

DECLASSIFIED

UCRL 680

~~Copy III/A~~

C2

~~SECRET~~

UNIVERSITY OF  
CALIFORNIA

# Radiation Laboratory

TWO-WEEK LOAN COPY

*This is a Library Circulating Copy  
which may be borrowed for two weeks.  
For a personal retention copy, call  
Tech. Info. Division, Ext. 5545*

BERKELEY, CALIFORNIA

UCRL-680  
0.2

## **DISCLAIMER**

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.



**DECLASSIFIED**



UNIVERSITY OF CALIFORNIA

Radiation Laboratory

Contract No. W-7405-eng-48

MONTHLY PROGRESS REPORT

No. 84

March 15 to April 15, 1950

April 28, 1950

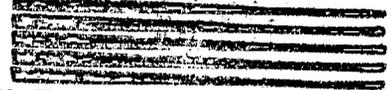
**CAUTION**

This document contains information affecting the National Defense of the United States. Its transmission or the disclosure of its contents in any manner to an unauthorized person is prohibited and may result in severe criminal penalties under applicable Federal Laws.

\*\*\*\*\*

Berkeley, California

**CLASSIFICATION CANCELLED**  
BY AUTHORITY OF THE DECLASSIFICATION  
BRANCH USAEC  
BY B. Forbett 3-29-57  
SIGNATURE OF THE PERSON MAKING THE CHANGE      DATE



## UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

March 15 to April 15, 1950

MONTHLY PROGRESS REPORT No. 84

1. BevatronUNCLASSIFIED

Magnet. Approximately 68 percent of the core frame steel has been received from the mill and 50 percent has been cut and drilled. Twenty-one percent of the leg slabs and 4 percent of the yoke slabs are assembled. The assembly is proceeding smoothly.

Bids have been invited for the fabrication, including painting, of the pole plates for the ten degree test vacuum tank. An order will be placed by April 25.

Building. The structural steel erection is complete and the magnet room is now covered. The two magnet room cranes have been erected. Excavation for the magnet foundation is scheduled to start within two weeks.

Magnet Power Supply. Agreement has been reached with Westinghouse on an allowable ripple of 6.3 percent peak to peak total, and 5.3 percent peak to peak for the 12 phase component. This is greater than the 4 percent peak to peak originally specified, but analysis has shown that its effect, if appreciable, can be compensated for. Requests for bids on the power supply installation are to go out next week. The first generator is to be tested at the Westinghouse plant on May 8.

Accelerator. Methods for compensating the magnet power supply ripple have been worked out to the point of being certain that compensation will be satisfactory. Work is continuing on the components of the frequency control and amplifier system.

Injector. The ion gun has been operating at .5 Mev and produces a proton beam current of .5 ma in a 1 mm diameter spot. Sparks occur with a frequency of approximately once every ten seconds over the 44 inch gap to ground in atmospheric air. Oil cooling for the voltage supply has been installed. No great amount of development work is planned at this time.

2. 184-inch Cyclotron OperationUNCLASSIFIED

The cyclotron was used for research experiments approximately ninety-eight percent of the 547 hours that the crew was on duty.

The above figures indicate that no time was taken for installation of new equipment and that no breakdowns occurred during the month.



UNCLASSIFIED

Following is a summary of operating statistics for the period.

Research Operating Time	536.75 hours	98.1 percent
Maintenance	2.75	.5
Repairs	3.0	.5
Visitors	4.5	1.9

3. 60-inch Cyclotron Operation

UNCLASSIFIED

Since the installation of the remodeled deflector assembly, no further difficulties have arisen. There has been an average operation efficiency of about 75 percent during this period.

4. Synchrotron Operation

UNCLASSIFIED

Consistently good performance during the past month has resulted in a new peak output figure of X-ray intensity. Several days of operation were experienced with average beam intensities of 6000 R/hr. Careful maximizing of controls produced a peak intensity of 9650 R/hr. Both of the above figures were measured at the center of the beam, one meter from the target, with an ionization chamber behind 1/8 in. of lead.

At present, the beam monitoring is being done at the operating console by using the output of an ionization chamber placed behind any experimental apparatus being used at the time. This arrangement results in lack of sensitivity of the console meter and makes maximization of the intensity difficult. A second ionization chamber, disposed to the front of the collimator and unaffected by experimental setups is soon to be used for this purpose and should result in an increase in average intensity to a value more nearly that of the peak intensity.

An emergency 16 hour shutdown in early April was necessary to secure loose upper pole tip wedges. The upper yoke was raised and a shimming operation performed to stop the motion of these wedges.

5. Linear Accelerator and Van de Graaff Operation

UNCLASSIFIED

The glyptal treatment, as mentioned in the last report, has cut down the bake-in time to around 2 percent, thus making the maximum time approximately 1 hour as compared to 6 or 8 hours before.

The breaking of the main charging belt delayed operations temporarily, but a new belt has since been installed.

