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Radiation Laboratory

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MONTHLY PROGRESS REPORT NO. 133

April 15, 1954 to May 15, 1954

June 10, 1954

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UNIVERSITY OF CALIFORNIA RADIATION LABORATORY

MONTHLY PROGRESS REPORT NO. 133\*

1. EXPERIMENTAL PHYSICS  
(A. E. C. Program No. 5211)

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Comparison of the Reactions  $p + d \rightarrow \begin{cases} \pi^+ + H^3 \\ \pi^0 + He^3 \end{cases}$  as a Test of Charge Independence

The latest results on this experiment were reported at the Washington meeting of the American Physical Society.

Owing to the 184-inch cyclotron shutdown, no further runs will be possible. A final report of the results is being prepared.

Fast Deuterons from High-Energy Nucleons Bombarding Various Elements

Data from a run using 300-Mev neutrons incident on various targets to produce pickup deuterons have been partly analyzed. Values have been obtained for the deuteron-production cross sections at  $40^\circ$  to the beam from Li, C, Cu, Cd, Pb, and U. These values, when compared with the values obtained for the deuteron-production cross section using a 300-Mev proton beam, enable one to compute the fraction  $f$  of surface nucleons that are neutrons. This fraction is listed below for various materials.

Li	$f = 0.564 \pm 0.115$
C	$f = 0.470 \pm 0.077$
Cu	$f = 0.699 \pm 0.075$
Cd	$f = 0.612 \pm 0.064$
Pb	$f = 0.775 \pm 0.090$
U	$f = 0.745 \pm 0.078$

High-Energy Photon Spectroscopy

The improvements in high-energy pair spectrometer techniques which have been developed during the recent research on proton bremsstrahlung and on the 15.2-Mev gamma emission from  $C^{12}$  have made it possible to secure more precise data on the total emission spectrum from  $\pi^0$ 's produced in the cyclotron target.

In an effort to reinvestigate the symmetry of this spectrum with a spectrometer that will give good data on the low-energy side of its maximum, a run has been scheduled for the last part of May and the equipment has been prepared with this in view.

\*Previous Report UCRL-2583 (No. 132)

This run will make use of the best beam-monitoring techniques presently available, consisting of a target thermocouple arrangement together with the usual  $\text{BF}_3$  counter and the beam-dependent singles counting rates of our pair-spectrometer channels.

### A Study of Neutron Polarization

Calculations on the quasi-elastic polarization of carbon, beryllium, and lithium have been completed and the results are available (given in the Quarterly Report for February-April).

### Elastic Scattering of Protons

Angular distribution of elastically scattered 31.5-Mev protons on gold is now under way. The cross section has been measured at several angles between  $10^\circ$  and  $75^\circ$  in the laboratory, showing a definite minimum around  $35^\circ$  and indicating another between  $60^\circ$  and  $75^\circ$ .

### Electron-Neutrino Angular Correlation in $\text{Ne}^{19}$

Testing of the differential pumping apparatus for the neutrino experiment is continuing. The charcoal trap has been activated and found to serve as an adequate pump for the system. The differential pumping pressure ratio has been measured and found satisfactory. The scintillator counter has been installed in the vacuum system and tested in place. The recoil counter has been installed and is ready to test. The behavior of the recoil counter is the crucial point in the new apparatus. If the recoil counter tests satisfactorily, a linear accelerator run will be scheduled.

### Liquid-Hydrogen Glaser Bubble Chamber

Tracks have been photographed in a liquid-hydrogen bubble chamber of metal construction with glass windows. Spontaneous eruption from the chamber walls did not interfere with the tracks. The chamber had a diameter of about 2-1/2 inches and a thickness of about 1 inch. At a chamber temperature corresponding to 70 pounds per square inch in the liquid-hydrogen bath surrounding the chamber, the sensitive time for tracks is of the order of 1 to 20 milliseconds. Quantitative measurements on bubble growth rates vs. time and temperature are in progress.

The successful operation of a chamber with metal walls and glass windows greatly increases the potentialities of this instrument. Some of the more obvious advantages over all-glass construction are in simplicity of construction, ease of obtaining optically flat windows, and rapid achievement of thermal equilibrium. In addition, there seem to be no essential limitations to prevent one from going to a large chamber. We are at present designing a chamber 6 inches in diameter and 3 inches thick, to be used as a research instrument. Experiments to determine the feasibility of expanding the chamber into a vacuum, rather than to one atmosphere, are in progress, with the hope that this will permit lower temperatures and pressures and make smaller demands on materials strength for large chambers.

