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MONTHLY PROGRESS REPORT NO. 124

July 15, 1953 to August 15, 1953

September 2, 1953

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UCRL-2332

UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

July 15, 1953 to August 15, 1953

MONTHLY PROGRESS REPORT NO. 124*

September 2, 1953

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

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High Energy Gamma Ray Spectroscopy

A run was made at the synchrocyclotron with the pair spectrometer set at the 90° position to the beam, viewing various internal targets through the hollow probe. The results of this run are as follows:

- (1) The π^0 gamma spectrum from 340 Mev protons on carbon is the most accurate we have up to now obtained. The maximum is close to 50 Mev.
- (2) A rough bremsstrahlung spectrum from 140 Mev protons on a thin beryllium target shows the possibility of a $d\nu/\nu \cdot \sqrt{E_0/2} - h\nu$ shape as distinguished from a $\nu d\nu \cdot \sqrt{E_0/2} - h\nu$ shape.
- (3) A search for sharp lines in the 12 - 40 Mev gamma region yielded no intense lines from beryllium, boron, oxygen, nitrogen, and aluminum, such as is seen at 15.3 Mev from carbon. The proton bombarding energy was 140 Mev.
- (4) A fairly efficient thermocouple beam monitoring technique was successfully used.

Production of H^3 and He^3 in Deuteron-Deuteron Collisions

A run was conducted to compare yields for the reaction $D + D \rightarrow H^3 + P$ and $He^3 + N$. A magnetic channel and pulse height 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 of the proper momentum to traverse the channel. Since this represents too high a background, the next run will use a liquid deuterium target with thin windows to minimize this background.

* Previous report UCRL-2299 (No. 123).

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A one-day run was conducted to finish the cross section angular distribution of the $D + D \rightarrow H^3 + P$ reaction. The anomalously low cross section previously found at 90° center-of-mass was found to be in error, and the entire curve now follows a straight line on semi-log paper. At the end of the run, a beam gating device was tried out to see whether time-of-flight techniques could be used to debunch the background and eliminate the necessity for the magnet. The gate worked satisfactorily, but the width of the fine structure pulses of deuterons was found to be about 2×10^{-8} sec. Since the difference in time-of-flight between the desired particles and the background is only about 1×10^{-8} sec., it seems that time-of-flight techniques will not be very useful.

Range-Energy Program

Work continues, and is about sixty percent complete, on a new set of range-energy information. Preliminary details of this work have been outlined in past Monthly and Quarterly Progress Reports.

Nuclear Internal Momentum Distributions

Hydrogen, lithium, beryllium, and boron have been observed. Preliminary results suggest qualitative differences among these elements. The values of the various energy widths necessary to determine the resolution of the equipment are being computed. A new gate generator will be tried out, with the hope of reducing the background counts in the spectrometer. It appears that the spectra will have to be gathered at a rate of two or three counts a minute, because of background problems.

The Photoproduction of Negative Pions from Deuterium

The process $\gamma + d \rightarrow \pi^- + p + p$ is being studied by observing pion-proton coincidences photoproduced by the 330 Mev bremsstrahlung of the Berkeley synchrotron. The contribution from the neutron in deuterium is studied by making a $CD_2 - CH_2$ subtraction.

This reaction has been studied previously¹ when the synchrotron beam intensity was down by approximately a factor of 200 from the present value. At that time coincidence counting equipment with a resolution time of about 10 millimicroseconds was used.

At the present time, improved coincidence counting equipment with a resolution time of about three millimicroseconds is being used. This equipment has been developed in the intervening period. Data with better statistics are being obtained.

1. R. Madey. Ph.D. Thesis (unpublished). University of California (UCRL-1634), January 9, 1952. "The Photoproduction of Negative Pions from Deuterium".

Cerenkov Radiation Detector

Continuing work on the Cerenkov counter, temperature dependence of noise in Dumont 6292 phototubes has been investigated and a modified Neher coincidence bridge constructed.

