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## Recent Work

### Title

MONTHLY PROGRESS REPORT NO. 134, MAY 15 TO JUNE 15, 1954

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MONTHLY PROGRESS REPORT NO. 134

May 15, 1954 to June 15, 1954

July 8, 1954

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Berkeley, California

UNIVERSITY OF CALIFORNIA RADIATION LABORATORY

MONTHLY PROGRESS REPORT NO. 134\*

1. EXPERIMENTAL PHYSICS  
(A. E. C. Program No. 5200)

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Fast Deuterons from High Energy Nucleons Bombarding Various Elements

The data obtained in a run made at 40° to the 300 Mev neutron beam have been analyzed and the values for the fraction,  $f$ , of surface nucleons that are neutrons have been determined. These were listed in the last report. For Li and C, the values of  $f$  are the same as the comparable volume fraction, which is  $N/A$ . For heavier elements and especially for Pb and U the value of  $f$  is significantly higher than  $N/A$ . This shows that for heavy elements there is a nuclear skin that is predominantly neutrons. This has been anticipated theoretically\*\* and is a result of the coulomb potential.

An attempt has been made to fit the observed deuteron yields and spectra by using the indirect pick up model of Bransden\*\*\* which can be written as:

$$\frac{d\sigma}{d\Omega dE} p + x \rightarrow d = \left[ \frac{d\sigma}{d\Omega dE} p + x \rightarrow p \right] P_1 + \left[ \frac{d\sigma}{d\Omega dE} p + x \rightarrow n \right] P_2$$

$P_1$  = Probability that a proton pick up a neutron

$P_2$  = Probability that a neutron pick up a proton

for a carbon target  $P_1 = P_2$ .

In this experiment we have measured  $\frac{d\sigma}{d\Omega dE} p + x \rightarrow p$  and we can make a reasonable guess at  $\frac{d\sigma}{d\Omega dE} p + x \rightarrow n$  by taking  $\frac{d\sigma}{d\Omega dE} p + x \rightarrow p$  and weighting it by the ratio of free nucleon cross sections given by  $\frac{\sigma_{np}(\theta)}{\sigma_{pp}(\theta)}$ . Using these energy spectra and choosing a power law for the energy dependence of the pick up process  $P = kE^{-n}$  we can try to fit the observed deuteron energy spectra and also the area under the spectra which are the differential cross sections. The best fit is given by

$$P = .12 \left( \frac{E}{100} \right)^{2.5}$$

The data can be fit quite well by any value of  $n$  from 2 to 4.

\*Previous Report UCRL-2624 (No. 133).

\*\*Johnson and Teller, Phys. Rev. 93, 357 (1954).

\*\*\*Bransden, Proc. Phys. Soc. A 65, 738 (1952).

Gamma Ray Pair Spectrometer

A run was made near the end of May at the 184 in. cyclotron in which the gamma energy spectrum from  $\pi^0$  production by 340 Mev protons on carbon was obtained. Data was taken at  $0^\circ$ ,  $90^\circ$  and  $180^\circ$  in the laboratory system.

The spectrum at  $90^\circ$  was viewed by the  $180^\circ$  pair spectrometer down a hollow probe placed along the main probe radius. Monitoring of the internal beam was done by our thermocouple system which measures the power input of the beam to the target. The data at  $0^\circ$  and  $180^\circ$  was taken by moving the spectrometer to the neutron hole where it viewed the same probe and target arrangement at the same cyclotron radius. This provided an accurate measure of the relative cross sections at the three angles. A run is being made during the middle of June in which  $\pi^0$  data at  $47^\circ$  and  $133^\circ$  will be obtained as well as proton bremsstrahlung spectra from 180 Mev proton bombardment of Be, Al, and Cu at  $0^\circ$  and  $180^\circ$ .

Coincidentally with measuring the  $\pi^0$  angular distribution, the previously reported 15 Mev gamma line from carbon was seen, thus providing a measure of its angular distribution from 340 Mev proton bombardment.

Liquid Hydrogen Glaser Bubble Chamber

A chamber is being constructed for the purpose of measuring low energy meson scattering.

