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MEDICAL AND HEALTH PHYSICS
QUARTERLY REPORT
APRIL, MAY, JUNE 1956

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April, May, June 1956

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* Preceding Quarterly Reports: UCRL-3386, UCRL-3268

MEDICAL AND HEALTH PHYSICS QUARTERLY REPORT

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STUDIES OF RADIOACTIVITY AND IRRADIATION

Joseph G. Hamilton, M. D., in charge

Crocker Laboratory
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ASTATINE STUDIES AND RELATED WORK

Patricia W. Durbin, C. Willet Asling, Muriel E. Johnston,
Nylan Jeung, Marilyn H. Williams, Marshall W. Parrott,
George Barr, and Ann Henderson

THE TOXICITY OF INTRAMUSCULARLY ADMINISTERED RADIUM-223

A study of the long-term effects of Ra²²³ on the rat, reported in the preceding Medical and Health Physics Quarterly Report (UCRL-3386, p. 5), is still in progress. Five groups of ten animals each were given doses of Ra²²³ ranging from 0.004 to 0.10 $\mu\text{c/g}$.

Preliminary observations are as follows: The mortality rate was proportional to the dose level. All the rats in the two highest-level groups (0.07 and 0.10 $\mu\text{c/g}$) were dead three weeks after the administration of Ra²²³. Approximately 25% of the original group still survive. These animals appear normal except for a continuing depression in body weight, red blood cell count, and white blood cell count. Differential white blood cell counts indicate a gradual decrease in percentage of lymphocytes with a corresponding increase in granulocytes.

Changes in red blood cell diameters were observed in all animals. An initial rapid decrease was followed by an increase in average diameter that reached a peak at approximately 70 days, and returned to normal in approximately 120 days. Reticulocyte counts will be made in a similar experiment.

EXCRETION OF CERIUM-144

A study of the mechanism of excretion of the light lanthanons in the laboratory rat, previously reported (UCRL-3386, p. 4), is being continued with Ce¹⁴⁴ as a representative of the group.

To explore the possibility of direct excretion of Ce¹⁴⁴ into the gastrointestinal tract, cathartics were given to test their effect on the rate of excretion of Ce¹⁴⁴ in feces. Groups of rats injected intramuscularly with Ce¹⁴⁴ complexed with citrate were given solutions of bile salts and

magnesium citrate orally each day during 11 to 20 days, and 31 to 40 days after injection. Preliminary tests show no apparent effect on the rate of excretion of Ce^{144} in feces.

The above rats were sacrificed at 60 days after the administration of Ce^{144} . Bone and liver samples will be analyzed to determine the chemical state of the Ce^{144} present in a further effort to elucidate the mechanism of excretion for this element.

RETENTION OF STRONTIUM-90 IN THE RHESUS MONKEY

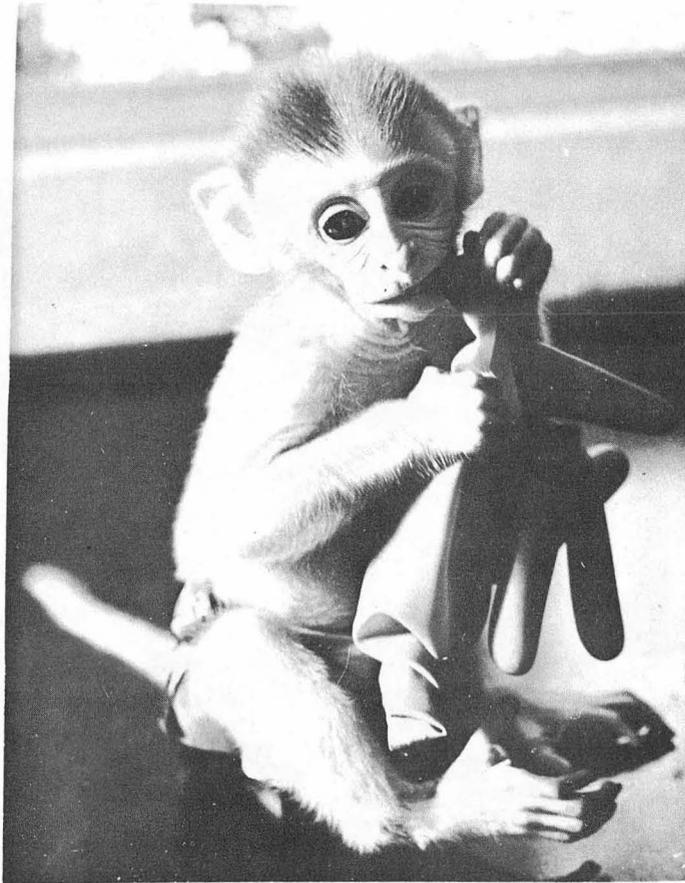
A long-term study of the effects of continued administration of small amounts of Sr^{90} to six rhesus monkeys has been initiated.

A daily dose of approximately $0.05 \mu c$ of the equilibrium $Sr^{90}:Y^{90}$ mixture is being given 5 days per week to each animal for a year. Cumulative urine and feces samples are collected weekly from each animal for analysis of radioactivity in order to estimate the continuous body retention of radioactivity over the entire year. Monthly measurements are made of body weight, red blood cell count, total and differential white blood cell count, microhematocrit, and hemoglobin.

