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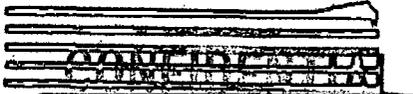
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MONTHLY PROGRESS REPORT NO. 127

October 15, 1953 to November 15, 1953

December 7, 1953

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UCRL-2428

UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

October 15, 1953 to November 15, 1953

MONTHLY PROGRESS REPORT NO. 127*

December 7, 1953

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

Gamma Ray Spectroscopy

A run was made at the linear accelerator in an attempt to measure the excitation function for a gamma line of approximately 15 Mev, excited by proton bombardment of carbon. This gamma line has previously been reported in connection with pair spectrometer work at the 184-inch cyclotron at various bombarding energies from 30 Mev to 340 Mev. This experiment was performed using a NaI(Tl) crystal two-inches in diameter by two inches long and pulse height analysis with photographic recording. Background difficulties prevented obtaining the excitation function, but it was possible to establish the existence of this gamma line at 32 Mev bombarding energy. Further work on the excitation function and the angular distribution of the gamma lines are planned. A more accurate determination of the gamma ray energy is to be made using the 180° focussing pair spectrometer at the 184-inch cyclotron.

Nuclear Internal Momentum Distributions

Correlated proton spectra have been obtained for CH₂, CD₂, Li, Be and B with the improved electronics obtained from the above runs. Lithium shows a sharp hydrogen-like peak, and the boron spectrum suggests something similar. Quantative calculations on this data are in progress.

Elastic Photoproduction of Neutral Pions from Deuterium

It has been decided to attempt to identify the reaction $\gamma + d \rightarrow \pi^0 + d$ by detecting the identifying deuteron only. This method appears feasible since there is no other known process of appreciable cross section whereby photons can eject high energy deuterons from a pure deuterium target. If deuterons are found with the expected energy spectrum one can be quite certain that the above reaction is being observed.

Energy and specific ionization are to be measured to identify the deuterons. Pulse height counters for this purpose have been constructed using plastic scintillators. The resolution of these counters was measured at the cyclotron using scattered protons of about 60 Mev energy. Corrections have yet to be applied to the data but it appears that the resolution

*Previous report UCRL-2395 (No. 126).

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is probably good enough to separate the deuterons from protons. Protons are expected to be the most serious source of background.

A synchrotron run using the above method is now in progress.

High Energy Pair Spectrometer

Further investigation of the previously seen and reported gamma line at 15.2 Mev from a carbon target under high energy proton bombardment yielded the following information: the same line is now seen by deuteron bombardment of B^{11} ; this line is not seen by alpha bombardment of Be^9 , deuteron bombardment of B^{10} , nor in other cases previously reported. A possible conclusion is that the line originates from a unique excited state of C^{12} which cannot, because of selection rules, disintegrate into three alpha particles.

Fast Deuterons from 340 Mev Protons on Nuclei

The fast electronic circuitry recently described in these reports has been used during a run with the 184-inch cyclotron in a search for indirect pick-up deuterons. A preliminary run about six months ago using slower electronics gave some information about the indirect pick-up process. The dependence of the cross section on atomic number was measured. Although the analysis of the data from this recent run is not complete, the deuteron cross sections all agree statistically to the values measured during the previous run. More elements were used this time to see if the deviation from the formula $\sigma = k A^{1.48}$ for high A was a real effect. It appears that the cross section does level off and maybe even starts downward for uranium, but this is not certain. The fast electronics was a decided improvement. This run was made at four times the beam that the previous run used, with fewer accidentals.

A Comparison Study of the Reactions $p + d \rightarrow H^3 + \pi^+$ and $p + d \rightarrow He^3 + \pi^0$ as a Test of Charge Independence

New counters are being built. The pulse height signal will come from 5819 phototubes, and the coincidence pulse will be from 1P21 phototubes.

It was found as the result of a cyclotron run that the previous arrangement, in which 1P21 phototubes provided the pulse height signal by viewing the scintillators edge on, did not give sufficiently good resolution to separate the desired processes from the background.