 $p + p \rightarrow \pi^+ + d$  Reaction

Analysis of data obtained recently has been made in which the  $90^\circ$  c. m. cross section was fit by the theory of least squares to the curve  $4\pi \frac{d\sigma}{d\Omega}(90) = a_{10}(\eta + \eta^3 \eta_c^{-2})$ . The results are:

$$a_{10} = 0.11 \pm 0.02 \text{ mb/ster.}$$

$$\eta_c = 0.62 \pm 0.16,$$

where  $\eta = P_\pi / M_\pi C$ .

Combining the data at  $0^\circ$  with Schulz's excitation function the following value of  $A$  vs  $\eta^{-2}$  is obtained:

$$A = (0.14 \pm 0.06) \left( 1 + \frac{0.39 \pm 0.20}{\eta^2} \right),$$

where the angular distribution is  $A + \cos^2 \theta$ .

From recent measurement of the left-right asymmetry of  $p + p \rightarrow \pi^+ + d$  with 73 percent polarized protons,  $|P| = 0.73$ , it has been determined that

$$|Q| = 0.39 \pm 0.05 \text{ at } \eta = 0.41, \text{ where } \frac{R-L}{R+L} = PQ \frac{A \sin \theta}{A + \cos^2 \theta}.$$

Marshak and Messiah<sup>1</sup> show that  $Q$  is related to the constant  $\eta_c$  by the following expression:

$Q = \sqrt{2} \eta_c \eta (\eta^2 + \eta_c^2)^{-1} \sin(\psi - \tau_1)$ , where  $\psi$  and  $\tau_1$  are defined by the following expressions:

$$\frac{S_0}{S_2} + \sqrt{\frac{1}{2}} = \left| \frac{S_0}{S_2} + \sqrt{\frac{1}{2}} \right| \exp i\psi$$

$$\frac{S_1}{S_2} = \left| \frac{S_1}{S_2} \right| \exp i\tau_1$$

$S_0$ ,  $S_1$ , and  $S_2$  are the complex transition amplitudes from the initial  $^1S$ ,  $^3P$ , and  $^1D$  proton states respectively. The notation is that of A. H. Rosenfeld.<sup>2</sup>

From the measured values of  $|P|$  and  $|Q|$  the value of  $|\sin(\psi - \tau_1)|$  is determined to be  $0.61 \pm 0.10$ .

#### Beta-Ray Neutrono Angular Correlation in Ne<sup>19</sup>

A linear accelerator run with the differential pumping apparatus on June 14-15 revealed several difficulties: (1) The recoil counter is not, at present, counting predominantly Ne<sup>19</sup>, (although the beta counter is). (2) Bombardment of the target with full beam results in a less in gain in the recoil counter. (3) Turning on the "clearing field" results in a background in the recoil counter.

Design of an additional charcoal trap to alleviate difficulties (1) and (2) is in progress. It is hoped that difficulty (3) may be avoided by operating the clearing field at reduced voltage.

#### Experiments on Proton Polarization at 32 Mev

Scattering angles have been extended out to 40° by means of two new plate holders with approximately .01 ster. solid angle. Scanning of plates obtained with protons double scattered in carbon has just begun. The small number of tracks thus far observed indicates an asymmetry of  $10 \pm 5$  percent. We have been concentrating on carbon targets in order to make observations near the first minimum of the diffraction scattering. Elements with higher  $Z$  have Rutherford scattering which is too large; elements with lower  $Z$  have their diffraction minimum at larger angles, and hence the yields are very small.

#### Polarization Experiments Using Linear Accelerator Beam Reduced in Energy to Approximately 3 Mev.

An attempt is being made to determine the sign of 32 Mev polarization by absorbing a once scattered beam to an energy where its second scattering in Helium will be strongly polarized.<sup>3</sup> Two runs have been made. A minimum

1. R. E. Marshak and A. M. L. Messiah, *Il Nuovo Cimento*, 11, 337 (1954).
2. A. H. Rosenfeld - "Production of Pions in Nucleon-Nucleon Collisions at Cyclotron Energies", to be published.
3. Myron Heusinkveld, Thesis, University of Minnesota, (1951).

of eight hours bombardment is required to obtain sufficient yield of doubly scattered particles. The accumulated background in the plates due to neutrons and gamma rays is very large.

