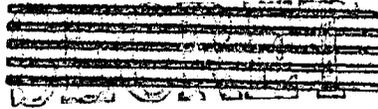


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Radiation Laboratory

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PROGRESS REPORT No. 79

October 15 to November 15, 1949

November 29, 1949

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Berkeley, California

UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

October 15 to November 15, 1949

PROGRESS REPORT No. 79

1. BevatronUNCLASSIFIED

Quarter Scale Model. Further experiments have shown the critical shape of the r.f. rise curve to be an initial small voltage followed by a rapid rise 600 to 800 microseconds later. This shape increases the beam about 75 percent over all others tried. Measurement of the radial and vertical beam oscillation frequencies by the methods suggested by Crane gives values of 68 percent and 86 percent of the rotation frequency respectively which is in good agreement with the theoretical value computed for the quadrant spacing and fringing field existing. With the fractionating jets in the diffusion pumps the pressure rise due to operation seems to be less than with the non-fractionating jets. The base pressure appears to be the same with each type. However, the conditions for observing small differences in the pump performance on the operating model are not very good. As the model has provided all the information felt necessary at this time for the design of the full scale machine, operation was discontinued on October 18. Detailed reports of the tests and operating results have been prepared by Dr. Lofgren and are available through the Laboratory Information Division.

Magnet Model Tests. Measurements have been made on the 1/12 scale magnet model which show an initial inductance of 4.2 henrys and a stored energy of 83 megajoules at 9800 gauss for the 2 x 6 ft. aperture full scale machine. Uniformity and residual field measurements are proceeding.

Building. Retaining walls are now about 90 percent complete. Although some small slides have occurred since the last report no great trouble has been experienced and if no heavy rain occurs for a week there should be no further interference with concrete work. About 75 percent of the column footings are finished and the air ducts below the magnet room floor are complete. Forming for the generator foundations is starting. Drawings for the magnet foundation have not yet been issued to the contractor.

Magnet. Steel deliveries are still held up by the strike. All the inspection and assembly tools are ready for use. The leg and yoke slabs of the sample sector have been assembled but the sector itself is not yet erected. Drawings have been issued for all the slab parts and many of the sector assembly parts. A measurement of the heat transfer resistance through one of the sample yoke slabs has been made to verify the basis of the design of the yoke slab cooling system. Results were more favorable than had been calculated.

Magnet Power Supply. George Farly visited the Westinghouse plant at Pittsburg during the week of October 31 to observe the ignitron tests. It is felt that the required failure rate of one per 8 hours will probably be met by the tubes as now designed although it is not possible to make shop tests that can duplicate the operating conditions. It is hoped to delay shipment of the rotating machines, now scheduled for February, until the building will be ready to receive them.

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Vacuum System. Design of a ten foot test section of the vacuum tube with internal poles and a single 32 inch pump is proceeding.

Magnet Coils. A flux plot of the field around the quadrant end windings to determine the mechanical forces on the coils and surrounding iron parts has been completed. Bids have been received on the bakelite cable spacers. Design of the cable supports is proceeding. The sample 100 ft. length of cable has been received and shows good mechanical properties.

Injector. Model tests to determine the dimensions of the linear accelerator electrodes is complete. Drawings of the ion gun changes to accommodate the PIG source have been issued.

2. 184-inch Cyclotron Operation

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The cyclotron was shut down for a period of two weeks last month for the installation of new equipment. This included a new large probe vacuum lock, a new electric deflector mechanism, and various carbon shields inside the vacuum tank.

Therefore, operation of the cyclotron for research experiments and tests used about fifty-four percent of the 483 hours that the crew was on duty.

3. 60-inch Cyclotron

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The cyclotron is in operation again although due to the necessity of baking the green parts, the operation level is very low. Internal beams of the order of 250 microamperes have been recorded as well as an external deuteron beam of 20 microamperes. Magnetic shimming is being attempted to better focus the beam.

4. High Current Cyclotron

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In designing and planning the proposed high current cyclotron completion dates on both separate items and the complete machine have been estimated. The schedule calls for completion of all electrical work by March 15, 1950. At this time, all mechanical components except the radiation shielding will be finished. A period of three to four weeks will follow to get the machine into operation and install the shielding.

The vacuum chamber and pole pieces are being fabricated at Mare Island Navy Yard and are scheduled for delivery the latter part of December. A mock-up of the oscillator and dee system has been tested. We have determined that there will be no difficulties from instability. The two modes of oscillation are separated by ~ 0.3 megacycle. Other measurements indicate that with 400 KV dee to dee, the i^2R losses will be of the order of 90 KW which is 10 percent lower than our original calculations. Early testing of the oscillator in its final form will be done with a pulse line 2 ms. long. This is an inexpensive but more certain way of overcoming the usual difficulties of applying extremely high voltages to the dees than to gradually work the voltage up under C.W. operation with the possible danger of damaging an oscillator tube.

