in the age distribution of the East Anglian herring fishery are partly attributable to natural causes.

D. H. CUSHING
A. C. BURD

Fisheries Laboratory,
Lowestoft.
March 19.

[1] Hodgson, W. C., *Fishery Invest.*, **2**, xi, 7 (1929).
[2] Scottish Home Department Annual Report for 1955. Appendix I (1956).

Protection from Whole-body X-irradiation afforded to Adult Mice by reducing the Body Temperature

IT has been shown that the survival-rate after irradiation of new-born rats[1] and mice[2] may be increased by reducing the body temperature to 2–5° C. at irradiation. A slight reduction in sensitivity of adult rats to whole-body irradiation has also been shown[3] by reduction of their body temperature to 18° or 19° C. The development of a technique for inducing hypothermia in rats by Andjus and Smith[4], and recently extended to mice by Goldzweig and Smith[5], has enabled us to demonstrate considerable protection in adult mice irradiated at a body temperature of 0–1° C.

The mice used were male adults of the 'T' strain bred at the National Institute for Medical Research. The *LD*50 (counting survival at 30 days) for normal mice of this strain is approximately 620 r. of X-rays given to the whole body (Fig. 1) based on observations made on 114 mice. All irradiations were done with 190 kV. X-rays, 6 mA., filtered through 1·5 mm. of copper and 1 mm. of aluminium. The cooled mice were irradiated when all heart and respiratory movements had stopped and the colonic temperature was 0–1° C. The revival was started about five minutes after completion of the irradiation and thirty minutes after the animals' body temperature had reached 1°. Doses of 900 r. (14 mice), 1,200 r. (15 mice) and 1,500 r. (7 mice) resulted in 100 per cent survival at thirty days. The mice lost weight during the first ten days after irradiation ; but had all regained their original body weight after twenty-two days. Fig. 2 shows the changes in weight of mice irradiated with 900 r. X-rays at a body temperature of 0–1° C. compared with a non-irradiated group whose body temperature was likewise lowered to 0–1° C. and with another group that were given 900 r. X-rays at normal body temperature.

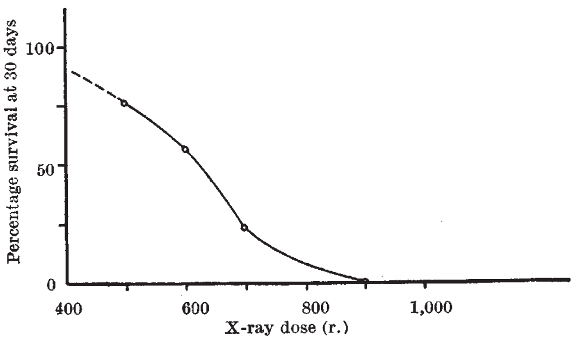

Fig. 1. Survival-rate of 'T' strain male mice after whole-body X-irradiation

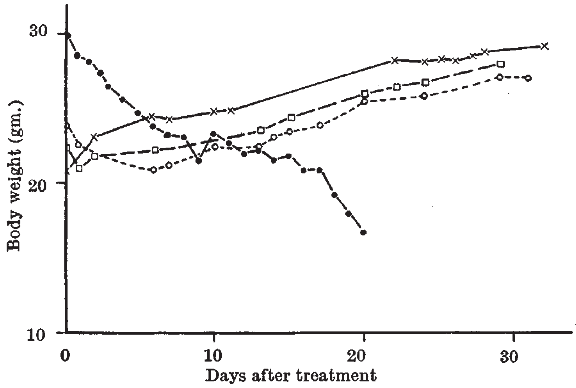

Fig. 2. Weight changes in 'T' strain male mice. ×, Normal controls ; □, hypothermic (0–1° C.) controls ; ○, 900 r. whole-body X-irradiation during hypothermia (0–1° C.) ; ●, 900 r. whole-body X-irradiation at normal body temperature

Higher doses of radiation than 1,500 r. at reduced body temperature have not yet been attempted, so the degree of protection given by this treatment has not been established. The dose required to give an *LD*50 at thirty days is, however, clearly more than 2·4 times that required at normal body temperature. The degree of protection is thus greater than that afforded to adult animals by chemical means or by partial anoxia. Nevertheless, since during the lowering of body temperature to 0–1° C. an as yet unknown degree of anoxia, which may be quite severe, is induced, the protection illustrated by these results cannot yet be proportionally assigned to the degree of anoxia on one hand and to the reduced body temperature on the other,

I am indebted to Dr. A. S. Parkes for the supply of the mice, and for facilities in his Division at the National Institute for Medical Research to learn the technique of cooling and reviving animals.

SHIRLEY HORNSEY

Medical Research Council
Experimental Radiopathology Research Unit,
Hammersmith Hospital,
London, W.12.
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[1] Hempelmann, L. H., Trujillo, T. T., and Knowtton, N. P., *A.E.C.U.*, 239 (1949).
[2] Lacassagne, A., *C.R. Acad. Sci., Paris*, **215**, 231 (1942).
[3] Baclesse, F., and Marios, M., *C.R. Acad. Sci., Paris*, **238**, 1926 (1954).
[4] Andjus, R. K., and Smith, A., *J. Physiol.*, **128**, 446 (1955).
[5] Goldzweig, S. A., and Smith, A., *J. Physiol.* (in the press).

Ultrasonic Absorption and Thermal Conductivity of Muscle

THE chance of survival in severe cold of an individual already comatose and with arrested peripheral blood flow will depend, other things being equal, upon the rate at which heat escapes by conduction through skeletal tissue from the central body region. Fat acts as thermal insulation, and is indispensable to Channel swimmers[1] ; but men leading a strenuous life, as in the Armed Services, usually have a thin layer only, and their ultimate tolerance of exposure must depend largely upon the thermal conductivity of their muscle tissue. This is extremely difficult to measure on the living individual ; but a large number of tests of excised tissue, human and beef, disclosed a range of variation from more than