Elastic Photoproduction of Neutral Pions from Deuterium

The pulse height method of measuring energy is now being tested at the synchrotron in connection with a $\gamma + d \rightarrow \pi^- + p + p$ run. Information thus far obtained indicates that the method will probably be satisfactory. The electron background is not great enough to cause serious difficulty.

A run using the liquid deuterium target is tentatively scheduled for the second week in September.

Electron-Neutrino Angular Correlation in Beta Decay

The problem of a large constant background counting rate on the recoil ion counter now appears to be completely solved. There were several indications that these pulses were caused by electrons drawn to the first dynode from the glass envelope of the electron multiplier by the negative ion accelerating field. Upon shielding the first dynode completely from all grounded glass, the background rate decreased from a few thousand counts per minute to six counts per minute. (These rates are at a gain and integral bias which is believed to be correct for counting the recoil ions.)

On the last run the counters and vacuum system were set up inside the bombardment area of the linear accelerator. On the next run it is planned to have the counters outside the shielding and run a pipe out from a target placed in the stripping foil port. This will decrease any background resulting from the bombardment and save set up time between runs since the equipment can be left in the new locations. The parts for the new target probe have been constructed, and will be tried in a run sometime within the next two weeks.

Polarization of 340 Mev Protons by Heavy Nuclei

Equipment for the investigation of polarization has been built, and a preliminary run has been made. Double scattering was observed, and counting rates were satisfactory, but experimental difficulties precluded any observed asymmetry.

Nuclear Scattering of 2.8 Mev Gamma Rays

Work is continuing on the measurement of the elastic scattering of gamma rays by light nuclei. The measured cross section for 2.8 Mev gamma rays on carbon is 6 ± 1 times the classical Thomson cross section at $80^\circ - 90^\circ$. It is improbable that the increase is due to Rayleigh scattering from the "bound electrons," but this possibility must be investigated by varying the scattering angle. It is more probable that the increased cross section is due to scattering from the meson cloud.

Resonance Excitation of Delayed Heavy Particle Emitters

Another bombardment of Mg^{24} verified the presence of the resonance peak, but the Na^{20} integrating counter was not reliable enough for accurate measurements. A new integrating counter with cylindrical geometry was built in order to get better discrimination between the alphas and betas. This counter was filled with 5 cm of Ne and two atmospheres of helium in order to avoid the limited lifetime characteristics of CO_2 . The linearity of the calibrating Faraday cup was checked by counting C^{11} after bombardment in the cup. The cup was found to be linear with current up to 8×10^{-8} amps. to within ± 2 percent, the accuracy of the measurement. Several characteristics of proportional counters made the linearity of the integrating counter sensitive to the scalar discriminator setting, but the counter could be made to operate satisfactorily.

Time-of-Flight Neutron Spectroscopy

Runs have been made with the time of flight instrumentation to determine the variation in total neutron cross section with energy for antimony, tantalum and bismuth. Carbon was run as a check. The results for bismuth shows the same general variation with energy as the data of Taylor and Wood for lead. Bismuth has a dip in cross section to 4.14 ± 0.14 barns at 62 Mev, followed by a rise to 4.92 ± 0.12 barns at 70 Mev.

The results for carbon agree well with values published by others, indicating that the instrumentation had been working properly.

Data for antimony and tantalum are being analyzed. As a part of the data, the direct beam neutron spectrum has been obtained. It agrees with the Serber "opaque-nucleus, all angles" model for 195 Mev deuterons stripped on a thin target. Inasmuch as the data were taken in the extreme forward direction, with a copper probe 1-1/4 in. long, one would not expect agreement with the theoretical curve just described.

Calculations are in progress to try to explain the spectrum shape. Spectra from beryllium and lead targets are to be examined also, to see if multiple scattering effects can produce a thin target spectrum from a physically thick target.

Film Program

A letter to the editor entitled "Yield of Low Energy Protons and Alphas Resulting from High Energy Bombardment of Ag" was submitted to the Physical Review for publication by R. W. Deutsch.

