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Art. XIV.—*The "Sooty Moulds" of some Australian Plants.*

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(With Plate IX.)

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Introduction.

Very little attention has been paid to the "sooty moulds," which occur in Australia. The only work of any consequence was done in 1896 by McAlpine(24) on the sooty mould of Citrus. He studied the mould as it occurs on the leaves of Citrus trees, and found a large variety of reproductive bodies connected with the mycelium. As he found the same variety of types on Citrus hosts from widely separated localities, he considered these were all stages of the one fungus (which he named *Capnodium citricolum* McAlp.) without any further verification of his hypothesis.

The present work was undertaken in an attempt—(i) to ascertain whether or not the various reproductive stages found on the leaves and stems of "sooty" plants in Australia are different stages in the life cycle of one form; (ii) if the reproductive stages belong to a mixture of forms, to elucidate the flora composing the sooty covering, and to compare it on generically different hosts; (iii) to gain some knowledge of the cultural characters of these forms.

Historical.

Many early workers, including Montagne, Zopf, and Rehm, have contributed to the literature on "sooty moulds," but Arnaud is the first person to make a detailed study of the group as a whole.

Arnaud (1-4) chiefly studied the "fumagines" as they occur on the host, and connected pycnidial stages with associated perithecial forms without any cultural evidence. He found all the "fumagines" occurring in the vicinity of Montpellier to be formed by a mixture of saprophytic fungi, which he placed with one exception, *Calicium,* in the family Sphaericaceae. Arnaud has divided this family into two big groups: I. Dictyospored Sphaericaceae, in which the ascospores are muriform, i.e., possess both longitudinal and transverse septa; and II. Phragmospored Sphaericaceae, in which the ascospores possess transverse septa only. The division between these two groups is not absolutely clear-cut, as the longitudinal septa are rare in some dictyospored species.

Theissen and Sydow(36) studied this group of fungi from a purely systematic point of view, and the key compiled by them

has been followed by many subsequent workers. They include the majority of the "sooty fungi" in the family Capnodiaceae, of the Perisporiales, which is characterized by cleistocarpous perithecia.

Doidge(9-14), who has followed Theissen and Sydow in regard to the systematic position of the "sooty moulds," has investigated the South African forms, as they occur on the host, by means of microscopic preparations made by the collodion method(9). These fungi were found in most cases to belong to the genus *Meliola* Fr., which is an ectoparasite, and so does not form a true "sooty mould." Cp. Neger(28).

Neger(28) demonstrated the composite nature of the sooty moulds which he examined, having isolated several fungi, such as *Dematium pullulans, Atichia glomerulosa, Fumago vagans,* &c., from the "sooty film," but he did not succeed in growing *Capnodium salicinum* in culture.

Tengwall(34) studied the "sooty moulds" from several hosts(29), in culture. He made inoculations directly from the leaf on to a hanging drop of saccharose agar, then, by means of shake cultures, he obtained the components in pure culture. The most frequent isolations thus obtained were *Dematium pullulans* de Bary and *Cladosporium herbarum* (Pers.) Link, although several other genera were also represented. He also attempted to resynthesize "sooty moulds," and found that the fungi which grew best were *Fumago vagans* Pers. and *Cladosporium herbarum.* Tengwall's results suggest that "sooty moulds" are formed by a mixture of distinct genera of fungi growing together. The evidence is insufficient, however, to establish this fact definitely, as no attempt was made to analyse the 'sooty moulds" as they occur in nature.

Sawhney(33) examined the "sooty coverings" occurring on the cotton plant, both culturally and in nature. He found this mould to be due primarily to a species of *Capnodium,* but also *Macrosporium* and *Alternaria* were found as constituents of the "sooty film." Sawhney has left his species of *Capnodium* unnamed. The character of the ascospores, which are dark, globose, and non-septated, would cause this form to be included in the species *Capnodium maximum;* but Sawhney regarded Saccardo's description of the latter species as too meagre for an adequate comparison to be made. He related a pycnidial form containing light-brown, bicellular spores to *Capnodium* sp. as its imperfect stage, but without evidence from single spore isolations.

Method.

Attention was given entirely to indigenous Australian plants affected with "sooty mould."

The culture medium used, unless otherwise stated, was honey agar. This is a 2 per cent. agar solution containing 1.5 per cent.

honey. In addition, use was made of *Myoporum* agar, oat agar, and Czapek agar. Synthetic media of high nitrogen content were also used for testing the effect of increased nitrogen supply on the growth and production of fruiting stages in certain of the isolated forms. A basal synthetic medium was used, to which different nitrogenous constituents were added. One litre of the basal or stock medium (15 grams agar + 1.25 grams K_2PO_4 + 0.75 grams $MgSO_4$ crystals + 2 grams glucose + 1000 ccs. water) contained 2 grams of ammonium nitrate, ammonium sulphate, asparagin, or peptone.

A large number of the cultures were made by means of gross inoculations, i.e., a small fragment of the "sooty covering" was transferred directly from the infected leaf to honey agar slopes, which were then incubated at 23° C., or allowed to remain at room temperature. In cases where an attempt was made to obtain single spore cultures, the "slide culture" method was used. The spores were placed in a drop of sterilized water on a sterile microscope slide. A very thin film of honey agar was then poured over the slide, which was then replaced in a sterilized petri-dish, and incubated. By means of microscopic examination it was possible, in one or two days, to locate the germinating spores and transfer them with a platinum needle to honey agar slopes.

I. Bursaria spinosa (Sweet Bursaria).

The infected material was collected at Healesville, Montrose, and Greensborough, which are situated east, north-east, and north-east from Melbourne.

A. In Nature.

Microscopic examination of the leaves after treatment with lacto-phenol* showed that the "sooty mould" possesses two types of mycelium: (i) a dark-brown, beaded form; and (ii) a lighter-coloured form, not constricted at the septa. The following structures were observed:—

(*a*) Perithecia, which are olivaceous, glabrous, thin-walled, sessile conceptacles, roughly spherical in shape, and each is provided with a slight beak. The asci can be seen through the perithecial wall in the young state, and form a tuft in the centre of the perithecium (Fig. 1). The ascospores are brown, muriform, usually with three, but occasionally four or five, transverse septa (Fig. 2). They measure on an average 16.5μ x 7.5μ. The average perithecial dimensions are 139μ x 107.5μ. These perithecia are very similar to those figured by Tulasne(37) for *Capnodium salicinium* Mont. (under the name of *Fumago salicina;* pl. xxxiv., Fig. 14A). The perithecia occurring on *Bursaria* also agree closely with those described by McAlpine(24)

* The lacto-phenol used consisted of equal parts of glycerine, water, phenol, and lactic acid.

under the name of *Capnodium citricolum* McAlp. The spores, however, are slightly smaller, and do not always possess the median constriction, characteristic of McAlpine's species.

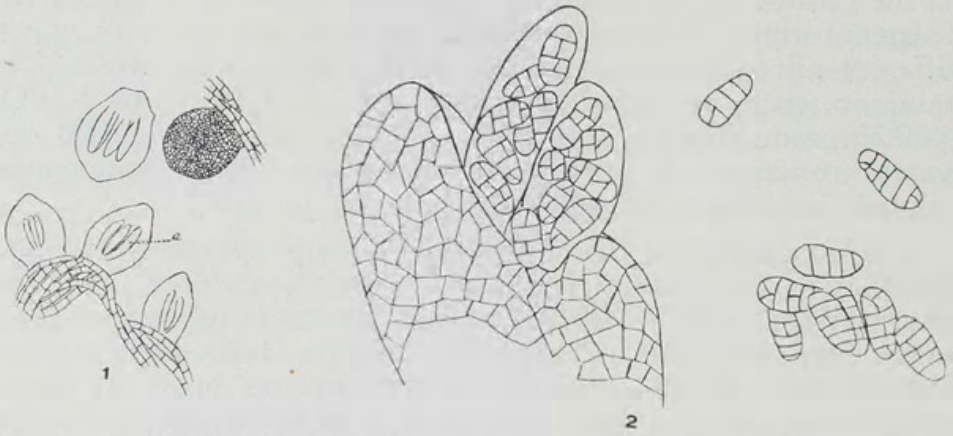

FIG. 1.—Perithecia of *Teichospora salicina*, containing asci (*a*) at various stages of development. × 50. FIG. 2.—Ruptured Perithecium of *Teichospora salicina* showing asci and ascospores. × 310.

(*b*) Light-olivaceous, flask-shaped pycnidia, provided with fringed mouths (Fig. 3). The contained pycnospores cannot be distinguished from ascospores. They are brown, muriform, with three transverse septa, and measure approximately 18μ x 8.3μ.

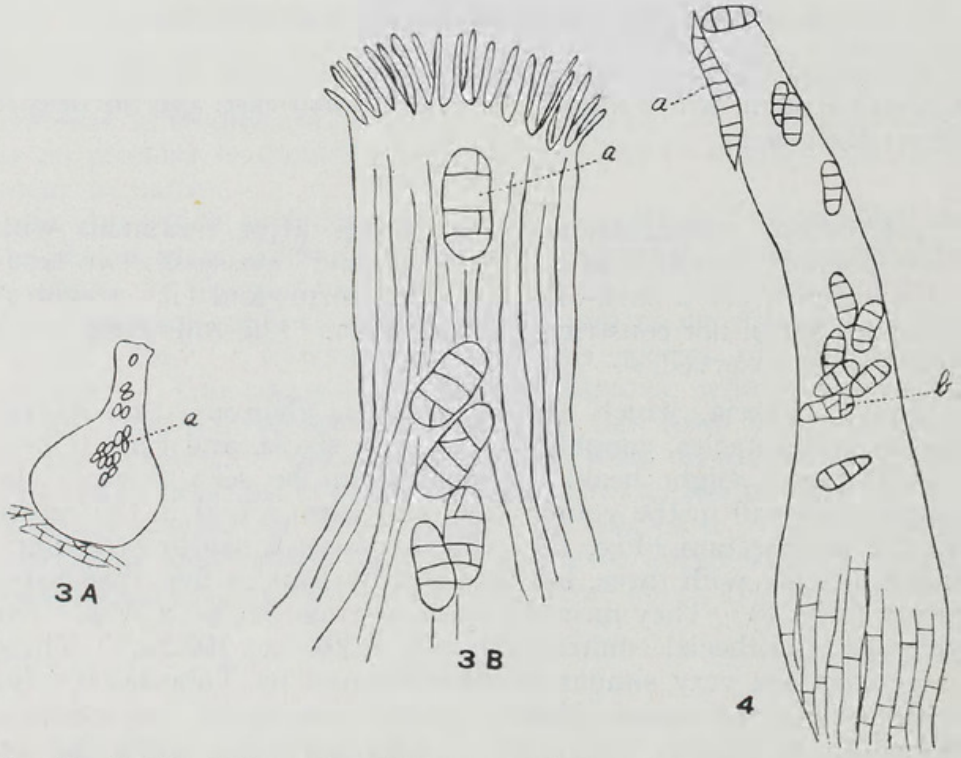

FIG. 3.—A. Pycnidium of *Teichospora salicina*, (*a*) pycnospore. × 50. B. Mouth and neck of Pycnidium showing fringed mouth. × 310. FIG. 4.—Pycnidium of *Teichospora salicina*. × 185. (*a*), spore of *Hendersoniella* adhering to outside of pycnidium; (*b*), pycnospore.

The pycnidial dimensions average:—

Length of pycnidium, 230μ.
Length of neck of pycnidium, 95μ.
Width of basal portion, 115μ.

They resemble closely those of *Capnodium salicinum* Mont. figured by Tulasne(37) (pl. xxxiv., fig. 14p), and might also be compared with McAlpine's description and figures (pl. xxv., fig. 7; pl. xxxi., fig. 28; pl. xxxii., fig. 37), of "pycnidia proper," found in "sooty mould" of Citrus.

