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RADIATION LABORATORY

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UNIVERSITY OF CALIFORNIA
Radiation Laboratory
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MONTHLY PROGRESS REPORT NO. 123

June 15, 1953 to July 15, 1953

August 3, 1953

CLASSIFICATION CANCELLED
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UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

June 15, 1953 to July 15, 1953

MONTHLY PROGRESS REPORT NO. 123*

August 3, 1953

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

High Energy Gamma Ray Spectroscopy

A run was made in which the pair spectrometer registered the 17.6 Mev gamma line from the bombardment of Li^7 by protons from the Van de Graaff generator of the linear accelerator.

The original purpose of this run was to check the energy calibration of the pair spectrometer, and to study the characteristics of line shape as a function of converter thickness.

Due to mechanical difficulties which prohibited bringing the pair magnet as close to the target as was desired, the intensity of the gamma radiation was too low to allow the securing of good line shape data. However, the energy calibration was found to agree satisfactorily with that originally obtained by the floating wire technique and the measurements of the magnet group.

It is now possible to say that the energy of the intense gamma line observed in the bombardment of carbon by high energy protons is 15.2 Mev.

Production of Tritons in Deuteron-Deuteron Collisions

A run was conducted to compare the yields for the reaction $\text{D} + \text{D} \rightarrow \begin{cases} \text{P} + \text{H}^3 \\ \text{N} + \text{He}^3 \end{cases}$. A magnetic channel and pulse height analysis were used to separate and identify particles. A CD_2 target was used. It was found, however, that for every valid triton from deuterium there were 36 tritons from carbon, which apparently had the correct range of energy. Since this background is much too high, the next run will be performed using the new liquid deuterium target.

Nuclear Internal Momentum Distributions

Several light elements have been studied. Quantative results will be ready for the next report.

* Previous report UCRL-2279 (No. 122).

Cerenkov Radiation Detector

A Cerenkov counter has been constructed according to Professor Moyer's design, which is intended for use in the detection of high energy electrons. The preliminary form is a 12-inch lucite radiator branching to two arms which are connected to two DuMont 6292 phototubes operated in coincidence. The Neher coincidence bridge was checked for this application and is being used.

Early tests on cosmic rays and a gamma source indicate that successful operation can be achieved. Further work will be done in checking for lucite scintillation, and with refrigeration of the phototubes to lower thermal noise background.

Elastic Photoproduction of Neutral Pions from Deuterium

While awaiting completion of the liquid deuterium target, studies have been made of alternate methods of identifying the deuteron in the reaction $\gamma + d \rightarrow \pi^0 + d$. It now appears that the measurement of time of flight and energy may have advantages over the original time of flight - B_p method. Specific ionization could also be measured to provide an additional check on the identity of the particles. It is planned to measure energy and specific ionization by photographing pulses from pulse light counters. Final preparations are being made for a run at the synchrotron to see if this method is feasible. If it appears promising, we will proceed with a full-scale run using the liquid deuterium target.

Range-Energy Program

Work is now in progress, and about thirty percent complete, on a new set of range-energy information which will be more complete than any previously turned out. The original data involved has come from the theoretical range-energy tables in the Report AECU-663 by Aron, Hoffman, and Williams. Using these results, calculations are being made to extend the range-energy information so that the final work will cover pions, protons, deuterons, H^3 and He^3 in such materials as Be, C, Al, Cu, Pb, air, H_2O , D_2O , H_2 , D_2 , CH_2 , CD_2 , trans-stilbene, and phenyl-cyclohexane. The new booklet, when complete, will be arranged in four parts as follows:

- (1) Tables of range and stopping power versus kinetic energy.
- (2) Curves of range versus kinetic energy for energies from 1 Mev to about 10^4 Mev.
- (3) Curves of stopping power versus kinetic energy over the above-mentioned energy range.
- (4) Tables of range-energy approximation equations of the form $R = K T^n$.

