted of one or two cells (FIG. 3, *K*, *a*, *b*; *L*, *a*). These outgrowths, like those of *D. gephyropaga*, were operative in capturing eelworms through adhesion (FIG. 3, *K*, *c*; *L*, *b-d*), the captives soon being disabled from intrusion of globose infective bodies and then undergoing invasion by assimilative hyphae. The fungus produced conidia which usually contained three (FIG. 3, *M-O*) or four (FIG. 3, *P*, *Q*) cross-walls, but were noticeably longer than the triseptate and quadrisepate conidia characteristic of *D. gephyropaga*. After falling on a moist substratum the conidia often ger-

minated in a commonplace manner by putting forth a germ hypha from each end (FIG. 3, R).

The same fungus came to light again a few years later in maize-meal-agar plate cultures which after being overgrown with *Pythium irregulare* Buism. had been further planted through addition of small quantities of leaf mold gathered on October 2, 1941, near Presque Isle, Maine, in woods consisting largely of poplar (*Populus* sp.) and beech (*Fagus grandifolia* Ehrh.) trees. More recently it reappeared in more than a dozen maize-meal-agar plate cultures which after being permeated with *Pythium* mycelium had been planted with small quantities of wheat (*Triticum aestivum* L.) straw kindly collected by Dr. W. J. Zaumeyer near Hermiston, Oregon, on August 20, 1947. In these later cultures the distinctive characteristics of the fungus were brought more clearly into relief through the circumstance that nearly at the same time wholly typical material of *Dactylella gephyropaga* was found developing abundantly in nematode-infested agar plate cultures planted with leaf mold collected near Greensboro, North Carolina, and near Farmer, North Carolina, late in December, 1947. On transferring conidia aseptically from erect sporophores to tubes of sterile maize-meal agar the Oregon hyphomycete was obtained in pure culture. Comparison with pure cultures of *D. gephyropaga* originating from the two aforementioned localities in North Carolina as well as from several localities in Maryland and Virginia revealed it as a separate species of the same genus. Since the new *Dactylella* here in question has so far been obtained only from northern localities, and has never been recognized in the numerous cultures which in the course of 15 years were prepared with decaying detritus from many different places near Washington, D. C., there is reason to suspect that it may be distributed in colder regions than *D. gephyropaga*.

In the laboratory, certainly, the new fungus shows adaptation to lower temperatures than *Dactylella gephyropaga*. When portions of agar newly permeated with its mycelium are excised from pure cultures and placed on nematode-infested substratum kept at temperatures between 25° and 30° C., scarcely any hyphae are extended from the transferred mycelium, and virtually no eelworms will be captured, though within this temperature range under like conditions *D. gephyropaga* promptly sends out mycelial hyphae in

all directions, and on them produces columnar outgrowths and scalariform networks that operate with spectacular efficiency in the capture of nematodes. When similar preparations are kept at temperatures between 15° and 18° C., however, the two fungi show reversed capacity for predacious activity; the new species soon extending many mycelial filaments well beset with columnar outgrowths effective in capturing eelworms, whereas *D. gephyropaga* will remain almost wholly inactive. Owing to its different temperature adaptations and its departures in morphology the new *Dactylella* compares with *D. gephyropaga* in much the same way as my *Dactylaria psychrophila* (16: 154-163) compares with the apparently more widespread retiary hyphomycete I described earlier under the binomial *Dactylaria thaumasia* (12: 518-523).

Unlike *Dactylella gephyropaga*, the Oregon strain of the new *Dactylella* (FIG. 6; FIG. 7), as also the strains from northern Wisconsin and northern Maine, often gives rise to predacious organs about as freely when growing undisturbed in pure culture on maize-meal agar (FIG. 6, A-F; FIG. 7, A-C) as when developing on nematode-infested substratum. In either type of culture some of the predacious organs consist individually of a short, stout, dome-shaped or columnar unicellular outgrowth filled uniformly with dense protoplasm of finely granular texture (FIG. 6, A; B; C, a; E, a. FIG. 7, B, a). The columnar outgrowths of somewhat greater length are commonly pluricellular, consisting of two (FIG. 6, C, b, c; E, b. FIG. 7, A, a; B, b; D, a), three (FIG. 7, A, b), four (FIG. 6, D, a; E, c-e), or more (FIG. 6, F) cells. Here and there two bicellular outgrowths may be found united distally by a unicellular bridging segment (FIG. 6, C, d) to form a rectangular mesh similar in shape and cellular make-up to the meshes of *Dactylella gephyropaga*. In addition, meshes of rectangular shape occur that show only little departure from the design characteristic of *D. gephyropaga* in having the columnar outgrowths united distally by a two-celled (FIG. 7, B, c) rather than by a one-celled bridging connection. On the whole, however, union between columnar outgrowths is much less frequent than in *D. gephyropaga*, and takes place in a more haphazard manner so that for the most part meshes are formed singly in promiscuously scattered positions, with comparatively little uniformity of size, shape, or cellular composition (FIG. 6, D, b,

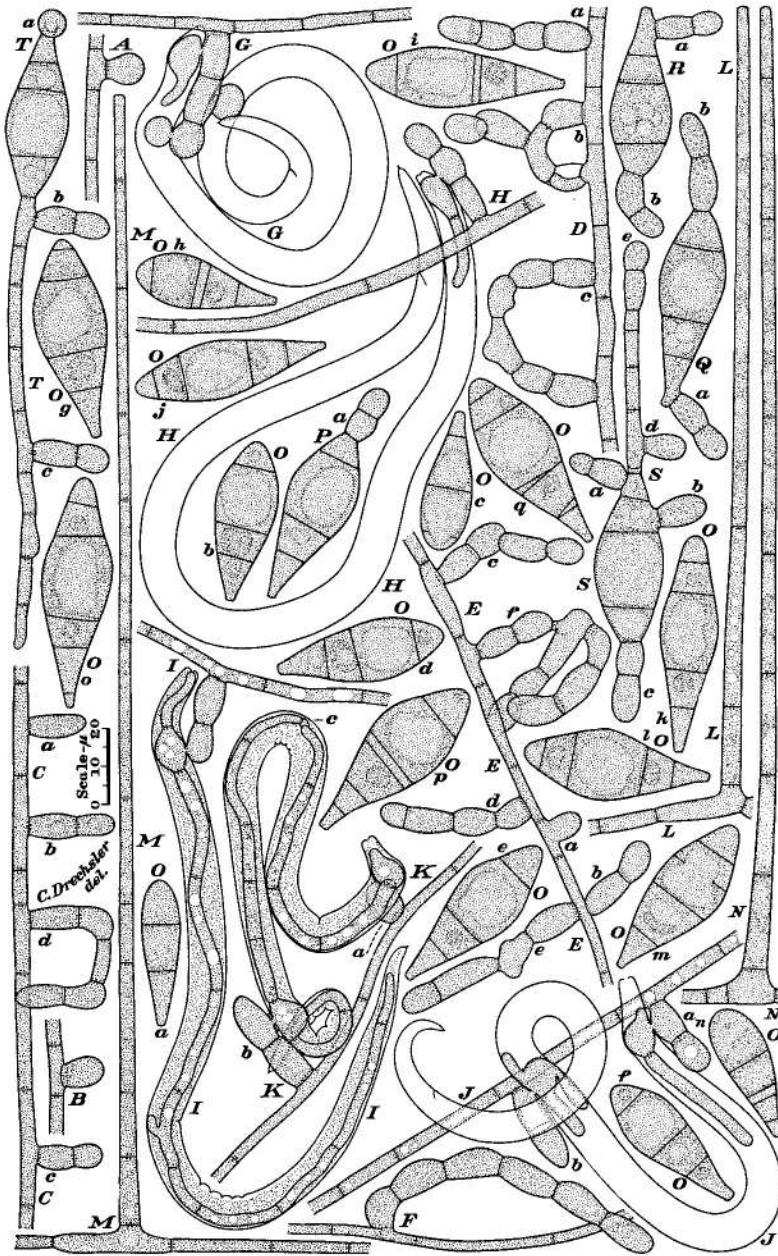


FIG. 6. *Dactylella cionopaga*.

c; *E*, *f*. FIG. 7, *C*). The arrangement of numerous meshes into extended scalariform networks, so frequent in *D. geophyropaga*, is not characteristic of the present fungus.

Since the new species forms closed meshes in lesser number than *Dactylella geophyropaga*, its capture of nematodes is accomplished almost wholly through adhesion. Very frequently only a single outgrowth is operative in holding an eelworm (FIG. 6, *G-I*; FIG. 7, *E-H*), though often, again, two or more outgrowths (FIG. 6, *J*, *a*, *b*; *K*, *a*, *b*. FIG. 7, *D*, *b*, *c*) are found participating. No coating of adhesive material is to be seen on the undisturbed outgrowth, but after a struggling animal has been held fast for some time a sizable cushion of colorless glutinous substance often becomes visible, especially in instances where the contact between fungus and eelworm is conveniently presented in profile view (FIG. 6, *K*, *b*; FIG. 7, *E*). Soon after capture is effected the animal's integument is narrowly perforated by one or more slender protrusions put forth by the fungus. Where pluricellular outgrowths are operative a protrusion may be extended from any or all of the component segments. Thus in the case of bicellular outgrowths, sometimes the distal segment (FIG. 6, *I*; *K*, *b*. FIG. 7, *D*, *c*; *E*) and sometimes the proximal segment (FIG. 6, *J*, *a*, *b*; FIG. 7, *F*, *G*) is directly active in penetrating into the captive; while with three-celled outgrowths penetration may take place from the median segment (FIG. 6, *H*), from the basal and apical segments (FIG. 7, *H*), or from all segments (FIG. 6, *G*). Once the integument is penetrated the narrow protrusion gives rise within the fleshy interior to a globose infective body (FIG. 6, *G*) that continues to enlarge until it occupies the entire width of the animal and in some instances may even distend the integument noticeably (FIG. 6, *K*, *b*; FIG. 7, *G*). The globose infective body, as in many other nematode-capturing hyphomycetes, disables the animal, and thereupon puts forth assimilative hyphae (FIG. 6, *H*, *J*; FIG. 7, *E*, *H*) which invade the helpless captive lengthwise (FIG. 6, *F*) until it is occupied from head to tail (FIG. 6, *I*, *K*; FIG. 7, *D*). Where the captured eelworm is very slender, like the eelworms that abundantly infested the plate cultures planted with the Oregon wheat straw (FIG. 6, *G-K*; FIG. 7, *D*, *F-H*), only a single assimilative hypha may be developed in most portions of the fleshy body, though stouter animals usually become permeated

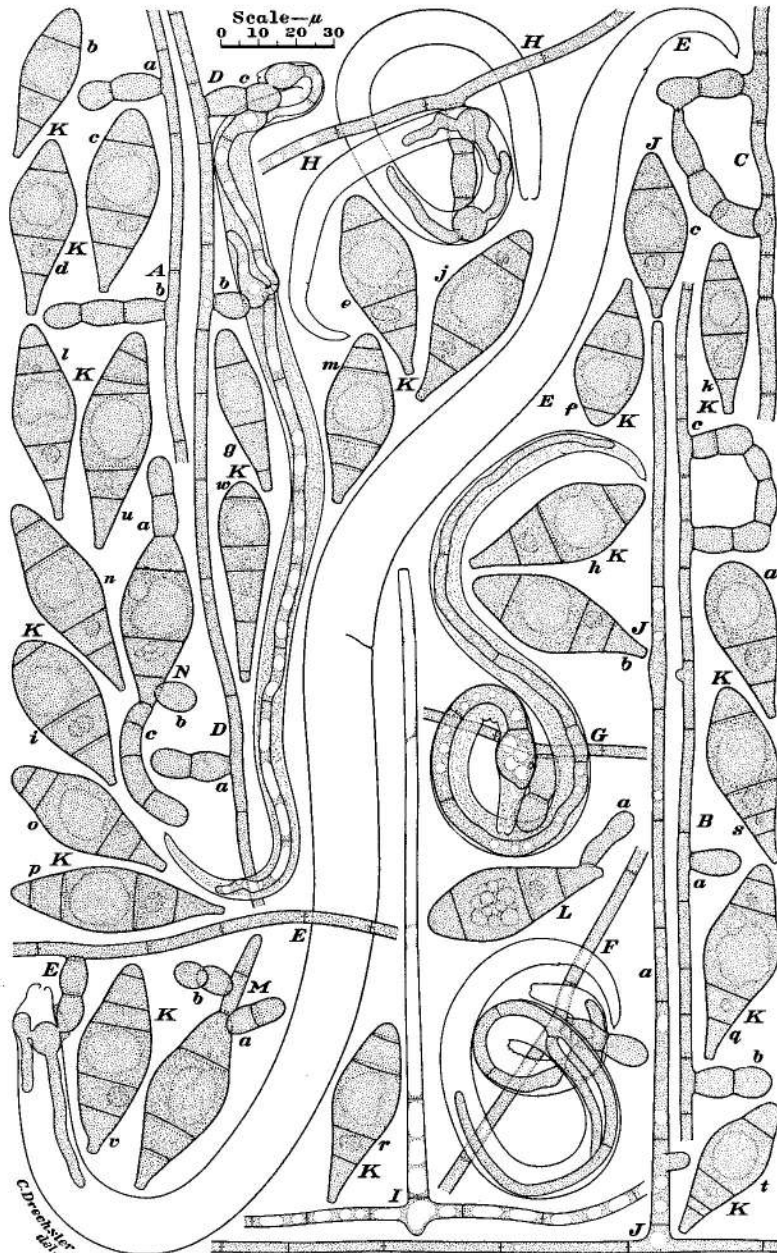


FIG. 7. *Dactylella cionopaga*.

by assimilative hyphae in numbers from two to six. Assimilative filaments of separate origin, and in stout eelworms assimilative hyphae arising from the same infective body, often become united distally through vegetative fusion (FIG. 6, *K, c*). After they have largely absorbed the globulose degenerating contents of the nematode, the assimilative hyphae show an increasingly vacuolate condition (FIG. 7, *D*). Ultimately as the animal becomes wholly depleted of digestible material the assimilative hyphae, through continued withdrawal of protoplasm backward into the external mycelium, are emptied of all living contents, and their membranous envelopes, together with the collapsing integument of the eelworm, gradually vanish from sight.

The fungus sporulates readily both in pure culture and on nematode-infested substratum. Its erect conidiophores (FIG. 6, *L-N*; FIG. 7, *I*) commonly vary from 170 to 300 μ in height, and thus seem generally shorter than those of *Dactylella gephyropaga*, as well as of most other similarly robust nematode-capturing hyphomycetes. Often a conidiophore (FIG. 7, *J, a*) after forming one conidium terminally (FIG. 7, *J, b*) will resume growth to produce a second conidium (FIG. 7, *J, c*) on a new tip farther upward; the first conidium being thereby pushed sideways and then presenting much the appearance of having been formed laterally. Occasionally growth is resumed once again, with ensuing development of a third conidium above the second, which in the meantime has like the first been brought into a lateral position.

The conidia thus formed, while of about the same width as those of *Dactylella gephyropaga*, are of noticeably greater length, and consequently have a somewhat more elongated shape together with greater volume. At the distal end they usually are broadly rounded, whereas proximally they taper toward a bluntly truncate base; so that they show various intergradations from a broadly fusiform to a clavate shape. In their septation they vary more than the conidia of *D. gephyropaga*, or of *D. aphrobrocha* and *D. bembicodes* among related constricting species. Many of the smaller, usually clavate specimens contain only two cross-walls (FIG. 6, *O, a*; FIG. 7, *K, a*). Among well developed conidia individuals with three (FIG. 6, *O, b-f*; FIG. 7, *K, b-i*) or four (FIG. 6, *O, g-n*; FIG. 7, *K, j-t*) cross-walls predominate, though not infrequently a five-

septate condition (FIG. 6, *O*, *o*, *p*; FIG. 7, *K*, *u-w*), virtually unknown in *D. gephyropaga* as also in *D. aphrobrocha*, and even a six-septate condition (FIG. 6, *O*, *q*) is encountered here. In quadri-septate specimens the cross-walls most commonly are placed in symmetrical arrangement (FIG. 6, *O*, *g*, *j*, *k*, *l*; FIG. 7, *K*, *j-r*) with a large cell occupying a median position between two smaller distal (apical and penultimate) cells and two smaller proximal (basal and parabasal) cells, yet rather often they occur in unsymmetrical arrangements with the large cell placed in penultimate (FIG. 6, *O*, *h*, *i*; FIG. 7, *K*, *s*, *t*) or in terminal (FIG. 6, *O*, *n*) position. The large cell of mature conidia contains usually a big conspicuous vacuole, while one or two of the remaining cells reveal commonly a globose mass that seems to be composed of densely conglomerated coarse granules. In some conidia where the large cell apparently begins to undergo division after its big vacuole has been formed, the belated cross-wall is laid down only within the parietal protoplasmic layer, leaving a large opening through which the vacuole extends from one daughter cell to the other (FIG. 6, *O*, *c*, *m*). Here and there a septum may be found that does not extend entirely across the conidium, but cuts off merely a small wedge-like portion from the proximal or the distal end of one of the larger cells (FIG. 6, *O*, *q*.)

Instead of germinating in commonplace manner by emission of a germ hypha from each end, many conidia after falling on a moist substratum give rise directly to adhesive outgrowths. Most frequently these outgrowths are put forth from one or from both of the end cells (FIG. 6, *P*, *a*; *Q*, *a*, *b*; *R*, *a*, *b*; *S*, *a*, *c*; *T*, *a*. FIG. 7, *L*, *a*; *M*, *a*; *N*, *a-c*), though sometimes they are found arising from intermediate cells (FIG. 6, *S*, *b*). Often, again, a conidium gives rise to one or more adhesive outgrowths (FIG. 6, *S*, *d*, *e*; *T*, *b*, *c*. FIG. 7, *M*, *b*) on a stout germ hypha. Such germ hyphae, which in themselves seem to lack adhesiveness, consist as a rule of only a few rather short segments, yet occasionally they may attain a length in excess of 100 μ (FIG. 6, *T*). While the adhesive outgrowths produced by detached conidia, like those arising from mycelial hyphae, commonly consist of one or two cells, in more than a few instances they are composed of three or four segments (FIG. 7, *N*, *c*).

In view of the frequently columnar shape of the predacious outgrowths a term compounded of two words meaning "pillar" and "trap," respectively, is proposed as specific epithet for the fungus.