(*c*) Elongated, dark-brown pycnidia. These are linear in form, tapering slightly towards the apex, but not differentiated into definite neck and basal region. (Fig. 4.)

The measurements are:—

Length of pycnidium, 217μ.
Width of basal portion, 48μ.
Width at apex, 21μ.

In this type of pycnidium, the mouth is not provided with a fringe. The contained pycnospores are the same as those previously described, only they are slightly smaller and the longitudinal septa are more rare. This may be an earlier stage in the development of the previously described type of pycnidium.

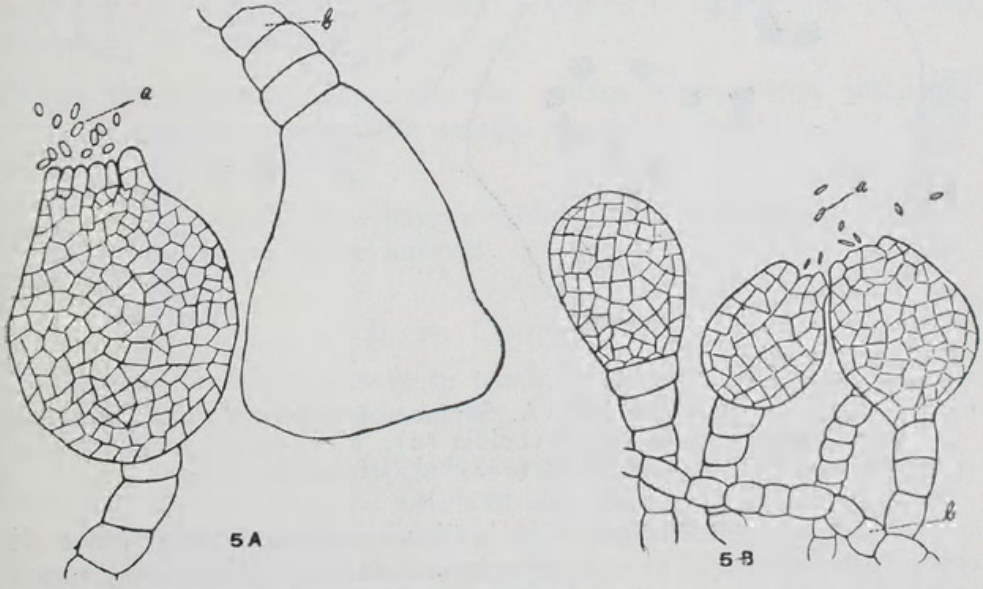

Fig 5.—Pycnidia of *Chaetophoma.* Cke. sp.? × 310. (*a*), spore; (*b*), beaded hypha. A. Growing on *Bursaria spinosa.* B. On *Leptospermum scoparium.*

(*d*) Brown spherical pycnidia, which usually occur terminally on the brown beaded hyphae. These contain hyaline non-septated spores, which vary in size, but average 3.5μ x 2μ (Fig. 5). The average pycnidial dimensions are 79μ x 54μ. These pycnidia

probably correspond with the *Antennaria* form described by McAlpine in the "sooty mould" of Citrus(25), also they agree very closely with *Chaetophoma,* described by Arnaud(2) as the spermogonial stage of the fungus *Pleosphaeria citri.* Similar bodies were also described and figured (Tab. vi., fig. 1) by Saccardo(31) in connexion with *Capnodium Walteri* Sacc.

(*e*) Brown flask-shaped pycnidia, containing brown spindle-shaped phragmospores. These pycnospores are shorter, but otherwise similar to the conidia of *Capnodium Walteri* Sacc., described by Saccardo(31), and figured by him arising from the ends of small erect conidiophores (Tab. vi., Fig. 1). According to the classification of the Fungi Imperfecti given by Lindau(20), pycnidia of this type would be placed in the genus *Hendersoniella* (Sacc.).

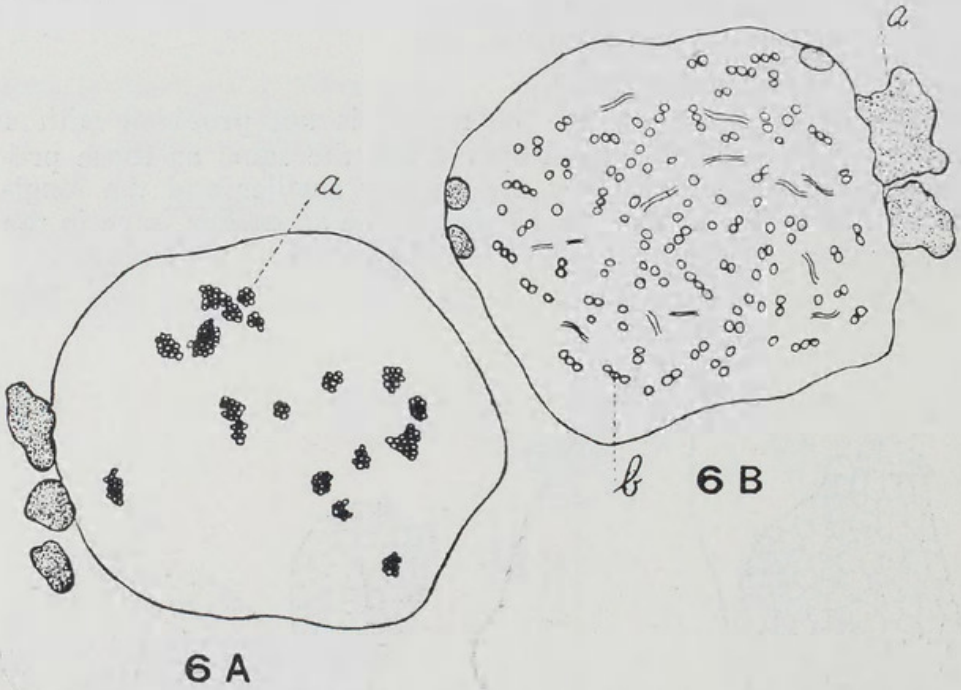

Fig. 6.—*Phycopsis* sp.? × 103. A. Surface of cushion focussed showing "propagula" or clusters of conidia (*a*). B. Focussed at deeper level showing internal structure; (*b*), chain of hyaline cells.

(*f*) Light-coloured spherical bodies, composed of a mass of colourless cells, held in a mucilaginous matrix. They vary much in size, but average dimensions may be taken as 280μ x 310μ. When they are mature, small clusters of brown cells or conidia may be seen scattered over the free surface of these cushions. (Fig. 6.)

McAlpine(24) described and figured similar bodies under the name "glomeruli," in connexion with the "sooty mould" of Citrus, and he referred them to the form genus *Heterobotrys.* Arnaud(2) considered such structures as gelatinized conceptacles

(perithecia or spermogonia) of any member of the Sphaericaceae, rather than as a distinct fungus. More recent investigations carried out by Mangin and Patonillard(22), and Cotton(8), on the aberrant and rather obscure family Atichiaceae, led the writer to identify this form with *Seuratia Vanillae* Pat., a species which was later placed by Mangin and Patouillard(22) in the genus *Phycopsis*.

Neither asci nor " spermogonia " were observed in the material examined, although the clusters of brown cells no doubt correspond to the " propagula " described by the latter authors. However, when the type specimen of *Phycopsis Vanillae*, made available to the writer by Monsieur Heim of the Muséum d'Histoire Naturelle, Paris, was examined, no " propagula " were observed, although in other respects it was very similar to the " sooty component " under discussion.

An examination of the family Atichiaceae, as represented in the herbarium of the Royal Botanic Gardens, Kew, suggested that this form might belong to the species *Heterobotrys paradoxa* Sacc., removed by von Höhnel to the genus *Atichia*(16). The fungus under investigation, nevertheless, seems more correctly placed in the genus *Phycopsis* as the thallus is never star-shaped, neither are the " propagula " restricted to localized areas of the thallus, both of which are characteristic features of the genus *Atichia* according to Boedijn(7).

(*g*) Dark-brown *Macrosporium* spores were found scattered through the meshes of the fungal network forming the sooty mould.

(*h*) On some of the leaves which were examined, *Cladosporium*-like spores were noticed.

B. In Culture.

No gross inoculations were made from this material; all are single-spore cultures, made by the " slide culture " method.

A series of single ascospore cultures was set up. Four cultures resulted, all agreeing in external appearance. They are slow-growing, firm, olivaceous colonies, with a powdery surface. Only one of these cultures fruited on honey agar. It formed elongated, linear pycnidia, measuring from 400μ-480μ in length, and 30μ-120μ in width. The mouths of these pycnidia are not fringed (Fig. 7). The contained pycnospores are brown muriform spores, with three transverse septa, and in them the longitudinal septa are quite frequently absent. They measure, on an average, 18μ x 6μ (Fig. 8). These pycnidia are similar to the " unfringed pycnidia " found occurring on the host. Both beaded and non-beaded hyphae occur, the non-beaded being most abundant.

When grown on Czapek's agar, this fungus retains its olivaceous powdery appearance, but forms a more pulvinate type of colony. Also, the pycnidia remain unaltered, but the pycnospores show an increase in the number of transverse septa, in many cases.

On oat agar, this form gives rise to a smooth black growth. Elongated pycnidia are produced which are readily visible to the naked eye. The majority of these pycnidia possess unfringed mouths, in one case, however, a suggestion of a developing fringe was observed (Fig. 9). The pycnospores again show an increase in the number of transverse septa.

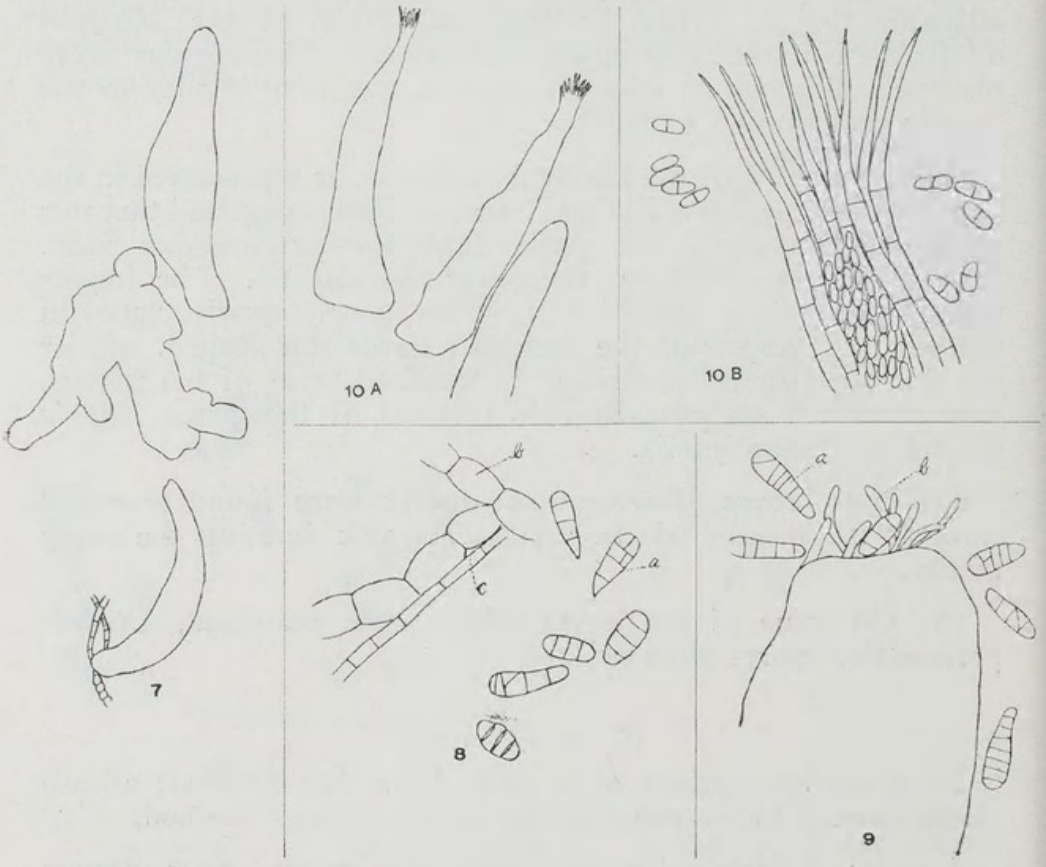

Fig. 7.—Pycnidia of *Teichospora salicina*, grown on honey agar. × 50. Fig. 8.—Showing free pycnospores and mycelium of *Teichospora salicina*, grown on honey agar. (*a*), pycnospore; (*b*), beaded hypha; (*c*), non-beaded hypha. × 310. Fig. 9.—Mouth of pycnidium of *Teichospora salicina*, grown on oat agar. × 310. (*a*), pycnospore showing increased septation; (*b*), developing fringe. Fig. 10.—Pycnidia of *Teichospora salicina* with abnormal type of pycnospore. A. Showing shape of the pycnidia. × 50. B. Showing fringed mouth of a pycnidium and pycnospores. × 310.

