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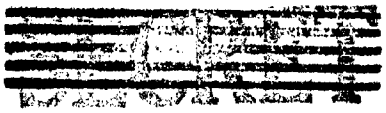

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RADIATION LABORATORY

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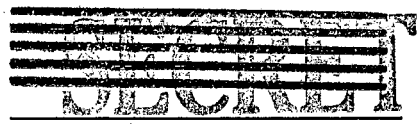

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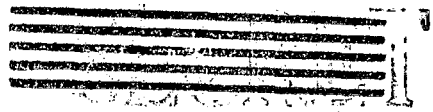

UNIVERSITY OF CALIFORNIA

Radiation Laboratory

Contract No. W-7405-eng-48

MONTHLY PROGRESS REPORT
No. 89

August 15 to September 15, 1950

September 29, 1950

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Berkeley, California

UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

August 15 to September 15, 1950

MONTHLY PROGRESS REPORT No. 89

1. Bevatron — UNCLASSIFIED

Building. The building is now about 98 percent complete, only the lighting and power wiring and some outside work remaining to be done.

Magnet. All the yoke and leg slab assembly work is complete and 80 percent of the yokes and 25 percent of the legs have been delivered to the building. The assembly shop will be closed down in a few weeks after clean-up work is completed. The layout of the bed plates on the foundation wall is proceeding and about half the jack locating rings are welded in place. The magnet cooling fans are being erected and the motors and duct sections are being installed. Both generator stators, flywheels, motors and bed plates have arrived. One bed plate is installed and one generator stator is in place. Three of the eight six-tube rectifier sets have arrived. Production sample cable spacers of one of the six types have been obtained and defects noted. By maintaining constant pressure on the supplier, Remler Mfg. Co., San Francisco, it is hoped that enough spacers can be obtained to start coil winding on November 1.

Injector. An error was found in the linear accelerator drift tube calculations making it necessary to redimension all the drift tubes and the stem locations. Owing to the lack of manpower available it will probably be several months before the new drawings are completed.

2. 184-inch Cyclotron Operation — UNCLASSIFIED

The 184-inch cyclotron was used for research experiments approximately 96 percent of the 497 hours that the crew was on duty. The time distribution was as follows:

	Hours	Percent
Operation	476-3/4	95.8
Filament change	1/2	0.2
Mechanical trouble	19-1/4	3.8
Electrical trouble	3/4	0.2
Total	497-1/4	100.0

[redacted] UNCLASSIFIED

3. 60-inch Cyclotron Operation

Steady alpha beams of from 6 to 10 μa (external) were maintained throughout this period. Operation of the instrument, although not completely satisfactory, has been at an efficiency level of about 80 percent.

4. Synchrotron Operation UNCLASSIFIED

The synchrotron beam was maintained at high intensity levels during this report period. Little time was devoted to actual machine development. All available time was used for physics research.

Operation was interrupted by the failure of one "GL506" ignitron in the magnet excitation circuit and by the breakdown of the injector high voltage supply. Comparatively little time was lost due to these difficultites. Investigation of the cause of ignitron "GL506" failure is continuing.

Preliminary investigation is under way for increasing the beam duty cycle by increasing the beam pulses from the present 6 per second to 12 per second. The magnet duty cycle would be unchanged.

Following are operating statistics for the period:

Research operating time	220.2 hrs	54.9 percent
Test of synchrotron	52.6 hrs	13.1 percent
Maintenance	128.2 hrs	32.0 percent

5. Linear Accelerator and Van de Graaff Operation UNCLASSIFIED

The Van de Graaff high voltage shell has been completely rewired. The new XM15 oscillators are all completed, the oscillator stands have been installed, and the wiring for the oscillator program has been started. The high voltage shell diffusion pump arrived, was tested, rejected and sent back to the manufacturer. The linear accelerator mechanical vacuum pump system was moved out into the spark gap shed and six-inch vacuum lines installed to the linear accelerator. The lead shielding on the North side has been finished. It is estimated that it will take approximately one month for the entire machine to be in working order. However, it will require an additional three weeks to put the Van de Graaff on wheels, so that bunching will be possible at a later date.

6. Experimental Physics UNCLASSIFIED

Film Program. The first exposure of electron sensitive emulsions to monoenergetic electrons and positrons from the synchrotron of 20, 40, 70, 100, and 200 Mev was successful in producing good tracks and these plates are quite workable. The grain density at minimum ionization is about 40 grains/100 microns. More runs will be made at reduced intensity with further precautions to avoid background. The tracks will then be studied to determine the free

path for various electron processes as a function of electron energy.