RHESUS MONKEY FAMILY: HENRY

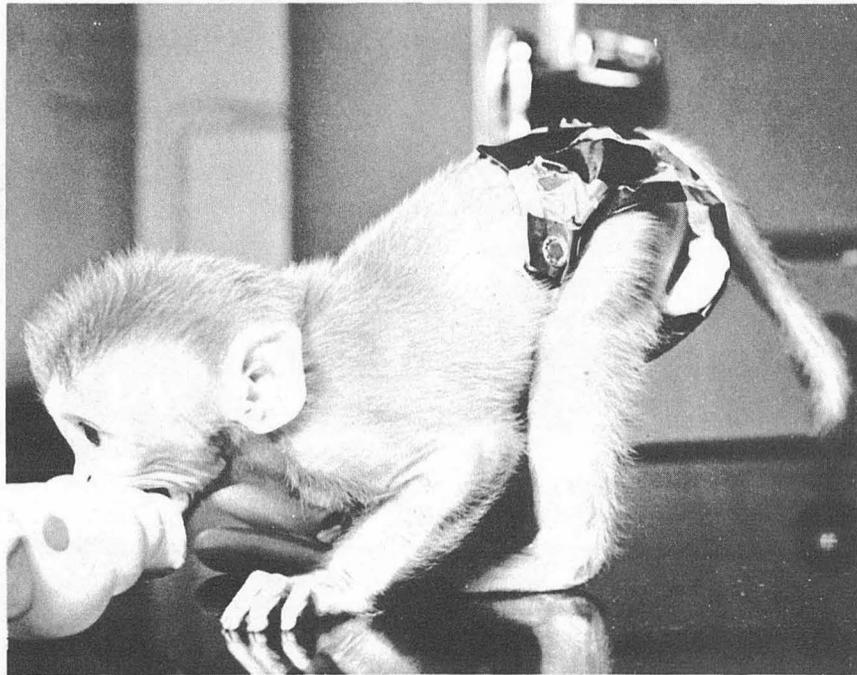
A third rhesus monkey, a male, weighing 17.5 oz, was born to "Rosy" on May 22, and was named "Henry." He was taken from the mother 1.5 hours after birth. In the removal process he was accidentally bitten by his mother and received a badly lacerated upper lip and hard palate; however, these injuries responded well to treatment. So that excreta can be collected, the animal has been in diapers since May 23, with the exception of a week in early June when a skin eruption of unknown etiology necessitated the removal of the diapers for treatment and subsequent healing of the lower half of his body. Excretions were collected for analyses as control samples up to June 25.

On May 28 an unsuccessful attempt was made to count the bremsstrahlung (as was done with the other two infant monkeys) with 2-in. crystal scintillation counters in Donner Laboratory. At that time it was decided that the Sr^{90} content of the infant (gained solely by placental connection with the mother) was less than $0.05 \mu c$. An experimental regime was begun on June 25 that consists of the feeding in the animal's milk formula of approximately 50 cps/day of Sr^{90} , 5 days a week. No side effects from this feeding have been encountered thus far. The animal is progressing normally, and as of July 9 weighed 30 oz (Figs. 1 and 2). The figures are photos of the infant taken July 6, at which time he weighed 29 oz. Excretions are being collected on a daily basis for analyses; no attempt can be made to separate urine and feces at present.



ZN-1530

Fig. 1. "Henry," third rhesus infant, age 45 days, weight 29 oz.



ZN-1531

Fig. 2. "Henry," showing plastic pants used to hold diaper on.

HISTOLOGY--AUTORADIOGRAPHY

A pilot study concerned with the sites of Ce^{144} deposition in foetal rat bone has been completed. Certain preliminary decisions as to specific localization of the material have been made by using modified serial section preparations: Slide 1 was stained by periodic acid-Schiff (PAS) reagent (specifically for mucopolysaccharides) and radioautographed with No-Screen x-ray film; Slide 2 was an NTA-stripping film radioautograph stained with hematoxylin and eosin; Slide 3 was stained with PAS and Von Kossa's silver stain for calcium salts and autographed with No-Screen x-ray film; Slides 4, 5, and 6, then 7, 8, and 9 repeated the series, and so on throughout the sample. This work is being reported upon by Dr. C. Willet Asling at the Gordon Bone Conference in Meriden, New Hampshire, in July, and will be detailed in a forthcoming report.

Further radioautographic studies have been done on the localization of At^{211} in the mammary tissue of young Sprague-Dawley female rats in an attempt to elucidate the role of astatine as a probable causative agent of the mammary tumors seen in far greater than normal incidence in astatine-treated animals. Thus far no evaluation of this project is possible, and more experimental techniques must be tried before any decisions can be reached, although we can demonstrate by means of alpha tracks the presence of the At^{211} in the glandular tissue in amounts we consider greater than the concentration seen in blood vessels. One of the most difficult problems encountered in this study is the separation (or stripping) of the mammary tissue from the body wall and subcutaneous area of the animal.

In addition, more tissues are being processed from Ra^{223} and long-term At^{211} experiments.

