

et al. 1986). Little is known of fungal diseases of ants, although ant-pathogenic fungi have been described in the families Clavicipitaceae (Thaxter 1888; Rogerson 1970), Hyphomycetales (Balazy et al. 1986), and Laboulbeniales (Thaxter 1908; Bequaert 1922); an unidentified unicellular fungal pathogen has been reported from the hemolymph of *Solenopsis wagneri* (Jouvenaz et al. 1977).

Outside the tribe Attini (Myrmicinae), no confirmed examples of fungivory are currently known in ants. Although the infrabuccal pockets of many ant species contain fungal filaments, the digestive tract does not; rather, the infrabuccal pocket serves as a temporary repository for fungi accumulated during the cleaning of the body, and the infrabuccal pellet is discarded in the refuse heap (Bailey 1920). In a rare exception, fungal filaments have been discovered within the digestive tracts of ants in the myrmicine tribe Cephalotini, *Cephalotes atratus* and *Zacryptocerus clypeatus* (Caetano and Cruz-Landim 1985; Caetano 1989; Kane 1995), but in this case the fungus is thought to serve as a digestive tract symbiont.

The northern European *Lasius fuliginosus* (Formicinae) constructs carton nests in hollow tree trunks and in the soil, cementing the carton with regurgitated sugary liquid. The fungus *Cladosporium myrmecophilum* is found growing only on this cemented carton (Lagerheim 1900); however, the ants do not consume it (Maschwitz and Hölldobler 1970). Fungi have been reported growing in epiphytic Rubiaceae that are inhabited by *Iridomyrmex* ants (Miehe 1911b; Bequaert 1922; Huxley 1978), within hollow stems of South American *Hirtella* (Chrysobalanaceae) occupied by *Allomerus* ants (Dumpert 1981), and on carton nests constructed by *Crematogaster* species in Nigeria (Farquharson 1914), but, again, there is little reason to believe that any of these ants is fungivorous.

Ants are thought to disperse the spores of mycorrhizal fungi in the order Glomales, fami-

ly Endogonaceae, including those of the genus *Glomus* (McIlveen and Cole 1976; Allen et al. 1984; Friese and Allen 1988, 1993; Janos 1993). Since glomalean spores are large (50–800 μm in diameter) and rich in lipids, and since spores are often found associated with roots in the chambers of soil-nesting ants, it has been suggested that some ants may consume them (D. P. Janos, pers. comm.). Went et al. (1972) found mycelium of various fungi in the refuse chambers of desert harvester ants in the genera *Veromessor* and *Manica*, and they reported that *M. hunteri* larvae consumed an unidentified fungus offered to them in artificial culture. Perhaps the best support for ant fungivory outside the Attini comes from observations made in Malaysia and Indonesia. In one case, a Malaysian *Prenolepis* species was photographed carrying off pieces of an unidentified basidiomycete fruiting body (Rosciszewski 1995). In a second case, fungal tissue fragments made up 50–80% of all food items carried to the nest by the giant forest ant *Camponotus gigas* in Borneo (Orr and Charles 1994; Levy 1996; S. Yamane, pers. comm.)

One group of exclusively New World ants, the Attini (Myrmicinae), are obligately fungivorous, with the fungus constituting the sole source of nourishment for the larvae and the dominant source for the adults (Barrer and Cherrett 1972; Littleddyke and Cherrett 1976; Quinlan and Cherrett 1979). Attine ants possess an elaborate array of behaviors for cultivating fungus gardens. The less-derived species cultivate their fungi on insect frass, seeds, and other organic detritus obtained from foraging in the leaf litter. The derived “higher” attines, including *Acromyrmex* and *Atta* species, cultivate their fungi on fresh vegetation, including leaves and flowers cut for that purpose. The identity of the attine fungal symbiont has been the source of speculation for over a century, although most researchers agreed that attines cultivated one or more species within the families Agaricaceae or