Cerenkov Radiation Counter

In view of the useful natural energy discrimination properties of a Cerenkov counter, a trial counter was made of a lucite Y with a 10-inch effective radiation depth for fast charged particles, and using two separated 6292 phototubes as detectors. In conjunction with this counter a fast Neher-type coincidence circuit was developed with a time resolution of better than 5×10^{-9} for .2 volt pulses, and a discrimination ratio of at least 25:1 for .4 volt pulses. In an effort to minimize accidental coincidences

from tube noise, cooling tests were run and it was found that tube noise drops sharply for moderate cooling.

Two trial runs have been made observing π^0 gammas. The first was directly in the neutron beam using a carbon target and gave pulses around .15 volt with excellent 0° to 180° ratios, and also the counting rate attenuated properly for gamma rays of the right energy range. The second was a run inside of the shielding observing π^0 gammas from both uranium and carbon targets. In the latter run considerable rf pickup and some low gamma energy pile-up was encountered. Future trials will include more adequate rf shielding of the counter and coincidence circuits, as well as observing charge particle orbits directly, which will allow the counter to be shielded from gammas coming directly from the target.

Ferramic cores were investigated further and the conclusion was reached that, while they are useful in coincident matrices and memory circuits, availability of reliable samples was doubtful, and actual use would have to wait on further manufacturing progress.

Resonance Excitation of Delayed Heavy Particle Emitters

Since the upper limit of successful operation of the neon-integrating counter appears to be about 3×10^{-8} amperes of beam, a new counter, to be filled in the same way is being constructed. In the counter, the beam will pass through a relatively field-free region separated from the counting volume by a grid. A slight bias on this grid will prevent counting the electrons of the ionization due to the beam pulse. It is expected that the saturation effect of the old geometry will be avoided in this way.

Experiment on Polarization in P-N-P Double Scattering

On Oct. 24 and 25, a neutron polarization experiment was run on the 184-inch cyclotron. Two coincidence telescopes of 10^{-8} sec. resolution were set up at about 22° right and left of a tantalum target situated on the low energy neutron beam line of sight in order to detect right and left counting difference. A gold target was run in on the main probe to the low energy line of sight giving neutrons at 0° to the beam and thus unpolarized neutrons. The equipment was checked out at this point and the right and left telescopes were moved in angle until they were recording an equal number of counts. Runs were then made with tantalum targets at full energy orbits on the low energy line of sight. These gave neutrons coming off at 45° right and 45° left and a check on misalignment. One target was then moved along the line of sight until the neutrons were coming off at 30° left and then at 20° left. All alignments were made optically and errors due to target misalignment were measured to be of order of 1 percent. The electronics were inverted and found to be symmetric. Background ratios were of the order of 8 or 10 to 1.

The results were reproduceable both days and were zero at all points to within about 4 percent.

A future run is planned adding a third counter on each telescope to take two absorber points at the same time, in order to reduce the effect of multiple collisions in the target nucleus.

Electron-Neutrino Angular Correlation in Ne¹⁹

In the effort to measure the time-of-flight spectrum of recoiling nuclei in the beta-decay of Ne¹⁹, the no-beam background in the recoil counter has been greatly improved, by carefully shielding all grounded insulators from the accelerating field.

A run using this system gave, for the first time, delayed coincidences above random background, which is an encouraging indication that the counter is detecting recoiling nuclei.

The time delays, however, are so short that it is apparent that most of the events counted are occurring in the wrong part of the apparatus, where it is impossible to interpret the time of flight in terms of recoil momentum.

Differential pumping to concentrate the Ne¹⁹ in the desired part of the recoil chamber is now being studied, and looks quite promising at present.

Elastic Scattering of 2.8 Mev Gamma Rays

An attempt to measure elastic scattering of 2.8 Mev gamma rays at 90° from liquid hydrogen, using a five curie source of Na²⁴ gamma rays, was frustrated by excessive loss rate of hydrogen from the 120 liter styrafoam container, frost formation on the outside of the styrafoam, and excessive background. Part of the background was caused by gamma rays irradiating the counter directly owing to an accidental contamination on the ground near the apparatus. Also air and ground scattering are believed to have contributed to the background.

The experimental technique was notably improved through obtaining better pulse height resolution in a large sodium iodide crystal so that the elastic peak was clearly discernable, through learning of the necessity of improved shielding to prevent air and ground scattered gamma rays from reaching the crystal, and through greatly improved technique for evaluating quantitatively the effect of the pile up of low energy electron scattered gamma ray pulses on the pulse height spectrum and counting rates.

