

# THE METHOD OF PARASITISM OF SOME SOUTH AFRICAN MICROTHYRIALES.

By C. G. Hansford.

The present paper deals with five species which were considered by Doidge in her review of the South African Microthyriaceae\* as showing fairly close relationship to one another, chiefly owing to the rarity of hyphopodia on the external mycelium. In view of the wide range of absorption mechanisms in the Microthyriales, it was felt advisable to investigate the present five species in detail, and the writer is indebted to Dr. Doidge for supply of material of each species for examination. Transverse sections of infected leaves

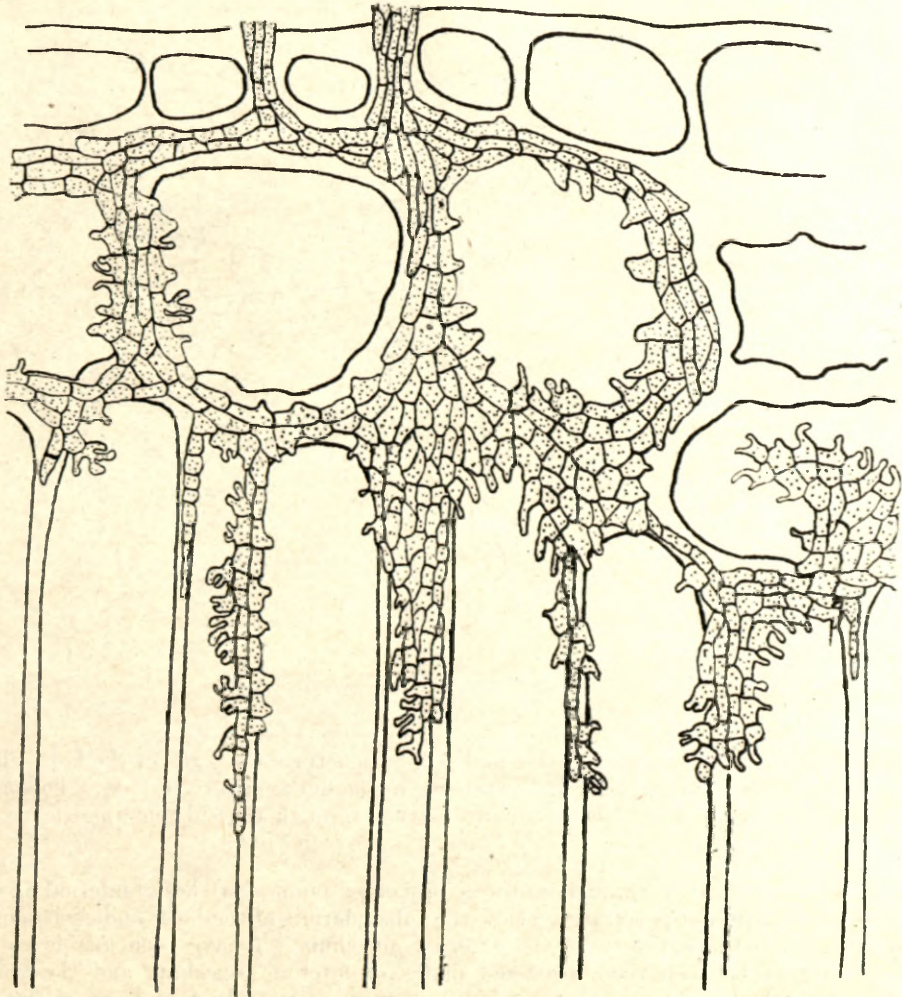


FIG. 1.

\* Doidge, E. M., Revision of South African Microthyriaceae. Bothalia IV, p. 273, 1942.

were cut and stained in Gueguen's stain, to obtain details of the absorption mechanism of each fungus, and the results obtained were checked by cutting horizontal sections so as to trace the connection of the internal mycelium or haustoria with the external mycelium and hyphopodia.

***Asterina dissiliens* (Syd.) Doidge.**

in *Bothalia* IV, p. 287, 1942.