Accelerator time was employed for the following experiments:

- (1) scattering of γ -rays by Cu target placed in 330 Mev bremsstrahlung beam;
- (2) high energy products from Ag and C under alpha bombardment. The emulsions have been developed and preliminary scanning has been undertaken.

Work has continued in the projects listed below: (a) momentum and angular distributions of spallation products from various targets under proton, deuteron, and alpha bombardment; (b) γ -ray spectrum from Pb under 320 Mev bremsstrahlung beam; (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 G5 nuclear emulsions; and (d) meson production from p-C¹² collisions.

Cloud Chamber Studies

N-p Scattering by 90 Mev Neutrons on Methane. Film from a previous study (Cross Sections for Products of 90 Mev Neutrons on Carbon) is being read to obtain additional n-p scattering data. Only the carbon events were analyzed in the earlier study. Five hundred proton tracks have been measured and calculations have been started. Approximately 100 more proton tracks will be measured.

Pion Production in Deuterium by 300 Mev Neutrons. Improvements have been made in the 10 atmosphere chamber to make it more sensitive to the meson tracks which are sometimes very faint and hard to reproject. Better temperature control has been obtained by soldering copper tubing to various parts of the chamber and circulating temperature-controlled water over these surfaces. A new control panel has been built which will allow more precise and consistent adjustment of the expansion ratio, and which includes protective circuits to prevent rupture of the diaphragm in case of limited power failure or loss of pressure from some of the solenoid valves.

Scattering of 32 Mev Protons by Helium. Measurements of the events in this study have been completed and data reduction has begun.

Scattering of 32 Mev Protons in Oxygen and Nitrogen. The cloud chamber has been operated satisfactorily at 1/3 atmosphere, using oxygen, and a run will be made soon.

Diffusion Chamber Study of Large Air Showers. Analysis of the events is being continued.

35 Atmosphere Diffusion Chamber Development. The chamber has been operated several times with helium at about 450 psi with good track quality but leaks still occur in the O-ring seals around the plastic light windows. One of these homalite windows cracked and a replacement has been cast. The latest window is much better than the previous ones as the result of a change in casting technique. In addition to the regular hardening catalyst, a cold-setting promoter was used. The resulting window is light blue in color rather than yellowish, and seems much clearer and freer of strains than before. It also has better surfaces and will require less polishing.

Products of 270 Mev Neutrons in Oxygen. Analysis of the film in this study is nearly complete. Five hundred stars have been measured and the fragments identified.

Synchrotron Studies

During the month there was some difficulty with synchrotron operation leading to resilvering the injector half of the donut. Except for one leak in a boot, this was the only trouble, and the beam was good the remainder of the time.

A long run was made for measurement of the Compton effect. While the rate of collection of data was not so great as had been hoped, the equipment operated satisfactorily and valuable data were obtained. The measurements were made at angles of 4° , 8° , 16° , and 30° between the incident and scattered quanta. Another run will be made in the next month.

Some short runs were made to expose plates to gamma rays scattered from different substances. Examination of plates exposed to γ -rays scattered from C show some scattered 30 Mev γ -rays, expected from a resonant process, but they are not so numerous as the π^0 γ -rays.

Some calibration studies were made although the difficulties mentioned above interfered. Chambers identical with those used at Illinois and Cornell are used to compare the calibration measured with the Blocker-Kenney apparatus usually used here. This calibration is particularly important in connection with the work being done on the excitation function for photofission.

A long run was made at the end of the period to remeasure the characteristics of the reaction $\gamma + d \rightarrow \pi^- + p + p$. The electronics have been improved considerably for measuring the coincidence of π^- and p and so much better data can be obtained than was secured in the original measurements.

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

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Nuclear Physics

Investigations of polarization effects in proton-deuteron scattering continues. It has been found possible to treat this process formally as a two-body process, and detailed calculations are now under way.

The energy spectrum of the neutrons produced by bombardment of targets with the internal proton beam of the cyclotron is still under investigation.