$p + p \rightarrow \pi^+ + d$  with Polarized Protons

Marshak and Messiah (Il Nuovo cimento, Vol. XI, No. 4, 1 April 1954) have pointed out that, if mesons are present in both S-wave and P-wave states in the above reaction, then it is possible to obtain, through interference between the S and P waves, an azimuthal asymmetry in the angular distribution, provided a polarized proton beam (or target) is used. Chamberlain, Segrè, Tripp, Wiegand, and Ypsilantis (Phys. Rev. 93, 6, 1430) have obtained a beam of polarized protons of approximately 320 Mev, and having an estimated polarization of  $P = 2 \langle S_y \rangle = 0.75$ , where y is the direction perpendicular to the plane of the scatter which produces the beam. Using this beam, we have made a preliminary measurement of the left-right asymmetry of the  $p + p \rightarrow \pi^+ + d$  production, in the plane perpendicular to the proton polarization, using coincidence detection of the meson and deuteron, and a liquid-hydrogen target. A positive effect has been observed, with a tentative result  $(L-R)/(L+R) = -0.18 \pm 0.04$ . Here L and R refer to the direction of the produced meson as seen by the incident proton. (The polarized proton beam is produced by a "left" scatter off a beryllium target, inside the cyclotron.) Checks were made to search for possible systematic errors resulting from improper alignment, effects of magnetic field on photomultipliers, and nonuniformity across the face of the plastic scintillator crystal, all with null results. In addition, the experiment was immediately repeated using the ordinary unpolarized scattered proton beam, which has been shown by Chamberlain et al. to be unpolarized. A null effect of  $-0.02 \pm 0.06$  was obtained in this over-all check. However, this latter test was seriously hampered by poor alignment of the unpolarized beam with respect to a 46-inch collimator immediately preceding the target. As a result, a highly asymmetric background, not present in the measurement with the polarized beam, had to be subtracted. In addition, insufficient data were obtained on the empty hydrogen container, which contributed from 5% to 20% of the full-target effect. For these reasons the results had to be considered tentative until they had been confirmed and the above-named experimental defects corrected. The experiment will be repeated in the near future to check these points.

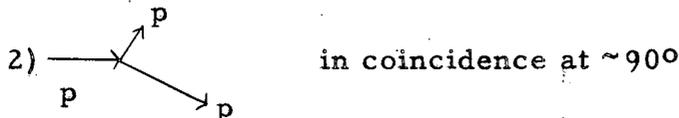
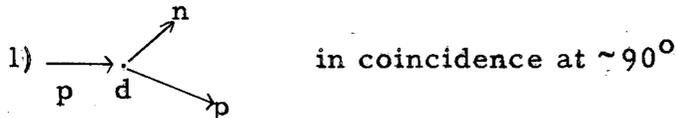
The experiment was repeated both with the unpolarized ("scattered") beam and, immediately thereafter, with the polarized beam. Both measurements were made at 310 Mev. The unpolarized beam gave a null result of  $(L-R)/(L+R) = -0.035 \pm 0.040$ , whereas the polarized beam gave  $(L-R)/(L+R) = -0.21 \pm 0.04$ . The measurements were made at full efficiency, as checked by gain plateaus, range curves, time-of-flight plateaus, and checks on geometrical lineup. The cross section obtained from the unpolarized beam agreed with the average of the left and right measurements made with the polarized beam. The liquid-hydrogen target was provided with a suitable blank, and a blank effect of about 15% was subtracted during the runs. It was discovered that the blank effect was mainly due to  $p + p \rightarrow \pi^+ + d$  events produced in ten inches of cold hydrogen vapor (as compared to about three inches of liquid hydrogen). This was checked by seeing the blank effect disappear when the target became completely empty, and by seeing that the blank effect behaved like  $\pi d$  coincidences. A rough calculation confirms the order of magnitude. The blank was observed to have the same asymmetry, within statistics, as the full target, as would be expected.

Calculation on the interpretation of the results in terms of the theory of Marshak and Messiah is in progress.

Scattering of Polarized Protons

During this month we have made an extensive experiment on the scattering by deuterium of polarized protons of 300 Mev energy.

The processes



have been observed and also the single neutrons and the single protons scattered have been measured for their asymmetry due to the polarization.

A letter to the Physical Review on this subject is being written.