PAPER SUBMITTED

A paper entitled "Long-Term Sequelae of Massive Doses of I^{131} in Rats," by Patricia W. Durbin, C. Willet Asling, Muriel E. Johnston, and Joseph G. Hamilton, has been forwarded to the American Journal of Roentgenology, Radium Therapy and Nuclear Medicine. The work covered by this paper was reported on by Dr. Durbin at the Radiation Research Society Meeting in Chicago in May 1956. Much of the work on which this paper was based has been previously reported in the Medical Physics Quarterly Report, UCRL-3398, p. 6, March, 1956.

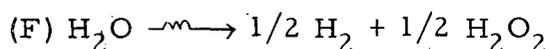
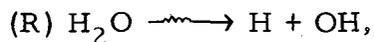
RADIATION CHEMISTRY

Warren M. Garrison in charge

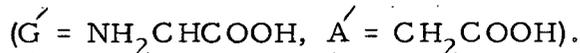
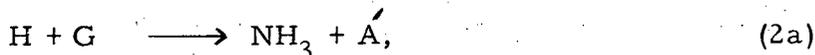
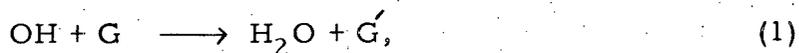
Boyd Weeks, Michael Jayko, Winifred Bennett,
Joseph Ward, and Sibyl Cole

INDIRECT AND DIRECT ACTION OF RADIATION ON AQUEOUS GLYCINE

Chemical reactions induced in aqueous glycine by radiation decomposition of water,



yield hydrogen, ammonia, and acetic and glyoxylic acids as principal products in oxygen-free systems.^{1, 2, 3} This indirect action is explained⁴ by a reaction sequence initiated by:



Subsequent reaction includes:



Hydrolysis of I, imino acetic acid, yields ammonia and glyoxylic acid.⁵ In the x-ray radiolysis of glycine solutions at concentrations above 0.3 to 0.5 M, all H and OH are removed via processes of the type (1), (2), (2a). The hydrogen yield, G_{H_2} (molecules per 100 ev absorbed energy), is independent of concentration at values above 0.5 M.⁶ The ammonia yield, however, increases linearly with glycine concentration in the range 0.5 to 2.0 M as a result of direct interaction of radiation with dissolved glycine molecules.^{2, 6}

¹ Allen, Hochanadel, Ghormley, and Davis, J. Phys. Chem. 56, 575 (1952).

² Maxwell, Peterson, and Sharpless, Radiation Research 1, 530 (1954).

³ Boyd M. Weeks, (Thesis), "Indirect and Direct Action of Heavy-Particle Radiation on Glycine in Aqueous Solution", UCRL-3071, July 1956.

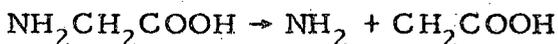
⁴ W. M. Garrison and B. M. Weeks, J. Chem. Phys. 24, 616 (1956).

⁵ A fraction of the imino acetic acid goes to ammonia, formaldehyde, and carbon dioxide (see Reference 4).

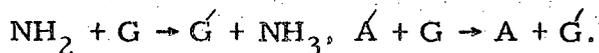
⁶ G. Stein and J. Weiss, J. Chem. Soc., 1949, 3256.

We consider first the effect of oxygen on the processes of indirect action. In oxygen-saturated solutions it may be assumed that H reacts preferentially to form HO₂ and that Reactions (2), (2a) are blocked. Reaction (1) is not affected. Initial hydrogen peroxide yields obtained⁷ in the x-ray radiolysis of oxygen-saturated 1 M glycine indicate that G is removed by the reaction $G + O_2 \rightarrow I + HO_2$, and that HO₂ is removed via $2 HO_2 \rightarrow H_2O_2 + O_2$.⁸ If the reported yields $G_R = 3.0$, and $G_F = 0.8$ are used, a calculated value of 3.4 is obtained for $G_{H_2O_2}$ on the basis of the foregoing. A yield of ~3.5 is obtained experimentally.⁷ The observed ammonia and glyoxylic acid yields ($G \approx 4.3$), however, are in excess of the value ($G_R = 3.0$) that represents the maximum yield obtainable for these products through indirect radical reaction in oxygen-saturated solution.^{10, 11} The excess ammonia ($G \approx 1$) is attributed to direct action.¹²

Since H atoms react with glycine in oxygen-free solutions, via (2), (2a), and since G_{H_2} does not increase with increasing glycine concentration above 0.5 M, we conclude that direct-action processes that result in C-H, N-H, and O-H bond rupture are not important. Nor can dissociation of the C-C bond to give NH₂CH₂ and COOH be the major process, since an initial glyoxylic acid yield of ~4 would not be obtained in oxygen-saturated solution on this basis. Although the experimental data suggest that the principal locus of decomposition involves the N-C bond, the dissociation reaction



would appear to be ruled out because the free radicals NH₂ and CH₂COOH may be removed via reaction with oxygen, and would not then contribute to the ammonia yield¹³ in oxygen-saturated solutions. On the other hand, the concept that direct action does result in the formation of NH₂ and CH₂COOH satisfies the experimental requirements in oxygen-free systems if the dissociation is followed by



⁷ Maxwell, Peterson, and White, *Radiation Research* 2, 431 (1955).

⁸ Cf. Barron, Ambrose, and Johnson, *ibid*, 2, 145 (1955).