In this species the hyphopodia are few and only on the main hyphae of the mycelium. Below the centre of the colony there is an extensive internal mycelium of hyaline hyphae penetrating through the cuticle and between the cells of the epidermis to form a thin layer around the upper ends of the palisade cells. The whole of this internal mycelium is divided by cross septa into small cells, and is entirely intercellular; it encloses the subepidermal and upper parts of the palisade cells with a thin plate of mycelium, usually one cell thick. In Fig. 1 this internal mycelium is shown in transverse section; the digitate processes

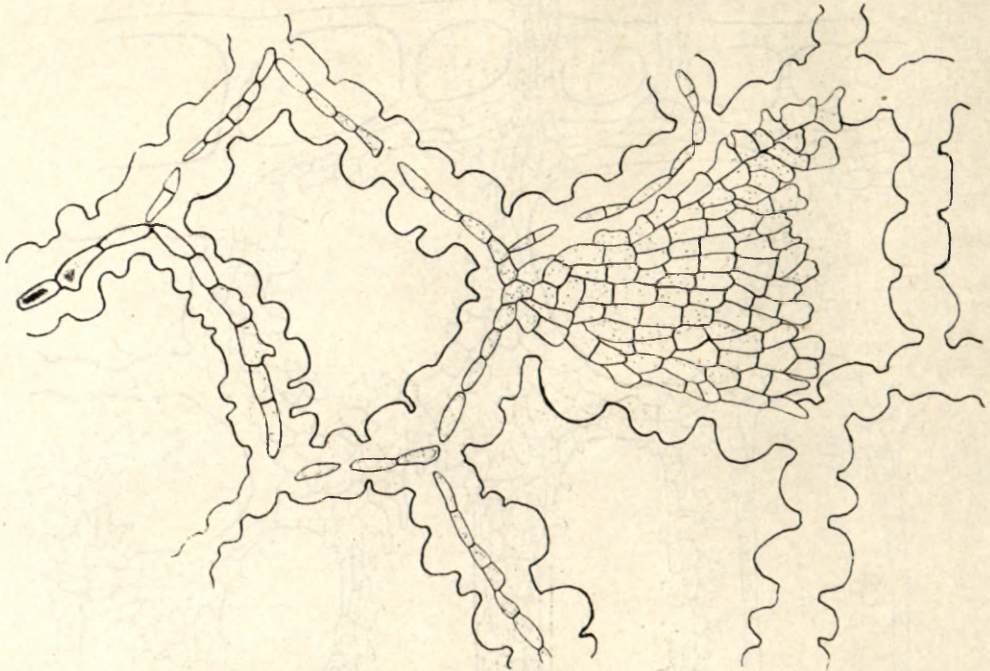


FIG. 2.

around the edge of each plate of mycelium do not penetrate the walls of the host cells, but are limited to the middle lamella and are shown in the figure in surface view. This internal mycelium is shown in Fig. 2 in horizontal section through the subepidermal layer of the host leaf.

At irregular intervals throughout the colony other smaller patches of internal mycelium are formed, usually not penetrating below the subepidermis of the host, and each connected directly through the cuticle with the external mycelium. I have been unable to detect any connection between these scattered plates of internal mycelium and the scattered hyphopodia, which appear to be functionless in this species. In Fig. 3 one of these subsidiary internal mycelia is shown in transverse section, connected directly with a cell of the external mycelium, while in Fig. 4 two plates of internal mycelium are shown originating from terminal cells of external hyphae. The last figure is of especial interest, as it shows

that the external mycelium does not penetrate through the stomatal opening to form its internal connection, but penetrates the cuticle through a groove surrounding each stoma, into the adjacent epidermis. In other cases penetration of the cuticle bears no relation to the stomata of the host leaf.

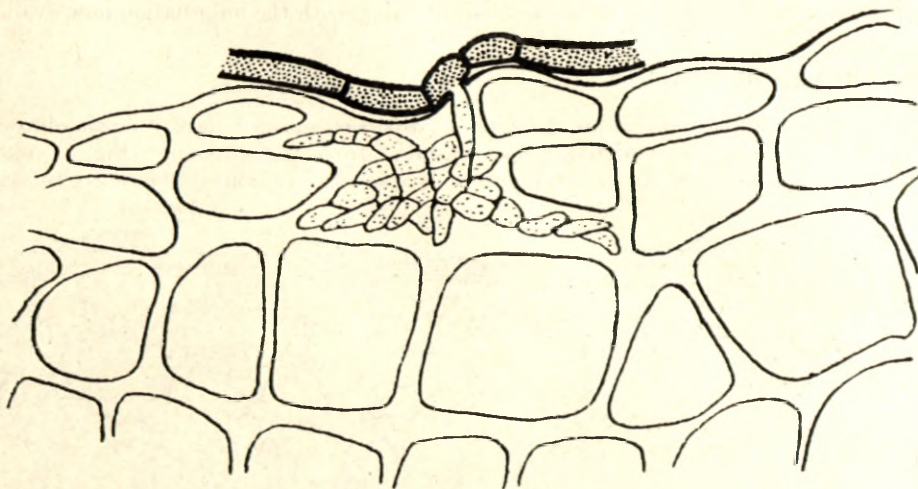


FIG. 3.

