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RADIATION LABORATORY

UCRL-1965

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UCRL-1965

UNIVERSITY OF CALIFORNIA

Radiation Laboratory

Contract No. W-7405-eng-48

MONTHLY PROGRESS REPORT
NO. 113

August 15, 1952 to September 15, 1952

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UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

August 15, 1952 to September 15, 1952

MONTHLY PROGRESS REPORT NO. 113*

October 3, 1952

1. BEVATRON UNCLASSIFIED
(A.E.C. Program No. 9500)

Magnet

The magnet test without pole pieces is proceeding. Regrounding of the magnet excitation system from a midpoint between the ignitron inverter-rectifier units to a midpoint on the magnet windings has caused a considerable reduction of the voltage ripple. Most of the sparking between magnet core laminations disappeared after this change. Azimuthal uniformity measurements of the residual field have indicated deviations of less than one tenth percent. Work is continuing on the problem of balancing the load between the two generators.

Vacuum System

The eight transition tanks have been received at UCRL. The first tangent tank should be fabricated by October 20. Construction of the first curved tank has started. Gasket trouble is delaying the vacuum testing of the transition tanks and the construction of the curved tanks. The gaskets have cracked during installation and the vendor is working on improving the bond between the hycar pieces placed in the mold.

Injector

The ion gun (replacing the original which is being used on a classified job) is being fabricated. It has been decided to use mercury diffusion pumps for the linac, but the presently designed oil diffusion will probably be used for the initial operation. Initial operation of both the ion gun and linac is expected in December.

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* Previous report UCRL-1944 (No. 112)

SECRET

2. 184-INCH CYCLOTRON OPERATION UNCLASSIFIED
(A.E.C. Program No. 5741)

The preliminary engineering survey for the redesign of the 184-inch cyclotron has been completed together with some model magnet tests. The results indicate that a proton energy of 650 Mev may be achieved. Work on the final design is underway in the engineering department. More precise model magnet tests employing the exact geometry of the redesigned machine will be started shortly.

Operating statistics for the past month are as follows:

Operation for customers	481.3 hours	92.1 percent
Electrical troubles	3.8	.8
Mechanical troubles	16.3	3.1
Power shutdown	15.8	3.0
Other	6.3	1.0
Totals	531.3	100.0 percent

3. 60-INCH CYCLOTRON OPERATION UNCLASSIFIED
(Operated by the University of California)

Operation was good during this month period. A slight increase in outage time occurred because of experimental interval target design work. Effort, along this line, was placed upon development of a water cooled window probe which could withstand large beams over small areas. Some attempts were followed by water leaks (small magnitude) that required extra tank pump-down time.

4. SYNCHROTRON UNCLASSIFIED
(A.E.C. Program No. 5731)

The synchrotron operated consistently at high intensity levels during this report period.

The 3 Mev electron linear accelerator assembly was completed the last week in August. Adjustments had to be discontinued until radiation shielding was installed. A beam current in excess of 0.018 amperes per pulse was obtained during the few minutes the machine was operated.

The operating statistics are as follows:

Total crew time	374.0 hours	
Total operating time	343.0	91.7 percent
Total non-operating time	31.0	8.3
Beam time available	327.0 hours	87.4 percent
Beam time used	222.3	59.4

5. LINEAR ACCELERATOR AND VAN DE GRAAFF OPERATION (A.E.C. Program 5751) UNCLASSIFIED

Operation during the past month was steady and at the same level that has been maintained over the last year. Some development work is being done on the pre-exciters which will be reported later.

Operating statistics for the 32 Mev linear accelerator and Van de Graaff machines are as follows:

Running time	300 hours	82 percent
Maintenance	16	4
Repair time	52	14
	368 hours	100 percent

6. EXPERIMENTAL PHYSICS (A.E.C. Program No. 5211) UNCLASSIFIED

Film Program

Physical Analysis of High Energy Disintegration Products. The program now being carried out is the measurement of the abundances and momenta of the products from Be, Al, Ni, Ag, Au and U when bombarded with protons, deuterons and alphas at two beam energies. To supplement this, the angular distributions of the products formed under alpha bombardment is being studied. A report, UCRL-1914, has been issued, which describes the experimental method and gives the results for C and Be bombarded with protons.