A new insulator for the focus electrode is in the design stage.

Operating statistics for this period were as follows:

-4-

Running time	247 hours	65 percent
Repair	110	29
Research	12.5	3.3
Bake-in	10.5	2.8

## 6. Experimental Physics

UNCLASSIFIED

Film Program.  $\pi^+/\pi^-$  Ratio. A study is being made of the intensities of the  $\pi^+$  and  $\pi^-$  mesons emitted from a number of elements at various energies of the bombarded protons. The ratios of the numbers of  $\pi^+$  to  $\pi^-$  for mesons of energies 50 Mev and 15 Mev are being obtained for C, CH<sub>2</sub> and CD<sub>2</sub>. The ratios for H and D will then be calculated by subtraction.

Interaction of High Energy Mesons with Nuclei. A program is in progress for the purpose of observing nuclear events produced by high-energy mesons. Electron sensitive plates which register minimum ionization have been exposed to 30 Mev  $\pi^-$  mesons. These mesons are identified by grain count and small angle Coulomb scattering. The plates are being studied for nuclear disintegrations and nuclear scatters associated with  $\pi^-$  mesons of this energy. It is expected that cross sections for scattering and for capture of these high energy mesons will be obtained.

Cloud Chamber. Measurements are being made on the tracks from the neutron-deuteron scattering experiment as well as from the shower experiment. About 1200 tracks from each have now been measured. In addition a run has been made to secure the energy spectrum of the neutrons that are produced when a LiD target is bombarded by the circulating proton beam in the cyclotron.

Some preliminary photographs have also been taken in the experiment to determine the energy spectrum of the electrons in the decay of the  $\mu$ -meson using the synchrotron. The cloud chamber is triggered by anthracene crystal counters in coincidence to detect positive mesons.

High Energy Photons. The recent work on the photons from nucleon collisions has been devoted to obtaining more accurate spectra from various conditions of production. These conditions refer to bombarding proton energy and angle of view of the pair spectrometer at the target with respect to beam direction. Data of this type have now been acquired to as great an accuracy as is warranted with the use of the proportional counter type of pair spectrometer, and further work on spectra will be deferred in favor of concentrating effort on the assembly of the new crystal counter pair spectrometer. Also during the past month evidence was obtained for the coincident emission of these photons in pairs which is in strong support of the neutral meson hypothesis. The instrumentation involving  $10^{-8}$  sec. pulse amplification and coincidence-anti-coincidence electronics is well along in development. By the use of this a much better experiment on the gamma-gamma coincidences will be possible.

Delayed Neutron Emitters. The magnet for the 200 Mev gamma ray-spectrometer has been assembled and is presently being tested for uniformity of field. Preliminary measurements on the stray field of the magnet show that the flux density is about 25 gauss at a distance of 30 inches from the vacuum tank wall which will

UNCLASSIFIED

permit the use of magnetically shielded 5918 photo-multipliers at the end of 30 inch light pipes as detectors. The field at 40 inches from the vacuum tank is less than 2 gauss, which allows the assumption to be made that the 350 Mev spectrometer which is of a similar design may be used at a distance of forty inches from the synchrotron without magnetic shielding and still not interfere with the operation of the synchrotron.

Variation of Neutron Collision Cross Sections. The neutron-proton total cross section has been more accurately measured for the 160 and 220 Mev neutrons produced by proton bombardment of a 0.5 inch Be target in the 184-inch cyclotron. The results are:

Neutron Energy	$\sigma_T \times 10^{-27} \text{ cm}^2$
160 Mev	$50.4 \pm 2.9$
	$54.8 \pm 6.0$ (1st result)
	$51.2 \pm 2.6$ (ave.)
220 Mev	$41.05 \pm 2.9$
	$41.0 \pm 4.1$ (1st result)
	$41.0 \pm 2.4$ (ave.)

Further measurements were taken on carbon, aluminum, copper, and lead in this energy region. All four nuclei have well defined plateaus in their cross section values as a function of energy from 180 to 270 Mev.

Capture of  $\pi^-$  Mesons in Hydrogen. The data discussed in the last report has been augmented and the results reported last time have been confirmed. The limits on the mass of the neutral meson are such that it cannot be excluded that neutral mesons could also be formed when negative  $\pi$  mesons are captured on deuterium. Apparatus for studying this process in deuterium is under construction.

Analysis of Photographic Plates Exposed to Mesons from Proton-Proton Collisions. An exposure has been made of mesons produced on proton-proton collisions in liquid hydrogen using magnetic analysis. The plates obtained by this method are the lowest background meson exposed photographic plates which thus far have been obtained by the Laboratory.