***Dactylella cionopaga* sp. nov.**

Mycelium sparsum; hyphis incoloratis, ramosis, mediocriter septatis, plerumque 2-5 μ crassis, hic illic prominentia glutinosa ferentibus; prominentibus glutinosis quandoque tuberiformibus sed saepius columnaribus, simplicibus vel parce ramosis, plerumque 10-90 μ longis, 5.5-10.5 μ crassis, in 1-7 (saepius in 1 vel 2) cellulis protoplasmate dense granuloso farctis consistentibus, ad septa leviter constrictis, quandoque inter se inordinatim conjunctis, rarius in laqueos quadrilateros vel semicirculos connexis—his prominentibus laqueisque vermiculos nematoideos errantes tenentibus, deinde tum integumentum animalis captivi perforantibus, tuber mortiferum intrudentibus, hyphas assumentes evolventibus quae carnem exhauriunt; hyphis assumentibus plerumque 2-5 μ crassis, mediocriter septatis. Hyphae fertiles incoloratae, erectae, vulgo simplices, 2-11 septatae, plerumque 170-300 μ altae, basi 5-7 μ crassae, sursum leniter attenuatae, apice saepe circa 3 μ crassae, ibi unum conidium ferentes, interdum recrescentes et 1 vel 2 alia conidia gignentes; conidiis incoloratis, plerumque late fusiformibus vel aliquid clavatis, apice late rotundatis, basi truncatis, vulgo 35-60 μ longis, 13-21 μ latis, 2-6 septatis plerumque triseptatis et quadrisepatis, post disjunctionem prominentia glutinosa praecipue ex apice et ex basi atque ex hypha germinationis brevi saepe emittentibus.

Vermiculos nematoideos diversos capiens consumensque habitat in stramento Tritici aestivi putrescenti prope Hermiston, Oregon, atque in humo silvestri prope Butternut, Wisconsin, et prope Presque Isle, Maine.

Mycelium scanty, spreading; vegetative hyphae colorless, septate, mostly 2 to 5 μ wide, here and there giving rise to adhesive outgrowths; adhesive outgrowths sometimes tuberiform but more often columnar, simple or branched, mostly 10 to 90 μ long, 5.5 to 10.5 μ wide, composed of 1 to 7 (usually of 1 or 2) cells densely filled with finely granular protoplasm, noticeably constricted at the septa, sometimes becoming fused with one another and thereby forming meshes which occasionally are rectangular or semicircular but more usually are of irregular shape—these outgrowths and meshes capturing nematodes through adhesion, later narrowly perforating the integument of each captured animal, then intruding a globose infective body and extending assimilative hyphae lengthwise through the interior to appropriate the fleshy contents; the assimilative hyphae 2 to 5 μ wide, septate at moderate intervals. Conidiophores colorless, erect, commonly unbranched, eventually divided by 2 to 11 cross-walls, mostly 170 to 300 μ high, 5 to 7 μ wide at the base, gradually tapering upward, about 3 μ wide at the tip, there producing a single conidium, though sometimes after repeated elongation forming one or two additional conidia. Conidia

colorless, mostly broadly spindle-shaped or somewhat clavate, broadly rounded at the distal end but at the narrower proximal end tapering toward the bluntly truncate base, commonly 35 to 60 μ long, 13 to 21 μ wide, containing 2 to 6 cross-walls though most usually triseptate or quadrisepate, often germinating by putting forth adhesive outgrowths especially from the basal and apical segments, though sometimes from an intermediate segment or from a short non-adhesive germ hypha.

Capturing and consuming different species of nematodes it occurs in decaying culms of *Triticum aestivum* near Hermiston, Oregon, and also in leaf mold from deciduous woods near Butternut, Wisconsin, and near Presque Isle, Maine.

A RETIARY DACTYLARIA PRODUCING TRISEPTATE CONIDIA FREQUENTLY OF UNUSUAL WIDTH

Agar plate cultures prepared, as opportunity offered, with small quantities of decaying material found on plant specimens received from Florida and Louisiana during the last 15 years have brought to light many of the nematode-capturing fungi that occur everywhere in the region surrounding Washington, D. C. In addition to *Arthrobotrys oligospora*, *A. conoides*, and *A. musiformis* Drechsler (12: 477-482) among the hyphomycetes employing adhesive networks for capturing eelworms, these plate cultures often displayed abundant development of predacious and reproductive apparatus wholly typical of *Dactylaria thaumasia*. Now and then they showed, further, a retiary form that arrested attention because many of its broad triseptate conidia appeared to be considerably wider than those of *D. thaumasia*. As the plate cultures were nearly always overrun by mites at an early stage, owing to heavy infestation of these animals in material from southern localities, they gave little encouragement for closer study or for isolation of the aberrant form. Better conditions for appropriate treatment were eventually given when presumably the same fungus developed rather extensively in several maize-meal-agar plate cultures which after being overgrown with mycelium of *Pythium ultimum* Trow had been further planted by adding small quantities of leaf mold gathered in deciduous woods near Roanoke, Virginia, on October 11, 1946. From observations on both pure and nematode-infested cultures the

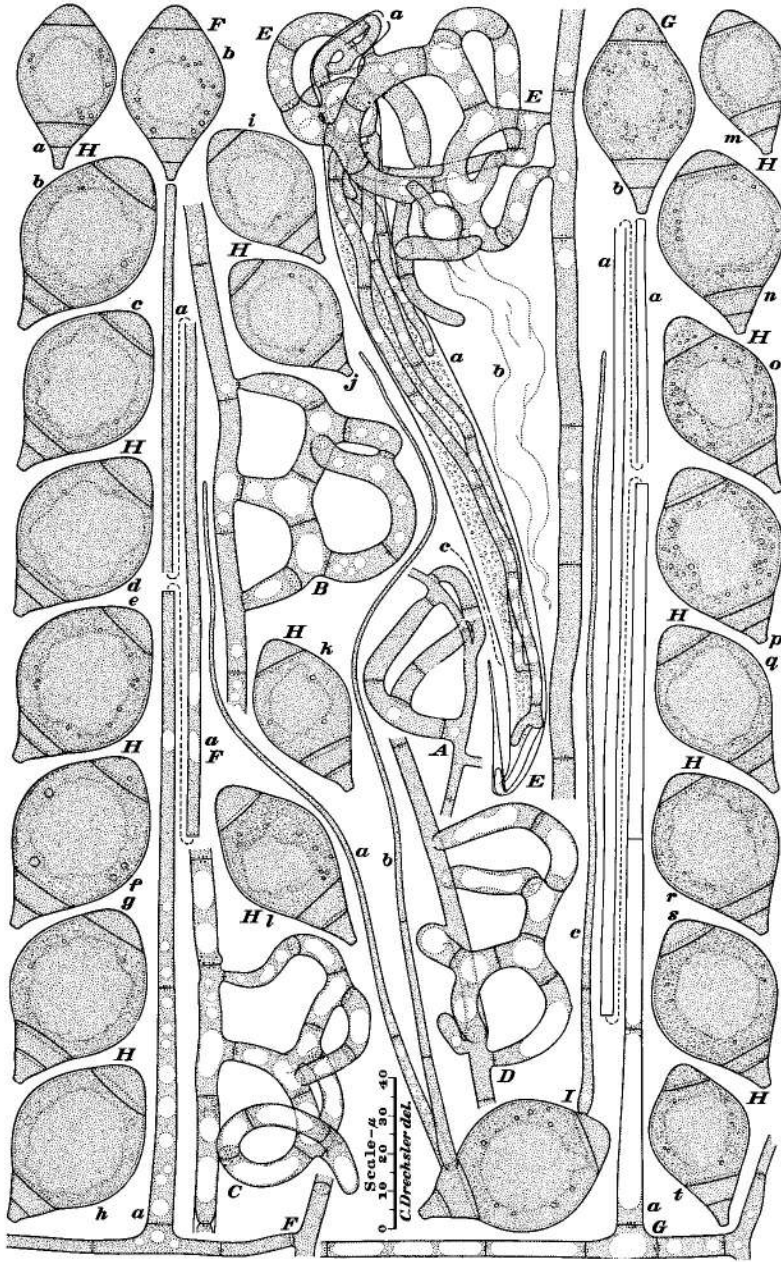


FIG. 8. *Dactylaria eudermata*.

fungus here concerned would seem to differ sufficiently from *D. thaumasia* to merit recognition as a separate species.

When sizable portions of agar well permeated with young mycelium are excised from pure cultures of the new hyphomycete and placed on agar plate cultures well infested with eelworms of such genera as *Rhabditis*, *Panagrolaimus*, *Acrobelloides*, and *Plectus*, new hyphae are extended in all directions from the transferred mycelium into the surrounding substratum. These radiating hyphae give rise at varying intervals to three-dimensional networks (FIG. 8, *A-D*; FIG. 9, *A, B*) which like the similar networks in many allied species are produced through successive development of rather thick recurving branches (FIG. 9, *C, a*). Each of these branches forms a closed semicircular loop or bail-like element by fusing terminally, at some distance from its origin, with a small protuberance put forth by a neighboring hyphal segment. The single fusion here takes place in much the same manner as each of the two fusions usually accomplished in the formation of a constricting ring. After the tips of the recurved branch and the opposed protuberance have come together somewhat broadly (FIG. 9, *C, b*) the portions of membrane at the surface of contact dissolve away (FIG. 9, *C, c*), though some time later the resulting continuity is modified by deposition of a cross-wall near the place of union (FIG. 9, *C, d*).

The hyphal bails and the networks compounded from them operate much like the similar apparatus employed by various other nematode-capturing hyphomycetes. Eelworms that in their continuous movement happen to run afoul of these structures are held fast despite their energetic struggles to escape. In some instances where little hyphal enwrapment is to be seen (FIG. 10, *A*) the captured animal must obviously be held mainly if not wholly through adhesion; but in other instances encirclement of the animal in one or several meshes (FIG. 9, *D*) gives reason for belief that it is held through both adhesion and entanglement. Following narrow perforation of the integument, the fungus disables the struggling eelworm by intruding one (FIG. 10, *A*) or more (FIG. 9, *D*) globose infective bodies from which assimilative hyphae are then extended (FIG. 9, *D*) to invade the fleshy interior from head to tail (FIG. 10, *B*). At first the assimilative hyphae are badly ob-

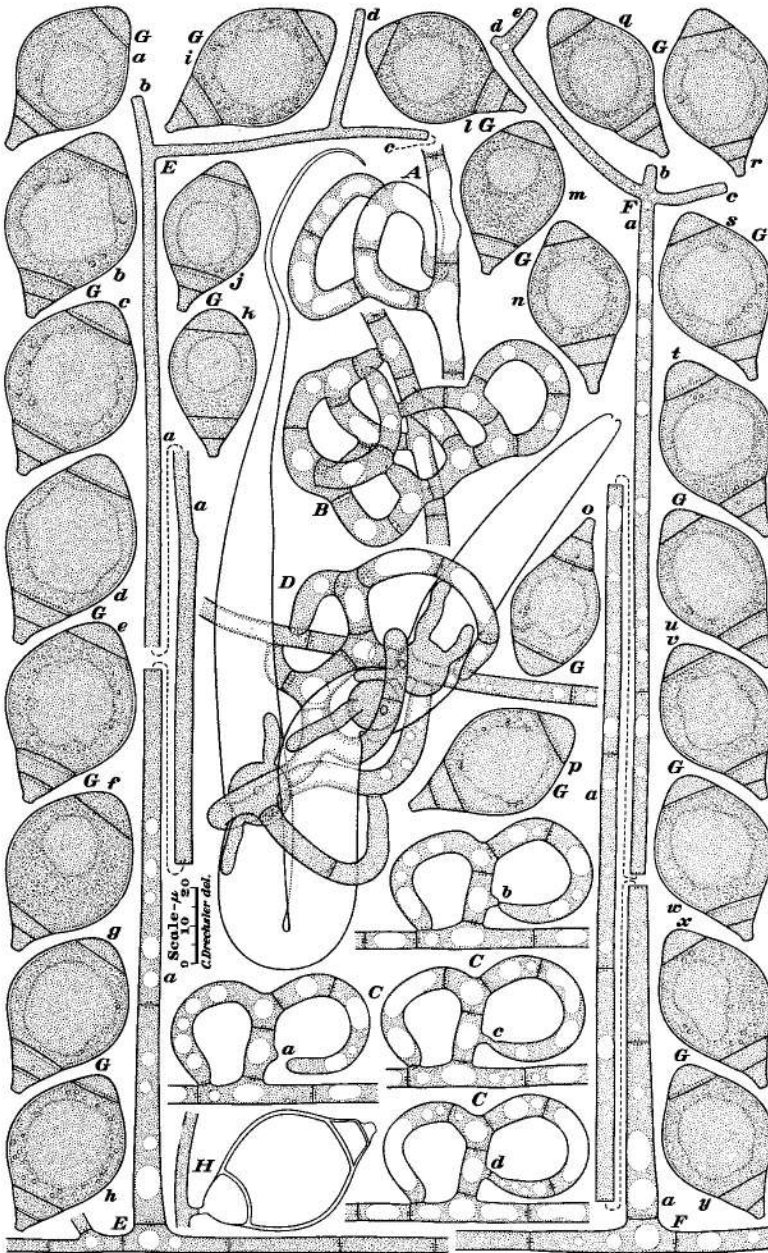


FIG. 9. *Dactylaria eudermata*.

scured from view owing to the globulose degeneration of the animal's musculature and organs. Later when the degenerating material has been largely absorbed (FIG. 8, *E, a*) the assimilative hyphae become more clearly visible, and instances of vegetative fusion between them are revealed (FIG. 8, *E, c*). At about this time they begin to show vacuoles. With further depletion of the digestible substance in the animal the vacuoles increase steadily in volume. Eventually the assimilative hyphae are wholly emptied of contents through withdrawal of their protoplasm backward into the external mycelium and, together with the collapsing pellicle, vanish from sight. In some instances the somewhat indurated infective body (FIG. 8, *E, b*) remains visible for a time after the associated hyphae have disappeared.

With ample nourishment being obtained through destruction of many nematodes the fungus soon produces conidiophores and conidia. The conidiophores arise in scattered positions from procumbent hyphae. Often they consist individually of a stout simple erect hypha, tapering gradually upward from base to tip, and ranging mostly from 0.4 to 0.5 mm. in height (FIG. 8, *F, a*; *G, a*. FIG. 10, *C, a*). These simple conidiophores bear terminally a single conidium (FIG. 8, *F, b*; *G, b*. FIG. 10, *C, b*) much like the simple conidiophores, for example, of *Dactylella aphrobrocha* and *D. bembicodes*, which, indeed, in their dimensions they resemble rather closely. The fungus likewise puts forth distally branched conidiophores (FIG. 9, *E, a*; *F, a*) that besides producing a spore at the tip of the main hypha (FIG. 9, *E, b*; *F, b*) bear additional spores singly on its primary branches (FIG. 9, *E, c*; *F, c, d*) and also on its secondary branches (FIG. 9, *E, d*; *F, e*) if such are present. As the branches are often rangy, sometimes exceeding 50 μ in length, the conidia produced plurally are in many instances attached at generous distances from one another. Nevertheless where conidia are held aloft in numbers of three or four they usually offer a clustered aspect, for owing to the large size of the individual spores the intervening spaces do not seem disproportionately wide.

The conidia produced by the fungus in nematode-infested culture (FIG. 8, *H, a-t*; FIG. 9, *G, a-y*; FIG. 10, *D, a-f*) owe their frequently large size more to their unusual width than to their length.

On the whole they appear about one-third wider and one-sixth longer than the similarly turbinate triseptate conidia of *Dactylaria thaumasia*. In fully developed spores the triseptate condition is so strongly predominant that the few biseptate specimens (FIG. 10, D, f) commonly present arouse misgivings as to their maturity, while quadrisepate conidia seem scarcely less alien to the fungus than to *Dactylella stenobrocha* and *Dactylella bembicodes*. As in *D. bembicodes* the three cross-walls are usually so placed that the penultimate cell greatly exceeds the others in dimensions and volume. This voluminous cell contains a large irregular vacuole, and is further distinguished by being surrounded with a noticeably thickened wall. When nematode-infested cultures, on being uncovered for microscopical examination, are exposed to dry air, the thin-walled apical cell collapses badly, whereas the sturdy penultimate cell, at least in respect to its peripheral outer membrane, commonly retains its shape; the result being that the conidia held aloft offer a curiously truncated appearance. Detached conidia are often found bearing one or more slender filamentous aerial outgrowths (FIG. 8, I, a-c), sometimes over 200 μ long, which originate commonly from the parabasal and apical cells. Under somewhat humid and rather warm (25° to 35° C.) conditions such outgrowths are extended freely also from conidia still supported on the conidiophores. In water or on a moist nutrient substratum germination takes place by the emission of one or more submerged germ hyphae (FIG. 10, E). Fusion of germ hyphae with mycelial filaments is frequent and often leads to evacuation of all protoplasmic contents from the conidia concerned (FIG. 9, H; FIG. 10, F).

The fungus grows rapidly in pure culture on maizemeal agar. In test-tube cultures on this substratum it sometimes produces a more copious aerial mycelium than I have hitherto observed in cultures of any other nematode-capturing hyphomycete. Often the column of rather loose cottony growth immediately above an agar slant is surmounted by an upper layer of firm felt-like texture; the appearance given then being rather similar to that commonly presented by tube cultures of my *Pythium arrhenomanes*. A few days after a pure culture has been planted it begins to produce conidia, which for the most part, however, reveal only

rather poorly the morphological features distinctive of conidia formed on nematode-infested substratum. Occasional specimens, it is true, are divided by three cross-walls into four cells whereof the one in penultimate position exceeds the others in size, but even in these specimens departure from the normal is often clearly evident in greatly reduced size of the apical and basal segments (FIG. 10, *G*, *a-c*). Very frequently the conidia formed in pure culture contain only two cross-walls, both of them placed near the proximal end, so that the large globose cell in terminal position here surmounts the much smaller parabasal and basal segments (FIG. 10, *G*, *d-m*). Frequently, again, the conidia contain only a single cross-wall, which being placed near the basal end delimits a large globose distal cell from a small proximal cell (FIG. 10, *G*, *n-q*). Like the spores formed in nematode-infested culture those produced in pure culture are often found bearing one or more aerial outgrowths of slender filamentous shape (FIG. 10, *H*), or are provided with broader germ hyphae of ordinary vegetative character (FIG. 10, *I-K*). The germ hyphae here likewise often fuse with neighboring mycelial filaments (FIG. 10, *L*, *M*), thereby establishing a passageway through which the protoplasmic materials of the conidium may migrate into the mycelium.