The pump for circulating molten bismuth in a closed system has been designed and is to be tested in the next few weeks. This test will furnish the necessary heat transfer data needed to complete the design of the target assembly.

5. Synchrotron Operation

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Beam intensities on the synchrotron have been steady for extended periods of time with the peak of 3300 R/hr reported last month having again been attained. Variations in the 12 KV line voltage have been troublesome because of console adjustments of the machine being necessary with each swing of voltage. This problem has been somewhat improved with the temporary injector H.V. regulator, Sola transformer regulation of the magnet pulser, and raising of the transformer taps.

A new policy of injector removal before complete filament failure has occurred has been adopted because of warping of the filament toward the end of its life apparently being the cause of fading and erratic beam intensities. At least three injectors so removed in the last month show this warping. An electronic switch has been designed and built which will turn the A.C. filament off during the time the synchrotron is on. This will remove the forces on the filament due to magnetic field interaction and may help to lengthen filament life. It will be tested soon. The design and 70 percent completion of a more versatile injector test tank has been accomplished. Also a new model of the Ba Zr oxide dispenser cathode gun is 30 percent complete.

A permanent "orbit" contractor has been connected to fire a pulse of D.C. into the north magnet compensating octants in series. Its effect there has been known for some time to give an increase in intensity of 2-1/2 times.

Further savings in beam time are being realized from the new installation of an automatic liquid N₂ dispenser and the roll away beam transit used for aligning apparatus in the beam.

The plan for monitoring the magnetic field phasing with octant peaking strips has been temporarily delayed to accumulate a set of peaking strips giving identical signals to within $\pm .05 \mu$ sec. Variations of $\pm .4 \mu$ sec have been found and are due to winding to core spacing variations. This tolerance has been improved and a usable set is being wound.

6. Linear Accelerator and Van de Graaff

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The linear accelerator has not been used during this month since it was found that the column of the Van de Graaff generator had accumulated an excessive amount of crud on its inside surfaces to permit it to hold full voltage. The column has been disassembled and the insulators sandblasted on the inside. The column has now been reassembled for testing. If this operation is successful the insulators will not need to be replaced. If unsuccessful, new insulators will be required.

The experimental oscillator employing two Eimac XM-15 triodes has yielded 440 kw into a 6 ft. resonant cavity operating in a freon air mixture. At this power (nearly 10 MV) operation was limited by spark breakdown. Work is now in progress to feed the oscillator into a vacuum cavity.

The operation of the linear accelerator without focusing grids has prompted some theoretical calculations on the operation of a "short" linear accelerator. As a result of this work it is likely that the "grid-less" linear accelerator operates in a focusing but phase-unstable manner. Such operation is not practicable however

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for a very long accelerator. One of the features associated with no-grid operation is an increased criticalness of injector voltage.

7. Experimental Physics

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Film Program. Observations on Tracks in Electron Sensitive Emulsions. Low ionization tracks from π^- meson endings are being studied using G.5 emulsions. Of 112 star prongs from 77 mesons, only 5 are protons of energy $> \sim 30$ Mev, in contradiction to hypotheses of Marshak and Fujimoto, Hayakawa, and Yamaguchi. Some low energy electrons are associated with meson termini, but a quantitative estimate will require plates of smaller low-energy electron and random grain background. No fast ($> \sim 1$ Mev) electrons have yet been found, but their observation also is limited by background.

Meson Mass Measurements. Work is continuing on a measurement of the masses of π^+ , π^- , and μ^+ mesons by comparison with the proton mass. During the past month, preliminary runs have been made with apparatus using the new cyclotron air lock.

Cloud Chamber. The cloud chamber group has completed the measurements in the experiment to determine the spectral distribution of γ -rays from the synchrotron. In addition we have just begun to measure the energy distribution of the electrons (and positrons) that are produced when the γ -ray beam is incident on a piece of lead 1/2 inch thick. This thickness corresponds to the maximum of the shower and the energy spectrum at this point is one of the things that can be predicted theoretically.

Positive π -Meson Decay. An attempt will be made to measure electronically the time between the stopping of a π -meson in a stilbene crystal counter and its subsequent decay producing a μ -meson. No runs have been made as yet.

Fission Induced in Uranium by π^- meson Capture. Plates have been impregnated with uranyl nitrate and exposed to mesons in the 184-inch cyclotron. Results are in agreement with the ion chamber experiments on fission induced by high-energy neutrons in which the fission energy is found to be essentially independent of primary energy. The results are also compatible with the assumption that any negative π meson captured in any uranium nucleus produces a fission.