⁹ E. J. Hart, *J. Am. Chem. Soc.* 76, 4198 (1954).

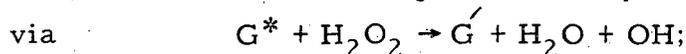
¹⁰ In Reference 4 it is shown that an ammonia yield greater than 3.0 (G_R) could result from indirect action if glycine suppressed the "molecular" yield of hydrogen peroxide (reaction F) by reaction with OH radicals in regions of high ionization density. The work of Barron et al. (see Reference 8) indicates that this type of reaction is not of major importance in the radiolysis of aqueous glycine solutions.

¹¹ The increase in G_{NH_3} that is obtained in 1 M glycine solutions equilibrated with 5 mm of oxygen (see Reference 7) indicates that reaction of H with glycine is not completely blocked at this particular oxygen/glycine concentration ratio.

¹² This would include any direct effect of subexcitation electrons [R. L. Platzman, *Radiation Research* 2, 1 (1955).]

¹³ Photolysis of ammonia-oxygen mixtures, in which the primary dissociation is $NH_3 \rightarrow NH_2 + H$, yields nitrate and nitrite. W. A. Noyes and P. A. Leighton, *The Photochemistry of Gases* (Reinhold Publishing Corp., New York, 1941)372.

This apparent anomaly is resolved, and the observed product relationships are explained, if formation of NH_2 and CH_2COOH in evacuated solution occurs through predissociation of an excited glycine molecule which in oxygen-aerated solution is removed preferentially¹⁴



the latter reaction would not be of importance in oxygen-free solution because the steady-state concentration of hydrogen peroxide is kept at a low value by the chain sequence, Eqs. (1), (5). Although reaction of the type



could occur, it is assumed not to represent a major path for removal of G^* because the stoichiometry would lead to hydrogen peroxide yields in excess of the observed values.

INDIRECT ACTION OF RADIATION ON ACETIC ACID IN OXYGEN-AERATED SOLUTION

In oxygen-saturated acetic acid solutions it may be assumed (a) that the primary radicals H and OH are preferentially removed via the processes



and (b) that the CH_2COOH radicals react in turn with O_2 to form the peroxy radicals $\text{O}_2\text{CH}_2\text{COOH}$.^{15, 16} The observed products--hydrogen peroxide, glycolic acid, glyoxylic acid, oxalic acid, formaldehyde, and carbon dioxide--are formed in subsequent reactions. In an attempt to establish the mechanism of these reactions, a detailed study has been made of the effect of radiation dosage on product yields. The experimental techniques, and the analytical procedures involving C^{14} tracer methods, were those which have been outlined in previous reports.^{17, 18} Table I shows product

¹⁴ Formation of "hot" NH_2 radicals via direct action would also lead to the observed ammonia stoichiometry if the reaction

$$\text{NH}_2 + \text{H}_2\text{O} \rightarrow \text{NH}_3 + \text{OH}$$

occurred before thermalization.

¹⁵ Medical and Health Physics Quarterly Report UCRL-3386, March 1956, p. 8.

¹⁶ H. R. Haymond, Some Effects of Dissolved Oxygen on the Heavy-Particle Irradiation of Aqueous Acetic Acid (Thesis), UCRL-2697, Sept. 1954.

¹⁷ Garrison, Haymond, Morrison, and Weeks, J. Am. Chem. Soc. 75, 2459 (1953).

¹⁸ Medical and Health Physics Quarterly Report, UCRL-3096, June 1955, p. 8.

yield data for 0.25 N CH_3COOH irradiated with 40-Mev helium ions from the Crocker Laboratory 60-inch cyclotron. It is seen that the G values for glycolic, glyoxylic, and oxalic acids are essentially independent of radiation dosage over the range studied. The results indicate that the product acids are not formed through successive oxidation steps but arise from parallel reactions involving the free-radical intermediates HO_2 and $\text{O}_2\text{CH}_2\text{COOH}$. The above data, together with the results of other studies on this system now in progress, will be considered in a forthcoming report in terms of a detailed reaction sequence.

Table I

Product	Radiation Yield (G)*		
	0.001 $\mu\text{amp-hr}$	0.003 $\mu\text{amp-hr}$	0.010 $\mu\text{amp-hr}$
Glycolic acid	0.10	0.11	0.11
Glyoxylic acid	0.54	0.60	0.35
Oxalic acid	0.13	0.12	0.20
Carbon dioxide			
Methyl carbon	0.57×10^{-2}	0.90×10^{-2}	0.28×10^{-1}
From			
Carboxyl carbon	0.7×10^{-1}	0.15	0.20

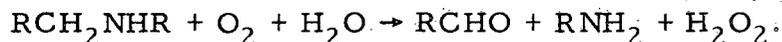
* Molecules of product per 100 ev absorbed energy

INDIRECT ACTION OF RADIATION ON COMPOUNDS CONTAINING THE N-C BOND

Amines

Radiation chemical studies of compounds containing the N-C bond are being continued. A detailed examination of processes involved in the formation of acetaldehyde and ethylamine by indirect action of radiation on diethylamine in oxygen-saturated and oxygen-free aqueous solutions is being made. Irradiations are being made with 40-Mev helium ions and 10.4-Mev protons. The solutions, which are aerated with oxygen or helium during bombardment, are acidified to pH3 with sulfuric acid to prevent escape of volatile base.

