Miniature Queens of the Ant *Myrmica rubra* L. (Hymenoptera, Formicidae)

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Introduction

Donisthorpe (1927) notes reports of miniature queens, or microgynes, of the ant *Myrmica rubra* L. (=*M. laevinodis* Nyl.), particularly that of Forel in 1868 and the specimen taken by Tomlin in this country. Collingwood (1958) also records *M. rubra* microgynes from Europe and a few from Britain and remarks on the sporadic nature of their occurrence. The related species, *M. ruginodis* Nyl., has a distinct microgyne variety and these have been investigated by Brian and Brian (1949 & 1954). Recently there has been some confusion as to the species studied by Brian and Brian, for example Stradling (1970) appears to have taken their results for *M. rubra* L. (=*M. ruginodis* Nylander cf. Santschi 1931) to be for *M. rubra* L. (=*M. laevinodis* Nylander cf. Yarrow 1955). This nomenclature is further confused by continental workers who do not recognise the name *M. rubra* for any species (Bernard 1968). For clarification of the relevant synonyms, see table. 1.

Table 1

Nomenclature used by M. V. Brian since 1957 and in this paper	Nomenclature used by M. V. Brian before 1957	Nomenclature used before 1931 and recommended by Bernard (1968)
M. rubra L.	*M. laevinodis* Nylander	*M. laevinodis* Nylander
M. ruginodis Nylander	*M. rubra* L.	*M. ruginodis* Nylander

In 1967 I observed the presence of microgynes in some colonies of *M. rubra*, that had been collected for experimental purposes, from a site in the Isle of Purbeck, Dorset. The remaining colonies in this particular area were left undisturbed and today there are still microgynes present. Colonies of *M. rubra* containing microgynes are thus a feature of this area and are not just a freak production of one season.

In July of 1971 I excavated a single colony, containing microgynes, in order to assess the relative populations of workers and queens. Only one colony was used for this purpose because of the rarity of the microgynes; the population of this colony is given here. Identification of the colony to the species *M. rubra* by the normal taxonomic characters of scape and epinotal spine was confirmed by biometry. The mean head width of twelve workers was found to be 0·978 mm while the mean spine length was