Shower Curves in Matter Produced by 335 Mev Bremsstrahlung. A thin ionization chamber has been used to investigate the ionization along showers initiated by the x-ray beam from the synchrotron. The showers have been studied in carbon, aluminum, copper and lead. An unexpectedly large amount of backward flux of ionizing particles in the heavy elements was found which made the large diameter of the chamber mandatory. Compton scattering and pair production contributions have been resolved in the initial part of the shower.

Neutron-proton Scattering at Small Scattering Angles. The geometry of photographic plates used in the linear accelerator proton-proton scattering experiments has been enlarged to extend the 90 Mev neutron-proton scattering data to small scattering angles. The results are in good agreement with prior n-p scattering data.

π^- capture in H_2 . An apparatus containing 600 cc of hydrogen at $-211^\circ C$ and 300 p.s.i. pressure has been tested and is being installed in the 184-inch cyclotron. Its purpose is to study the expected gamma rays from the reaction $\pi^- + H \rightarrow p + \gamma$.

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Excitation Curve for $C^{12}(p, pn)C^{11}$ Reaction. The positron C^{11} activity produced when carbon is bombarded with high-energy particles has become a useful monitor in various experiments. An effort is therefore being made to establish absolute excitation curves for the reactions. The (p, pn) is being studied in the linear accelerator and the 184-inch cyclotron.

Proton-proton Scattering Near 30 Mev. Plates read by different observers taken in the linear accelerator with protons scattered in hydrogen are being sampled to estimate deviations caused by observer error. The primary energy used in the experiment has been fixed at $29.6 \pm .3$ Mev.

Proton-proton Scattering at 340 Mev. Two high-speed distributed amplifiers are complete and have been tested. They give a pulse output up to 30 volts, with rise time about 10^{-8} seconds. Since it is difficult to arrange adequate tests of the fast electronic coincidence circuit it is planned in the first experiments with the apparatus to photograph the pulses on an oscilloscope screen whenever the electronic circuit registers a coincidence. The photography has been found feasible using a Techtronix oscilloscope modified for 12 kv acceleration potential and using Eastman Linagraph Panchromatic film. It is expected that the new amplifiers will be fast enough to give some new information about the time dependence of the beam intensity from the cyclotron.

Proton Elastic Scattering. In a preliminary measurement of the angular distribution of elastically scattered 345 Mev protons, differential cross sections were obtained for C, Cu and Pb which were in rough agreement with the prediction of the transparent nucleus theory. In the Cu measurement there is a clear indication of the secondary diffraction maximum at about 15° .

High Energy Photons. An effort was made to detect γ - γ coincidences of the high-energy photons believed to be due to neutral meson decay. Due to background counting rates this experiment was not successful. A cloud chamber method is in preparation.

During the past month a pre-amplifier for use with photo-multiplier tubes in the scintillation pair counter has been designed and constructed. Its function is to take the output pulses from the photo-multiplier tube, and by means of a tapered line to deliver them into a concentric line running to a remote distributed amplifier. Preliminary tests with a sine wave generator indicate a satisfactory gain of 2 and a bandwidth of more than 100 mc. The output impedance is 125 ohms so the pre-amplifier can be connected to the main amplifier through any reasonable length of cable.

BF_3 Ionization Chamber for Delayed Neutron Investigations. Attempts to collect electrons in an ionization chamber filled with 1 atmosphere of purified $B^{10}F_3$ and fitted with a pulse amplifier were unsuccessful. A mixture of 20 cm of $B^{10}F_3$ and 55 cm of argon however was successful. A signal to noise ratio of 8:1 is obtained with collecting voltages of 2500 volts. The capacity of the chamber has been reduced by substituting six .050 in. electrodes for the previous continuous cylindrical shell. Further purification of the gas will be attempted.

Meson Induced Fission Experiment. Initial test runs have been delayed because of the unavailability of cyclotron time.

In the meantime, a test is in process to determine the feasibility of operating a cathode follower circuit in high magnetic field strengths of the order of 15,000 gauss. Such a cathode follower would be used as an impedance transformer

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at the position of the fission chamber (i.e. in the cyclotron magnetic field) in an effort to reduce background counts from stray "pickup".

Other Studies in the Synchrotron. The meson program has continued with an additional run on a 0.6 in. spherical target in the "sea of copper" and two long successful bombardments of the liquid hydrogen target. Scanning of the nuclear plates exposed in these runs is now proceeding. Two methods of counting mesons directly are being tried in the beam. One utilizes the steering field to bend negative mesons of a given energy range into crystal counters and the other is based on a coincidence of mesons traversing one crystal counter and entering a second, followed by a pulse from the decay electron. The electronics and preliminary work on these methods have progressed to the final stage of proving before taking data.