In view of the presence of an extensive internal mycelium and of the apparent absence of functional hyphopodia, it seems to the writer preferable to remove this species from the genus *Asterina*, which in our view should be limited to species of true ecto-parasitic habit,

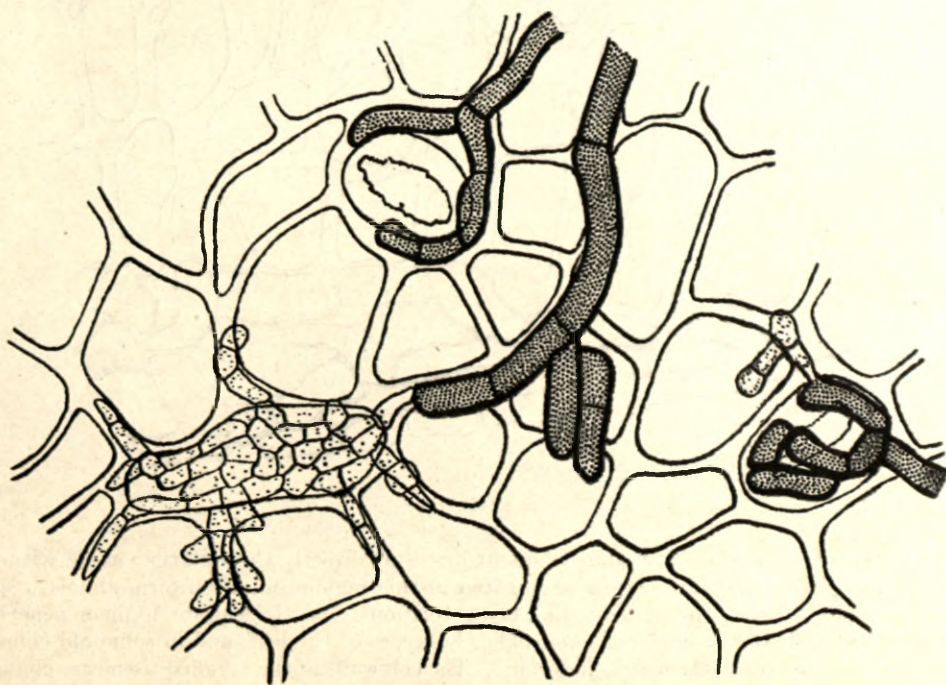


FIG. 4.

possessing hyphopodia and haustoria in epidermis and subepidermis formed singly and exclusively from the hyphopodia. For the present it appears best to return the species to the genus *Asterinella*, in which it was originally placed by Sydow.\* This genus contains species with a wide range of internal absorption mechanisms, and at present it is not possible to sort these into separate genera on the basis of habit, with the information now available.

***Asterina inconspicua* Doidge, l.c.**

Each colony of this species, on *Chilianthus arboreus*, shows a dark yellowish-brown to brown central spot in the underlying host tissues. In section this spot (Fig. 5) contains a subcuticular plate of mycelium varying from dark brown in colour in the centre to hyaline