Reaction of secondary amines with Fenton's reagent, which produces OH radicals by reaction of ferrous ions with H_2O_2 via the Haber-Weiss mechanism $Fe^{+2} + H_2O_2 \rightarrow Fe^{+3} + OH + OH^-$, has been found to give products that are qualitatively the same as those obtained through radiolysis. This supports the previously described¹⁹ mechanism of the oxidative rupture of the N-C bond, which is represented by the net reaction



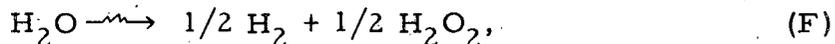
Protein

Aqueous pepsin (0.8% in oxygenated, buffered solution) has been irradiated with cyclotron-produced neutrons. Changes produced under these conditions, including loss of pepsin activity (as determined by reaction with hemoglobin), and changes in carbonyl content (as determined by reaction with 2, 4-dinitrophenylhydrazine), are being studied.

A discussion of mechanism in the radiolysis of compounds containing the N-C bond is being prepared for publication and will be presented in future UCRL reports.

CHEMICAL ACTINOMETRY OF CYCLOTRON RADIATIONS

As described in a previous report (UCRL-3096), the formic acid-oxygen actinometer²⁰ is being used to establish for cyclotron radiations the G values (number of water molecules decomposed/100 ev) for the forward (F) and radical (R) reactions in water,



Hart has shown, on the basis of a detailed study of mechanism in the radiolysis of the formic acid-oxygen system, (a) that under conditions of complete radical removal

$$G_{H_2O_2} = 1/2 G_F$$

$$G_{CO_2} = G_R$$

¹⁹ Medical and Health Physics Quarterly Report, UCRL-3096, June 1955, p. 8.

²⁰ E. J. Hart, Rad. Res. 1, 53 (1954).
Garrison

and (b) that $G_{H_2O}(G_R + G_F)$ is a constant ($3.45 \pm .03$) regardless of the type of ionizing radiation. In the work reported herein, the values of G_R and G_F are calculated from hydrogen peroxide and carbon dioxide yield data obtained at radiation dose levels on the order of 2×10^{18} ev/ml. As has been previously discussed (UCRL-3096), the G values obtained at these doses correspond to initial yield values. The irradiations of 0.05 N sodium formate at pH 12 are carried out under the experimental conditions described in the Medical and Health Physics Quarterly Report, UCRL-3386, March 1956.

Typical data for protons and helium ions are given below. The target solutions were aerated with oxygen at 1 atmosphere pressure. The beam intensity was 0.010 μ a

	$G_{H_2O_2}$	G_{CO_2}	G_R	G_F	G_{H_2O}
Protons (10.4 Mev)	2.89	2.34	2.34	1.10	3.44
Helium ions (30 Mev)	2.15	1.61	1.61	1.08	2.69

The observed G_{H_2O} value for protons falls within the range of values reported by Hart^{20,21} i. e., from 3.37 for tritium beta rays to 3.88 for Co^{60} gamma rays--and indicates that complete radical removal by oxygen is being approached. With helium ions, the linear energy transfer is higher, and it is evident that complete radical removal by oxygen is not realized.

A preliminary investigation of hydrogen peroxide and carbon dioxide yields in neutron-irradiated sodium formate solutions has been made. Irradiations were carried out in the neutron flux produced by bombardment of a thick beryllium target with 24-Mev deuterons from the 60-inch cyclotron. It has been shown²¹ that the energy distribution of this neutron flux is essentially equivalent (as regards energy transfer to water) to monoenergetic neutrons of 10 Mev. An exposure of about 10 minutes with a deuteron beam current of 25 μ amp (5 μ amp-hr) gives approximately the same hydrogen peroxide and carbon dioxide yields from 100 ml of 0.05 NHCOONa solution as the standard dose ($\sim 2 \times 10^{18}$ ev/ml) of cyclotron protons. This value, as already pointed out, is well within the range where specific yield G is independent of dose.

Absolute dose measurement for recoil protons is not practical, but on the assumption that G_{H_2O} is the same (3.44) for these recoil protons as for the 10.4-Mev cyclotron-accelerated protons, relative hydrogen peroxide and carbon dioxide yields can be used to calculate G_R and G_F . Several measurements of G_{CO_2} and $G_{H_2O_2}$ were made under conditions identical with those for the cyclotron-accelerated proton studies. Within the limits of experimental error, G_R and G_F for the two types of radiation are identical for solutions aerated with oxygen at 1 atmos pressure.

²¹ Z. E. Tochilin, S. W. Ross, B. W. Shumway, G. D. Kohler, and R. Golden, Rad. Res. 4, 158 (1956).