Work on the induced radioactivity experiments has proceeded through the past month and is being continued. The transition curves of lead, copper, aluminum, and carbon are complete except for minor checking. Preliminary work has started on (γ, p) energy distribution and the thin window ionization chamber is ready for calibration.

8. Theoretical Physics

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P-p Scattering. A paper is being written on this subject.

Meson Program. The theory of the positive negative ratio and the angular distribution for mesons produced by the synchrotron is being completed in detail for various meson theories.

($n-\gamma$) Reactions on the Synchrotron. The shower theory is being compared with experimental results with fairly good success.

Neutron Cross Sections. The 280 Mev neutron absorption cross sections agree well with theory. There is a discrepancy in the scattering cross section which is being investigated.

Cyclotron Design. Machine studies of cyclotron design are in progress.

9. Chemistry

CONFIDENTIAL

Part A

Specific Alpha Activity of Plutonium. Work is continuing on the redetermination of the specific alpha activity of plutonium. At present, the best data indicate that the old value for Pu²³⁹ (70,660 c./m. μ g. at 52 percent geometry) should be revised upward to about 71,500 c./m. μ g. The most plausible explanation of the discrepancy is that self-absorption in the earlier samples was not completely eliminated. The best estimate of the half-life of Pu²⁴⁰ is now 6800 years.

Plutonium Fission Cross Section. Some measurements of fissionability with slow neutrons have been made at the Argonne heavy water pile with some mass-spectrographically enriched plutonium isotopes. The results are best explained by fission cross section of 500 to 1000 barns for Pu²⁴¹ and 50 barns or less for Pu²⁴⁰, based on 750 barns for Pu²³⁹. There was not enough Pu²⁴² in these samples to show an effect. Additional experiments are in progress.

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A New Isotope of Americium. Some americium which contained Am^{241} , Am^{242} , and Am^{243} , from the neutron irradiated plutonium sample designated as "12B", was exposed to neutrons in the Argonne heavy water pile. A 25-minute electron activity was induced. Careful chemical separations demonstrated that it is an isotope of americium, and the best assignment seems to be Am^{244} , which is expected to be a β^- emitter. If the sample contains 3 percent Am^{243} (based on alpha activity and estimated half life) and if the mass assignment is correct, the activation cross section is about 50 barns.

Alpha Particles of Plutonium and Americium. A new procedure has been developed for making very thin films of plutonium and americium by distillation in high vacuum. These samples have made possible alpha pulse analyses of high resolution which have permitted detection of two new alpha particle groups. A group of energy 5.21 Mev is attributed to Am^{243} . A group at 4.91 Mev is believed to belong to Pu^{241} .

Polonium Decay Chains. Work is continuing on identification of the decay products of the neutron deficient polonium isotopes. Recent experiments have verified that the 1.5-hour Po assigned to mass 205 decays to Pb^{201} (8 hours), which then produces Tl^{201} (72 hours). It was already known that this Po^{205} also decays to 14-day Bi^{205} . A long-lived bismuth activity has now been observed which is probably the daughter of Po^{207} , and is therefore Bi^{207} .

Crystal Structures of CeB_4 , ThB_4 , and UB_4 . The compounds CeB_4 , ThB_4 and UB_4 have been shown to crystallize in a new structure, which has been worked out from x-ray diffraction patterns. The parameters for the tetragonal unit cells are:

	CeB_4	ThB_4	UB_4
a	7.21 A	7.26 A	7.08 A
c	4.09 A	4.11 A	3.98 A

The atomic positions are: Space group D_{4h}^5 - $P4/mbm$

4 Ce, Th, U	in 4 (g), x = 0.31
4 BI	in 4 (e), x = 0.2
4 BII	in 4 (h), x = 0.1
8 BIII	in 8 (j), x = 0.2, y = 0.04

This structure may be considered as a combination of the structures of cubic ThB_6 and hexagonal UB_2 . It was incorrectly reported last month, because of under-estimation of the boron content of the samples.

ChemistryUNCLASSIFIED

Part B

Synthetic and Experimental Chemistry. The study of the synthesis of a number of compounds of interest in biology and chemistry has continued. These include plant acids, amino acids, and important synthetic intermediates. High specific activity preparations of malic and fumaric acids were begun, and a high specific activity synthesis of several carboxyl-labeled branch chain fatty acids was completed. Preliminary runs on the preparation of the purine derivatives, guanazolo and guanine, were completed with yields of 15-20 percent based on sodium cyanide. The synthesis of a number of other purine derivatives was also completed, and radioactive preparations on some of these materials will be started in the near future.

on some of these materials will be started in the near future.