By the development of these cultures from ascospore inocula, the corresponding pycnidial forms observed on the host are shown to be stages in the life history of the perithecial form.

A series of single pycnospore cultures was also set up to compare the forms so obtained in culture with those obtained from ascospore inoculations. The resulting cultures are very similar to the ascospore cultures grown on honey agar. They are slow-growing olivaceous colonies of powdery appearance, with perhaps slightly greater development of aerial hyphae than in the ascospore cultures. No fruiting bodies of any kind were found, even after an interval of six months. This form was grown on oat, peptone, and Czapek's agar, but still remained sterile. On each of these media, the growth was indistinguishable from that of an ascospore culture on the same medium. This fact substantiates the belief that the pycnidial and perithecial forms belong to the one fungus. Another culture was obtained, similar in macroscopic appearance to those just described. It developed from a muriform spore (not determined whether an ascospore or a pycnospore). This culture may be described as a slow-growing olivaceous form, powdery in appearance (Plate IX., Fig. 1).

In the early stages of its growth, the margin of the colony is yellow. With the naked eye, elongated fruiting bodies can be seen projecting from the surface. They are the pycnidia, which contain brown, bi-cellular spores, measuring 9.5μ x 4μ. The pycnidia are elongate, linear bodies, tapering slightly towards the apex, measuring approximately 527.5μ in length, and 75μ in width. In most cases, the apex is expanded, forming a fringed mouth, in some, however, it remains bluntly pointed (Fig. 10). Two types of mycelial hyphae are present, (i) a light olivaceous form, which is not constricted at the septa, and appears to be associated with the pycnidia; (ii) a dark-coloured beaded form.

Thus this culture, both as regards type of mycelium and external form of pycnidia, may be compared with the others obtained from muriform spore inocula (ascospores and pycnospores). It differs, however, in the bi-celled character of the pycnospores. It may be that the spores have remained immature owing to cultural conditions, and it is interesting to note that McAlpine (pl. xxv., fig. 7*c*, *e*, pl. xxxi., fig. 28*a*, pl. xxxii., fig. 37) has figured pycnidia, which he assigned to his "pycnidia proper," as containing spores in all stages of septation from the didymosporous condition to phragmosporous and muriform types.

In earlier attempts to obtain the "sooty mould" fungi from *Bursaria*, two additional forms were obtained:—

(*a*) Cultures of a black, slow-growing form, the surface of which is smooth in appearance. The pycnidia appear as black spots on the surface of the colony, and are roughly spherical in shape, although, when ruptured, they are of rather square appearance, measuring 115μ x 62μ. The contained pycnospores are spherical,

non-septate, hyaline spores, approximately 3μ in diameter (Fig. 11). Both beaded and non-beaded hyphae are present, but the non-beaded form is most abundant. This agrees almost exactly with the *Chaetophoma** form observed in nature.

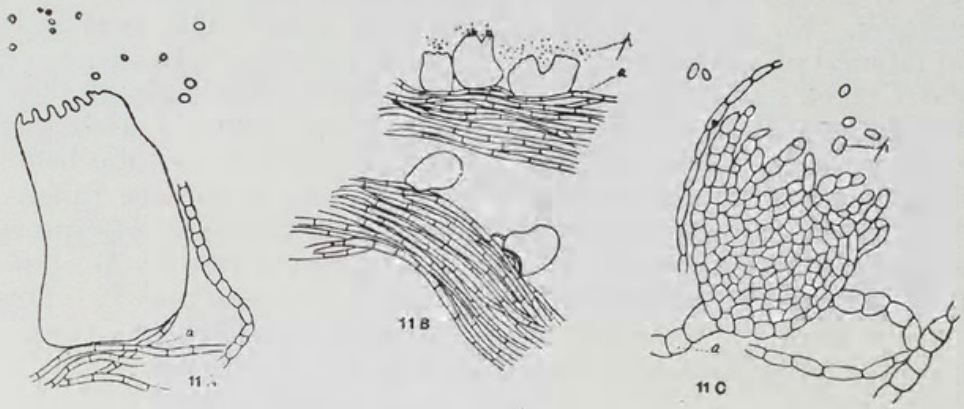

FIG. 11.—Pycnidia of *Chaetophoma*. Cke. sp.? Grown in culture. A. Isolated from *Bursaria spinosa*. × 150. B. From *Leptospermum scoparium*. × 40. C. From *Leptospermum scoparium*. × 250. (*a*), hyphal stratum or subiculum; (*p*), pycnospore.

(*b*) Cultures of a white slow-growing form, which at first is slimy in character, resembling a bacterial culture. Later, the colony is drier in appearance, and the central region roughens, becoming maize-yellow in colour (Ridgway), while the margin remains white. Microscopic examination of the marginal area reveals a mass of hyaline, irregularly septated hyphae, while in the roughened yellow region, these are aggregated to form hemispherical masses, which occur in the meshes of the general hyphal network. This fungus may be associated with *Phycopsis* found occurring on the host.

DISCUSSION.

The sooty covering of *Bursaria* leaves has been shown by cultural methods to be a mixture of fungi, which form a definite "fungal association" on the surface of this host, and include:—

(i) A perithecial form associated with its imperfect fruiting stage.

(ii) Pycnidial fruiting bodies belonging to various fungi.

(iii) Fungi represented by conidial fruiting stages.

* A sub-culture of this fungus was sent to the "Centraalbureau voor Schimmelcultures," Baarn, where it was identified as *Microxyphium theae* van B., and after examining a type culture of the latter, I agree with this identification. However, as my isolation has never produced the "flaschenpykniden" described and figured by F. H. van Beyma Thoe Kingma(6), I prefer to place this fungus in the genus *Chaetophoma* Cke.

Also, I have not been able to find any "flaschenpykniden" in the culture of *Microxyphium theae* van B. sent to me from Baarn.

Prior to the investigations by Neger(28), these various fruiting structures were regarded as stages in the life-history of a pleomorphic form, described under the generic name *Capnodium* Mont.

(i) *Perithecial Form.*

In considering the systematic position of the forms isolated by me, it is the perithecial fungus, with its associated pycnidial stage, which must be considered in relation to the genus *Capnodium.*

Montagne(25) in his description of this genus stressed the importance of the elongated type of perithecium as a generic character, but the structures which he interpreted as perithecia were recognized later by Tulasne(37) as pycnidia, and the type species was figured by the latter with sessile, glabrous, spherical perithecia. However, since then, some forms have been described with more elongate perithecia.

Recognizing this, Arnaud(3) has placed all the perfect forms found in "sooty mould" coverings in the family Sphaericaceae, as he considers that the perithecia in most cases possess ostioles, although indistinct. In addition, he regards the elongation of the perithecia as an unsatisfactory generic character, as it is, according to him, only a teratological modification dependent on the conditions under which they develop.* A humid atmosphere and an abundance of food material induce elongation of the conceptacles, while when the supply of honey dew is scanty the spherical type of perithecium predominates. Arnaud therefore discarded the genus *Capnodium,* and placed the various species in the genera *Teichospora, Pleosphaeria,* and *Limacinia. Teichospora* and *Pleosphaeria* include the muriform-spored species, and *Limacinia* the phragmospored types. The genus *Teichospora* is distinguished from *Pleosphaeria* in that perithecia are glabrous in the former, and setulose in the latter. In his consequent rearrangement of the species of Montagne's genus, Arnaud has placed the type species in the genus *Pleosphaeria,* as *Pleosphaeria salicina*(3). Later, however, he grouped it as a member of the phragmospored Sphaericaceae, under the name *Limacinia salicina* Nob., because the longitudinal septa in this species are rare. Tulasne's figures show, however, the perithecia of this species to be devoid of bristles, and for this reason Gaumann(15) has transferred it to the genus *Teichospora.*

The "sooty mould" on *Bursaria spinosa* has been described and figured by Saccardo(31, 32) under the name *Capnodium Walteri* Sacc. This type material was collected from the Upper Yarra, Australia. He shows the perithecia as flask-shaped bodies, with long necks from which asci are protruding, and the mature ascospores with phragmosporous divisions.

* Theissen and Sydow(36) regard the elongation of the perithecia as of generic value, and retain the genus *Capnodium* in the family Capnodiaceae of the Perisporiales, Lind. The genus is further characterized by brown, muriform ascospores.

An examination of a large number of species of this host affected with "sooty mould" from various and widely separated localities has never revealed a perithecium of this type, and, moreover, the ascospores are always muriform in character. In addition, a number of herbarium specimens, obtained from the Plant Research Laboratory, Department of Agriculture, and labelled *Capnodium Walteri* by McAlpine, were examined. The perithecia from this material proved to be sessile, spherical, and glabrous, containing asci and muriform ascospores, and, indeed, in every way similar to those observed on specimens collected during the course of this investigation.

Thus, the characters on which the species *Capnodium Walteri* was based do not really apply to the perithecia, which develop in the "sooty coat" so prevalent on the leaves and stems of *Bursaria spinosa*. The characters to be considered in an attempt to place this form in its correct systematic position are glabrous, spherical perithecia, and muriform ascospores measuring approximately 7.5μ x 16.5μ. It seems, therefore, that Saccardo mistook pycnidia (see below) for perithecia. These perithecial characters agree with descriptions of *Capnodium salicinum*, the type species of Montagne's genus. Type material of *Capnodium salicinum* was not available to the writer; but specimens of this fungus, preserved in the mycological herbarium of the Department of Agriculture, on *Olea europea*, revealed perithecia identical in all respects with those from *Bursaria spinosa*.

Following Arnaud's classification, the perithecial fruiting bodies found on *Bursaria* leaves, should then be known as *Teichospora salicina* (Mont.) Gau.*; Syn. *Capnodium salicinum* Mont.; Syn. *Capnodium Walteri* Sacc.

The striking similarity of the figures in McAlpine's description of *Capnodium citricolum*, together with the agreement in spore measurement, led me to examine material of this species, labelled by McAlpine, and preserved in the herbarium of the Department of Agriculture. This form, too, does not differ in any important respect from the *Bursaria* fungus, and it seems that *Capnodium citricolum* McAlp. must be included also in *Teichospora salicina*. *Teichospora salicina* has been connected with a pycnidial stage (Figs. 3 and 4). These pycnidia are probably the most characteristic feature of any mount made from the "sooty coats" of *Bursaria* leaves, and, indeed, they could be seen macroscopically as small erect bodies projecting from the leaf surface. The flask-shaped bodies figured by Saccardo(31) as perithecia in his description of *Capnodium Walteri*, appear to be identical in shape and form with these pycnidia.

* Following the key of Theissen and Sydow(36) *Teichospora salicina* would be placed in the genus *Coccodinium*, for the perithecia are sessile. Nevertheless, these authors retain *Capnodium salicinum* in the original genus, assigning it to this position because they consider the perithecia to be elongated, as stated in Montagne's description of this species.