BIOLOGICAL STUDIES OF RADIATION EFFECTS

John H. Lawrence, M. D., in charge

Donner Laboratory of Biophysics and Medical Physics
University of California, Berkeley, CaliforniaALTERATION OF A SARCOMA BY HETEROLOGOUS TRANSPLANTING
IN CORTISONE-TREATED ANIMALS

(Preliminary Report)

Charles W. Riggs

Heterologous transplants of neoplasms may be achieved by several methods. Greene² described the implantation of human neoplasms into the anterior chamber of the guinea pig eye without pretreatment of the host. Toolan⁴ described the transplanting of human neoplasms into rats and hamsters which had received prior x-ray exposure or cortisone injections or both. Barrett and Deringer¹ described what they termed "an induced adaptation" in a mouse mammary adenocarcinoma, achieved by growing the tumor in hybrid hosts (normal host X refractory host), so that the percentage of takes in the refractory host was increased. Why some heterologous transplants take and others do not is not understood. Hauschka³ gives an excellent summary of the immunologic aspects of cancer, with an extensive bibliography.

Although the incorporation of specific proteins of foreign hosts into the heterologous tumor transplant has not been demonstrated, it is reasonable to expect that some changes, major or minor, may occur in the molecular structure of a neoplasm that is receiving its nutrients from a foreign or heterologous host. If some protein alteration does occur in heterologous transplants, this alteration may change the tumor enough for it to exhibit some antigenic properties when transplanted back to its native host strain. This concept is the basis for the following experimental procedure.

- ¹ M. K. Barrett, and M. K. Deringer, An Induced Adaptation in a Transplantable Tumor of Mice., *J. Nat. Cancer Inst.* 11, 51-59 (1950).
- ² H. N. S. Greene, The Significance of the Heterologous Transplantability of Human Cancer, *Cancer* 5, 24-44 (1952).
- ³ T. S. Hauschka, Immunologic Aspects of Cancer: A Review, *Cancer Research* 12 (9), 615-33 (1952).
- ⁴ H. W. Toolan, Transplantable Human Neoplasms Maintained in Cortisone-treated Laboratory Animals, *Cancer Research* 14 (9), 660-666 (Oct. 1954).

Materials and Methods

"A" strain mice, bearing Sarcoma 37, were used as donors. The Sarcoma 37 is a rapidly growing undifferentiated sarcoma, originally obtained from the National Cancer Institute. In our experience with 217 serial passages through our A mice, 100% takes are observed, 100% deaths occur in 12 to 20 days after bilateral transplants, with no spontaneous regressions.

Tumor material was taken from the A donors and transplanted unilaterally to the flanks of three groups of mice:

- Group One -- 3 A mice (homologous transplant).
- Group Two -- 5 Swiss mice, no treatment other than transplant (heterologous transplant).
- Group Three - 5 Swiss mice, each of which received 2.5 milligrams of cortisone acetate subcutaneously at the time of transplant and two milligrams each Monday, Wednesday, and Friday until harvest.

It was observed that the rate of tumor growth in Groups One and Three were grossly the same, while the growth rate in Group Two was retarded by about one-half. Tumors were harvested from each group on the eighteenth day and transplanted into four groups of five-month-old A strain mice, 30 animals in each group, and the rate of tumor growth and the survival times were observed.

The four groups for the second transplanting were:

- 1 -- From A mice to A mice, unilateral transplant (controls).
- 2 -- From Swiss mice which had received cortisone to A mice, unilateral transplant.
- 3 -- Bilateral transplant to A mice, from A mice on one side and from cortisone-treated Swiss mice on the second side.
- 4 -- From untreated Swiss to A mice, unilateral transplanting.

Results

One hundred percent takes of all transplants were observed in all sites on the fifteenth day. Those mice which died before the fifteenth day evidenced large tumors. All control animals were dead by the twenty-seventh day. Group 2, A-strain mice which had received Sarcoma 37 from cortisone-treated Swiss mice, had 40% surviving on the twenty-seventh day, and five individuals had evidenced complete regression of their tumor masses by the thirty-fifth day. On the sixtieth day the five survivors received a second transplant consisting of the normal Sarcoma 37 from tumor-stock A-strain mice. Two showed no evidence of tumor growth; the remaining three had pea-sized lesions on the twenty-fifth day, at which time five controls had all died bearing large tumor masses.

Group 3 mice bearing two tumors, one from cortisone-treated Swiss and one from A mice, showed an increased survival over mice

bearing bilateral transplants of the normal A mouse tumor; the survival curve was similar to that of the unilateral transplant controls.

Group 4 mice with a single transplant from untreated Swiss mice survived longer than the single-transplant controls, but no individual exhibited tumor regression such as those which occurred in Group 2.