Meson Spectrometer Magnets. The 22-inch magnet was assembled, but insulation defects were found. A number of metal chips were found to be piercing the insulation. This trouble is now believed to be corrected and the magnet is being reassembled. Its resolution and solid angle of acceptance will be measured with an alpha particle source.

The detail drawings of the 40-inch magnet are being completed.

Cloud Chamber

A run was made at the linear accelerator using a 16-inch pantograph type cloud chamber. The chamber was filled with helium, which was bombarded by 32 Mev protons. About 750 pictures were taken, and track measurement and data reduction are in progress.

The high energy n-p scattering experiment using the ten-atmosphere cloud chamber was run at the 184-inch cyclotron, using the 270 Mev neutron beam and a lithium-deuteride cyclotron target. Because of the long sensitive period characteristic of the high pressure chamber, it was possible to use three cyclotron pulses per picture, increasing the data run per picture by a factor of three. More than 950 pictures were taken, and these should give about 2,000 events.

Pair Spectrometer for Bremsstrahlung Studies.

Modification of the spectrometer regularly used for neutral meson studies has been completed and a test run on the neutral meson photon spectrum has been made. The purpose of this spectrometer is two-fold; first, to study the bremsstrahlung spectrum from proton nucleon collisions and, second, to investigate carefully the region of the neutral meson photon spectrum below its energy of maximum intensity. The purpose of later study is to investigate the symmetry of the spectrum so as to ascertain whether or not other sources of high energy photons are contributing to the spectrum.

Internal Momentum Distributions in Light Nuclei.

Work has continued on substitutes for the geiger tube array. Following an idea proposed by R. F. Post, a long proportional counter is being developed in which the position of an incident particle can be determined by comparing the pulse heights at each end of the counter. Considerable work has been done in developing appropriate amplifiers so that the pulse heights can be compared on an oscilloscope and recorded photographically.

The use of 35 photomultiplier tubes, Type 931A, with anthracene crystals is also being investigated. A pilot model is being developed for use in the cave.

The Photoproduction of Negative Pions from Deuterium.

The photon beam intensity from the synchrotron has been gradually increased until now it is a factor of 50 to 100 times stronger than it was in July, 1951, when this experiment was first started here. The experimental arrangement for the detection of negative pion-proton coincidences from the reaction $\gamma + n \rightarrow \pi^- + p$ was designed for the run this past month to take advantage of the maximum available beam intensity. The distance of the proton counter from the target was chosen to give the maximum spatial separation of protons and $\beta \simeq 1$ background electrons that come from the target. Such a separation in space occurs because the photon beam was found previously to be emitted in short bursts with the 2.1×10^{-8} second period of the radio frequency oscillator. Since most of the electrons that contribute to the background will move with nearly the speed of light, the electrons will arrive at the proton counter in bunches with the same 2.1×10^{-8} second period as the photon beam. Thus, the maximum spatial separation of protons and background electrons that come from the target to the proton counter occurs when the difference in time of flight between protons and electrons is equal to one-half of the rf period of the photon bunches. For this condition, the distance r_p of the proton counter from the target is given by

$$r_p(\alpha,k) = \frac{1/2\tau_{r.f.}}{\frac{1}{\beta_p c} - \frac{1}{\beta_e c}} = \frac{10.5 \times 10^{-9} \text{ sec}}{\left(\frac{1}{\beta_p c} - 3.33 \times 10^{-11}\right)} \text{ sec/cm.}$$

This distance is a function of the proton production angle θ and the incident photon energy k since the proton velocity $v_p = \beta_p C$ is a function of these two variables.

A measurement of the angular distribution of the negative pions in this reaction by the coincidence detection of negative pions and protons is restricted to backward pion angles in the center of mass coordinate system because of the proton production energies which become too low for efficient detection with the present apparatus when the pions are emitted in the forward direction. In order to include the widest range of angles possible with the present apparatus, calculations of the experimental arrangement were made for photons in an energy band around 280 Mev. In addition, only a single counter, instead of a telescope of two counters as in the pion detector, was used for the proton detector.

