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REPORT OF HEALTH ACTIVITIES

at
University of Chicago
Metallurgical Laboratory
Contract Number W 7401 - eng - 37

MONTH OF NOVEMBER 1945

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Table of Contents

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HEALTH DIVISION REPORT FOR NOVEMBER 1945

CLINICAL MEDICINE AND MEDICAL RESEARCH - Leon O. Jacobson, Section Chief

During the past month, October 16 to November 15, 1945, 51 physical examinations were done; 17 were academic and 34 non-academic personnel. 31 pre-employment physical examinations were done. During this same period 2771 clinical laboratory examinations were made. This included laboratory work on 29 new personnel, 149 controls and 338 in the work hazard group. Abnormalities considered on the basis of the white blood count showed individuals with abnormalities in this group of 28%, 17%, and 23% respectively.

150 r of total body x-irradiation has produced a leukopenia, anemia and thrombocytopenia in an individual with mild chronic rheumatoid arthritis. This dose was delivered at the rate of 12.5 r per day.

Experimentation indicates that a blood picture involving a pre-existing anemia of the regenerative type is no more adversely affected by total body x-irradiation than that of controls with normal hemoglobin and erythrocyte values.

An enzyme which hydrolyzes adenosine triphosphate has been isolated from leucocytes. These cells have been obtained from venous blood as well as from peritoneal exudates produced by the intraperitoneal injection of sterile saline, mineral oil, or phospholipids. The enzyme is absent in human erythrocytes and plasma and seems to be present in lymphocytes rather than in polymorphonuclear cells.

It differs from muscle adenosine triphosphatase (myosin) in its pH optimum, heat stability, and activation phenomena; the white cell ATPase is activated by Mg^{++} and somewhat inhibited by Ca^{++}, while the muscle enzyme is inhibited by Mg^{++} and activated by Ca^{++}.

The substance absorbing at 247 mu which has been reported to be at least relatively increased in the urine of irradiated dogs has been tentatively identified as kynurenic acid. This substance is a derivative of tryptophane and as such, corresponds, in a way, to the substance in human urine responsible for the urorosein reaction.

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A fairly simple procedure has been devised for the quantitative estimation of this substance in urine. Using this procedure studies are now in progress which are yielding much more quantitative data than has yet been possible.

BIOLOGICAL RESEARCH SECTION - W. S. Cole, Section Chief

Effect of Dose on Retention of Ingested Y^{91} in the Rat: Earlier experiments gave an indication that the retention of ingested Y^{91} was higher at high dose levels than at low levels. Further studies showed that the rate of excretion (fecal) was slowed by radiation. The present experiment was designed to demonstrate conclusively whether or not absorption and retention were higher at high levels.

The possibility of contamination was reduced, but not entirely ruled out. The results indicate that retention in the carcasses of rats receiving 20 μc/g amounted to .0078% while it was approximately .0017% in rats receiving 1 μc/g. The percentages retained in the femurs of the two groups, however, were almost identical, being .0029% and .0022% in the 20 μc and 1 μc groups respectively. From the extremely low retention values, it is obvious that any injury in the rat caused by ingested Y^{91} is not due to retained yttrium, but is due solely to that in transit.

The Absorption of Ingested Plutonium: Six rats were given plutonium by stomach tube as the plus 4 nitrate at a concentration of about 0.5 mg. per ml. and at a pH of about 2. The rats were given 2 ml. of this solution by stomach tube followed by 2 ml. of 0.01 N HNO_3 as a rinse for the uncalibrated tube. The actual dose found to be 934 micrograms per rat. (4.7 μg/g)

The rats were sacrificed at intervals following ingestion and two femurs from each of five of the rats were ashed and analyzed. Due to the small amount of plutonium present the zirconium phosphate method was used, thus making it possible to analyze the entire femur rather than an aliquot. At the same time reagent blanks and control femurs were analyzed and their values, along with the background count, were deducted from the results on the experimental femurs. The results were then corrected by a previously determined recovery factor of 1/0.8.

The results are shown in table 1. The femurs contained from 2.9 to 8.4 x 10^{-5} percent of the dose. Multiplication of the femur by 30 gave a figure for the entire skeleton of from 8.7 to 25 x 10^{-4} percent of the dose. Previous experiments have indicated that probably 10% of the retained absorbed portion is in the soft tissues. This would increase the total amount absorbed and retained to a range of from 9.7 to 28 x 10^{-4} percent of the ingested plutonium.

Table I.

Absorption of Orally Administered Plutonium by Rats

Animal	Days after Ingestion	Femurs Average c/m	Femurs % of dose	Skeleton % of dose (calculated; Femur x 30)	% of dose absorbed and retained (calculated: skeleton/0.9)
9860	2	55.7	0.000084	0.0025	0.0028
9861	3	45.9	0.000069	0.0021	0.0023
9858	4	32.3	0.000049	0.0015	0.0017
9862	6	24.1	0.000036	0.0011	0.0012
9859	13	19.5	0.000029	0.00087	0.00097

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At present there seems to be no explanation for the apparent consistent decrease in femur content with time. No equally rapid rate of elimination from the skeleton had been observed in other experiments. The results show that the plus 4 nitrate given orally to rats a level of 4.7 micrograms per gram is absorbed from the gastrointestinal tract in an amount not over 3×10^{-3} percent.