Biological Chemistry. The testing for biological activity of the purine derivatives in tumor-bearing mice was begun. Biological work on guanine and guanazolo, however, will await completion of the high specific activity preparations.

Work has been continued on the rate of metabolism to $C^{14}O_2$ of simple labeled organic compounds and on the metabolic products from incubation of liver slices from normal and neoplastic tissues with α - and β -labeled sodium propionate.

Other animal biochemical studies including the metabolism of sodium isobutyrate- $1-C^{14}$ and sodium isocaproate- $1-C^{14}$ in the rat have continued. It has been shown by measuring the carbon dioxide expiration rate and the C^{14} concentration in the protein, lipids, and other body fractions that the isocaproate is appreciably degraded by β -oxidation to produce what is probably an acetic acid fraction, while the isobutyrate is decarboxylated without production of such a fragment. This is in agreement with previously postulated theories and with work from other laboratories in this country.

Photosynthesis Chemistry. The study of the path of carbon in photosynthesis is being continued with chemical work on the identification of intermediates of normal photosynthesis by algae and higher plants. The phosphate esters which have not yet been completely identified are being compared with authentic compounds using the newly developed phosphorus detection technique on paper chromatograms. Authentic 3-phosphoglycerate and P^{32} -labeled esters are being used in these studies.

The carboxylic acids intermediate in the regeneration of the two-carbon CO_2 acceptor of photosynthesis are being investigated further. Particular interest is directed towards the role of glycolic acid in plant metabolism. This acid is built up in the light in the absence of CO_2 to as much as 25 percent of total activity and is rapidly oxidized in the dark. The possible occurrence of related compounds is being investigated and experiments designed to elucidate its role have been performed.

Polysaccharides probably involved in starch synthesis are under investigation. Effects of malonate and iodoacetamide inhibition of low light intensities and of temperature upon the reactions of photosynthesis are being determined. Effects of the pH of photosynthesis which was proposed by Franck (Arch. Biochem., 23 297 (1949)) to explain the variance between results of this laboratory and the Chicago laboratory on the nature of photosynthesis, and that between Emerson and others and Warburg on the quantum yield, are being studied. We have performed experiments from pH 4 to pH 8.7 with no apparent difference in nature or amount of the intermediates of photosynthesis reported earlier.

Photosynthesis and photoreduction by the bacterium Rhodospirillum rubrum is being investigated for comparison with that of green plants. Photoreduction, the hydrogen-oxygen reaction, and photosynthesis by the alga Scenedesmus have been compared as to products and relative rate of synthesis of the major compounds.

Chemistry

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Part C. Project 48B

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

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1. Studies of refractory carbides, borides, and silicides.
2. Thermodynamics of CN and N₂.
3. Absorption coefficients of CN and C₂.
4. Vapor pressure of Fe and C.
5. Thermodynamics of gaseous aluminum, nickel manganese and iron oxides and hydroxides.
6. Thermodynamics of molybdenum halides and oxides.
7. Low melting metal systems.
8. Theory of bonding in solid and gaseous oxides.
9. Construction of high temperature calorimeter and theory of its use.
10. Apparatus for the measurement of thermal conductivities of gases.
11. Design of equipment to extend work on film boiling to the case of forced convection.

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

1. The exchange of iodine atoms between iodate ion and iodine.
2. The chelate complex of lanthanum with TTA.
3. Thermodynamic studies on rhenium.

Engineering Development of Plutonium Separation. The following subject is being investigated:

1. Solvent extraction using chelate process.

Ore Reduction. The following subjects are under investigation:

1. Micro amperometric titration of uranyl ion with chromous ion under investigation.
2. Solvent extraction using chelate process. A study of phosphate complexing.
3. A study of equilibrium in uranyl phosphate precipitation is under way.

10. Medical Physics

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Part A

Tracer Studies. Current tracer work includes metabolism studies of the rare earth elements: Ho¹⁶⁶, Yb¹⁷⁵, and Lu¹⁷⁷ in the rat following intramuscular, intravenous and stomach tube routes of administration. Results of the studies on Ho¹⁶⁶ and Yb¹⁷⁵ so far indicate the similarity of these elements in their biological properties with the other members of the rare earth series.

Decontamination and Bone Metabolism Studies. When massive doses of zirconium citrate (0.2 gm. Zr/Kg.) were administered to rats immediately following intravenous injection of Cb⁹⁵, Y⁹⁰ and Pu²³⁹, a larger proportion of these radioelements was retained in the blood at the end of the first hour, and the urinary excretion was considerably enhanced.