Despite their frequently rather different appearance the conidia produced by the fungus in pure culture are not essentially different in kind from the conidia formed on nematode-infested substratum. They are manifestly not referable to a separate category of spores, such as is recognizable in the uniseptate allantoid conidia of *Dactylella heterospora* and in the globuliferous conidioid bodies of *D. doedycoides*. Their generally smaller size, the disproportionate reduction of their smaller cells, and more especially the usual occurrence of their large cell in distal position owing to frequent lack of a small cell at the apex, seem to come about as modifications resulting from the different nourishment supplied in maize-meal agar not inhabited by eelworms. It seems possible that the modifications in question fall outside the range of ordinary variation, and perhaps are to be construed as pathological abnormalities deriving from nutritional deficiency. In any case the tendency toward morphological deterioration here offers marked contrast

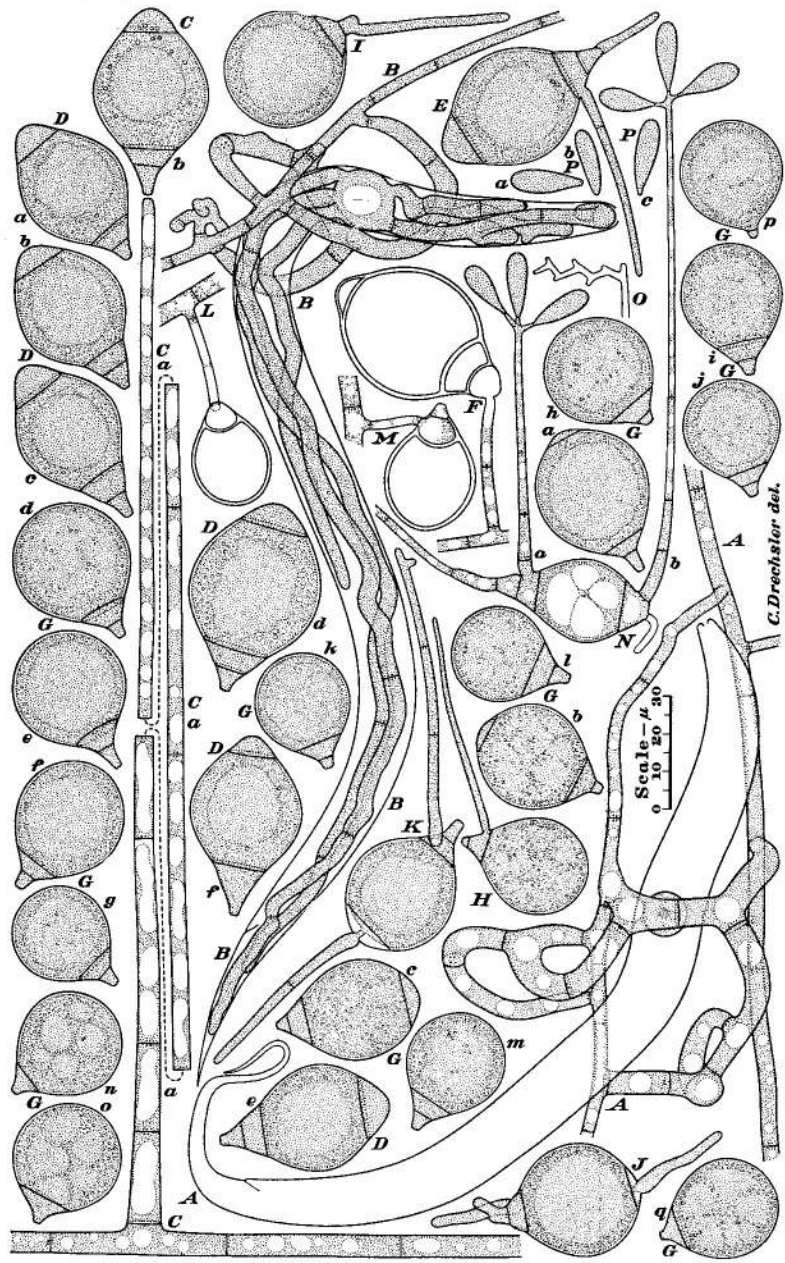


FIG. 10. *Dactylaria eudermata*.

with the luxuriant and wholly correct sporulation of *Dactylaria thaumasia* when grown in pure culture on maize meal agar.

Yet conidia essentially different in kind from the broad triseptate spores hitherto discussed have come under observation. One of the original plate cultures in which the fungus had grown out directly from plantings of leaf mold showed within a limited area a number of detached triseptate conidia that after falling on the moist agar substratum had put forth one or more germ conidiophores (FIG. 10, *N*, *a*, *b*) bearing small secondary conidia in loose capitate arrangement. These germ conidiophores, measuring 65 to 275 μ in height and 3 to 4 μ in basal diameter, tapered gradually upward to a width of 1.5 to 2 μ at the tip, where they terminated usually in a few—mostly in 2 to 5—sterigmatic spurs each bearing a secondary conidium; though in some instances secondary conidia up to seven in number were found borne on spurs, each about 5 μ long, produced one after another by successive subapical branching (FIG. 10, *O*). The secondary conidia (FIG. 10, *P*, *a-c*) were colorless, unseptate, of clavate shape, 15 to 25 μ long, and 4.3 to 6.5 μ wide. In the same area of the Petri plate culture similar conidia were borne also on small conidiophores arising from mycelial filaments. Efforts to start pure cultures from the meager supply of unseptate conidia were unsuccessful, and the cultures started from broad triseptate conidia taken from tall conidiophores in the area have not so far yielded a secondary or regularly unicellular conidial stage. Although it seems probable that the subsidiary spore stage belonged in the life history of the present fungus, the connection has not yet been established. Much the same uncertainty remains here as was noted earlier (16: 163-166) in respect to the likely connection of a rather similar secondary conidial stage with *Dactylaria psychrophila*.

The fungus offers further parallelism with *Dactylaria psychrophila* in having a sporulating habit so meagerly capitate that its assignment to the genus *Dactylaria* needs to be justified in part by its manifestly close relationship to the more pronouncedly capitate *D. thaumasia*. As its adhesive meshes are of about the same dimensions as those of *D. thaumasia* and most other reticulate hyphomycetes, its networks appear not to share the somewhat closer texture noted in the predacious apparatus of *D. psychro-*

phila; and certainly they do not share the markedly closer texture usual in networks of my *D. polycephala* (12: 527–531). Like *D. psychrophila* the fungus produces larger conidia than *D. thaumasia*, but its conidia owe their larger size mainly to greater width, whereas those of *D. psychrophila* owe their larger size mainly to greater length. Quadrisepate partitioning, so infrequent in conidia of the fungus, is commonplace among conidia of *D. psychrophila*. Pure cultures of the fungus on maize meal agar have not so far shown chlamydo spores or any other kind of indurated bodies; whereas similar cultures of *D. thaumasia* commonly produce thick-walled chlamydo spores in such abundance that the substratum is given a reddish coloration.

A term meaning "with good, stout hide" may serve conveniently as specific epithet for the new hyphomycete in recalling the thick membrane surrounding the massive penultimate segment of its conidia.

***Dactylaria eudermata* sp. nov.**

Mycelium effusum; hyphis sterilibus incoloratis, mediocriter septatis, plerumque 1.8–7.5 μ crassis, laqueos tenaces arcuatos vel circulares in reticula saepe conjunctos proferentibus; his laqueis reticulisque vermiculos nematoideos illaqueantibus, deinde tum integumentum animalis captivi anguste perforantibus, tuber mortiferum globosum intrudentibus, hyphas intus evolventibus quae carnem exhauriunt. Hyphae fertiles incoloratae, erectae, plerumque 2–8 septatae, vulgo 400–500 μ altae, basi saepius 6–9 μ crassae, sursum leniter attenuatae, apice 2.5–3.5 μ crassae, simplices vel prope apicem aliquid ramosae, itaque nunc unicum conidium gignentes, nunc 2–4 conidia in capitulum laxum ferentes; conidiis incoloratis, ellipsoideis vel obovoideis vel late turbineis, apice rotundatis, deorsum paulum attenuatis, basi truncatis, plerumque 37–55 μ (saepe circa 48 μ) longis, 21–35 μ (saepe circa 28 μ) crassis, vulgo triseptatis, paenultima eorum cellula 21–35 μ (saepe circa 29 μ) longa, aliis cellulis eorum multo minoribus, inter se subaequalibus, vulgo 4–8 μ (saepe circa 6 μ) longis; interdum omnibus cellulis glabris, interdum aliquibus cellulis minoribus 1 vel 2 appendicibus praeditis; appendicibus incoloratis, filiformibus, rectis vel flexuosis, continuis vel prope basim 1–2 septatis, plerumque 50–275 μ longis, basi 2–4 μ crassis, sursum leniter attenuatis, apice circa 1 μ crassis.

Vermiculos nematoideos diversos capiens consumensque habitat in humo silvestri prope Roanoke, Virginia.

Mycelium spreading; vegetative hyphae colorless, septate at moderate intervals, mostly 1.8 to 7.5 μ wide, often especially in the presence of nematodes giving rise to arched or circular hyphal meshes, which, though at first discrete, are later frequently com-

pounded into more or less extensive networks; the meshes and networks capturing nematodes through adhesion and entanglement, then narrowly perforating the integument of each captured animal and intruding one or more infective bodies of subspherical shape, from which are extended assimilative hyphae, mostly 2 to 5 μ wide, to appropriate the fleshy contents. Conidiophores colorless, erect, usually containing 2 to 8 cross-walls, commonly 400 to 500 μ high, 6 to 9 μ wide at the base, tapering gradually upward to a width of 2.5 to 3.5 μ near the tip, simple or somewhat branched at the distal end, consequently sometimes producing a single conidium and at other times bearing 2 to 4 conidia in loose capitate arrangement. Conidia colorless, ellipsoidal or obovoid or broadly turbinate, broadly rounded at the tip, somewhat tapered proximally, truncate at the base, mostly 37 to 55 μ (average about 48 μ) long, 21 to 35 μ (average about 28 μ) wide, commonly triseptate, the penultimate cell 21 to 35 μ (average about 29 μ) long, the other three cells much smaller, individually most often 4 to 8 μ (average about 6 μ) long and sometimes bearing 1 or 2 aerial outgrowths; aerial outgrowths colorless, filamentous, straight or flexuous, continuous or with 1 or 2 cross-walls in the proximal portion, 50 to 275 μ long, 2 to 4 μ wide at the base, tapering gradually upward to a width of approximately 1 μ at the tip.

Capturing and consuming nematodes of different species, it occurs in leaf mold in deciduous woods near Roanoke, Virginia.

A CANDIDA-LIKE DACTYLARIA CAPTURING EELWORMS BY ADHESION
TO SLENDER-STALKED ADHESIVE KNOBS

Several maize-meal-agar plate cultures which after being permeated with mycelia of *Pythium mamillatum* Meurs had been further planted on April 29, 1948, with small quantities of partly decayed bluegrass (*Poa pratensis* L.) detritus newly collected in a field near Beltsville, Maryland, showed 16 days later some expanses of conidial apparatus rather similar to that of *Dactylaria candida* (Nees) Sacc., but differing in being less strongly capitate. A more decisive difference came to light when the underlying mycelium was examined, for though the vegetative hyphae manifestly obtained their nourishment by capture of nematodes abundantly infesting the substratum, the animals were in all instances held fast through adhesion to stalked globose unicellular knobs comparable in size and efficacy to the adhesive knobs utilized by my *Dactylella*

asthenopaga (12: 496-499) and my *Dactylaria haptospora* (13: 456-461) as well as by the nematode-capturing fungus (12: 492-496) held referable to *Dactylella ellipsospora* Grove (22). The mycelium was wholly lacking in non-constricting rings, such as those employed very effectively by the widespread nematode-capturing hyphomycete I have assigned (12: 523-527) to the ancient species of Nees von Esenbeck. However, since this hyphomycete, besides producing non-constricting rings, gives rise terminally on very slender stalks to small globose unicellular knobs which in soft agar cultures have only rarely been found operative in capturing eelworms, it was necessary to consider whether the observed absence of non-constricting rings together with the greater size and efficiency of the globose knobs might perhaps have resulted from unusual environmental conditions. The fungus growing out from the bluegrass detritus was therefore isolated by removing its conidia from the erect conidiophores to sterile agar. From the pure cultures thus obtained portions of agar well permeated with young mycelium were excised and placed on Petri plate cultures that had become infested with saprophilous nematodes introduced on decaying materials of various kinds. Among the cultures used in these trials were some that had been started by planting the sterile substratum with pieces of softened discolored roots of matai or Chinese water-nut [*Eleocharis dulcis* (Burm. f.) Henschel] plants received from Winter Park, Florida, late in July, 1948. After being promptly overgrown by my *Pythium myriotylum* the agar here afforded abundant multiplication of a slender species of *Panagrolaimus*, which later suffered destruction in large numbers when young mycelium of the Beltsville hyphomycete was superadded. As the invasive development of predacious and parasitic fungi is in general more clearly visible in slender than in stout eelworms, material pertaining to or resulting from the destruction of the *Panagrolaimus* was used advantageously in preparing the figures relating to the fungus (FIGS. 11, 12).

None of the nematode-infested cultures in which portions of young mycelium were planted showed any development of non-constricting rings. From the superadded mycelium rather slender filaments grew out that at somewhat variable intervals and mostly in submerged positions consistently gave rise to unicellular adhesive

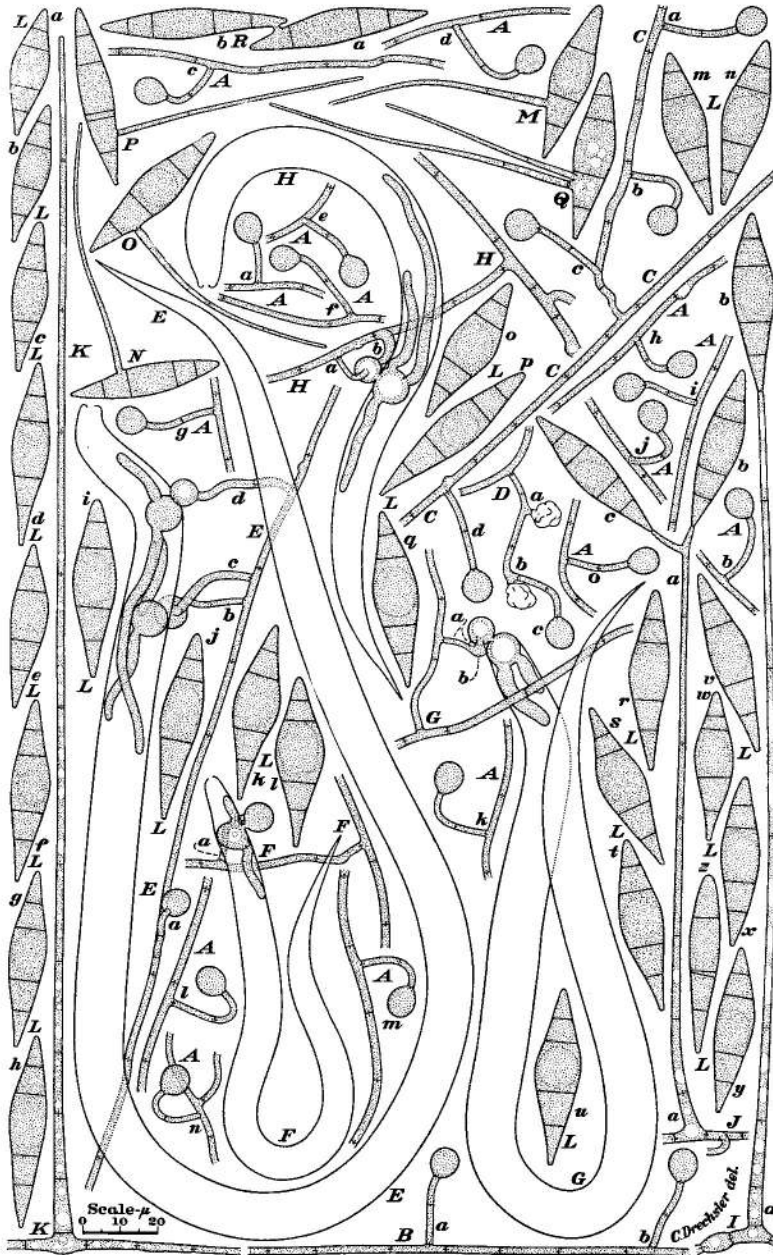


FIG. 11. *Dactylaria haptotyla*.

knobs on stalks sometimes consisting of one cell (FIG. 11, *A, a, b*. FIG. 12, *A, a-d; D, a*) but more often consisting of two cells (FIG. 11, *A, c-o; B, a, b; C, a-d; E, a*. FIG. 12, *A, e-k; B, a, b; C, b*) and occasionally consisting of three cells (FIG. 12, *C, c*). Most frequently the stalks were 1.4 to 1.9 μ wide and from 10 to 25 μ long. They appear appreciably stouter, therefore, than the corresponding stalks of *Dactylaria candida*, which, as a rule, measure only 1 to 1.4 μ in width. At the same time they seem markedly more slender as well as generally longer than the homologous stalks of *Dactylella ellipsospora*, since these usually measure 2.4 to 3 μ in width and 5 to 10 μ in length; the dimensional contrast here offering some parallelism with the contrast between the stalks supporting the constricting rings of *Dactylella aphrobrocha* and those supporting the constricting rings of *Dactylella bembicodes*. Nearly the same degree of contrast is evident when comparison is extended to the stalks of *Dactylella asthenopaga*, which, as is apparent from their recorded dimensional ranges—2 to 3 μ for width, and 3 to 10 μ for length—are similarly of short sturdy conformation. The stalks of *Dactylaria haptospora*, commonly 1.5 to 2.5 μ wide and 4 to 30 μ long, offer notably better agreement with respect to measurements.