Survival curves are shown in Fig. 1

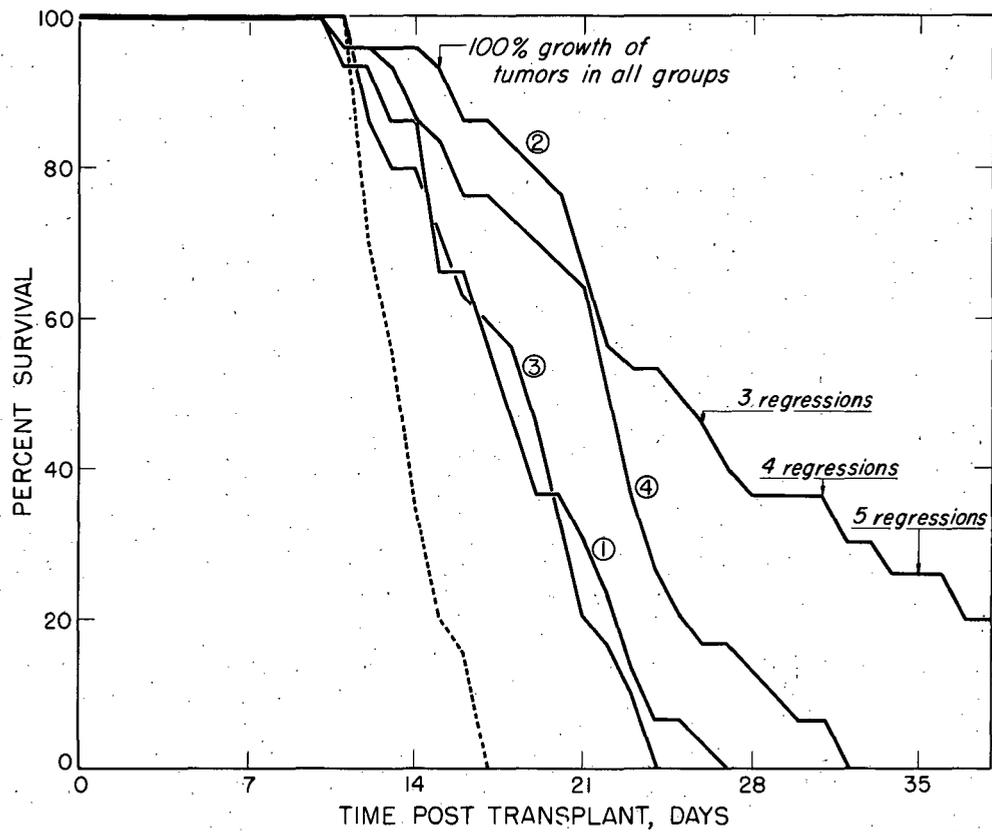
Summary

Two groups of A strain mice which received bilateral transplants, in the flanks of Sarcoma 37 had different survival curves. Those which received one normal tumor and one from a cortisone-treated Swiss mouse exhibit a longer survival than controls which received two implants of the untreated sarcoma.

In three groups of A mice which received unilateral transplants there are three different survival curves. It would appear that growing Sarcoma 37 in an untreated heterologous host has, in some manner, altered the tumor. Thus when it is returned to the homologous host, survival is lengthened. Further, this effect is enhanced by giving the heterologous host cortisone acetate during the period of tumor growth.

REPORT ISSUED

A study of the timing of the synthesis of desoxyribose nucleic acid (DNA) with respect to mitosis is the subject of a report by Lola S. Kelly, J. Dorothy Hirsch, Genevieve Beach, and Wynne Palmer, "Incorporation of Phosphorus-32 into DNA of Regenerating Liver; the Effect of Irradiation," issued as UCRL-3480, July 1956.



MU-10864

Fig. 1. Survival curves for mice receiving Sarcoma 37 transplants.

- ① One side, regular A to A (controls), 30 mice.
 - ② One side, from Swiss with cortisone to A, 30 mice.
 - ③ Both sides, regular A one side, Swiss with cortisone other side, 30 mice.
 - ④ One side, from Swiss, no cortisone, to A, 30 mice.
- Previous group of 20 controls with bilateral transplant.

HEALTH CHEMISTRY

Nelson B. Garden

EQUIPMENT DEVELOPMENT

Seven portable 2-inch lead shields, plus seven pairs of castle-type manipulators, are nearing fabrication completion; these shields incorporate newly designed improved features. Their installation in the laboratories will constitute the initial use of these manipulators in the 2-inch shields; they have been used exclusively in the 6-inch caves to date. Continued improvement has resulted in a design of a plywood box more adaptable for use with these gamma shields.

Preliminary consideration is being given to the problems expected to arise from the start-up of the new heavy-ion accelerator and the "pepped up" 184-inch cyclotron, especially in the fields of target holders and target handling. The microtarget, in use on the 60-inch cyclotron bombardments, continues to receive study, as does the "target cart," which consists of the facilities for unloading the target and disconnecting the utilities lines (cooling water, etc.) to the target during bombardment; the decontamination problem of the enclosed sections of the target cart is usually a touchy but important one, from aspects of both cross-contamination and safety.

Berkeley's 2500-curie Co^{60} source, created at the MTR over the last two-odd years, was pulled from the pile and brought back to Berkeley in a 2300-lb container which provided 7 in. of lead and 1-3/8 in. of uranium, or 9.2 in. of lead equivalent, as shielding. The radiation at the surface of the container (of 20 in. o.d.) was about 140 mr/hr; the boxed container, whose wooden surface was 8 in. from the surface of the lead, measured less than 50 mr/hr, and the radiation in the cab of the truck was less than 1 mr/hr. The source is awaiting the completion and testing of its 10-in.-thick lead housing.

An improved device for removing samples from operations in the 6-in. caves, involving floating glove ports and bags, is about ready for test.

Preparation for the next MTR-irradiated plutonium napkin-ring samples is under way; emphasis is being placed on the reduction of "shine" which was not troublesome immediately adjacent to the cave but produced undesirable levels some distance away.

The component parts of the two shipping containers, each consisting of three nested hollow cylinders of uranium (described in UCRL-3268), are being encased in 1/8-in. stainless steel, and the containers will be ready for use shortly.