The tendency has been to create new species of "Capnodium" when a fresh host was involved, so that a great multiplicity of species with ill-defined characters has resulted. It is not surprising to find the same species of *Teichospora* on a variety of hosts, for a correlation between the species of the fungus and associated scale insects should perhaps be looked for, rather than with the host plant attacked.

(ii) *Pycnidial Forms.*

Two pycnidial forms, which were not connected with any perithecial stage, were observed.

(*a*) The form referred to the genus *Chaetophoma* Cke. is a very common constituent of "sooty mould" on *Bursaria.* This form was obtained in culture forming an intensely black, smooth type of growth, quite distinct from that of *Teichospora salicina.* This provides evidence contrary to the view held by McAlpine and Arnaud, for these workers connected *Antennaria* and *Chaetophoma* respectively, with the life history of the appropriate perithecial stage.

(*b*) An elongated pycnidial form, which was placed in the genus *Hendersoniella* Sacc. This type occurs more rarely than *Chaetophoma* in "sooty coverings," on this host, and was not obtained in culture.

(iii) *Conidial Forms.*

(*a*) In *Phycopsis* sp., another common constituent of "sooty moulds," the conidial stage only was observed. Owing to its distinct cultural characters, it is obviously not connected with the perithecial form. This fact further supports the view expressed by Mangin and Patouillard(22), and later again by Cotton(8), that this form is an independent fungus, although it commonly occurs on leaves attacked by various "Capnodiaceae."

(*b*) *Macrosporium* and *Cladosporium*-like spores were frequently found scattered through the hyphal felt forming the "sooty mould." Cultures of these fungi were not, however, obtained from inoculations made from *Bursaria.*

Scale Insect.

The scale insect attacking the specimens of *Bursaria spinosa* examined was identified by C. C. French, Jnr. as *Eriococcus eucalypti* Maskell.

II. Leptospermum.

(i) *Leptospermum scoparium* Forst. Manuka Tea Tree.

This plant is chiefly an inland form, but occasionally occurs in coastal areas.

Infected material was collected at Healesville and Lilydale, which are situated East-north-east of Melbourne, also at

Woolamai, which is situated near the southern coast of Victoria, in the vicinity of Western Port Bay.

Apparently, *Leptospermum scoparium* forms a very suitable host for the development of "sooty mould," as it is copiously infected in widely separated localities. The specimens examined were covered by a very thick "sooty coating," on both leaves and stems.

A. In Nature.

Examination of the "sooty covering" showed a dark, septated mycelium, constricted at the septa, giving it a beaded appearance. The hyphae were occasionally found twining round leaf hairs,

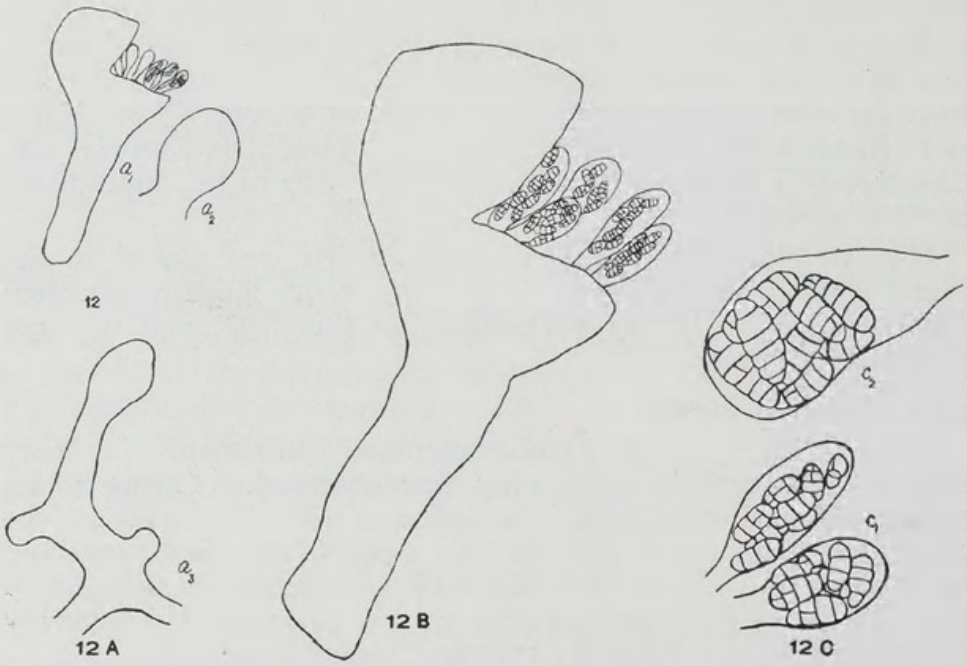

Fig. 12.—Perithecia and asci of *Teichospora australe* (Mont.) Arnaud. A. Perithecia × 50 showing variations in type of pedicel. (a_1), solitary perithecium provided with a long stalk. (a_2), solitary perithecium with a short stalk (almost sessile); (a_3), group of perithecia developed on a common branching stalk. B. Solitary stalked perithecium. × 200. C. Asci. × 310. (c_1), young asci, showing ascospores in triseptate condition; (c_2), mature ascus.

apparently using them for a support. In addition, the following structures were observed:—

(*a*) Glabrous perithecia, which are roughly spherical in shape, and each is borne on a stalk or pedicel of variable length. These perithecia are usually solitary, but in some cases several heads arise from a common branching stalk (Fig. 12, A and B). The perithecial wall is thick, black, and carbonaceous in appearance. Their dimensions are:—Length of perithecium + stalk, 380μ. Width of perithecium or head, 200μ. Length of stalk, 200μ. Width of stalk, 55μ. They contain asci, with brown muriform

ascospores, which are at first provided with three transverse septa. Later these spores become five to six septate, when they measure on an average 21μ x 8μ (Fig. 15, C). The type of perithecium, and septation of the adult ascospores, are very similar to those figured by Berkeley and Desmazières (5, Fig. 9) for *Capnodium australe* Mont. In his description of this species, Montagne(26) stressed the importance of the branching of the perithecia. These bodies obtained from *Leptospermum scoparium*, however, are generally solitary, the branched type being of less frequent occurrence. In this respect, these perithecia agree more closely with those described and figured later by Maire (21, Fig. 1, P.P.[1]) for *Capnodium cistophilum* Fr.

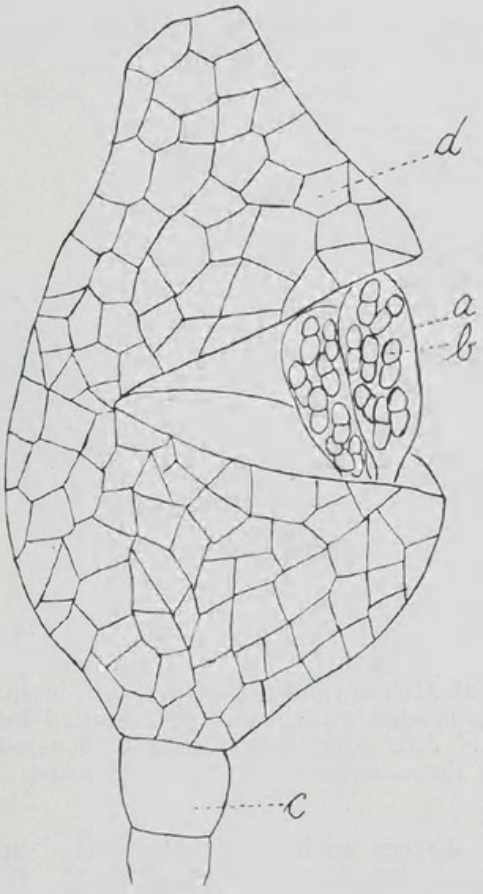

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FIG. 13.—A ruptured unidentified *Perithecium* showing asci and ascospores. × 375. (*a*), wall of ascus; (*b*), ascospore; (*c*), beaded hypha; (*d*), wall of perithecium.

(*b*) Thin-walled, spherical, sessile perithecia, which are borne terminally on the beaded hyphae. They are glabrous, and measure on an average 113.5μ x 75μ (Fig. 13). In external appearance,

these bodies bear a marked resemblance to the pycnidia of *Chaetophoma;* however, their contents are quite different. They contain asci, and hyaline, bicellular ascospores, which average 9μ in length, and 4μ in width. These are probably immature, as several brown bicelled spores were noticed occurring in the " sooty film," but they were not observed occurring in an ascus, nor even as proceeding from a perithecium.

(*c*) Olivaceous pycnidia, which are very elongated structures of approximately the same width throughout, measuring 420μ-800μ in length, and 25μ-30μ in width (Fig. 14A). They appear to be associated with a lighter-coloured, non-beaded mycelium, and they contain hyaline non-septate spores, measuring 3-3.5μ × 1μ. The pycnidial wall consists of hyphae arranged in a parallel manner, and, in some cases, on focussing through this wall, a collar is visible just below the mouth of the pycnidium (Fig. 14B). These

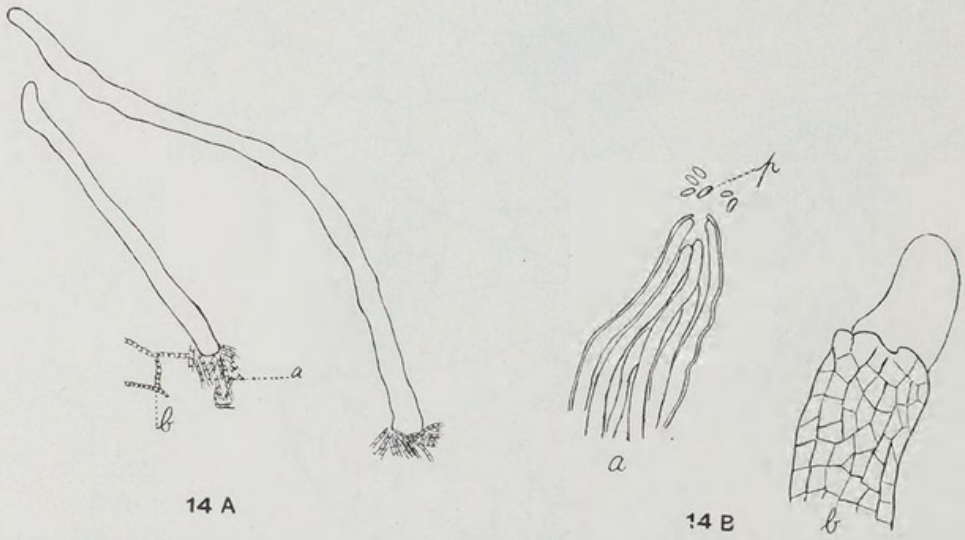


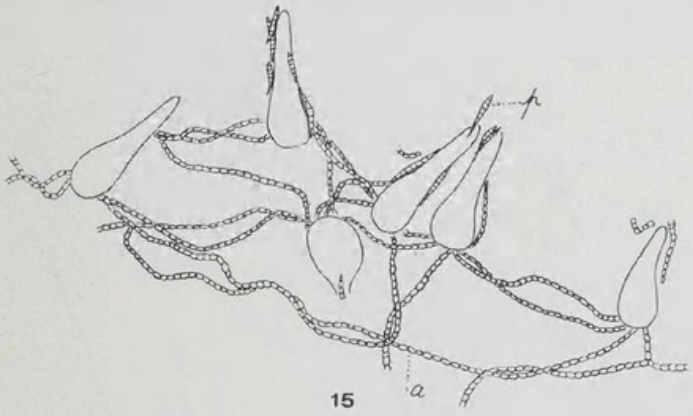
FIG. 14.—Pycnidia of *Microxyphium Leptospermi*, n. sp. A. Pycnidia. × 50. (*a*), non-beaded mycelium; (*b*), beaded hypha. B. Tip of a pycnidium. × 310. (*a*), upper surface focussed; (*b*), appearance on focussing through the wall; (*p*), pycnospore.

pycnidia closely agree with the so-called " spermogonia " of *Teichospora salicina* figured by Tulasne (37, Pl. XXXIV., Fig. 14s.). The description and figures of cerato-pycnidia given by McAlpine (24, Pl. XXXII., Figs. 33, 34), as well as the structures figured by Arnaud (2, Pl. II., Fig. 1), and called by him ceratiform pycnidia, are also in entire agreement with this type of fruiting body found on *Leptospermum scoparium.*

(*d*) Spherical pycnidia, with light-brown cellular walls, which are usually developed terminally, but may arise in an intercalary position on the beaded hyphae. They measure 32μ x 42μ, and contain hyaline, non-septate spores, averaging 3.5μ in

length, and 1μ in width (Fig. 5B). These pycnidia are identical with those described from *Bursaria spinosa,* and referred to the genus *Chaetophoma* Cke. The spores, however, are slightly narrower than those previously described.