A two pion counters and the proton counter were connected in triple coincidence with a resolution time and a dead time of 3×10^{-9} seconds. For 280 Mev photons, a laboratory proton angle of 26.5 degrees, and a correlated laboratory pion angle of 103 degrees, the optimum distance of the proton counter from the target turns out to be 55 inches, and the pion pulses were delayed by about four times the resolution time of the coincidence circuit. The 1.50 cm. water and heavy water targets that have been used in previous runs were found to be too thick for this new experimental arrangement. The reason is that the time of flight dispersion of protons produced by 280 Mev photons in different parts of the target is larger than the improved resolution function of the coincidence circuit. When a thinner (0.67 gm/cm^2) CD_2 target and its carbon equivalent were used, the ratio of the yield from CD_2 to that from C was found to be several times higher than any previously obtained ratio of the yield from D_2O to that from H_2O. Previously, the ratio of the counting rates from D_2O and H_2O targets was around two or three to one. During the last run, the ratio of counting rates from CD_2 and C targets was around fifteen or twenty to one.

Trouble with so-called "feed-through" pulses from the pion telescope was encountered during the last run. That is, when the photomultiplier high voltage was turned off the proton counter, the pion telescope would sometimes deliver or "feed-through" a coincidence pulse. The discrimator bias could be adjusted to bias out all such "feed-through" counts, but then only a small bias range remained for the efficient detection of coincidences. The "feed-through" free operating bias was only a factor of two or three above the pion telescope "feed-though" bias. This condition in itself would be satisfactory; however, the fact that the coincidence output level appears to drift from one day to the next renders the situation unsatisfactory.

Synchrotron Studies.

During this period the synchrotron operated very satisfactorily. The unsteadiness mentioned in last month's report seems to have been taken care of by spraying the inside of the donut.

During this period R. M. Littauer of the synchrotron group at Cornell visited the laboratory with a standard ionization chamber calibrated at Cornell.

There they use both the method of Blocker, Kenney, and Panofsky and the pair spectrometer method. The two methods agree very well. Littauer's comparison of their standard chamber (an ionization chamber with one inch copper walls front and back) with the Nunan meter calibrated by Blocker and Kenny indicated a discrepancy of 25 percent, in the direction that for a given beam, Berkeley believes more quanta are coming out than does Cornell. It is satisfactory that the results are so close, and a recalibration will soon be made at Berkeley since the operation of the synchrotron during the last calibration was poor so that the data were considered unreliable.

During the month an investigation was made of the detection of π mesons by means of the π-μ decay. The electronics used at the cyclotron is being employed with different counters for the detection of π^+ mesons from H and D at small angles. A good deal of test work is necessary to insure that the whole counting system is operating satisfactorily, but it is hoped that within the next month, such a state can be reached.

One run was made on the $\gamma + D \rightarrow p + p + \pi^-$ process, and satisfactory operation of the meson detecting system, which identifies the mass from measurements of E and dE/dx, was secured. In addition one run was made to get nuclear emulsions with high energy electron tracks for the film group.

7. THEORETICAL PHYSICS (A.E.C. Program No. 5211) UNCLASSIFIED

An investigation of low energy photodisintegration of He^3 is being initiated.

A study of the internal pair conversion of negative pions in hydrogen is being carried out with a view of determining whether an experiment can yield information about the type of meson-coupling.

The neutral pseudoscalar meson theory in the one-mode Tomonaga intermediate coupling approximation is being studied.

The radiative corrections to scattering of low energy electrons by heavy nuclei are being investigated.

A theoretical investigation of the quantum corrections to the radiation of electrons in circular plane orbits in a magnetic field is being pursued.

The angular correlation and the energy distribution of electron pairs in neutral pion decay are being examined.

8. THE M.T.A. PROGRAM (A.E.C. Program No. 9200) SECRET

Target Physics Research

Attenuation of deuterons and protons in various target materials has been studied. Some of the more significant cross sections measured are listed

below. Whereas probable errors are not stated, minor inconsistencies in the proton cross sections are an indication of the reliability of the values given.