The last two curies of the decaying Na²⁴ source mentioned above were used to measure the elastic gamma ray scattering at 90° from carbon, with a result of about one and one half times the classical differential Thompson scattering cross section, with statistical errors of about 20 percent. This number, while still preliminary, is believed to be more reliable than the value of six times the classical Thompson cross section reported earlier, with which it is in strong disagreement. The main source of systematic error in the former result is believed to have been a small electronic drift, along with the very steep pulse height spectrum, and lack of a well resolved elastic pulse height peak which detected such drifts in the latest run.

In order to be able to repeat the measurements until they are believed to be reliable, a longer lived source than the 14 hour Na²⁴ is needed. To avoid excessive background, which varies steeply with energy, the gamma

ray energy must be kept high. To this end a Co^{56} source (80 days, 3.3 Mev) has been ordered. The experimental geometry is being rebuilt so as to eliminate air and ground scattering. An electronic mock up of the low energy pulses which give pile up is being built.

Liquid Hydrogen Bubble Chamber

A Glaser* bubble chamber designed to operate using liquid nitrogen or liquid hydrogen has been constructed, and shown to be radiation sensitive when filled with liquid nitrogen. The apparatus is being rebuilt before being tested with liquid hydrogen. The major change of design is in the mechanism for temperature control, which had been a nichrome heating element, and which will instead be a pressurized liquid hydrogen bath.

Film Program

During this report period, cyclotron time was employed for analyzing the high energy spallation products from alpha-carbon collisions.

At the linear accelerator, data were obtained on the N^{12} β spectrum using the spiral orbit spectrometer. The data are now being analyzed. In addition, a Be^9 target was bombarded for a short time and the decay of B^8 and Li^8 was observed.

As a part of the program studying the selective scattering of γ -rays by complex nuclei, electron sensitive nuclear emulsions were exposed directly to the bremsstrahlung beam. These plates will be used to evaluate the absolute cross sections in this research as well as to study the shape of the bremsstrahlung spectrum.

Study is continuing on the high energy reaction ${}^1_1\text{H}^2 + {}^3_3\text{L}^7 \rightarrow {}^1_1\text{H}^1 + {}^3_3\text{Li}^8$; the interaction of high energy alpha particles in G5 nuclear emulsion; and the development of focusing methods for mesons and electrons.

Cloud Chamber Studies

Pion Production in Deuterium. A three day run was successfully completed in October and film analysis is continuing.

32 Mev Protons in Oxygen. A poor run was made. Analysis of previous runs is continuing.

35 Atmosphere Diffusion Chamber. The bottom volume of the chamber was isolated so that the top glass acts as a piston on expansion. This reduces turbulence materially. A new wick system was installed that improves the vapor supply. Tests are continuing.

90 Mev Neutrons in Hydrogen. Measurements of previous runs are continuing and another run is in progress.

*Donald A. Glaser, Phys. Rev. 91, 762 (1953).

32 Mev Protons in Methane. Two one day runs were made, one of which was extremely good, i. e., both the cloud chamber and linac were in operation for 16 hours. The scanning has been completed and about 350 $C^{12}(P, P')^3\alpha$ events have been tentatively identified. The cross section is approximately 40 mb. based on the scanning identification. Film analysis continues.

Interactions of 32 Mev Protons with He⁴. The energy distribution of beam particles is under investigation.

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

Investigation of the several problems discussed in the preceding report continues.

An attempt to obtain the relativistic Coulomb wave function for an electron in the field of a large Z nucleus having the proper scattering boundary conditions has been initiated. These wave functions are needed for the calculation of matrix elements for processes involving the Coulomb field of heavy nuclei such as bremsstrahlung, pair production, and electron-induced nuclear excitation.

An investigation of the first non-adiabatic approximation to the lowest order nucleon-nucleon interaction has shown that the usual elimination of the wave functions of the negative energy states is incorrect.

An attempt is being made to improve the intermediate coupling meson nucleon scattering calculations by taking account of virtual isobar states.

The investigation of eddy current distribution in the new 184-inch cyclotron dees has been completed.