High Energy Gamma Ray Telescope

Preliminary tests of a high energy γ -ray telescope were made at the 184-inch cyclotron in conjunction with other instrumentation investigations. The telescope was composed of two counters, connected in coincidence, each having a DuMont 6292 photomultiplier viewing Cerenkov radiation in water. The telescope was situated at 90° with the incident proton beam. Converters of Pb and C having equivalent stopping power for heavy charged particles were alternately placed in front of the telescope. (A six-inch beryllium block was placed between the target and the converters to stop charged particles directed toward the channel.) The difference in the coincidence counting rates from Pb and C converters represented the gamma ray yield.

The coincidence counting rate per unit integrated beam showed a target in - target out ratio of about eight. The fact that the coincidence counting rate vanished when the beam was turned off eliminated the possibility that the target out counts resulted from the noise pulses in the photomultiplier tubes. Removing the water from one of the counters gave a coincidence counting rate from the target about the same as the target out rate when both counters were filled with water. Since the counter telescope was well shielded with lead, these latter two results indicate that the target out counts are probably caused by neutron bombardment of the photocathodes of the two photomultipliers.

The singles counting rate as a function of photomultiplier high voltage showed that the first counter of the telescope is less efficient than the second. This result is to be expected from the construction of the two counters forming the telescope. A water container formed a part of each counter. The container for the first counter is a two-inch cube at the end of a cylinder of height four inches and diameter two inches. The second water container is a cylinder of the same dimensions as that forming a part of the first container. To form the telescope the first counter is placed at 90° to the second and converted electrons pass through the cube of the first and down the cylinder of the second. This geometry is responsible for the inefficiency of the first counter.

The following table shows that under various conditions a difference exists in the coincidence counting rate for Pb and C converts. Since the converted electrons must have enough energy to pass through at least two inches of water, a lower limit is placed on the energy of the detected gamma rays.

Target	Beam Channel Meter Reading	Con-verter	Doubles	Inte-grator Volts	Photomultiplier High Voltage	Counts per 0.01 Integrator Volt
3 in. Be	0.4×10^{-9}	0.27 Pb	33 ± 8	0.04	C-1, C-2 1.7 kv 1.4 kv	8 ± 2
3 in. Be	0.4×10^{-9}	$\frac{11}{8}$ in. C	1 ± 1	0.01	1.7 kv 1.4 kv	1 ± 1
					Difference	7 ± 2
						Counts per Integrator Volt
3 in. Be	0.2×10^{-8}	0.27 Pb	76 ± 9	0.3	1.6 kv 1.4 kv	253 ± 30
3 in. Be	0.2×10^{-8}	$\frac{11}{8}$ in. C	37 ± 6	0.3	1.6 kv 1.4 kv	123 ± 20
					Difference	130 ± 36
$\frac{5}{16}$ in. C	0.6×10^{-8}	0.135 Pb	159 ± 13	1.0	1.5 kv 1.5 kv	159 ± 13
$\frac{5}{16}$ in. C	0.6×10^{-8}	$\frac{5}{16}$ in. C	113 ± 11	1.0	1.5 kv 1.5 kv	113 ± 11
					Difference	46 ± 17

The electronics arrangement for this run can be described briefly as follows. The negative signal from each counter of the telescope was passed through two Hewlett Packard 460A wideband amplifiers. The signal then passed through a 6BQ7 limiter-inverter stage (without delay line clippers) to a crystal diode double coincidence circuit. The output from the coincidence circuit went to a three-stage EFP-60 pulse lengthening amplifier with a 6AQ5 pentode output tube. This amplifier could deliver as much as a 45 volt output signal in the microsecond range; however, since the linear range was only about 20 volts the discriminator bias on the scaler was calibrated and set at 15×0.9 volts. This EFP amplifier delivered the signal to the scaler directly. The singles counts from each counter were recorded on separate scalers; in addition, a scope viewed the signal from the monitor output of the EFP-amplifier.

The Photoproduction of Negative Pions from Deuterium

The details and results of this experiment will be reported in a forthcoming UCRL Report.

