alcohol concentration. The true rate of alcohol metabolism at this high blood alcohol concentration can thus be estimated as the sum of the maintenance dose of 156 mg/kg/hr plus the deficit of 30 mg/kg/hr, or 186 mg/kg/hr. If this rate be applied directly to man, the maximal daily consumption for a 70-kg man would be 312.5 g of alcohol, or about 26½ oz of 100 proof whisky, which falls in the same order of magnitude as the 32 oz calculated from prolonged daily consumption in dogs.

From these data we may then conclude that the maximum daily consumption of alcohol by a man of average weight is represented by a quart of 100 proof liquor, and that estimates greater than this are in error. Equally, it may be concluded that this consumption may only be achieved by maintaining the blood alcohol concentration at a high level.

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Preliminary Observations on the Biological Effects of Radiation on the Life Cycle of *Trichinella spiralis*

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Trichinella spiralis is the causative agent of human trichinosis. The disease is acquired as a result of eating undercooked meat, usually pork, containing the parasite in the encysted larval stage. Trichina infection appears to be somewhat common in the United States as it has been found in 14.34% of human post-mortem examinations (*2*). Since there is no simple economical method of treating meat at slaughter to kill trichinae larvae, any information which may improve present conditions is desirable. It has been found that a very intense beam of X-rays or cathode rays produced in a newly developed high voltage machine rapidly destroyed bacteria, yeasts, and molds, and the application of this method to the sterilization of food has been suggested (*1, 3*).

The writers, in this study, have undertaken some preliminary experiments to determine whether treatment of meat with radiations would have lethal action on the encysted trichinae larvae or would produce some morphological change which would prove detrimental to the life cycle of the parasite. For the purpose of clarity the life cycle of *Trichinella spiralis* is briefly summarized. The larvae develop and reach maturity in the intestinal tract of the host 2–3 days following ingestion of infected meat. On the fifth or sixth day about 99 to 100% of the female worms show embryos in the uterus (Fig. 1a). These embryos are liberated into the lymph spaces of the host's intestines and eventually reach the musculature where they become infective in less than 3 weeks.

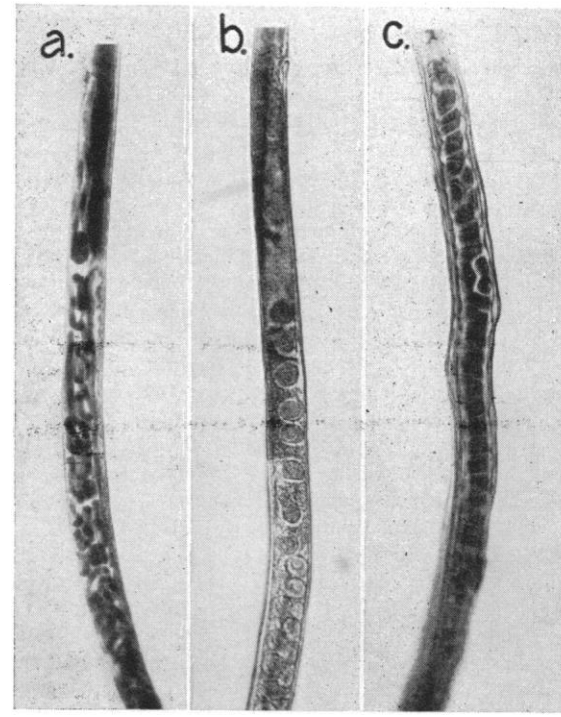

Fig. 1. Adult females of *Trichinella spiralis* recovered from small intestine of rats 6 days following experimental infection. (a) Normal adult with embryos in the uterus, recovered from a control rat which had received nonirradiated infected muscle; (b) adult showing undeveloped embryos in the uterus recovered from a rat which had received infected meat irradiated for 96 hr; (c) adult recovered from a rat which had received meat irradiated for 144 hr showing abnormality in the shape of the body wall.

The method used in these experiments consisted in preparing small cellophane wrappings each enclosing about 1 g of trichinous rat meat and placing the packets between two tubes containing radioactive cobalt, in a refrigerator at about 4° C. The dose of irradiation received by the meat was estimated to be 2000 r for each 24 hr, consisting largely of gamma rays, the beta rays having been filtered out. After the meat was irradiated for a specified interval of time, the contents of each of two wrappings were fed to each of two white rats.[1] One of the rats was killed 6 days after infection to determine the condition of the adult worms in the intestinal tract. The second rat was killed 30 days after infection to determine presence or absence of encysted trichinae larvae in the musculature; if larvae were not found by use of the press preparation method, the muscle was artificially digested and examined. A control rat receiving un-

[1] Acknowledgment is made to Dr. A. R. Lamb, Experiment Station, H.S.P.A., for making laboratory animals available.

treated meat was maintained for each rat fed irradiated meat; both were killed at the same time.