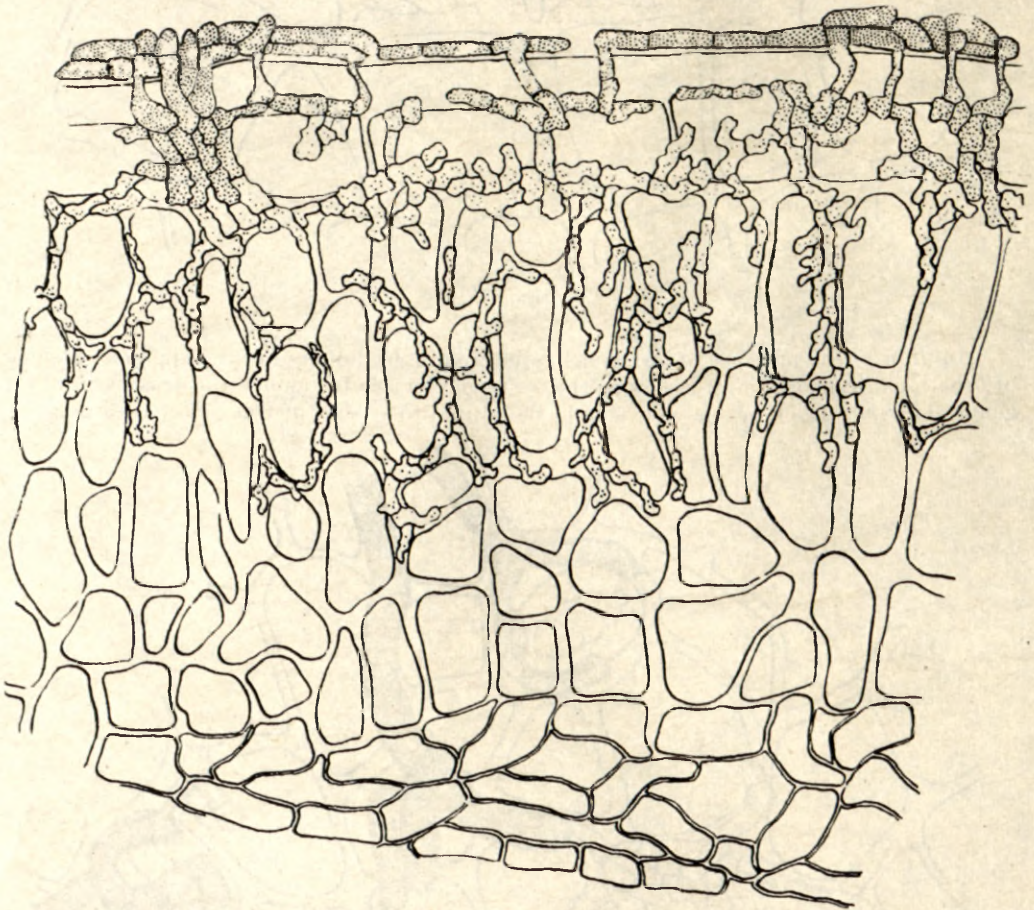


FIG. 5.

around the edges, and connected at frequent intervals directly through the cuticle with the external hyphae, which are closely aggregated in this region and often form almost a solid plate of cells. From the subcuticular layer tortuous, shortly septate hyphae penetrate between the cells of the epidermis and palisade layers of the leaf, and in some old colonies they may almost reach the lower epidermis. The cell walls of the invaded tissue are changed

\* Sydow, H., in *Ann. Myc.* XXII, p. 425, 1924.

chemically so that they stain pink to red with Sudan III, while their contents are partly or completely disorganised and no longer contain visible chloroplasts. The whole internal mycelium is intercellular and no haustoria are produced in the host cells.

At irregularly scattered points over the colony subsidiary penetrations of the host are made, direct through the cuticle. These originate from some of the hyphopodia, which first form a delicate hypha penetrating through the cuticle and spreading over the epidermis underneath. While this is occurring, the hyphae of the external mycelium form a small irregular plate of short branches surrounding the hyphopodium, and at a later stage some of these branches penetrate the cuticle to connect with the enlarging subcuticular mycelium. Early stages in the development of these subsidiary internal connections are shown in Fig. 6, one viewed from the surface of the leaf, and the other from below the epidermis.

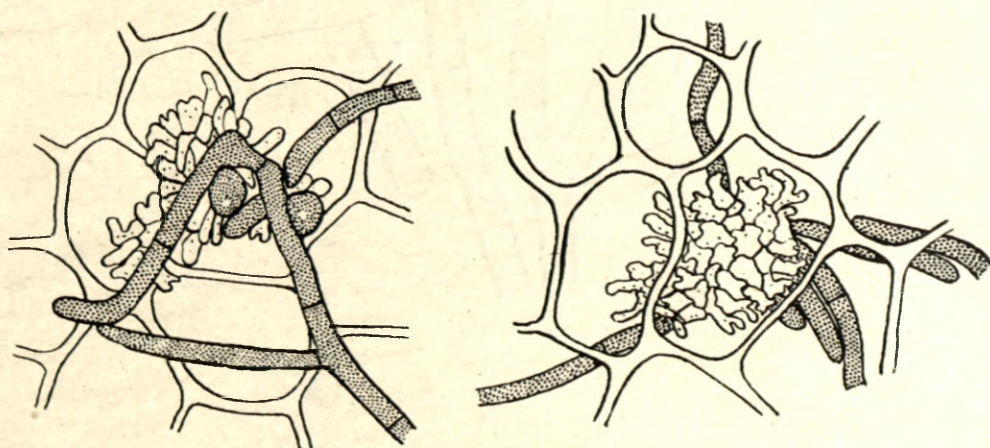


FIG. 6.