(*e*) Long-necked, flask-shaped, pycnidia, which contain numerous dark, 8-11 septate, spindle-shaped, phragmospores, measuring on an average 47μ in length and 5.5μ in width (Figs. 15, 16). The average pycnidial measurements are:—Length of pycnidium, 186μ. Width of basal portion, 61μ. Length of neck, 100μ. Width of neck, 19.5μ.



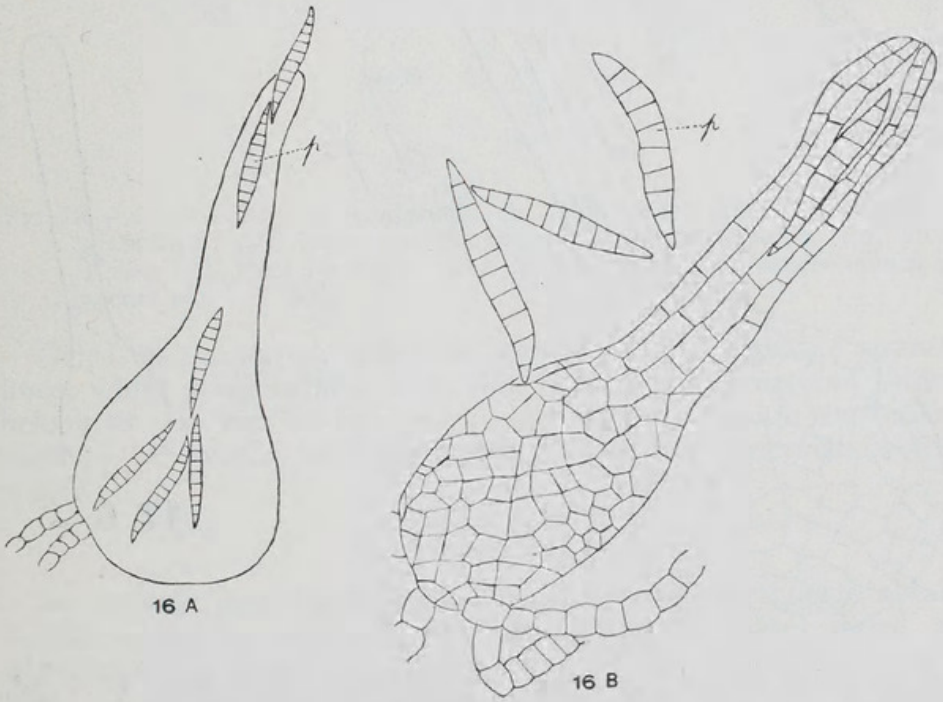


FIG. 15.—Pycnidia of *Hendersoniella* Sacc. on leaf of *Leptospermum scoparium.* × 50. (*a*), beaded hypha; (*p*), pycnospore. FIG. 16.—Isolated Pycnidia of *Hendersoniella* Sacc. Magnification; A × 185; B × 310. (*p*), pycnospore.

This form, which was also found on *Bursaria,* may be placed in the genus *Hendersoniella* Sacc.

(*f*) Another flask-shaped pycnidial form, which, however, differs from the one just described, both in respect to the type of spore, and in the basal portion of the pycnidium being more inflated. The pycnidia are reddish-brown in colour, and contain brown, spherical, non-septate, or more rarely bi-cellular spores

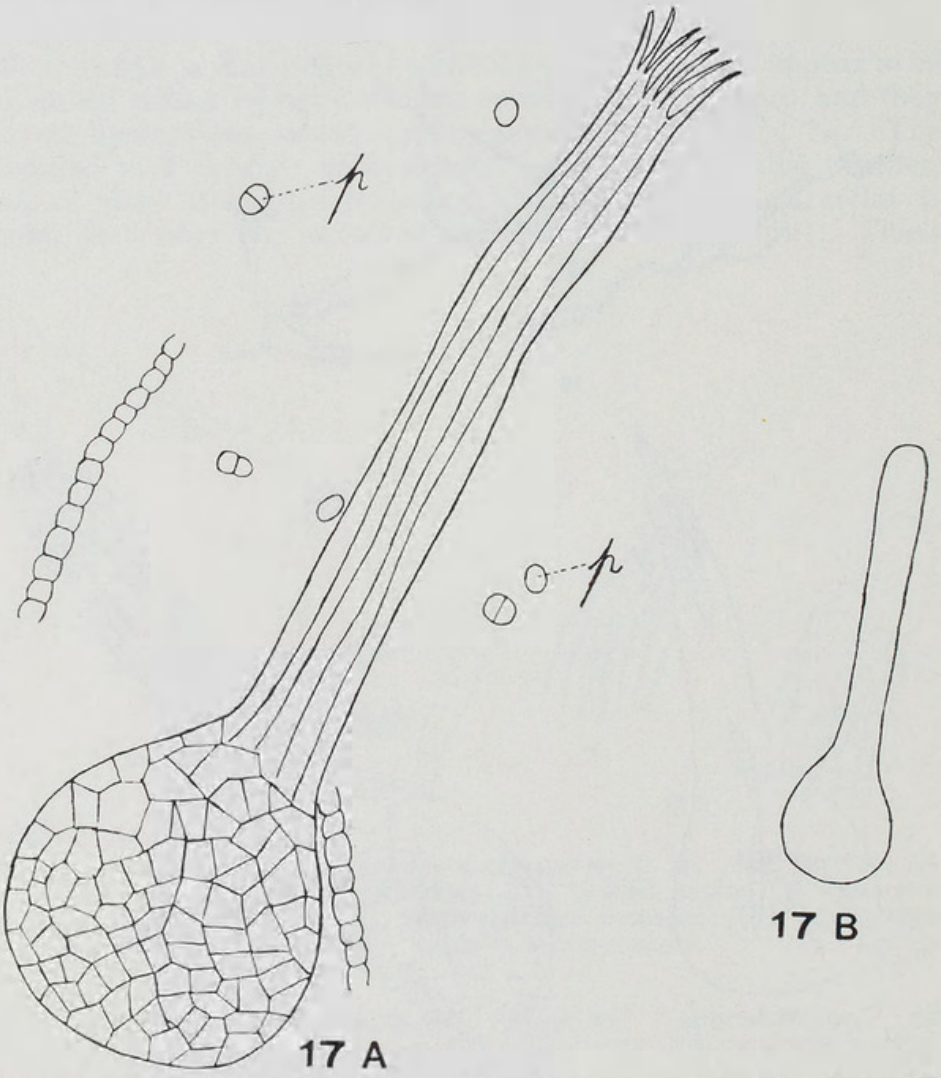


Fig. 17.—*Flask-shaped Pycnidium.* Magnification: A × 400. B × 103. (*p*), pycnospore.

which average 9μ x 7.5μ. The pycnidial mouth is provided with a hyaline fringe (Fig. 17). The pycnidial dimensions are:— Length of pycnidium, 340μ. Width of basal portion, 85μ. Length of neck, 240μ. Width of neck, 30μ.

(*g*) An elongated pycnidial form, containing brown muriform spores, provided with three transverse septa, and measuring

approximately 13μ x 5.5μ. These pycnidia, which frequently branch (Fig. 18), may be compared with those which have been associated with *Capnodium cistophilum*, and which were figured and described by Maire (21, p_2, ps_2), as "pycnidia of the second order." The pycnidial wall is formed of hyphae which run parallel to the length of the pycnidium, and when young the mouth appears to be formed of the free ends of these hyphae, which adhere closely together, forming a mulberry-like head (Fig. 19B).

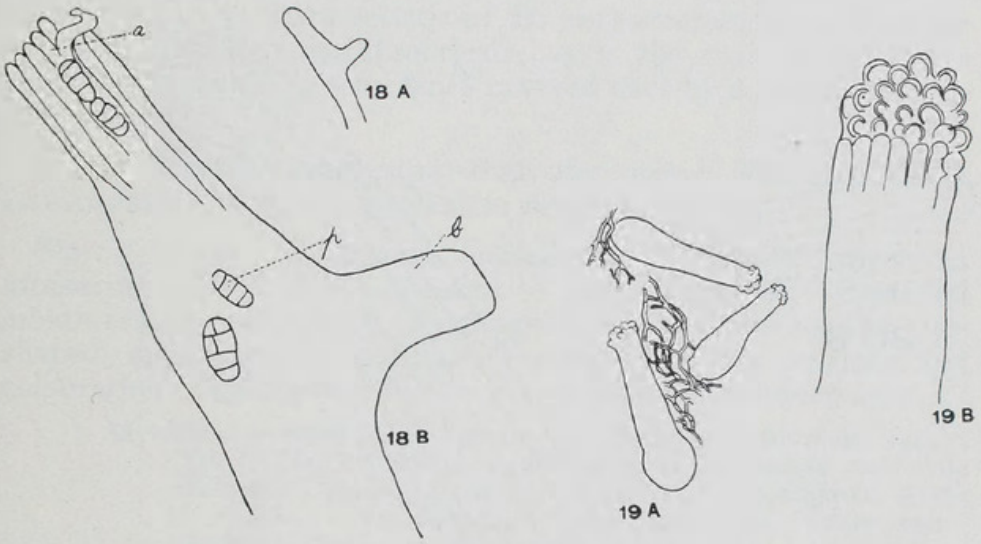


FIG. 18.—*Adult elongated pycnidium.* A × 50. B × 310. (*a*), mouth of pycnidium; (*b*), branch of pycnidium; (*p*), pycnospore. FIG. 19.—*Young elongated pycnidia.* A × 60. B showing immature mouth of pycnidium. × 300.

(*h*) Light-coloured, spherical bodies, of mucilaginous appearance, which vary in size from 45μ-125μ in diameter, and which belong to a species of the fungus *Phycopsis*, although the brown clusters of conidia or "propagula" were not observed in this material.

B. IN CULTURE.

An attempt was made by the "slide culture" method to obtain single ascospore cultures, but unfortunately these failed to germinate. A series of cultures was set up, however, using a piece of germinating mycelium as the inoculum. As a result, the following forms were obtained:—

(*a*) Cultures bearing elongated pycnidia containing hyaline, non-septated, rod-like spores 5μ x 1.5μ, which correspond in all important respects with the olivaceous pycnidia found on the host.

