FOOD DISTRIBUTION WITHIN LABORATORY COLONIES
OF THE ARGENTINE ANT,
TRIDOMYRMEX HUMILIS (MAYR)

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Introduction.

The Argentine ant *Iridomyrmex humilis* (Mayr) has been unintentionally distributed by man from its original home in South America to almost all parts of the tropical and subtropical regions of the world. It is presently found and recognized as a pest in such distant areas as parts of Australia, South Africa, Europe, and North America. In the United States it is distributed through the Southeastern States but is primarily a pest in the State of California, where its habit of fostering aphids and coccids, and incidentally of protecting many scale insects, has made it an important pest of the citrus industry. The California Citrus Research Center therefore has undertaken an extensive study both to increase the basic knowledge of this ant and to develop more effective methods of control.

It is the purpose of this paper to examine the food, feeding behavior, and pathways of food distribution within colonies of the Argentine ant. This information will contribute to an understanding of the social behavior and colony organization of this and other ants, as well as be of value in developing control methods based on the use of baits.

Enough general feeding behavior of most species of ants is known to categorize them by their major food sources, i.e., grain gatherers, predators, fungus growers, honeydew collectors, etc. For a great number of the better known species, even the exact type of food and the general foraging and feeding behavior are known. Information is lacking only after the food is carried by the foraging workers into the nest and is lost from sight. Although the distribution of the food within the colony—worker to worker, worker to queen, and worker to larvae—has been suggested as one of the major factors that has allowed ants to develop their social organization, it has been almost impossible until recently to trace and chart these pathways of food flow.

One of the oldest methods of tracing food distribution among ants is by the use of dyes added to liquid foods. According to Goetsch (1939), Fonel originally used this method in 1879 to prove the then original idea that there was an exchange of food between worker ants.

Later workers, such as Goetsch, substituted starch for dye and determined its presence by crushing the ant in a drop of iodine. Goetsch also determined the number of ants to which one individual would pass food by feeding a single ant an arsenical poison and observing how many other ants died in the nest.

A simple and accurate method of tracing food transfer among insects recently came into being with the development of radioactive isotopes.
The first attempt to use these tracers to study food transfer in colonies of social insects was undertaken with honeybees by Nixon and Ribbands (1952).

The first use of radioactive tracers in studying ants was by Pendleton and Gundemann (1954). These workers injected $^{32}P$ into the stem of a thistle (Cirsium undalaltzm, Nutt.). The aphids feeding on it were labeled, as was the honeydew they secreted. Insects preying on the aphids and the ants feeding on the honeydew could then be identified.

The first experiments using tracers to label ants in artificial nests under laboratory conditions were conducted by Gosswald and Klopp (1956 a) who used $^{32}P$ to mark the beneficial small red forest ant, Formica rufopratensis minor Gosswald. This was followed by a series of other papers on forest ants by Gosswald and Klopp (1956 b, 1958, 1959, 1969 a, b, 1961, and 1963) and other workers in their laboratories, Benwig (1959), Beck (1961), Hooldoblher (1961), Stumber (1961), and Naarmann (1963). These workers, using labeled sugarwater or honey, studied many aspects of the social life of ants, ranging from food exchange between workers and brood to the relationship of social parasitic ants and myrmecophiles.

Others who have studied food distribution in ants include Eiser and Wilson in 1957 and 1958. These researchers used radioactive tracers to label honeywater and compared the rate and amount of food exchanged by ants of several different species, representing widely different groups within the Formicidae.

Before the use of radioactive tracers, it was almost impossible to study the patterns of food distribution, even though the literature reveals that the subject was the object of considerable speculation. Wheeler (1910) and Forel (1923) mention the subject in their monographic works.

Le Masne (1951) included a section on the food and trophallaxis of ants in Grasse's Traité de Zoologie. Le Masne (1952) also studied the food exchange within colonies of the very primitive ant Ponera eduardi Forel. Additionally, Le Masne (1953) presented a very complete work on the relationship between the worker ant and the larvae in which he considered in detail the food and feeding of larvae of several species of ants.

More recently, Torossian (1958, 1959, 1960, 1961) investigated the exchange of proctodeal eliminations among species of several Dolichoderinae ants, including the Argentine ant. The 1961 work is the only record of a food study on the Argentine ant.

Method and materials.

All ants used in the experiments came from a one-hectare section of an orange grove near Escondido, San Diego County, California. This particular grove was known to be free of any insecticidal treatment for the last 10 years and had a southern exposure which contributed to higher winter populations of ants.

The colonies used in experiments were set up in artificial nests modified from the ones described by Brian (1951). Nests were constructed of 10 by 1.5 cm plastic petri dishes containing both a moist and a dry plaster of Paris layer on the floor (fig. 1). The moist surface was maintained by a cotton wick embedded in the plaster of Paris and extending through a hole in the bottom of the dish to a water supply in a small plastic container on which the nest rested. The moist plaster furnished a supply of free water for the ants as well as maintained a high humidity in the nest.

A 1/2-em hole in one side of the lid of the petri dish was covered with the inverted bottom half of a 3.5-em plastic petri dish, forming a small second chamber off the main nest. The food for the ants was placed in this small chamber. This procedure was adopted so the main nest was not disturbed each time the colony was to be fed. When in use, the nest was held closed with a pair of rubber bands and partially covered with a piece of opaque paper to provide shade.

Each experimental nest contained a colony of about 200 workers, 3 queens, and various stages of the brood. This type nest containing this size colony will