In the present report, based on six separate experiments, the following observations have been made: Irradiation produced no lethal effect on the larvae nor did it affect their power of developing to the adult stage. Irradiation showed increased and variable deleterious effects on the reproductive cells of the adult female worms with increased dosage. In four experiments in which meat was continuously irradiated for 4 days it was estimated that 12 to 86% of the female worms were sterile, i.e., the embryos failed to complete their development (Fig. 1b). The remainder of the female worms showed embryos in the uterus. Irradiation for 5 days resulted in the sterility of about 43 to 100% of the adult females. Irradiation for 6 days resulted in the sterility of about 60 to 100% of the female worms. In two other experiments in which meat was irradiated for 4–6 days, presence of sterile female worms was observed but the percentage affected was not determined.

Female parasites, not made sterile as a result of irradiation, produced embryos which were able to invade the musculature of the host and become infective. Of six rats receiving meat irradiated for 6 days, and killed 30 days later, four showed no larvae in the musculature.

In addition to affecting the reproductive tissue, irradiation produced abnormality in the form of irregular elevations or vesiculations of the body wall of the parasite (Fig. 1c). This condition was evident along the posterior half of the female worm and was found to be more prevalent as the period of irradiation increased.

These results show that gamma radiation at the dose, intensity, and temperature applied is not lethal to trichinae larvae encysted in meat, but under proper dosage renders the female worms sterile and unable to complete their life cycle. Experiments are in progress to determine, among other things, the effects of larger dosages applied for a shorter time from a more intense source.

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Effect of Temperature on the Mutual Adhesiveness of Epithelial Cells[1]

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Previous work in our laboratory has demonstrated that an important physical characteristic of cancer cells is decreased mutual adhesiveness, and that this property is apparently due to a low calcium content of such cells (*1*, *3*, *4*). These observations have stimulated investigation of other factors which might affect normal cell adhesiveness and have led to the finding that adhesiveness is greatly affected by temperature.

[1] Aided by a grant from the Donner Foundation.

The method used has been described previously (*1*), and only a summary will be given here. Attached pairs of human buccal epithelial cells were used. The force required to separate each pair by micromanipulation was measured. This force, calculated in milligrams, was determined by measuring the bend produced in a previously calibrated microneedle as it was moved in a direction tending to separate one member of a pair of cells from the other. During micromanipulation, the cells were kept immersed in a balanced salt solution. A constant high temperature was maintained by a warm box surrounding the micromanipulator; and a low temperature, by the use of a refrigerated room.

Adhesiveness of the epithelial cells was determined at three different temperatures. At room temperature of $22.5 \pm 1°$ C the mean force required to separate 100 pairs of cells was 1.53 mg, with a standard error of ± 0.067. When the epithelial cells were separated at $37 \pm 1°$ C, their adhesiveness was found to have decreased; the mean value for 50 pairs of cells was now 0.88 mg, with a standard error of ± 0.070. This value was significantly lower than that obtained at room temperature, for the difference in means was 6.7 times the standard error of their difference. Thus, it is concluded, an increase in temperature produced a decrease in adhesiveness of buccal epithelial cells.

When epithelial cells were separated at a low temperature ($11 \pm 1°$ C), the mean value of adhesiveness for 100 pairs of cells was 1.91 mg, with a standard error of ± 0.100. This value was significantly higher than the room temperature value (1.53 mg), as the difference in means was 3.16 times the standard error of the difference. It is concluded, therefore, that a decrease in temperature produced an increase in adhesiveness of epithelial cells.

These results demonstrate that changes in temperature can significantly alter the adhesiveness of cells to each other. While quantitative measurements of most biological and biochemical processes change in the same direction as does the environmental temperature, the property of adhesiveness changes inversely as the temperature. Alterations in adhesiveness produced by changes in temperature may be of no great significance in homoiothermic animals, where body temperature remains approximately constant. However, such alterations are probably of importance in cold-blooded animals. Thus, Lucké and Schlumberger (*2*) have demonstrated that renal carcinoma of the leopard frog metastasizes more extensively when the environmental temperature is increased. Conceivably, increase in temperature may further reduce the already decreased adhesiveness of cancer cells, thereby leading to greater invasiveness and enhancing the chances for vascular dissemination.

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