

# An Improved Method for the Determination of the Lethal Temperature of Insects, with Especial Reference to Studies on *Periplaneta americana*

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Published data upon the lethal temperatures of poikilothermic animals show considerable variation both as to the results obtained and the methods employed. The two main reasons for these discrepancies are the absence of a standard procedure, and the neglect of several internal and environmental factors that may affect the lethal temperature. The author has attempted to deal with these two aspects of the problem. First, an apparatus has been constructed which permits a uniform increase in environmental temperature until the lethal point is reached. Second, the effect of several internal and environmental factors upon the lethal temperature of the cockroach, *Periplaneta americana* has been studied.

In the construction of the apparatus, an ordinary aquarium insulated with fiber board is used as a water-bath. The water is stirred constantly, and is heated by two 75 watt light bulbs. The lethal chamber consists of a 250 ml. Erlenmeyer flask immersed in the water and provided with a three-hole rubber stopper through which is inserted a sensitive thermometer, and the air inlet and outlet tubes. The circulating air is first passed through seven feet of coiled glass tubing immersed in the water. This preheats the environmental air to exactly the temperature of the bath, thus preventing local overheating of the insect. The "lethal temperature" is taken as the lowest temperature at which the last member of a homogeneous group of insects dies after exposure to a uniform temperature rise of one degree every five minutes starting at the normal environmental temperature. Heretofore the lethal point has been expressed in terms of a given survival time at a constant temperature. This suffers from the disadvantage that two variables are involved. In the improved method, however, with a uniform temperature rise of one degree every five minutes, the lethal point can be expressed in terms of temperature alone. Data are thus easily compared in terms of this one variable.

The internal and environmental variables were controlled closely in *Periplaneta* by the use of a laboratory colony of roaches. Members of the same egg-sac were used as controls for the study of various factors affecting the lethal temperature. The following results have been obtained under a temperature rise of one degree every five minutes:

1. Roaches hatched from the same egg-sac and reared in the laboratory all die within a range of  $0.3^{\circ}$  C., regardless of their age. Roaches captured at random show a wider variation.

2. At 100% relative humidity, the logarithm of the weight of *Periplaneta americana* gives a hyperbolic curve when plotted against the lethal temperature e.g. at a weight of 0.003 gm. the L. T. is 48° C., whereas at a weight of 0.04 gm. the L. T. is 51° C.
3. A low relative humidity decreases the L. T. of very young roaches, but has no such effect upon older specimens.
4. The lethal temperature of all insects tested was within the range 45-55° C.
5. Starvation, injury and poisons decrease the L. T. of all types of insects.
6. The L. T. of grasshopper nymphs is 53° C. as compared to only 48.5° C. for cricket nymphs of corresponding weight and environment.