A study of the gaps in clogged tracks has been made. Measurements of the integrated "emptiness" of a track seem to provide a reliable measure of the particle mass and charge. Heretofore there has been no good way to utilize measurements of the grain density of clogged tracks.

A channel calculated to accept a meson beam of 50 ± 1 Mev mesons was constructed and tested in the 184-inch cyclotron. A beam with the anticipated energy and energy spread was found, but the intensity was less, by at least a factor of ten, from that expected. It is tentatively concluded that the effective proton beam at the 80-inch position is less than the one microampere assumed. The present intensity makes the feasibility of a good scattering experiment with this channel marginal.

An attempt has been made to find the deuterons from the assumed reaction $P(p,\pi^+)D$. The first experiment failed because of high proton background. Another method will be tried in the near future.

A number of experiments in which plates were exposed for workers in other laboratories were made. In connection with this program a simple means was developed to expose plates for correctly measuring the positive/negative meson production ratio.

Cloud Chamber. Data from the n-d scattering experiment is being read. The high speed coincidence circuits for the μ-decay experiment is nearly completed, and a new timer for the synchrotron cloud chamber has been constructed and is nearly completed. This is to be used to replace much of the timing equipment at the synchrotron. An x-ray shield is being constructed for the synchrotron cloud chamber building.

The experiment on the photodisintegration of the deuteron is progressing slowly because of difficulty in getting shop time. A precision chamber for counter controlled events is in final design, while designs for a 10 atmosphere chamber for neutron experiments are proceeding. An experiment to study π^- capture by helium nuclei is under design.

Proton Elastic Scattering. Runs using better angular resolution have given results which are in agreement with previously reported results. Trouble is still being experienced in fast, high-discrimination-ratio coincidence circuits which are both reliable and rugged. Work is being continued toward this end.

A run was made with the $1/5^{\circ}$ collimator previously reported. One-fifth degree scatterers were used, and nuclear plates (100 micron G5) for detection. The plates were placed edge-on to the beam. The results look promising, pending reading and interpreting of the plates. The tracks show up sharply and well collimated.

Cerenkov Radiation. The absolute accuracy of the energy of the deflected proton beam by using Cerenkov radiation has been much improved and will presently be of the order of ± 2 Mev. A preliminary run, with E. Segrè measuring the range

in copper, shows substantial agreement with the calculated range energy curve. Further checks of the range energy curves will be made presently.

Neutral Meson Program on the 184-inch Cyclotron. The yield of neutral mesons versus energy of bombarding protons was determined by using pair spectrometer with wide energy band detection. The electronic equipment for the detection of gamma pairs from the decay of neutral mesons was completed.

Bremsstrahlung from 190 Mev Deuterons. A number of runs have been made to determine the nature of bremsstrahlung from 190 Mev deuterons using a carbon target. The multiple channel GM tube pair spectrometer is being used and the spectrum is being surveyed from approximately 15 Mev to 80 Mev at 45°, 135° and 180° angles. The background radiation makes observations at 0° less practical with the present pair spectrometer. The data obtained so far are sufficient only to say that the intensity does not decrease the energy as rapidly as might be expected.

Development of Pair Spectrometers. Delay in procurement of parts and in fabrication of electronic equipment is holding up completion of the 350 and 200 Mev pair spectrometers.

Synchrotron Studies. Several types of experiments have been carried out with the synchrotron during the past month. The meson counting experiments have been continued and further work on the neutral meson will be done during the coming month.

Measurements have been made of the angular distribution of the shower γ-rays produced in Pb by a narrow beam of synchrotron x-rays. The detectors are Cu foils in which the induced radioactivity is measured. Initial results compare favorably with theory. In this technique the Cu detectors are placed at some distance from the Pb so that the angles which the γ-rays make as they emerge from the Pb are measured rather than the lateral spread of the shower in the Pb.

The yield of neutrons from targets bombarded with γ-rays is being measured with a BF_3 counter surrounded with paraffin. The yields are in agreement with those reported by Kerst and follow a Z^2 dependence for large Z. In the light elements there seems to be no regular variation with Z. The yield of neutrons and the number of (γ,n) processes in Cu indicate substantially more neutron than from the (γ,n) processes alone. One run has been made on the yield of neutrons per unit thickness of Pb as a function of the thickness of Pb. It has shown results similar to those reported by Strauch for radioactivity as a function of thickness in Pb. Further work will be done on this problem.