Life-time of the Positive  $\pi$ -meson. Another one-day run has been made at the synchrotron. A two stage fast chain amplifier has been made especially for this purpose and carefully adjusted to give a pulse of very short duration. 500  $\pi^+$  decay processes were recorded by photographing a high-speed oscillograph trace. The time of the decay process can be reliably determined in all cases in which the decay process follows the stopping of the  $\pi$ -meson in the stilbene by as much as  $2 \times 10^{-8}$  sec. The analysis of the records is still in progress.

P-p Scattering. One attempt has been made to measure the differential scattering cross section, at least at a few angles, at reduced energy. Apparently reliable

UNCLASSIFIED

work can be done using energies as low as 170 Mev.

The 340 Mev protons are slowed to 170 Mev by passage through a lithium absorber.

Other Synchrotron Studies. Work on the angular distribution of protons produced by synchrotron x-ray bombardment has progressed and two short bombardments in the induced activity experiments have been done. Further checks on the angular distribution of mesons from hydrogen were made.

Electronic Equipment for High Energy Pair Spectrometer. A complete coincidence channel has been assembled and tested. Two type 5819 photomultiplier tubes viewed directly a single stilbene phosphor, which in turn was excited by radiation from a P32 source.

Coincidences were registered on the standard laboratory scalers. The coincidence circuit, which has been developed, employs type IN23B silicon crystal diodes and gives signal-to-noise ratios of eight or better from one volt input signals. Each channel of the dual coincidence circuit contains a distributed preamplifier, which has a voltage amplification of about two, and a Hewlett-Packard distributed amplifier.

The coincidence resolution time is a few  $\times 10^{-8}$  sec.

Particle Spectrometer. Measurements of the energy spectrum of the neutron beam produced by 350 Mev proton bombardment of a 2 in. Be target in the 184-inch cyclotron have been continued. It is felt that no practical purpose would be served by carrying these measurements to a higher degree of accuracy, as there appears to be no detailed structure in the spectrum. This view is born out by the results of Knox, which indicate that the average particle in the proton beam traverses the target a sufficient number of times to work out, by energy attenuation, any such details as a high energy peak in the neutron beam.

Preliminary measurements of the energy spectra of heavy particles ejected from carbon, copper, and lead targets placed in the 270 Mev neutron beam indicate that these particles are mainly protons, and that their spectra are very similar in shape to those found by Hadley and York, working with the 90 Mev neutron beam.

Scintillation Crystal Production. The large crystal growing furnace is now in steady production and the quality of the crystals grown has shown a steady improvement due to refinements in the temperature control, rate of cooling, and purification of the material. Currently two crystals are being grown simultaneously in this furnace with about an 8-9 day cycle.

The size of the crystals being grown at present is approximately 4 in. x 2 in. x 3/4 in.

A smaller furnace is being equipped for production and these added facilities will allow production of crystals other than of trans-stilbene.

UNCLASSIFIED7. Theoretical Physics

Work on the p-p scattering has been directed toward rechecking the conclusions that repulsive forces at short distances could not be responsible for the flat angular distribution. The question of whether relativistic effects might somewhat alter the predicted angular distribution is also being examined. Experimental results at intermediate energies of 200 Mev and between 18 and 30 Mev check very well with predictions.

A paper has been completed on the theory of n-d scattering.

Calculation of meson production cross sections has been broadened by including more general models both in the way of meson theory and with the use of empirical potentials. Calculations have been made of the angular energy distribution of coincidence gamma rays produced in photo-meson production and in  $\pi^+$  capture.

8. MTA ProgramSECRET

The Radiation Laboratory and the California Research and Development Company are cooperating in the development of the Materials Testing Accelerator. As announced to the press, Camp Shoemaker, near Livermore, has been acquired from the Navy Department for the site of the new project.

During the period of this report a number of conferences were held with representatives of various manufacturers interested in supplying equipment. The principal effort has been devoted to the test program in an effort to fix the dimensions and general specification of the initial 60 foot long linear accelerator.

The accelerator, which is in a sense a pilot model, will be 60 feet in diameter and will operate at a frequency of 12.2 mc. It will accelerate deuterons to an energy of 30 Mev. Focussing magnets will be provided in the drift tubes to provide radial focussing. The machine is being designed to permit extension to an energy of 350 Mev with a minimum of change in the initial 60 foot section.

It is expected that an order can be placed for the construction of the 60 foot vacuum tank by the end of May and that drawings of the building will be ready for the contractor by July 1. The date Aug. 14, 1951 has been set for the completion of this phase of the project.

A number of test and development programs are underway involving the injector, the oscillators, the drift tubes and drift tube focussing magnets, the effects of tank pressure on operation, and the construction of a 1/60 th scale complete working model to accelerate electrons.

Model magnet tests are also being done on the high energy, constant frequency cyclotron. The decision has been made to construct an operating model to accelerate electrons. It will have a pole diameter of 1 meter, a magnetic field of 20 oersteds, and frequency of 50 mc. It is hoped that the dimensions of the full scale cyclotron can be set by Sept. 15.

