CHAPTER II

HISTORICAL REVIEW

Different degrees of morphological adaptation towards mycoparasitism may be recognised. Several plasmodiophoraceous organisms are intercellular parasites of other fungi. Woronina polycystis was the first to be discovered. The parasite plasmodium becomes fragmented by the repeated formation of septa by the host so that a row of infected segments results (Cooke and Nicholson, 1933), but the possibility exists that the observed series of parasitized segments result multiple infection (Sparrow, 1960). A second species, W. pythii is an obligate parasite of Pythium, Sorodiscus cokeri is another parasite of Pythium species but causes little or no hyperetrophy, while Octomyxa achlyae and O. brevilegnise complete their life cycles in their saprolegniaceous hosts in ways similar to W. polycystis (Karling, 1942b; Pentergrass, 1950). The parasitic habit of many of the chytrids upon other aquatic or semiaquatic fungi and algae is apparently quite common. A number of these genera are described and illustrated by Fitzpatrick (1930) and Karling (1942). Practically nothing is known regarding their nutritional requirements. Three sorts of mycoparasitic chytrids may be recognised namely ectoparasites, parasites with epibiotic reproducive parts but endobiotic rhizoidal systems and endoparasites.

Solutoparies pythii is an ectoparasite with rhizoids but encircle and apparently do not penetrate the hyphae of the pythiaceous host, which becomes stimulated to branch abnormally. There are number of mycoparasitic chytrids which have epibiotic sporangia nourished through rhizoidal systems inserted into the host. Phlyctachytrium synchytrii is such a parasite on the resting sporangia Synchytrium endobioticum; Chytrium rhizophydii, Septosperma anomalum and S. rhizophidii on other chytrids. Some chytrids parasitize filamentous fungi, Chytriomyces parasiticus on Aphanomyces laevis, Rhizophydium carpophilum on number of water molds.

Rhizophydium fungicola attacks the mycelium of imperfecti fungus, Gleosporium theobromae. Internal mycoparasitic chytrids include species of Rozella and Olpidium. R. cladochytrii parasitizes saprophytic species of the cladochytriaceae. Other species of Rozella attack various aquatic fungi (Karling, 1942a). Three species of Olpidium are known to be mycoparasitic, namely O. uredinis which infects the uredospores of several Puccinia species. O. rhizophlyctidis which inhabits species of Rhizophlyctidis and O. allomycetos has a prediction for A. annomalus and which infects Allomyces species and Karlingia rosea. Other internally parasitic chytrids include Plectrachlelus fulgens and P. zopfians which form their sporangia within the species of Pilobolus and Pringsheimiella diocia which parasitizes Achlya

species, P. diocia forms its resting spores only when two sexually opposite or compatible strains of parasite are present. Catenaria allomycis was discovered growing within Allomyces annomalus in the soil, it can also infect both generations of certain other Allomyces.

Rhizodiomyces apophysatus, which parasites species of Saprolegnia and Achlya. Rhizidiomycopsis juponicus is a parasite of the oogonia of a species of Aplanes. Hypochytrium infestans was discovered, inhabiting the ascocarp of a Discomycetous (Sparrow, 1960). Hyphae of Aphanomyces parasiticus invade the mycelium, young sporangia and young oogonia of certain other saprolegniaceous fungi and emerge only after they have exhausted host hyphae (Coker, 1923). Aphynomyces exoparasiticus (Couch, 1926). A. cladogamus and Plectospira myriandra (Drechsler, 1943) parasitize pythiaceous hosts. Among the Ectrogellaceae, Pythiella bessevi is an endobiotic holocarpic hyperparasite of the Olpidiopsis schenkiana, in its turn parasitic in Spirogyra. The allied P. vernalis parasitizes and causes galls of the filaments of certain species of Pythium.

A number of endobiotic mycoparasites are classified as Lagenidiales. Indeed two species of the type genus Lagenidium itself are mycoparasites, one L. destruens being a particularly virulent parasite on a species of Achlya (Sparrow, 1960). Further,

the genus Olpidiopsis is chiefly composed of parasites of freshwater fungi. Protoplasts of Olpidiopsis species on entering saproleginaceous hosts by way of germ tubes produced by the biflagellate zoospores of the parasite quickly induce deformation of their hosts (Barnett, 1912). A saprolegniaceous thallus begins to reproduce, it begins immune to infection by O. incrassata (Slifkin, 1961). Olpidiopsis species appear to be obligate parasites, although, the cultivation of maturity of some immature thalli of Olpidiopsis transferred from their saprolegniaceous host to artificial media. The genus Rozellopsis contains Rozella like parasites with biflagellate zoospores (Karling, 1942a). Rozella inflata (= Pleolpidium inflatum) which parasitizes various pythiaceous hosts (Prowse, 1954).