The globose or prolate ellipsoidal adhesive knobs of the Beltsville fungus have been found varying mostly from 7 to 10 μ in length and from 6 to 8.5 μ in width. As has been intimated they differ little in size from the adhesive knobs of the three previously described nematode-capturing hyphomycetes that produce no other type of predacious organ; though on a strict comparison of relevant measurements they would seem slightly smaller than the knobs of *Dactylella ellipsospora*, and slightly larger than those of *Dactylella asthenopaga* and *Dactylella haptospora*. They are markedly larger, of course, than the meagerly operative knobs of *Dactylaria candida*, which commonly measure only 4 to 7 μ in length and 3.8 to 6 μ in width. In nearly equal measure they exceed in size also the meagerly operative knobs of my *Dactylella lysipaga* that usually range from 5 to 8 μ in length, and from 4.5 to 6 μ in width.

Frequently in predacious organs that have attained some age without capturing a nematode, the adhesive cell loses its protoplasmic contents and collapses emptily (FIG. 11, *D, a*) as the supporting stalk grows out obliquely near the distal end to form a sec-

ond adhesive cell on the prolongation. The same process may then be repeated, with the second adhesive cell in turn losing its contents and collapsing (FIG. 11, *D, b*) as a third adhesive cell (FIG. 11, *D, c*) is produced. In such successive elongation each new increment is at first continuous throughout. Indeed, young stalks generally (FIG. 12, *C, a*) remain in an unseptate condition until the terminal swelling destined to be delimited as an adhesive knob is nearly full grown.

The glandular knob, if left undisturbed, does not show under ordinary microscopical inspection any recognizable coating of adhesive material on its surface. An eelworm coming in contact with it is nevertheless held securely despite energetic struggles to escape. After these struggles have proceeded for some time, a cushion of colorless glutinous substance often becomes visible between the knob and the integument of the captured animal (FIG. 12, *D, b; E, a; F, a*). Soon the adhering knob perforates the integument by means of a slender protuberance, which, on reaching the fleshy interior, immediately widens out into a globose infective body that usually continues to expand (FIG. 12, *D*) until it extends entirely or almost entirely across the nematode (FIG. 11, *E-H; FIG. 12, E*). The nematode gradually becomes enfeebled from the injury thus sustained, and thereupon is invaded further by assimilative hyphae arising from the infective bodies (FIG. 11, *E-H; FIG. 12, E, F*). These assimilative hyphae grow lengthwise through the animal until they occupy it from head to tail (FIG. 12, *G, H*). At first, even in slender eelworms, they are to a considerable degree obscured from view, owing to the globulose degeneration of musculature and organs that accompanies their progress. Later, when the degenerating materials have been largely absorbed, they become more clearly visible. With further reduction of the animal's substance, they show an increasingly vacuolate condition (FIG. 12, *H*) as their protoplasmic contents are withdrawn backward into the external mycelium. Eventually they are completely emptied of living protoplasm, and their membranous envelopes, together with the collapsing integument surrounding them, disappear from sight.

In the withdrawal of protoplasmic contents from the assimilative hyphae into the external mycelium, the passageway provided by the narrow stalk originally supporting the adhesive knob (FIG. 11, *E, b;*

H, a. FIG. 12, *D, b*; *F, a*) is often supplemented by a passageway provided by a second and noticeably wider hyphal element (FIG. 11, *E, c*; *H, b*. FIG. 12, *D, c*; *F, b*) connecting the adhesive knob with the mycelial filament at a point a short distance from the origin of the stalk. This second hyphal connection is often present at an early stage in the invasion of the eelworm, and may possibly be formed to replace the stalk, which, owing to its slenderness, must often incur injury from the struggles of the animal. It may be presumed that localized injury occasions the disappearance of protoplasm within the distal portion of the stalk (FIG. 11, *G, a*; FIG. 12, *H, a*) in the rather frequent instances where the new hyphal element (FIG. 11, *G, b*; FIG. 12, *H, b*) is found arising from a median position in the stalk rather than from the parent mycelial filament. Sometimes the original stalk seems to disappear completely, so that the supplementary hyphal element, recognizable by its greater width, provides the only communication between the adhesive knob and the mycelium (FIG. 11, *E, d*. FIG. 12, *G, a*; *H, c*). On the other hand, in instances where the captured eelworm is of relatively small size, the adhesive knob may remain attached, at least during the earlier stages of invasion, solely by the stalk on which it was produced (FIG. 11, *F, a*; FIG. 12, *E, a*).

The fungus usually puts forth conidiophores and conidia in moderate abundance both in pure culture and on nematode-infested substratum. Very often, in the beginning, most of the conidiophores present in a stand (FIG. 11, *I, a*; *J, a*; *K*) will bear spores singly (FIG. 11, *I, b*) or in twos (FIG. 11, *J, b, c*). At this stage the fungus looks much like a *Dactylella*. Later, however, with the production of additional spores on short branches or spurs, many conidiophores (FIG. 12, *I, a, b*; *J*) come to bear three (FIG. 12, *I, c-e*) or four (FIG. 12, *I, f-i*) or as many as five conidia in loosely capitate arrangement, thereby acquiring an appearance and habit usually associated with the genus *Dactylaria*. On the whole, capitate development here would seem tardier and less pronounced than in *Dactylaria candida*.

In their handsome fusiform shape the conidia rather closely resemble those of *Dactylella ellipsospora*, *Dactylella lysipaga*, and *Dactylaria candida*, while differing markedly from the clavate spores of *Dactylella athenopaga*, as well as from the elongated cylindrical

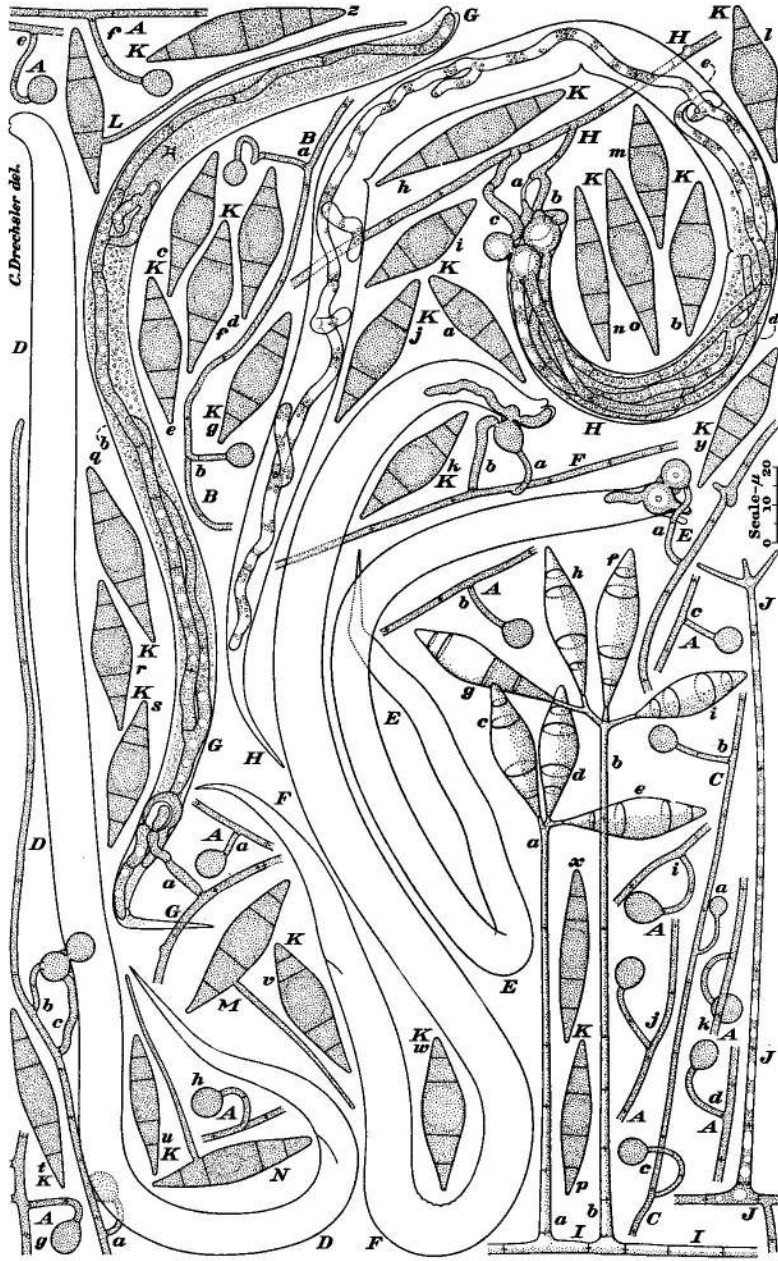


FIG. 12. *Dactylaria haptotyla*.

conidia of *Dactylaria haptospora*. When fully developed they contain three (FIG. 12, *K*, *a*, *b*) or four (FIG. 11, *L*, *a-z*; FIG. 12, *K*, *c-x*) or occasionally five (FIG. 11, *P*; FIG. 12, *K*, *y*, *z*) cross-walls. The quadrisepate condition, with the cross-walls so placed that a largish median cell is delimited between two smaller proximal cells and two smaller distal cells, usually predominates, and thus seems to represent the manner of septation most characteristic of the species. Conidia having such septation give measurements for length ranging from 34 to 55 μ , and measurements for width ranging from 7.4 to 13.3 μ ; the computed averages for these dimensions being 43.7 μ and 10.7 μ , respectively. Computed values for average lengths of the five component cells are as follows: basal cell, 9 μ ; parabasal cell, 7.3 μ ; middle cell, 14.4 μ ; penultimate cell, 6.1 μ ; apical cell, 6.9 μ . Owing to the greater variability generally evident here in the size and septation of the conidia, the measurements just given must be held less accurately descriptive of the species than are the corresponding measurements, for example, of *Dactylella aphrobrocha*.

Often while it is still borne aloft on the conidiophore, or after it has fallen off, a conidium, whether triseptate (FIG. 11, *M*), quadrisepate (FIG. 11, *N*, *O*; FIG. 12, *L-N*), or quinquesepate (FIG. 11, *P*), will extend a slender tapering filamentous outgrowth into the air. These outgrowths, which commonly are 25 to 100 μ long, 1.5 to 2.5 μ wide at the base, and about 1 μ wide near the tip, arise most usually from the parabasal segment. Sometimes a conidium will put forth two such aerial outgrowths (FIG. 11, *Q*). Two detached conidia (FIG. 11, *R*, *a*, *b*) lying near together on the surface of a culture often become fused to one another in much the same manner as neighboring mycelial filaments or neighboring assimilative hyphae (FIG. 12, *G*, *b*; *H*, *d*, *e*).

A term compounded of two words meaning "to fasten," and "knob," respectively, is deemed suitable as specific epithet for the fungus.

***Dactylaria haptotyla* sp. nov.**

Mycelium sparsum; hyphis sterilibus incoloratis, mediocriter septatis, plerumque 1.4-3.8 μ crassis, bullas globosas vel ellipsoideas, 7-10 μ longas, 6-8.5 μ crassas, ex ramulo recto vel curvato, saepius 7-27 μ longo, 1.4-1.9 μ crasso, in 1-3 cellulis consistente, singillatim hic illic emittentibus; his bullis ad vermicu-

los nematoideos inhaerentibus, itaque animalia tenentibus, integumentum eorum perforantibus, tuber mortiferum intrudentibus, hyphas intus evolventibus quae carnem exhauriunt. Hyphae fertiles incoloratae, erectae, saepius 4-11 septatae, 115-325 μ altae, basi 3-4.5 μ crassae, sursum leniter attenuatae, apice circa 1.5 μ crassae, primum saepe simplices et in unum conidium abeuntes, deinde apice saepe parce ramosae denique 2-5 conidia in capitulum laxum ferentes; conidiis hyalinis, vulgo fusoides, basi truncatis, apice anguste rotundis, plerumque 33-55 μ (saepe circa 43.7 μ) longis, 7.4-13.3 μ (saepe circa 10.7 μ) crassis, 3-5 septatis, saepissime quadriseptatis denique cellula antepaenultima crassiore et longiore quam aliis cellulis.

Vermiculos nematoideos specierum multarum capiens consumensque habitat in foliis caulibusque *Poa pratensis* putrescentibus prope Beltsville, Maryland.

Mycelium scanty; vegetative hyphae colorless, septate at moderate intervals, mostly 1.4 to 3.8 μ wide, often especially in the presence of nematodes, giving rise here and there on stalks frequently straight or somewhat curved, 7 to 27 μ long, 1.4 to 1.9 μ wide, sometimes unicellular but usually bicellular and occasionally tricellular, to unicellular knobs subspherical or prolate ellipsoidal in shape, 7 to 10 μ long and 6 to 8.5 μ wide; the knobs holding fast to nematodes, individually perforating the integument of the adhering animal, then intruding a globose infective body from which assimilative hyphae are extended to appropriate the fleshy contents. Conidiophores hyaline, erect, often containing 4 to 11 cross-walls, usually 115 to 325 μ high, 3 to 4.5 μ wide at the base, tapering gradually upward, about 1.5 μ wide at the tip, at first often simple and terminating in a single conidium, later often provided near the apex with a few short branches or spurs, and then bearing 2 to 5 conidia in loose capitate arrangement; conidia colorless, usually spindle-shaped, tapering downward toward the narrow truncate base, somewhat narrowly rounded at the distal end, mostly 33 to 55 μ (average about 43.7 μ) long, 7.4 to 13.3 μ (average about 10.7 μ) wide, containing 3 to 5 cross-walls but most often divided by 4 cross-walls into 5 cells whereof the one in middle position usually exceeds the others in length and width.

Capturing and consuming nematodes of different species it occurs in decaying leaves and stems of *Poa pratensis* near Beltsville, Maryland.

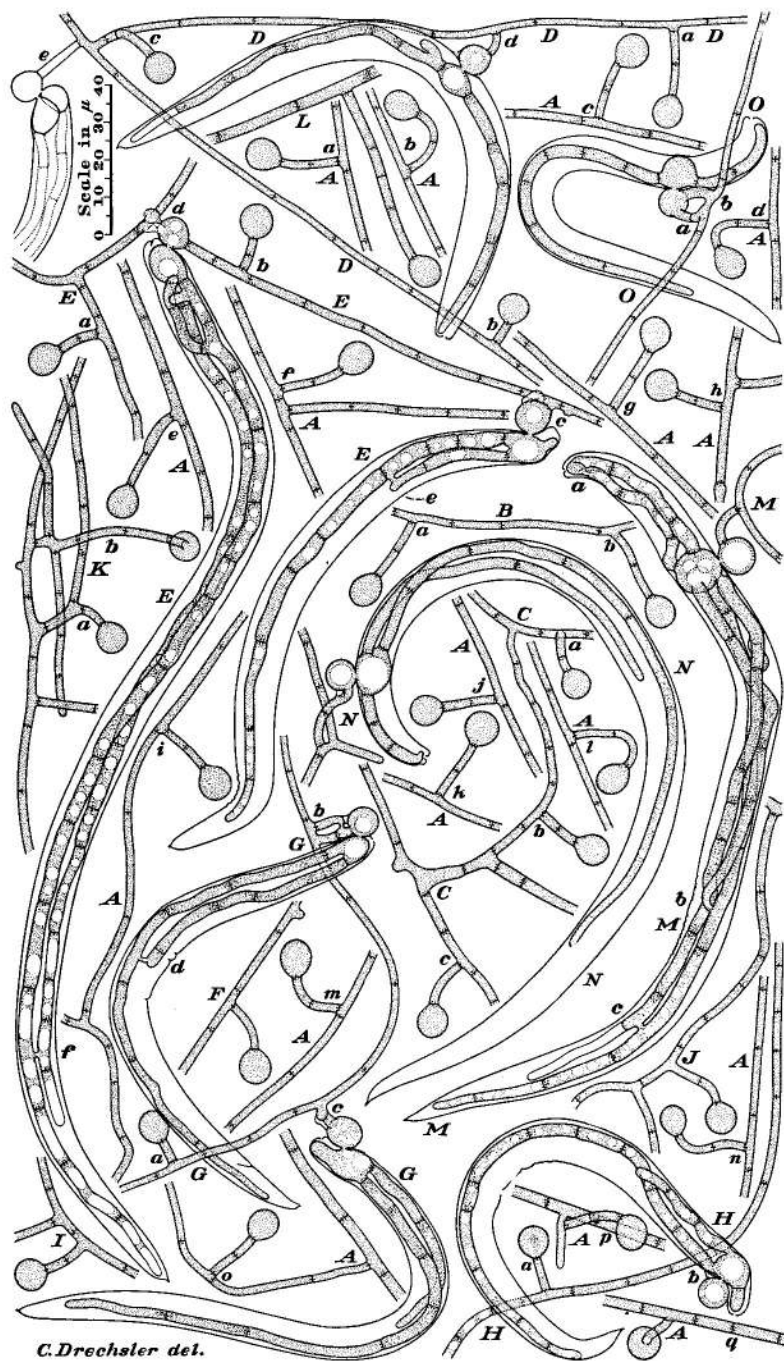
A CANDIDA-LIKE DACTYLARIA WITH EFFICACIOUS ADHESIVE KNOBS AND INDURATED HYPHAE

A nematode-capturing fungus which like *Dactylaria haptotyla* resembles *Dactylaria candida* in its conidial apparatus came to light in several maize-meal-agar plate cultures that after being

overgrown by my *Pythium arrhenomanes* had been further planted with small quantities of partly decayed vegetable refuse taken from a garden in Roanoke, Virginia, on October 11, 1946. In these cultures the massive lobulate sporangial complexes that were soon produced everywhere by *P. arrhenomanes* served as a very abundant food supply for stylet-bearing nematodes addicted to feeding on fungus protoplasm after the manner described by Christie and Arndt (6) for *Aphelenchoides parietinus* (Bastian 1865) Steiner 1932. Consequently the parasitic nematodes prospered greatly, and after two weeks were present in unwonted numbers. About 15 days after the vegetable detritus had been added the stylet-bearing animals, as well as the saprophilous eelworms intermingled with them, began to suffer noticeable losses from the destruction of many individuals by predacious mycelia that grew from the opaque material into the subjacent agar. Capture of nematodes was effected here exclusively by adhesive knobs of a size then known to me—*Dactylaria haptotyla* not having been discovered at the time—only in *Dactylella ellipsospora*, *Dactylella asthenopaga*, and *Dactylaria haptospora*. When, as soon happened, conidiophores arose from the predacious mycelia, they bore conidia which, while differing markedly from those of *Dactylella asthenopaga* and *Dactylaria haptospora*, resembled in a general way the conidia of *Dactylella ellipsospora* with respect to outward shape and to septation. Agreement with respect to sporulating habit was lacking, however, for the conidia here, instead of being borne for the most part singly, were held aloft plurally in loose heads, thereby offering much the same appearance as *Dactylaria candida*. To determine more especially whether non-constricting rings, familiar as the efficient predacious organs of *Dactylaria candida*, might be formed under changed conditions, the Roanoke fungus was isolated through removal of conidia from the loose heads to sterile agar; and from the pure cultures thus obtained sizable portions of its mycelium were cut out and placed on Petri plate cultures that had become well infested with nematodes originating from different kinds of decomposing plant materials. Development of non-constricting rings never ensued in these trials. The fungus, under varying conditions, continued to capture nematodes solely by means of adhesive knobs.