Particle	Energy Range (Mev)	Average Inelastic Cross Section (barns) Be	U
Deuterons	0-190	0.45	3.45
Protons	150-340	0.14	1.64
"	150-200	0.174	1.89
"	200-270	0.169	1.76
"	270-340	0.152	1.60
		Cross Section for Production of High Energy Protons (barns)	
Deuterons	0.190	0.40	1.05

The above cross sections and other pertinent information have been incorporated in a calculation of the neutron yield as a function of bombarding particle energy based upon a theory of the high energy cascade process by which the stripped and knock-on nucleons from the primary nuclear process contribute to the total yield by causing additional nuclear processes to occur deep into the target. The results obtained from the cascade theory are in good agreement with experimental results for protons up to 340 Mev and for deuterons up to 230 Mev. The theory applied to higher energies gives about 30 neutrons/deuteron at 500 Mev and 50 neutrons/deuteron at 700 Mev. Further refinement of the cascade theory is in progress.

The detailed measurement of the distribution in energy and angle of the high energy stripped and knock-on nucleons from high energy proton and deuteron bombardment with a proportional counter telescope is in progress.

The spectrum of evaporation neutrons (0-10 Mev) from a thin uranium target bombarded by 190 Mev deuterons has been studied by observing proton recoils in photographic emulsions and in a cloud chamber. The spectrum appears to have a maximum at about 1.5 Mev and an average energy of 3.0 Mev or slightly higher. For this spectrum the fast fission effect in U-238 is significantly greater than for the normal fission spectrum. This effect contributes appreciably to the total neutron yield in uranium.

Preparations for the acceleration of He-3 in the 184-inch cyclotron has continued. A system for operating the cyclotron continuously on a small sample of helium by recirculation, purification by passing through a liquid nitrogen cooled activated graphite trap and final compression into a small reservoir at a pressure slightly less than atmospheric has been developed and tested. After three hours operation on a two liter sample of helium, 98.5 percent was recovered with impurities not to exceed 0.1 percent. The He-3 particles will be accelerated to 500 Mev and stripped by a beryllium target to produce deuterons of about 320 Mev average energy. It is believed that an external beam of deuterons of the

order of 10^{-13} ampere can be produced in this way. If successful this project will permit neutron yield measurements with 320 Mev deuterons, thereby greatly extending the yield-energy data and providing an effective check on the theoretical yield extrapolation.

Sparking Studies

Work is also continuing on the program to find materials suitable for drift tubes which have low sparking rates under high voltage conditions and which resist the damage of high energy sparks. Some experiments are also being carried out on basic spark mechanism.

Ion Pump Development

The ion pump activities are decreasing with two exceptions. A comprehensive report is being written for publication and certain experimental work of particular interest to Project Whitney is continuing. This is being carried out by people who plan to transfer to that project.

Cavity Design

Measurements of shunt impedance as a function of cavity geometry has been continued. Measurements have been made not only for present A-12 parameters, but also for higher β's in the event that higher energy design is desirable.

Beam Bunching

The proton model of the beam buncher was operated during the past month for the d.c. case of no rf, so that the bunching and acceleration could not be tested. Sufficient rf voltage (20 kv across each gap) was not yet available, but the d.c. beam dynamics were checked completely. A stable rotating beam was obtained down the bore of the 10 drift tubes, and behaved dynamically exactly as the theoretical report predicted. In general, the beam was completely stable for a wide variety of conditions. The angular momentum could be varied from that required to have the beam just miss the central rod by 1/4 in., to that required to give almost a circular orbit, 2-1/2 in. diameter, and no beam loss was observed. A stable beam could be maintained with from 5 to 50 kv on the central rod. With half the design voltage (25 kv) on the central rod, 15 kv of rf gave no beam loss. It is therefore anticipated that little beam loss will occur when full rf (20 kv) and 50 kv d.c. on the central rod is used. The magnitude of the beam used is small for the convenience of measuring and has no bearing on future capacity. Work has just been completed on a new rf system which will give considerably more than the required 20 kv between drift tubes.

9. CHEMISTRY CONFIDENTIAL
Part A
(A.E.C. Program No. 5311)

Mass Spectroscopy

The time-of-flight mass spectrometer, modified for collection of isotopes, has been used to confirm the mass assignment of the 7-hr. thallium as Tl^{199}.

Optical Spectroscopy

Samples containing Pu^{238}, Pu^{239}, Pu^{240}, and Pu^{242} were examined with the high resolution spectroscopic equipment at the Argonne National Laboratory. Isotope shifts were observed for many lines in the arc and spark spectra. The shifts are smaller than but of the same order of magnitude as those observed for uranium isotopes. No hyperfine structure has yet been observed for plutonium isotopes.

