

# EXPOSURE OF THE NASONOV GLAND BY HONEYBEES (*APIS MELLIFERA*) COLLECTING WATER

by

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Worker honeybees expose their Nasonov scent glands on flowers in exceptional circumstances (FRISCH & RÖSCH, 1926; FREE & RACEY, 1966), but readily do so when collecting sugar syrup. Adding an odour to a dish of sugar syrup diminishes the tendency of bees foraging on it to expose their Nasonov glands (FREE, 1968; WENNER *et al*, 1969); thus, it seems that bees are particularly likely to add their own scent to a food source that lacks one and so facilitate its discovery by newcomers recruited by bee dances (FRISCH, 1946; 1967). Because odourless food sources are rare in nature, it is difficult to explain how this scenting behaviour could have evolved (FREE, 1968). However, although bees prefer to collect water containing decaying vegetable and animal material, which often has a pronounced odour, to cleaner and odourless water (BUTLER, 1940), the latter is frequently most easily obtainable. Hence we have now studied the scenting behaviour of bees collecting water.

## METHODS AND RESULTS

On 16 June, 1969, shallow unglazed earthenware dishes (18 cm diam.) were distributed at least 5 m apart in a garden containing numerous honeybee colonies. A continual supply of distilled water was maintained in 14 dishes and rain water mixed with decaying vegetation and mud (to be referred to subsequently as rain water) in 20 dishes. In the morning of 26 June, when many of the dishes were being visited by bees, each was observed for 5 minutes, and the bees that did and did not scent during this time were counted. These observations were repeated on the afternoon of 26 June, and on the morning and afternoon of 30 June. On each occasion the tendency to scent was much greater when collecting the distilled water than the rain water (Table 1).

In the next experiment (17 July) the possible effect of the taste of the water on Nasonov gland exposure was eliminated. Each earthenware dish was covered with wire gauze, on top of which was put a glass Petri dish containing distilled water. The 34 earthenware dishes used were allocated

TABLE 1

*Comparison of the tendency of bees to scent on dishes containing distilled water and rain water*

	No. dishes visited		Percentage of bees scented (total no. bees in brackets) on dishes with:		Significance of difference in tendency to scent
	Distilled water	Rain water	Distilled water	Rain water	
26 June morning	7	10	56 (48)	19 (48)	$P < 0.001$
afternoon	9	11	53 (125)	19 (132)	$P < 0.001$
30 June morning	5	8	67 (12)	20 (15)	$P < 0.05$
afternoon	10	13	65 (57)	13 (62)	$P < 0.001$

alternately into two equal groups (A and B). Distilled water was put into all the earthenware dishes during the morning, but during the afternoon Group A dishes were filled with rain water. The behaviour of bees visiting each dish was observed for five minutes in the morning and afternoon as before. Scenting on Group A dishes was diminished in the afternoon (Table 2). In a series of similar experiments the earthenware dishes were kept empty during the morning observation, and a few drops of methyl benzoate or benzyl acetate, in a small glass dish, were put inside the earthenware

TABLE 2

*Tendency of bees to scent in the presence or absence of an odour at the water site*

Scent added to experimental group in the afternoon		No. dishes visited		Percentage of bees scented (total no. bees in brackets) on:		Significance of difference in tendency to scent
		Experimental	Control	Experimental group of dishes	Control group of dishes	
Rain water to group A	17 July morning	8	9	38 (42)	32 (41)	nil
	afternoon	9	10	10 (92)	35 (89)	$P < 0.001$
Methyl benzoate to group B	18 July morning	15	12	33 (137)	23 (81)	nil
	afternoon	16	12	11 (108)	22 (126)	$P < 0.05$
Benzyl acetate to group B	31 July morning	9	8	14 (28)	14 (29)	nil
	afternoon	10	12	10 (93)	21 (165)	$P < 0.05$
Methyl benzoate to group A	6 Aug. morning	10	10	19 (77)	22 (68)	nil
	afternoon	15	12	5 (165)	17 (96)	$P < 0.01$
Benzyl acetate to group B	14 Aug. morning	10	10	24 (67)	19 (69)	nil
	afternoon	12	12	20 (70)	27 (164)	nil

dishes of Group A or B in the afternoon. In all except the last experiment, adding an odour to the water source significantly diminished Nasonov gland exposure. This effect, together with the bees' natural preference for collecting water contaminated with organic material, which gives it a pronounced odour, probably explains why exposure of the Nasonov gland by water-gatherers has previously escaped detection.