Further work on the production of stars by γ-ray beams of different maximum energies has been done. Calibration of the total energy flux at reduced energies has been done in order that the star production at different energies can be compared.

7. Theoretical Physics SECRET

MTA. Further work on the orbits of electrons emitted from the drift tube surfaces has indicated that it probably will not be possible to trap these electrons

by an appropriate design of the magnets used to radially focus the accelerated beam. The problem must and can be handled apparently by reducing the field emission.

8. M.T.A. Program SECRET

Mark I Conversion. The decision was made not to design the Mark I machine for proton acceleration at this time even though it will probably be necessary to convert it later for polonium production. However, the Mark I production target will be built for a proton beam. Mark I will operate first with deuterons and a current measuring target. After satisfactory data has been obtained on this type of operation, the machine will be converted to proton acceleration for polonium production.

Design work on the drift tubes for proton acceleration will proceed on the basis that the test program with the current measuring target will require 3 to 6 months. The drift tube design should be completed by January 1, 1951 and the drift tubes themselves and the production target should be ready by about January, 1952.

Mark I Cost Revision. The cost figures for Mark I have been raised slightly less than 15 percent over the January estimates. Major items contributing to this that were unforseeable are the conversion to a proton beam, the beam precessor, necessary spare parts and health instruments not previously provided for, and the increased cost of drift tubes and related facilities produced by their increased number and design modification. In order that the increase of funds requested not exceed 15 percent of the original estimate it has been necessary to drop the plans for duplicating at Livermore the test cavity in use in the Radiation Laboratory.

Field Emission. It has been found, following experience at Brookhaven with the Van de Graaff machine, that the field emission characteristics of the drift tubes in the 200 mc vacuum cavity could be considerably improved by the use of calrod heaters in the drift tubes heated to about 200°C. In order to provide heating for the Mark I drift tube surfaces to evaporate the oil film thought to be responsible for the high field emission from copper, calrod heaters will be soldered inside the tube to the 1/4-inch thick copper walls alternating with cooling water tubes. An equilibrium temperature of 250°C will be the aim. It is expected that heating will be needed only at the last stages of tank pump down or at intervals of several days. Because of the delay that would be required for redesign, no provision is being made to allow the drift tubes to run hot during accelerator operation.

Calculations have shown that the tangential magnetic fields of about 700 gauss obtainable with the present magnets and flux leaders make it impossible for electrons to travel from one drift tube to another. Consequently, it should be possible to suppress electron emission satisfactorily with flux leaders, even though the drift tube magnet power requirements are increased.

Oscillator and Tube Design. It had previously been decided that RCA would develop a 4-6 megawatt tube. Their present cost estimate for this development work

far exceeds their original estimate so that thought is being given to the use of clusters of smaller tubes in the Mark I design. This idea has been successfully tried in recent tests. RCA is now investigating the possibility of the development of a shielded triode 1-megawatt tube. They estimate that not more than 8-12 months would be required to get into production and the production rate would be adequate to meet the Mark II schedule.

The oscillator employing the RCA 5831 tube is being tested. The power input is 200 kw with 25 kv plate voltage. The oscillator efficiency is 95 percent. The oscillator efficiency and power consumption were measured under cw operation, but normal operation during the test was pulsed.

Ion Source. The beam from the ion source when measured by thermal methods appears to be 20-25 percent larger than shown by measurements with a biased collecting cup. Also the beam measurement by a transformer method gave much higher readings than the Faraday cup. The transformer method measures the beam without stopping it and so would be useful as a beam monitoring method on the full scale source.

A total ion current of 1.2 amps at 70 kv has been obtained at a distance of 16 inches from the source. At 24 inches the current collected was 800 ma. The pulses are 1 ms repeated once per second. The next step will be to operate at the Mark I duty cycle of 25 ms pulses at a rate of 8 per second. The focussing system has been changed by adding a fourth electrode to hold the beam in for several additional inches. A completion date of December 1 has been set for the full-scale ion source.

Beam Sweeper. The present design for the beam sweeping equipment calls for a magnet resembling the stator of a large three phase induction motor. It would sweep the beam through a circle having the radius of the undeflected beam. The peak beam intensity would then be reduced to 1-1/2 times the average undeflected beam intensity.

Tank Viewing System. Requirements for viewing the interior of the tank have led to the conclusion that two rows of four windows will be placed in the tank but only one row will be initially provided with periscopes on the side opposite the coupling loops, so that they may be observed.