The low energy (15 Mev) photo-neutron resonance is being studied by means of a perturbation method which takes into account correlations between nuclear particles. It is hoped in this way to calculate the shape of the excitation function for photo-neutron emission.

Problems Involving Mesons and the Electromagnetic Field

The study of the Compton effect on nucleons and the photodisintegration of the deuteron has been completed and is being written up.

A new technique for treating the problem of meson scattering from a fixed nucleon has been developed. This technique has been applied to the charged scalar theory and gives results in exact agreement with both weak and strong coupling theories in the appropriate limits. Moreover, this method can be applied in the intermediate region by making use of the numerical calculations which have been carried out in connection with the Tomonaga approximation.

A phenomenological study of meson production in proton-nuclear collisions has been undertaken with particular attention being devoted to Coulomb effects. The influence of possible central proton-clustering on the π^+/π^- ratio is also being studied.

In view of the extreme complication of the problem of the one-particle of the Green's function for electrodynamics, the simple problem of a scalar meson interacting with a massless scalar meson field is being considered.

Work on the meson-nucleon equation in the adiabatic limit is continuing. Methods for numerical solutions are being considered.

Miscellaneous Studies

Calculations of target corrections to bremsstrahlung produced by high energy electrons have been carried out for copper and platinum targets.

Some work has been done to establish a suitable set of parameters for a linear accelerator for heavy ions (C, N, and others). It should be possible to use a magnetic strong focussing for most of the length, thus eliminating most of the grid losses. It was tentatively decided that the machine would require an ionization of at least C^{4+} and similar specific charges for the other ions in order to be economically practicable, but the question is still under study.

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

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During the past month a further run was made to determine more accurately the trajectories followed by the 320 Mev deuterons stripped from He³ ions. A more elaborate set of slits and shielded ion chambers was built up inside the cyclotron on the proton probe, and was designed to rotate about a vertical axis as well as move in and out radially, thus defining the direction of various trajectories. It was hoped by this method to be able to increase the deuteron beam peeled off by the deflector system, but failure of the motor rotating the system of slits and counters forced postponement of this experiment.

$MnSO_4$ tank runs were made using the 320 Mev deuteron beam in an attempt to measure the external yield from a 2 ft. by 2 ft. uranium secondary with a carbon primary. The mean of four measurements was 4.25 ± 0.4 neutrons per incident deuteron.

A final attenuation run was made to establish the cross section for inelastic scattering of deuterons from several targets. A complete report of this work is being written.

A liquid scintillator recoil-proton telescope for measuring the energy spectrum of the cyclotron neutron beam is being constructed, preparatory to making external yield measurements with the manganese sulfate tank in the neutron beam.

A new absorber changer to make possible rapid changes of both thick and thin absorbers has been built and is ready to use.

The large liquid scintillator tank for high-efficiency neutron counting is under construction, and is expected to be out of the shop by Sept. 15. Various experiments are being planned for this tank once it is completed.

4. ACCELERATOR CONSTRUCTION AND OPERATION UNCLASSIFIED

Bevatron Construction. (Program No. 9001)

Magnet. Installation of pole accessories, such as the radial tie rods and stays, was completed. All pole tips, stanchions and filler frames were installed. About three-fourths of the pole face windings were pulled into place. After the curve tank top panels were placed, installation of the top pole bases was begun.

Vacuum System. Installation of the south tangent tank has been completed. This includes the vacuum testing of baffle division plates and the tying in of air, water and electrical services. The tangent tank side plates have been sent out to vendor for finish machining. Cold trap flanges are being welded on the top cover plates.

The curve tanks are all in place and only the installation and vacuum testing of cover panels on one-half of one tank remain to be done.

The diffusion pump baffle refrigerating system operates satisfactorily with individual expansion valves on each bank of two baffles. Although the refrigerant gas temperature in the suction line just outside the tangent tank varies $25^\circ F$ during a cycle of the valve, the baffle temperature varies $5^\circ F$ at most. Individual expansion valves are being installed on the north, south and west tangent tanks.