This is a slow-growing form, with olivaceous mycelium, and powdery surface due to the development of aerial hyphae (Plate

IX., Fig. 2). Microscopically, the hyphae are septated, not constricted at the septa, and pale olivaceous in colour. The pycnidia are elongated and linear in form, measuring 270μ x 29μ, and they are composed of olivaceous hyphae arranged in a parallel manner (Fig. 20A). They are usually simple, but occasionally bifurcation may occur (Fig. 20B). Pycnidial forms of this elongated

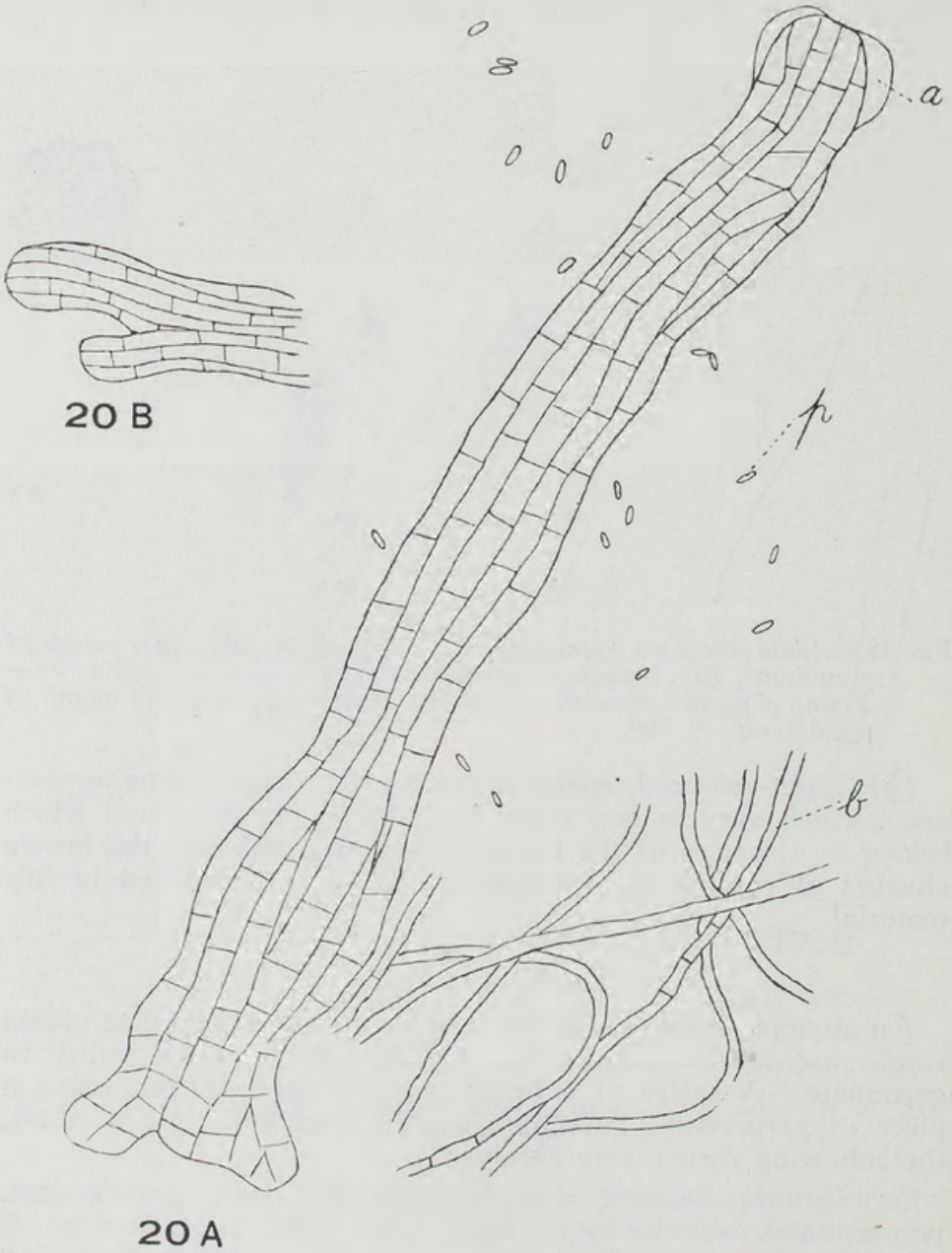


FIG. 20.—A. Pycnidium of *Microxyphium Leptospermi*, n. sp., showing (*a*), gelatinous cap covering mouth; (*b*), non-beaded mycelium; (*p*), pycnospores. × 375. B. Tip of pycnidium showing bifurcation. × 375.

type, when found in connexion with "sooty moulds," have been associated with the name *Microxyphium*(7, 36), which was first established by Saccardo as a section of the genus *Capnodium*.

A type culture of the species *Microxyphium purpuraefaciens*, which was described by F. H. Van Beyma Thoe Kingma(6), was obtained from the "Centraalbureau voor Schimmelcultures." Examination reveals that the isolation from *Leptospermum* is very similar to this fungus, but differs in that it does not give a bright rose colouration to the medium, when grown on malt or honey agar, as is characteristic of *M. purpuraefaciens*. Also, the pycnidial mouth is not fimbricate, as is the case in the latter species, although it is sometimes covered over by a gelatinous cap. (Fig. 20A, *a*).

It is therefore suggested that the name MICROXYPHIUM LEPTOSPERMI, n. sp., be applied to this species.

Slow-growing, olivaceous mycelium. Elongated pycnidia measuring 270μ x 29μ, composed of parallel hyphae. Pycnidial mouth remains unfringed. Pycnospores hyaline, non-septate, rod-shaped, measuring 5μ x 1.5μ. Fungus does not produce any colouration of the medium when grown on malt or honey agar.

> Mycelium, cretum lente, fulvum in colore, cum pycnidiis longis, 270μ × 29μ, hypharum parallelarum factis, ostiole pycnidiale sine fimbris manse; pycnospores hyalines, non-septates, strati, 5μ × 1.5μ. Cum fungus in "malt agar" aut "honey agar" crescitur color in medio non est.

(*b*) Cultures of another pycnidial form, which differs in macroscopic appearance from the one just described, being densely black in colour, and showing no development of aerial hyphae. (Plate IX., Fig. 3). This form is identical both macroscopically and microscopically with *Chaetophoma* isolated from *Bursaria*. The pycnidia, which are roughly spherical to square in shape, measuring 50μ x 80μ, contain hyaline, elliptical non-septate spores, measuring approximately 5.5μ x 3.5μ (Fig. 11B and c).

(*c*) Several cultures of *Cladosporium*, which in three instances produced dark irregularly-shaped bodies, devoid of contents. In view of the fact that perithecia have been described in connexion with *Cladosporium herbarum* by Janczewski(17-19), their further development was watched carefully. However, after a period of nine months, these bodies still remained sterile, thus they are probably sclerotes, and of no particular interest.

(*d*) One culture of *Dematium pullulans*.

(*e*) Two dark-coloured sterile forms. After twelve months, these cultures still failed to produce spores or fruiting bodies of any kind, and thus their systematic position could not be successfully ascertained.

Discussion.

The earliest record of "sooty mould" occurring on *Leptospermum* in Australia was made in 1902 by McAlpine under the name of *Limacinia melaleucae* nomen nudum. As this specimen was apparently not preserved, an examination was impossible. However, an infected specimen of *Leptospermum lanigerum* Smith was obtained from the Mycological Herbarium, Department of Agriculture, and an examination of this material disclosed glabrous perithecia containing brown, muriform ascospores, in which the longitudinal septa are rare.

This specimen was recorded by McAlpine in 1908 in the files of the Department under the name of *Capnodium*, but it was later altered to *Limacinia melaleucae*, probably because in the ascospores observed the longitudinal septation was not evident. The perithecia from this specimen resemble those found on *Leptospermum scoparium* during the course of this investigation, although, as far as my observations go, they are all short-stalked, and the ascospores are tri-septate.

From direct microscopic observations, and from cultural work, the "sooty mould" occurring on *Leptospermum scoparium* is found to be of a composite nature, and to be composed of:—

(1) Two perithecial forms.

(2) Various pycnidial types.

(3) Sterile forms, and those represented by conidial stages only.

(1) *Perithecial Forms.*

The muriform-spored perithecial form observed so frequently on this host may be referred to *Capnodium australe* Mont., although as no measurements are given for this latter species, it is difficult to make a strict comparison.

In assigning this form to its correct systematic position according to Arnaud's classification(3), the generic characters to be noted are:—(i) glabrous perithecia, (ii) brown muriform ascospores. These features are characteristic of the genus *Teichospora*, and therefore the fungus concerned should be named *Teichospora australe* (Mont.) Arnaud. Syn. *Capnodium australe* Mont.

In his description of *Capnodium cistophilum* Maire(21) has figured only unbranched perithecia. As previously indicated, branched perithecia are of rare, rather than regular occurrence, in *Teichospora australe* (Mont.) Arnaud, obtained from *Leptospermum scoparium*. Moreover, the ascospore measurements and figures, given by Maire(21) for *Capnodium cistophilum* Fr. are in

close agreement with the immature ascospores of *Teichospora australe.* Thus the name *Capnodium cistophilum* may perhaps be included as a synonym for this fungus.

An attempt was made to obtain " single ascospore cultures " of *Teichospora australe* from *Leptospermum scoparium,* but these were unsuccessful, hence nothing is known of the cultural characters of the fungus, or of its associated pycnidial stages.

(2) *Pycnidial Types.*

Several types of pycnidia were found occurring on the host, but no cultural evidence was obtained for assigning any of these to either of the " perfect forms."

(3) *Sterile Forms,* and those represented by *conidial stages* only.

Scale Insect.

The scale insects found on the specimens of *Leptospermum scoparium* examined were identified by C. C. French, Jnr., as *Eriococcus leptospermi* Maskell.

(ii) *Leptospermum laevigatum* F. v. M. Coast Tea Tree.

This is a coastal plant, and infected material was collected from the shores of Port Phillip Bay (at Mentone, Chelsea, and Mornington), and also from Ventnor, on Phillip Island, which is situated in Western Port Bay. At Mentone and Mornington, the tea tree was growing on the cliffs, but at Chelsea and Ventnor, it occurred further inland.

A. In Nature.

An examination of these " sooty coverings " was made, after treating with lacto-phenol, and also from permanent microscopic preparations made by the collodion method(9). These observations revealed the following as constituents of the " sooty mould ":—

(*a*) *Chaetophoma* pycnidia, similar to those found on *Bursaria* and *Leptospermum scoparium.* Pycnidia were observed bearing a marked resemblance to the one illustrated in Fig. 11c from a culture of this fungus obtained from *Leptospermum scoparium.*

(*b*) Spherical, mucilaginous bodies, identical with those previously described as the fungus *Phycopsis;* also, light-coloured spherical bodies of a mucilaginous appearance, similar to those just referred to, but differing, in that these are setulose structures

(Fig. 21). They measure on an average 140μ x 150μ, and each shows a lighter-coloured central region. No reproductive bodies of any kind were observed in connexion with this form.

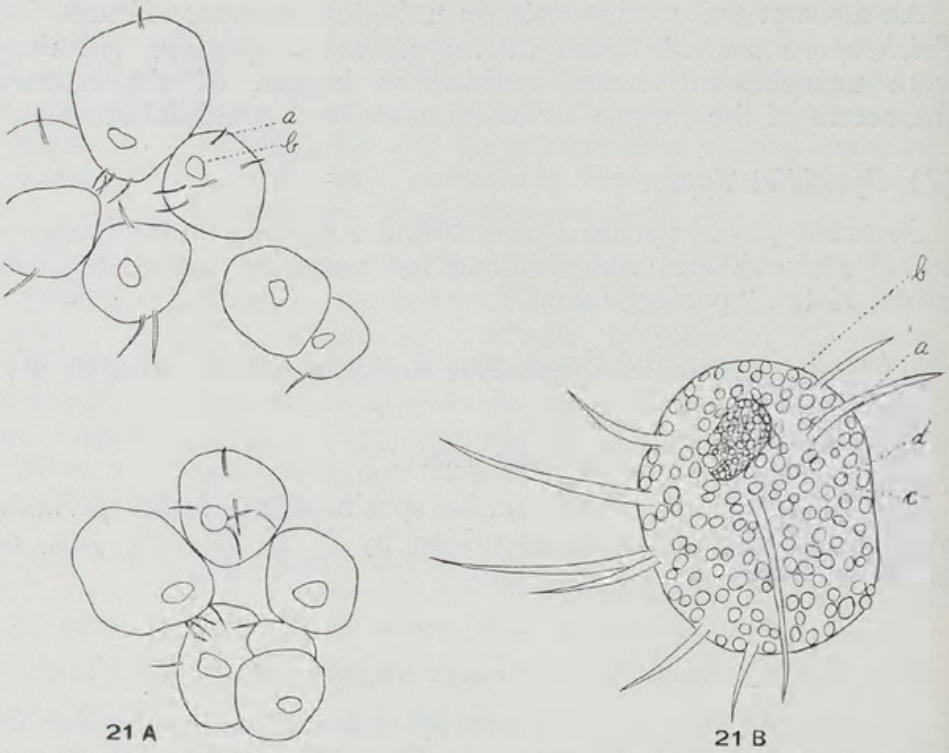


Fig. 21.—*Phycopsis*-like bodies bearing bristles. A. A group of these bodies occurring on leaf of *Leptospermum laevigatum*. × 50. (*a*), bristle; (*b*), lighter-coloured central region. B. One of these bodies showing detailed structure. × 185. (*a*), bristle; (*b*), lighter-coloured central region; (*c*), mucilaginous matrix; (*d*), light-coloured cell.

