1975). In the following sections we will first describe each system as it appears in a relatively unmodified laboratory environment, then characterize it further with the results of experiments.

1. Recruitment to Food

a) Description of Behavior. When workers discovered a food mass too large to move, they recruited workers to the site of the discovery by what appeared to be a combination of a trail pheromone and tactile signals. Recruitment to food was distinguished from other recruitment systems by the combined following three characteristics: (1) before returning homeward, some of the discoverers laid 'signposts' in the vicinity of the food by depositing short looping trails in several directions out from the food mass; (2) a more elaborate tactile display was frequently employed, during which the trail-laying ant antennated the nestmate encountered, opened its mandibles as though offering food, and waved its head slowly over that of the nestmate; and (3) food exchange often occurred. When the colony was hungry, the frequency and intensity of trail-laying increased markedly. A more detailed account of food-recruitment will now be given.

The first ants to encounter pools of honey water fed to repletion or near repletion over a period of several minutes, then departed while dragging the tips of their abdomens over the substratum. Some of these trail-layers headed directly back toward the nest. Others made one to several looping movements in various directions for ten centimeters or less in the vicinity of the food discovery, in what appeared to be 'signpost' marking. Still others, forming less than ten percent of the whole, deposited steady trails 90° or more away from the direction of the nest in what appeared to be a disoriented state. The odor trails laid by these first scouts did not seem to be adequate either to trigger or to orient following by nestmates; other foragers crossing the trails even within seconds of their deposit were not visibly affected by their presence. Nevertheless, we were confident that pheromone trails were being laid. Workers recruited from the nest vicinity (evidently in part by tactile signals, to be described below) followed the initial trails with a moderate degree of fidelity, while in later stages of the recruitment process masses of ants traveled along what was clearly a central trunk trail of accumulated pheromones.

When a trail-layer encountered a sister worker she typically turned toward her, antennating her head rapidly and opening the mandibles as though offering to regurgitate food. The head was commonly waved slowly back and forth over that of the nestmate. The greater the hunger of the colony, the more intense and prolonged were these signals. In a minority of cases, actual regurgitation of food occurred, but the donor never surrendered more than a small fraction of its crop contents.

Following each encounter the trail-layer had a strong tendency to turn 180° and to run back for variable distances in the direction of the food, still dragging the tip of its abdomen over the ground. Consequently only a very few of the initial trail-layers, generally less than 10 percent, ran all of the 260-cm