The adhesive knobs are borne on stalks most often, perhaps, consisting of two cells (FIG. 13, *A*, *a-q*; *B*, *a*; *C*, *a*, *b*; *D*, *a*; *E*, *a*, *b*), but nearly as often consisting of a single cell (FIG. 13, *C*, *c*; *D*, *b-e*; *F*; *G*, *a*; *H*, *a*; *K*, *a*). In stalks composed of more than one cell the basal segment may include a portion of the parent hypha (FIG. 13, *B*, *b*; *I*; *J*), or may even extend into a branch arising nearby from the parent hypha (FIG. 13, *K*, *b*). The stalks are commonly from 2 to 2.5 μ wide and from 10 to 20 μ long, though some unicellular examples do not greatly exceed 5 μ in length (FIG. 13, *D*, *b*; *G*, *a*), while among the four-celled specimens (FIG. 13, *L*) occasionally to be found some measure about 50 μ in this dimension. They would seem, therefore, somewhat wider than the stalks in *Dactylaria haptotyla*, and, to extend the comparison, are appreciably narrower and also longer than the stalks of *Dactylella ellipsospora*.

The knobs of the Roanoke hyphomycete, like the similar organs in allied species, show no visible coating of adhesive material as long as they are left undisturbed. Nevertheless, eelworms that come into contact with them are held fast despite prolonged struggles to escape. Some little time—frequently about 15 or 30 minutes—after capture of a nematode has been effected, a cushion of hyaline glutinous material can be seen between the knob and the animal's integument (FIG. 13, *D*, *d*). Soon the knob puts forth centrally in the region of contact a slender protuberance that penetrates the integument to give rise within to a globose infective body. This body usually expands until it occupies the entire width of the animal (FIG. 13, *D*, *d*; *E*, *c*, *d*; *G*, *b*, *c*; *H*, *b*; *M*; *N*; *O*), which thus is severed internally and as a result becomes incapable of energetic movement. Thereupon the infective body produces assimilative hyphae that continue to grow lengthwise through the fleshy interior (FIG. 13, *N*, *O*) until the eelworm is permeated from head to tail (FIG. 13, *D*, *d*; *E*, *c*, *d*; *G*, *b*, *c*; *H*, *b*; *M*). At first the assimilative hyphae are only indistinctly visible, being then obscured because of the globulose degeneration marking their progress through musculature and organs; though in slender nematodes, such as the stylet-bearing parasites found utilized as prey in the original cultures (FIG. 13, *D*, *E*, *G*, *H*, *M*, *N*, *O*), the difficulties of observation are less serious than in stouter

FIG. 13. *Dactylaria sclerohypha*.

animals. When the degenerating contents have in large part been absorbed by them, the assimilative hyphae, usually numbering from 1 to 3 in slender captives, become more clearly discernible, and reveal cross-walls at moderate intervals as well as scattered instances of vegetative fusion (FIG. 13, *E, e, f; G, d; M, a-c*). The hyphal segments, moreover, now frequently begin to show vacuoles. These vacuoles increase in volume as the animal's contents are further reduced (FIG. 13, *E, c, d; H; M*). Through continued withdrawal of protoplasm backward into the external mycelium, the assimilative hyphae are often completely evacuated of living substance, so that ultimately their empty membranous envelopes, together with the collapsing integument surrounding them and the empty membrane of the associated predacious organ (FIG. 13, *D, e*), gradually vanish from sight.

As in *Dactylaria haptotyla* many adhesive knobs that have been operative in capturing a nematode are found attached to the parent mycelial filament not only by the stalk whereon they were formed (FIG. 13, *O, a*) but also by a supplementary hyphal element (FIG. 13, *O, b*) of later origin. Sometimes a supplementary element intercalated between the knob and the parent hypha may become united laterally with the stalk (FIG. 13, *G, b*), which in its distal portion has been emptied of protoplasm presumably as the result of injury incurred from the struggles of the eelworm. Very frequently, however, where the supplementary element replaces a distal portion of the stalk, it is intercalated between the knob and the proximal living portion of the stalk (FIG. 13, *E, d; G, c; N*). Rather often, again, the stalk is found wholly emptied of protoplasmic material so that the supplementary hyphal element provides the only live communication between the knob and the mycelium (FIG. 13, *E, c*).

On nematode-infested materials, as also in pure culture on maize meal agar, the fungus usually puts forth a scattered stand of conidiophores. The earliest conidiophores (FIG. 14, *A, a*) are sent up from procumbent mycelial hyphae, but when these have fallen over on the substratum (FIG. 14, *B, a; C; D, a*) after fulfilling their immediate function, they commonly give rise from a segment near the base to a secondary conidiophore (FIG. 14, *B, b; C; D, b*), which in turn may give rise to others of tertiary and

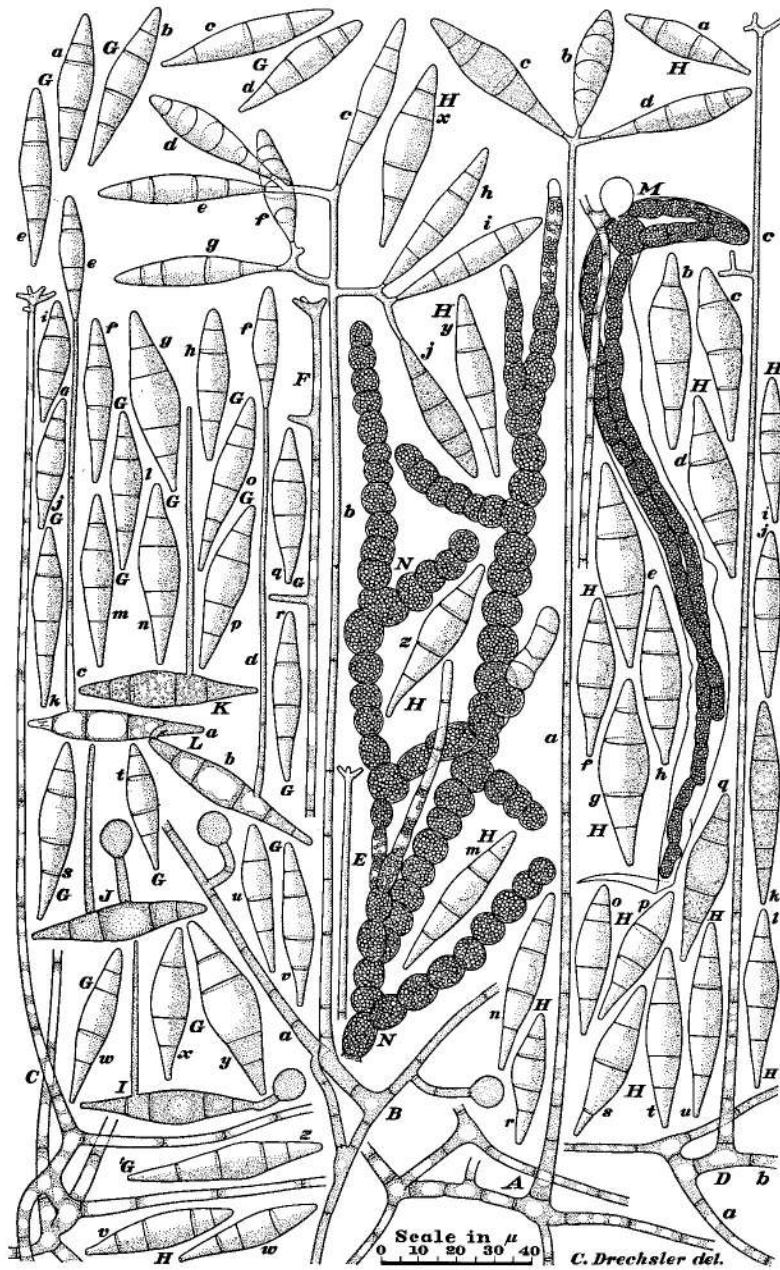


FIG. 14. *Dactylaria sclerohypha*.

higher orders (FIG. 14, *C; D, c*). As a rule the conidiophores are slender in proportion to their length, often seeming hardly sturdy enough to support the conidia, usually 3 to 8 in number (FIG. 14, *A, b-d; B, c-j*), which they hold aloft in loose capitata arrangement 200 to 350 μ above the substratum. In many instances their several sterigmatic spurs are all borne at the tip (FIG. 14, *C, E*), but not infrequently, again, one or more of the spurs are placed some distance below the tip (FIG. 14, *D, c; F*).

The conidia rather closely resemble those of *Dactylaria candida* and *Dactylaria haptotyla* in their dimensions and generally fusiform shape (FIG. 14, *G, a-z; H, a-z*). They are most commonly found divided by four cross-walls, although more than a few have three cross-walls (FIG. 14, *G, c, t, u, x; H, c, p, s, w*) and occasional specimens contain five (FIG. 14, *G, o; H, k*). Measurements of quadrisepate specimens have shown a range in length from 32 to 54 μ , and a range in width from 5.9 to 14.3 μ ; and have given averages of 44.6 μ and 9.3 μ , respectively, for these two main dimensions. Measurements of the five component cells have yielded averages for lengths as follows: basal cell, 10.8 μ ; parabasal cell, 8.4 μ ; middle cell, 11.5 μ ; penultimate cell, 6.2 μ ; and apical cell, 7.7 μ . While in quadrisepate conidia the middle cell would thus seem generally somewhat longer as well as wider than the others, its length, on the whole, does not greatly exceed that of the basal cell, and in individual specimens is found appreciably smaller.

Under warm moist conditions conidia frequently put forth slender aerial filamentous outgrowths while they are still held aloft on the conidiophore. Similar outgrowths are often extended erectly after the spores have fallen on a moist substratum (FIG. 14, *I-K*). In many instances a filamentous outgrowth from a fallen conidium (FIG. 14, *L, a, b*) serves as a conidiophore (FIG. 14, *L, c, d*) in producing at its tip a secondary conidium (FIG. 14, *L, e, f*) usually of smaller dimensions than most conidia of primary origin but having similar shape and septation.

Fallen conidia that happen to lie close together (FIG. 14, *L, a, b*) very frequently become united through vegetative fusion manifestly of the same sort displayed abundantly in mycelial filaments and conidial apparatus throughout the series of clampless pre-

dacious hyphomycetes. Another vegetative attribute is shown by fallen conidia in their ready production of stalked adhesive knobs directly from one of their component cells (FIG. 14, *I, J*). Development of like predacious organs on detached conidia was noted earlier in the descriptive account of *Dactylella asthenopaga*. As might well be expected, stalked adhesive knobs are also produced occasionally on conidiophores (FIG. 14, *B, a*) that have fallen over on moist substratum while they were still largely filled with living protoplasm.

After the fungus has been producing conidia in nematode-infested cultures for a period of 10 to 15 days, it often diverts much of its substance toward the formation of chlamydospores or indurated portions of mycelium. Once the change in reproductive tendency has set in, the assimilative hyphae in many instances will not convey their protoplasm to the external mycelium, but instead will retain it within their constituent segments to be thickly interspersed with globulose reserve materials elaborated from the digestible contents of the eelworm (FIG. 14, *M*). In taking on a durable state the hyphal segments here usually become noticeably but not markedly widened. The infective cell, which likewise undergoes induration, reveals generally no further increase in size.

Development of resting bodies through transformation of assimilative hyphae within captured animals has so far never been observed in any other clampless nematode-capturing hyphomycete, nor, for that matter, in the four members of the Zoöpagaceae known to capture eelworms (10, 11, 14, 17), nor, again, in the two species of similar biological habit that have been described in the clamp-bearing genus *Nematoctonus* (18, 20). Among the various hyphomycetes attacking eelworms after the usual manner of parasites, by means of hyphae arising through germination of affixed or ingested spores, analogous internal development of resting bodies has become familiar to me only in the production of chlamydospores by the ubiquitous *Harposporium anguillulae* Lohde. In the present fungus, besides, scattered filaments of the external mycelium, together with many of their branches, undergo induration to form often rather extensively ramified sclerotoid bodies (FIG. 14, *N*). The hyphal segments here, both in the main filaments and in the branches, frequently become distended to three times their original

width, so that the indurated cells are generally of subspherical shape, and in many instances may even measure more in transverse diameter than in length. As in the similar sclerotoid bodies of *Dactylella heterospora*, the more strongly distended cells, which here may form chains over 1 mm. long, are always densely filled with globulose contents, while the cells that have become only slightly distended show correspondingly less internal modification.

A term having reference to the filamentous character of its resting bodies may serve appropriately as specific epithet for the fungus, especially as the resting bodies often occur in a somewhat web-like arrangement.

Dactylaria sclerohypha sp. nov.

Mycelium sparsum; hyphis incoloratis, mediocriter septatis, plerumque 1.5–3.2 μ crassis, hic illic ex ramulo recto vel curvato, 5–50 μ longo, 2–2.5 μ crasso, in 1–4 (saepissime in 1 vel 2) cellulis consistente, bullas tenaces globosas vel ellipsoideas 8.3–10 μ longas, 7.2–8.6 μ crassas, singillatim emittentibus; his bullis ad vermiculos nematoideos inhaerentibus, ita animalia tenentibus, integumentum eorum perforantibus, tuber mortiferum intrudentibus, hyphas plerumque 2–4.5 μ crassas intus evolventibus quae carnem exhauriunt. Hyphae fertiles incoloratae, erectae, saepius 5–10 septatae, 200–350 μ altae, basi 3.3–5 μ crassae, sursum leniter attenuatae, apice 1.4–2 μ crassae, primum saepe simplices et in unum conidium abeuntes, postea apice vulgo aliquid ramosae denique 2–8 conidia in capitulum laxum ferentes; conidiis incoloratis, vulgo fusoides, apice anguste rotundatis, basi truncatis, plerumque 32–54 μ (saepius circa 44.6 μ) longis, 5.9–14.3 μ (saepius circa 9.3 μ) crassis, 3–5 septatis, saepissime quadriseptatis denique cellula antepenultima eorum plerumque crassiore et longiore quam aliis cellulis, post disjunctionem bullam tenacem vel hypham fertilem interdum emittentibus; hyphis fertilibus germinationis simplicibus saepius circa 100 μ altis, basi 2–2.5 μ crassis, sursum leniter attenuatis, apice circa 1.2 μ crassis, saepius biseptatis vel triseptatis, unum conidium ferentibus; conidiis ordinis secundi fusiformibus plerumque triseptatis vel quadriseptatis, vulgo circa 32 μ longis et 6.5–7 μ crassis. Corpora perdurantia intra animalis atque in materia circumdanti orta, filiformia, vulgo ramosa, paene incolorata vel flavidula, protoplasmatis valde guttulosi repleta, saepe 0.2–1 mm. longa, in cellulis plerumque 8–15 μ longis et 3–13 μ crassis consistentia.

Vermiculos nematoideos multarum specierum capiens consumensque habitat in materiis plantarum putrescentibus prope Roanoke, Virginia.

Mycelium scanty; vegetative hyphae colorless, septate at moderate intervals, mostly 1.5 to 3.2 μ wide, often especially in the presence of nematodes giving rise here and there on straight or curved stalks, 5 to 50 μ long and 2 to 2.5 μ wide, usually uniseptate or biseptate but sometimes triseptate or quadriseptate, to solitary ad-

hesive knobs, globose or ellipsoidal in shape, commonly 8.3 to 10 μ long and 7.2 to 8.6 μ wide; these knobs holding fast to nematodes, thus capturing the animals, then perforating the integument of each captive and intruding a globose infective body from which assimilative hyphae, mostly 2 to 4.5 μ wide, are extended lengthwise to appropriate the fleshy contents. Conidiophores colorless, erect, often containing 5 to 10 cross-walls, frequently 200 to 350 μ high, 3.3 to 5 μ wide at the base, gradually tapering upward to a width of 1.4 to 2 μ at the tip, at first often simple and terminating in a single conidium but later often provided distally with short branches or spurs and then bearing 2 to 8 conidia in loose capitate arrangement; conidia colorless, commonly spindle-shaped, narrowly rounded at the tip, truncate at the base, mostly 32 to 54 μ (average about 44.6 μ) long, 5.9 to 14.3 μ (average about 9.3 μ) wide, containing from 3 to 5 cross-walls but most often divided by 4 septa into 5 cells whereof the middle one is widest and usually longest, after being abjoined sometimes putting forth a stalked adhesive knob or a conidiophore; conidiophores of germinative origin usually simple, often biseptate or triseptate, about 100 μ high, 2 to 2.5 μ wide at the base, tapering gradually upward to a width of 1.2 μ at the tip, whereon is borne a single secondary conidium; secondary conidia spindle-shaped, mostly triseptate or quadrisepate, commonly about 32 μ long and 6.5 to 7 μ wide. Resting bodies formed within the animal's integument and also externally, filamentous, frequently branched, nearly colorless or faintly yellowish, often 0.2 to 1 mm. long, composed of cells mostly 8 to 15 μ long and 3 to 13 μ wide that are filled with densely globuliferous protoplasm.

Capturing and consuming nematodes of different species it occurs in decaying plant materials near Roanoke, Virginia.