(*c*) Clusters of brown spores, some bicellular and others muriform, were observed scattered through the "sooty film."

B. In Culture.

A number of gross inoculations were made from infected material, as a result of which the following cultures were obtained:—

(*a*) A densely black growth; identical in every way with cultures of *Chaetophoma* obtained from *Bursaria* and *Leptospermum scoparium*.

(*b*) Cultures of a white form similar to the fungus isolated from *Bursaria*, which, although not identified, it was suggested might be associated with the genus *Phycopsis*.

(*c*) Cultures of a dark-olivaceous form identified at the Imperial Bureau of Mycology as a typical *Pleospora herbarum* (Pers.) Rabenh. An abundant development of elongate perithecia occurred on honey agar, although the conidial stage, *Macrosporium*

sarcinula Berk. (Fig. 22B) was only produced on *Myoporum* agar, and on synthetic media in which ammonium sulphate or ammonium nitrate was used as source of nitrogen. The ascospores are brown, muriform spores, provided with seven transverse septa (Fig. 22A). The connexion between *Macrosporium sarcinula* and *Pleospora herbarum* was again confirmed by cultural work, using both ascospores and conidia as inocula (Mason(23)).

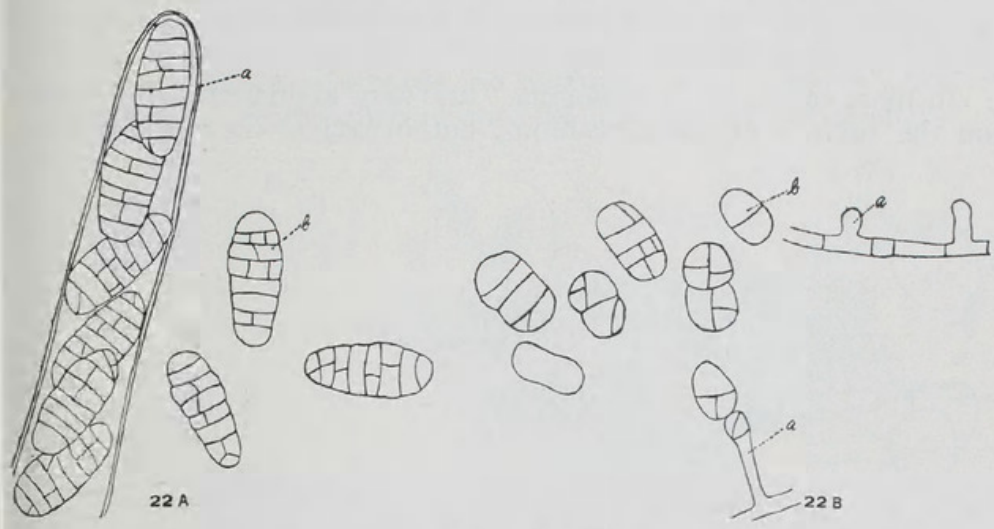


FIG. 22.—*Pleospora herbarum* (Pers.) Rabenh. A. Ascus and ascospores. × 250. (*a*), wall of ascus; (*b*), loose ascospore. B. Conidial stage *Macrosporium sarcinula* Berk. × 250. (*a*), conidiophore; (*b*), young conidium showing single median transverse wall, characteristic of the early septation of these spores.

(*d*) Cultures of *Epicoccum, Alternaria, Cladosporium,* and *Dematium pullulans.*

(*e*) Several cultures of a dark form which, however, remained sterile, and so could not be placed systematically.

DISCUSSION.

The "sooty mould" of this host is also due to a mixture of fungal forms. The unidentified white form and *Chaetophoma* sp., both of which were found naturally-occurring on the host and isolated in culture, are apparently widespread "sooty" forms, as they have been found also on *Bursaria* and *Leptospermum scoparium.*

Scale Insect.

Three types of scale insect were found occurring on the specimens of *Leptospermum laevigatum* examined. They were identified by C. C. French, Jnr., as:—

Asterolecanium styphelia Maskell.
Chionaspis eugeniae Maskell.
Eriococcus leptospermi Maskell.

III. Myoporum insulare R. Br. Boobialla.

Specimens infected with "sooty mould" were collected from the cliffs skirting Port Phillip Bay, especially at Mornington, Queenscliff, and Frankston.

A. In Nature.

The only fungal form found occurring on the host has been assigned to the genus *Phycopsis*. This form is visible to the naked eye as minute black spots on the leaves.

In most cases, the "propagula" are very abundantly produced on the surface of these cushions, but in others they are absent

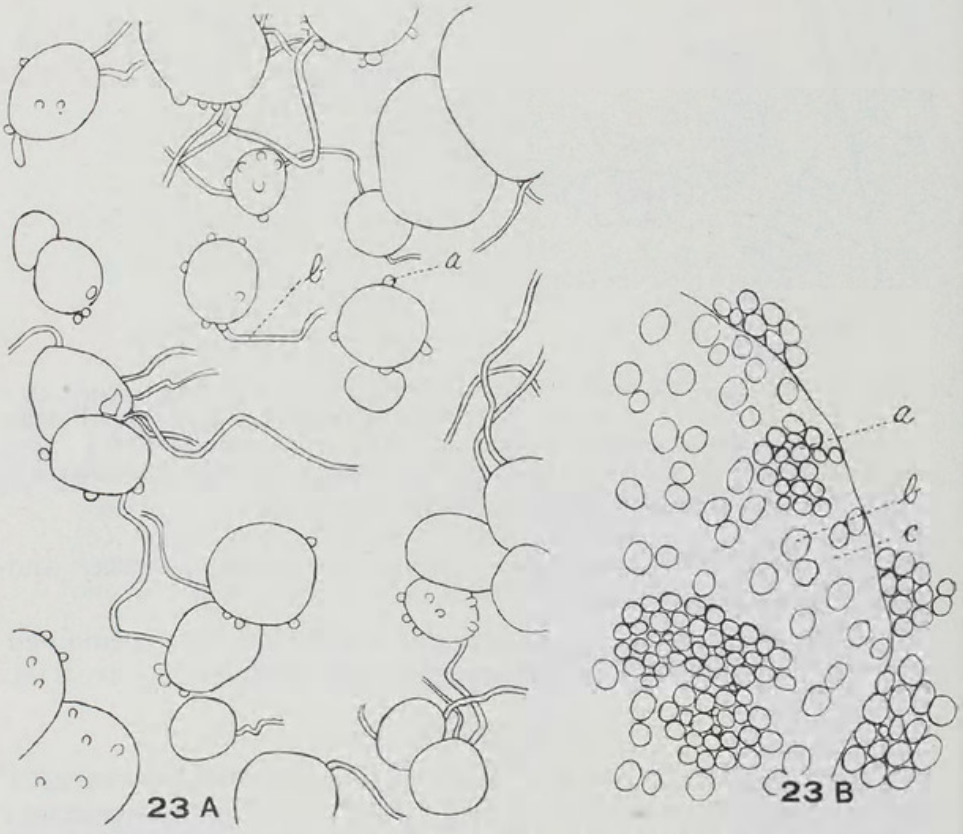


Fig. 23.—*Phycopsis* sp. A. Cushion-like bodies of this fungus occurring on a leaf of *Myoporum*. × 50. (*a*), propagulum; (*b*), fungal hypha. B. Portion of a cushion-bearing "propagula." × 310. (*a*), propagulum; (*b*), colourless cell; (*c*), gelatinous matrix.

altogether (Fig. 23). Some attempt was made to determine the structure of these cushions by means of sections stained with iron alum haematoxylin. These are very similar to the section of "un conceptacle seuratioide" illustrated by Arnaud (2, Pl. II., Fig. 3). Chains of thin-walled, faintly-staining cells apparently form the mass of the cushion, while on the surface are found clusters of thick-walled cells, the "propagula."

Sections of infected and uninfected leaves were cut and stained with iron alum haematoxylin. Healthy leaf sections show capitate, epidermal glands, which may form a secretion similar to the " honey dew " produced by the intervention of scale insects. In the case of an infected leaf, the fungus may be seen covering the head of the gland, and travelling down into the depressions on either side of the stalk (Fig. 24). The epidermis of these leaves is provided with a thick cuticle, which is thrown into folds. The fungal hyphae pass down into these corrugations, but although a careful search was made, no haustoria were observed, neither does the mycelium penetrate into the leaf through the stomata.

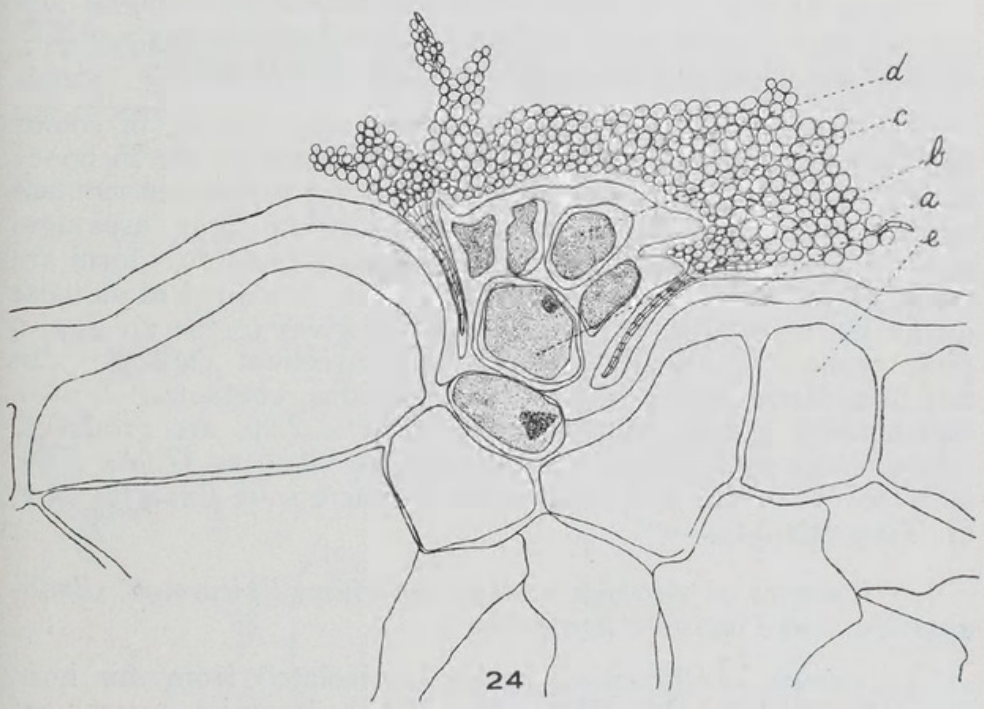


FIG. 24.—T.S. leaf of *Myoporum* through an epidermal gland, showing development of the fungus in this region. × 310. (*a*), cuticle; (*b*), stalk of gland; (*c*), head of gland; (*d*), fungus; (*e*), epidermal cell.

