

stretch from the food source to the leaf nests without reversing direction. This tendency to wheel back and forth caused the recruitment of new workers to proceed nestward only gradually: foragers in the arena were initially contacted at a higher rate than those on the tree trunk, which were contacted faster in turn than those in the leaf nests. The process was reinforced by the remarkable fact, which we do not believe to have been reported in any other species, for contacted workers to lay odor trails back and forth on their own. It was further reinforced by the strong response of workers that had not been fed, causing the recruiters to be delayed by peripheral workers. After these workers had received food, or proceeded on to the food site themselves, or both, the recruiters were delayed less frequently and were able to proceed all the way to the leaf nests more rapidly. The final result was the establishment of a chain of multiple odor trails running all the way from the food find to the leaf nests.

The recruitment process itself was most clearly marked at the leaf nests. Within half a minute after a trail-laying, food-laden forager entered a leaf nest, a group of workers typically left the nest excitedly and ran down the tree trunk in the direction of the food find. In 12 observations made of this phenomenon, the number of workers departing in the first 30 s ranged from 6 to 28 ( $\bar{x}=14.5$ ,  $SD=6.4$ ); prior to this activity, only one or two ants at most emerged during each 30-s interval. The trail-layer became more agitated in its contacts with nestmates as it entered the leaf nest and it often accompanied them back out, continuing to drag the tip of its abdomen as it proceeded down the trunk of the tree. That recruitment was occurring was also demonstrated by the buildup of the number of workers in the foraging arena to levels high above those occurring in the absence of food. The 'reinforcer' workers previously described—those laying trails without having yet visited the food site—did not appear to be effective in recruiting nestmates. When such individuals entered the leaf nests, groups of workers did not come out as was the case after the entry of food-laden recruiters. Typical case histories are illustrated in Figures 3 and 4.

In order to observe the recruitment process more closely, we conducted food recruitment experiments with the colony housed in the artificial tree constructed of glass test tubes. Food-laden workers were seen to make short, fast runs at resting nestmates. They typically approached individuals head-on, antennating them and waving their heads sidewise through several complete movements delivered at 2–3 times per second. Often the mandibles were also opened in what appeared to be brief food-offering movements. Usually about five workers were addressed in this manner before food exchange actually occurred. After liquid had been transferred, the recruiters continued to run in seemingly random looping patterns through the tube chambers, an action that created strong excitement among their nestmates. Many of the ants thus aroused then left the nest and ran out along the odor trail, in some cases departing even before the recruiters themselves. Some of them reinforced the odor trail while traveling outward, even before they had visited the food source. In a sample of eight such recruitment episodes watched from start to finish, the recruiters remained within the tube nests for 75–360 s ( $\bar{x}=179.9 \pm 85.1$  s),