Film Program

Cyclotron Research. Experiments that were performed during this report period were the spallation of Ag by alpha and deuteron bombardments; the high-energy spallation products in the forward direction from Be, C, Al, Ni, Ag, and U, initiated by 340-Mev proton bombardments; and small-angle proton-proton scattering at 340 Mev.

The adaptation of nuclear track emulsion to the study of small-angle p-p scattering resulted from the following argument: For every proton scattered near  $0^\circ$  there is a corresponding proton of low energy that is scattered near  $90^\circ$  in the laboratory system. The method is to detect the low-energy protons coming from a thin ( $2.4 \text{ mg/cm}^2$ ) polyethylene target near  $90^\circ$ . The protons resulting from p-p collisions in the  $(\text{CH}_2)_n$  target are correlated in energy and angle, and therefore correlated by range and angle through the range-energy relation for emulsions. The angular region to be studied is  $3^\circ$  to  $13^\circ$ . The corresponding recoil-proton ranges in emulsion are  $10\mu$  and  $1000\mu$ , respectively. The angle-range criteria will be used to eliminate background protons arising from proton-carbon collisions. Preliminary scanning indicates that approximately one-sixth of the proton tracks measured are from true p-p scatters.

Synchrotron Research. A concerted effort has been placed upon the determination of the energy resolution for 6.14-Mev electron pairs in G-5 emulsion. To date approximately 30 pairs have been measured. This project is a part of the study of the selective scattering of photons by C and Pb nuclei under the bombardment of 330-Mev bremsstrahlung.

Other. Other programs of research are the interaction of 30.8-Mev protons and 380-Mev alpha particles in G-5 nuclear track emulsion.

### Cloud Chamber Studies

35-Atmosphere Cloud Chamber. The optical distortion measurements were repeated with the parallel flat glass camera windows installed. The system is now improved so the distortion gives a spurious curvature of less than  $0.01 \text{ meter}^{-1}$ .

Four-by-eight-foot Cloud Chamber. A couple of weeks were devoted to the investigation of optimum operating temperatures and conditions. Enough data have been gathered to permit the design and construction of a three-way-valve control mechanism. This mechanism is theoretically capable of controlling the bottom temperature to within  $0.1^{\circ} \text{ C}$ .

Photography. The new cameras designed and built for the 4-by-8-foot cloud chamber have been undergoing a series of fog tests. The tests have proved that the cameras have definite light leaks and necessary changes are being made before they are put into operation.

Results of recent tests of Linagraph Pan film for use in cloud-chamber photography showed that the particular batch of film currently in use was too old and not sensitive enough for our purposes.

Cloud-Chamber Windows. A technique has been devised for casting astrolite cylinders. This material is alcohol-proof and has been used in the 35-atmosphere chamber light windows. We have wanted to use alcohol in our expansion chambers for some time, making it possible to use a lower expansion ratio. Glass cylinder walls have been used in some chambers, but neither the 10 atmosphere or the 22-inch chamber is adaptable to glass cylinders. Since astrolite contracts approximately 5% on polymerizing, casting a cylinder raises many problems. A successful cast of a 13-inch-diameter cylinder was made in March, and after a failure a 23-inch-diameter cylinder was successfully cast. The present technique requires that the core of the mold be removed as soon as the plastic reaches a jell state. This takes about 12 hours at room temperature with the present proportion of liquid plastic, catalyst, and cold-setting promoter. The cast is then baked at  $100^{\circ} \text{ C}$  for about 8 hours, after which time the reaction has gone to completion and the cast is ready for machining.

### Synchrotron Studies

The synchrotron operation was concerned with two groups of experimenters: Kenny, McDonald, and Anderson; and Steiner and Jungerman. The first group finished up the experiment to determine the triplet cross section at 300 Mev quantum energy by measuring the absorption cross sections of  $\text{C}_6\text{H}_6$  and  $\text{C}_6\text{H}_{12}$ . Calculations are being made at the present time and will be reported by McDonald in his thesis. The same group made further measurements of the ratio of pair production in Be and Pb. These will be included in the report of the work on the Compton cross section in Be.

Steiner and Jungerman have attempted to get more points on their fission cross-section measurements from Bi and U. Work on this problem at Cal Tech left some uncertainty as to the values at energies below 335 Mev, so the present run was made to try to pin down some of the points where the fission cross section is low. Results of the whole experiment will be reported soon.