Beta Ray Spectrometer

The new power supply for the beta ray spectrometer was completed. Two additional counting tubes were added to the beta spectrometer to intersect the trajectories of all of the particles coming through the exit slit. This change was found to be necessary during the previous runs on the linear accelerator.

Design work was started on new counters for the double scattering experiment using DuMont 6292 photomultipliers and plastic scintillators. Work was also started on a faster coincidence circuit for this experiment to make 10^{-8} sec. coincidences rather than the 10^{-6} sec. coincidences that were used in the previous run. This change is being made to reduce the accidental counting rate.

Thomson Scattering of 2.8 Mev Gamma Rays

Work is continuing on the measurement of the elastic scattering of gamma rays by light nuclei. Attempts are being made to increase the size as well as the resolution of the NaI crystal. Thus far, the Na^{24} source of 2.8 Mev gamma rays has been too weak to give desirable counting rates. Arrangements are being made to obtain a Na^{24} source of 100 curies.

Operation of the Van de Graaff Beam "Chopper"

The Van de Graaff proton beam "chopper" was tested on July 6, 1953. The chopper consists of an r. f. oscillator operating at about 487 kc and producing up to 30 kilovolts across pairs of plates one meter long separated by one cm between which the proton beam from the Van de Graaff passes. Two pairs of slits were built to act as adjustable collimation before the beam entered the region of the plates. It was found that by proper collimation the beam could be successfully deflected such that its duration across the entrance port of the linear accelerator was less than 10^{-8} sec. and with a separation of about one μs . It was also found that bias voltage between plates and ground to remove secondary electrons was not particularly helpful and was not employed.

Operation of the chopper was observed by monitoring the linear accelerator beam with a stilbene crystal counter and displaying the pulses on the sweep of a fast scope. Ratio of intensities of the beam with and without the chopper on, as measured with a Faraday cage, appeared to be in the neighborhood of 1:200 which is expected. This measurement will be repeated since there was insufficient time to measure the ratio carefully.

It is hoped to produce pulses of about 5×10^{-9} sec. duration with the chopper, corresponding to the period of the linear accelerator r. f., and consequently, because of the phase bunching property of the linear accelerator, to produce output pulses of less than 10^{-10} sec. duration with one μs spacing which will then be used in fast time of flight experiments.

Film Program

Experiments performed during this report period on the detection and measurement of spallation products from Ni, Ag, Au, U, Al, and Be when bombarded by high energy protons and deuterons. Also the spiral orbit spectrometer was adapted to obtain a high density, mono-energetic meson beam in the region of 24 Mev.

Work has continued in the following projects: (a) γ -ray energy spectrum from Pb when bombarded by the 300 Mev bremsstrahlung beam (b) momentum and angular distributions of spallation products from various targets under proton, deuteron and alpha bombardment; (c) high energy β -ray spectra; (d) γ -ray spectrum from a 330 Mev proton bombarded Be target; (e) interactions of 386 Mev alpha particles in G-5 nuclear emulsion; (f) energy distribution of α -particles following the decay of Li^8 and B^8 ; and (g) meson production from p-C¹² collisions.

The energy spectra for He^4 and He^3 for all angles up to 60 degrees in the laboratory have been obtained from the bombardment of Ni by 340 Mev protons. The integrated ratio of the He^3 to He^4 production in this angular interval is 11.5 ± 1.0 percent. The He^3/He^4 production ratio above 25 Mev is about 0.30. No reliable estimate of the H^3/He^4 ratio can be obtained from the data.

Cloud Chamber Studies

A run was made at the cyclotron using the 22 in. pantograph chamber filled with argon at approximately 15 cm. above atmospheric pressure. The meson beam passed through a 1/4 in. lead plate in the center of the chamber. Results of scanning a portion of the film are given below.

Cross section Mb.