Recent communication with Dodder indicates that the polarization of 9.5 Mev protons scattered on hydrogen should still be large. One run at this energy has just been completed. Plates are not yet examined.

#### Cyclotron Polarization Experiments

One run has been made in the program to determine the sign of polarization. The 73 percent polarized beam was absorbed to a nominal energy of approximately 30 Mev. This reduced energy beam was then scattered approximately 45° in carbon and detected in nuclear plates. The plates are now being scanned.

A high pressure helium chamber is being constructed for attempting a second scattering measurement at the 9.5 Mev value mentioned above.

#### Scattering of Polarized Protons in Hydrogen

The 73 percent polarized proton beam of the cyclotron was absorbed to 30 Mev, and then passed through water-loaded G5 emulsions. These plates are being scanned for possible asymmetry of the characteristic hydrogen scatters in the emulsion. Exposures were made independently by Goldhaber and by Bradner. The plates are being scanned jointly by the two groups.

#### Film Program

Synchrotron Research. The energy measurements of photons selectively scattered by Pb from the 330 Mev bremsstrahlung beam has been completed. The energy spectrum has a peak in the region of 6 to 8 Mev. While this is theoretically expected, the 7.4 Mev neutron capture  $\gamma$ -ray may be included in this peak. An experiment has been performed to determine the amount of this background. Carbon and copper targets were also bombarded.

The observed distribution of pair energies from monoenergetic photons of 6.14 Mev has also been obtained. The apparent mean energies of the distributions found using 200 $\mu$  and 400 $\mu$  emulsions are 6.43 Mev and 6.19 Mev respectively. The standard deviations of the distributions are 1.43 Mev and 1.37 Mev, respectively.

Cyclotron Research. The following projects are active: The study of high energy nuclear reactions in light and heavy elements; two body reactions, viz  ${}_3\text{Li}^7 + {}_1\text{H}^2 \rightarrow {}_3\text{Li}^8 + {}_1\text{H}^1$ ; small angle p-p scattering; and the interactions of 380 Mev alpha particles in G-5 emulsion.

#### Cloud Chamber Studies

35 Atmosphere Chamber. The photography has been improved without adverse effect on chamber operation by isolating the upper pole of the magnet from the cloud chamber region of the pressure vessel by a constricted area rather than by plate glass as formerly.



Interactions of 28 Mev protons with He<sup>4</sup>. Analysis of the inelastic data has shown that the rest frame momentum spectrum of protons from the reaction He<sup>4</sup>(p, 2p)H<sup>3</sup> agrees very well with what we would expect on the basis of a transition matrix that is independent or a slowly varying function of momentum. In other words there is no evidence of a resonance in the inelastic reactions for excitation energies up to about 22 Mev.

Four by Eight Foot Cloud Chamber. The circuitry was set up and the best arrangement of flash tubes determined for photographing tracks. Pictures were taken and it has been found that background is greatly diminished by photographing in synchronization with a pulsed clearing field.

A three way valve and thermocouple arrangement was installed for regulating the temperature of the chamber bottom and preliminary adjustments have shown that the temperature can be kept to within 2°C at a temperature of -55°C.

A needle valve and float system has been made up and installed for maintaining a constant supply of methyl alcohol to the top tray.

Cloud Chamber Calculations. Punched card methods have been applied to the calculations and analysis of cloud chamber data. In our practice, the data obtained by reprojecting cloud chamber pictures are recorded directly onto the cards, each card containing the data pertinent to a single track. Numbers that will be used in the calculation of the various quantities are then punches into the cards, along with identification numbers. Subsequent calculations are then facilitated by grouping and ordering the cards according to the parameters actually involved in the calculation at hand, instead of performing the calculations in the order that the tracks were read, as has been done previously. The punched identification numbers allow a single operation to regroup the cards for tracks of multiprong events. Furthermore, the end results of these calculations, when punches into the cards, are easily available for the rapid compilation of the statistical results of the experiment. It is hoped that the method will effect a considerable saving in time while decreasing the frequency of mistakes in calculations.