Synchrotron operation was only fairly good during this period.

2. THEORETICAL PHYSICS  
(A. E. C. Program No. 5211)

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The attempt to renormalize the integral equations for meson-nucleon systems obtained previously is continuing. The equations in the first approximation have actually been renormalized in a consistent fashion.

The fringing effects and aberrations of a magnetic spectrometer are under investigation in order to assist in the design of an instrument of relatively high transmission and resolving power.

The investigation of Compton scattering on nucleons has been completed and a thesis on the subject is being written.

A UCRL report on the electrostatic stripping of deuterons produced in pickup processes has been completed.

Work on the high-energy neutron spectrum produced by protons impinging on complex nuclei is being continued.

Work on the  $\alpha$ -decay from spheroidal nuclei (in collaboration with Dr. J. O. Rasmussen of the nuclear chemistry group) is continuing. At present, the numerical solution of the coupled differential equations describing the passage of the  $\alpha$ -particle through the barrier is being approached.

Work on the theory of turbulence is continuing.

A formulation of the Tamm-Dancoff method which is mass renormalized to all orders has been developed. This is part of a study of mass renormalization in intermediate coupling theory.

Work on the intermediate coupling approximation for meson-nucleon scattering is being concluded.

The form of the nuclear potential used in the optical model (including the spin orbit potential) has been obtained in terms of the individual nucleon-nucleon scattering processes.

A comprehensive paper is being prepared on neutron polarization.

3. MTA TARGET PHYSICS PROGRAM  
(A. E. C. Program No. 4900)

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During this month many of the films from the preceding month's cyclotron run (before the addition of the cadmium propionate to the large scintillator tank) were scanned in search of short-lived gamma rays, with essentially

negative results. Another cyclotron run was made after the cadmium propionate was added to the scintillator solution, and low-intensity (about one particle per beam pulse) deuteron beams were allowed to strike different thicknesses of uranium target. The sweep of a Tektronix 517 oscilloscope was triggered by the passage of a deuteron through a crystal telescope placed between the beam snout and the scintillator tank, and the pulses from the tank were displayed on the trace. Since the neutrons from the targets are captured with a half life of 15 microseconds in the scintillator solution (after an initial slowing-down time of the order of 2  $\mu$ sec), the sweep is exponential instead of linear, in order to space the pulse more uniformly on the sweep. With a total sweep length of 50  $\mu$ sec, one principal source of difficulty has been the simultaneous focusing of pulses in different regions of the trace. The films from this run are under analysis now.

During this period an experiment was conducted to identify the particles produced when 490-Mev  $\text{He}^3$  particles interact with a nucleus. Efforts to identify particles by measuring their  $H_p$  and range showed only stripped protons and degraded  $\text{He}^3$  ions or deuterons. Thus nuclear emulsions obtained from Ilford were exposed to the direct  $\text{He}^3$  particle beam in the cave; these are 600- $\mu$ -thick G-5 stripped emulsions, 1/2 by 2 by 6 inches, so all the primary and stripped secondary particles should be observable. Processing of the emulsions is still continuing.

#### 4. ACCELERATOR CONSTRUCTION AND OPERATION

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##### Bevatron Operation (Program No. 5720)

Owing to a short circuit in one of the generators, there has been no operation since April 1.

Before this occurrence it had become increasingly apparent that the power supply needed further adjustments, as faults were occurring too frequently. Test operations showed that rise times were excessively short and charge capacitors have been installed to increase the rise time to 10 microseconds.

In addition, surges of about 1000 volts have been observed on the current of the ignitrons. They are known to cause failure of the associated rectox units, and it is believed that they may be due to high ignitron pressure. Several steps have been taken to correct this situation. The cooling-water system has been improved and leaks in the ignitron are being repaired. Some of the ignitrons have an excessive rate of rise of pressure although no cracks have been found. We believe they were not sufficiently baked out, and are carrying out an extended program of outgassing.

##### 184-inch Cyclotron Operation (Program No. 5741)

The cyclotron was used for research experiments approximately 94 percent of the 515 hours that the crew was on duty. The time distribution was as follows:

Operation for customers	482.25 hours	93.6 percent
Mechanical troubles	17.25	3.2
Electrical troubles	11.00	2.2
Visitors, maintenance, etc.	<u>5.00</u>	<u>1.0</u>
Totals	515.50 hours	100.0 percent

184-inch Cyclotron Modification (Program No. 4900.02)

Magnet. The second auxiliary coil has been delivered, the seal welds have been made, and vacuum testing is in progress.