Mark I Current Measuring Target. The current measuring target will consist of 20 mil stainless steel tubes carrying cooling water. The beam will lose 8 Mev of energy in the stainless steel and the remainder in the water. It is estimated that 9 feet of shielding concrete will be needed around the target. A fast acting door between the target and the tank will be provided.

Electron Models. The electron accelerating model of the linear accelerator has been assembled and has produced what appears to be a real beam.

The first test of the electron model of the high current cyclotron was unsuccessful because of the too rapid variation of the magnetic field with radius. The contours of the magnet pole faces will be modified to overcome this difficulty.

Livermore Test Cavity. The 35 foot Livermore test cavity will be designed so that it can later be extended to 60 feet and equipped with drift tubes to serve as a second accelerator for Po^{208} production.

Mark I Construction. The general construction program is still on schedule although some difficulty is being experienced in getting a satisfactory delivery schedule for booster pumps. Assurances have been received from G.E. that their work on the fabrication of the main oscillator power supply is on schedule.

Mark II Target Design Studies. Target designs considered to date for Mark II have been along conservative lines. Target designs using solid 1/2 inch uranium rods are satisfactory provided the ratio of peak to average intensity does not exceed 2. In the contrary case the temperature at the center of the uranium rods becomes excessive. One design considered would employ target elements consisting of three concentric tubes of copper clad uranium plus a central plug of aluminum. The principal draw-back to this scheme is the possibility that neutron losses might be as high as 50 percent. In order to get a better neutron economy some thought is being given to a target composed of bare uranium within a closed helium filled vessel having a 1/32-inch window for the beam.

9. Chemistry SECRET

Part A

Spallation of Iron with 340 Mev Protons. The yields of 13 nuclides from Cl^{34} to Co^{55} have been determined for the spallation of iron with 340 Mev protons. Seven other yields have been observed, but the cross section calculations require the determination of an unknown counting efficiency in each case.

Isotopes of Zirconium. Several zirconium isotopes have been produced by spallation of niobium. The half-life of Zr^{87} has been found to be 85 $\pm$ 3 minutes, and its positron energy 2.44 Mev. It decays by the following scheme:

$$Zr^{87} \xrightarrow[\beta^+]{85m} Y^{87m} \xrightarrow[IT]{14h} Y^{87} \xrightarrow[K]{80h} Sr^{87m} \xrightarrow[IT]{2.7h} Sr^{87}$$

These results are in disagreement with the work of Robertson, Scott and Pool (Phys. Rev. 76, 1649 (1949); 78, 318 (1950)).

A new isotope is assigned to Zr^{86} because it decays to an isotope previously assigned to Y^{86}:

$$Zr^{86} \xrightarrow{14h} Y^{86} \xrightarrow[\beta^+]{14.5h} Sr^{86}$$

A long lived activity, not yet well characterized, is belived to be due to Zr^{88}.

Shell-Stabilized Isotopes of Radium. High-energy spallation of throium has produced Ra^{213}, which decays:

$$Ra^{213} \xrightarrow{\alpha} Em^{209} \xrightarrow{K} At^{209}$$

Present data indicate the half-life of Ra^{213} to be about two minutes and that of Em^{209} to be one to ten minutes. There has also been found evidence that Ra^{212} decays by electron capture to Fr^{212} with a half-life of one or two minutes.

Half-Life of Actinium. In order to resolve the discrepancy in reported values for the half-life of Ac^{227}, ranging from 7 years to 21.7 years, we have measured a sample, aged for several years, by the differential technique of Segrè and Wiegand. Measurements over a period of 100 days resulted in a value of 22.0 ± 0.3 years.

Fission of Uranium with 340 Mev Protons. The study of the yields of products of the high energy fission of uranium is being continued. Recent results include the yields of Ba^{140} + Cs^{140} + Xe^{140} + etc.; La^{140}; and Nd^{140} + Pm^{140} + etc. These data and similar ones allow an analysis of the distribution of Z for the primary products of a given mass. Similar data are being gathered to reveal the distribution of A for primary products of a given Z.

Curium Metal. Curium metal has been prepared on the microgram scale by the reduction of CmF_3 with barium metal. The metal is silvery, about as malleable as plutonium, and appeared to tarnish more rapidly than other actinide metals. The greater reactivity is probably due to the extreme radioactivity; the power output per microgram is 1.2×10^{-4} watt and is enough to maintain the temperature of the metal substantially above that of its environment.

Measurements of the physical properties are being made.

