and biological half-life of radionuclides in producer and consumer organisms, and the efficiency of their passage through various trophic levels, present some problems which may have considerable significance in the nutrition of animals and man, and the future course of biological evolution.

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Radioprotection by Acclimatization to Cold

THREE parallel series of irradiation have been run simultaneously to compare, in rats, the effects of acute and chronic whole-body irradiation by cobalt-60 γ-rays and to establish the radio-modifying effects of cold acclimatization in the latter condition[1].

Male Sprague–Dawley rats weighing 200–250 g at the beginning of the experiment were used. Acclimatization to cold was obtained by keeping the animals for one month at 5° ± 1° C prior to irradiation[2]. During and after the irradiation the rats were kept at 23° ± 1° C. Only animals irradiated a few hours after being removed from the cold are considered in this communication.

During acute irradiation rats were kept in 'Lucite' boxes. The focal distance to the middle of the rats was 30 cm from a practically punctiform cobalt-60 source. The absorbed dose in the middle of a phantom rat was 15·4 rads/min ± 4 per cent. Chronic irradiation was performed with the same irradiator, by placing cages on a specially designed rack at a focal distance of 270 cm or 300 cm which gave absorbed doses, measured as already described, of 10–12 rads/h, with a maximum variation of ± 2·5 per cent between rats in any one group[3].

The dose rate for chronic irradiation was therefore about 85 times smaller than for acute irradiation.

All animals were weighed daily for at least one month after irradiation and blood analyses were carried out twice a week.

Groups of 12 animals received total doses increasing by steps of 100 or 150 rads. For each series the doses given ranged from less than the LD_0 to the LD_{100}.

The theoretical lethal doses are calculated by the probit analysis method[4].

Table 1 summarizes the results obtained in regard to LD_0 and LD_{50}.

Table 1. CALCULATED *LD*'S FOR SPRAGUE–DAWLEY RATS IN VARIOUS IRRADIATION CONDITIONS

	Acute γ-irradiation	Chronic γ-irradiation	Cold ± chronic γ-irradiation
LD 2–0/30 days	420 rads	580 rads	1,210 rads
LD 5 /30 days	480 rads	670 rads	1,290 rads
LD 50 /30 days	740 rads	1,010 rads	1,620 rads

For these rats the LD_{98-100}/30 days was 1,060 rads for acute irradiation. The LD_{100} has not been calculated in the chronically irradiated series, for if the irradiation lasts more than 4–5 days complex recovery processes occur during the irradiation period with an apparent increase in radio-resistance[5]. The relationships between dose rate and radio-sensitivity are now being investigated.

The figures show that the relative biological effectiveness of γ-irradiation, at 10–12 rads/h, is about 72 per cent of the efficiency of acute irradiation, all parameters other than the dose rate being the same.

In the LD_0 range the biological efficiency of chronic irradiation is reduced by one half in cold acclimatized rats. At the LD_{50} level the protection coefficient due to acclimatization to cold is reduced to 1·6; but variations for total doses above 1,200 rads might be influenced by changes in radio-sensitivity during prolonged irradiation, as mentioned before.

If the animals are returned to laboratory temperature before irradiation, the radio-protective action of acclimatization remains at a maximum for about one week and diminishes slowly thereafter; this aspect of the problem will be reported in a forthcoming communication.

This work raises two interesting points.

(1) Acclimatization to a comparatively mild physiological stress (exposure to 6° C) is accompanied by a marked increase in radio-resistance. A radio-protection factor of about 2 is obtained at the LD_0 level; this is as good as, or even better than, what is obtained with the most potent radio-protective drugs[6]. Contrary to what happens with these pharmacological agents, which must be administered immediately prior to irradiation, the protective action of cold acclimatization lasts for at least one week after the rats are back to normal conditions. The biochemical reasons for this protection are now under investigation.

(2) The LD_0 (1,200 rads) for cold acclimatized chronic irradiated rats is significantly higher than the LD_{100} (1,050 rads) for the same animals submitted to an acute dose of γ-rays. It is therefore possible to obtain series of rats which survived a very large dose of radiations, for the investigation of late and genetic effects of irradiation.

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Absence of Secondary Disease in Rats treated with Homologous Bone Marrow Transfusions after Administration of 'Myleran'

IT has been shown in this laboratory that under some experimental conditions the homologous bone marrow treatment may be successful in preventing fatal bone marrow aplasia induced by high doses of 'Myleran'[1,2]. On the other hand, it is well known that a number of lethally whole-body irradiated mammals, which survive the first 30 days after exposure, thanks to homologous or heterologous bone marrow transfusions, may succumb during the second and third month[3,4]. This delayed mortality known as secondary disease is attributed by several investigators to an immunological reaction of the graft versus the host. Some success has been reported in preventing or treating the secondary disease in irradiated animals by various means[5–10]. In this communication the preliminary results concerning absence of secondary disease in rats treated with homologous bone marrow transfusions after administration of 'Myleran' are given.

White male *L*-strain rats used as host animals were bred in the Institute by random mating. At the start of the experiments they were 3–4 months old, weighing 140–150 g. In intra-strain experiments bone marrow