Rf Design and Vibrating Condenser. The first pair of nitrated blades has been received and is being prepared for operation. Some difficulty has been encountered in removing the stop-off material, which protected the tip from being nitrated.

The Mare Island schedule for manufacturing additional blades is still unsatisfactory, and overtime has been authorized to expedite critical machining operations.

The shutdown date has been postponed until June 10 to permit certain additional physics experiments to be completed.

60-inch Cyclotron Operation (Operated by the University of California)

The alteration shutdown of the 60-inch cyclotron is proceeding according to schedule, although unexpected delay is being experienced in iron shim delivery and magnetic field plotting. An age failure of the newly installed generator has caused the field-plotting slowdown.

Synchrotron Operation (Program No. 5731)

Operation of the synchrotron continued during this report period. The operating schedule was extended to include extra running time. Some difficulties with voltage holding on the accelerating gap were overcome by cleaning the gap. This was accomplished by using a dental air abrasive unit, really a small sand blaster.

Operating statistics for the period:

Operation for customers	376.5 hours	92.3 percent
Maintenance	<u>32.0</u>	<u>7.7</u>
	353.0 hours	100.0 percent

Linear Accelerator and Van de Graaff Operation (Program No. 5751)

The linear accelerator and Van de Graaff have been operated routinely throughout this period. No major changes have been made in either machine, except for the removal of the new 4W20000 preexciter. This has been transferred to the bevatron injector linac for test. It has proven capable of preexciting the 10-Mev tank with excellent reliability, and it is planned to leave it there

until the "finished models" are out of the shops. Some redesign is being made between the experimental model and the final design to permit easy service.

The deuterium system, which had been installed for the Van de Graaff ion source, has been temporarily removed to permit the installation of a neon gas system. This will be used to supply a neon beam from the Van de Graaff for ion-stripping measurements. It has been demonstrated on the bench that the ion source works with neon.

Planning relating to equipment moves required by the proposed building changes has been mostly completed. Most of the work is scheduled for August.

Operating statistics for the period:

Operation	312.25 hours	86.7 percent
Van de Graaff maintenance	28.75	8.0
Linear accelerator maintenance	19.0	5.3
	<u>360.0 hours</u>	<u>100.0 percent</u>

5. CHEMISTRY  
(A. E. C. Program No. 5311)

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Spallation-Fission Competition in Pu<sup>239</sup>

Part of a study of the excitation functions of alpha-induced fission and spallation has been completed and has been issued as a separate report, UCRL-2560.

Decay Schemes of Cm<sup>241</sup> and Am<sup>240</sup>

In the course of determination of some spallation-fission excitation functions of Pu<sup>239</sup>, some work was done on the decay schemes of Cm<sup>241</sup> and Am<sup>240</sup>. The alpha-to-EC branching ratio of the former was determined by observation of the growth of its EC daughter, Am<sup>241</sup>, and was found to be 0.72 ± 0.07 percent. The calculated alpha partial half life then becomes 13 ± 2 years. In addition, a large number of pulse-analyzer energy determinations gave an average value of 5.95 ± 0.02 Mev, which is 0.05 Mev higher than that previously reported. The gamma spectra and the intensities of Cm<sup>241</sup> were also obtained on the sodium iodide crystal spectrometer. A new gamma ray in Am<sup>241</sup> of 590 kev was observed, which is not populated by the alpha decay of Bk<sup>245</sup> to the same isotope. Further, no gamma ray of 180 kev was observed in the EC decay, although this level is populated in the alpha decay of Bk<sup>245</sup>.

The EC gamma spectrum of Am<sup>240</sup> to Pu<sup>240</sup> does not show a transition to the ground state; three gamma rays are seen: 1400, 1020, and 920 kev, of which the 1400 and 920 are also seen in the beta decay of Np<sup>240</sup> to the same isotope. A new value of the half life was found to be 47 ± 2 hrs, somewhat shorter than the previously obtained value.

### Decay Scheme of Pa<sup>231</sup>

The alpha spectrum of Pa<sup>231</sup> has been determined on the alpha-ray spectrograph and the following energies were obtained:  $E_{\alpha} = 5.042, 5.014, 4.996, 4.932$  and  $4.718$  Mev. Previous work on this isotope had not resolved the two alpha groups at 5.014 and 4.996 Mev. These values fit in very well with the gamma spectra obtained in other laboratories, and allow construction of a revised decay scheme for Pa<sup>231</sup>.