Absorption Spectrum of Hydrated Americium Chloride. The absorption spectrum of hydrated americium chloride has been photographed at room temperature and at liquid nitrogen temperature. At room temperature 40 lines were observed. At low temperature, 70 were measured. These peaks are mostly very narrow, approximating line widths observed in emission spectra. Interpretation of the data is incomplete.

Microcalorimetry. The microcalorimeter which has been used in this laboratory for determination of heats of solution of transuranium compounds and elements is being modified in an effort to decrease its heat leak. Another microcalorimeter, of the adiabatic type, is also being worked on. It is hoped that the latter calorimeter will allow heat measurements on reactions extending over several hours.

One-Tube Coincidence Counter. A coincidence circuit has been devised which makes use of a single 6BN6 tube and which promises to be satisfactory.

Chemistry — UNCLASSIFIED

Part B

Synthetic and Experimental Chemistry. High specific activity preparations of the following compounds have been completed in the past month. Yields based on

$C^{14}O_2$ and quantity of radioactivity handled are indicated in parentheses. Cyclohexanone-2-C^{14} (40 mc, 45 percent); valine-1-C^{14} (30 mc, 51 percent); succinic acid-1-C^{14} (10 mc, 55 percent); succinic acid-2-C^{14} (10 mc, 30 percent); cuprous cyanide-C^{14} (10 mc, 65 percent); and sodium isovalerate-2-C^{14} (5 mc, 32 percent).

Among the various compounds whose preparations are being studied at present are the following: Norvaline-3-C^{14}, norleucine-3-C^{14}, D and L-valine-C^{14}, aspartic-1-C^{14} acid, aspartic-2-C^{14} acid, ethylene glycol-1,2-C_2^{14}, α-naphthyl acetic-α-C^{14} acid, vinyl acetic-1-C^{14} acid, glucose-1-C^{14}, mannose-1-C^{14}, methyl-C^{14} iodide (100 mc run), sodium acetate-2-C^{14}, valine-4,4'-C_2^{14}, valine-2-C^{14} and isopropyl-1,3-C_2^{14} iodide.

A program of research has been undertaken to synthesize a morphine derivative in which C^{14} has been incorporated into the molecule in a stable C-C bond and thus allow the metabolic fate of the compound to be more easily and closely followed. At the same time, new derivatives with decreased addiction liability are sought among the nuclear alkylated morphine derivatives. Work is in progress on the synthesis of 6-methyldihydrodesoxycodeine-D by hydrogenation of 6-methoxydesoxycodeine-C.

Oxalic acid-1,2-C_2^{14} has been decomposed in 100 percent sulfuric acid at 41.8°, 63°, 79.9° and 99.8°C. Measurement of the activities of the products are now in progress. Preliminary data indicate that there is a C^{14} isotope effect of about 6 percent in this reaction. Diethyl α-naphthylmalonate has been hydrolyzed to the sodium salt of the acid. The hydrolysis and isotope effect in decarboxylation of the resulting product is in progress.

Work is continuing on the investigation of the problem of counting low specific activity C^{14} samples from biological experiments.

Biological Chemistry. During the past month work on a number of biological projects has continued. These include the following.

a. Study of the metabolism of purines. In this work, high specific activity C^{14}-labeled adenine, 8-azaadenine, guanine, and 8-azaguanine have been given to mice and the metabolic products studied by chemical means as well as by paper chromatography. Material balances and animal distribution and excretion have also been determined.

b. The work on the metabolism of simple fatty acids by in vitro liver slices has continued. Effort has been directed toward the discovery of the various metabolites produced when propionic acid labeled in various positions is thus incubated. Lactic acid has been isolated and degraded and various other hydroxy acids have been partially characterized.

c. The biochemistry of cholesterol and other steroids has been studied. The isolation of cholesterol from egg yolks from chickens fed radiocarbon compounds and the degradation of the steroid has continued. The role of cholesterol in the S_f13 factor from human heart disease cases has been investigated both by paper chromatography and infra-red spectroscopy. The feeding to rabbits of

cholesterol and various alcohols to induce abnormal blood pictures has also continued.

d. The elimination studies and metabolic oxidation to $C^{14}O_2$ of C^{14} from humans fed glycine-2-C^{14} has continued with members of the Medical Physics Group.

e. The study of the metabolism and excretion of stilbamidine-amidine-C_2^{14} in normal and cancerous mice has continued with the Medical Physics Group.

Photosynthesis Chemistry. The nature of the chemical processes occurring during photosynthesis is being approached in several ways. The intermediates are being identified and the sequence of their formation determined. Suspected intermediates are being synthesized with C^{14} and their assimilation by plants studied. The effects of abnormal conditions of photosynthesis upon this sequence and the products formed are being investigated.

