LYMPHOPENIA FOLLOWING EXPOSURES OF RATS TO "SOFT" X-RAYS AND THE β-RAYS OF RADIUM

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Murphy and his collaborators have referred to a difference between the effects of large and small doses of x-rays on the circulating lymphocytes of the rat, large doses producing a diminution, and small doses an increase in their numbers (1, 2). The dose required for the latter they refer to as a "stimulating" dose. Our own observations (3) upon the effects of moderately penetrating x-rays, ranging in quantity from very small to quite large doses, showed that, in all cases, there was a preliminary disappearance of lymphocytes from the ciculation, generally observable an hour after the exposure to the x-rays. In view of the fact that in many of Murphy's experiments x-rays of a very easily absorbed type were used, it occurred to us that it might be useful to extend our observations with "soft" x-rays similar in character to those used by Murphy, and to supplement them by the use of β-rays of even less penetrating power than these "soft" x-rays. From the data below, it will be seen that, as in our previous experiments, an initial fall in the number of circulating lymphocytes occurs, provided that the blood observations are done soon after the exposure to the radiation.

In view of these findings, it appears that the terms "destroying" and "stimulating" doses as used by Murphy may prove misleading, for they are apt to give the impression that essentially different effects are observed after short and prolonged exposures to x-rays. This, however, has not been our experience, for whereas the lymphopenia following a large dose (4) may continue for as long as a week or 10 days, a small dose produces a lymphopenia which lasts but a few hours.

It is in our opinion important to bear in mind that the lymphocytosis which occurs after a small dose or after a large dose of these radiations follows a primary lymphopenia.

Experimental Conditions.

X-Rays.—The "soft" x-rays used for our present purpose were those emitted by a Coolidge tube at an alternative spark-gap of 0.75 cm. between spheres 5 cm. in diameter; this is equivalent to $\frac{3}{4}$ inch between a point-to-point spark-gap. The dose of radiation admin-

TABLE I.

Rats Exposed to "Soft" X-Rays for 12″.

Weight of rat.	Lymphocytes per c. mm. before exposure.	Lymphocytes per c. mm. after exposure.	Fall.
gm.			*per cent*
118	28,700	10,400	63.6
108	18,400	9,800	46.8
130	27,000	8,800	67.5
About 100.	32,400	12,500	61.4
	30,400	14,300	53.4
	18,000	8,500	55.6
Average			58

TABLE II.

Rats Exposed to β-Rays for 34 Minutes.

Weight of rat.	Lymphocytes per c. mm. before exposure.	Lymphocytes per c. mm. after exposure.	Fall.
gm.			*per cent*
60	5,100	2,700	47
90	8,600	5,900	29
160	8,000	5,200	35
105	19,300	10,400	46
95	13,400	9,100	32
90	7,200	4,500	37
Average			38

istered to the rats was equivalent to what is referred to in our paper as a twelve″ dose; this corresponds approximately to $\frac{1}{150}$ of a rad. Our previous experimental finding was that when a rat was exposed to x-rays of a moderately penetrating character for 12″, an average reduction of 50 per cent in the number of circulating lymphocytes occurred 1 hour after the irradiation. It will be seen from the data

in Table I that, with an equivalent exposure to "very soft" x-rays, the average reduction in the first six rats selected for the test was 58 per cent.

β-Rays.—Two varnished radium applicators 4 by 4 cm. were used, each containing 80 mg. of radium bromide (Ra $Br2H_2O$); the animals were confined in a box 15 by 15 by 15 cm.; the radium was let in to the roof of the box, so that it was 16 cm. from the floor, nothing intervening between the radium and the animal on the floor of the box. The exposure lasted 34 minutes, this being the time necessary for the surface dose to be $\frac{1}{150}$ of a rad, the same as in the x-ray experiment.

Blood examinations were made immediately before the exposures to radium, and again 1 hour after the end of the exposures. Six rats were used; the results will be seen in Table II.

The smaller percentage decrease observed with β-rays is probably to be attributed to their smaller penetrating power than the "soft" x-rays. It seems to us that the experimental results indicate that, had Murphy done blood counts soon after his x-ray exposures, he would have observed this lymphopenia in his small dose studies.

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