A method has been developed for determining the phosphatase activity of fresh bone homogenates. Experiments are now being carried out to determine the effect of injected plutonium on bone and blood phosphatase.

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The effect of rickets on the metabolism of radiobarium is being investigated.

Radioautographic Studies. Radioautographic studies of plutonium in lung are in progress. Praseodymium studies using a higher dose are being completed. Experiments with americium at one and twenty-four hours time intervals are under way.

Routine work is being done on rat tissues injected with I^{131} and Ho^{166} .

Radiochemistry. Millicurie amounts of Ho^{166} , Yb^{175} , Lu^{177} , Cb^{95} , Zn^{95} , Ba^{140} from Oak Ridge have been prepared for injection. Na^{22} has been isolated from an old magnesium target using carrier-free procedures. The factors influencing the distribution of carrier-free I^{131} in water-carbon tetrachloride systems are being investigated.

Medical PhysicsUNCLASSIFIED

Part B

Biological Effects of Radiation. Hematology. An analysis is being undertaken of the hematological data which has been gathered on the personnel of the Radiation Laboratory during the last several years. Two more or less arbitrary groups have been compared so far, one group being made up of 109 persons, the nature of whose work makes repeated exposure to low doses of radiation probable, the other group comprising 259 individuals whose work does not involve exposure to radiation. In one point of comparison there seems to be a significant difference at the present stage of analysis. There was a reversal of the normal granulocyte/lymphocyte ratio on at least one occasion in 36 of the 109 persons in the first group (33 percent), while this occurred in only 20 of the 259 "controls" (7.7 percent). The frequencies based on the total number of counts were $83/765 = 10.9$ percent and $30/790 = 3.8$ percent, respectively.

Radiation Effects in Bacteria. Work continues in determining factors which influence the radiation sensitivity of the bacterium E. coli.

Double Nucleated Lymphocyte Problem. In attempting to evaluate the significance of the presence and number of double nucleated lymphocytes in the peripheral blood, 247,000 leukocytes have been counted in the blood smears of 21 persons working at the Radiation Laboratory. 12 of these individuals when considered together, since their work involves not infrequent exposures to low doses of radiation and especially, in most instances, proximity to the 184-inch cyclotron, show an incidence of only 2 such cells out of 127,000 white cells counted. In the non-radiation group of 9 individuals, the incidence was 13/120,000. These data, although they are still insufficient for conclusions, contrast with those reported on non-radiation personnel and cyclotron workers at Rochester. Counts are also being made on mice exposed to the 90 Mev neutron beam of the 184-inch cyclotron to be compared with counts in normal control animals.

Metabolism of Simple Carbon Compounds Labeled with C^{14} . Lactate labeled in the methyl carbon has been injected intravenously into mice and the rate of conversion to CO_2 measured. The specific activity of the exhaled CO_2 from these mice (6) is extremely erratic and is inconsistent with a consideration that lactate is at steady state metabolism in the mice. If these results are correct, mouse lactate levels

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must fluctuate several times through factors of 2-3 over a period of a few hours.

Assessment of Effects of Radioisotope Therapy. In order to determine whether certain blood clotting mechanisms are altered following therapeutic administration of radioactive isotopes, clot retraction rate and heparin prolonged clotting time determinations are being made on patients with polycythemia and leukemia before and at intervals after treatment.

A study of the renal blood flow and glomerular filtration rate in patients with polycythemia vera has been started. Determinations will be made before treatment and after response to treatment. The purpose of this study is to find out whether there is any correlation of these values with the hypertension and albuminuria commonly found and whether there is an improvement in kidney function when the blood viscosity and high red cell mass return to normal as a result of therapy.

Studies with Stilbamidine Labeled with C^{14} . The study of excretion and tissue deposition of C^{14} labeled stilbamidine in mice is almost completed. The stilbamidine is excreted in the urine and feces, no activity appearing in the breath. 40-80 percent of the injected activity is excreted during the first four days following intravenous injection. The quantity eliminated is about equally divided between the urine and feces. Tissue deposition data have been obtained at intervals after injection up to three months. Two and three months after injection very minute amounts of activity still remain in a number of tissues. The largest total activity found in any organ three months after administration is found in the kidney, and this is only 1 percent of the injected dose. After 3 months no detectable activity was found in the marrow, bone, plasma or red blood corpuscles.

Physical Chemistry. Infra-Red Spectroscopy. The collection of spectra of compounds of interest in several phases of the laboratory program continues, with special emphasis on steroids, amino acids, purines, fatty acids, and on those large molecules amenable to study.

Light Scattering Photometer. Preliminary calibration runs are being made on the light scattering photometer. In the next phase of the program, several lipoproteins from humans and from serum of rabbits developing atherosclerosis will be studied in an effort to obtain an independent check on the molecular weight data now being obtained ultracentrifugally.

