ENTOMOLOGY

Infra-red Receptors in *Melanophila acuminata* DeGeer

A NUMBER of insects of different orders have been reported swarming near various sources of fire and smoke, although the families Buprestidae (Coleoptera), Platypezidae and Empididae (Diptera) have received the greatest attention. The most well-known insect associated with fires, however, is a species of Buprestid, *Melanophila acuminata*, which has been reported as being attracted over long distances to a variety of burning materials such as wood, oil, mill refuse, smelter products and trash in refuse dumps[1,2]. Other species of *Melanophila* (*consputa* Lec., *notata* Cast. et Gory, *coriacea* Kerr. and *ignicola* Champion) have similar habits[3-6].

The mechanism of orientation to fires by these insects has not been previously investigated, but most authors have assumed that it is an attraction to the smoke from fires[2,7]. This seems to be a reasonable assumption since, in some cases, it has been found that *Melanophila* must have flown great distances (60–100 miles) to account for its presence at fires[2], and an olfactory type of orientation could accomplish this. Yet I have failed to demonstrate any reactions other than an avoidance of smoke, carbon dioxide or carbon particles in an olfactometer in the laboratory.

All six species of the North American sub-genus *Melanophila* are attracted to fires and all possess a sensory pit contiguous with the lateral margins of both coxal cavities of the mesothoracic legs[8]. In my investigations on the mechanism of orientation of *M. acuminata* to fires I have examined the morphology, histology and function of these sensory pits. Each pit, which measures about $450\mu \times 200\mu$, contains from about 70 to more than 100 sense organs covered with a mass of fibrous waxy material. Each sense organ consists of two parts: a thin, transparent cuticular sphere about 14μ outside diameter connected to a sense cell by way of a canal through the endocuticle and an adjoining structure which excretes thin filaments of wax. After establishing that these organs were not olfactory, auditory or proprioceptive in function a simple technique revealed that they were sensitive to infra-red radiation. A specimen, attached by the pronotum to a triangular piece of metal foil and suspended in the air, was stimulated from the side with radiation from a tungsten lamp passing through a camera shutter and a series of lenses and infra-red transmitting filters. Responses were obtained at shutter speeds of 1/2–1/300 sec in the wave-length region of $0{\cdot}8$–$2{\cdot}7\mu$. Later, responses were obtained from brief exposures to radiation ranging as high as $6{\cdot}0\mu$ in a spectrophotometer. The response consists of a distinct reflex in the form of twitching of the antenna on the side of the body being stimulated and occurs only when the radiation is focused on the sensory pit and when the insect is still. The magnitude of the twitch varies directly with the intensity of the stimuli. There were no responses when the pit was painted over with bronze paint or when the radiation was focused on other parts of the body except the antennæ. A related species, *M. drummondi* Kirby, which does not possess the mesothoracic sensory pit did not respond to wave-lengths of $1{\cdot}25\mu$ or greater. Both species, however, responded when the antennæ were stimulated with very intense radiation passing through a Kodak 87-*C* filter which starts transmitting at about $0{\cdot}8\mu$. These reactions did not take place when wave-lengths greater than $1{\cdot}25\mu$ were used and it is likely that temperature receptors which are present on the antennæ of *M. acuminata* and which can detect a difference as small as 2° C in air temperature[9] were responsible for these reactions. The pit sense organs, however, require very little energy to give a response. The energy in calories has yet to be calculated from a standard source; but an idea of the quantity involved can be obtained by considering the amount of radiation used in a spectrophotometer. By the time this radiation has passed through two slits and a prism and has been reflected from several mirrors very low intensities reached the insect.

This is the first example, so far as is known, of an insect possessing distinct sense organs for detecting infra-red radiation. It is suspected that *M. acuminata* orients to fires by detecting infra-red radiation at considerable distances from the source. During flight the pit organs are completely exposed and could function tropotactically to guide the insect to the heat source. The antennal temperature-receptive sense organs probably function for short-range orienting when the insect is near a fire while the pit organs of the mesothorax function for long-range orientation.

The morphology of these sense organs and the details of this work will be published elsewhere. I thank Dr. F. L. Weichman of the Department of Physics for his advice and loan of various filters and Mr. W. R. Dyer for his assistance in these investigations. Mr. R. Swindlehurst of the Department of Chemistry kindly allowed me to use the spectrophotometer and was very helpful in all ways. This work was supported by the National Research Council of Canada.

WILLIAM G. EVANS

Department of Entomology,
University of Alberta,
Edmonton, Alberta.

[1] Champion, G. C., *Entomol. Mon. Mag.*, **45**, 247 (1909).
[2] Linsley, E. G., *J. Econ. Entomol.*, **36**, 341 (1943).
[3] Van Dyke, E. C., *Pan-Pacif. Entomol.*, **3**, 41 (1926).
[4] Manee, A. H., *Entomol. News*, **24**, 167 (1913).
[5] Beeson, C. F. C., *Forest Insects* (Dehra Dun, 1941).
[6] Champion, G. C., *Entomol. Mon. Mag.*, **54**, 199 (1918).
[7] Evans, W. G., *Pan-Pacif. Entomol.*, **38**, 59 (1962).
[8] Sloop, K. D., *Univ. Calif. Pub. Entomol.*, 7 (1937).
[9] Evans, W. G. (unpublished results).

MICROBIOLOGY

Effect of Temperature on Flagellation, Motility and Swarming of *Proteus*

IT was noted[1] that the swarming of *Proteus hauseri* was more extensive at room temperature than at 37° C and variants were described which were motile at 37° C but formed swarming colonies only at room temperature. Apart from observations[2] on a single strain of *P. vulgaris* there are no reports about the effects of temperature on flagellar synthesis by *P. hauseri*, and it was decided to investigate it in relation to motility and swarming. Strains investigated were those previously[3] used. Strains of *P. morganii*, *P. rettgeri* and *Providence* used in the same investigation were also examined. The solid media were those of Naylor[4] with Difco agar replacing Oxoid agar. The medium without sodium chloride is named *N* and the other is called *S*. These media were also used at an agar concentration of 1 per cent. Plates were well dried before use. The liquid medium was Oxoid nutrient broth. These 5 media were inoculated with single loopfuls of overnight broth cultures grown at 22° C. Cultures were kept in incubators at 22°, 37°, and 43° C and examined after 24 h for spread and motility by hanging-drop preparations, for flagella by staining, and *H* antigens were determined by slide agglutination of living cultures. Antigens for antisera production were grown in broth and killed with formalin.

All strains which spread were motile and possessed numerous peritrichously arranged flagella. All 28 strains of *P. hauseri* grown at 43° C on *N* or *S* agar or in broth were non-motile and aflagellate. At this temperature cultures did not even swarm on 1 per cent agar. This is at variance with a statement[5] that *Proteus* forms swarming cultures regardless of the temperature. In this respect it