Mesons entering plate	3,710	
Mesons stopped in plate		
Certain	15	388
Questionable	7	181
Stopped in plate and proton emerges		
Certain	7	181
Questionable	3	78
Stopped in plate and pair emerges	1	26
Stopped in plate and half of pair emerges	3	78
Backward scatter	5	130
	Total	1063

A run was made at the cyclotron using a rectangular diffusion cloud chamber with a deuterium target inside and the same 50 Mev meson beam used in the run above. The target was a cylinder 3 in. in diameter and 9 in. long containing deuterium at 70 atmospheres. The chamber was found to be too short to show the particles emerging from the target and a larger chamber is being constructed.

A run was attempted with the 35 atmosphere chamber, but no useable pictures were obtained. Water vapor condensed on one of the glass surfaces just above the sensitive regions and the heater wires which had been designed to remove this vapor were inadequate. The heater system is being modified to operate on direct current so that larger currents can be used without damage to the wires due to interaction with the magnetic field.

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

UNCLASSIFIED

The majority of projects reported last month are continuing.

A calculation of the stopping power of liquid deuterium for He^3 and H^3 nuclei, and of the multiple scattering, is under consideration; the results would be useful in connection with experiments planned to test the charge independence hypothesis by use of the reactions $p + d \rightarrow \text{He}^3 + \pi^0$ and $p + d \rightarrow \text{H}^3 + \pi^+$.

The azimuthal density distribution of the particle bunch in an FM cyclotron has been measured and found to be sufficiently large to be consistent with a theoretical estimate that little if any phase oscillation damping should occur. Calculations are in progress to determine to what extent this observed distribution reflects the phase dependence of catching efficiency near the center.

The modified Green's function method, discussed previously, has been applied to an interacting system of nucleons, mesons, and photons. The amplitude for photomeson production was shown to be simply related to the variational derivatives of the propagation function of the nucleon-photon and nucleon-meson systems with respect to the meson and photon sources respectively. With this expression it should be possible to trace the effect of an isobar in the nucleon-meson system on photomeson production. The possibility of this kind of a phenomenological approach on a field theoretical level is being currently investigated.

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

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During the past month, several different cyclotron runs were made. Previous studies with the two internal ion chambers on the proton probe had indicated that the optimum target position for the production of the 320 Mev deuteron beam from He^3 stripping was somewhat inside the edge of the high voltage dee. A run was made with such a target, but the beam blew up so rapidly that the part of it peeled off by the focus magnet remained about the same.

The neutron yield was measured for 190 Mev deuterons with the large water tank, using 2 ft. by 2 ft. uranium primary and secondary targets with aluminum interspersed to simulate NaK cooling, and found to be 3.0 neutrons per incident deuteron, slightly lower than the value for unmoderated targets. The yield for a 2 ft. by 2 ft. carbon primary and uranium secondary was measured to be 2.3.

Two final runs were made to clarify the theory of attenuation of deuterons in various materials, and the existence for monoenergetic deuterons of two definite linear portions of the logarithmic attenuation curve was established.

The secondary standard condenser was returned from the Bureau of Standards after calibration, and was found to have been within 0.1 percent of the nominal value. This result establishes the accuracy of beam current measurements using the vacuum Faraday cup.

The values of the deuteron and proton inelastic cross sections obtained from the 190 Mev data (3.75 and 2.0 barns, respectively) were used with the measured attenuation curve of 320 Mev deuterons in uranium to calculate an energy spectrum of these particles, and the results showed a considerably narrower spectrum than previously computed, still peaked at about 320 Mev, and with a very small low energy tail.

A time-of-flight run was made with 190 Mev deuterons to establish a reference point, and then with the 320 Mev deuterons to obtain an independent measurement of the energy spectrum. The results have not yet been "unfolded" from the experimental data.

