

### Taxonomic position of *M. hirsuta*

There seems little doubt that *M. hirsuta* is a workerless parasite that has evolved from its host species, *M. sabuleti*. There are several routes that can lead to social parasitism; one is through a process of slave-making that has led to a complete absence of worker forms in the slave-maker. Another is by a degeneration of a symbiosis or a temporary parasitism to obligate-temporary parasitism then further to obligate-permanent parasitism. Yet another method is by a process of mutation within a colony to produce a form that achieves breeding isolation within that colony and eventually becomes a parasite of the normal form; this has been discussed by Buschinger (1970). I believe that *M. hirsuta* has evolved by this last method.

If the idea of rapid mutation within a colony is examined in more detail, several aspects of the colony structure would seem to be important in order that speciation can be achieved. The original host species should be polygynous and tolerate the recruitment of young queens into its colony who can be considered to act as a sort of parasite (Elmes, 1973); this facultative polygyny seems essential, for it is hard to see how a monogynous society that will not normally tolerate other fertilized females, even originating from their own colony, will tolerate the recruitment of many parasitic-like queens that are derived from itself. Monogynous colonies are more likely to be parasitized by species evolved through the facultative temporary parasitic route, for example the parasitism of *Tetramorium* by *Strongylognathus*. Facultative polygynous species are most likely to produce microgyne forms and the mutation that enables the establishment of a microgyne variety is probably not far removed from the mutation required to produce a truly parasitic variety. In the case of *M. rubra* microgynes are known to have a slightly aberrant breeding biology (Elmes, 1976), and if such a species produced a microgyne form that never contributed to the worker population of the colony, it could be considered as parasitic and it is easy to imagine how breeding isolation of the new form could occur within the original colony. This would be especially so if microgyne forms tend to mate within the nest and do not need the stimulus of a nuptial flight.

Brian & Brian (1955) suggested that the spread of the microgyne form of *Myrmica ruginodis* Nyl. is chiefly by colony division; therefore if microgyny occurs spontaneously in different geographically isolated populations of the parent species it could lead to simultaneous evolution of parasitic forms peculiar to the local host population. If, once a parasitic form has been established for a long time, it still retains the capacity to spread by flight, then it could become widespread in the host population. I consider that *Sifolinia*, the satellite genus of *Myrmica* (Kutter, 1973), has probably evolved in this way from a microgyne form that has retained its proclivity for nuptial flight or a parasitic form such as *M. hirsuta*. *M. hirsuta* may indulge in nuptial flights as is suggested by the occurrence of queens in pitfall traps, although an alternative explanation might be that they mate in the nest and then later wander off on foot in search of a new host colony.

I have unpublished morphometric evidence that suggests that *M. scabrinodis* is very typical for the *Myrmica* genus as represented in Western Europe; and if this is compared with a *Sifolinia* species such as *Sifolinia karavajevi* Arnoldi, which I consider to be fairly representative of *Sifolinia* it is seen that: *Sifolinia* typically has no worker caste and is a parasite of a *Myrmica* host, there being very little chance of interbreeding with the host; the males have only twelve antennal joints compared with *Myrmica* which has thirteen; the spurs on the tibia of legs II and III are absent or simple compared with the reduced pectinate spurs of *Myrmica*; the petiole and post-petiole are relatively wide, this is a character that can only be recognized after a degree of familiarization with *Myrmica*; *Sifolinia* have wings that have a partially open discoidal cell and no division of the cubital cell as opposed to *Myrmica* where the cells are closed and partially divided respectively; finally, again a more comparative character, *Sifolinia* tend to have longer more dense hairs on the body compared to *Myrmica*.

To summarize, I believe that the genus *Sifolinia* has evolved by a fairly direct route from microgyne-like ancestors through parasitic *Myrmica* forms; the path of this evolution seems to be associated with a degeneration of *Myrmica* characters until the end product is a form that resembles *S. karavajevi*, differing