Inasmuch as the typical application requires only some five hundred to two thousand cards, a rapid hand sorting system is much preferable to a machine sorting system; we have therefore chosen the McBee Keysort system. Two experimenters are now using these cards for the organization and reduction of the data with good success, and it is planned to extend the methods to other experiments.

### Synchrotron Studies

The synchrotron ran well during the past month. The  $\pi$ - $\mu$  gear was tested by using its output to trigger an oscilloscope presentation of the stopping crystal output. It was found that the gear gave a high percentage of false  $\pi$ - $\mu$  decay signals. Modifications of the gear are being made to eliminate spurious output pulses. Another modification of the  $\pi$ - $\mu$  gear is also underway in an effort to eliminate excessive dead time observed during a short run last month.

Additional plates were exposed to detect low energy resonance scattering, of gammas, from a carbon target. Neutron background was studied by exposing lithium loaded plates.

Spiral orbit spectrometer experiments occupied most of the month's running time. The 40 inch spiral orbit spectrometer was tested in position and found to operate satisfactorily. The magnet was placed on the very thick east end of the floor in order to secure the necessary floor strength. Data have been collected on the  $\pi^+$  and  $\pi^-$  cross sections at  $90^\circ$  and 14 Mev meson energy for nine elements from H to Pb. The high pressure gas target has been tested and used to look at the reactions  $\gamma + D \rightarrow \pi^+ + 2n$ ,  $\gamma + D \rightarrow \pi^- + 2p$  at  $90^\circ$  in the lab. system and at meson energies of 31, 37, and 45 Mev. The  $\pi^-/\pi^+$  ratio in deuterium is observed to be approximately 1.5 at all energies investigated. Additional work is contemplated at energies below 31 Mev and at 70 Mev.

2. THEORETICAL PHYSICS  
(A. E. C. Program No. 5200)

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Some calculations on the motion of charged particles in a static magnetic field, initiated in connection with a magnetic spectrometer, continue.

A paper on the statistical model for high energy events has been prepared and submitted for publication to the Physical Review.

The work on renormalization of the set of integral equations for meson-nucleon systems is continuing. The second approximation (the first one containing a vertex renormalization) has been consistently renormalized, and attempts are being made to develop a set of rules for carrying out this process for an arbitrary approximation.

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

The investigation of scattering in the intermediate coupling region is being continued.

The energy and angular distribution of high energy neutrons produced by the interaction of 500 Mev  $\text{He}^3$  nuclei with a carbon target has been calculated. The results agree with experiment.

An attempt is being made to interpret deuteron stripping by means of a complex potential for the interaction of the neutron and proton with the nucleus.

A thesis reporting on the investigation of Compton scattering on nucleons has been written, and a paper summarizing this study is in preparation.

The work on the  $\alpha$ -decay from spheroidal nuclei is continuing.

Studies of beam dynamics in the proposed heavy ion accelerator have led to the following decisions:

1. Acceleration will occur in two steps: (a) a "pre-stripper" of three-fourth inch bore employing grid focussing will accelerate the output beam of a Cockcroft-Walton to an energy of  $3/4$  Mev per nucleon; (b) a "post-stripper" of bore tapered from 2 inches to three and one-half inches, employing magnetic strong focussing will further accelerate the ions to an energy of 10 Mev/nucleon.

2. Between the two sections will be a region of high gas pressure where the ions will have their specific ionization increased, by stripping, from 0.15-0.20 to greater than 0.3 of the  $e/m$  ratio of the proton.

3. The frequency will be 70 mc; the post-stripper will be 91 feet long and contain 70 drift tubes.

Work is now proceeding on the pre-stripper with particular attention to the details of the effect of the grids on the ion trajectories. Some work is also in progress on the Cockcroft-Walton accelerating column, for there is reason to expect some difficulties from space charge effects.

A survey of the Feynman papers on liquid helium and related topics has been completed.