4. ACCELERATOR CONSTRUCTION AND OPERATION UNCLASSIFIED

Bevatron Construction. (Program No. 9001)

Magnet. By July 15 about three-fourths of the pole tips had been installed in one quadrant and installation was starting in a second. The first pole face winding tubes have been installed by pulling them through their supports and it is expected that this operation will go smoothly once the proper equipment has been assembled. Wiring for the purpose of grounding on metal parts in the vacuum tank and for distributing the induced voltages across the insulated joints has been installed in one quadrant. Design work is continuing on the connections to the ends of the pole face windings which are brought out through the tangent tanks. Provision is being made for water cooling these windings.

Vacuum System. Three quadrant tanks have been reworked and are installed in the magnet. Completion of the fourth is expected about July 22. No difficulties have been encountered. All 24 of the vacuum pumps are installed. Tests are in progress to improve the control of the freon refrigeration of the pump baffles.

Injector. Measurements of the output beam of the linear accelerator indicate a mean energy of 8.6 Mev compared to 10 expected. The energy spread is plus or minus 200 kilovolts and the angular divergence plus or minus 5 milliradians. The steady output beam is now 40 microamperes with 50 microampere peaks (last month the beam was reported erroneously as 35 milliamperes, whereas 35 microamperes was correct). The low beam energy should give no trouble with injection, however an attempt will be made to find its cause.

Accelerator. Installation of electronic and cooling equipment is still proceeding in the north tangent area.

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

The cyclotron was used for research experiments approximately 96 percent of the 517 hours that the crew was on duty. The time distribution was as follows:

Operation for customers	496.5 hours	96.0 percent
Electrical troubles	12.5	2.4
Mechanical troubles	2.5	0.5
Miscellaneous	5.5	1.1
Total	517.0 hours	100.0 percent

184-inch Cyclotron Conversion. (Program No. 4900,02)

The one-half scale rf model has been completed and tests are in progress. Resonance at the appropriate frequencies occurs at very nearly the calculated dimensions. Current effort is to move the cross mode out of the frequency range in order that there will be no chance of its being excited.

Orders for the forging and heat treating of the vibrating condenser blades are in the hands of the purchasing department and fabricators have been selected for these parts. Negotiations are still in process on the machining contract.

It has been decided to cancel the electron model of the 184-in. cyclotron since theoretical studies indicate that it will not be easy to obtain a sufficiently large electron beam on the machine for deflector studies.

It has been decided to attempt to provide a deflector at the time of conversion in order that an external beam may be used for experimentation but to postpone the meson cave, the proton probe, and other auxiliary equipment until a later shutdown.

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

No incident occurred during the past month to impair the performance of the 60-inch cyclotron. Work is in progress to improve the set-up time, meaning to provide a consistent focused beam for smoother work. Two hour use of strong focusing magnets has greatly aided this work.

Synchrotron Operation. (Program No. 5731)

The synchrotron continues its highly satisfactory operation. Research bombardments are continuing using the electron linear accelerator. Considerable effort is being applied to development problems for the Livermore electron accelerator.

Operating statistics are as follows:

Operation for customers	352.5 hours	95.8 percent
Maintenance	15.5	4.2
Totals	<u>368.0 hours</u>	<u>100.0 percent</u>

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

The linear accelerator and Van de Graaff operated on a normal schedule during the period from June 16 to July 6. On the night of July 6 trouble developed with the Van de Graaff. Upon opening, it was discovered that all six textolite supports had failed mechanically. These members had broken about one inch inside the aluminum sleeves which fasten them into the high voltage terminal. There was evidence on further disassembly that at least two and possibly more of the supports had been cracked for some time. Since a complete set of textolite tubes of the required size was on hand, the work of rebuilding the machine was started immediately. During this shut down the control system, which used 28 volt motors and a selector system operated by two strings, is being replaced by a system of eleven strings. These will directly actuate the desired controls in the high voltage terminal. It is expected that the machine will be returned to operation during the first week in August.

It is planned to install a set of diagonal braces in the upper half of the machine at a later date. These should relieve the bending moment at the point of entrance of the textolite into the high voltage terminal, thereby preventing future mechanical failures of the type experienced.

