LETTERS TO THE EDITORS

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Effects of Ionizing Radiations on Serum Complement and Enzymes

ANIMALS exposed to ionizing radiations almost invariably have a lowered resistance to bacterial infection. The serum complement system which aids lysis of invading bacteria is known to be readily inactivated by radiomimetic substances such as nitrogen mustard¹, and it was considered of interest to examine the effects of X-rays and electrons on this system *in vitro*. It was hoped that an investigation of the effect of various types of radiations on the relatively labile complement system might yield useful information about the biological effects of these radiations. The 15-MeV. linear accelerator at St. Bartholomew's Hospital has been used as the source of X-rays and electrons in all our experiments, and guinea pig serum has been used as a source of complement.

Fig. 1

It has been found that doses of X-rays and electrons up to 200,000 rads have little or no detectable effect, if undiluted serum or strong solutions are irradiated; but when dilute solutions are irradiated, the specific haemolytic activity of serum complement is destroyed. Fig. 1 shows the inhibition produced by irradiation with electrons as a function of dose and concentration of serum. With a very dilute serum (1:100 dilution) some inhibition was observed with as little as 500 rads, and it is considered probable that the enhanced destruction of complement in dilute solutions may be a result of the reduction of concentration of protective substances in the serum.

When using electron irradiation, the mean dose-rate was about 12 million rads per min.; but practically the same results were obtained with X-rays at a dose-rate of about 1,000 rads per min., indicating that the effect is independent of dose-rate.

The percentage inhibition is approximately an exponential function of the dose, but there does not appear to be a simple relationship between the amount of destruction and the degree of serum dilution.

In most of these experiments the diluted serum was irradiated in the presence of air; but irradiation of the serum in a Thunberg tube from which the air had been removed and replaced by nitrogen containing 5 per cent carbon dioxide did not produce a significant change in destruction of the complement

in 1:20 or 1:50 dilution of serum, by an X-ray dose of 50,000 rads.

The destructive effect of X-rays on complement can be partially prevented by the addition of cysteine or cysteamine to the diluted serum before irradiation. For example, a dose of 50,000 rads completely destroyed the complement activity of diluted (1:50) serum, but the inhibition was reduced to 48 per cent in the presence of *M*/500 cysteine and to 32 per cent in the presence of *M*/500 cysteamine.

The possibility that complement inactivation by radiation was due to the production of anti-complementary substances in the serum during the irradiation has been examined. Irradiated dilute serum was added to normal serum, and subsequent determination of the total complement titre showed that no long-lived inhibitory substance was present in the irradiated serum.

An examination of the enzymic activity of samples of the irradiated and non-irradiated 1:20 and 1:50 diluted serum used for the complement tests showed that X-ray doses of 20 and 50 kilorads caused no reduction in the activity of the cholinesterase, lipase or alkaline phosphatase present in the serum. The fact that these enzymes are unaffected by the same conditions in which complement is powerfully inactivated emphasizes the marked selectivity in the biological effects of X-rays. This work is being continued by studying the serum complement and enzyme activity-levels in irradiated guinea pigs and other experimental animals.

Since haemolytic complement is readily inactivated by nitrogen mustard¹, the results presented here provide a further instance of the similarity in biological effects produced by X-rays and the so-called radiomimetic substances (such as the nitrogen mustards).

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¹ Watkins, W. M., and Wormall, A., *Biochem. J.*, **52**, 365 (1952).

Absolute Amount of Ribonucleic Acid in Viruses

ON the basis of work with plant virus strains, Knight¹ expressed the view that all strains of virus contain the same quantity of nucleic acid. Recent experiments have shown that there exist a number of animal viruses which contain only ribonucleic acid. If one plots the percentage of ribonucleic acid against the particle weight of viruses containing ribonucleic