INTRODUCTION

The interest in the orientation of ants which arose at the end of the last century was marked by many theories based mainly on the observations made in Nature. One of the most noteworthy of the investigations was however made under experimental conditions, for Lubbock (1884) demonstrated that workers of the species Acanthomyops niger were capable of using the position of the illuminating source as a point by which to guide their way back to the nest. These results were repugnant to the Loebian school for they implied a plastic learning process during each outward journey which would condition the return. Bethe (1898) repeated the experiments but was unable to adduce any evidence of visual orientation, to him this ant appeared to be rigidly dependent on an odour trail with an inherent polarisation which the ant could appreciate. Later Brun (1914) was able to show the light-compass reaction by which this species used the direction of the sun’s rays as its guide.

Work on other species had shown rather similar conflicting results. It became apparent that ants could probably use a number of types of stimuli, even from different senses, in order to find the way back to the colony after a foraging trip. As Schneirla (1944) has pointed out it seems logical to suppose that an ant must have a vocabulary of sense data from which to choose should a particular form of stimulation be removed. It seemed

1) This work was done at the Zoology Department, Cambridge University, while the writer was receiving a Further Education and Training Award from the Ministry of Education, and formed part of a thesis for a Ph. D. degree.
therefore worthwhile to investigate the orientation of \textit{A. mger} in an endeavour to discover what is the main method of orientation and whether there is any choice in the type of stimulation used whereby other senses or a different aspect of the one sense can be used when the main method becomes impossible. At the same time a comparison was made between the behaviour of this species and of \textit{A. fuliginosus} which to judge from Brun's (1914) work and from its closely packed foraging columns found under natural conditions, was dependent on an odour trail. The results concerning the latter ant are published separately (Carthy, 1951).

\textbf{MATERIALS AND METHOD}

It was not found necessary, though it was convenient, to maintain complete colonies of either species. For the experiments groups of about a hundred workers and fifty or more larvae were kept in plaster nests. These were a version of the Janet type nest cast in Plaster of Paris. Measuring 4 1/2 ins. square, with 8 chambers about 3/4 in. in depth, they were of a convenient size for handling. A variety of other types of artificial nest was used for the whole colonies, a very full account of which is given by Wheeler (1910) and MacGregor (1948). One important factor which determined whether a colony should establish itself in the nest seemed to be the amount of space for a particular number of individuals, some crowding seemed to be essential.

Individuals were marked with spots of cellulose enamel on the thorax and abdomen. Though at first it was necessary to anaesthetise the workers with carbon-dioxide before marking them, later, handling them without injury became easier and anaesthesia was avoided in case it led to effects on their later behaviour. The paint adhered well though at first the workers cleaned it off each other, but renewed marking remained on for several weeks.

Food was an unsatisfactory substance for the ants to carry back to the nest for once replete the "drive" to fetch more back to the nest diminishes. If larvae are offered, however, the ant will continue to carry them back to the colony until the supply is exhausted, the "drive" to do so remaining at the maximum up to the removal of the last larva.

For an experiment, a nest was connected by glass tubing to a rotatable arena (Figure 1) in the centre of which was placed a pile of larvae on a coverslip. The inside of the brass wall was painted matt-black and the seven entrances not in use were closed by brass plugs fitting flush with the inner surface of the wall and matching in colour. The glass base plate rested on graph paper. Lines to coincide with the major divisions of the graph paper