### 3. ACCELERATOR CONSTRUCTION AND OPERATION

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#### Bevatron Operation (Program No. 5761)

There has been no operation of the bevatron since the generator fault on April 7. Replacement of the shorted stator windings and repair of the fused laminations were completed about the first of June. The generator has also been realigned, had its shaft examined by magnaflux and has been excited. It has not, however, been tested under load. The ignitrons continue to give trouble although some progress has been made in finding and correcting certain difficulties. The water cooling system has been cleaned, several leaking ignitrons have been repaired, eight of them have been shipped back to Westinghouse for replacement of anode seals and cleaning. Other tubes have been outgassed for extended periods. Protective elements have been installed on both the generator leads and on the grid leads of the ignitrons.

Meanwhile other work is continuing. The magnet has been releveled, certain experimental apparatus has been installed, the pre-excitation of the linear accelerator has been improved, and a beginning has been made on a buncher to increase the output of the linear accelerator.

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

The cyclotron was put on a 24-hour operational basis during the last three weeks of this month. This was done in order to finish certain experimental work before the anticipated shutdown in June. The cyclotron was operated 24 hours per day for five days a week and 16 hours per day for the remaining two days of the week. The experiments involved were few but necessitated long runs for collection of data and thus a bare minimum of time was used for changing setups. For these reasons, a record innage of 99.6 percent was registered for a crew time of 620 hours during this month.

The time distribution was as follows:

Operation for customers	618.3 hours	99.6 percent
Maintenance, visitors, etc.	2.5	0.4
	<hr/>	<hr/>
Totals	620.8 hours	100.0 percent

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

During the past monthly period, work continued on the alterations to the 60-inch cyclotron. At present the scheduled starting time has been delayed three weeks, to correct some unexpected difficulties and beam searching will probably begin around July 1st to 15th.

Synchrotron Operation (Program No. 5731)

The synchrotron continued to operate at good intensity levels for the Physics Research program during this report period.

The final phases of the Livermore electron linear accelerator were nearing completion at the end of this report period.

Following are the operating statistics for the period.

Operation for customers	376.5 hours	92.3 percent
Maintenance	32.0	7.7
	<hr/>	<hr/>
Totals	408.5 hours	100.0 percent

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

The linear accelerator and Van de Graaff operated throughout the period from May 15 through June 15. A one day shut down was made to permit installation of a helium gas supply and thermal leak in the high voltage shell. With this equipment it is now possible to produce helium ion beams with the Van de Graaff. Experiments are planned to study the problems involved in producing 32 Mev helium beams with the linear accelerator.

Following are operation statistics for the period.

Operation for customers	318.5 hours	92.5 percent
Van de Graaff maintenance	23.0	6.8
Linear Accelerator maintenance	2.5	0.7
	<hr/>	<hr/>
Totals	344.0 hours	100.0 percent

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

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Transcurium Elements

A considerable amount of information on the chemistry of the elements americium through element 100 has been deduced from solution tracer chemistry and the column behavior of the aqueous ions. This work is being issued as a separate report.

Negatron Decay in Am<sup>240</sup>

It is of interest in the heavy element systematics to determine the exact relative masses of Am<sup>240</sup> and Cm<sup>240</sup>, i. e., observation of a beta decay process in either direction. Estimates from the closed cycles and decay systematics actually indicate Cm<sup>240</sup> is unstable with respect to electron capture by  $0.06 \pm 0.10$  Mev, but neither this transition nor the negatron decay of Am<sup>240</sup> has yet been observed.

An intense source of Am<sup>240</sup> free of Cm<sup>240</sup> was allowed to decay, after which pulse analysis indicated  $\leq 0.02$  d/m of Cm<sup>240</sup>. From this value a limit of  $1 \times 10^{-7}$  for the ratio  $\beta^-/\text{EC}$  can be set for Am<sup>240</sup> corresponding to a partial beta half-life of  $\geq 3 \times 10^4$  years.