Injector. The output beam of the ion gun has been worked up to about 2 milliamperes and the voltage optimized, for overall injector performance, at about 450 kilovolts. This is 20 kilovolts above the design value. The linear accelerator output beam is about 70 microamperes and is now at 9.8 Mev which is the design voltage. Operation of the injector is satisfactory and work on proton-proton scattering is being conducted.

Shielding. By August 15, all shielding drawings were complete and in the process of being checked and released.

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

The cyclotron was used for research experiments approximately 98 percent of the 515 hours that the crew was on duty. The time distribution was as follows:

Operation for customers	505.0 hours	98.01 percent
Electrical troubles	1.25	0.24
Mechanical troubles	3.50	0.68
Others	5.50	1.07
Total	515.25 hours	100.00 percent

184-inch Cyclotron Modification. (Program No. 4900.02)

Magnet. Auxiliary coil tank machining is nearly completed at Mare Island. Some weld cracks were encountered during machining and preliminary vacuum testing, and steps are being taken to have these repaired by Mare Island welders.

Radio Frequency Design. Thermal conductivity tests have been completed which indicate that the dee cooling tubes may be soldered to copper strips which are, in turn, riveted to the dee skin. The proving of this process is believed to be a big advance in the art of dee and liner fabrication since the previous method of soldering cooling tubes directly to the skin always resulted in considerable warpage and its consequent straightening expense. At the heat loads anticipated in the modified cyclotron the extreme temperature difference between the cooling water and the dee skin attributed to this added thermal resistance is only about 4° C.

Vibrating Condenser. Power measurements have been completed on the 6 in. wide nitralloy blades permitting specifications to be written for the driving magnet power supply. It is apparent that about 15 kilowatts will be required to operate the full scale condenser blades in air. Only a little over one-third of this is expected for vacuum operation. The air operation, however, is believed necessary for initial adjustment of the equipment. In case the power requirement of the full scale equipment is greater than anticipated, it has been observed that a reduction of a factor of two can be achieved by operating in helium.

Deflector. Further orbit plots indicate that the pulsed magnetic deflector will be sufficient in itself to bring the beam out of the cyclotron in the angular distance between the dee and the present steering magnet location. This permits elimination of the shielded magnetic channel with a consequent saving of many days of magnetic measurements and shimming.

General. Work is proceeding on planning operations to determine in detail the steps to be taken during the shut-down. A considerable effort will be placed on this phase of the work in order to insure the shortest possible lapse of time from shut-down to the resumption of cyclotron operation.

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

A decrease in demand for 60-inch cyclotron time became apparent this month resulting from vacations and fiscal needs. The unsolicited time was used to pursue ion source development and heavy ion acceleration work. The performance of the machine, when in use, was adequate to meet commitments.

Synchrotron Operation

The synchrotron continued to produce a beam for physics research. A new bombardment cave for the electron linear accelerator was started. No serious difficulties were encountered during this period.

Operating statistics are as follows:

Operation for customers	364.5 hours	92.3 percent
Maintenance	30.5	7.7
Total	395.0 hours	100.0 percent

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

There was no machine operation for research during the period July 16 to August 15, 1953. The repairs to the Van de Graaff were completed by August 15. The new control system described in the previous report has been working very well. The Van de Graaff has been to 4 Mev on several occasions during the week of August 10 - 15th, and it is anticipated that the machine will be returned to routine operation soon.

Progress on the improvement program for the linear accelerator oscillators has been satisfactory, the main effort going into the design of a new coupling loop. This will be made so as to permit adjustment of loading of the oscillators without breaking the accelerator vacuum.

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

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Rhodium Isotopes

The rhodium isotopes produced by high energy fission (or spallation) of tantalum have been investigated. The most interesting result is a new activity, of 2.1-hour half-life, which is tentatively assigned to Rh^{107} . This activity has also been found in good yield from the high energy fission of uranium, but has not been reported in the products of fission induced by thermal neutrons. A 25-minute Rh^{107} , which would be an isomer if the above assignment is correct, is well-known as a thermal fission product. These facts are explained by the fact that in low energy fission Rh^{107} is produced primarily by decay of other isobars, if its immediate parent Ru^{107} decays primarily to the shorter-lived isomer.