## 9. Chemistry

SECRET

## Part A

"Fission" of Bromine and Silver. Some time ago it was reported that the reaction  $\text{Cu}^{63} + \text{H}^1 \longrightarrow \text{Cl}^{38} + \text{X}$  was observed at bombardment energies so low that X cannot consist of any combination of separate protons, neutrons, and alpha-particles, but must contain one or more heavier fragments. The experiment has been repeated by producing  $\text{Sc}^{44}$  from  $\text{Br}^{79}$  and  $\text{Co}^{55}$  and  $\text{Co}^{61}$  from  $\text{Ag}^{107}$ , with similar results. In the last case, the ratio of the amounts of the two isotopes found shows that, if all the  $\text{Co}^{55}$  is made from copper impurity, only 60 percent of the  $\text{Co}^{61}$  can come from copper. The cross sections for these "fission" reactions are of the order of  $10^{-7}$  barns.

Beta-Spectroscopy. The radiations of the 12-day  $\text{Tl}^{202}$  have been shown to contain 3 conversion electron lines corresponding to a single gamma-ray of 427 Kev. No evidence was found for a continuous spectrum of beta-particles, which might be present if  $\text{Pb}^{202}$  is beta-stable. No radioactivity has ever been found for  $\text{Pb}^{202}$ , and its beta-stability is uncertain.

Experiments with  $\text{Cm}^{242}$  showed that, when very thin samples are used, recoil of daughter atoms before emission of conversion electrons causes poor resolution of the electron spectrum. Better results were obtained when the sample was covered with a film of thickness  $3 \times 10^{-5}$  g/cm<sup>2</sup>. Three lines are observed corresponding to L conversion of a 49-Kev gamma-ray.

New Isotopes of Praseodymium. A new 4.5 hour period has been assigned to  $\text{Pr}^{139}$  by showing that it decays to 140 day  $\text{Ce}^{139}$ .  $\text{Pr}^{139}$  decays both by positron emission and by electron capture. A 2-hour activity (not  $\text{F}^{18}$ ) is tentatively assigned to  $\text{Pr}^{138}$ . It also decays both by positron emission and by electron capture.

Properties of  $\text{Po}^{207}$ . The alpha-particles of  $\text{Po}^{207}$  have been measured as  $5.11 \pm 0.02$  Mev, to be compared with the previous value  $5.1 \pm 0.1$  from samples of lower purity. An experiment is in progress to measure the  $\alpha/\text{K}$  decay ratio, based entirely on alpha-counting data, by comparing the amount of long-lived  $\text{Bi}^{207}$  produced from  $\text{Po}^{207}$  with that produced by a measured amount of  $\text{At}^{211}$ . A preliminary value is  $1.6 \times 10^{-4}$ . It has also been confirmed that the 2-day  $\text{Pb}^{203}$  is the product of the alpha-decay of  $\text{Po}^{207}$ , giving further confirmation to the mass assignments.

Gamma-Radiation from Polonium. A mixture of 61 percent by alpha-activity  $\text{Po}^{210}$ , 37 percent  $\text{Po}^{208}$ , and 2 percent  $\text{Po}^{209}$ , prepared by 19 Mev deuterons on bismuth, was examined for gamma-rays and electrons. Soft radiations were found which correspond to 7 gammas per  $10^5$  alphas in the mixture. When corrected for the  $\text{Po}^{210}$ , assuming 7 gammas/ $10^6$  alphas this represents 18 gammas per  $10^5$  alphas for the  $\text{Po}^{208}$ ,  $\text{Po}^{209}$  mixture. Which isotope is responsible has not been determined.

Short-Lived Astatine Isotopes. In addition to activities reported previously and assigned to astatine, a new 12 sec. period with 6.50 Mev alpha-particles has been observed by bombarding bismuth with full energy helium ions in the rabbit

SECRET

of the 184-inch cyclotron. Its mass is guessed to be about 199. Another period (reported as 3 minutes) has been revised to 1.7 minutes; it has alpha-particles of 6.35 Mev.

Crystal structures of Oxychlorides of Rare Earth Elements. Previous workers have reported the crystal structures of the oxychlorides of only three of the rare earth elements: LaOCl, PrOCl, and NdOCl. These all have the tetragonal PbFCl type structure. SmOCl, EuOCl, GdOCl, and TbOCl have now been prepared and have been shown to have the same structure. The lattice dimensions will be reported when the series has been completed.

ChemistryUNCLASSIFIED

## Part B

Synthetic and Experimental Chemistry. The new method for the preparation of alcohols from acids has been studied. Propyl bromide has been obtained in 53 percent yield by direct high pressure hydrogenation of a mixture of cadmium and nickel salts of propionic acid. This corresponds to a yield 70-80 percent of propyl alcohol. The procedure is of general applicability.