Beta Decay Scheme of Np<sup>238</sup>

The beta decay scheme of Np<sup>238</sup> and the subsequent level structure of Pu<sup>238</sup> has been studied by lens spectrometry. A complex decay scheme of four beta groups populating at least four levels with as many observed gamma rays has been proposed and spin assignments and abundances have been assigned. The resulting decay scheme shows two "vibrational" levels and associated "rotational" fine structure.

Half-Lives and Decay Schemes of Short-Lived Isotopes

An apparatus has been constructed for use in studying the decay schemes of short-lived isotopes and consists essentially of a variable speed metallic tape moving from a continuously supplied source of activity through suitable counting and/or coincidence apparatus. It has been used and tested in the decay of Mo<sup>90</sup> in which it was thought that a gamma transition was delayed possible a few seconds. The Mo<sup>90</sup> source was mounted near the moving metallic tape and a potential difference of ~900 volts applied. The collected recoils from the positron emission gave a considerable enrichment of the Nb<sup>90</sup> daughter and by varying the speed of the tape into the crystal spectrometer coincidence apparatus, it was demonstrated that the gamma ray in question has a half-life of more than 1  $\mu$ sec. and less than 1 sec.

Spontaneous Fission Half-Lives

From the observation that there appears to be a most stable mass number with respect to spontaneous fission in a series of isotopes of a given element, a hypothesis has been made that there are, in reality, two main effects which effectively determine the half-life of spontaneous fission. One of these, the nuclear repulsive force, proportional to  $Z^2/A$ , has previously been clearly recognized.

It is now proposed that another effect, namely, increased energy released in fission with increasing mass, will so combine with the other mass term ( $Z^2/A$ ) so that there will be a certain mass which is most stable towards fission and thus reproduce the experimental observations. It has been found possible, for example, to write an equation for spontaneous fission using four arbitrary constants based on this hypothesis thus lending some credulity to the proposal. Theoretically, the mass-fission energy proposal can be tested by the lengthy method and calculations proposed by Fong, and this will be done in the future.

### High Temperature Chemistry

Work is in progress on the following problems: the determination of the ground state of SO, an interpretation of the spectrum of C<sub>3</sub>, a study of the thermodynamic properties of MoCl<sub>4</sub> gas, the mechanism of vaporization of arsenic, measurement of reflection coefficients of molecular beams, a study of vapor pressure of sodium carbonate, and the testing of apparatus for measurement of absolute absorption coefficients.

### Chemical Engineering

Equipment for measuring thermal conductivities of gases at high temperatures is being reassembled after re-building.

Studies are continuing on the relation between the pressure drop and flow rate in gases at low pressure.

### Basic Chemistry

Work is in progress on the topics: construction of apparatus for the measurement of rates of fast electron transfer reactions, studies of fluoride complexing of Pb<sup>++</sup>, Cu<sup>++</sup>, Zn<sup>++</sup>, Hg<sup>++</sup> and Sn<sup>++</sup>, the aqueous chemistry of ruthenium, and the chemistry of Ti (II).

### Health Chemistry

For the first time in approximately eight years (the period of existence of the Health Chemistry Group) the pressure of work has been reduced to the point where special training can be worked into the schedule and selected men indoctrinated to undertake the responsibilities originally planned for personnel in contact with the chemists working with radioactive isotopes. These individuals must be able to work with the chemists in planning the experiments and to anticipate all requirements--namely, transportation, shielding, equipment, decontamination, waste disposal, etc. The responsibility of this new position (being referred to as Radioisotope Control Chemist of Engineer) is to see that the groups to care for the different phases are alerted and informed as to what will be expected of them. If these positions are properly filled, further improvement in the economy, efficiency and achieved safety for the Health Chemistry Group should result.

The training is being given by the leaders of the various groups with specialized knowledge, skills and functions and consists of lectures and demonstrations.

Members of the Equipment Development, Airborne Activity Control, Activity Handling and Decontamination groups have been engaged in examining and evaluating equipment at the former CRandD site in Livermore with the view of the possibilities of adapting the material for Health Chemistry use where indicated. Meter equipment has also been reviewed. The Health Chemistry Central Storage Facilities has received various stocks of source material (uranium and thorium) for use by UCRL personnel on request.