Isotopes of Iridium and Platinum

Bombardments of iridium with protons from the linear accelerator and from the 184-inch cyclotron have produced several isotopes of platinum and iridium. A new 11-hour platinum activity and its 10-day iridium daughter are assigned to mass 189 on the basis of excitation evidence. A new 7-hour platinum activity has been shown to decay to 41-hour Ir^{188} , and is thus assigned to Pt^{188} .

Alpha-Gamma Coincidences

A gamma scintillation counter in coincidence with an alpha counter at the end of the magnetic alpha spectrograph now permits energy spectra to be obtained for the gamma rays in coincidence with a specific fine structure group of alpha particles. The apparatus has been tested with Am^{241} , one of the more favorable cases. The 60 kev gamma ray is observed in coincidence with the three main alpha groups, as expected from the decay scheme previously reported. The low counting rates make the measurements time consuming, but they are expected to prove very useful in the determination of other decay schemes.

Vapor Pressure of Solids

Several measurements have been made of the vapor pressures of AmF_3 and of PuF_3 by the effusion method. The results for PuF_3 check very well with the previous work of Simpson and co-workers, and the values for AmF_3 have high internal consistency. Therefore the apparatus is believed to be reliable, and it is planned to make measurements of other compounds of the radioactive elements.

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, the 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 thiosulfate, 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 on the following items:

1. Work is proceeding on the creation of a unit for carrying pistol-grip target holders, with their bombarded targets, from the 60-inch cyclotron to the respective laboratories without possibility of contamination. The unit would house the entire target assembly system, including vacuum and water lines, which then would not be broken until the system reaches its ultimate enclosure.
2. Equipment for use in magnetic susceptibility work with curium and americium has been set up and is in use.
3. Equipment for processing Idaho-Falls-bombarded uranium foil was set up and used successfully.
4. Equipment for processing special thorium bombardment work was supplied and used.
5. Revamping of the equipment and processes used in the work with special soils took place.
6. Fifteen Berkeley Boxes were assembled, fitted and delivered on requests from researchers.
7. The entire group has spent most of its time in projects for Livermore.

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

Physical Chemistry of Lipoproteins

The developments of the past several months within the laboratory for the quantitative determination of the various lipid subfractions of a lipoprotein are now being applied to extend the knowledge of internal structure of the various lipoprotein classes. The earlier data indicated that lipoproteins below S_{f12} have very low glyceryl ester contents. In the past month isolation of several samples of S_{f6} lipoprotein have been made and the glyceryl ester content is being determined by the combination of chromatographic separation plus infra spectrophotometric estimation. It appears that glyceryl ester is definitely present in low abundance as a constituent of S_{f6} lipoproteins. This is important data in the understanding of the mechanism of the lipolytic mechanism of action on lipoproteins induced by heparin administration.

The instability of lipoproteins upon dialysis was mentioned in previous reports. Since it appears that this instability is the result of the loss upon dialysis of some low molecular weight constituent, and effort is being made to identify this substance (or substances) which are apparently integral in maintaining undenatured lipoprotein structures. The current work is involved in attempts to identify low molecular weight nitrogenous components and metal ions that may participate.

The role of monoglycerides as possible constituents of the lipoproteins and as a possible reactant or product in lipoprotein transformations is being investigated with the lead oxidation procedure of Borgstrom.

Immuno chemical studies of S_{f6} and S_{f13} lipoproteins indicate complete cross reactivity of anti-sera for either antigen in precipitin tests with either antigen. In spite of this the quantitative course of the reaction with S_{f6} antigen differs markedly from that for S_{f13} antigen. The significance of this observation for structural features of the lipoproteins is being further investigated.

The light scattering photometer for study of lipoprotein structure and transformation is nearing completion. It is anticipated that testing and calibration will be in progress this month.