A CLAMPLESS HYPHOMYCETE CAPTURING NEMATODES IN THICK
NON-CONSTRICTING RINGS

The several maize-meal-agar plate cultures which after being planted with leaf mold from woods near Greensboro, North Carolina, permitted abundant development of *Dactylella aphrobrocha*, were occupied rather extensively also by a number of other clampless hyphomycetes of like predacious habit. Among these allied fungi was a species that produced three-celled non-constricting rings (FIG. 3, *S*; *T*; *U*, *a*; *V*) and globose or ellipsoidal unicellular knobs (FIG. 3, *U*, *b*) on delicate, mostly bicellular stalks often about 25 μ in length. While the development of these two types of pre-

dacious organs on the same mycelium offered general parallelism with development in *Dactylella lysipaga*, *Dactylella leptospora*, and *Dactylaria candida*, the rings here could immediately be recognized as being larger and more massive than those of the three species mentioned. They measured from 20 to 26 μ in outside diameter and thus with respect to this dimension exceeded the rings of the three similar species by approximately 5 μ . In respect to thickness of the three cells composing them they ranged from 3 to 5 μ , their more usual transverse measurement of approximately 4 μ exceeding the corresponding measurement in the three known similar forms by about 1 μ . On the whole they would appear, indeed, very nearly equal in size and volume to the constricting rings of *Dactylella stenobrocha*. This approximate equality provides an exception to the marked dimensional disparity generally observable among annulated members of the predacious series, between the rather frail non-constricting rings and the conspicuously sturdy constricting rings.

For the most part the rings operated like those of *Dactylella lysipaga*, *Dactylella leptospora*, and *Dactylaria candida*. In some instances the slender supporting stalk withstood the frantic struggles of the ensnared nematode, though often incurring injury distally (FIG. 3, *W*, *a*) that needed to be repaired through intercalation of a new hyphal connection (FIG. 3, *W*, *b*). In other instances the stalk broke, permitting the animals, now tightly encircled by the ring (FIG. 3, *X*, *a*) to continue moving about for a few hours longer. In either event the ring would soon put forth from its inner surface a narrow protuberance which after penetrating the animal's integument gave rise within the fleshy interior to a globose infective body. Owing apparently to the greater volume of protoplasm contained in the ring the infective body here continued to enlarge, as a rule, until it occupied the whole width of the eelworm, whereas in the three species with smaller rings it commonly extends only partly across the animal. The virtually complete severance of musculature and organs promptly resulted in disablement of the eelworm, thereby making possible early extension of assimilative hyphae from the infective body throughout the fleshy interior. Where a nematode, after breaking the stalk, moved some distance from the predacious mycelium before succumbing to infection, its

substance was utilized by the fungus to put forth from the rings one or more external hyphae that grew out to establish a new tract of predacious mycelium (FIG. 3, X, *b*).

The knobs were never observed taking any part in the destruction of eelworms. It may be presumed that in this species as also in *Dactylella lysipaga*, *Dactylaria haptospora*, and *Dactylaria candida*, these relatively small organs are designed to function under conditions somewhat different from those suitable for the operation of non-constricting rings—under conditions apparently not often occurring in agar plate cultures of the sort employed by me. Although the mycelium bearing the two kinds of predacious organs was kept under observation until it degenerated from age, it has not so far been found giving rise to conidiophores and conidia, nor has it been seen associated with any other type of reproductive apparatus. The fungus would appear distinct from *Anulosporium nematogenum* Sherbakoff (30) in view of the larger dimensions of its rings. Its further characterization is deferred until the discovery of a conidial stage may permit reference to the proper genus in the predacious series of hyphomycetes.

GONATOBOTRYS SIMPLEX AND ITS RELATIONSHIP TO THE PREDACIOUS HYPHOMYCETES

In the classic "Pracht-Flora" wherein Corda (9) more than a century ago published the original account of his *Arthrobotrys superba* he likewise presented the original description of his *Gonatobotrys simplex*. The two fungi were set forth as being similar in their development of conidiophores with swollen nodes, in the spiral arrangement of warty sporiferous protuberances on the nodes, and in their production of oblong spores in successive capitate clusters. Owing, however, to difference in cellular make-up of their spores each was presented, in conformity with the requirements of taxonomic practice, as the type of a separate new mucedinous genus; unseptate conidia being thereby specified for the genus *Gonatobotrys*, and uniseptate conidia for *Arthrobotrys*. De Bary made the two genera more familiar by citing them together, in both editions of his well known manual on fungi (1: 46, 47; 2: 50), as exemplifying successive development of conidial

clusters on a repeatedly prolonged conidiophore. The unseptate conidia specified for it gave occasion for assignment to *Gonatobotrys* of such diverse species as *G. microspora* Rivolta (28) and *G. pallidula* Bresadola (5): the former, with its continuous mycelium, having subsequently been recognized as a phycomycete and enrolled among the Mucorales under the binomial *Cunninghamella microspora* (Riv.) Matruchot (26: 56; 31: 168); whereas the latter, with clamp-connections in its mycelial filaments, has been transferred to the resupinate basidiomycetes as *Peniophora pallidula* (Bres.) Bres. apud Bourdot et Galzan (4, 29). Neither the unhappy application of *Gonatobotrys*, nor the persistent confusion of *Arthrobotrys oligospora* with *Trichothecium roseum* Link to which some discussion was given earlier (12: 469-472), can be held to have upset the parallelism pointed out by Corda, as far as this parallelism concerns forms wherein the sporiferous and mycelial hyphae are divided by ordinary cross-walls. The possibility is not to be dismissed that among septate clampless hyphomycetes such parallelism might in some instances, if not generally, derive from close kinship, and thus might be associated with biological similarities. For this reason, after *A. superba*, together not only with *A. oligospora* and other congeners but also with many related hyphomycetes producing multiseptate spores of various sizes and shapes, was found subsisting habitually through capture of nematodes, cultures infested with eelworms have been observed closely for the development of predacious fungi referable to *Gonatobotrys*. In the course of more than a decade, however, no clampless hyphomycete bearing unicellular conidia in successive or in solitary clusters has ever been found preying on eelworms in infested agar cultures planted with decaying vegetable materials of different kinds. Therefore, when some years ago a true *Gonatobotrys* appeared abundantly on tomato (*Lycopersicon esculentum* Mill.) and muskmelon (*Cucumis melo* L.) leaves in the laboratory, opportunity was taken to try it out on nematodes, and also to grow it in pure culture for comparison with familiar members of the predacious series of clampless hyphomycetes.

The muskmelon leaves here in question were gathered in a field near Baltimore, Maryland, on July 13, 1942, and bore large dry lesions due evidently to *Alternaria cucumerina* (Ell. & Ev.) J. A.

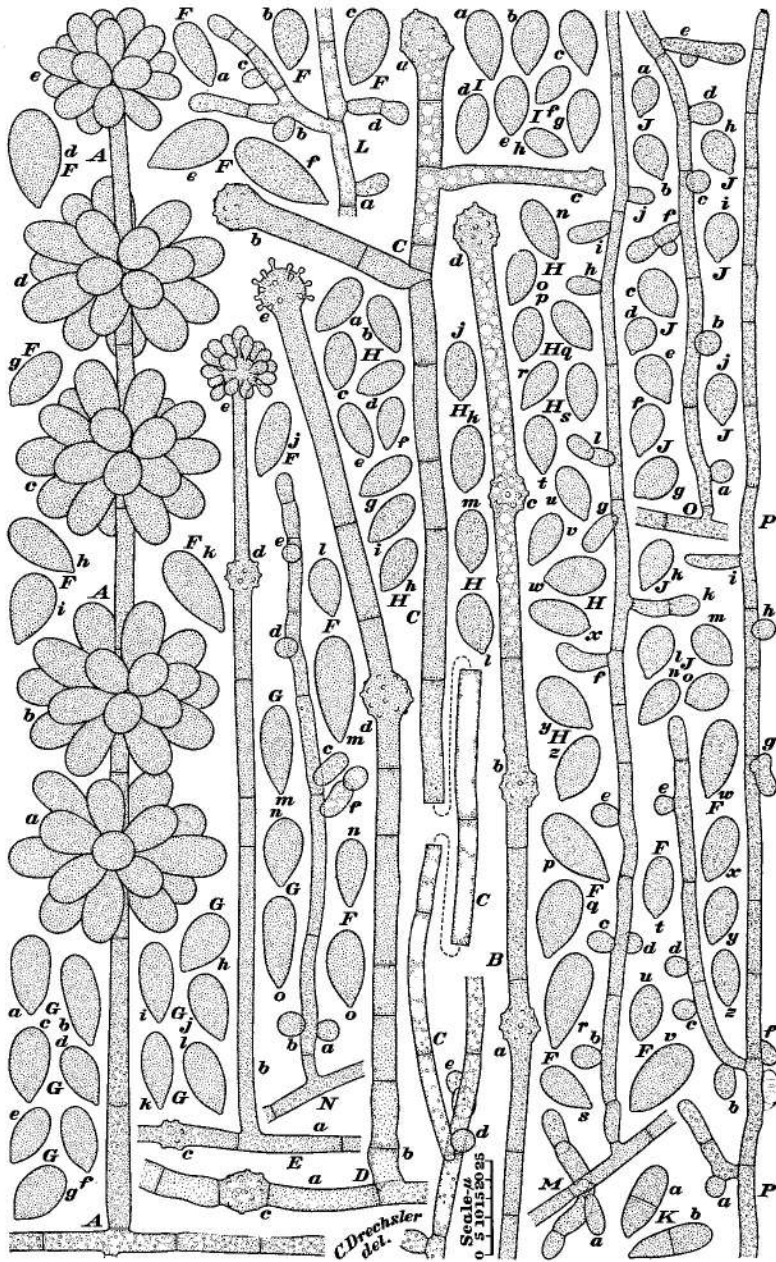


FIG. 15. *Gonatobotrys simplex*.

Elliott. Rather similar lesions attributable to the early-blight fungus, *Alternaria Solani* (Ell. & Martin) Sor., were present on the tomato leaves when these were collected in a field near Beltsville, Maryland, on July 25, 1942. Soon after their removal from the plants the leaves were arranged in a moist chamber and stored at a temperature of 18° C. On examining them 10 days later they were found covered extensively with several different molds. The *Gonatobotrys* appeared as a white compact layer covering irregular patches mostly 1 to 5 square centimeters in area. It offered to the naked eye a delicately granular appearance; the individual granules becoming recognizable under the microscope as conidial clusters (FIG. 15, A, a-e) borne at intervals of 20 to 100 μ on erect or drooping conidiophores mostly 4.5 to 7 μ wide. When small tracts of the sporulating layer were mounted in water under a cover-glass, virtually all mature conidia became abjoined from the conidiophores, exposing to view the denuded nodes, usually 8 to 12 μ wide, and beset with truncated wart-like protuberances (FIG. 15, B, a-d). In pure culture on maize meal agar the conidiophores frequently bore at some little distance below the expanded sporiferous tip (FIG. 15, C, a) one or more lateral branches each of which similarly terminated in a fertile tip often perceptibly swollen (FIG. 15, C, b, c). Such branching, as a rule, was associated with less abundant development of spore clusters on the repeatedly prolonged axial hypha. Older conidiophores, both in pure culture (FIG. 15, D, a) and on the softened leaves (FIG. 15, E, a), often declined to the substratum, and would then send up an erect branch (FIG. 15, D, b; E, b) in a position usually a little removed from any of its nodes (FIG. 15, D, c; E, c). Through the production of spore clusters at successive nodes (FIG. 15, D, d, e; E, d, e) these branches served as secondary conidiophores.

The development of the several conidia in a cluster appears here more strictly simultaneous than in any of the species of *Arthrobotrys* and *Dactylaria* that are known to capture eelworms. At the earliest stage in the formation of a cluster the distended tip of the conidiophore is found bearing from twenty to thirty protuberances, all equally minute (FIG. 15, D, e); the appearance then given recalling young sporophores of *Cunninghamella echinulata* (Matr.) Thaxter. Growth of the protuberances proceeds steadily,

each of them keeping pace accurately with the enlargement of its fellows (FIG. 15, *A, e; E, e*), so that all reach definitive size and are ready to be abjoined as conidia at the same time (FIG. 15, *A, a-d*). Conidia produced on tomato and muskmelon leaves are generally of an elongated obovoid shape though noticeably apiculate at the basal end (FIG. 15, *F, a-z; G, a-o; H, a-z; I, a-h*). They measure commonly from 12 to 29 μ in length and from 7 to 13.5 μ in greatest width. Conidia produced in pure culture on maize meal agar are of more broadly obovoid conformation and of smaller dimensions, their length varying ordinarily from 11 to 15 μ , and their greatest width from 7 to 10 μ (FIG. 15, *J, a-o*). The unseptate condition is always characteristic of the conidia, regardless of the substratum on which they are formed. However, in some mounts of material produced on tomato leaves a few uniseptate specimens (FIG. 15, *K, a, b*) were found among many thousands wherein a cross-wall was lacking. These closely resembled the conidia of *Arthrotrrys superba* and may, perhaps, have been present as an incidental admixture of that species.

In pure culture on maize meal agar the fungus grows more slowly than the larger number of clampless hyphomycetes that are known to subsist by capturing eelworms. Nevertheless in 10 to 15 days it usually gives rise to aerial hyphae and conidiophores in easily recognizable quantity. To the naked eye the aerial weft offers a fairly pronounced orange coloration decidedly deeper in shade than the pink coloration characteristic of the conidial apparatus formed so abundantly in pure cultures of *Dactylaria polycephala*. When sizable portions of agar permeated with young mycelium of the fungus were transferred to agar plate cultures infested with various eelworms, amoebae, and testaceous rhizopods, no predacious or parasitic characteristics came to light. From such trials, however, it might be premature to deny all possibility of the fungus subsisting on animals, since in pure culture its mycelial hyphae are regularly found bearing globose or digitate lateral branches that consist commonly of one (FIG. 15, *L, a-c; M, a-j; N, a-e; O, a-e; P, a-i*) or two (FIG. 15, *L, d; M, k, l; N, f; O, f*) cells, and thereby in some degree resemble the adhesive outgrowths of *Dactylella cionopaga*. Though these curious lateral branches have shown no efficacy for the destruction of the few types of animals present in my cultures,

the large variety of minute animals capable of multiplying on the lower leaves of vegetable crop plants, especially during prolonged periods of wet weather, might well offer scope for many biological relationships not hitherto revealed to sight.

As my fungus when developing on leaves in the dark at a temperature of 18° C. agrees rather well with Corda's description of *Gonatobotrys simplex*, it is assigned to that ancient species,—the assignment appearing further justified through observations by Coemans (7), Harz (23), and Matruchot (25) which show that wide variability with respect to coloration and branching is usual here. On grounds of priority Corda's binomial seems preferable to some others with which it has been held synonymous; for *Gonatobotrys* clearly antedates the genus *Oedocephalum* Preuss (27: 131) as well as the genus *Desmotrichum* Lévillé (24), while similarly the species *G. simplex* antedates *G. flava* Bon. (3: 105), *G. ramosa* Riess ex Fresenius (21), and *Oedocephalum roseum* Cooke (8). The relationship of the fungus to *Arthrobotrys* and to the series of clampless predacious hyphomycetes remains problematical. Although the general parallelism in manner of conidial development argues for kinship, the protoplasm in the conidiophore seems of markedly different texture from that in most mucedinous forms known to capture eelworms. Woronin bodies are either absent here or far less readily discernible than in the familiar species of *Arthrobotrys*. The rather distinctive odor given off by maize-meal-agar cultures of all known nematode-capturing species of *Arthrobotrys* has never been detected in any cultures of the *Gonatobotrys*.

Since Corda set forth *Gonatobotrys simplex* as growing parasitically on *Helmisporium tenuissimum* Nees, it was deemed appropriate to try out my fungus on two dematiaceous forms—*Alternaria Solani* and *Alternaria tenuis* Nees—that developed abundantly nearby on the same tomato leaves. Accordingly sizable portions of agar well permeated with young mycelium were taken from pure cultures of the *Gonatobotrys* and placed on maize-meal-agar plate cultures of the two species of *Alternaria*. In these trials the *Gonatobotrys* showed no capacity for parasitizing the two dematiaceous forms.

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EXPLANATION OF FIGURES

FIG. 1. *Dactylella stenobrocha* as found developing in nematode-infested agar plate cultures; drawn to a uniform magnification with the aid of a camera lucida; $\times 500$ throughout. *A*, Portion of mycelial hypha bearing an open predacious ring in its original position. *B-E*, Portions of hypha, each bearing an open predacious ring that is turned sideways, thereby showing advantageously its three arcuate cells and the two cells making up the stalk. *F*, Longer portion of hypha bearing two open predacious rings, *a* and *b*, that are turned sideways, thereby revealing their cellular make-up advantageously. *G*, Portion of hypha bearing a predacious ring that has closed emptily without capturing an eelworm; the ring being turned sideways shows advantageously the shape and vacuolate condition of the contracted arcuate cells. *H*, Portion of hypha with a ring that has contracted in capturing a specimen of *Plectus* sp.; two stout protuberances, one extending from the closed ring forward within the animal, and the other extending from the closed ring backward within the animal, represent assimilative hyphae in an early stage of development. *I*, Portion of hypha with a ring that has contracted in capturing a specimen of *Plectus* sp.; the two assimilative hyphae, one extending forward and the other backward within the animal, have attained their definitive length, with each showing some swelling of its terminal segment. *J*, Portion of hypha bearing a closed ring that holds a captured specimen of *Plectus* sp.; the two long assimilative hyphae extending to the animal's head and tail, respectively, each show some enlargement of the two terminal segments and the pronounced vacuolization of all segments that comes with advanced exhaustion of fleshy substance. *K*, Portion of prostrate hypha, *a*, with two erect conidiophores, *b* and *c*, whereon are borne the conidia *d* and *e*, respectively; each conidiophore being shown, from want of space, in three parts whose proper connection is indicated by broken lines. *L*, Portion of prostrate hypha, *a*, with a fallen conidiophore, *b*, that has given rise to an

erect secondary conidiophore, *c*, which bears at its tip the well developed conidium *d*; the conidiophore *c* being shown, from lack of space, in three parts whose proper connection is indicated by broken lines. *M*, Short basal portion of a fallen conidiophore, *a*, from which has been sent up the erect secondary conidiophore *b*, bearing terminally a conidium, *c*; the conidiophore *b* being shown, from lack of space, in three parts whose proper connection is indicated by broken lines. *N*, Mature detached conidia showing usual variations in size and shape, together with variations in number and position of septa as follows: *a-c*, single septum near the proximal end; *d-o*, two septa near the proximal end; *p-s*, two septa symmetrically placed, one near the proximal end, the other near the distal end; *t-z*, three septa, two near the proximal end, one near the distal end. *O*, Two conidia, *a* and *b*, each with three septa placed near the proximal end.

