POLYETHISM IN WORKERS OF THE ANT MYRMICA

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I. — INTRODUCTION

This work was undertaken in the course of an investigation into the factors controlling dormancy in female larvae of the ant Myrmica, carried out between the years 1951 and 1954. The author is indebted to the Carnegie Trust for the Universities of Scotland for a grant enabling this work to be undertaken; also to Professor C. M. Yonge and members of the staff of the Zoology Department of the University of Glasgow; in particular to Dr. J. W. H. Lawson, Dr. W. Russell Hunter and Mr. D. A. Muir for their advice and guidance; finally to Mrs. A. D. Brian, and to Mr. M. V. Brian (now of the Nature Conservancy, Dorset) without whose continued encouragement and advice this work would not have been undertaken.

The material used in this investigation comprised colonies of the following species: Myrmica laevinodis Nyl., Myrmica scabrinodis Nyl., and Myrmica rubra (L) as divided into M. rubra microgyna and M. rubra macrogyna by Brian and Brian (1949).

All colonies of ants used were collected in the counties of Lanark, Dunbarton, Stirling and Ayr in the West of Scotland.

The significance of this section of the investigation and its relationship to other work which has been completed is as follows. Experiments on the induction of dormancy in female myrmicine larvae (carried out initially by Brian (unpublished) and subsequently by the present author) have shown that the physiological “condition” of the workers is important. Worker “condition” has been defined by Brian (1954) who has separated workers into three sequential seasonal categories (vernal, aestival and serotinal) which can be compared with a similar series of physiological “conditions” observed in the laboratory. The present author has used the term prevernal to describe
another seasonal worker condition. For larval growth, the 26 week summer in the West of Scotland is equivalent to a 13 week season at 25°C in the laboratory (BRIAN, 1954). The four terms used can therefore be defined as follows:

Prevernal. — Workers collected in the field in March and early April. Workers during the first three weeks of incubation at 25°C after hibernation at 10°C.

Vernal. — Workers in the field in May, and workers between four and six weeks after the start of incubation at 25°C.

Aestival. — Workers in the field in July, and workers between seven and nine weeks after the start of incubation at 25°C.

Serotinal. — Workers in the field in September, and workers between ten and twelve weeks after the start of incubation at 25°C.

The present work examines the origin of these differences of "condition", and the mechanisms by which they affect the brood rearing capacity of workers at different seasons.

EHRHARDT (1931), working on Myrmica rubra (the taxonomy of this and other related species in Britain has recently been discussed by BRIAN and BRIAN, 1940) showed that the behaviour of individual workers differed and that there was apparent change in the behaviour of individual workers with age. The ethological changes she describes show that the young workers are associated for long periods with the brood mass but, as they become older, they show increasingly a tendency to stand near the brood mass, not, apparently, doing anything in particular. Finally the workers become foragers and spend little time with the brood mass. These observations showing ageing accompanied by worker polyethism in a monomorphic species of ant have not hitherto been pursued. In addition to the classical examples of polyethism described in highly polymorphic genera (examples are quoted in WHEELER, 1910), differences in worker behaviour within the same caste have been demonstrated by CREN (1937). Investigation of these conditions in colonies of characteristically monomorphic genera, as WILSON (1954) considers Myrmica, is desirable. In particular, both differential worker behaviour and the possible polymorphism associated with workers of differing ethal types (workers showing behaviour differences) require study. Both these problems have been investigated and the results are described in the present papers.

2. — PRELIMINARY EXPERIMENTS WITH COLONY FRAGMENTS

On the basis of Ehrhardt's observations (1931) it appeared that ageing of the ant colony could cause increased worker activity (foraging). Such increased activity in senescent ants could be solely responsible for the different brood rearing capacities of worker colony fragments of different seasonal ages. Two experiments were therefore undertaken as follows.

Experiment I. — The relative oxygen consumption of colony fragments of varying seasonal ages was measured by modified Barcroft respirometers. The experiment was unsuccessful because the rate of oxygen consumption of the worker group as a whole, was masked by the oxygen consumption of individual workers which were, sporadically, very active. Not more than 5% of the workers were active at any one time. No statistical differences could be detected between the age groups.

Experiment II. — The relative locomotor activity of colony fragments of varying seasonal ages was measured by means of an actograph (CHAUVIN, 1947). Individual workers were again responsible for most of the