B. IN CULTURE.

Gross inoculations were made from this host, as a result of which the following forms were isolated:—

(*a*) A pycnidial form which, when grown on honey agar, at first forms a colourless mycelium and gives to the medium a salmon-buff colouration (Ridgway). At a later stage, the mycelium darkens to Prouts' brown (Ridgway). The pycnidia are brown, spherical, ostiolate, measuring approximately 280μ x 250μ, and they contain hyaline non-septated spores averaging 5μ x 1.5μ. The mycelium is septated, and swollen dark-brown segments occur at intervals.

This fungus was grown on various media to compare its growth and try to induce it to produce its perfect stage. Synthetic media were used (Asparagin agar, ammonium sulphate agar, and ammonium nitrate agar), as well as *Myoporum* and oatmeal agar. Most rapid growth occurred on ammonium nitrate agar; the second part of the experiment was, however, completely unsuccessful, as on all these media the pycnidial was the only fruiting stage produced. This form is probably a *Phoma* or closely allied genus, but time was not spent in determining its accurate systematic position. Tengwall(34) has recorded *Dendrophoma* from the "sooty covering" of *Mahonia aquifolia.*

The *Myoporum* form is probably only present accidentally, and is not a typical member of the "sooty flora" on the leaves of this host, as the pycnidia have never been observed in nature.

(*b*) A dark form, orange-citrine to medal bronze in colour (Ridgway), which remained quite sterile when grown on honey agar. When grown on media with a high nitrogen content (ammonium nitrate agar, ammonium sulphate agar, asparagin agar, and peptone agar) the cultural characters of this form are completely altered. In the early stages of its development on these media the mycelium is colourless, and it gives to the medium a pink colouration, later, however, the mycelium darkens. In addition, dark, spherical ostiolate pycnidia, containing brown, non-septated spores, approximately 5.5μ x 2.5μ, are produced. The average pycnidial dimensions may be taken as 470μ x 380μ. This form agrees with the generic characters of *Coniothyrium,* cf. Tengwall(34).

(*c*) Cultures of *Alternaria, Macrosporium, Epicoccum, Cladosporium,* and *Pleospora herbarum.*

The culture of *Pleospora herbarum,* isolated from this host, was identified by Mr. Wiltshire at the Imperial Bureau of Mycology as a strain of the normal form. It differs from the typical *Pleospora herbarum,* by reason of its sparse perithecial development and its conidial stage, which, although sometimes abnormal, may still be referred to the species *Macrosporium sarcinula* Berk.

Discussion.

Although many specimens of *Myoporum* were examined from various localities, the only form observed is *Phycopsis,* and in this respect it is in strong contrast to the "sooty coverings" of the other hosts examined.

However, in culture, additional forms were obtained. These resulted from gross inoculations, and are possibly contaminants of the typical sooty flora.

Scale Insect.

The scale insects attacking *Myoporum insulare* were identified by C. C. French, Jnr., as *Lecanium nigrum* var. *depressum* Nietner. *Saissetia oleae* (Lecanium) Bern. raised scale.

IV. Melaleuca sp. Linn.

This material was collected at New Haven, Phillip Island, which is situated in Western Port Bay. The plants were growing not directly on the coast, but a little inland.

A. In Nature.

Examination of the leaves after treating with lacto-phenol showed, in addition to the brown septated mycelium, the following structures:—

(*a*) Black, spherical, glabrous perithecia, with dense walls, and which measure approximately 110μ x 144μ. The asci contain

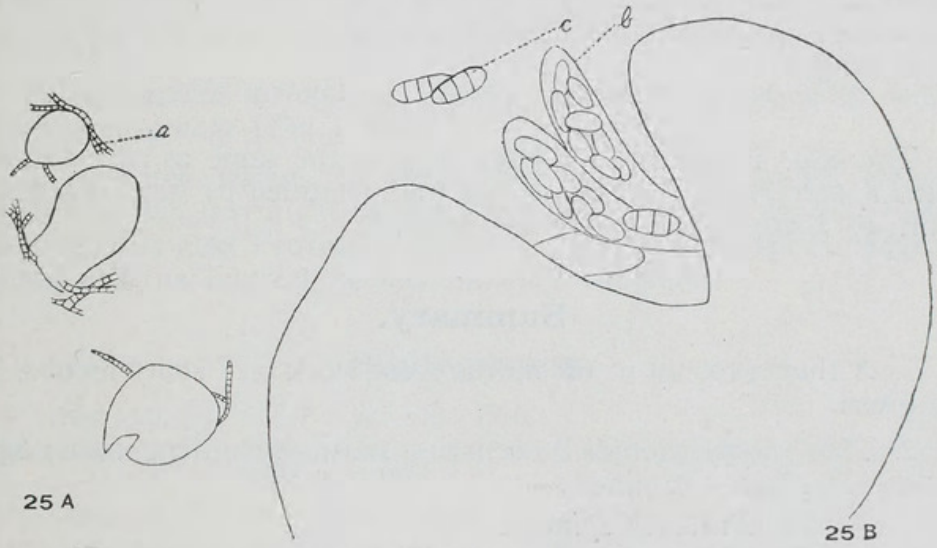


Fig. 25.—*Limacinia fuliginodes* (Rehm) Sacc. A. Perithecia. × 50. (*a*), mycelium. B. Ruptured perithecium. × 310. (*b*), wall of ascus; (*c*), mature ascospore.

eight ascospores, which are brown, phragmospored, tri-septate, and measure 14μ x 5μ (Fig. 25). The spore measurements and type of septation, as well as the perithecial characters of this form, agree with those of the fungus, originally described by Rehm(29) under the name *Capnodium fuliginodes*. This species was subsequently transferred by Saccardo, first to the genus *Meliola*, and later to *Limacinia*.

Apparently the species *Limacinia melaleucae* nomen nudum was made in 1899, when *Melaleuca* sp. infected with "sooty mould" was collected by McAlpine at Flinders.

A microscopic examination of the type material of this species was made, and its ascospore characters were found to be quite distinct from those of *Limacinia fuliginodes*.

The ascospores are brown and tri-septate, but larger than those of the latter species, measuring on an average $21\mu \times 7\mu$; and they are roughly slipper-shaped. After comparison with descriptions of the *Limacinia* species recorded by Saccardo, it seems *Limacinia melaleucae* nomen nudum, should be included in the species *Limacinia crassa* (Pat.) Sacc.

(*b*) Perithecial stage of *Teichospora australe* (Mont.) Arnaud.

(*c*) Mucilaginous cushions of *Phycopsis* sp., not showing any development of "propagula."

B. In Culture.

Little time was available for cultural work from this host. An attempt was made to obtain single ascospore cultures, which, however, was unsuccessful, as the only forms isolated were common saprophytic types, including *Cladosporium*, and a *Phoma*-like fungus.

Scale Insect.

The scale insect attacking this host is the same as that found on *Leptospermum scoparium*. It was identified by C. C. French, Jnr., as *Eriococcus leptospermi* Maskell.

Summary.

1. A short account of the more recent work on "sooty moulds" is given.

2. The "sooty moulds" occurring naturally on the following hosts have been examined:—

(i) *Bursaria spinosa*.
(ii) *Leptospermum scoparium*.
(iii) *Leptospermum laevigatum*.
(iv) *Myoporum insulare*.
(v) *Melaleuca* sp.

3. Cultural work has been carried out—using single-spore inoculations in some cases.

Many fungal forms have been isolated, and are listed under their respective hosts.

4. The cultural characters of many of these forms have been determined, and are described.

5. The composite character of the "sooty moulds" is demonstrated, and the inadequacy of the earlier accounts of these "sooty coverings" is noted.

6. *Capnodium Walteri* Sacc. on *Bursaria spinosa* has been shown by direct observation and cultural work to be *Teichospora salicina* (Mont.) Gau. This fact demonstrates the cosmopolitan distribution of the type form of the genus.

Capnodium citricolum McAlp. is synonymous with *Teichospora salicina.*

7. One of the pycnidial forms is connected by cultural evidence with *Teichospora salicina.*

8. *Teichospora australe* (Mont.) Arnaud is recorded on *Leptospermum scoparium,* as the common perfect form found on this host.

Teichospora australe has been recorded previously on Conifers in Australia, and the same fungus appears in the unpublished records of the Mycological Herbarium, Department of Agriculture, Victoria, under the name *Limacinia melaleucae* (nomen nudum) on "Tea-Tree."

9. *Limacinia fuliginodes* (Rehm.) Sacc. is recorded on *Melaleuca* sp. This is the first record of this fungus for Australia.

10. *Limacinia melaleucae* nomen nudum is synonymous with *Limacinia crassa* (Pat.) Sacc.

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Explanation of Plate IX.

Fig. 1. Colony of *Teichospora salicina*, photographed after six weeks' growth. Magn. 2. This colony bears pycnidia containing bi-cellular pycnospores.

Fig. 2. Colony of *Microxyphium Leptospermi*, n. sp., photographed after six weeks' growth. Magn. 5.

Fig. 3. Colony of *Chaetophoma*, photographed after six weeks' growth, Magn. 2.

Fig. 1.

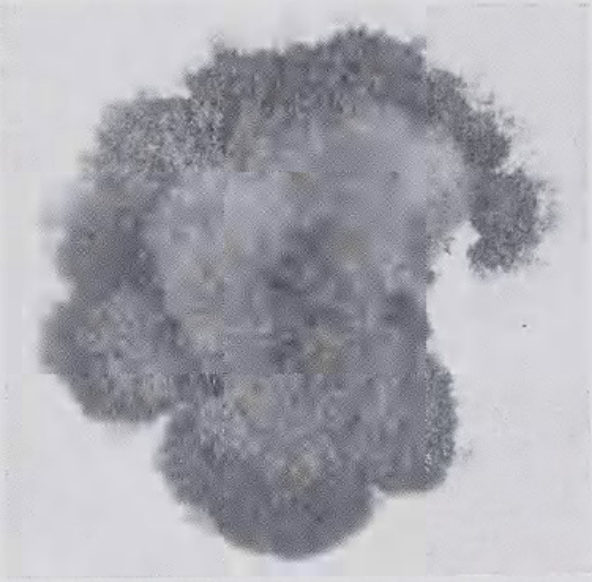

Fig. 2.

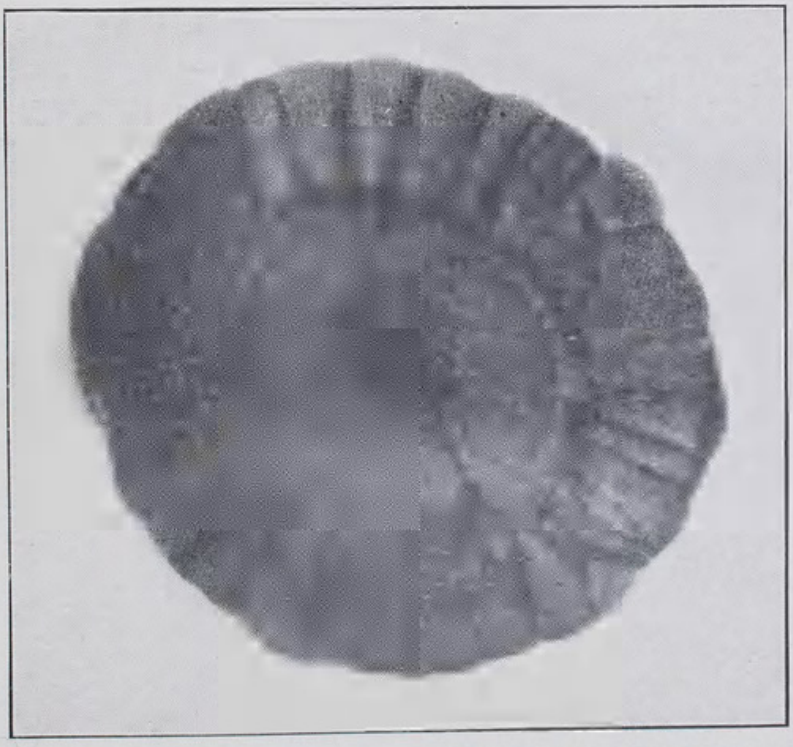

Fig. 3

Sooty Moulds.