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

During this period most of the emphasis of the experimental target physics research group continued to be placed on the problems of measuring the yield of neutrons from thick and thin targets bombarded by high energy neutrons. To this end a monitor consisting of a scintillation counter telescope looking at a polyethylene target was calibrated against the variable absorber scintillation counter telescope described in the last monthly report. The monitor responded to all neutrons in a wide range of energy, and was used in the neutron beam of the 184-inch cyclotron to monitor the total neutron flux hitting various thin targets placed in the tunnel of the manganese sulfate tank. Runs were made using several different target materials in an attempt to measure σ_{1n} , the cross section for producing one neutron per incident high energy neutron. Unfortunately, the

monitor did not perform reliably, the results of two successive runs differing by a factor of two. It is planned to use a Q-metal fission chamber as the monitor in the next run, and calibrate this against the variable absorber scintillation counter telescope.

The construction of the large liquid scintillator tank is essentially complete, and tests are being made on smaller samples to determine the most feasible way of coating the inside surface with a highly reflecting coating. The Dumont 6282 photomultiplier tubes are being matched electronically for uniform gain, and the tubes should be ready to mount in the tank within the next few weeks.

4. ACCELERATOR CONSTRUCTION AND OPERATION

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Bevatron Construction. (Program No. 9001)

Magnet. The magnet has run almost every evening for measurements of the magnetic field and tests of the peaking transformers which provide signals to the frequency controls and timing circuits. About 3000 pulses were made during the month. Interruptions continued to occur due to various troubles with the magnet power supply but it is believed these are gradually being ironed out. On November 15 about three weeks work remained in measuring the magnetic field. The field shape is very close to that of the model. The field at the maximum rated output of the power supply is about 15,500 gauss, corresponding to an energy of 6.2 Bev. The uniformity and location of the median plane appeared to be very good from the preliminary checks made so far.

The air duct shrouding work was completed November 9 and tests are being made of the flow throughout the magnet to make sure there are no obstructions present. Forced cooling has not been needed so far.

Accelerator. Changes are being made in the high level radio frequency equipment to shield components from the stray magnetic field. Developmental work is still continuing in the shop on the low level frequency control unit. These items are becoming critical on the overall schedule.

Schedule. A review of the work to be done indicated that January 15 was the earliest date on which to expect beam injection experiments to begin. Magnetic field measurements are expected to continue until December 15, approximately, after which a shutdown will be made to install the remaining pole face windings and their connections in the tangent tanks. A reentrant section will be installed in the west tangent tank at this time to improve the geometry for positive meson beam. The moving target to be installed in the southwest quadrant is still on the drawing board and is expected to be ready for installation if needed, about February 1.

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

The oil seepage into the vacuum system from the upper magnet coil tank had to be repaired temporarily because it reached a stage where

it was interfering with the operation of the cyclotron. Fortunately, most of the leaks could be reached and thus repaired to a point where the leakage is now negligible.

The time distribution was as follows:

Operation for customers	463.00 hrs.	86.8 percent
Electrical troubles	3.75	0.7
General maintenance	2.75	0.5
Tank oil leak	56.00	10.5
Visitors	7.00	1.3
Miscellaneous	1.00	0.2
Totals	533.50 hrs.	100.0 percent

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

Magnet. The company supplying the silicone tape for wrapping the auxiliary coil conductor has requested that the rejected tape be returned to them for recoating. They believe that they can produce a satisfactory product without exceeding the thickness tolerance specified.

The pole disc blank has been machined nearly to final dimension. Some warping has occurred but it is believed the final cuts can be made so as to correct this condition.

RF Design. The detailed drawing of the dee frame is nearing completion and should be released to the shop immediately. Other drawings of the rf components including the redesigned insulator are in process.

Vibrating Condenser. Some delay has been encountered in placing the order for machining the vibrating blades. Negotiations are now in process with L and F Machine Works in Los Angeles, the only company at present who is willing to accept this order on a firm price basis.

Deflector. The decision as to the type of deflector has been postponed until the circulating beam can be obtained in the rebuilt cyclotron. At that time a measurement will be made to determine the fraction of the beam reaching a radius corresponding to $n = 1$. If sufficient beam reaches this radius, the cost of the deflector, it is hoped, can be reduced considerably.

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

The cyclotron was run, for bombardment purposes, 272 hours of the 410 hours available; 70 hours were used in feeler, exit strip and deflector experimentation. The result of this work has been the largest beam outputs recorded in some time--namely, 100 μ a of external deuterons and 40 μ a of external alpha-particles at nominal power levels.