Equipment is being readied by the Equipment Development Group for Idaho Falls transuranic irradiations, which will contain significant amounts of alpha and fission product activity.

The Activity Handling Group supervised the preparation of the old 184-in. cyclotron dees for disposal at sea; it was necessary to reduce them to small pieces by sawing and by use of acetylene torches.

Because of the increased number of shipments and the more stringent ICC regulations, the Health Chemistry personnel responsible for outgoing shipments of radioactive material have put into use a new shipping memorandum to be included in each shipment for further assurance to both shipper and receiver that the package has been checked properly with respect to ICC and general safety regulations.

The Berkeley Box Group assembled and fitted thirteen gloved boxes on request by researchers.

5. BIOLOGY AND MEDICINE  
(A. E. C. Programs 6300-6500)

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Tracer Studies

Toxic iodine and radium studies and tracer studies using actinium, terbium, europium, and promethium in rats are continuing as are the chronic astatine studies in rats and monkeys.

The chemical state of astatine in the human body is under investigation.

Radiation Chemistry

Studies of aqueous solutions of glycine, acetic acid and formic acid have continued. Identification and determination of products of irradiation in the target solutions bombarded prior to the cyclotron shutdown has taken most of the time this past month.

Histology

Work is continuing on the nitrocellulose - embedded bones. Difficulties have been encountered in the azure - eosinate staining procedure which have slowed progress considerably.

Bio-Organic Chemistry

Active research projects during the last month have included the following work:

1. The synthesis of high-specific-activity alanine-2-C<sup>14</sup> for the preparation of the dipeptide, leucyl-alanine-2-<sup>14</sup>.
2. Preparation of labeled steroids including cholic acid and 25-methyl cholesterol.
3. The preparation of tetrahydrofurylacetic acid as an intermediate in thioctic acid homologue synthesis.
4. The elucidation of part of the cosmic-ray effect in scintillation counting.
5. The introduction of novel methods of C<sup>14</sup> scintillation counting using gaseous compounds.
6. Rate studies on the catabolic oxidation of labeled organic substances to CO<sub>2</sub> in irradiated mice, in rats, and with various pantothenic acid fractions in deficiency studies.
7. The demonstration of the carboxylation of ribulose diphosphate to give phosphoglyceric acid by use of a cell-free enzymatic preparation. This has been the most important advance in the photosynthesis studies in the last month.
8. Techniques for and measurement of absorption spectra of translucent substances such as intact leaves, algae suspensions, and blood samples. The work has been completed and written up.
9. A definitive identification of the primary product of photosynthesis as either 2- or 3-phosphoglyceric acid, using molybdate-treated papers, now progressing.
10. Continuation of the separation of phosphorylated compounds from photosynthesis cycles using P<sup>32</sup> as an analytical tool.
11. Study from several approaches of the dynamics of photosynthesis under varying conditions of light and dark in gaseous compositions, and as an adjunct to the determination of the quantum yield of photosynthesis in various wave-length and light-intensity combinations.
12. The chemistry of thioctic acid and various disulfide analogues.
13. Growing various algae to find specific species for specific purposes, such as for use in continuous oxygen-evolution systems.



6. PLANT AND EQUIPMENT REPORT UNCLASSIFIED

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

Roof work is complete with the exception of the installation of equipment. The cement finishers are topping the stairways and other exposed concrete walls and slabs. Carpenters are hanging doors at various points in the building. Hanging of the remaining wall board and finish trim is held up until the distilled water system is installed. Second floor lighting fixtures and receptacles are being installed. The lab service mains are being installed along with the corridor branch connections to the boiler room. The heating and ventilating branch ducts are going in at the present time. Rough grading is going on around the building exterior and there is general cleaning up over the whole job. The whole project is approximately 75 percent complete taking into consideration the latest time extension on the contract.

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

The job is out for bid and bids will be opened June 16, 1954. Relocation of utility lines at the site is approximately 50 percent complete.

