

Lepidoptera, Neuroptera, Orthoptera, Psocoptera, and Thysanura. Some parasitic symbionts simply steal food from ant foragers. For example, species of the Old World calliphorid fly genus *Bengalia* dart into columns and snatch away the food of various ant species (e.g., *Bothroponera*, *Camponotus*, *Dorylus*, *Leptogenys*, *Technomyrmex* species) (Bequaert 1922; Maschwitz and Schönegege 1980). Mosquitos of the genus *Malaya* (= *Harpagomyia*) are able to solicit regurgitated droplets from various Asian and African *Crematogaster* species (Jacobson 1909; Farquharson 1918; Wheeler 1928).

Many symbionts live inside ant nests, gaining their nourishment by feeding on refuse in the nest middens, by stealing the food of the ants, by preying on adult ants or brood, or by preying on other symbionts. In the very large nests of some ant species, remarkably large numbers of such "ant guests" can be found. For example, in one large refuse chamber within a four-year-old nest of *Atta sexdens rubropilosa*, Autuori (1942) found adult forms of 1491 Coleoptera, 56 Hemiptera, 40 Mollusca, 15 Diptera, 4 Reptilia, and 1 pseudoscorpion. In a study of 150 army ant colonies, Rettenmeyer (1962) collected 8000 mites, 2400 phorid flies, 1100 limulodid beetles, 300 staphylinid beetles, 300 Collembola, 170 Thysanura, 150 Diplopoda, 140 hystericid beetles, and 6 diapiiid wasps.

Facultative ant-nest symbionts, which are also found living without ants, are typically species that are predisposed to soil and leaf litter environments, such as oribatid mites and Collembola. For example, pyrgodesmid millipedes are frequently found in the refuse piles of the nests of lesser attines, e.g., *Mycetarotes parallelus*. In contrast, obligate symbionts of ants, presumably derived from facultative ancestors, are found only in ant nests, and often only in the nests of particular ant species. Mites of the genus *Antennophorus* (Antennophoridae), for example, live on the body surfaces of ants in the closely related genera *Acanthomyops* (Formi-

cinae) and *Lasius* and obtain nourishment by stealing drops of food during trophallaxis or by actively soliciting such droplets by mimicking the tactile signals used by ants for this purpose (Janet 1897; Wasmann 1902; Karawajew 1906; Wheeler 1910). Many other ant-nest symbionts, including the thysanuran *Atelura formicaria* and the hystericid beetle *Hetaerius brunneipennis*, steal or successfully solicit regurgitated food (Wheeler 1908).

The pseudoscorpion *Sphenochernes schulzi* lives in nests of the Argentinean fungus-growing ant *Acromyrmex lundii*, where it apparently feeds on worker ants by first immobilizing them with injected poison, then imbibing their hemolymph (Turk 1953). The third instar of the lycaenid caterpillar *Maculinea teleius* (Lepidoptera) follows ant pheromone trails and enters nests of *Myrmica rubra*, where it feeds on the brood (Chapman 1920; Malicky 1969; Schroth and Maschwitz 1984). Other examples of nest symbionts that have acquired the ability to follow ant pheromone trails include the milichiid fly *Pholeomyia decorior*, a symbiont of the fungus-grower *Trachymyrmex septentrionalis* (Sabrosky 1959) and the cockroach *Attaphila fungicola*, resident in nests of *Atta texana* (Moser 1964). In an example of extreme integration, the staphylinid beetle *Lomechusa stumosa* (Staphylinidae: Aleocharinae) possesses specialized "appeasement glands" at the tip of its abdomen containing a proteinaceous substance that seems to exercise a calmativ effect on its ant host, the European *Formica sanguinea*. Once incorporated into the nest, it preys on the ant brood and obtains regurgitated liquid food from workers (Hölldobler 1967, 1968; Hölldobler and Wilson 1990).

Numerous parasitoid species prey upon ants, including species of the hymenopteran families Diapriidae (Masner 1976; Huggert and Masner 1983) and Eucharitidae (Clausen 1940a, 1940b, 1940c, 1941; Heraty and Darling 1984; Heraty 1985, 1986). Flies (Diptera) of the family