In these drawings the internal mycelium is shown lightly shaded, and at these stages is entirely subcuticular and hyaline.

In view of the extensive internal mycelium of this species the writer prefers to remove it from the genus *Asterina*, as *Asterinella inconspicua* (Doidge) comb. n., though it may be regarded as exhibiting a transition towards the true ectoparasitism of *Asterina* in that the hyphopodia become functional late in the development of the colony.

***Asterina secamonicola* Doidge.**

in *Bothalia* II, p. 233, 1927.

As noted by Doidge (l.c., IV, p. 286), the hyphae of the external mycelium are much branched around the scattered hyphopodia, and in mature colonies most of the hyphopodia are surrounded by a close irregular plate of mycelium. (Fig. 7). Viewed from below the epidermis the hyphopodium is seen to have produced a coralloid hyaline haustorium filling the whole upper part of a single epidermal cell (Fig. 8). In transverse section (Fig. 9), the haustorium may either be inside the epidermal cell, more or less adnate to its upper wall, or in other cases apparently external to the epidermal cell and beneath the cuticle. I have been quite unable to detect any other internal absorption apparatus in this species, which is therefore correctly classified as an *Asterina*, and truly ecto-parasitic in habit.

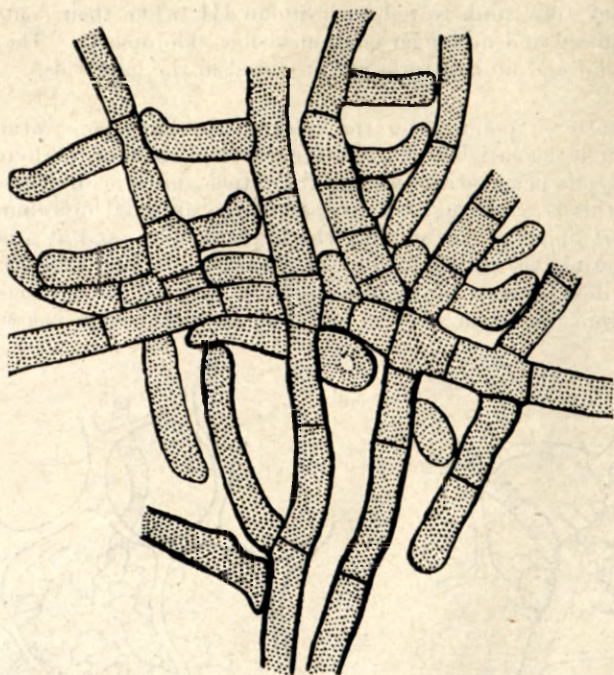


FIG. 7.

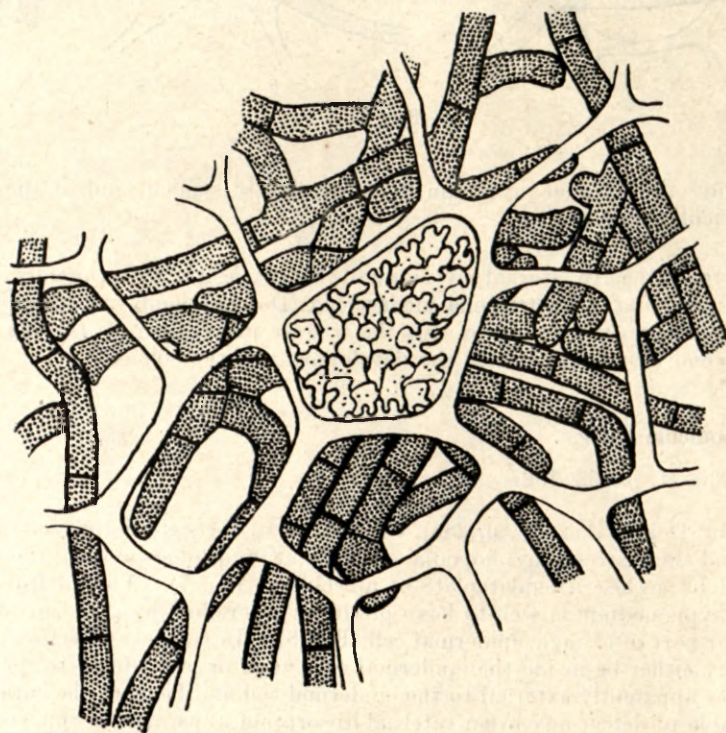


FIG. 8.