### Alpha-Recoil Collection in Gamma-Counting Chambers

It has been observed that the recoil products from an alpha decay can conveniently be collected on the face of the metal cylinder that holds the crystal and photomultiplier tube in the normal gamma-ray crystal-spectrometer setup. Grounding this metallic holder results in loss of collection efficiency, as does turning off the high voltage of the photomultiplier. The technique should prove very useful in the study of the decay schemes of short-half-lived isotopes, especially when these are involved in a chain of alpha and beta emitters.

### Ion Source Studies

Various geometries and shapes of filaments for the ion source of a mass spectrometer have been tested for Pu<sup>238</sup> to determine the optimum conditions for collection. It was observed that the closer the filament was placed to the final slit the more broadened the line structure became. U-shaped filaments appear to be much more satisfactory, probably because of providing greater opportunity for ionization and also because of some focusing effect. They also hold the sample much better during heating. These combined effects give a factor of about 100 in favor of the folded, U-shaped filaments over other types.

### X-ray Studies of Curium Oxide

The powder pattern of a 200- $\mu$ g sample of curium oxide (47% Cm<sup>244</sup>) has been determined. Past attempts at curium crystal structures have not been successful because of the short half life of the Cm<sup>242</sup> isotope and subsequent disintegration of the lattice structure. Five lines of a cubic pattern were observed, which were approximately of the correct size predicted for Cm<sub>2</sub>O<sub>3</sub>, although the possibility of the samples' being CmO<sub>2</sub> has not been completely eliminated. The lattice constant obtained was  $10.88 \pm 0.10 \text{ \AA}$  (predicted:  $10.96 \pm 0.04 \text{ \AA}$ ). The value of the constant for Am<sub>2</sub>O<sub>3</sub> is  $11.03 \text{ \AA}$ , and  $5.383 \text{ \AA}$  for AmO<sub>2</sub>. On this basis, a value of  $5.35 \text{ \AA}$  can be predicted for CmO<sub>2</sub>.

### Process Chemistry

Work is in progress on the following problems: preparation of titanium metal; film boiling from subcooled liquids; thermal diffusion in liquids; capacity of perforated-plate liquid-vapor contacting columns; gas-phase mass transfer studies; vacuum flow through annular sections; solubility studies; agitation of liquid-liquid system; thermal conductivity of gases at high temperatures.

### Metals and High-Temperature Thermodynamics

Work is in progress on the following topics: heats of formation and absolute absorption coefficients of high-temperature molecules; gaseous carbon species; magnesium oxide gas; reflection coefficients of molecular beams; sodium carbonate vapor; molybdenum chloride vapor; refractory silicides.

### Basic Chemistry, including Metal Chelates

Results have been obtained in some studies on fluoride complexing. The chemistry of ruthenium and the chemistry of titanium (II) ion are being studied.

### Health Chemistry

The Equipment Development group continues to improve existing equipment for processing Idaho Falls irradiations, which contain high alpha and high beta-gamma levels of activity.

Nine drums and barrels containing scrap uranium and thorium from machining operations were prepared for shipment to a recovery center.

A minor spill of liquid containing radioactivity from a gloved box being prepared for disposal at sea in the driveway behind Bldg. 5A provided an incident for testing the worth of the paraffin coating put on part of the driveway in that area; it was demonstrated that the surface which had been coated was much more readily decontaminated than the more porous uncoated pavement.

A program for testing radium sources for leakage is in operation.

The Berkeley Box group continues to assemble and fit gloved boxes for researchers on request.

## 6. BIOLOGY AND MEDICINE (A. E. C. Program Nos. 6300-6500)

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### Physical Chemistry of Lipoproteins

The result of the analysis of the fate of  $H^3$ -labeled fatty acid on feeding to humans with grossly disturbed lipoprotein metabolism ("idiopathic" hyperlipemia type) are now being calculated. These should provide further evidence concerning the direction of lipoprotein interconversion in the human.

An integrated concept of the development of coronary heart disease and coronary atherosclerosis has been developed mathematically and the hypothesis put to test by predicting coronary disease mortalities for both sexes over the age range from 30-70 years. The agreement with actuarial data on mortality is striking. The only point deviating significantly from actuarial data is for 35-year-old females, where the incidence was predicted from lipoproteins to be higher than actuarial data show. Certainly as a first-order treatment of the evolution of coronary disease, the hypothesis appears highly satisfactory. Refinements are now being sought.

