

and poison gland secretions serve as alarm substances (Hölldobler, 1977). It also accords with other results, to be reported later in this article, that implicate the sternal gland substances in the specialized behavior of short-range recruitment. In contrast, trails composed of rectal gland extract induced prolonged following by much larger numbers of ants, which oriented in a calm manner indistinguishable from that displayed by workers traveling along natural odor trails. Preparations made from the remainder of the abdomen caused no perceptible reaction. The differences in response to the various organs were consistent during five replications employing two colonies. We conclude that the pheromone used in long-range recruitment originates in the rectal gland and is dispensed when the ant everts the gland and drags it over the substratum.

The second notable result is that the ants respond to the rectal-gland trail only if they have been previously excited. This effect helps to explain the observations, made on numerous other occasions, that ants crossing natural trails without meeting a recruiter did not follow the trails. By elimination, it appears likely that the essential accessory stimulus is the tactile contact experience during antennation from the recruiting ant.

We were able to confirm the role of the hindgut (incorporating the rectal gland) as the source of the trail substance in the course of a second set of experiments conducted under very different circumstances. *Oecophylla* colonies organize emigrations from one nest site to another by recruitment that employs antennation (sometimes accompanied by body jerking) and odor trails. Both trail-laying and following were closely similar to that observed during food recruitment (other details of the emigration process will be given later). We compared the activity of the rectal and sternal glands by presenting artificial trails made from both. Fifteen hindguts were placed in 0.5 ml ether; in a second preparation 15 sternal glands were also placed in 0.5 ml ether. Artificial trails 30 cm in length were then drawn with the two extracts at 45° angles away from the natural emigration trail and on opposite sides, so that they diverged at an angle of 90° from each other. The number of workers leaving the natural trail and following each artificial trail during the first 5 min was then recorded.

The results of this second experiment, given in Table 2, confirm that hindgut substances (and presumably those originating in the rectal gland) are more potent than substances in the sternal gland. However, the stimulus is truly effective only when visual cues are removed. When the ants followed the natural

Table 2. The following of artificial trails by workers attracted away from a natural emigration trail. Data are provided for ants orienting when the room was lighted, during which visual stimuli competed with the trails, as well as when the room was darkened. The data given are the number of replications (*n*), the mean number of workers responding (\bar{x}), and the standard deviation (SD)

Glandular source	Light on			Light off		
	<i>n</i>	\bar{x}	SD	<i>n</i>	\bar{x}	SD
Hindgut	3	4.7	1.5	9	19.9	9.5
Sternal gland	3	2.0	2.0	9	2.0	2.5