Biological Radiation Effects on Lipoproteins

The observations of the radiation effect upon lipoproteins in the rabbit have been extended to other species, including the dog, mouse and rat. Further tests upon rabbits indicate correlations of lipoprotein disturbance with the time of death of irradiated animals.

Egg lipoprotein disappearance studies from the serum of normal and irradiated rabbits continues. In the irradiated animal egg, lipoprotein clearance is significantly faster four hours post irradiation than in the normal animal. The clearance time is close in the post-irradiation animal to that observed in the animal receiving heparin. This further suggests the desirability of assessing the problem of heparin release post-irradiation.

Tracer Studies

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

Radiation Chemistry

The effects of hydrogen ion concentration on the radiolysis of acetic acid solutions have been studied. Processes for the determination of aldehydes, ketones and glycolic acid are being developed. Studies of the radiolysis of aqueous glycine solutions have been continued.

Radioautography

Preparation of tissue sections taken from a normal monkey (Mischief) is proceeding. Radioautographs are being prepared from the thyroid of this same animal. Extensive autopsies have been done on a large number of rats injected with At^{211} , and preparation of these tissues is under way.

Plant Biochemistry

The nature of the process of photosynthesis continues as the principal research interest in this field. The following work is taking place at the present time:

1. The form and distribution of thioctic acid in plants are being determined by bio-assay methods.
2. The "steady-state" reservoir sizes of important algae metabolites are being determined.
3. The chemical, physical, and photochemical properties of thioctic acid, trimethylene disulfide, and related compounds are under investigation.
4. The exchange reaction between thioctic acid and S^{35} -labeled nickel sulfide is being investigated.
5. In order to study possible "second carboxylation" reactions, phosphoglyceric acid- C^{14} is being formed in algae in the dark, and the subsequent light reaction is being studied.
6. 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.

Animal Biochemistry

1. The effects of coenzyme A and thioctic acid during total-body X-irradiation are being studied.
2. A determination of the effect of Δ^7 -cholestenol (lathosterol) upon the development of lipoproteins of various molecular weights has been carried out as part of a study of the nature of atherosclerosis.
3. The turnover rates of labeled adenine in the soluble nucleotides, desoxynucleic acids, and pentose nucleic acids of mice is being studied, along with the effects of X-irradiation on the rate of incorporation of the adenine into these compounds.
4. The effect of coenzyme A on the conversion of acetate- 2-C^{14} to lipids and proteins is being studied.

Organic Chemistry

1. A synthesis of C^{14} -labeled thioctic acid, starting with labeled ethylene, is under investigation.
2. Studies are continuing on the effects of high-energy ionizing radiation on such organic compounds as methanol, ethylene glycol, choline, acetyl choline, glycine, and polystyrene.
3. Syntheses of C^{14} -labeled peptides are being studied.
4. Malonic ester- 2-C^{14} has been prepared in 60-70 percent yield from sodium acetate- 2-C^{14} .

7. PLANT AND EQUIPMENT REPORT UNCLASSIFIED

Bevatron Instrument. (Account No. 5-271-9001)

At present all curve tanks have been installed and all of the pole tips are in place. Three of the quadrants are now covered over. The accelerator system has been completed and is now in place. The fourth tangent tank has had all of its utility connections completed and is being tested. The injector is approximately 95 percent complete.

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

Under the general contract to Swinerton and Walberg all the drilling of caissons has been completed and all of the caissons are filled with concrete and reinforced steel. The general contractor is at present building forms for the caisson caps and fittings for the walls. The C. F. Braun Company, plumbing contractor, has been working placing sewer and drain lines and the plumbing contractor is approximately 15 percent complete. The entire project is approximately 13 percent complete.

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

The prospectus has been submitted to the A. E. C. for their approval of the project.