The sequence of compounds appearing as a function of time is being determined for normal and iodoacetamide-poisoned Scenedesmus. By determining the distribution of C^{14} in the amino acids in the protein hydrolysates it is hoped to correlate the synthesis of protein with the appearance of labeled free amino acids in plant extracts. Identification and chromatography of the amino acids is in progress.

Since it has been shown that phosphoglyceric is a "first product" of $C^{14}O_2$ fixation during photosynthesis, the nature of the C_2 acceptor molecule is of considerable importance. No clear-cut analogous reactions have yet been demonstrated in animal metabolism. By degrading phosphoglyceric acids of short photosynthesis it has been shown that it must have a symmetrically labeled C_2 precursor. With this in mind, the synthesis of C^{14}-labeled glycol from oxalic acid has been undertaken. As soon as sufficiently high yields are obtained preliminary assimilation experiments will be done. The remaining C_2 compounds will be tried in turn. Acetate has been re-examined as a precursor of the C_2 compound but found to form only fats and tricarboxylic acid compounds.

The Sakami reaction by which animals synthesize serine from glycine has now been shown to have its counterpart in plants. Serine from Scenedesmus fed glycolic acid-2-C^{14} has been degraded and found to contain 7 percent, 62 percent and 42 percent in carbons 1 to 3, respectively, serine from Scenedesmus fed glycine-2-C^{14} will be similarly degraded. The one-carbon compounds possibly involved in such transformations have been fed to Scenedesmus and the products examined by radiochromatography. Formate and methanol appear to be possible intermediates, while formaldehyde, although converted to polymers in the plant, is not incorporated in the usual products of photosynthesis.

The phosphate esters involved in sucrose synthesis have been further separated using washed filter paper for chromatography. Separation of the hexose monophosphates, previously in an unresolvable area, has been accomplished. The possibility of separations is important since the classically prepared glucose-6-phosphate has been shown by exchange resin analysis to contain another

phosphate, the identity of which is being investigated using enzymatic hydrolysis.

An experiment has been done to prepare both P^{32}-and C^{14}-labeled phosphate esters. With doubly labeled esters it is hoped to expedite the identification of phosphate-containing compounds. It should be possible to determine both specific activity of the C^{14}-labeled compounds and the number of phosphate groups on the molecule.

Phosphoglycolic acid has been synthesized from phosphoglyceric acid and separated from it on ion exchange resin columns. The product is being characterized.

Chemistry SECRET

Part C

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

1. Liquid metal systems and heats of formation of intermetallic compounds.
2. Theory of refractory behavior.
3. Thermal conductivity of gases.
4. Measure and study of heat transfer coefficients in forced convection film boiling.

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

1. Thermodynamic studies on rhenium
2. Fe^{3+}-Fe^{2+} electron exchange rate.
3. The thermochemistry of germanium (II).

10. Medical Physics FOR OFFICIAL USE ONLY

Part A

Tracer Studies. Studies upon the fate of carrier-free chromium, titanium and tantalum have been conducted using rats. The relationship between sodium space and x-ray irradiation in rats is being continued, and studies upon terbium produced in the pile have been completed.

Decontamination and Bone Metabolism Studies. This work is being terminated this period since Doctor Copp has left the project. Final results will be presented in the Quarterly Report.

Chelating Studies. The assays of the samples in the experiment to determine the effect of chelating agents on the excretion of plutonium have been completed. Work is continuing on several other problems, namely (1) the assay of cerium

samples in the in vivo chelating experiments, (2) the experiments to determine the effect of Fe 3 in forcing Mn depletion studies, (3) long-term experiments to deplete rats of iron using Fe 3.

Radiochemistry. Millicurie amounts of carrier-free radio-columbium have been prepared for injection. Approximately 100 μc of Co^{51} have been isolated in the carrier-free state from deuteron bombarded vanadium using a previously developed isolation procedure. Carrier-free radio-scandium has been isolated in microcurie amounts from deuteron bombarded titanium. A carrier-free procedure for the isolation of Mo^{99} from alpha bombarded zirconium is being developed.

Medical Physics — UNCLASSIFIED

Part B

Influence of Tumors on the Concentration of Carbon 14 Labeled Stilbamidine in the Liver. It is now established that in Strain A mice the presence of certain transplanted tumors is associated with a significant increase in the liver concentration of carbon 14 labeled stilbamidine. Moreover it has been found that normal C 57 strain mice mice have C^{14} stilbamidine liver concentration that are in the same range as tumor bearing mice of other strains.