FIG. 2. *Dactylella stenobrocha* as found developing in nematode-infested agar plate cultures; drawn to a uniform magnification with the aid of a camera lucida; $\times 500$ throughout. *A*, Portion of mycelial hypha bearing two predacious rings, *a* and *b*, in their original positions. *B-E*, Portions of hypha, each bearing a predacious ring that is turned sideways, thereby showing its cellular make-up advantageously. *F*, Short portion of hypha with a closed predacious ring nearly in its original position. *G*, Portion of hypha with a predacious ring that has closed in capturing a specimen of *Plectus* sp.; no penetration into the animal has yet taken place. *H*, Portion of hypha whereon is borne a predacious ring, *a*, that closed in capturing a specimen of *Plectus* sp. and then invaded the animal with three assimilative hyphae, two of which are rather markedly distended in their two terminal segments; nearby is attached a second predacious ring, *b*, that has closed empty without capturing any eelworm. *I*, Portion of hypha with a predacious ring that has closed in capturing a specimen of *Plectus* sp., and has extended an assimilative hypha forward, and another one backward through the animal's body; the last two segments of the hypha directed forward each showing marked enlargement. *J*, Portion of hypha with a predacious ring that has closed in capturing a specimen of *Plectus* sp., and has given rise to assimilative hyphae extending forward and backward through the animal's body; *a*, anastomosis of two assimilative hyphae. *K, L*, Portions of prostrate hypha, each with an erect conidiophore, *a*, near the tip of which is shown a conidium, *b*, that was abjoined from it; the conidiophore *a* in each instance is shown, from lack of space, in three parts whose proper connection is indicated by broken lines. *M*, Mature detached conidia, showing usual variations in size and shape, together with variations in number and position of septa as follows: *a*, single septum near basal end; *b-m*, two septa near the basal end; *n, o*, two septa symmetrically placed, one near the proximal end, the other near the distal end; *p-z*, three septa, two of them near the proximal end, the other near the distal end. *N*, Conidium with three septa, two of them near the proximal end, the other one near the distal end. *O*, Detached triseptate conidium that has sent up an aerial hypha from its small apical segment. *P*, Detached biseptate conidium that has sent up an aerial hypha from its basal segment. *Q*, Abjoined triseptate conidium that has sent up two aerial hyphae, one from its small parabasal segment, the other from its small apical segment. *R*, De-

tached conidium that has put forth a germ tube from a position next to its base.

FIG. 3. Drawn to a uniform magnification with the aid of a camera lucida; $\times 500$ throughout. *A, B*, Portions of hyphae, each with a denuded conidiophore of *Dactylella stenobrocha* as found in nematode-infested agar plate cultures; each conidiophore being shown, from a lack of space, in three parts whose proper connection is indicated by broken lines. *C-H*, *Dactylella stenobrocha* as found developing in pure culture on maize meal agar: *C-E*, Portions of hyphae, each with a conidiophore from whose tip a single conidium has been abjoined. *F*, Uniseptate conidia, *a-o*, showing usual variations in size and shape. *G*, Biseptate conidia showing usual variations in size and shape, some of them (*a-h*) having both cross-walls placed near the proximal end, and others (*i-p*) having one cross-wall near each end. *H*, Triseptate conidium. *I*, Detached conidium of *Dactylella aphrobrocha* produced in a nematode-infested agar plate culture that had been planted with deciduous leaf mold gathered near Fairfax, Virginia, in November, 1942. *J-R*, *Dactylella cionopaga* as found developing in nematode-infested agar plate cultures that had been planted with deciduous leaf mold gathered near Butternut, Wisconsin, in September, 1938: *J*, Portion of hypha bearing a simple three-celled predacious outgrowth, *a*, and a branched seven-celled predacious outgrowth, *b*. *K*, Portion of hypha with three predacious outgrowths, *a-c*, to which is affixed a small stylet-bearing nematode; a globose infective body intruded from the two-celled outgrowth *c* has given rise within the animal to a growing assimilative hypha. *L*, Portion of hypha with four predacious outgrowths, *a-d*, of which three (*b-d*) have jointly captured a small nematode (probably referable to *Plectus* sp.) and have each intruded a bulbous infective body into the captive; the several assimilative hyphae extended from the infective bodies have become joined through vegetative fusion. *M, N*, Detached triseptate conidia. *O-Q*, Detached quadrisepate conidia. *R*, Quadrisepate conidium germinating by two polar germ tubes. *S-X*, Unnamed hyphomycete found capturing nematodes in agar plate cultures that had been planted with leaf mold gathered near Greensboro, North Carolina, in December, 1947. *S, T*, Portions of mycelial hyphae, each bearing a non-constricting ring. *U*, Portion of mycelium bearing a non-constricting ring, *a*, and a globose adhesive cell, *b*. *V*, Portion of hypha with a non-constricting ring. *W*, Portion of hypha with a non-constricting ring that after having operated in capturing a nematode (possibly referable to *Wilsonema* sp.) has intruded into the animal a globose infective body from which four assimilative hyphae are being extended lengthwise through the fleshy interior; the narrow stalk, *a*, originally supporting the ring has been evacuated distally, and a new connection, *b*, has been formed. *X*, Small eelworm that after being captured in a non-constricting ring, *a*, tore loose the encircling organ but was nevertheless later killed through intrusion of a globose infective body from which it was then invaded throughout by assimilative hyphae; a mycelial hypha, *b*, grew out externally from the ring.

FIG. 4. *Dactylella aphrobrocha* as found developing in nematode-infested agar plate cultures; drawn to a uniform magnification with the aid of a camera lucida; $\times 500$ throughout. *A*, Portion of hypha bearing a large predacious ring in its original position. *B*, Portion of hypha bearing an open

predacious ring, *a*, in its original position, and another such ring, *b*, displaced sideways a little; the stalk supporting ring *b* is unusual in length, and in being composed of three cells. *C*, Portion of hypha with two open predacious rings, *a* and *b*, both being turned sideways out of their original positions. *D*, Portion of hypha bearing an open predacious ring of relatively small size. *E*, Portion of hypha with a rather large open predacious ring that is turned sideways a little. *F-H*, Portions of hypha, each bearing an open predacious ring that is turned flatwise, thereby advantageously showing its cellular make-up. *I*, Portion of hypha with two open predacious rings, *a* and *b*, both being turned flatwise. *J*, Portion of hypha with a closed predacious ring that is turned flatwise. *K*, Portion of hypha with a predacious ring that has closed in capturing an eelworm (possibly referable to *Plectus parvus* Bastian) and has given rise to assimilative hyphae within the animal. *L*, Portion of hypha with a predacious ring that after capturing an eelworm has extended several assimilative hyphae lengthwise through its body; these hyphae have very nearly exhausted the animal's fleshy substance, and are becoming vacuolate from transfer of protoplasm to the external mycelium. *M, N*, Portions of prostrate hyphae, each bearing an erect conidiophore, *a*, near the tip of which is shown a conidium, *b*, that was abjoined from it; the conidiophore *a* being shown in each instance, from lack of space, in three parts whose proper connection is indicated by broken lines. *O*, Random assortment of detached mature conidia, showing usual variations in size and shape, together with variations with respect to number and position of septa as follows: *a-c*, three septa present, two of them placed near the proximal end, and one near the tip; *d*, three septa present, one of them placed near the proximal end, and two near the tip; *e-s*, four septa present, in symmetrical arrangement, two being placed near each end. *P, Q*, Symmetrically quadriseptate conidia, each of which has extended an aerial hypha from its rather small parabasal cell. *R*, Symmetrically quadriseptate conidium that has put forth two aerial hyphae, one from the penultimate segment, the other from the parabasal segment. *S, T*, Symmetrically quadriseptate conidia, each germinating by putting forth a germ tube from its basal and its apical cell.

FIG. 5. *Dactylella aphrobrocha* as found developing in nematode-infested agar plate cultures; drawn to a uniform magnification with the aid of a camera lucida; $\times 500$ throughout. *A*, Portion of mycelial hypha bearing a large open predacious ring in its original position. *B*, Portion of hypha with an open predacious ring that has been turned sideways to a considerable degree. *C-H*, Portions of hyphae, each with an open predacious ring that is turned flatwise, thereby showing advantageously usual variations in size and shape of the arcuate cells, the stalk cells, and the aperture. *I*, Several successive stages in the formation of a predacious ring; *a*, simple branch of circinate curvature, with two cross-walls delimiting the two cells of the stalk; *b*, same branch $1\frac{1}{2}$ hours later, showing its tip directed toward the tip of a secondary spur that is growing out from the distal segment of the stalk; *c*, same branch 30 minutes later than *b*, showing its tip in contact with the tip of the spur, and presence of a third cross-wall, which delimits the proximal arcuate cell; *d*, same branch 30 minutes later than *c*, showing fusion of tip and spur, and continued homogeneous appearance of protoplasmic contents throughout the ring and its stalk; *e*, same branch 17 hours later than *d*,

showing completed ring in functional condition, each of the arcuate cells containing an irregular elongated lacuna of obscurely globulose or foamy composition. *J*, Portion of hypha with a rather small predacious ring in lateral view; the stalk here being exceptional in consisting of three cells. *K*, Portion of hypha with a predacious ring which after capturing a small eelworm (possibly referable to *Plectus parvus*) has given rise to young assimilative hyphae within the animal. *L*, Portion of hypha with a predacious ring which after capturing a small eelworm has given rise to assimilative hyphae extending lengthwise through the animal. *M*, Portion of mycelium with a predacious ring which after capturing an eelworm of larger size has given rise to assimilative hyphae extending lengthwise through the animal; the stalk *a* originally supporting the ring having suffered injury, a new connection; *b*, has been formed between the mycelial hypha and one of the swollen cells. *N*, Portion of hypha with a predacious ring which after capturing an eelworm gave rise to assimilative hyphae extending lengthwise through its body; the original stalk, *a*, and two of the swollen cells having incurred destructive injury, a new hyphal connection, *b*, has been formed between the parent mycelial filament and the irregular proximal infective cell of the assimilative hyphal system. *O*, Portion of prostrate hypha bearing an erect conidiophore, *a*, which on its axial tip and on the tip of a branch, *b*, bore the conidia *c* and *d*, respectively; the conidiophore, from lack of space, being shown in three parts whose proper connections are indicated by broken lines. *P*, Random assortment of conidia, showing usual variations in size and shape, together with variations in number and position of septa as follows: *a-c*, three septa present, whereof two are placed near the proximal end, and one near the distal end; *d-w*, four septa present in symmetrical arrangement, two being placed near each end.

FIG. 6. *Dactylella cionopaga* drawn to a uniform magnification with the aid of a camera lucida; $\times 500$ throughout. *A*, *B*, Portions of hypha, each bearing a unicellular dome-shaped adhesive outgrowth. *C*, Portion of prostrate hypha bearing a unicellular columnar adhesive outgrowth, *a*, two bicellular adhesive outgrowths, *b* and *c*, and a five-celled adhesive arch, *d*. *D*, Portion of prostrate hypha bearing a four-celled columnar adhesive outgrowth, *a*, together with a three-celled adhesive arch, *b*, and a six-celled adhesive arch, *c*; the adhesive arch *b* is surmounted by a two-celled adhesive process. *E*, Portion of prostrate hypha with a low adhesive protuberance, *a*, arising from one of its segments; on the hypha are borne further a two-celled adhesive outgrowth, *b*, three four-celled columnar adhesive outgrowths, *c-e*, and an eight-celled network of two meshes, *f*. *F*, Portion of prostrate hypha with a six-celled adhesive outgrowth. *G*, Portion of hypha with a three-celled adhesive outgrowth which after capturing a slender eelworm (possibly referable to *Plectus* sp.) has intruded three bulbous excrescences into the animal; the excrescence intruded from the basal segment having given rise to a short, growing assimilative hypha. *H*, Portion of prostrate hypha with a three-celled adhesive process that after capturing a slender eelworm has intruded into the animal a bulbous excrescence from which a short, growing assimilative hypha has been extended. *I*, Portion of prostrate hypha bearing a two-celled columnar adhesive outgrowth that after capturing a slender eelworm has intruded into the animal a bulbous excrescence from which one

assimilative hypha has been extended forward and another backward through the fleshy body. *J*, Portion of prostrate hypha with two bicellular adhesive outgrowths, *a* and *b*, each of which has intruded a bulbous excrescence into a slender eelworm that they had captured jointly; assimilative hyphae have begun growing out from each of the intruded bodies. *K*, Portion of prostrate hypha with a unicellular adhesive outgrowth, *a*, and a two-celled adhesive outgrowth, *b*, which have each intruded a bulbous excrescence into a slender eelworm captured jointly by them; assimilative hyphae extended from the two bulbous bodies have become united by an anastomosing connection, *c*. *L-N*, Portions of prostrate hyphae, each bearing an erect conidiophore from which a conidium has been abjoined. *O*, Mature detached conidia, showing usual variations in size and shape, together with variations with respect to septation as follows: *a*, two cross-walls present; *b-f*, three cross-walls present; *g-n*, four cross-walls present; *o, p*, five cross-walls present; *q*, six cross-walls present. *P*, Fallen conidium that has put forth a two-celled adhesive outgrowth, *a*, from its distal end. *Q, R*, Fallen conidia, each of which has put forth one two-celled adhesive outgrowth, *a*, from its proximal cell, and another, *b*, from its distal cell. *S*, Fallen triseptate conidium which has given rise directly to three sessile adhesive outgrowths, *a-c*, besides putting forth at its proximal end a stout hypha that bears on the side a unicellular adhesive process, *d*, and at the tip has a two-celled adhesive part, *e*. *T*, Fallen conidium which at one end has put forth directly a sessile adhesive outgrowth, *a*, shown as viewed endwise, and at the other end has produced a stout hypha bearing two bicellular adhesive outgrowths, *b* and *c*.

FIG. 7. *Dactylella cionopaga*, drawn to a uniform magnification with the aid of a camera lucida; $\times 500$ throughout. *A*, Portion of mycelial hypha bearing a two-celled columnar adhesive outgrowth, *a*, and a three-celled columnar adhesive outgrowth, *b*. *B*, Portion of mycelial hypha whereon are borne a unicellular adhesive outgrowth, *a*, a two-celled columnar adhesive outgrowth, *b*, and a six-celled adhesive arch, *c*. *C*, Portion of prostrate hypha with a five-celled adhesive arch formed by distal union of two outgrowths. *D*, Portion of prostrate hypha bearing in addition to an inactive two-celled adhesive outgrowth, *a*, two other adhesive outgrowths, *b* and *c*, that have been operative in capturing a slender eelworm (possibly referable to *Plectus* sp.) and in intruding globose infective bodies from which assimilative hyphae have been extended through the animal. *E*, Portion of prostrate hypha with a two-celled adhesive outgrowth on whose distal cell a well developed eelworm is held affixed by means of a visible cushion of glutinous material; from the distal cell a globose infective body has been intruded that has given rise to growing assimilative hyphae. *F*, Portion of prostrate hypha with a two-celled adhesive outgrowth whose proximal segment is holding captive a slender eelworm; from a globose infective body intruded into the animal assimilative hyphae are being extended through its fleshy body. *G*, Portion of prostrate hypha with a two-celled adhesive outgrowth to whose basal segment a slender eelworm is held affixed; from the globose infective body intruded by the fungus a single assimilative hypha has been extended lengthwise through the animal's body. *H*, Portion of hypha bearing a three-celled adhesive outgrowth, whose proximal and distal segments have both been operative in capturing a slender eelworm; each of the two segments has

intruded a globose infective body from which one hypha is being extended forward and another backward through the animal's body. *I*, Prostrate hypha with a conidiophore from which a single conidium has been abjoined. *J*, Portion of prostrate hypha with an erect conidiophore, *a*, on which were produced the two conidia *b* and *c*, each of them shown with its basal end close to the position where it had been attached. *K*, Detached conidia showing usual variations in size and shape, together with variations in septation as follows: *a*, two septa present; *b-i*, three cross-walls present; *j-r*, four cross-walls present in symmetrical arrangement, two small cells being placed above and two small cells being placed below a large median cell; *s, t*, four cross-walls present, with the largest cell placed in penultimate position; *u-w*, five cross-walls present. *L*, Detached conidium that has put forth a unicellular adhesive outgrowth, *a*, from its basal cell. *M*, Detached conidium that has put forth one two-celled adhesive outgrowth, *a*, directly from its apical cell, and has extended from its tip a short stout hypha whereon is borne perpendicularly another two-celled adhesive outgrowth, *b*. *N*, Detached conidium that has put forth a two-celled adhesive outgrowth, *a*, from its tip, and from its basal cell has given off a unicellular adhesive outgrowth, *b*, as well as a four-celled adhesive outgrowth, *c*.

FIG. 8. *Dactylaria eudermata*, as found developing in nematode-infested agar plate cultures; drawn to a uniform magnification with the aid of a camera lucida; $\times 500$ throughout. *A-D*, Portions of mycelial filaments, each bearing an adhesive hyphal network. *E*, Wide mycelial filament bearing a hyphal network, which, after being operative in capturing a sharp-tailed eelworm, *a*, intruded a globose infective body that has given rise to assimilative hyphae extending lengthwise through the fleshy interior; *b*, portion of the empty integument of a nematode that had been captured and depleted of its substance earlier; *c*, fusion of two assimilative hyphae. *F*, Portion of prostrate hypha with an erect conidiophore, *a*, from the tip of which has been abjoined a single conidium, *b*; the conidiophore being shown, from lack of space, in three parts whose proper connection is indicated by broken lines. *G*, Small portion of mycelial hypha with the proximal portion of a fallen conidiophore from which has been sent up a secondary conidiophore, *a*, that produced at its tip the conidium *b*; the conidiophore is shown, from lack of space, in three parts whose proper connection is indicated by broken lines. *H*, Detached mature conidia, *a-t*, showing usual variations in size and shape. *I*, Detached conidium that has sent up two slender aerial hyphae, *a* and *b*, from its parabasals cell, and one similarly slender aerial hypha, *c*, from its apical cell.