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

Gamma House, Building 66, will be reviewed by the Regents at their next meeting and special proposed drawings have been completed for their perusal. Bids on the Destructor have been received and a decision will be made from these bids in the near future. Alterations to the Director's Office in Building 50 are approximately 75 percent complete. The parking lot south of Building 15 is approximately 46 percent complete and the paving around Building 68 is approximately 10 percent complete.

MAN-MONTHS EFFORT REPORT
SCIENTIFIC PERSONNEL

Program No.	Subdivision	Man Months Effort	Vac. and Sick Leave
<u>Operations</u>			
3000	Weapon's Research	General	230.26 13.93
4000	Reactor Development - MTA	Design and Development	17.87 1.80
5000	Physical Research	General Physics Research	78.82 13.92
5200	Basic Physics Research	Theoretical Studies	16.50 2.16
		Film Detection	16.85 2.79
		Cloud Chamber	14.56 1.92
		Magnetic Measurements	4.42 0.68
		General Instrument Design	2.45 -
		Sub-Total	<u>133.60 21.47</u>
5261	Applied Physics Research	Special Cyclotron Development	-
5311	Basic Chemistry Research	Chemistry of Heavy Elements	8.73)
		Nuclear Properties of Heavy Element Isotopes	16.96)
		Transmutations with 184 in. and 60 in. Cyclotrons	9.50)
		Analytical and Services	15.56)
		Mass Spectroscopy, Beta Ray Spectroscopy	1.88) -- 6.93
		Instrument Development and Services	5.84)
		X-Ray Crystallographic Measurements	2.85)
		Radiation Chemistry	1.49)
		Office and Travel	4.88)
		High Temperature and Special Chemistry	16.00
		Health Chemistry Research	6.74 2.55
		Sub-Total	<u>90.43 9.48</u>
5361	Applied Chemistry Research	Process Chemistry	14.38
5731	Electron Synchrotron	Operations	5.78
5741	Synchro Cyclotron (184 in.)	Operations	10.86
5751	Linear Accelerator	Operations	16.74
5761	Proton Synchrotron-Bevatron	Operations	9.22
TOTAL PHYSICAL RESEARCH			<u>281.01 30.95</u>

MAN-MONTHS EFFORT REPORT
SCIENTIFIC PERSONNEL

Program No.	Subdivision	Man Months Effort	Vac. & Sick Leave	Com- ments	Vac. & Sick Leave
6000	Biology and Medicine Research				
6300	Medical Research				
	Health Medicine	1.50			
	Metabolic Ward	-			
	Internal Irradiation	6.58		1.40	Consultan
	Sub-Total	<u>8.08</u>			Man Montl
6400	Biological Research				
	Miscellaneous	2.90)		2.00)	
	Instrumentation	2.06)		-)	
	C ₁₄ Metabolism	4.96)		0.50)	
	Use of Radioactive Material in Human Physiology	12.74)		3.35)	
	Trace Elements	3.21)		0.22)	
	Physical Biochemistry	16.07)	-- 5.89	3.49)	-- 1.76
	Biochemical Response to Radiation	3.66)		1.00)	
	Metabolism of Lipo-proteins	5.24)		9.24)	
	Iron Metabolism Hematopoiesis	3.48)		1.00)	
	Biological Effects of Cosmic Radiation	2.44)		0.25)	
	Radiation and Mutation Rate	1.68)		-)	
	Bio-organic Chemistry	28.51	2.40	-	
	Metabolism of Fission Products	17.79	2.56	-	
	Animal Colony	1.72	0.28	3.15	
	Sub-Total	<u>106.46</u>	<u>11.13</u>	<u>24.20</u>	<u>1.76</u>
6500	Biophysics Research				
	Health Physics	5.09		-	
	Irradiation Studies	5.08		0.47	
	Sub-Total	<u>10.17</u>		<u>0.47</u>	
TOTAL BIOLOGY AND MEDICINE RESEARCH		<u>124.71</u>	<u>11.13</u>	<u>26.07</u>	<u>1.76</u>
GRAND TOTAL - OPERATIONS		<u>653.85</u>	<u>57.81</u>	<u>26.07</u>	<u>1.76</u>

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