In the high activity preparation of purines guanine hydrochloride has been obtained in 44 percent yield based on  $CN^-$ , 8-azoguanine (guanazolo) in 47 percent yield, also based on  $CN^-$ . The adenine and 8-azoadenine preparations have yet a few steps to go. Purity determinations will be made.

High specific activity oxalic acid has been prepared by reacting  $C^{14}O_2$  with K in sand. The yield was 50.8 percent and 15 percent unreacted  $CO_2$  was recovered. This material is to be used in studies of isotope effects.

The separation of amino acids by fractional elution with dilute acids from cation exchange columns has been studied. Valine can be separated from a mixture of glycine, alanine,  $\alpha$ -aminobutyric acid and leucine. Under the proper conditions all others could be separated, except for the glycine and alanine.

Other syntheses with radio carbon that have been studied in the last month include: glucose-1- $C^{14}$ , vinylacetic-1- $C^{14}$  acid, malonic-2- $C^{14}$  ester, succinic-1- $C^{14}$  acid, malic-1- $C^{14}$  acid, cyclohexanone-1- $C^{14}$ , valine-methyl- $C^{14}$ , iso valeric-methyl- $C^{14}$  acid and diphenylmalonic-carboxyl- $C^{14}$  acid.

Biological Chemistry. During the past month a number of blood serum samples from atherosclerosis patients has been studied by paper chromatography to determine if there was any correlation between macro cholesterol bearing molecules and amino acid distribution. It was found that the method was not sensitive enough to show any differences.

The isolation of nucleic acid from a rat fed iso butyric-methyl- $C^{14}$  acid has been studied. Activity has been found in this fraction from the whole rat carcass, less the pancreas, liver and spleen.

UNCLASSIFIED

The preparation and testing of a number of purine derivatives and isomers for anti carcinoma activity has been continued. No positive results have yet been found, but it is too soon to make definite statements.

The work on the identification of intermediates of liver metabolism of simple organic molecules has continued.

Fluoroacetic acid, is being prepared to study its effect on bacterial enzyme systems. If good results are obtained it will be prepared labeled with  $C^{14}$ .

The fate of the isopropyl group of isobutyric acid has been studied. Based on preliminary results it is postulated that the propyl group may be converted to acetone, oxidized to pyruvic acid and thence to acetic acid and  $CO_2$ .

Photosynthesis Chemistry. Work has continued on the identification of the intermediates of  $CO_2$  reduction. The phosphate esters which we have shown to be involved in conversion of  $C^{14}O_2$  to sucrose have been partially separated by paper chromatography. The individual compounds or groups have been subjected to enzymatic hydrolysis to give free sugars and carboxylic acids. The products formed include glyceric acid, trioses, fructose, glucose and mannose. Small amounts of aspartic acid and alanine have been observed. Whether these result from hydrolysis of amino acid phosphates is under investigation.

The ion exchange resin separation of  $C^{14}$ -labeled phosphate esters is in progress. Most of the phosphates from 30 second photosynthesis by barley are hexose monophosphates as determined by elution from Dow A-1 resin columns.

The Role of Glycolic Acid. The appearance of large amounts of glycolic acid and glycine when plants are illuminated without  $CO_2$  suggests that these two-carbon compounds are involved in  $CO_2$  uptake. Labeled glycolic acid is being fed to Scenedesmus to determine whether it acts as a  $CO_2$  acceptor. Preliminary results indicate that it does and the investigation is being continued.

$CO_2$  Fixation by Microorganisms. The radioactive compounds formed by  $C^{14}O_2$  exchange in a protozoan (Tetrahymena geleii), a yeast (Hansenula), water molds (Allomyces arbuscula and Blastocladia Pringsheimii) and bacteria (Lactobacillus casei) are being identified. These include respiration intermediates and a number of carboxylic acids.

pH Effects in Photosynthesis. Extension of  $C^{14}O_2$  fixation to extreme pH ranges (1.6-12) has allowed determination of the pH dependence of photosynthesis in algae. The rate is considerable at pH 1.6 and pH 11. The amounts of compounds formed at the extremes have been studied and found to differ considerably. High pH favors malic acid synthesis, low pH favors sucrose synthesis.

Inhibitors. The effects of inhibitors of photosynthesis, malonate, cyanide, hydroxylamine and iodoacetamide, upon the compounds formed has been studied. The results are being interpreted and further experiments will be performed.

-11-

SECRETChemistry

## Part C - Project 48 B

Metals and High Temperature Thermodynamics. Work is in progress on the following problems:

1. Gaseous hydroxide species.
2. Liquid metal systems and heats of formation of intermetallic compounds.
3. Theory of refractory behavior.
4. Thermal conductivity of gases.
5. Heat transfer in forced convection film boiling.

Basic Chemistry, Solvent Extraction. The following problems are under investigation:

1. The chelate complex of lanthanum with TTA.
2. Thermodynamic Studies on rhenium.
3.  $\text{Fe}^{3+}$ - $\text{Fe}^{2+}$  electron exchange rate.