OPERATIONS DIVISION

The decontamination facilities in Bldg. 5A are being reopened for limited use because Health Chemistry's decontamination area in Bldg. 70 is being taken over by a group given high priority for developing a molecular beam apparatus.

In accordance with the U. C. Regents' specifications under which it was built, the temporary shack known as "Paydirt," located behind Bldg. 5, in which was processed several tons of specially procured contaminated soils, was torn down; decontamination and removal of processing equipment was completed during the last quarter.

AIRBORNE ACTIVITY CONTROL

A detailed analysis and report of the airborne aspects of the processing of the irradiated plutonium napkin rings (received October 1955) was submitted. The airborne control treatment involved (a) use for the first time of membrane filters for sampling and final cleanup on a low-leak system--0.02 cfm; (b) ionization chamber and charcoal trap studies; (c) use of phosphate-buffered scrubber solution to eliminate NH_4Cl smoke problems.

After extensive experimentation, the group developed a technique ("greased membrane") for disconnecting heavily contaminated process gas lines quickly and safely. This technique was then applied to the equipment used in Livermore recently, in the processing of multicurie quantities of both alpha emitters and fission products, described in the preceding Quarterly Report (UCRL-3386), and the lines were readied for burial at sea.

Air in the east tangent tank of the Bevatron was sampled and an analysis was submitted for the oil therein; the air showed a drop of from 406 to 0.3 ppm after the addition of a CWS No. 6 filter in the air supply system.

The installation of manometers in all Berkeley Box manifold systems was completed.

The group participated in the nationwide AEC fall-out studies in connection with the Spring Pacific tests.

An improved dust respirator of the half-mask type has been procured; this respirator is the interim choice resulting from accumulated studies on this item.

The group is partially engaged in the refurbishing of the air-cleaning equipment for the next MTR-irradiated plutonium napkin rings in Bldg. 70's 6-inch cave setup.

Studies made by the group forecast and subsequently established airborne I^{131} contamination from the 300-mc NaI rat injection experiments. An emergency exhaustor was installed when a high gas-particulate ratio

of 100 or more was revealed. This problem is receiving continued attention as the program to determine the biological effects of massive doses of radioactive iodine on mammals in short- and long-term studies continues, with ever increasing quantities of injected material.

A new design of a GL filter to reduce costs and to prevent bypassing was completed and tested.

The exploration of noble-gas capture from pile-irradiated plutonium napkin rings using refrigerated charcoal in a closed system was continued.

A design study of an in-hood unit for handling perchloric acid fumes, both with and without radioactive aerosols, has been initiated.

Numerous samples of "teflon" fabric and data thereon have been procured for use in a development study of a reaction-vessel demisting unit.

GENERAL

The manpower shortage continues to be critical, here as elsewhere. Members of the Health Chemistry staff have of necessity taken on intensified responsibilities as technical coordinators, working with both the monitors and the chemists in an effort to resolve the increasing number of researchers' problems. Health Chemistry members' participation in the Spring Pacific Tests further aggravated the situation. Also, transfer of some well-trained and experienced Health Chemistry members to the similarly hard-pressed Chemistry Department, in response to its invitation, has depleted us further.

Members of the group attended a meeting in Ann Arbor of the newly formed Health Physics Society during June.

HEALTH PHYSICS

Burton J. Moyer

STATISTICAL SUMMARY OF MONITORING PROGRAM

Survey Instruments Maintained

Beta-Gamma Meters	36
I D L Meters	21
Juno logarithmic ion chamber	20
Abacus logarithmic ion chamber	30
Recording Intensity Meters	9
Victoreen proteximeter	3
Slow-Neutron Proportional Counters	15
Fast-Neutron Proportional Counter (Portable)	11
Slow-Neutron Portable Unit	4
Balanced Chamber, Fast-Neutron, Portable.	3
Special Tissue Wall Survey Instrument	1

Personnel Meters in Use

Total Personnel Covered with Film Badges	4248
Total Man-Days Coverage with Electroscopes	4475
Total Man-Days Coverage with Dosimeters	2675
Total Man-Days Coverage with Slow-Neutron Chambers	2465

Bevatron

1800 Electroscopes -- 20 used per day for 3 months.

Crocker

1350 Slow-Neutron Chambers -- 15 used per day for 3 months
 1350 Dosimeters -- 15 used per day for 3 months
 1350 Electroscopes -- 15 used per day for 3 months

Building 53

1115 Slow-Neutron Chambers
 1325 Dosimeters
 1325 Electroscopes

Cases of Weekly Exposure Above 0.3r

<u>Weekly Film Expos. Above</u>	<u>184-inch Area</u>	<u>60-inch Area</u>	<u>Linac</u>	<u>Chem</u>	<u>Other</u>	<u>Total *</u>
0.3	0	22	2	29	3	56
0.5	0	5	0	24	2	31
1.0	0	1	0	10	0	11
1.5	0	1	0	2	0	3
2.0	0	1	0	0	0	1
2.5	0	0	0	0	0	0
3.0	0	0	0	0	0	0
4.0	0	0	0	0	0	0
6.0	0	0	0	0	0	0
6.5	0	0	0	0	0	0

* excluding Livermore

Moyer

Information Division
7/31/56 sa