Chemical analysis of ultracentrifugally isolated lipoprotein molecules continues in the effort to build up our fundamental store of knowledge concerning possible structural variation in particular classes from individual to individual.

The role of albumin-fatty acid binding in determining the hydrolysis of glyceryl ester by the heparin active factor has been investigated in detail. It appears that the reaction is inhibited by fatty acid. Whether this phenomenon is the result of attainment of equilibrium with appreciable quantities of unhydrolyzed glyceryl ester, or whether a kinetic inhibition by fatty acid is operative, cannot yet be ascertained definitely.

Light-scattering studies of the molecular weight and shape factors of Sf 6 lipoproteins are under way, now that the light-scattering equipment has been calibrated and is functioning satisfactorily.

The quantitative evaluation of the high degree of prediction of mortality and type of mortality (early or delayed) following total-body irradiation through segmental analysis of lipoprotein alterations is being completed.

#### Effects of a Nucleoprotein Fraction from Embryonic Organs

A method has been developed for isolating an active nucleoprotein fraction from whole chick-embryo extract. To determine if this fraction is localized in certain regions of the 12-day chick embryo, various tissues and organs of 12-day chick embryos were dissected out and collected in separate batches. Using the above method, a corresponding nucleoprotein fraction was then isolated from each organ extract. These fractions were tested for outgrowth-promoting activity in cultures of chick-heart fibroblasts, in Carrel flasks and in roller tubes. On the basis of dry weight of nucleoprotein fraction, equal concentrations of the tissue nucleoprotein elicited a favorable outgrowth response in terms of surface area and density of cells when whole embryo nucleoprotein fraction was tested. Of the organs and tissues tested (heart, gut, liver, brain, cord, etc.), the cord and cartilage showed an enhanced outgrowth while the others had a lesser effect. In general, in cultures of the active-organ nucleoprotein fractions, the cell morphology closely resembled that of the cultures supplemented with the whole-embryo nucleoprotein fraction. These results indicate that the whole-embryo nucleoprotein fraction consists of several nucleoprotein fractions with differing biological activity.

#### Tracer Studies

Tracer studies are continuing using actinium, terbium, europium, and promethium, as well as acute iodine experiments in rats and chronic astatine studies in rats and monkeys.

The chemical state of astatine in the body is still under investigation, as is the toxicity of radium in rats.

#### Radiation Chemistry

Radiation chemical studies of acetic acid-water, glycine-water, and formic acid-water systems have continued. Work during the past month has been devoted almost exclusively to the determination of radiation products in

the large number of target solutions irradiated during the previous two months in anticipation of the cyclotron shutdown.

### Histology

With the completion of soft-tissue preparations of  $At^{211}$ -treated rats, work has proceeded to the embedding, sectioning, and staining of femurs from both control and treated animals.

### Bio-Organic Chemistry

Considerable advancement has been made in the last month on several projects. The irradiation decomposition of choline and choline analogues is near completion and gives consistent results. Our attention is now turning to other compounds. In our program on the synthesis of labeled compounds, two high-specific-activity preparations are under way for radioactive dipeptides.

The apparatus for continuous analysis of  $C^{14}O_2$  from intact animals has been improved. Specific activity, total activity, and  $CO_2$  concentration curves have been determined for a fatty acid, a fat, a sugar, and an amino acid in rats and a rabbit.

Perhaps the most pleasing of all has been the progress in the plant biochemistry research. Three fundamental projects have been started: to measure the absorption spectra of cell suspensions, to measure the bond and strain energies in disulfides, and to test the thioctic acid theory of photosynthesis energy transfer. Further, considerable advancement has been achieved with existing projects, such as measuring the rate dynamics of a photosynthesizing system as a function of gas concentrations and intermediate buildup, or controlling the biological system under study to a very small tolerance.

## 7. PLANT AND EQUIPMENT REPORT UNCLASSIFIED

### Chemistry Laboratory Building 70 (Account No. 5-471-1002)

Exterior stucco coat and glazing are nearly complete. The colored rock chips have been placed on the roof and the corrugated transite screens on the roof are nearing completion. The ceramic tile is being installed in the first-floor rest rooms. First-floor lighting fixtures are being installed and cables are being pulled from main switchboard to second floor. The piping for corridor mains and the laboratory service branches are going in at the present time. Elevator installation is complete. The entire project is approximately 83% complete.