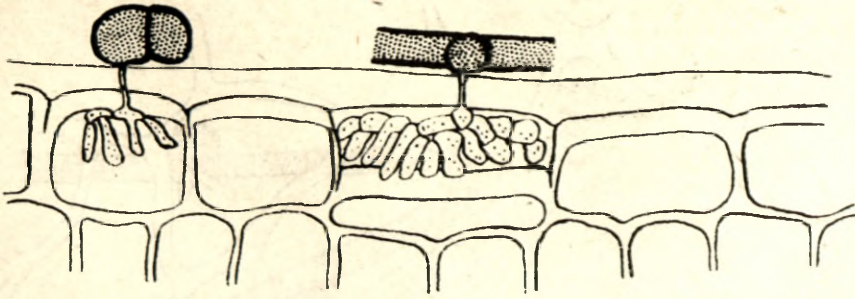


FIG. 9.

***Lembosia piriensis* Doidge.**

in *Bothalia* I, p. 78 (1922).

In this species each of the scattered hyphopodia forms a single coralloid haustorium in the epidermis beneath, at first filling a single cell of the host, but later in some cases extending into one or two adjacent cells. There is no other penetration of the host visible in our preparations, and the fungus is correctly placed in the genus *Lembosia*. Figure 10

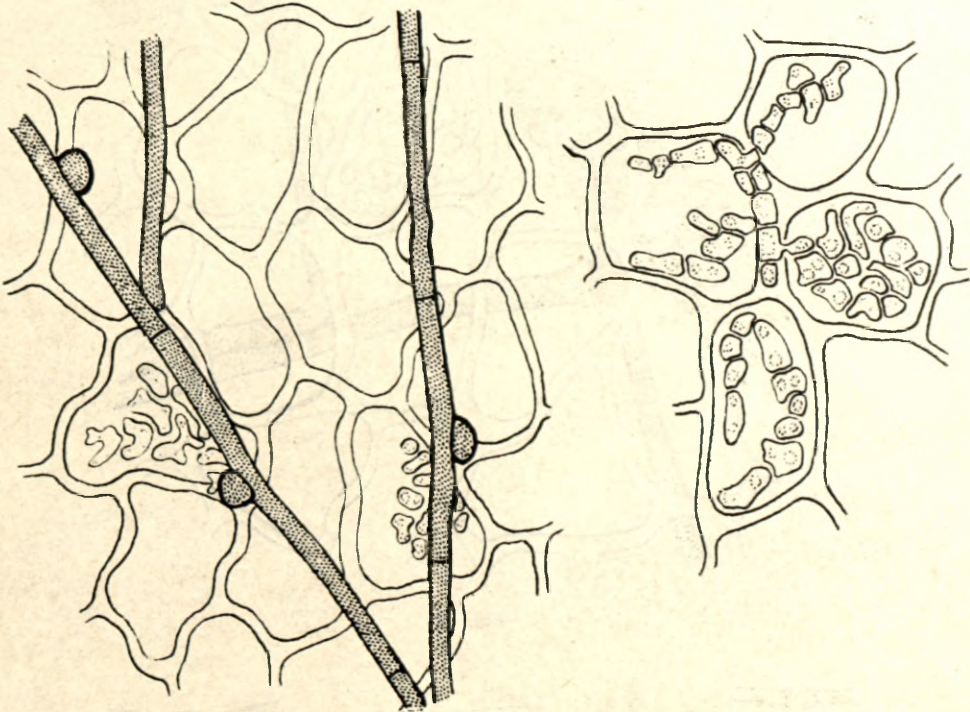


FIG. 10.

shows a surface view of the mycelium with haustoria in the epidermis below, on the right a haustorium extending over four epidermal cells is drawn. Figure 11 shows haustoria and mycelium in an older part of the colony, viewed from below the epidermis, while Fig. 12 shows the haustoria in transverse section.