Labeled Cholesterol. The pilot experiments in which rabbits were maintained on tritium-containing water, in an effort to determine the rate of production of cholesterol endogenously in the rabbit and whether there is cholesterol turnover in the aorta of the rabbit, are now in the phase of sample counting. The next approach here must await these data.

Meanwhile an entire preliminary run on the in vitro production of cholesterol by destructive exchange with tritium water has been made. It appears that there has definitely been some cholesterol synthesized. This will now be repeated with modifications using a much more active tritium water in an effort to make enough sterol for biological use.

Lipoproteins in Arteriosclerosis. Further characterization of the chemistry and physical chemistry of the lipoproteins both of human and rabbit is in progress.

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With a background of the data obtained in the experiment of cholesterol feeding in the rabbit, several new groups of animals are now being studied with respect to the effect on the lipoproteins of several chemicals known to modify the course of cholesterol induced atherosclerosis. Also now that the lipoproteins are identified and can be fractionated, a study of turnover rates of these molecules in normal and atherosclerotic rabbits is under way using P^{32} labeled phospholipid.

184-inch Cyclotron Studies. (1) Study of the inhibition of cell division of yeast cells by radiation with various specific ionization has been completed in association with Dr. Raymond Zirkle. High specific ionization is more effective in producing inhibition of cell division than low specific ionization. Some of the cells continue dividing after irradiation for one or more cell divisions before this process stops and the mechanism may be explained by assuming that the radiation effect has genic factors and extragenic factors. (2) Radiation effects on water. The work is being continued. (3) Environmental effects on chromosomal breakage. The work is being continued. (4) Trace analysis. The work is being continued.

Iron Metabolic Studies. Iron studies in progress and to be continued are: (1) The effect of x-radiation on iron distribution in rats. (2) Plasma and red cell iron turnover studies in normal and abnormal human subjects. (3) The absorption of iron from food by normal and abnormal human subjects.

During the past two months, a distribution study of radio Fe (single intravenous injection) administered 3 days following 500 R x-ray (200KV) to a group of rats having their spleen protected and to another group not having their spleens protected was carried out. The group having the protected spleens showed about 20 percent of the normal appearance of Fe^{59} in their red cells. The unprotected group accumulated no Fe^{59} in their red cells. The spleen concentration in the protected group indicated that the major portion of the Fe^{59} appeared in the red cells by virtue of synthesis in the spleen; however, the marrow concentration of Fe^{59} in these animals also seemed significantly higher.

The usual plasma turnover study is being continued in patients having rheumatoid arthritis and Hodgkins Disease. A special study is being done on a patient who shows the ability to accumulate iron in normoblasts but who has a defective ability to convert this Fe to Hb. This subject's peripheral red cells are being examined following a tracer dose of Fe^{59} in order to determine what part, if any, of the iron present is not there as hematin Fe.

Rabbit liver tagged in vivo with Fe^{59} has been fed to 4 normal controls, 1 leukemic and 1 hemachromatotic along with other food so as to constitute a meal. The percent of the fed dose recovered in subsequent stools has varied from 94 percent to 80 percent. The data on the hemachomatotic patient is not included. It is hoped that this type of study can be enlarged to include other foods.

11. Health Physics and Chemistry

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Radiation Field. The 60-inch cyclotron has resumed operation after the rebuilding program and shows a considerably increased radiation field. Measurements of the content and direction of the radiation flux indicate a large neutron contribution from shielding roof leakage and from the east-side aperture.

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Other Studies. Items under development by research and development personnel are a "Junior" cave which is a box for microchemical work shielded by two inches of lead and a laminated lead glass window, a container and dispenser for use in handling ^{131}I , a carrying case for syringe containing active material, and plugs for glove ports on activity-containing Berkeley Boxes while not in use.

12. Plant and EquipmentUNCLASSIFIED

Bevatron Building and Equipment. Pouring of concrete for building foundation is approximately 90 percent complete. Excavation for magnet foundation is nearing completion. The steel strike has delayed the fabricating of the building steel and, hence, the start of the erection will be delayed until sometime in January, 1950. The steel strike has also held up delivery of the magnet steel. It is anticipated that approximately 700 tons will leave Geneva, Utah this week. The engineering design work has been concentrated on design of the vacuum system. Vendors of the large electrical components have been asked to delay shipment because of the strike holdups.

Central Research Laboratory Building. Landscaping of building is still in progress.

Construction of Animal House and Cafeteria. The cafeteria construction contract has gone out for bid and the design of the animal house is starting in earnest.

