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A Simple Trap for Certain Minute Flying Insects[1]

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During a study on the distribution of midges (Diptera: Cecidomyiidae), a simple trap was developed to catch these insects. The basic structure is a wooden board (12×12 in., ½ in. thick), covered with white cloth and standing 4 in. from the ground. A 2×18-in. metal strip is fixed about 4 in. above the board (Fig. 1). The under side of the strip is smeared with no. 20 motor oil. Threaded ½-in.-diam rods are used as legs and props. The board and the strip are fixed on the threaded rods at the indicated heights by nuts. Insects are caught on the oil surface. They can be easily removed with forceps and cleaned in kerosene.

The trap takes advantage of the insects' attraction to the white surface. The lightness of oil and the thinness of the layer limit the catch to minute flying forms, 5-mm body length or smaller, including Diptera, Hemiptera, Homoptera, and Neuroptera. Some of these insects are not among the specimens commonly collected with conventional methods, perhaps because of the small size. For example, numerous specimens of a species of *Anarete* (Cecidomyiidae) were caught which were found to belong to a new species (*A. pritchardi* Kim) (Kim 1967). Two specimens of a species of Enicocephalidae (Hemiptera) were caught; it is rather rare, since only one specimen from Minnesota is in the insect collection of the University of Minnesota. It is interesting to note that both the midge and the Enicocephalid are known to have a swarming habit.

The cloth cover may be changed to other colors to attract different insects. Thus a different species of *Anarete* (*A. corni* (Felt)) which also forms swarms was caught with a grey cover (Chiang 1971).

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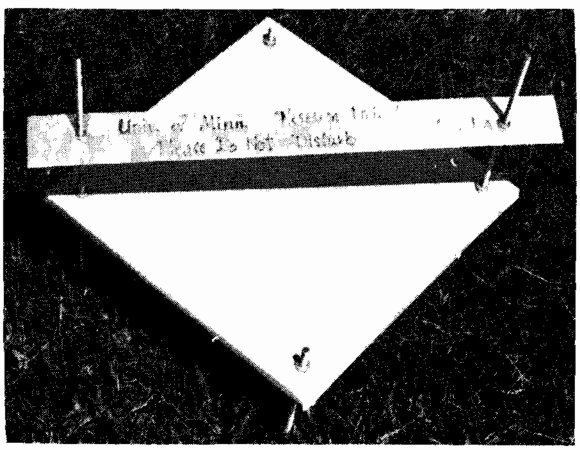

FIG. 1.—General structure of the trap.

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Habituation of Mealworm Pupae, *Tenebrio molitor*[1,2]

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In holometabolous insects, information acquired at the larval stage can persist through the intervening pupal stage and influence adult behavior (Thorpe and Jones 1937, Thorpe 1939, Borell du Vernay 1942, Borsellino et al. 1970, Somberg et al. 1970, Dethier and Goldrich 1971, Alloway 1972). To account for this relatively permanent storage of information, one must assume that those neural elements which hold this information endure through metamorphosis. The question remains: Can new information be acquired and can behavior be modified *during* the extensive neural reorganization that accompanies metamorphosis (Edwards 1969, Satija and Luthra 1969)? The present study indicates that a simple kind of behavior modification, namely habituation, can occur at the pupal stage during the transformation from larva to adult in *Tenebrio molitor* L.

When a young pupa of *T. molitor* was suddenly exposed to light, it began to contract its abdomen (Fig. 1). Upon exposure to continuous light, the frequency of abdominal contractions declined from 20/min to less than 2/min (Fig. 1). If this decline in response was due to habituation, then the frequency of abdominal contractions should recover to normal following either a stimulus-free interval or a change in stimulus pattern (Thompson and Spencer 1966). To test for recovery after the decline, we divided the pupae into 2 groups: one group was placed in darkness for one hour and then was reexposed to continuous light; the other group was immediately exposed to flickering light with no intervening rest period. Both groups showed recovery (Fig. 1, 2). Moreover, the reinstated response to flicker-

[1] Coleoptera, Tenebrionidae.

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ing light was above the initial level (Fig. 2), a result that is characteristic of dishabituation (Thompson and Spencer 1966).