Endocrine Influence of Iron Turnover. Plasma iron turnover rates of hypophesectomized rats is slowed. ACTH given to such animals restores the turnover to normal. Hypophysectomized animals excrete more iron than do normal animals. ACTH causes a further increase in excretion. ACTH aids in the maintenance of a normal red cell mass in hypophesectomized animals.

Metabolism of Carbon 14 Labeled Glycine. The life of the red blood cells with radioactive glycine. Patient No. 3 who has chronic myelogenous leukemia died approximately four months after administration of 100 microcures of carbon 14 labeled glycine. At autopsy tissues were obtained from the bones, spleen, liver and kidney. These tissues varied in activity from 0.15 to 0.3 disintegrations per minute per milligram of barium carbonate. Calculations show that approximately 10 to 15 percent of the dose was retained within the body. Analysis of the breath curve showed that approximately 86 percent of the dose was excreted in the breath. This was the 10 to 15 percent retention and the 3 to 5 percent excretion in the urine completely accounts for the carbon 14 given to this patient. This study would indicate that at least, in this one patient, that there was another component in the breath curve, namely a fourth component. On the assumption that the amount remaining will be eliminated as a single exponential, this component would have a calculated half time of from two to three years. It is difficult to more fully analyze the data at the present time with regard to this, inasmuch as the apparatus for the measurement of carbon 14 is not sufficiently sensitive to detect the component in the breath of these patients.

Double Nucleated Lymphocyte Problem. Irradiation experiments have now been done with both Bagg albino and Swiss strains of mice. Data evaluated so far shows an increased incidence of double nucleated lymphocytes in the Bagg strain after

bombardment with deuterons and with neutrons, which was not demonstrated in similar experiments with Swiss mice. Neither strain has so far shown the effect with x-irradiation.

Bacteriology. Temperature of incubation after ultra-violet irradiation has been found to affect the survival of E. coli. Organisms grown at 37°C after irradiation show a lower mortality than those grown at 30°C. This corroborates results reported by Anderson and Whittle from Oak Ridge.

The interrelationship of this phenomenon with photodensitization (see previous progress reports) is being studied.

11. Health Physics and Chemistry

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Shielding Survey. The study of fast neutron fields around the 184-inch cyclotron has been continued. Ilford C-2 nuclear plates have been employed to study the fast neutron flux at various depths in the concrete shielding surrounding the 184-inch cyclotron. The plates are exposed for a certain time during a routine cyclotron run and developed; then the plates are scanned for stars produced by fast neutrons. At present two runs have been made and the results are encouraging. Further studies will be made through the shielding at other points and the results will be reported in subsequently monthly and quarterly reports.

The study of fast and slow neutron fields around the synchrotron has been studied further and it appears that at present the shielding is quite adequate.

With improved instrumentation and techniques a more detailed study of the fast and slow neutron fields around the 60-inch cyclotron is being carried out. Results will be reported on at a later date.

Research and Development Group Activities. Following is a list of the principal items in progress:

1. Equipment for use in processing a sample from Chalk River for Los Alamos personnel is essentially complete.

2. The preparation of equipment for proton bombardment of uranium by chemists Folger and Stevenson is partially done.

3. One Berkeley gloved box for animal chemistry has been made which embraces alterations and improvements in animal chemistry box layout and a box for use with mass spectrograph has been completed.

4. Two centrifuges made ready for issue from decontaminated parts and five new centrifuges made ready for issue.

5. Design and experimental work took place on the following items; improved glove box door, new type centrifuge suspension (removable pot type), single-piece, curved edge glove port, panel-assembly type box, and panelyte-lined glove box.

12. Plant and Equipment

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Bevatron. The building is approximately 97 percent complete. All that remains to be done is to check the mechanical equipment. This is awaiting connection of the water supply to the building by the University. About 40 percent of the magnet steel has been delivered to the building. Switchgear is 15 percent complete. 98 percent of the wiring raceway gallery is complete. The west motor generator bed plate is complete and the east motor generator bed plate is being installed. The first rotor is reported in transit from Pittsburg.

Construction of Cafeteria. The landscaping design is nearing completion.

Construction of Animal House. Architects' working drawings and mechanical drawings are almost complete.

Construction of Sheetmetal and Salvage Shop. Preliminary plans on the sheetmetal shop have been approved by the University and final plans are being prepared.

Radiological Laboratory at the University of California Medical School. The excavation is 83 percent complete and some of the form work and concrete work is complete.

