SECURITY INFORMATION

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PROGRESS REPORT (RCS)

RESEARCH AND DEVELOPMENT PROJECT/FIELD/AREA [illegible] 6-59-08-13

1. PROJECT TITLE
Effects of Irradiation

3. REPORT DATE 31 Dec 51

4. BASIC FIELD OR SUBJECT

5. SUB FIELD OF SUBJECT SUB GROUP

6. CONTRACT AGENCY

7. CONTRACTOR OR LABORATORY
Army Medical Research Laboratory
Fort Knox, Ky.

CONTRACT/W. U. NO.

8. DIRECTING AGENCY

9. REQUESTING AGENCY

10. RELATED PROJECTS

11. PARTICIPATION AND/OR COORDINATION

12. DATE APPROVED

13. PRIORITY

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15. REQUIREMENT AND/OR JUSTIFICATION

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16. BRIEF OF PROJECT AND OBJECTIVE

Early Effects of Ionizing Radiation

BRIEF. The 1st effects of x-irradiation damage are being studied at the cellular level by means of various histochemical and vital staining techniques.

PROGRESS. To study early effects on the cornea, rats were irradiated with 300 r and killed 24, 36, 48, and 72 hours later. Results to date: the telophase in the corneal cells from rats sacrificed 36 hours after irradiation is characterized by secondary effects in the form of bridges and fragmentations. The effects of x-rays on desoxyribonucleic acid formation and on mitotic activity in the intestinal crypt epithelial cells of rats were studied. The average protection against the inhibition effect of x-rays on DNA new formation was about 32% when 800 mg of cysteine per kilogram of rat weight were given 10 minutes before irradiation with 880 r. The cysteine did not protect against the irradiation effects on mitotic activity. It is believed that in addition to the mitotic cycle (v. Hevesy) other means of nucleic acid metabolism exists. Triphenyl-tetrazolium chloride given to mice 10 or 20 minutes before irradiation gave a 30 to 40% protection against a lethal x-irradiation of 620 r. The protective action of TTC was probably associated with the transformation to its formazan by the body tissues. It therefore was important to know the normal tissue ability to reduce TTC to its formazan. Preliminary tests showed that when 0.25 mg of TTC in $\frac{1}{2}$ cc of saline was given intraperitoneally to mice the average mg % of formazan recovered per gram of tissue was: kidney, 5.5; liver, 2.1; small intestine, 2.5; and spleen, 3.1. The combined effects of ionizing and thermal irradiation were studied to determine if an additive

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JNRB FORM 14, 1 APR 1949 — PAGE ___ OF ___ PAGES

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effect is produced. White mice were carefully depilated over the rump, irradiated with 600 r, then burned (small area on the rump) 30 seconds at 1-3/4 inches from a 6-ampere carbon arc. The remainder of the body was protected by a water-cooled jacket. Those animals receiving the burn alone showed 100% survival over 30 days. Those receiving only the ionizing irradiation showed the typical survival curve for mice receiving 600 r. The animals 1st burned, then (½ to 2 minutes) thereafter irradiated, showed a much higher death rate.

FUTURE. Plans for Next Period. Since the protective effects of TTC may be due to traces of metallic impurities, different tetrazolium compounds as well as TTC from various sources will be tried. A study will be made of the formazan formation in pre- and postirradiated animals and results correlated with survival times. The severity of the burns is being checked by histopathologic studies. A strain of naked mice will be used. The possible metabolic changes produced by the nonlethal burning will be checked by intensive blood and urine studies.

Quantitative Studies on the Effects of Nonionizing Radiation on the Skin

BRIEF. Quantitative studies of the spectral reflectance of the skin are being made in order to evaluate the effects of ultraviolet radiation in producing erythemas and tans, and to determine the ultraviolet absorption by the skin.

PROGRESS. For a quantitative study of the components of the skin which determine its color, melanin and blood were investigated spectrophotometrically. Melanin was obtained in various degrees of purity and the spectral transmittance of melanin in layers of different thickness was measured in the range from 210 m to 1500 m. By adding a 5 mm thick layer of oxyhemoglobin to the various layers of melanin composite spectral transmittance curves were obtained. Collection of reflectance data (white & negro skin, male & female) continued.