Ore Reduction. The following subjects are under investigation:

1. Solvent extraction using chelate process. A study of phosphate complexing.
2. A study of equilibrium in uranyl phosphate precipitation.

10 Medical PhysicsFOR OFFICIAL  
USE ONLY

## Part A

Tracer Studies. Metabolic studies on radio-tantalum, carrier-free rhenium, astatine, and sodium 22 are being undertaken in rats.

Chelating Experiments Continued. In vitro experiments showing ethylenediamine-tetracetic acid (EDTA, Versene acid) to be a powerful chelating agent which forms soluble non-dissociated complexes with various elements such as calcium, yttrium, iron, plutonium and cerium have been described in previous progress reports. The use of this compound in vivo to remove yttrium which had been previously injected into animals has also been described. At present, in vivo experiments attempting to remove various elements from the body using this agent are in progress.

Plutonium-cerium. A group of rats have been injected with  $\text{Pu}^{239+6}$  and  $\text{Ce}^{144}$ . Half of the group have been treated under various dosage and time schedules with the calcium salt of EDTA. The urine and feces from both groups have been collected daily and are now in the process of being analyzed. If the expected results are forthcoming, there should be greater excretion in the treated animals than in the non-treated animals.

Calcium. A group of animals have been injected with  $\text{Ca}^{45}$ . Half of this group have received the calcium complexed with EDTA. The difference in urinary excretion between the two groups is now being determined.

FOR OFFICIAL  
USE ONLY

A long-term experiment involving the slow removal of calcium from rats by the use of continued daily low dosages of EDTA is now in progress.

Iron. A group of animals has been injected with  $\text{Fe}^{59}$  and half of these are receiving Fe 3 (a derivative of EDTA). The effect of urinary and fecal excretion is being measured.

Yttrium. The final results on the forced excretion of yttrium with EDTA are now available. In brief, the animals which received EDTA two hours after the injection of yttrium show approximately 40 percent less yttrium in the skeleton than the control group. The other groups show amounts of 10-20 percent less of yttrium in the skeleton than the control group.

Decontamination and Bone Metabolism Studies. Studies of the effects of alkaline phosphatase on the rate of calcium turnover and uptake by bones, following intravenous injection have been undertaken. A group of rats injected intravenously with a mixture of alkaline phosphatase and  $\text{Ca}^{45}$  when compared with a group of rats injected with  $\text{Ca}^{45}$  only, shows no significant difference in the rate of  $\text{Ca}^{45}$  loss from plasma in time intervals up to 2 hours after injection.

The withdrawal of  $\text{Ca}^{45}$  from skeletal tissue by ethylenediaminetetra acetic acid is being studied. Low calcium and low phosphorus diets are used in conjunction with this study. Kinetic studies of the uptake of  $\text{Y}^{90}$  by both skeletal and soft tissues have been undertaken.

The Study of Radiation Damage Produced by Astatine in the Rat. This work is continuing. During the past month 30 animals were sacrificed and representative tissues at the higher dose levels, namely .25, .50 and .75  $\mu\text{c}$  per kg of body weight, were taken for histopathological study. A total of 125 specimens were taken and the sections will be prepared and stained by the staff of the Division of Pathology at the Medical School in San Francisco. The animals were given radio-iodine 24 hours prior to sacrifice, and radioautographs are being prepared in an attempt to correlate pathological changes with the pattern of uptake of iodine by the damaged thyroid tissue. During these studies the changes in number and cell type of leukocytes were closely followed.

Effect of x-rays on electrolyte balance experiments are being set up to study the distribution and excretion of sodium and potassium in irradiated rats.  $\text{Na}^{22}$  and  $\text{K}^{43}$  are to be tried as tracers.

Radiochemistry. Carrier-free procedures have been developed for the isolation of  $\text{Re}^{183, 184}$  and  $\text{Os}^{185}$  from a tungsten cyclotron exit strip. Isotonic solutions of  $\text{Re}^{183, 184}$  have been prepared for injection. Carrier-free  $\text{Mg}^{27}$  has been isolated from deuteron-bombarded aluminum using a previously described radio-colloid technique. The  $\text{Mg}^{27}$  yield was found to be approx. 2.3  $\text{mc}/\mu\text{a-hr}$ . Milli-curie amounts of  $\text{At}^{211}$  have been prepared for animal experiments. Preliminary data indicate that astatobenzoic acid may be obtained by exchange of  $\text{At}^0$  with iodo benzoic acid.

-13-

Medical PhysicsUNCLASSIFIED

## Part B

Biological Effects of Radiation. Deuteron irradiation of rats. The irradiation of rats was continued as part of a program of studying the lethal effect of local dose of radiation with the 184-inch cyclotron.

Yeast. Some tetraploid yeast cells were isolated from a colony of diploids and their survival against x-radiation was studied.