M.T.A. Project. Development and design continuing.

Measurements Project. Development and design continuing.

Miscellaneous Construction. Power Distribution. Work on the associated power extensions is continuing.

Fire Protection. The 8 in. high pressure water tie line across the Bevatron area has been completed. Work is now in progress in providing a line to the south end of Warehouse No. 46.

Alterations to Synchrotron Building. Construction of the counting room in the synchrotron building is approximately 95 percent complete.

Cyclotron Improvements. Motor generator house for the increased magnet excitation is 100 percent complete.

Rehabilitation of Usable Sections of Building No. 8. Work in connection with the rehabilitation of sections of Building No. 8 not seriously damaged by the fire is getting under way.

Miscellaneous Utilities. The communications, gas and sewer extensions to the area north of the Bevatron Building are 95 percent complete. It was necessary to make these extensions before installation of the concrete paving in this area.

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Old Radiation Laboratory. Alterations to Rooms 208 and 209 in the Old Radiation Laboratory (for North American Aviation) are 25 percent complete.

Alterations to Rooms 106 and 107, Building No. 4. These alterations are 25 percent complete.

LMB/10-5-50
Information Division

MAN-MONTHS EFFORT REPORT

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Scientific Personnel

Program	Subdivision	Man-Months Effort	Comments
184-inch Cyclotron	Operation	13.8	
Synchrotron	Operation	7.9	
Linear Accelerator	Linear Accelerator - General	7.1	
	Van de Graaff - General	7.2	
	Development	1.5	
Bevatron	Building	-	
	Injector	.2	
	Magnet	.8	
	Vacuum System	-	
	Miscellaneous	-	
Experimental Physics	Cloud Chamber	10.5	
	Film Program	22.6	
	Proton-proton Scattering	-	
	Absolute Cross Section Measurements	-	
	General Physics Research	19.6	
	Meson Experiments with Synchrotron	1.3	
	Scintillation Counters - Research Experiments	1.7	
	Pair Counter Experiments	9.7	
	Particle Momentum and Energy Analysis	2.8	
	Proton Elastic Scattering	1.5	
	Meson Counting at the Synchrotron	2.3	
	Preparation of Liquid Targets	1.7	
	Instruments for General Use	3.1	
	Special Development	12.7	
	Magnetic Measuring Equipment	.6	
Theoretical Physics	Bevatron	.7	
	General Physics Research	16.5	
Isotope Separation	Nier Spectrometer	.3	
Radioactivity Physics	General	3.3	
	Crystal Program	-	

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Program	Subdivision	Man-Months Effort		Comments
Chemistry, Part A	Chemistry of Transuranic Elements	8.9		
	Nuclear Properties of Transuranium Elements	7.8		
	Transmutations with the 184-in. Cyclotron	19.0		
	Analytical and Service	18.3		
	Process Chemistry	11.7		
	Special Chemistry Development	1.0		
Chemistry, Part B	Synthetic and Experimental Chemistry	4.9		
	Biological Chemistry	7.2		
	Photosynthesis Chemistry	5.9		
Chemistry, Part C	Metals and High Temperature Thermodynamics	7.0		
	Basic Chemistry, including Metal Chelates	4.0		
	General	2.5		
	Ore Reduction	0.8		
Biology and Medicine Part A	Metabolism of Plutonium and Allied Materials	10.0		
	Decontamination Studies	6.0		
	Radiochemistry	4.0		
	Radioautography	2.0		
Biology and Medicine Part B	Tumor Metabolism	1.4	1.6	Consultant Man Months
	Special X-ray Studies, Radioactive Measurements, etc.	6.9	2.6	
	Radioactive Carbon Studies	2.0	.3	
	Fundamental Medical Research	7.5	2.8	
	Hematology	.4	.2	
	Medical Work with the 184-in. Cyclotron	1.3	-	
	Fly Genetics	2.2	-	
	60-in. Cyclotron Bombardments	.3	-	
	Physical Chemistry	7.0	.5	
	Specific Irradiation	4.1	-	
	Donner Animal Colony Expense	2.4	.9	
	Atherosclerosis Program	20.4	5.2	
	Radioactive Iron Studies	2.3	1.1	
Biology and Medicine, Part C	Synthetic and Experimental Organic Chemistry	17.6		
Health Chemistry, Physics	Monitoring and Disposal	8.1		
	Research and Development	21.3		
	Film Badge Program	4.9		
	Medical Examination Time	1.8		
Measurements Project Development	General	8.3		
M.T.A.Project	Design and Development	32.0		