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

The Accelerator Technicians' Shop in Building 64 is approximately 90 percent complete with only the removal of some siding by the rolling door and clean-up to complete. The bevatron rain shields are 75 percent complete and need only to be installed in place. The 184 in. Area Cooling Tower job has been postponed for approximately five months because of the delay in the 184 in. cyclotron shutdown. Building 10 alterations are about 20 percent complete with the walls in place for the control room. The relocation of rest rooms in Building 6 is approximately 20 percent complete. Walls and partitions are complete and ready for fixtures and painting.

MAN-MONTHS EFFORT REPORT  
SCIENTIFIC PERSONNEL

Program No.	Subdivision	UCRL Man-Months Effort	UCRL Vac. and Sick Leave
<u>Operations</u>			
3000 Weapon's Research	General	298.28	28.92
	Arc Research	19.89	0.87
		<u>318.17</u>	<u>29.79</u>
4000 Reactor Development - MTA	Design and Development	18.85	1.59
5000 Physical Research			
5200 Basic Physics Research	General Physics Research	49.83	9.97
	Theoretical Studies	11.54	2.58
	Film Detection	13.11	1.58
	Cloud Chamber	8.98	1.10
	Magnetic Measurements	2.40	1.35
	Physics Projects	5.79	
	Subtotal	<u>91.65</u>	<u>16.58</u>
5311 Basic Chemistry Research	Chemistry of Heavy Elements	3.65	
	Nuclear Properties of Heavy Element Isotopes	8.05	
	Transmutations with 184" and 60" Cyclotrons	5.49	
	Analytical and Services	12.17	7.95
	Mass Spectroscopy, Beta Ray Spectroscopy	1.31	
	Instrument Development and Services	4.50	
	X-Ray Crystallographic Measurements	2.38	
	Office and Travel	7.63	
	High Temperature and Special Chemistry	4.10	0.22
	Health Chemistry Research	13.41	
	Subtotal	<u>62.69</u>	<u>8.17</u>
5361 Applied Chemistry Research	Process Chemistry	3.28	
5731 Electron Synchrotron	Operations	7.97	
5741 Synchro Cyclotron (184")	Operations	7.90	
5751 Linear Accelerator	Operations	8.77	
5761 Proton Synchrotron-Bevatron	Operations	16.49	
	Subtotal	<u>44.41</u>	
<b>TOTAL PHYSICAL RESEARCH</b>		198.75	24.75

Program No.	Subdivision	UCRL	UCRL	Consultants	
		Man- Months Effort	Vac. and Sick Leave	Man- Months Effort	Vac. and Sick Leave
6000 Biology and Medicine Research					
6300 Medical Research	Health Medicine	1.54			
	Internal Irradiation	5.91		0.67	
	Subtotal	<u>7.45</u>		<u>0.67</u>	
6400 Biological Research	Miscellaneous	5.29		3.09	
	Instrumentation	2.53		-	
	C <sub>14</sub> Metabolism	3.61		1.20	
	Use of Radioactive Material in Human Physiology	10.70		4.54	
	Trace Elements	4.11			
	Physical Biochemistry	12.50	6.96	3.35	1.72
	Biochemical Response to Radiation	2.22		1.65	
	Metabolism of Lipo-proteins	4.25		9.74	
	Iron Metabolism Hematopoiesis	3.55		-	
	Biological Effects of Cosmic Radiation	3.53		-	
	Radiation and Mutation Rate	1.86		0.24	
	Bio-organic Chemistry	25.36	1.99		
	Metabolism of Fission Products	15.20	2.90		
	Animal Colony	3.31	0.13	3.79	
	Subtotal	<u>98.02</u>	<u>11.98</u>	<u>27.60</u>	<u>1.72</u>
6500 Biophysics Research	Health Physics	1.93			
	Irradiation Studies	1.91		1.01	
	Subtotal	<u>3.84</u>		<u>1.01</u>	
TOTAL BIOLOGY AND MEDICINE RESEARCH		<u>109.31</u>	<u>11.98</u>	<u>29.28</u>	<u>1.72</u>
GRAND TOTAL - OPERATIONS		<u>645.08</u>	<u>68.11</u>	<u>29.28</u>	<u>1.72</u>

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