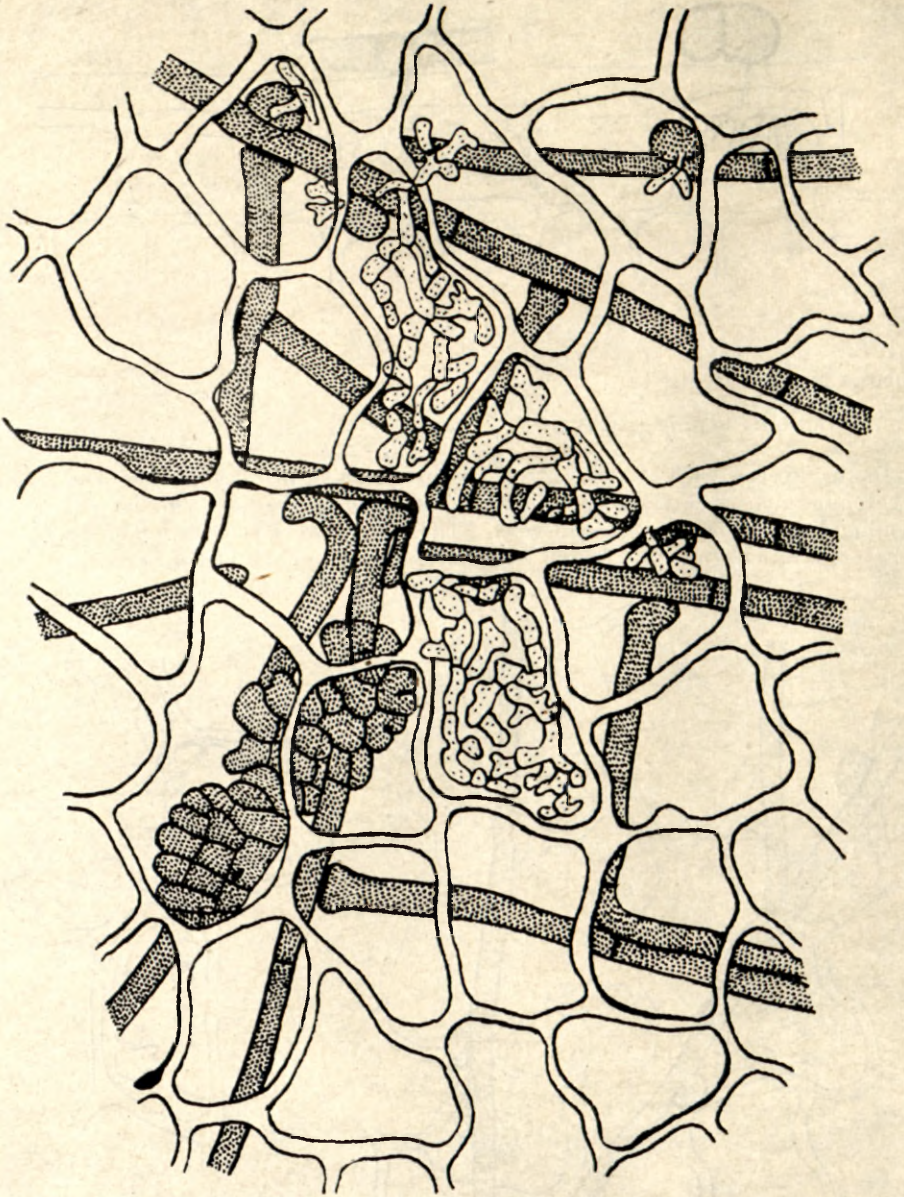


FIG. 11.

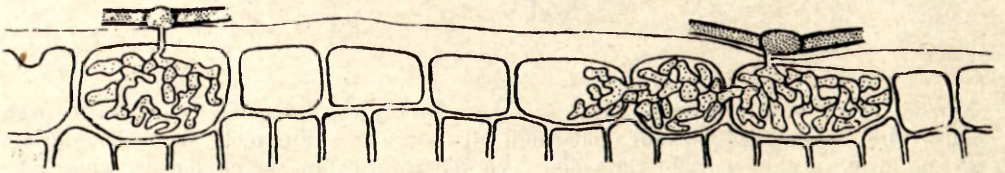


FIG. 12.



**Lembosia durbana** van der Byl.

in South African Journ. Sci., XXVI, p. 319 (1926).

Beneath the centre of the colony, where the external mycelium is densely aggregated, and from which it radiates outwards more or less regularly, there is an extensive plate of subhyaline to hyaline mycelium beneath the cuticle, connected by fairly numerous pegs direct through the cuticle to the external hyphae. From the subcuticular plate hyphae descend between the cells of the epidermis to form a similar plate of small cells between