Bacteria. Irregularities in survival curves of *E. coli*, strain B, with ultraviolet irradiation, mentioned in the last monthly progress report, appear to have been resolved. These populations die exponentially along a two component curve. Experiments are in progress to test the mechanistic significance of the different components.

Post irradiation survival of these bacteria has been found to depend also on the temperature at which they are incubated. This effect is being explored in more detail.

Hematology - double nucleated lymphocyte problem. There has been no essential change noted in the incidence figures among laboratory personnel and patients reported last month.

Results of a preliminary animal experiment indicate that there may be a significant rise in the numbers of these double nucleated cells in the peripheral blood of mice shortly after irradiation with fast neutrons.

Trace Analysis. The activation analysis program is being continued.

Carbon Labeled Glycine. The breath excretion curve for the first patient given carbon 14 glycine has been almost completed. The turnover time for the plasma globulin in this patient was approximately seven days. In the albumin there appears to be a short component and a long component. Carbon 14 activity in the hemoglobin reached a plateau level at about 10-15 days and has remained constant for the first 50 days.

A second patient was given carbon 14 glycine on April 8, 1950.

Carbon Labeled Stilbamidine. The multiple myeloma patient who was given the stilbamidine has died. An autopsy was obtained and the various tissues are now being analyzed for carbon 14. The patient was also given methane therapy.

Iron Metabolism. Plasma and red cell iron turnover studies have been carried out in five patients having malignant neoplasms before and after treatment with nitrogen mustard. The plasma iron turnover rate is significantly slowed and the red cell uptake is depressed following the mustard.

Rats are being prepared with larger than normal amounts of body stores of iron. These animals will be used to test a strong iron complexing agent which may cause iron excretion.

UNCLASSIFIED

The data from the South American studies is rapidly being compiled. Preliminary perusal indicates that changes in iron turnover rates consequent to changes in altitude are prompt and definite. Subjects living at 15,000, moved to sea level may have a decrease in turnover rate by as much as a factor of five. Contrariwise those moving from sea level to 15,000 feet may increase by the same amount.

Physical Chemistry. Tracer studies with tritium labeled cholesterol and P<sup>32</sup> labeled lipids on the S<sub>10-20</sub> fraction previously described in animal and human atherosclerosis are in progress.

Tritium Labeled Water. Total body water and sodium determinations are being continued in normal and abnormal subjects. It has been learned that equilibrium of injected tagged water occurs approximately three hours after injection instead of at earlier times as had been previously thought.

#### 11. Health Physics and Chemistry

FOR OFFICIAL  
USE ONLY

Neutron Survey Instrumentation. As a means for obtaining information about the energy spectra of neutron fluxes in surveys around the accelerators, a series of polyethylene-lined counters are being made with different thicknesses of foils. Two of these have now been made and tested with a standard source. They show plateaus and appear to be suitable for survey work. Their ability to discriminate between various mean energies will be tested in surveys.

In the linear accelerator where the intensity and duration of proton pulse gives an instantaneous counting rate for neutrons in the thousands per second, it is necessary to know how well the counter follows the flux. An estimate of the dead time of the counter may be possible using scattered high energy neutrons from the cyclotron beam. This will be tried soon.

Projects Completed by the Research and Development Group. The activities of the Research and Development Group during the period of this report include:

1. Building 5A Decontamination Annex. Equipment for the decontamination chamber is ready for a test run.
2. Equipment for movement of Hanford dissolver solutions from Hanford containers. Equipment complete and ready for dry runs.
3. Hanford dissolver solution processing. Shielded enclosure for ozonizer completed.
4. Preparation for Hanford bombardment arriving at end of month. These preparations are essentially complete.
5. Health Chemistry equipment drawings. Berkeley Box outlet filter drawings, isometric sketches for Berkeley Boxes (made to facilitate ordering) and x-ray diffraction protective enclosure drawings were completed.

-15-

FOR OFFICIAL  
USE ONLY

6. Berkeley Box department. Three boxes were completed; one box reclaimed and refitted. All blower motors in all buildings were oiled. Ten lucite pipette racks were completed, and adjustments, changes and additions made on three boxes already in use. Preparation of the blower and housing for the duct system in Room 203E, Bldg. 4 were made, and the preparation and installation of a duct and filter system for x-ray camera loading and unloading in Lewis Hall was completed.

A total of 82 cemented, waste-filled drums, 4 gas cylinders and 2 gloved boxes were dumped at sea during this period.

12. Plant and EquipmentUNCLASSIFIED

Bevatron. Erection of the structural steel for the building is complete and the installation of the roof is approximately 75 percent complete. The contractor is about to begin work on the magnet foundation. On the bevatron equipment \$1,000,000 order, the contractor has reported approximately 75 percent completion.