To track habituation as a function of age, additional groups of older pupae and pharate adults (2, 4, 6, 8, and 10 days after larval-pupal ecdysis) were exposed to continuous light. After decline of the response, each group was placed in the dark for one hour and then was re-exposed to continuous light. All groups showed response decrement with initial exposure and recovery with rest. However, the onset of the response and the rate of habituation varied with age. In contrast to the young pupae (Fig. 1), whose responses commenced within the 1st minute of exposure to light and declined gradually over the next 10–12 minutes, the responses of the early pharate adults (4, 6, 8 day) did not commence until 3–4 minutes after exposure and declined rapidly within the next 3–4 minutes. As in the young pupae, the response of the late pharate adults (10 day) was immediate and habituated gradually (15–20 minutes). In the early pharate adults, the temporal summation before the overt response and the rapid decay of this response are most probably consequences of the extensive neural reorganization at this stage. The higher responsiveness in the young pupae and the late pharate adult may be taken to reflect the functional integrity of their respective nervous systems.

In summary, the present study demonstrates that throughout the period of neural remodelling, central neurons retain the ability to coordinate behavioral responses and to adjust to variation in environmental stimuli. Not many cells need be involved, for coordination of motor output in arthropods requires only a very few neurons (Kennedy 1966) and habituation may be explained by shifts in the temporal properties of a single synapse (Castelluci et al. 1970, Bruner and Kennedy 1970).

It is interesting to consider the adaptive significance of the light-elicited contraction and its habituation. We have noted that when the light stimulus was highly localized, vigorous contractions often caused the pupa to roll over, thereby allowing it to escape from the light. These contractions constitute an evasive behavior. Selection may have favored habituation of this behavior such that environmental noise does not elicit a protracted, energetically-wasteful wiggle.

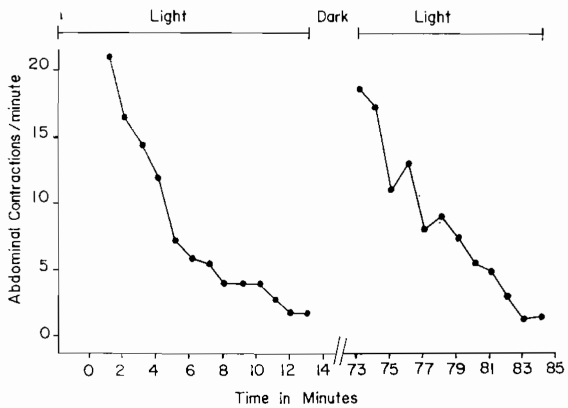

FIG. 1.—Habituation of pupae one day after ecdysis. After exposure to continuous light for 13 minutes, the pupae were placed in darkness for one hour and then re-exposed to light. Averages for 10 animals are shown on the ordinate.

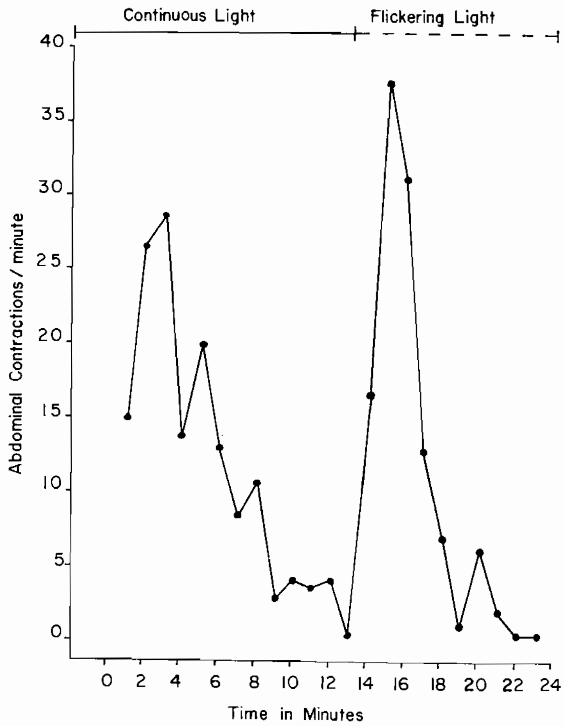

FIG. 2.—Habituation of pupae one day after ecdysis. After exposure to continuous light for 13 minutes, the animals were illuminated with flickering light. Averages for 5 animals are shown on the ordinate.