Investigation of the oscillator operation for the linear accelerator is continuing on a small scale. It is hoped that, with minor modifications, the grid dissipation of the 10,000A3 tubes can be reduced. It is believed that increased tube life will result from such modification.

Following are the operating statistics:

Running time (research)	228 hours	55 percent
Repairs and maintenance	188	45
Totals	<u>416 hours</u>	<u>100 percent</u>

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

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Carbon Ion Bombardments

Several bromine activities have been produced from copper by bombardment with carbon ions in the 60-inch cyclotron. One of these, an activity of 35-minute half-life, is assigned to Br⁷⁴ on the basis of relative yields from enriched Cu⁶³ and enriched Cu⁶⁵ targets.

Absorption Spectrum of CmF₃

Four lines in the absorption spectrum of solid CmF₃ have been observed with a grating spectrograph of high dispersion. No reliable observations have been made of the spectra of Cm⁺³ solutions because of interference due to the peroxide produced by the alpha radiation.

Even-Even Energy Levels

Extensive work has been done in this laboratory and elsewhere on the energy levels of even-even nuclei of the heaviest elements. Detailed study of alpha spectra by means of the magnetic spectrograph together with scintillation spectroscopy of the gamma radiations has been very productive of data. There appears to be a rather regular pattern of excited states which can be assigned as even parity and spin 2, 4, and 6 respectively. The relative spacings are approximately those predicted for a simple rotator. In several cases another low-lying state, which is probably of odd parity and spin 1, also appears.

Zeeman Magnet

A large electromagnet for Zeeman spectroscopic work has been installed and is ready for use. Work is in progress on building suitable sources.

Radiation Chemistry

Solutions of sulfuric acid, ceric sulfate, and formic acid have been irradiated with X-rays and the product gases and solutions analyzed. The rate of production of cerous ions and of carbon dioxide are found to be dependent on the concentrations of the solutions.

Metals and High Temperature Thermodynamics

Work is in progress on the following problems: refractory silicides, heats of formation and absolute absorption coefficients of high temperature molecules, reflection coefficients of molecular beams, magnesium oxide gas, sodium carbonate vapor, and high temperature halide molecules.

Basic Chemistry

The following problems are under investigation: studies involving ammonia, the complexing of scandium by fluoride ion, the thermodynamics of thio-sulfate, a study of hydrates, rare earth fluoride complex ions, ferric fluoride complex ions, and the hydrolytic polymerization of zirconium.

Process Chemistry

Work is in progress on the following problems: the preparation of titanium metal, film boiling from subcooled liquids, the thermal conductivity of gases at high temperatures, the capacity of perforated plate liquid-vapor contacting columns, mass transfer in agitated liquid systems, gas phase mass transfer studies, and thermal diffusion in liquids.

Health Chemistry

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

1. Further equipment and processes to be used in the processing of special soils and subsequent experimentation with this material.
2. The largest part of the time spent by this group has been used in designing and fabricating boxes and auxiliary equipment for processes at Livermore and in connection with the Livermore program.
3. Nine Berkeley Boxes have been assembled, fitted and delivered on requests from researchers.

6. BIOLOGY AND MEDICINE UNCLASSIFIED (A. E. C. Program No. 6300-6500)

Radiation Studies with the 184-inch Cyclotron

A new device has been completed which allows irradiation of parts of the brain of larger animals. Two small monkeys have received pituitary irradiation amounting to 5,000 and 10,000 rep units. The deuteron beam was used and the animals were rotated during the exposure. Studies on pituitary irradiation of rats are being continued with very low doses.

Instrumentation

A specially built image amplifier tube was received and is being studied for the purpose of obtaining images of distribution of gamma rays in the human and animal body. The instrument when completed should give simultaneous images of the distribution of gamma rays without involving the use of a scanner. The images will be obtained by the use of a tungsten pinhole camera.