Observations were also made on the behaviour of individual water-gatherers during several consecutive trips. On 10 June bees visiting two dishes, A and B,

TABLE 3

*The scenting behaviour of individual bees during consecutive trips*

Dish	Type of water	Date	All bees		All trips		Bees that did not scent		Bees that scented
			No. foraged	% scented	No.	% on which bees scented	Mean no. trips	Mean no. trips	
A	Distilled	11 June	28	21	859	11	26	48	
	Distilled	12 June	25	28	1027	3	40	44	
B	Distilled	11 June	25	52	723	15	27	30	
C	Rain	3 Sept.	18	11	296	6	16	20	
	Distilled	4 Sept.	26	27	537	15	18	27	
D	Distilled	3 Sept.	30	77	1300	26	28	48	
	Rain	4 Sept.	21	33	321	9	14	32	

6 m apart, were given distinguishing paint marks. The dishes were emptied of water and refilled with distilled water on 11 June when both were watched for three hours during the morning and three hours during the afternoon; dish A alone was watched for a further six hours on 12 June. Individual bees showed no consistency from one day to another in their tendency to scent, and only one of the six bees that scented at dish A on 11 June was included among the seven that scented at dish A on 12 June (Table 3). It is not known why a greater percentage of bees scented at dish B than at dish A.

In another experiment, the behaviour of marked bees visiting two dishes, C and D, was watched continuously for eight hours on 3 September and six hours on 4 September from when water was provided. Dish C contained rain water on 3 September and distilled water on 4 September, whereas dish D received the reverse treatment (Table 3). On 3 September the proportion of bees that scented, and the proportion of trips during which scenting occurred, was greater at the dish with distilled water than with rain water ( $P < 0.001$  for each comparison) and on 4 September the proportion of trips during which scenting occurred was greater on the dish with distilled water ( $P < 0.02$ ).

Bees that scented made a mean of 16 trips (7 bees) before doing so when collecting rain water and 11 trips (34 bees) when collecting distilled water (difference not significant). Once they had begun to scent they continued to do so on only 26% and 50% respectively of their remaining trips. However, on average a bee foraging on rain water scented on 57% of the trips it made between the first and last trip on which it scented for the day, and a bee foraging on distilled water did so on 68% of such trips. The bees did not expose their Nasonov glands as readily or consistently when collecting water as when collecting concentrated sugar syrup (FREE, 1968) but this may merely reflect its relative attractiveness, and perhaps at times when water is in greater demand scenting is more pronounced.

Because a bee did not usually begin scenting for the day until it had made several foraging trips, it seemed unlikely that scenting was in response to difficulty in finding the water site. However, to test this possibility bees were observed foraging on dishes of distilled and rain water for five minutes as before, and then the dishes were moved 1 m from their original sites, to confuse the bees temporarily, and again watched for five minutes. The percentage of bees that scented before and after displacement of dishes containing distilled water was 53% and 51% respectively and of dishes containing rain water was 29% and 29% respectively. Hence displacement of the dishes had no effect on Nasonov gland exposure.

## DISCUSSION AND CONCLUSIONS

Under natural conditions Nasonov gland exposure by foraging bees is usually associated with water collection and not with nectar or pollen collection. Bees recruited to an attractive natural food source do not follow the dance directions very precisely (FRISCH, 1967); nor is it desirable that they should do so. A natural food crop is usually distributed over a considerable area, and, if the arrival points of the recruits are also widely distributed, a colony can exploit it more efficiently than if all its foragers concentrated on a small area. However, probably most naturally occurring water sites, other than early morning dew or rain, are more discrete than those of nectar or pollen and have less pronounced odours, and the exposure of the Nasonov glands by foragers at such sites helps recruits to find them sooner. It is not known whether bees expose their Nasonov glands when foraging on dew or rain drops, but it is doubtful whether this would commonly occur as they are likely to evaporate before the bees make sufficient trips to begin scenting. The exposure of Nasonov glands by bees foraging for nectar in glasshouses (FRISCH, 1926; FREE & RACEY, 1966), or on dishes of odourless sugar syrup

(FRISCH, 1967; FREE, 1968), is probably a response to an abundant supply of forage that is usually associated only with foraging for water. Arguments about the relative importance of dance communication and bee odour in the finding of dishes of sugar syrup by recruits (JOHNSON, 1967; WENNER, 1967) are of doubtful validity when attempts are made to relate them to communication of floral sources of nectar.

#### SUMMARY

It has been found that when worker honeybees have made several consecutive trips for water many of them expose their Nasonov glands at the source of supply, and especially when it lacks an odour of its own. It is suggested that the tendency of bees to expose their Nasonov glands when collecting sugar syrup or abnormally abundant supplies of nectar is an adaptation of the behaviour that naturally occurs when collecting water.

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#### ZUSAMMENFASSUNG

Wassersammelnde Honigbienen stülpen nach mehreren einander folgenden Ausflügen beim Wasser oft ihr Duftorgan aus, besonders wenn dort ein Eigengeruch fehlt. Verfasser neigt dazu, das gleiche Ausstülpen des Duftorgans am Zuckerwasserschälchen oder ungewöhnlich reichen natürlichen Nektarspendern auf das gleiche Verhalten der Wassersammlerinnen zurückzuführen.