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Parasites of the Leafminer *Phytomyza vomitoriae* (Diptera: Agromyzidae)[1]

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The dipterous leafminer *Phytomyza vomitoriae* Kulp is one of the most serious pests of dwarf yaupon holly, *Ilex vomitoria*. Kulp (1968) reported that yaupon holly was the only known host and that the bionomics of the leafminer was largely unknown. Apparently there are no reports of parasites from *P. vomitoriae*.

Dwarf yaupon plants 4–6 in. high were observed during studies on biology and control of the leafminer in Spalding County, Ga. The plants were growing in 50% shade which seems to be a very desirable environment for the leafminer as the plants became heavily infested during August and September of 1971. Heavily mined leaves drop from the plant, often resulting in severe defoliation. The leafminer increases in numbers as the growing season advances, with injury reaching a peak in late summer.

Six species of hymenopterous parasites began to emerge from the pupae of *P. vomitoriae* as the leafminer infestation became heavy. Examinations of leaf mines revealed that 92% of the pupae had parasite emergence holes. A total of 181 hymenopterous parasites was cage-reared from field-collected material. The relative abundance of the 6 species is shown in Table 1. The late 1971 summer parasitism seemed very effective in controlling this leafminer as the plants were almost free of mines in early spring of 1972.

[1] Received for publication Oct. 5, 1972.

Table 1.—Hymenoptera reared from pupa of *P. vomitoriae*. Georgia Experiment Station, Experiment, Ga. 1971.

Family	Genus and species	No.	% of total
Braconidae	*Opius* sp.	72	40
Eulophidae	*Achrysocharella* sp.	21	12
	Chrysochris petiolate (Girault)	59	32
	Derostenus sp.	22	12
	Diglyphus intermedius (Girault)	4	2
Pteromalidae	*Halticoptera* sp.	3	2

ACKNOWLEDGMENT

P. vomitoriae was determined by G. Steyskal. The Eulophidae and Pteromalidae were determined by B. D. Burks, and the braconid by P. M. Marsh. I am grateful for their taxonomic assistance.

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Two New Species of Fossil Crane Flies (Diptera: Tipulidae) from the Ruby River Basin (Oligocene) of Southwestern Montana[1]

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Fifteen impressions of crane flies were discovered during investigations of fossil insects from the Ruby River Basin of Montana. Eight specimens were preserved well enough for taxonomic descriptions. The 8 specimens represent 2 new species, each belonging to the genus *Tipula* L. These species are the 1st members of this genus to be described from this locality. The fossils were found in paper shales of Oligocene age between Peterson and Morman Creeks, sec. 23, T. 7 S, R. 5 W., Madison County, Mont. The diggings are located ca. 13 miles from the town of Alder, Mont. A brief description of the geologic history of this region can be found in a previous paper (Lewis 1971).

I thank Dr. H. F. Becker of the New York Botanical Gardens and Messrs. John Alley and Jack Wulf of Butte, Mont., for the use of this material. These specimens help point out the similarity of crane flies from this geologic epoch with those of comparable age in the Florissant beds.

The following descriptions will categorize the fossil flies.

Tipula rubiensis, n. sp.

(Fig. 1, A)

Six specimens have been collected belonging to this species. They range in state of preservation from almost complete specimens to only wings. Because some lack reverse impressions, it is difficult to see all the necessary features on each specimen. The following description will therefore be of the designated holotype.

Described from a female. Legs present, but rather dismembered. *Head* not well preserved, with antennae not completely preserved. Eyes distinct.

Wings hyaline, with veins appearing dark brown; veins sometimes widened by cloudy markings; darkly pigmented patch above and basad from 1st M2; length and width 19.7 and 4.9 mm, respectively. Sc_1 bent posteriorly and meeting R_1 well before the middle of cell R1; Sc_2 (free tip) forking from R_1+Sc_2 at a point well beyond the middle of cell R1; R_3 directed in almost a straight line to wing margin; R_{4+5} slightly bowed upward in middle and dropping to a point near most distal margin of wing; 1st M2 of medium size, twice as long as broad; petiole of cell M1 less than half the length of 1st M2; both M_1 and

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