Regional Circulation

Investigations have been carried out on the effect of thyroid activity on the liver blood flow. Mice fed dessicated thyroid have shown increased liver blood flow as measured by the colloid disappearance rate method developed in this laboratory. Preliminary measurements on patients indicate a correlation between clinical hyperthyroidism and increased liver blood flow.

Tracer Studies

Experiments on the relative biological effects of alpha and beta emitters on rats and primates and the deposition of aerosols in the lungs of primates are continuing. A recheck on long term cerium studies is in progress. Experiments on radium and iron have been instituted.

Radiation Chemistry

Studies have been made of the effects of rapid mixing on the radiolysis of acetic acid solutions. Analytical processes have been and are being developed for the determination of the aldehydes, ketones which are produced in the irradiation of organic systems. Ion exchange techniques are being applied to the study of radiation effects in aqueous solutions of organic acid salts.

Organic Chemistry

Research efforts in organic chemistry have been devoted to the following projects.

1. Studies are being made of the effects of high-energy ionizing radiation on organic compounds. Compounds which are under investigation are methanol, ethylene glycol, choline, and choline analogues.
2. Uric acid-8-C¹⁴ has been synthesized.
3. Possible syntheses for the preparation of thioctic acid-S³⁵ are under investigation.
4. Syntheses of C¹⁴-labeled peptides are being studied.
5. A Toepler pump and vacuum line system for use in introducing tritium into organic compounds is being constructed.

Animal Biochemistry

The following work is in progress:

1. The effect of X-irradiation upon the incorporation of labeled adenine into the soluble nucleotides, desoxy-nucleic acids, and pentose nucleic acids is being studied.
2. Rabbits are being fed a high-lathosterol diet to determine the effect of this cholesterol analogue upon the development of atherosclerosis.
3. An investigation is being made of possibility that thioctic acid may be an aid in protecting against total-body X-irradiation.
4. The effect of coenzyme A on the conversion of acetate-2-C¹⁴ to lipids and proteins is being studied. These conversions are also being studied in relation to pantothenic acid deficiency.

Plant Biochemistry

The research in progress in this field includes the following studies:

1. Chemical degradations of ribulose and sedoheptulose are being carried out for the purpose of determining the distribution of carbon-14 in these important photosynthetic intermediates.
2. A large scale isolation of mannoheptulose from avocado leaves has been completed.
3. The form and distribution of thioctic acid in plants are being determined by bio-assay methods.
4. The chemical, physical, and photochemical properties of thioctic acid, trimethylene disulfide, and related compounds are under investigation.
5. In order to study possible "second carboxylation" reactions, phosphoglyceric acid-C¹⁴ is being formed in algae in the dark, and the subsequent light reaction is being investigated.
6. The optimum conditions for the formation of radioactive sedoheptulose from C¹⁴O₂ in Sedum are being studied.

7. PLANT AND EQUIPMENT REPORT UNCLASSIFIED

Bevatron (Account No. 5-271-9001)

Difficulties in the insulation of curve tanks have been corrected and three of the curve tanks are back in position. The fourth one will be installed in the very near future. All of the pole tips are now completed and 30 percent of them have been installed in place. The fourth tangent tank has been placed in its position complete with vacuum pumps and the utility connections will be started in the near future. The injector is approximately 93 percent complete.

Chemistry Laboratory Building 70 (Account No. 5-271-1002)

Swinterton and Walberg, the general contractors, have not been working due to the strike concerning the laborers' union. The only work that has been progressing is the drilling of caissons, and 80 percent of the caissons have now been drilled and filled with concrete and reinforcing steel. No other subcontractor on Building 70 has started work as of this date. The entire project is approximately 8.5 percent complete.

Electronics Research Building 80 (Account No. 5-271-2002)

A new prospectus has been composed and will be submitted to the AEC in the near future.

Miscellaneous Construction (Account No. 5-271-2001)

The Gamma House, Building 66, will be reviewed by the Regents at their next meeting. The Destructor is at present out to bid and a contract will be let in the near future. The sprinkler system in Building 14 is 100 per cent complete. Alterations to the Director's Office are approximately 50 per cent complete. The parking lot south of Building 50 is approximately 40 per cent complete, and the paving around Building 68 is at present out to bid and a contract will be signed in the near future.