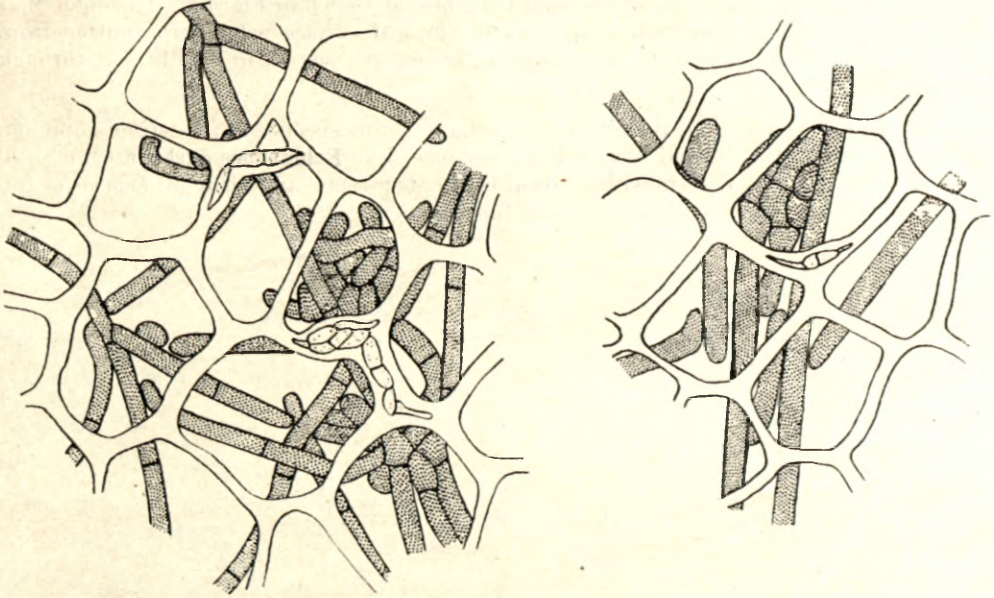


FIG. 13.

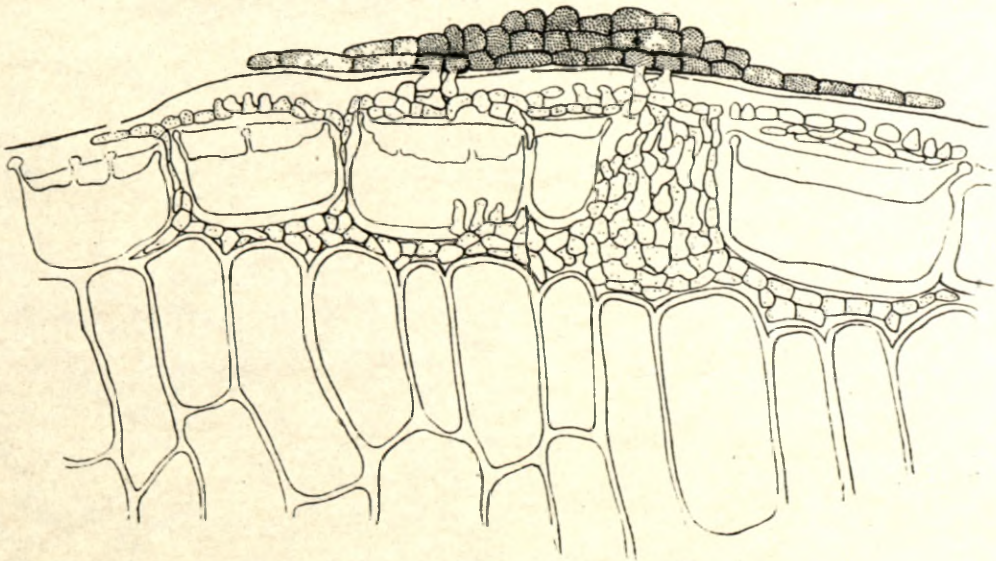


FIG. 14.

the epidermis and palisade layers of the leaf; no deeper penetration of these hyphae has been found. There are no haustoria in the host cells, and the internal mycelium is completely intercellular. At scattered points in other parts of the colony, beneath the mycelial aggregations which surround some of the hyphopodia, smaller patches of internal mycelium are formed, usually without the subcuticular plate but with the hyphae descending between the epidermal cells to form small patches of mycelium above the palisade layer. It is possible that these secondary penetrations of the host originate from the hyphopodia but in our preparations it was not possible to establish this point, as each hyphopodium is surrounded by an irregular plate of mycelial branches, as shown in Fig. 13. The epidermal cells have a series of pits extending up towards the leaf surface, which are omitted from Fig. 13 for the sake of clarity, though shown in transverse section in Fig. 14, cut through the centre of the colony.

The presence of an extensive internal mycelium in this species, in the writer's opinion, removes it from *Lembosia*, and it would be best placed as **Echidnodes durbana** (v. d. Byl) comb. n., though it shows transition towards the true ectoparasitism of *Lembosia* and *Asterina*, in so far as the hyphopodia being functional.