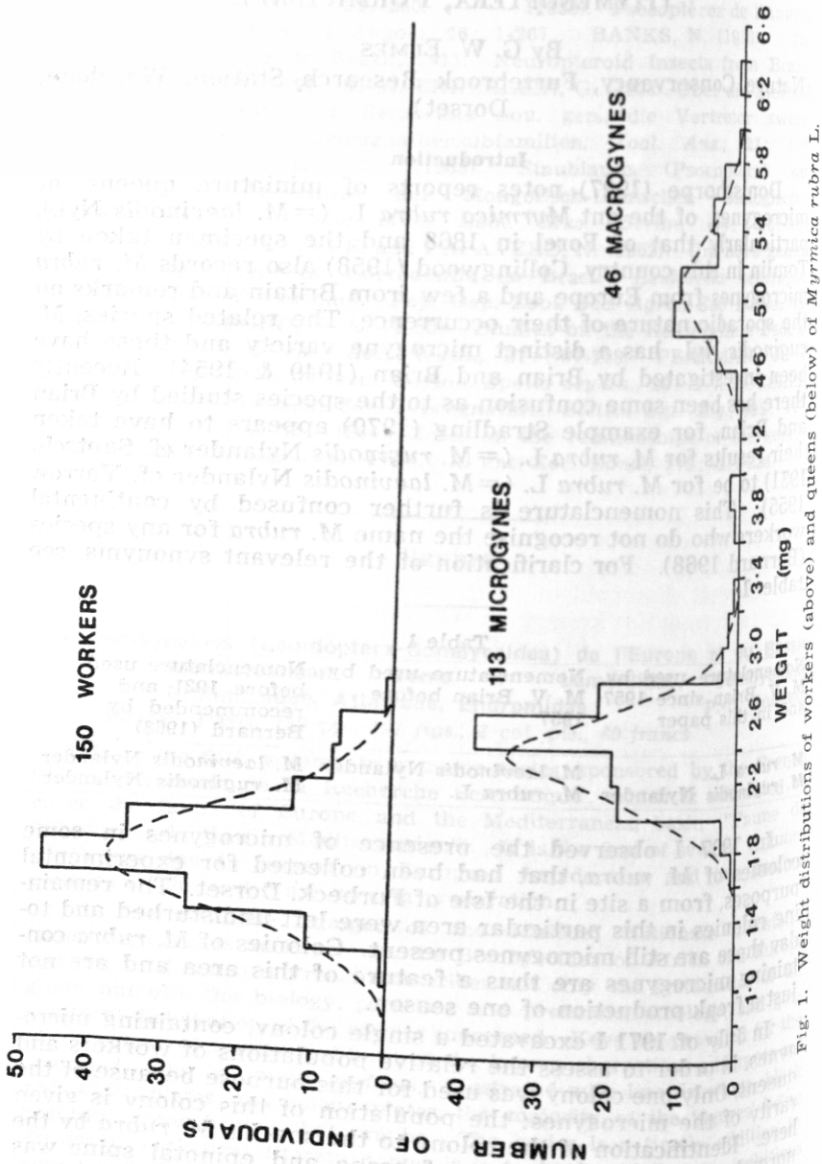

Fig. 1. Weight distributions of workers (above) and queens (below) of *Myrmica rubra* L.

0·229 mm: this places the colony well within the species *M. rubra* as described by Brian and Brian (1949).

Colony Population

The colony contained 1020 workers and 159 queens; the queens could be separated into two classes, upon visual inspection, being microgyna (miniatures) and macrogyna (normals), giving 113 microgynes and 46 macrogynes. All the queens and a sample of 150 workers were weighed, as a rapid method of determining the size distribution of the different castes. Normal curves were fitted to the resulting distributions and these are shown in figure 1. Means and Standard Deviations obtained from these curves are $1{\cdot}70 \pm 0{\cdot}30$ mg for workers, $2{\cdot}35 \pm 0{\cdot}25$ mg for microgynes and $5{\cdot}10 \pm 0{\cdot}35$ mg for macrogynes. All 46 queens visually assessed as macrogynes fell into the heavier distribution but 3 queens classed as microgynes were intermediate to the two weight distributions and were ignored when fitting the curves. From the figures it can be seen that the queens form two distinct distributions with no overlap. The smallest queens are about as big as the average worker whilst the largest workers are about as big as the average sized microgyne.

Discussion

Brian and Brian (1954) have made a detailed investigation of the occurrence and biology of microgynes of *M. ruginodis*, and found that, although the two types of queen are sometimes difficult to separate on morphology, they have quite a different biology. The microgynes indulge in secondary pleometrosis and reproduce by colony fission, whereas the macrogynes do not recruit young queens and found new colonies after nuptial flights.

M. rubra would seem to be different, having individuals of both the macrogyna and microgyna morphological types in the same colony; this never occurs in *M. ruginodis*. If *M. rubra* are evolving into two varieties, in the same manner as *M. ruginodis*, then it seems likely that there are two types of *M. rubra* queen that are indistinguishable morphologically but are separable on the ant perceptable characters described by Brian and Brian (1949). Thus there would be two types of macrogyne, the original type that is haplometrotic (or at least does not recruit new queens) and a second variety that is secondarily pleometrotic. The pleometrotic colonies, that reproduce mainly by fission, should not be under the same pressure to produce large queens for colony reproduction, providing that small queens are as effective at colony regulation as large queens. Preliminary laboratory trials with microgynes of *M. rubra* have shown that they are as efficient as large queens for the suppression of growth of large larvae. This would indicate that microgynes of this species are capable of fulfilling the same role as normal queens (Abbott pers. comm.). Therefore in these pleometrotic colonies,

the mutation producing a microgyne need not be harmful and might in fact be beneficial to the colony. In these circumstances the evolution of a small queen would seem probable, the morphological divergence being the result of a much earlier divergence of behaviour rather than the morphological differences producing a different behaviour. It should be possible to test this by comparing the behaviour of normal queens of *M. rubra* from colonies with single or few queens with those from grossly pleometrotic colonies.

It might be asked how the microgynes could spread from site to site if they behave in the manner of the microgynes of *M. ruginodis* and only found colonies by colony fission. It could be that microgynes sometimes fly and are accepted into colonies with the pleometrotic variety of queen that have not yet produced a microgyne mutation or, alternatively, in those colonies that contain both sister microgynes and large queens, the large queens may fly and carry the genes for the mutation to new areas. However, the mechanism of dispersion cannot be very efficient because the microgynes of *M. rubra* in Purbeck are only known to exist in one of many valleys, in the same system of hills, where *M. rubra* is common. Perhaps a detailed study of the frequency and distribution of microgynes of *M. rubra* in Purbeck will cast some light upon this problem.

It seems probable that the evolution of small queens in *M. ruginodis* is well advanced and that a similar evolution in the related *M. rubra* is in the process of taking place.

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