Construction of Shops - plumbing, electrical, sheetmetal and salvage. The plumbing and electrical shop has been completed. Design of the sheetmetal and salvage shop has not, as yet, been started.

Miscellaneous Construction. Warehouse. Building is complete except for a small section of the roofing and installation of interior fire walls, office space and utilities.

Alterations to Laboratory Buildings. The structural alterations to Room 203E, Chemistry Building, have been completed and the major equipment installed; however, the utility hookups and finishing work still remains.

Power Distribution. Pulling of cable has been continuing as has the installation of the switchgear at the campus substation.

Fire Protection. Present phase of work is essentially complete; the remaining work is to be accomplished next spring.

Radiological Laboratory at the University of California Hospital. The architects are still preparing the working drawings.

Alterations to Synchrotron Building. The extension phase of this job is essentially complete. It is now contemplated that a second phase will require extending the main synchrotron building.

Decontamination Unit. The structural steel for this small building has been erected, but the job is being held up because of a low priority on the work schedule.

UNCLASSIFIEDMAN-MONTHS EFFORT REPORTSCIENTIFIC PERSONNEL

<u>Program</u>	<u>Subdivision</u>	<u>Man-Months Effort</u>	<u>Comments</u>
184-inch Cyclotron	Operation	10.3	
	Deflector	1.0	
60-inch Cyclotron	- -	-	Non-Project
Synchrotron	R.f. System	.3	
	General	1.6	
	Injection	1.1	
	Magnet Tests and Operation	2.8	
	Miscellaneous Equipment	.5	
	Vacuum System	1.2	
Linear Accelerator	Linear Accelerator - General	3.7	
	Van de Graaff - General	3.3	
	Development	2.4	
Bevatron	Building	.1	
	Injector	1.6	
	Magnet	2.4	
	1/4 Scale Model Development	2.6	
	Vacuum System	.1	
Experimental Physics	Cloud Chamber	6.9	
	Film Program	9.9	
	Ionization Chamber and Crystal Counter	3.0	
	Neutron-proton Scattering	.5	
	Proton-proton Scattering	3.0	
	Neutron Diffraction	-	
	Meson Range and Decay Measurement	.5	
	Absolute Cross Section Measurements	1.7	
	General Physics Research	11.6	
	Instruments for General Use	1.0	
	Meson Experiments with Synchrotron	4.5	
	Scintillation Counters - Research Experiments	.4	
	Pair Counter Experiments	3.2	
	Compton Scattering Experiments with Synchrotron	-	
	Beam Studies with XC Cyclotron	1.7	
	Particle Momentum and Energy	.7	
Proton Elastic Scattering	1.0		
Theoretical Physics	Synchrotron	-	
	Bevatron	1.3	
	General Physics Research	13.7	
	Cyclotron	.3	

UNCLASSIFIEDMAN-MONTHS EFFORT REPORTSCIENTIFIC PERSONNEL
(Continued)

<u>Program</u>	<u>Subdivision</u>	<u>Man-Months Effort</u>	<u>Comments</u>
Isotope Separation	Nier Spectrometer	1.2	
	Low Mass Spectrograph	.2	
Chemistry, Part A	Chemistry of Transuranic Elements	3.5	
	Nuclear Properties of Transuranium Elements	5.0	
	Transmutations with the 184-inch Cyclotron	13.3	
	Analytical and Service	18.2	
	Process Chemistry	4.5	
Chemistry, Part B	Synthetic and Experimental Organic Chemistry	5.3	
	Biological Chemistry	6.6	
	Photosynthesis Chemistry	6.9	
Chemistry, Part C	Metals and High Temperature Thermodynamics	4.0	
	Basic Chemistry, including Metal Chelates	1.5	
	Engineering Development & Plutonium Separation	6.5	
	Ore Reduction	2.5	
Medical Physics Part A	Metabolism of Plutonium and Allied Materials	9.0	
	Decontamination Studies	5.0	
	Radiochemistry	4.0	
	Radioautography	2.0	
Medical Physics Part B	Tumor Metabolism	.7	1.4 Consultant
	Special X-ray Studies, Radioactive Measurements, etc.	5.6	2.2 Man-Months
	Radioactive Carbon Studies	.6	-
	Fundamental Medical Research	5.0	2.3
	Hematology	.3	.7
	Medical Work with the 184-inch Cyclotron	2.6	.1
	Fly Genetics	3.3	-
	60-inch Cyclotron Bombardments	.3	-
	Physical Chemistry	7.4	1.0
	Specific Irradiation	1.8	-
	Donner Animal Colony Expense	1.5	1.0
Health Physics, Chemistry	Monitoring and Disposal	5.7	
	Research and Development	17.2	
	Film Badge Program	4.9	
	Medical Examination Time	3.1	

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