Although a number of perenosporales is known to be characteristically a parasite of other fungi. Mycoparasitism has been observed to occur in dual cultures of certain Pythium species (Drechsler, 1943). Parasitism by P. oligandrum may be taken as an example.Hanskins (1963) described a species of Pythium which in laboratory trials parasitized 79 of 98 species of fungi. On 69 hosts, it produced oogonia an event which depends on the presence of particular exogenous sterols (Hanskins et al., 1964).

Within the mucorales are displayed biotic interactions with other fungi which range from almost fortiutious parasitism to highly

specialised obligate parasitism. Such a range exists e.g. among the mucors which grow on the fruit bodies of higher fungi while a number of species of Absidia, Mucor, Rhizophus which invade the fruit bodies of higher fungi are certainly not always parasitic, other mucors such as Sporodinia grandis (=Syzygites megalocarpus), Dicranophora fulva and Spinellus species although capable of saprophytic growth are regularly found on Basidiomycete sporophores.

Parasitism by mucors on other fungi is common. It is accomplished in three major ways : first by the proliferation of endoparasitic mycelium as in Syncephalis, second by the insertion into the host of haustoria arising from an extramatrical mycelium as in species Piptocephalis, Dispira, Dimargaris and Tieghmiomyces and by hyphal fusions between parasite and host in Parasitella and Chaetocladium.

Except for Syncephalis wynnae which parasitizes the Discomycete Wynnea macrotis (Thaxter, 1897), all species of Syncephalis are facultative parasites of mucors. Species of Piptocephalis parasitize only mucorales, except for P. xenophila which develops better on Ascomycetes (Dobbs and English, 1954). Dispira cornuta (D. americana = D. circinata) fide Agers, 1935) parasitizes only mucorales but D. simplex is known to parasitize only ascomycete Chaetomium bastrychodes (Benjamin, 1961, 1963).

Species of Parasitella and Chaetocladium are morphologically specialised but culturable parasites. Burgeff (1924) concluded that parasitism of Absidia glauca and A. caerulea by Parasitella and Chaetocladium was strictly sex limited in that single strains of the heterothallic parasites attached only complementary strains of these two heterothallic hosts. However, Satina and Blakslee (1926) concluded that the parasitic reactions was not truely sex limited since they found numerous exceptions. A few members of kickxellaceae occur in association with other fungi and may prove to be mycoparasitic (Benjamin, 1959).

A number of fungi are reported to be parasitic on members of the family Agaricaceae and other higher fungi. Many fructifications are species of Hypomyces H. chrysospermum is common on boletes on which it most frequently appears in its chlamydospore stage (Sepedanium). The genus Cordyceps contains 5 species (including the familiar C. aphiglossoides and C. capitata) which live upon the subterrenan ascocarp of Elaphoclossum and two which live upon the sclerotia of Claviceps (Kobayasi, 1941). Battarina inclasa is another parasite of hypomyces ascocarp of Tuber puberulum. Eudarluca caricis (= Eudarluca australis) in both perithecial and pycnidial (= Darluca filum) stage is a cosmopolitan parasite of many macrocyclic and microcyclic rusts. Its perfect stage is generally found on Puccinia species on members of family graminae and cyperaceae (Erikson, 1966). Keener (1934)

showed that isolates of this easily cultured parasite differed in their virulence toward different species of rusts.

A few Discomycetes are mycoparasitic e.g. Micropyxis geoglossi which grows and fruits on the living apothecia of another Discomycete, Trichoglossum. The few Basidiomycetes which are known to be mycoparasitic are all Hymenomycetes e.g. Cladopus subdepluens fruits on the pores and stipe of Polyporus perennis. Boletus parasiticus attack the fruit bodies of Scleroderma species, while Asterophora lycoperdoides and A. parasitics (sometimes classified as species of Nyctalis) live and fructify on a number of Agarics (especially Russula and Lactarius species).

The above parasites of fruit bodies and others like Cladopus parasiticus and Valvariella surrecta cause little or no deformation of their hosts, but Stropharia epimyces dwarfs and renders more or less sterile the sporophores of Coprinus comatus and C. atramentarius on which it grows (Buller, 1924). There are also examples of Hypomycetes attacking non basidiomycetous fungi. Barnett (1963) has recently recorded that in laboratorty tests some wood rotting polypores and agarics penetrate and damage the endoconidia of Ceratocystis species. He suggests that mycoparasitism would have some survival value for these fungi.