Hematological Effects of Plutonium: Blood sampling in Experiment PS_2, ABC male mice that were given 0.25 µg/g of plutonium, ended this month with the 40th week count because of death of all experimental animals. The hemoglobin level showed a moderate, progressive reduction that reached its lowest point at 25 weeks. Erythrocyte counts showed a 10 to 15 percent reduction that persisted throughout the 40 weeks of the experiment. The total leucocyte count fell rapidly after treatment and reached a maximum reduction of 80% by 8 weeks. This was followed by some recovery and after 16 weeks the total leucocyte count maintained a 50% level until termination. The heterophil value also showed an immediate reduction that reached its maximum depression at 8 weeks. Recovery followed rapidly after this point, however, and the heterophil counts were above those of the controls at 32 weeks. The lymphocyte reaction with this 0.25 µg/g dose followed the same basic pattern described for the total leucocytes and consisted of an immediate reduction that reached an 80% depression at 8 weeks, a recovery to a 50% level by 16 weeks which was maintained until the last available count at 40 weeks. It is concluded that recovery occurred in the heterophil count in spite of continuous irradiation, but that no recovery occurred in the red cell and lymphocyte counts.

MEDICAL INDUSTRIAL HAZARDS SECTION

The routine analysis of urines for plutonium during the past month was curtailed considerably in order that the new method for assaying could be initiated. Samples were collected as scheduled but analysis was postponed.

The bismuth phosphate-lanthanum fluoride method, involving the ashing of the urine, which was adopted for use has proven quite satisfactory. There has been better than 90% recovery in over 30 low activity spiked samples. The quantity of lanthanum used (0.25 mg) should not offer any serious handicap in background contamination since this would give only 0.1 count per minute. The best lanthanum we have been able to obtain contains about 0.3 counts per minute per mg.

Several experiments have been started in attempt to use inactive heavy metals to cause increased plutonium excretion. This work has just begun and no results are available at present.

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The New Chemistry groups have been working with a considerably increased number of radioactive samples which had been bombarded at California, Hanford or Clinton. The activities of these are quite high, some running greater than 200 r/hr. which is the upper limit of available instruments. The conditions under which the samples have been handled in the past has frequently left much to be desired. Concrete evidence of over exposure has been obtained on a number of the working personnel. This situation should be much improved following the recent completion of the hot laboratory in Room 12. Within the past few days work on the first sample to be handled in this room was begun.

The situation at the Argonne and Site B remains essentially unchanged. Large amounts of radioactive materials are handled at the Argonne essentially without material over exposure. Of interest is the over exposure to neutrons of three New Chemistry personnel who were working there for one day on a special problem. In general the measure of neutron intensity at the Argonne has been quite low, particularly in work areas.

The solvent extraction column which has been set up in the squash court in the West Stands has been working during the past month. However, several spills have occurred. The activity of the solutions is such that such spills constitute a serious hazard. The chief problem in this area is the overall contamination of work areas other than the above mentioned squash court. It seems difficult, if not impossible, to get the personnel to clean up areas other than the ones in which they are currently working. This will pose a tremendous problem if and when this area is returned to the University.

3750 pocket meter readings were done during the month ending November 15, 1945. Eight over exposures were noted during this period. 2117 badge meters were developed during the month. Fifty-one readings greater than 0.6 r for a week, or 0.1 r for a day's exposure were noted. Twenty-one of these were total body exposures. Of these ten were exposure to gamma radiation. Twenty-four experimental wrist or palm badges gave readings greater than the above limits.

A visit to Ames was made during the past month. The uranium production line has virtually ceased operation. Work in the experimental project consists mainly of report writing and small scale experimental work on beryllium, beryllium alloys, thorium, and thorium alloys.

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LAF_1 mice which have received 8.8 r per day for a total dose of approximately 3000 r (gamma radiation) have a reduction in the erythrocytes per mm^3. Hybrid guinea pigs exposed on a daily level of 0.11 r, .1 r, 2.2 r and 4.4 r respectively all show an effect on the hematological constituents on the peripheral blood except the group on 0.11 r per day. The total chronic doses received by these groups are 110 r, 1075 r, 2150 r, and 4300 r. A group of guinea pigs exposed to a total dose of 1000 r on a 8.8 r per day level and which had developed severe anemia at the time the exposure was discontinued have not as yet recovered after $5\frac{1}{2}$ months. Five groups of rabbits exposed chronically to gamma irradiation on daily levels of 8.8 r, 4.4 r, 2.2 r, 1.1 r and 0.11 r per day and which have thus far received 7400 r, 2700 r, 1850 r, 925 r, and 93 r respectively all show a reduction in platelets per mm^3 except for the two lower dose levels. Histological examination of mice chronically exposed to 12.5 r x-irradiation at the approximate age of 5 months show a sequence of irreversible changes resulting in the ovaries, first, in the disappearance of follicles followed by epithelial down growth and finally in tumor formation. Hence even a small dose is capable of initiating ovarian changes which result eventually in tumor formation.

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