TEMPERATURES LETHAL TO THE LOUSE

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At present there is a demand for information about the temperature which can be relied on to kill lice (*Pediculus humanus*) and their eggs on rather short exposures. What little is known is set out in my recent book (Buxton, 1939); but it is imperfect, and some of it inaccurate. A full set of determinations has therefore been carried out.

Experimental Apparatus

It seems that in some of the early work the temperature was not measured just where the insects were placed; another source of error was that insects were put in a

FIG. 1.—Apparatus, made from a large test-tube, in which lice or eggs may be exposed to precise conditions of temperature.

container and then inserted in a thermostat, the worker not realizing that it might take some time for the container to reach the temperature of its surroundings. These errors may be avoided by the simple apparatus shown in Fig. 1. The tube stands in a beaker, which is in the tank of the thermostat, and fluctuations of temperature inside the tube are less than 0.1°C . The temperature is measured in a similar tube, set beside the experimental one, in the same beaker. When an experiment is to be made the tube is not removed from its position, but lice or eggs on a minute fragment of cloth are dropped down the inner tube to the bottom, where they very rapidly come to the temperature of the surroundings. No control of humidity is necessary, for it is known that lice and their eggs are not very sensitive to this factor, which may therefore be neglected for the short periods under consideration.

Results

The results (Fig. 2) were obtained with a strain of body lice originally derived from South London. The insects were taken straight from the man on whom they were reared, and dropped into the apparatus, so that their nutritional state was good. The figure shows results which are very sharp and consistent. The lowest temperature which kills all lice (ten were used to determine each point) is 51.5°C . for five minutes, 49.5°C . for ten to thirty minutes, and 46°C . for forty-five minutes to one hour. The temperature fatal to adults (of both sexes) and larvae is the same. Females which have been exposed to temperatures just below the lethal lay infertile eggs:

for instance, ten females and nine males were exposed to 46°C . for forty minutes; none died, but the females laid fifty-eight eggs in the three following days, none of which hatched.

A similar determination was made for eggs, which were kept, before and after exposure, at 28°C ., approximately the temperature of the surface of the body: at this temperature the egg stage generally lasts ten days. Provided the eggs are under five days old, it is found that the lowest

FIG. 2.—Results of exposing groups of lice to particular temperatures and for certain periods. Crosses indicate that all lice are killed; white circles that all are alive twenty-four hours later; black-and-white circles indicate that some are killed.

fatal temperatures are 53.5°C . for five minutes, 52°C . for ten minutes, 50°C . for thirty minutes. With older eggs, incubated eight or more days, the lethal temperatures are lower: the difference was not precisely determined, but amounts to several degrees centigrade. It seems that there is a zone about 46° to 47°C . in which exposures damage the embryo, so that it may complete its development but fails to emerge from the shell. I have, for instance, exposed about 200 eggs (one to five days old) to 46.4°C . for two hours: about half were killed outright, as shown by the fact that no further development took place; the rest developed eye-spots and limbs, and then died, excepting about 1 per cent. which hatched.

Practical disinfestors do not regard eggs as dead unless they are collapsed and shrunk. That reasoning is on the safe side, for collapse indicates that the egg has been subjected to temperatures well above the lethal, as exposure to temperatures just above those necessary to kill does not cause visible damage: for instance, young eggs (one to two days) shrink after ten minutes' exposure at 61°C .; but not after ten minutes at 56°C .; old eggs (seven to ten days) do not shrink unless exposed to over 65°C . for ten minutes.

Comment

To many medical men who are accustomed to the use of heat for killing bacterial spores the temperatures which kill the louse will seem very low, though the louse differs little in this respect from many other insects. The thermal death-point for eggs and lice being where it is, one may say that ordinary laundry processes as applied to cotton goods should generally be sufficient to kill all stages of this insect; but the temperatures at which woollens are washed are so low that they would probably be ineffective. It is understood that in dry cleaning, after the garments have been exposed to the solvent they are dried in a hot revolving drum, and that temperatures far above those necessary to kill the louse are generally employed. These processes are therefore doubly safe, for the solvent itself (carbon tetrachloride, petrol, etc.) would almost certainly destroy lice and eggs. This point is mentioned because the efficacy of dry cleaning and laundry processes is a matter about which questions are often asked.

REFERENCE

Buxton, P. A. (1939). *The Louse: An Account of the Lice which infest Man, their Medical Importance and Control*, pp. 25, 33 (Arnolds, London).