Construction of Cafeteria. Construction is 50 percent complete. Work is somewhat behind schedule but is proceeding rapidly. Wood framing is essentially complete; roofing and masonry work are in process. Utility roughing is not complete as yet; the walk-in refrigerator has been installed.

Construction of Animal House. Preliminary design of the animal house is proceeding.

Construction of Sheetmetal and Salvage Shop. Design work not started yet.

Warehouse. Open storage area is not yet complete.

Radiological Laboratory at the University of California Medical School. Working drawings and specifications are complete and are currently being checked prior to being let for bid.

Miscellaneous Construction. Alterations to Laboratory Buildings. Alterations to Room 203E in the Chemistry Building are completed.

Power Distribution. Work on the 12 kv line to the hill switching station has not been completed as yet. Work on the other sections is continuing.

Fire Protection. The first phase of the project is complete; work on second phase has been suspended.

Alterations to Synchrotron Building. The shop extension is complete; plans for the counting room are still in preliminary stages.

Roads and Parking Areas. The section of reinforced paving north of Building 6 has been completed.

Alterations to Bldg. 16. These alterations have been completed.

Cyclotron Improvements. The motor generator house for the increased magnet excitation equipment is 30 percent complete.

-16-

UNCLASSIFIED

## MAN-MONTHS EFFORT REPORT

## SCIENTIFIC PERSONNEL

PROGRAM	SUBDIVISION	MAN-MONTHS EFFORT	COMMENTS
184-inch Cyclotron	Operation	10.3	
60-inch Cyclotron	- -	- -	Non-Project
Synchrotron	Operation	8.4	
Linear Accelerator	Linear Accelerator - General	3.5	
	Van de Graaff - General	3.5	
	Development	.9	
Bevatron	Building	.03	
	Injector	1.6	
	Magnet	1.1	
	Vacuum System	.03	
	Miscellaneous	.03	
Experimental Physics	Cloud Chamber	4.7	
	Film Program	10.4	
	Ionization Chamber and Crystal Counter	2.4	
	Neutron-proton Scattering	.7	
	Proton-proton Scattering	1.5	
	Absolute Cross Section Measurements	.7	
	General Physics Research	7.1	
	Meson Experiments with Synchrotron	3.0	
	Scintillation Counters - Research Experiments	.8	
	Pair Counter Experiments	5.5	
	XC Cyclotron	1.2	
	Particle Momentum and Energy Analysis	1.2	
	Proton Elastic Scattering	.7	
	Magnetic Measuring Equipment	.8	
	Meson Counting at the Synchrotron	1.0	
Cryostat - Preparation of Liquid Targets	1.0		
Instruments for General Use	-		
Theoretical Physics	Bevatron	.4	
	General Physics Research	12.3	
Isotope Separation	Nier Spectrometer	.1	
Radioactive Physics	General	2.2	
	Crystal Program	.3	

-17-

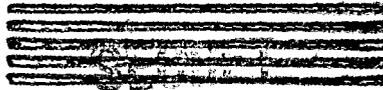
UNCLASSIFIED

## MAN-MONTHS EFFORT REPORT

SCIENTIFIC PERSONNEL  
(Continued)

PROGRAM	SUBDIVISION	MAN-MONTHS EFFORT	COMMENTS
Chemistry, Part A	Chemistry of Transuranic Elements	4.5	
	Nuclear Properties of Transuranium Elements	4.9	
	Transmutations with the 184" Cyclotron	13.0	
	Analytical and Service	17.7	
	Process Chemistry	10.0	
Chemistry, Part B	Synthetic and Experimental Chemistry	5.9	
	Biological Chemistry	8.7	
	Photosynthesis Chemistry	5.9	
Chemistry, Part C	Metals and High Temperature Thermodynamics	4.0	
	Basic Chemistry, including Metal Chelates	3.0	
	General	1.0	
	Ore Reduction	2.0	
Biology and Medicine Part A	Metabolism of Plutonium and Allied Materials	12.0	
	Decontamination Studies	7.0	
	Radiochemistry	4.0	
	Radioautography	2.0	
Biology and Medicine Part B	Tumor Metabolism	.6	1.6 Consultant Man-Months
	Special X-ray Studies, Radioactive Measurements, etc.	7.9	2.1
	Radioactive Carbon Studies	1.6	.3
	Fundamental Medical Research	6.8	3.8
	Hematology	.4	.7
	Medical Work with the 184" Cyclotron	1.7	.6
	Fly Genetics	2.3	.3
	60" Cyclotron Bombardments	.2	-
	Physical Chemistry	11.6	6.4
	Specific Irradiation	3.5	-
Donner Animal Colony Expense	.5	1.0	
Biology and Medicine Part C	Synthetic and Experimental Organic Chemistry	19.7	
Health Chemistry, Physics	Monitoring and Disposal	6.3	
	Research and Development	18.5	
	Film Badge Program	5.1	
	Medical Examination Time	2.4	

**DECLASSIFIED**



DECLASSIFIED