Crystal Chemistry

Several of the binary metal-silicon systems are being studied. New phases which have been identified are Nb_5Si_3 and Ta_5Si_3 which have the Mn_5Si_3 type structure.

Isomerism of Bi^{210}

Better data on the decay of the long-lived Bi^{210} isomer indicate that for every 270 nuclei that undergo alpha decay, one decays to Po^{210}. The half-life for alpha decay is $\sim 10^6$ years, and therefore the rate of decay to Po^{210} corresponds to a half-life of $\sim 2.7 \times 10^8$ years.

Beta Spectrum of Fr^{223}

The beta spectrum of 21-minute Fr^{223} has been investigated by combination of data from many samples. The beta spectrum is complex, and a tentative resolution gives 1.10 ± 0.05 and 0.76 ± 0.05 Mev for the two components. Additional data are needed, especially near the upper limit of the spectrum. Electron lines are observed at 15, 22, 30, 110, 195, and 220 kev. The $\pi\sqrt{2}$ spectrograph was used for these measurements.

Tantalum Fission and Spallation

Additional elements have been isolated among the products from tantalum after exposure to 340 Mev protons. The curve of yield vs. mass shows a broad peak of 0.1 mb at masses 80-85, a minimum of 0.001 mb at masses 105-110, and a maximum of 50 mb in the spallation region near tantalum.

CHEMISTRY UNCLASSIFIED
Part B
(A.E.C. Program No. 5311)

Metals and High Temperature Thermodynamics

Work is in progress on the following problems:

1. Determination of the vapor pressure of tim.
2. Thermal conductivity of gases.
3. Gaseous molecules.
4. Gaseous oxides
5. Refractories.

Basic Chemistry

The following problems are under investigation:

1. The hydrolytic polymerization of zirconium.
2. Thermodynamics of indium.
3. Heats of complexing.
4. Studies in non-aqueous solvents.
5. Thermodynamics of $S_2O_3^=$.
6. Rare earth fluorides.
7. Potential of the RuO_4^--RuO_4 couple.

CHEMISTRY UNCLASSIFIED
Part C
(A.E.C. Program No. 6400)

The research activities of this group continue to involve studies under the three major classifications of organic chemistry, animal biochemistry, and plant biochemistry.

Organic Chemistry

Work in organic chemistry during the past month has included (1) syntheses of leucine-3-C^{14}, aspartic acid-3-C^{14} and Δ^7-cholestenol, (2) continued studies on the isotope effect involved in the pinacol rearrangement, (3) studies leading toward the chemical degradation of ribulose and sedoheptulose, and (4) research leading to the syntheses of morphine-7-C^{14} and codeine-7-C^{14}.

Animal Biochemistry

Research has been carried out on the metabolism of valeric acid in mouse liver slices, on the effect of heparin on the rate of fatty acid metabolism, and on the metabolism of morphine-N-methyl-C^{14} in humans.

Plant Biochemistry

Fundamental studies on the path of carbon in photosynthesis have been continued. During the past month this research has included (1) a search for photosynthetic intermediates, (2) measurement of steady-state reservoir sizes in photosynthesis, (3) separation of phosphorus-containing algae metabolites and measurement of the distribution of phosphorus radioactivity in these compounds, (4) studies on the incorporation of carbon-14 into the ribonucleic acid of a photosynthesizing alga, (5) identification of sucrose phosphate in sugar beet leaves, and (6) studies on the radioactive constituents of ethanol distillates after the photosynthetic fixation of labeled carbon dioxide.

10. MEDICAL PHYSICS UNCLASSIFIED
Part A
(A.E.C. Program No. 6400)

Tracer Studies

Studies involving the metabolism of plutonium in rats are being continued. Arrangements are being made to introduce an aerosol of americium into the lungs of monkeys.

Radioautography

The Orthophot equipment was received and trail photomicrographs are in progress.

Work is also in progress on the damaged thyroid of the experimental monkey.

Radiation Chemistry

Studies have continued on radiation induced reactions occurring in aqueous acetic acid solutions under heavy particle radiation. Mechanisms have been postulated which adequately account for the quantitative results. This material is now being gathered together for publication.