FIG. 9. *Dactylaria eudermata*, as found developing in nematode-infested agar plate cultures; drawn to a uniform magnification with the aid of a camera lucida; $\times 500$ throughout. *A*, Portion of stout mycelial filament bearing a small adhesive network consisting of only two meshes. *B*, Portion of stout mycelial filament bearing a more extensive adhesive network. *C*, Successive stages in the closure of an adhesive hyphal bail: *a*, portion of mycelial filament bearing a completed hyphal bail to which a second hyphal bail is being added; as the elongating recurved uniseptate branch approaches distally the hyphal bail from which it originated the segment toward which its tip is directed extends a protuberance to meet it; *b*, same predacious ap-

paratus 40 minutes later than in *a*, the protuberance and the tip of the recurving branch now being in contact; *c*, same predacious apparatus 20 minutes later than in *b*, showing fusion of the protuberance and the recurved branch; *d*, same predacious apparatus 2½ hours later than in *c*, showing one septum formed near place of union and another septum formed about 20 μ backward, so that the completed hyphal bail is divided into three segments of about equal length. *D*, Portion of stout mycelial filament bearing an adhesive hyphal network in which a sharp-tailed eelworm (possibly referable to *Rhabditis* sp.) has been captured; the network has intruded three globose infective bodies from which assimilative hyphae, numbering six in all, are growing lengthwise through the animal. *E*, Portion of prostrate hypha bearing an erect conidiophore, *a*, that bore three conidia, one having been abjoined from the axial tip, *b*, another from the tip of a primary branch, *c*, and a third from the tip of a secondary branch, *d*; the conidiophore being shown, from lack of space, in three parts whose proper connection is indicated by broken lines. *F*, Portion of prostrate hypha with an erect conidiophore, *a*, that bore four conidia, one having been abjoined from the axial tip, *b*, two from tips of primary branches, *c* and *d*, and a fourth from the tip of a secondary branch, *e*; the conidiophore being shown, from lack of space, in three parts whose proper connection is indicated by broken lines. *G*, Mature detached conidia, *a-y*, showing usual variations in size and shape. *H*, Empty envelope of conidium that has yielded its contents to the mycelial hypha with which it is fused.

FIG. 10. Drawn to a uniform magnification with the aid of a camera lucida; × 500 throughout. *A-F*, *Dactylaria eudermata* as found in nematode-infested agar plate cultures: *A*, Portion of mycelium bearing an adhesive network in which a sharp-tailed eelworm (possibly referable to *Rhabditis* sp.) has been captured; a globose infective body is being intruded into the living captive. *B*, Portion of hypha bearing an adhesive network in which a sharp-tailed eelworm has been captured; from the single large bulbous infective body intruded by the fungus, assimilative hyphae have been extended lengthwise through the animal. *C*, Portion of prostrate hypha whereon is borne a conidiophore, *a*, from the tip of which a single conidium, *b*, has been abjoined; the conidiophore being shown, from lack of space, in three parts whose proper connection is indicated by broken lines. *D*, Detached conidia, most of them (*a-e*) divided by three cross-walls, but one (*f*) containing only two cross-walls. *E*, Conidium germinating by production of two germ tubes, one being extended from the basal end, the other arising laterally from the parabasal segment. *F*, Conidium that after fusing with a mycelial hypha has been emptied through transfer of its contents to the mycelium. *G-M*, *Dactylaria eudermata* as found in pure culture on maize meal agar: *G*, Detached conidia, showing variations in size and shape, together with variations in number and position of septa as follows: *a-c*, three septa present, with the largest cell placed in penultimate position as in most conidia produced in nematode-infested cultures; *d-m*, two septa present, with the largest cell being terminal in position; *n-q*, one septum present, with the larger cell being in distal position. *H*, Conidium that has put forth an aerial hypha from its small parabasal cell. *I*, Conidium that has germinated by extending a germ tube from its minute basal segment. *J*, Conidium germinating by

putting forth one germ tube from its small basal cell, another from its slightly larger parabasal cell, and a third from its small apical cell. *K*, Conidium germinating by putting forth one germ tube from its rather small parabasal cell, and another from its small apical cell. *L*, Conidium that after becoming fused with a mycelial hypha, was emptied by transfer of contents to the mycelium. *M*, Conidium that after becoming fused with a mycelial hypha, has been nearly emptied through transfer of contents to the mycelium. *N-P*, Conidial apparatus, presumably belonging to *Dactylaria eudermata*, that was found in a nematode-infested culture: *N*, Fallen conidium from which have arisen two conidiophores, *a* and *b*, each bearing three unicellular secondary conidia. *O*, Tip of a conidiophore sent up from a fallen conidium resembling that shown in *N*; from this tip and its lateral prolongation were abjoined seven unicellular secondary conidia. *P*, Detached unicellular secondary conidia, *a-c*.

FIG. 11. *Dactylaria haptotyla*, as found developing in nematode-infested cultures; drawn to a uniform magnification with the aid of a camera lucida; $\times 500$ throughout. *A*, Portions of mycelial hyphae, each bearing a predacious organ consisting of a globose adhesive cell and a unicellular (*a, b*) or a bicellular (*c-o*) stalk. *B*, Portion of hypha with two predacious organs, *a* and *b*, both having two-celled stalks. *C*, Portion of mycelium with four predacious organs, *a-d*, each having a two-celled stalk. *D*, Portion of hypha with a predacious organ whose stalk, on repeated elongation, bore successively three adhesive cells, *a-c*, whereof the two formed earliest, *a* and *b*, have degenerated. *E*, Portion of hypha bearing besides the inactive predacious organ *a*, two other predacious organs that have operated jointly in capturing a nematode (*Panagrolaimus* sp.) and have each intruded a globose infective body from which assimilative hyphae are being extended; one of these active predacious organs is attached to the mycelium not only by its original stalk, *b*, but also by a supplementary connection, *c*, while the other organ seems attached only by a supplementary connection, *d*. *F*, Portion of mycelium with a predacious organ, *a*, that has been operative in capturing a small nematode (*Panagrolaimus* sp.) and has intruded a globose infective body from which assimilative hyphae are being extended. *G*, Portion of mycelium with a predacious organ that has been operative in capturing a nematode (*Panagrolaimus* sp.) and has intruded into the captive a globose infective body from which assimilative hyphae are being extended; the distal segment of the bicellular stalk, *a*, originally supporting the adhesive cell, having been damaged, a supplementary connection, *b*, has been formed uniting the proximal segment of the stalk with the adhesive cell. *H*, Portion of mycelium with a predacious organ that has been operative in capturing a nematode (*Panagrolaimus* sp.) and has intruded a globose infective body from which assimilative hyphae are being extended; the adhesive cell here is found attached not only by its original stalk, *a*, but also by a supplementary stalk, *b*. *I*, Portion of prostrate hypha with an erect conidiophore, *a*, whereon is borne a conidium, *b*. *J*, Portion of prostrate hypha with an erect conidiophore, *a*, bearing one conidium, *b*, on its axial tip, and another conidium, *c*, on the tip of a distal spur. *K*, Portion of prostrate hypha with an erect conidiophore from which a single conidium has been abjoined. *L*, Detached conidia, *a-s*, showing usual variations in size and shape; all containing four cross-walls,

with the middle cell, except in *z*, exceeding the other cells in size. *M*, Detached triseptate conidium that has put forth an aerial hypha. *N*, *O*, Detached quadrisepate conidia which have each put forth an aerial hypha. *P*, Detached quinquesepate conidium that has put forth an aerial hypha. *Q*, Detached quadrisepate conidium that has put forth two aerial hyphae. *R*, Two conidia, *a* and *b*, that have become fused by means of an anastomosing connection.

FIG. 12. *Dactylaria haptotyla*, as found developing in nematode-infested cultures; drawn to a uniform magnification with the aid of a camera lucida; $\times 500$ throughout. *A*, Portions of mycelial hyphae, each bearing a predacious organ, the adhesive cell of which in some instances, *a-d*, is supported on a unicellular stalk, and in other instances, *e-k*, is supported on a bicellular stalk. *B*, Portion of mycelial hypha with two predacious organs, *a* and *b*. *C*, Portion of hypha bearing a young predacious organ, *a*, and two fully formed predacious organs, *b* and *c*; the stalk in *b* is commonplace in being composed of two segments, whereas that of *c* is exceptional in consisting of three segments. *D*, Portion of hypha bearing besides an inactive predacious organ, *a*, another predacious organ that has operated in capturing a nematode (*Panagrolaimus* sp.) and has begun intruding a globose infective body into the animal; the adhesive cell of the active organ is supported by the original stalk, *b*, and also by the supplementary hyphal connection, *c*. *E*, Portion of hypha with an adhesive organ, *a*, that has operated in capture of a nematode (*Panagrolaimus* sp.) and has intruded into the animal a globose infective body from which assimilative hyphae are being extended; the adhesive cell here is connected with the parent hypha only by its original stalk. *F*, Portion of hypha with a predacious organ that has operated in capturing a nematode (*Panagrolaimus* sp.) and has intruded a small infective body from which assimilative hyphae are being extended; the adhesive cell here is attached to the parent hypha by its original two-celled stalk, *a*, and also by a supplementary connection, *b*. *G*, Portion of hypha with a predacious organ that has operated in capture of a nematode (*Panagrolaimus* sp.) and has intruded a globose infective body from which assimilative hyphae have been extended lengthwise through the animal; the adhesive cell having degenerated, its interior is in part occupied by a prolongation from the supplementary connection, *a*, which provides now the only communication between the assimilative hyphae and the external mycelium; at *b* is shown an anastomosis of an assimilative hypha with the tip of one of its branches. *H*, Portion of hypha with two predacious organs that have operated jointly in capturing a nematode (*Panagrolaimus* sp.), and have each intruded a globose infective body from which assimilative hyphae have been extended; the stalk *a* originally supporting one of the adhesive cells having degenerated distally, a supplementary connection, *b*, has been formed between the adhesive cell and the uninjured proximal segment of the stalk; *c*, supplementary hyphal connection that replaces the stalk originally supporting the other adhesive cell; *d*, *e*, anastomoses of assimilative hyphae. *I*, Portion of prostrate hypha with two conidiophores, *a* and *b*, which support aloft three (*c-e*) and four (*f-i*) conidia, respectively. *J*, Portion of mycelium with an erect conidiophore from which three conidia have been abjoined. *K*, Detached conidia, showing usual variations in size and shape, together with variation in septa-

tion as follows: *a, b*, three septa present; *c-x*, four septa present; *y, z*, five septa present. *L-N*, Quadrisepate conidia that have each put forth an aerial hypha, as usually, from the parabasal cell.

FIG. 13. *Dactylaria sclerohypha*, as found developing in nematode-infested agar plate cultures; drawn to a uniform magnification with the aid of a camera lucida; $\times 500$ throughout. *A*, Portions of hyphae, *a-q*, each bearing a predacious organ with a two-celled stalk. *B*, Portion of hypha with two predacious organs, *a* and *b*, each having a two-celled stalk, though in *b* the proximal cell extends into the parent hypha. *C*, Portion of hypha with three predacious organs, two of them (*a, b*) having bicellular stalks, the other (*c*) having a unicellular stalk. *D*, Portion of mycelium bearing one predacious organ, *a*, with a two-celled stalk, and four other predacious organs, *b-e*, with unicellular stalks; *d* has been operative in capturing a nematode and has intruded a globose infective cell from which assimilative hyphae have been extended lengthwise through the animal; the predacious organ *e*, together with the two infective cells and the assimilative hyphae it extended into a captured nematode, is shown empty of protoplasmic contents. *E*, Portion of mycelium bearing two inactive predacious organs (*a* and *b*) with bicellular stalks, in addition to two predacious organs (*c* and *d*) that have each operated in capturing a separate eelworm and have each intruded into their captive a globose infective body from which assimilative hyphae have been extended; both *c* and *d* are attached mainly by supplementary connections; *e, f*, anastomoses of assimilative hyphae. *F*, Portion of hypha bearing a predacious organ with a unicellular stalk. *G*, Portion of hypha bearing one inactive predacious organ (*a*) with a unicellular stalk, and two predacious organs (*b* and *c*) that have each operated in capturing a separate nematode and have each intruded a globose infective body from which assimilative hyphae have been extended lengthwise within the animal; both active organs (*b* and *c*) show development of a supplementary hyphal connection; *d*, anastomosis of assimilative hyphae. *H*, Portion of hypha bearing an inactive predacious organ (*a*) with a unicellular stalk and also a predacious organ (*b*) that has operated in capturing a nematode and has intruded a globose infective body from which assimilative hyphae have invaded the animal lengthwise. *I, J*, Portions of mycelium each bearing a predacious organ with a two-celled stalk; the proximal cell in both instances extends into the parent hypha. *K*, Portion of mycelium bearing one predacious organ (*a*) with a unicellular stalk and another (*b*) with a long four-celled stalk. *M*, Portion of hypha bearing a predacious organ that has operated in capturing a nematode and has intruded a globose infective body from which assimilative hyphae have invaded the animal lengthwise; *a-c*, anastomoses of assimilative hyphae. *N*, Portion of mycelium bearing a predacious organ that has operated in capturing a nematode and has intruded a globose infective body from which assimilative hyphae have grown lengthwise in the animal; the empty distal portion of the two-celled stalk originally supporting the adhesive cell has been supplanted by a short supplementary hyphal connection. *O*, Portion of hypha with a predacious organ that after operating in the capture of a nematode has intruded a globose infective body from which assimilative hyphae have grown lengthwise through the animal; the

adhesive cell here is attached by its original two-celled stalk, *a*, and also by a supplementary connection, *b*.

FIG. 14. *Dactylaria sclerohypha*, as found developing in nematode-infested agar plate cultures; drawn to a uniform magnification with the aid of a camera lucida; $\times 500$ throughout. *A*, Portion of prostrate mycelium from which has been sent up an erect conidiophore, *a*, bearing three conidia, *b-d*. *B*, Portion of mycelium with a prostrate hypha representing apparently a fallen conidiophore, *a*, which has sent up from a proximal segment an erect secondary conidiophore, *b*, bearing eight conidia, *c-j*, in loose capitate arrangement. *C*, Erect conidiophore bearing five sterigmata in rather close arrangement, from each of which a conidium has been abjoined; the branching hyphae at the base consist largely of proximal portions of older conidiophores that have fallen over on to the substratum. *D*, Prostrate mycelial hypha with proximal portions of both the fallen primary conidiophore *a*, and the fallen secondary conidiophore *b*; from the latter is shown arising a tertiary conidiophore, *c*, with five denuded sterigmata. *E, F*, Distal portions of denuded conidiophores provided with sterigmata in numbers of three and five, respectively. *G, H*, Random assortment of detached conidia, *a-z*, showing usual variations in size, shape, and septation. *I*, Detached conidium that has put forth a pediculous organ from its distal end, and an erect aerial hypha from its parabasal cell. *J*, Detached conidium that has put forth a pediculous organ from its median cell and an erect aerial hypha from its parabasal cell. *K*, Detached conidium that has put forth an erect aerial hypha from its parabasal cell. *L*, Two detached conidia, *a* and *b*, united through vegetative fusion, that have sent up the conidiophores *c* and *d*, respectively, which bear the conidia *e* and *f*, respectively. *M*, Cuticle of a captured nematode within which the assimilative hyphae and the globose infective body have become conspicuously indurated. *N*, Portion of an extensive branching hyphal system consisting mostly of somewhat thick-walled, enlarged, globose, indurated cells (or chlamydospores) with globuliferous contents.

FIG. 15. *Gonatobotrys simplex*, drawn to a uniform magnification with the aid of a camera lucida; $\times 500$ throughout. *A*, Portion of prostrate hypha with an erect conidiophore bearing five conidial clusters *a-e*; drawn from material that developed on a tomato leaf in a moist chamber at 18° C. *B*, Denuded terminal portion of a conidiophore formed on a tomato leaf in a moist chamber at 18° C.; the conidiophore shows four noticeably swollen nodes, *a-d*, beset with truncate protuberances from which conidia have been abjoined. *C*, Denuded conidiophore with a swollen tip, *a*, bearing truncate protuberances from which conidia were abjoined; clusters of conidia likewise were abjoined from the swollen tips, *b* and *c*, of the two lateral branches; to the prostrate hypha from which the conidiophore arises is attached a globose unicellular branch, *d*, and a bicellular branch, *e*; drawn from a pure culture of the muskmelon strain on maize meal agar; from lack of space the conidiophore is shown in three parts whose proper connection is indicated by broken lines. *D*, Portion of primary conidiophore, *a*, from which a secondary conidiophore, *b*, has been sent up; one denuded sporiferous node, *c*, is shown in the primary conidiophore, and another, *d*, in the secondary conidiophore; the swollen tip *e* of the secondary conidiophore is beset with conidia in a very early stage of development; drawn from a pure culture of the muskmelon

strain on maize meal agar. *E*, Portion of primary conidiophore, *a*, from which a secondary conidiophore, *b*, has been sent up; a denuded sporiferous node, *c*, is shown in the primary conidiophore, and another, *d*, in the secondary conidiophore; the swollen tip, *e*, of the secondary conidiophore is beset with young growing conidia; produced on a tomato leaf in a moist chamber at 18° C. *F* (*a-s*), *G* (*a-o*), Detached conidia showing usual variations in size and shape; taken from a tomato leaf that had been kept in a moist chamber at 18° C. *H* (*a-s*), *I* (*a-h*), Detached conidia taken from a muskmelon leaf that had been kept in a moist chamber at 18° C. *J*, Detached conidia, *a-o*, as found in a pure maize meal-agar plate culture of the muskmelon strain seven days after inoculation. *K*, Two uniseptate conidia, *a* and *b*, found among a multitude of non-septate conidia produced by the fungus on a tomato leaf in a moist chamber at 18° C. *L*, Portion of mycelium from a maize meal-agar culture, showing three unicellular globose branches, *a-c*, and a bicellular branch, *d*. *M*, Portion of mycelium from a maize meal-agar culture, showing ten unicellular globose or ellipsoidal branches, *a-j*, and two bicellular branches, *k* and *l*. *N*, Portion of mycelium from a maize meal-agar culture, showing five unicellular globose or ellipsoidal branches, *a-e*, and a bicellular branch, *f*. *O*, Portion of mycelium from a maize meal-agar culture, showing four unicellular globose branches, *a-d*, borne laterally on a longish hypha, and two others that are borne separately on a unicellular branch, *e*, and a bicellular branch, *f*. *P*, Portion of mycelium from a maize meal-agar culture, showing eight short unicellular branches, *a-h*, and a somewhat longer unicellular branch, *i*.