Ampelomyces quisqualis (= Cicinnobolus cestaii) is a

parasite which forms pycnidia within the conidiophores, ascocarps and even vegetative cells of powdery mildews. It is possible that the hyperparasite overwinters as a saprophyte on the leaves bearing the mildews. Ampelomyces quisqualis grows and sporulates on various nutrient agar media (Emmons, 1930). A number of other hyperparasitic species of Ampelomyces have been described but it seems doubtful that they are distinct from A. quisqualis (Hansford, 1946). Coniothyrium minitans is a parasite of the sclerotia and sometimes the apothecia of certain species of Sclerotinia. A number of other pycnidial fungi parasitize leaf inhabiting Ascomycetes (Hansford, 1946) and other higher fungi (Seeler, 1943).

Various Hypomycetes are capable of mycoparasitism, but for many of these, it is probably not their prominant habit. This is probably true for certain species of Trichoderma, Penicillium and Cephalosporium. T. lignorum parasitizes a number of different soil fungi in artificial culture media on acid parasitizes the hyphae of Armillaria mellea and Polyporus schweinitzii (Ayton, 1953). This sort of parasitism evidently occurs under more natural conditions, too, for Boosalis (1956) found that a Trichoderma species was able to parasitize the mycelium of Rhizctonia (Corticum) solani in unsterilised field soil, as also could Penicillium vermiculatum. A species of Penicillum and Aspergillus have also been observed

to invade the sporangiophores of Mucoraceous fungi, just as species of Cephalosporium invade the hyphae, conidiophores and conidia of certain species of Helminthosporium (Kenneth and Issar, 1964).

A greater degree of physiological specialisation for mycoparasitism is shown by Gonatobotryum fuscum (Shingo, 1960), G. simplex (Whaley and Barnett, 1963) and Calcarisporium parasiticum (Barnett and Lilly, 1958) all of which are unable to grow in the absence of appropriate hosts. A rather differently specialised form of mycoparasitism is shown by Dactyellea spermatophaga and Trinacrium subtile, which invade the oospores of root-rotting and other soil inhabiting Oomycetes (Drechsler, 1938). A comparable degree of mycoparasitic specialisation is shown by certain hypomycetous hyperparasites of rust fungi. Tuberculina maxima is the 'purple mold' which invade the aecidia, spermogonia of, principally, certain Cronarticum species including C. ribicola. In tropical Africa, certain species of Titea are likewise parasitic in the sori of rusts, T.hemileae invading Hemiliea on Coeffe (Hansford, 1946).

Several Hypomycetes which parasitize the cultivated mushrooms are economically important e.g. Mycogone perniciosa is an important pest which causes enlargement of stipe, reduction or suppression of the cap and eventually rapid decomposition of the flesh of the mushroom.Other Hypomycetes which parasites of

mushroom include Verticillum malthousei and Cephalosporium costantini both of which can deform the host, though not like Mycogone causing rapid decomposition and C. lamellaecola which causes fusication and mildewing of the gills (Smith, 1924; Ware, 1933).

Under natural conditions, too, many Hypomycetes are associated with the fruit bodies of higher Basidiomycetes (Nicot, 1962). Although harmless saprophytes sometimes grow on perennial or coraceious fruit bodies, the relationship of many hypomycetous is undoubtedly a parasitic one. Parasitism of larger ascomycetous fruit bodies is also known e.g. Fusidium parasiticum attacks the stomata of Xylaria species, it sporulates abundantly over the surface but does little harm to the underlying tissues (Backus and Stowell, 1953). Many Hypomycetes which parasitize leaf inhabiting Ascomycetes are listed by Hansford (1946).

Like so many true fungi, Myxomycetes too may be attacked by fungal parasites. These are principally Hypomycetes. Stilbum tomentosum is common and forms abundant white coremia on the fructifications of Trichia and other slime moulds (Petch, 1945). As well as parasitizing higher plant Rhizctonia solani can parasite other fungi, in spite of its own susceptibility of certain mycoparasites (E.E.Butler, 1957), on mucorales and the imperfect fungus and Amblyosporium botrytis, the only higher fungus.

Rhizoctonia solani is known to attack. No study of the basic nutritional requirements of these fungi has been attempted.

Many fungi are known to be parasitize phytopathogenic nematodes. In 1934, Rozsypal Schmidt reported a Bhotomycopsis chytridiale which attack Heterodera schachtii. Drechsler (1937) described 40 species of fungi which attack nematodes. The important ones are Dactylaria, Acrostalgamus, Dactylella and Arthrobotrys.