length of fast, and the delayed feeding effect, found in the higher vertebrates. Because the planarians are very far removed phylogenetically from the vertebrates and are among the most primitive animals that possess a central nervous system, bilateral symmetry, and encephalization, these, as well as other (*4*), behavior patterns may predate, and be more universal than, the vertebrate brain.

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Relationship between Locomotory Habits and Enzyme Concentration in Insects

Abstract. The activity of alpha-glycerol phosphate dehydrogenase has been measured in muscles from four insect species. In flying insects the enzyme activity is much greater per unit weight for flight muscles than for leg muscles. The results indicate a direct relationship between muscle levels of the enzyme and habitual mode of locomotion.

In contrast to most vertebrate smooth muscles, insect muscles possess low concentrations of lactate dehydrogenase and relatively large amounts of alpha-glycerol phosphate dehydrogenase (*1*). These enzyme differences are known to reflect differences in glycolytic pathways that are thought to be related to the very different efficiencies of vertebrate and insect muscles. As there are very large differences between insect species in habitual modes of locomotion, we have conducted experiments to determine whether these differences can be related to enzyme activities in insect muscles.

Four insect species were examined. The bumble bee *(Bombus terrestris)* is a strong flier and uses this means for its collection of food. The praying mantis *(Orthodera ministralis)* does fly but also often walks. The katydid *(Caedicia simplex)*, although winged, rarely flies and depends on walking as its almost sole means of locomotion. The tree weta *(Hemideina thoracica)* is wingless.

Adult specimens of these four species were captured locally. Flight muscles were dissected from the winged insects, and thoracic muscles, corresponding to flight muscles, from the wetas. Leg muscles were removed from all four species. All muscles were dissected into ice-cold, 0.9-percent potassium chloride solution and their weight was derived by difference.

The muscles were ground in a Potter-Elvehjem, all-glass, tissue homogenizer with more of the cold KCl solution. The resulting homogenate was centrifuged at 13,000 rev/min for 20 minutes at 2°C. The supernatant was used as the source of alpha-glycerol phosphate dehydrogenase.

Activity of the enzyme was determined by the following method, which is adapted from that of Chefurka (*2*). A mixture was prepared containing 0.37 μmole of dihydroxyacetone phosphate (DHAP), 3.0 μmole of reduced nicotinamide-adenine-dinucleotide ($NADH_2$), enzyme extract, and 0.1*M* phosphate buffer, *p*H 7.4. The final volume was 3.0 ml.

The reaction was initiated by the addition of DHAP, and the enzyme activity was determined by following the oxidation of $NADH_2$ spectrophotometrically at 340 mμ at 25°C. A control was used containing no DHAP. A unit of alpha-glycerol phosphate dehydrogenase activity is defined as the amount producing an initial rate of oxidation of 0.01 μmole of $NADH_2$ per minute under the above conditions of assay. Results are given in Table 1.

It is apparent that flight muscles contain much more of the enzyme than leg muscles. Moreover, the activity of the enzyme in the flight muscles of the winged species seems directly proportional to the flying habits. There is a similar decrease in the alpha-glycerol phosphate dehydrogenase activity in the leg muscles. The flightless weta, however, has a moderate alpha-glycerol phosphate dehydrogenase activity in its leg muscles.

Table 1. α-Glycerol phosphate dehydrogenase in insect muscles.

Insect	Muscle	Enzyme (units per gram fresh wt.)
Bumble bee	Flight	4500
Bumble bee	Leg	2200
Praying mantis	Flight	1090
Praying mantis	Leg	175
Katydid	Flight	855
Katydid	Leg	85
Weta	Thoracic	250
Weta	Leg	475

These experiments appear to demonstrate a close relationship between the habitual locomotory habits of an insect and the alpha-glycerol phosphate dehydrogenase activity of its muscles (*3*).

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Imprinting: Its Effect on the Response to Stress in Chicks

Abstract. Young chicks imprinted to surrogate mothers were compared with nonimprinted controls on two tests designed to measure resistance to stress. Half of each group was run with and half without a surrogate present during the stress. One test involving survival time under starvation showed no effects. However, in the other test, imprinted chicks showed fewer distress calls in response to auditory stimulation than nonimprinted controls.

Several writers have suggested a close relation between emotion and imprinting. Thus, maturation of fear may determine the critical period during which imprinting occurs (*1*). Conversely, imprinting may have as a main function the reduction of fear in the young animal (*2*). Gray (*3*) has reviewed evidence at the human level and suggests that, here also, lack of attachment to a parent or parent-surrogate has deleterious effects on emotional development.

The experiments reported here were aimed at providing further evidence on the relation between imprinting and emotion. Specifically, our aim was to examine both the effects of the im-