### Electronics Research Building 80 (Account No. 5-471-2002)

Final working drawings are being checked before approval by the University. Relocation of utility lines at the site is under way.

Miscellaneous Construction (Account No. 5-471-2001)

The Accelerator Technicians' Shop in Building 64 is approximately 70% complete, with only the installation of the rolling door and the outside utilities to complete. The contract for the 184-inch Area cooling tower has been let and preliminary work has started. Work has also been started on the Building 10 alterations and the relocation of rest rooms in Building 6.

MAN-MONTHS EFFORT REPORT  
SCIENTIFIC PERSONNEL

<u>Program No.</u>	<u>Subdivision</u>	<u>UCRL Man-Months Effort</u>	<u>UCRL Vac. and Sick Leave</u>
<u>Operations</u>			
3000 Weapons Research	General	311.17	13.97
	Arc Research	18.62	0.14
		<u>329.79</u>	<u>14.11</u>
4000 Reactor Development - MTA	Design and Development	13.15	0.83
5000 Physical Research			
5200 Basic Physics Research	General Physics Research	51.66	3.64
	Theoretical Studies	15.61	1.63
	Film Detection	13.98	0.90
	Cloud Chamber	10.14	0.63
	Magnetic Measurements	1.29	0.61
	Physics Projects	6.73	
	Subtotal	<u>99.41</u>	<u>7.41</u>
5311 Basic Chemistry Research	Chemistry of Heavy Elements	3.99	
	Nuclear Properties of Heavy-Element Isotopes	11.59	
	Transmutations with 184" and 60"		
	Cyclotrons	6.03	
	Analytical and Services	12.07	7.10
	Mass Spectroscopy, Beta-Ray Spectroscopy	1.94	
	Instrument Development and Services	5.17	
	X-Ray Crystallographic Measurements	2.50	
	Office and Travel	5.82	
	High-Temperature and Special Chemistry	4.32	
	Health Chemistry Research	13.24	
	Subtotal	<u>66.67</u>	<u>7.10</u>
5361 Applied Chemistry Research	Process Chemistry	3.50	
5731 Electron Synchrotron	Operations	7.84	
5741 Synchrocyclotron (184")	Operations	7.82	
5751 Linear Accelerator	Operations	8.55	
5761 Proton Synchrotron-Bevatron	Operations	15.29	
	Subtotal	<u>43.00</u>	
<b>TOTAL PHYSICAL RESEARCH</b>		<b>209.08</b>	<b>14.51</b>

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Program No.	Subdivision	UCRL	UCRL	Consultants	
		Man- Months Effort	Vac. & Sick Leave	Man- Months Effort	Vac. & Sick Leave
6000 Biology & Medicine Research					
6300 Medical Research	Health Medicine	1.80			
	Internal Irradiation	6.19		0.75	
	Subtotal	<u>7.99</u>		<u>0.75</u>	
6400 Biological Research	Miscellaneous	5.45	3.05	2.67	0.85
	Instrumentation	1.70		-	
	C <sup>14</sup> Metabolism	3.95		1.25	
	Use of Radioactive Material in				
	Human Physiology	10.08		5.12	
	Trace Elements	4.30		-	
	Physical Biochemistry	12.48		4.00	
	Biochemical Response to				
	Radiation	2.60		1.93	
	Metabolism of Lipoproteins	3.99		10.48	
	Iron Metabolism Hematopoiesis	4.19		-	
	Biological Effects of Cosmic				
	Radiation	2.35		-	
	Radiation and Mutation Rate	2.00		0.25	
	Bio-Organic Chemistry	25.79	1.71		
	Metabolism of Fission Products	16.08	2.02		
	Animal Colony	3.08	0.05	4.00	
	Subtotal	<u>98.04</u>	<u>6.83</u>	<u>29.70</u>	<u>0.85</u>
6500 Biophysics Research	Health Physics	2.61			
	Irradiation Studies	1.92		1.05	
	Subtotal	<u>4.53</u>		<u>1.05</u>	
<b>TOTAL BIOLOGY AND MEDICINE RESEARCH</b>		<u>110.56</u>	<u>6.83</u>	<u>31.50</u>	<u>0.85</u>
<b>GRAND TOTAL - OPERATIONS</b>		<u>662.58</u>	<u>36.28</u>	<u>31.50</u>	<u>0.85</u>

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