Work is started on the similar radiation study of glycine solutions and the analytical techniques are being developed.

MEDICAL PHYSICS UNCLASSIFIED
Part B
(A.E.C. Program No. 6400)

The Effect of Radiation on Lipoprotein Metabolism

It has previously been reported that following irradiation there is an immediate metabolic block of lipoprotein interconversion. This developing block is highly associated with the lethality of a given severe dosage of whole body radiation in the rabbit.

Recently it has been pointed out that the block develops immediately after irradiation. These observations are based upon the measured rate of conversion of a standard load of lipoprotein given intravenously to rabbits. The utilization rate of lipoproteins as measured by the half time of conversion of this standard lipoprotein dose is:

Normal rabbit:	10 hours half-time disappearance of lipoproteins
1 day post irradiation (800r):	No utilization of lipoproteins
Normal rabbit with 10 mg. heparin:	1/2 hour half-time disappearance of lipoproteins
1 hour post irradiation (800r):	1/2 hour half-time disappearance of lipoproteins

It therefore appears that during the initial period following irradiation there is an enhanced utilization of lipoprotein as though the rabbit had received a moderate amount of heparin. Thus the severely irradiated rabbit passes through three phases of altered fat metabolism:

1. An immediate period of enhanced utilization resembling the effect of heparin administration.
2. The period from one to three days when there is little to no interconversion of lipoproteins. This period is similar to a state of induced heparin deficiency and it can be prevented by heparin administration.
3. The super-recovery of lipoprotein conversion ability, similar to phase one.

Nucleic Acid Studies

The incorporation of P^{32} into desoxypentose-nucleic acid (DNA), nuclear pentose nucleic acid (nPNA), and cytoplasmic pentose nucleic acid (cPNA) of liver was measured in rats which had been exposed to 2500r total body X-irradiation and in mice which had been exposed to 600r total body X-irradiation. It was found that the incorporation of P^{32} into cPNA was increased in all cases, while into DNA and nPNA it was depressed. In the Sprague Dawley rats an increase in the weights of the liver was observed concurrent with the increase in cPNA specific activity. An interrelationship between protein and cPNA synthesis has been postulated.

Studies with C^{14} Labeled Tyrosine

Preliminary to possible study of certain human tumors using C^{14} labeled tyrosine, mice were injected with this material in order to determine quantitative localization in adrenal and thyroid tissues. Measurements of radioactivity in the peripheral blood were also made.

The peak concentration of radioactivity occurred in the adrenal and thyroid glands during the first hour after intraperitoneal injection of labeled tyrosine. Peak blood levels occurred during the first two hours. The above

experiment was undertaken primarily to aid in estimating the dose that would be needed for human studies.

Red Cell Life Studies

Measurement of the red cell life span simultaneously by long term studies of C^{14} activity and Fe^{59} activity in red cells and by the differential agglutination method are continuing in chronic lymphocytic and chronic myelocytic leukemia.

11. HEALTH CHEMISTRY UNCLASSIFIED
(A.E.C. Program No. 5311)

The Equipment Development Group has been engaged in work on the following items:

1. A modified Berkeley Box, whose features include four ports--two for use with ball-socket manipulators and two in which gloves can be fitted, lead sheeting on the glove port panel, etc., has been created for use in the continuing work in the purification of the americium milked from some Los Alamos plutonium slugs, described previously. The high beta-gamma levels associated with this work have made such extra shielding and remote handling features mandatory.

2. Equipment for processing additional "cows" (milking americium from plutonium) has been completed and dry runs are being made. This setup is in the annex of Bldg. 5A.

3. One portion of the neptunium-containing materials from Hanford has been processed, in conjunction with Health Chemistry operators; a second plase will be started shortly.

4. Equipment for processing an Idaho Falls bombardment for CRandD is essentially completed.

5. A long range program of bombardments at Idaho Falls is becoming crystallized. Equipment to be shipped to the reactor site for on-the-spot processing of certain samples is almost completed for an October 15 sample, and equipment for the November 15 irradiation to be processed at Berkeley is under way in fabrication, and plans for other equipment to be used in the future are taking shape. This program again brings to attention the many-hundred-fold general increase in levels of activity being dealt with in the Radiation Laboratory.