FUTURE, plans: A statistical analysis of the reflectance data; a detailed study of the reflectance pattern in the 700 to 1000 m range made possible by utilizing an infrared spectrophotometer; irradiation experiments with known amounts of energy and measurement of the resulting skin color changes.

REFERENCES.

"The Absorption of Human Skin between 430 and 1,010 m u for Black-Body Radiation at Various Color Temperatures," Heer, R. R. Jr., Science, 115:2975, 15 (1952).

Enzyme, Endocrine, and Metabolism Studies in Total Body Irradiation

BRIEF. The alterations in activity of various enzyme systems and in the function of various endocrine organs of animals receiving total body x-irradiation are being studied in an attempt to determine effective pharmacologic and chemical means of preventing the damaging effects of ionizing radiations.

PROGRESS. Exposure of rats to 1000 total body x-irradiation produced a fall in the plasmin inhibitor titer of plasma, beginning the 2nd day after irradiation and gradually increasing. Since starvation exhibited a similar effect no definite conclusions could be made as to the irradiation per se causing a lowering in the

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titer. Total body x-irradiation (1000 r) and starvation caused nearly identical weight losses.

Since protection of mice from the lethal effects of total body x-irradiation is afforded by shielding the spleen during irradiation it was questioned if spenectomized animals would be less resistant to x-irradiation. Rats were splenectomized and irradiated 6 to 15 days post-operatively with 650 to 800 r. They were only slightly less resistant than sham operated and control animals. The influence of pitressin administration on the functional activity of the adrenal was tested. Pitressin (5 units I P) apparently caused stimulatia of the adrenal since the cholesterol content 15, 60, and 120 minutes after injection was decreased approximately 20%.

FUTURE. Studies will continue on the effects of total body x-irradiation on the interaction of various endocrine systems.

REFERENCES.

A.M.R.L. Report No. 71, 15 December 1951, "Effect of Total Body X-Irradiation on the Plasmin Inhibitor Titer in the Blood of Rats."

Effect of Irradiation on Single Cell Organisms

BRIEF. Studies are being made on unicellular organisms in order to obtain an uncomplicated picture of cell damage and possible adaptation to irradiation and other stresses.

PROGRESS. An amperometric method for the determination of sulfydryl content of yeast cells was developed which permits the detection of sulphydryl compounds in amounts of 10 gamma with an accuracy of ± 2%. Yeast cells irradiated with sufficient doses of ultraviolet light showed a decrease in sulfydryl content and in the number of viable cells. Subsequent irradiation with strong visible light led to a partial reversal. X-irradiation of yeast cells also produced a decrease in the sulfydryl content and the number of viable cells. Subsequent irradiation with visible light led to only a slight increase in the number of viable cells but had no effect on the sulfydryl content of the cells.

FUTURE. Will study the activity of isolated crystalline thiol enzymes and the effects of irradiation on the thiol enzymes within the yeast cell.

REFERENCES.

A.M.R.L. Report No. 72, 15 December 1951, "The Influence of Visible Light on the Sulphydryl Content of Yeast Cells after Ionizing and Ultraviolet Irradiation."

Biophysical Study of Burns

BRIEF. Spectral reflectance studies are being extended to include the near ultraviolet and the infrared radiations in order to evaluate time-intensity relations to the degree of skin damage.

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PROGRESS. More experiments were done, using methods of the preceding report for producing the burns and spectrophotometrically recording reflectance measurements. To determine some of the color elements of the skin whole blood, plasma, hemolyzed red cells, and excised skin of rabbits and guinea pigs were examined spectrophotometrically and the curves compared with those obtained from the intact skin of the living animal. The spectral reflectance diagram of the excised skin showed the carotene absorption band at 482 m u while the blood, the hemolyzed cells, and the intact skin showed also the oxyhemoglobin bands at 542 and 576 m u.

FUTURE. Studies on heat erythema and/or burns produced under controlled conditions and with calibrated instrumentation will follow the above experiments.