MAN-MONTHS EFFORT REPORT
SCIENTIFIC PERSONNEL

Program No.	Subdivision	Man Months Effort	Vac. & sick Leave	Comments	Vac. & sick Leave
<u>Operations</u>					
3000	Weapon's Research General	197.79	6.34		
4000	Reactor Development-MTA Design and Development	18.14			
5000	Physical Research				
5200	Basic Physics Research				
	General Physics Research	68.79	10.57		
	Theoretical Studies	16.05	2.10		
	Film Detection	16.61	1.33		
	Cloud Chamber	11.42	1.17		
	Magnetic Measurements	2.85	1.08		
	General Instrument Design	5.06			
	Sub-Total	120.78	16.25		
5261	Applied Physics Research Special Cyclotron Development	-			
5311	Basic Chemistry Research				
	Chemistry of Heavy Elements	6.82)			
	Nuclear Properties of Heavy Element Isotopes	10.33)			
	Transmutations with 184 in. and 60 in. Cyclotrons	6.53)			
	Analytical and Services	15.97)			
	Mass Spectroscopy, Beta Ray Spectroscopy	1.25)	-- 3.89		
	Instrument Development and Services	5.17)			
	X-Ray Crystallographic Measurements	1.49)			
	Radiation Chemistry	1.50)			
	Office and Travel	8.45)			
	High Temperature and Special Chemistry	6.00			
	Health Chemistry Research	8.41	2.53		
	Sub-Total	71.92	6.42		
5361	Applied Chemistry Research Process Chemistry	9.79			
5731	Electron Synchrotron Operations	5.56			
5741	Synchro Cyclotron (184 in.) Operations	9.84			
5751	Linear Accelerator Operations	14.66			
5761	Proton Synchrotron-Bevatron Operations	8.26			
TOTAL PHYSICAL RESEARCH		240.81	22.67		

MAN-MONTHS EFFORT REPORT
SCIENTIFIC PERSONNEL

Program No.	Subdivision	Man Months Effort	Vac.& sick Leave	Comments	Vac.& sick Leave
6000	Biology and Medicine Research				
6300	Medical Research				
	Health Medicine	1.48			
	Metabolic Ward	-			
	Internal Irradiation	5.41		2.47 Consultant	
	Sub-Total	<u>6.89</u>		Man Months	
6400	Biological Research				
	Miscellaneous	3.13)		2.00)	
	Instrumentation	1.97)		-	
	C14 Metabolism	4.90)		0.48)	
	Use of Radioactive Material in Human Physiology	10.56)		3.91)	
	Trace Elements	3.59)		0.30)	
	Physical Biochemistry	13.44)-	3.68	2.71)-	1.51
	Biochemical Response to Radiation	3.40)		0.47)	
	Metabolism of Lipo-proteins	5.77)		7.99)	
	Iron Metabolism Hematopoiesis	3.61)		0.47)	
	Biological Effects of Cosmic Radiation	2.25)		0.25)	
	Radiation and Mutation Rate	2.00)		0.25)	
	Bio-organic Chemistry	27.48	1.27	-	
	Metabolism of Fission Products	15.30	3.28	-	
	Animal Colony	1.98	0.02	3.44	
	Sub-Total	<u>99.38</u>	<u>8.25</u>	<u>22.27</u>	<u>1.51</u>
6500	Biophysics Research				
	Health Physics	4.75		-	
	Irradiation Studies	4.35		0.57	
TOTAL BIOLOGY AND MEDICINE RESEARCH		<u>115.37</u>	<u>8.25</u>	<u>22.84</u>	<u>1.51</u>
GRAND TOTAL - OPERATIONS		<u>572.11</u>	<u>37.26</u>	<u>25.31</u>	<u>1.51</u>

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