6. Arrangements are complete to transfer the hundred-odd curies of cobalt 60 from storage containers to the permanent housing of this source. This work will be partially done in the 6-in. lead cave.

7. Consultations have been held regarding the UCRL program at Livermore.

8. Numerous small pieces of equipment used in the chemical processing of radioactive materials have been designed and fabricated; these will be described in detail in the next quarterly report.

9. Eight Berkeley Boxes were assembled and fitted in fulfilment of requests during this period.

12. PLANT AND EQUIPMENT RESTRICTED

Chemistry Laboratory Building. (Program No. 9500. 5-424-1002)

The final drawings on the preliminary plans are not now expected to be completed until late in November or early December.

Synchrotron Research Building. (Program No. 9500. 5-424-2001)

The old buildings have been razed, the concrete slabs broken up, and excavating has begun for the Synchrotron Research Building.

Bevatron Instrument. (Program No. 9500. 5-424-9001)

Work is being continued on testing the Magnet and there are no further developments on the Ion Gun except that a frame has been constructed to enclose it. Also, plans are being made to begin construction of a Curve Tank Envelope.

Radiological Laboratory at the U.C. Medical Center. (Program No. 9600 6-424-9008)

The insulation and sound proofing has been completed and the job itself is practically one hundred percent complete.

MAN-MONTHS EFFORT REPORT
Scientific Personnel

PROGRAM NO.	SUBDIVISION	MAN-MONTHS EFFORT	COMMENTS
9500 Bevatron	Miscellaneous	9.70	
Operations			
2000 M.T.A.	Design and Development	45.73	
3000 Weapons Research	General	43.11	
5211 Physics Research			
Experimental Physics	Cloud Chamber	19.76	
	General Physics Research	64.45	
	Instrument for General Use	2.32	
	Magnetic Measuring	1.91	
Theoretical Physics	General	17.67	
Photographic Film Detectors	General	17.44	
5261 Applied Physics Research			
Mark III Cyclotron	Electron and X-C Models	8.45	
Chemistry Research			
5311 Basic Chemistry Research, Part A	Chemistry of Heavy Elements	5.58	
	Nuclear properties of Heavy Element Isotopes	12.89	
	Transmutations with 184-inch and 60-inch Cyclotrons	11.00	
	Analytical and Services	21.89	
	Special Chemistry Development	-	
	Mass Spectroscopy, Beta Ray Spectroscopy	2.60	
	Instrument Development and Services	4.59	
	X-Ray Crystallographic Measurements	3.06	
	Health Chemistry Research	7.56	
5311 Basic Chemistry Research Part B	Metals and High Temperature Thermodynamics) Basic Chemistry, including Metal Chelates) General	13.87	

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MAN-MONTHS EFFORT REPORT
Scientific Personnel

PROGRAM NO.	SUBDIVISION	MAN-MONTH EFFORTS	COMMENTS
5361 Applied Chemistry Research	Process Chemistry	7.79	
Reactor and Accelerator Operation			
5731 Electron Synchrotron	Operation	10.90	
5741 184-inch Cyclotron	Operation	10.98	
5751 Linear Accelerator	Operation	13.01	
Biological Research			
6300 Biology and Medicine	Internal Irradiation and Hematological Response	5.48	1.57 Consultant Man-Months
	Health Medicine	6.81	
6400 Biological Research	Instrumentation for Quantative Measurements of Radiation	2.44	.40
	C^{14} Metabolism	3.20	.25
	Use of Radioactive Materials in Human Physiology and Experimental Medicine	13.39	2.87
	Trace Elements and Irradiation Studies	7.64	.86
	Radiation and Mutation Rate	2.10	.25
	Physical Biochemistry	15.21	4.03
	Biochemical Response to Irradiation	4.74	.50
	Miscellaneous	4.59	4.33
	Metabolism of Lipo Protein and Lipids	4.14	12.75
	Iron Metabolism Hematopoiesis	3.67	.92
	Synthetic and Experimental Organic Chemistry	26.95	-
	Metabolism of Fission Products	17.47	-
6500 Biophysics Research	Biological Effects of Cosmic Radiation	2.69	.11
	Health Physics	2.30	-

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