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

No major changes were made in either the Van de Graaff or linear accelerator during this period. The rubberized Van de Graaff charging belt broke after 750 hours of operation. It was replaced by a belt of

the same type. The development program for the 4W20000 pre-exciter is continuing.

Following are the operating statistics for the period.

Operation	267.0 hours	76.0 percent
Van de Graaff repairs	82.5	23.4
Linear accelerator repairs	<u>2.5</u>	<u>0.6</u>
Totals	352.0 hours	100.0 percent

Synchrotron Operation. (Program No. 5731)

After reassembly of the synchrotron, using the new resonator, difficulties in operation were noticed. Apparently a field disturbance was introduced by the new resonator that could not be corrected for in the range of the existing field compensating controls. A field plot program was undertaken, and additional field shimming coils installed. This undertaking allowed the synchrotron to reach full energy output. However the intensity of the beam was unsteady and was subject to a phenomenon of fading. Adjustment of the machine controls did not bring up the intensity, but it eventually would build up again by itself. A donut coating program was undertaken, and this allowed somewhat steadier operation. The beam intensity fell off as the beam energy was boosted to full 330 Mev. The intensity output was spotty again and further donut coating was undertaken. At the conclusion of this report period, the beam had not been regained; and the synchrotron was unstable. During the beam adjustments some experimental work by the physics group was undertaken using the low level intensity beam. If correction of the above-mentioned difficulties does not make the synchrotron usable, it is planned to disassemble the magnet and replace the new resonator with the old one, which has been repaired in the interim.

Operating statistics are as follows:

Operation for customers	46.5 hours	13.3 percent
Maintenance	<u>302.2</u>	<u>86.7</u>
Totals	348.7 hours	100.0 percent

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

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Heavy Isotope Spallation Yields

A study is being made of the distribution of yields of spallation products from Pu²³⁹ bombarded with 38 Mev helium ions. From our experiment the yields of curium isotopes gave yields for the (α, n), (α, 2n) and (α, 3n) reactions as 0.65, 4.1 and 1.2 mb, respectively. These values are low, as was expected because of fission competition. There are too few other data of this type in this region to give an overall picture of the variations to be expected, and one purpose of the present work is to give a basis for such predictions.

Isomer Yields

The study of the excitation functions for (d,p) reactions has been extended to the production of the two isomers of Pd¹¹¹. At all energies the metastable state (spin reported as 11/2) is formed in lower yield than the ground state (spin reported as 5/2). This result contradicts the previous experience in which high energy transmutations favored the product with higher spin.

Fission of Tantalum

The yields of products from tantalum induced to fission by 340 Mev protons have now been extensively studied. The maximum cross section for a single fission product is about 0.2 mb. The center of gravity of the yield curve corresponds to mass about 170 for the principal fissioning nuclide, compared to 181, the atomic mass of tantalum.

Decay of U²³⁹

The isotope U²³⁹ decays by emission of beta particles followed by 73 kev gamma rays. The conversion ratios for this gamma ray in the L shell correspond to an E1 transition, as does the fact that the lifetime of the upper state is observed to be less than 5×10^{-9} sec.

X-ray Spectroscopy

The electron capture of Tl²⁰⁴ has been confirmed by identification of mercury x-rays (K α_1 , K α_2 and K β) by means of the bent crystal x-ray spectrometer. This isotope is being investigated by other methods as well to help elucidate its decay scheme.

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 agitation of liquid-liquid systems, solubility studies, thermal diffusion in liquids, the capacity of perforated plate liquid-vapor contacting columns, gas-phase mass transfer studies, and the vacuum flow through annular sections.

Metals and High Temperature Thermodynamics

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

Health Chemistry

The Equipment Development group and the Airborne Activities Control group completed the equipment for processing a highly active irradiation received during this period from the MTR at Idaho Falls. These

groups have, on receipt of the material, commenced the processing in conjunction with the Chemistry group. This work is being done at Livermore.

Maintenance, repair, modification, etc., continues to be done on local equipment.

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

Physical Chemistry of Lipoproteins

Most of the work of the past month has centered about the procedure being developed in the laboratory for the systematic chemical breakdown and analysis of all the lipid constituents of lipoproteins. This work is progressing satisfactorily with the exception of some discrepancies involved in the apparent partial hydrolysis of part of the phospholipid which gives falsely high fatty acid values. It appears that the difficulty here lies primarily in the conditions for solvent extraction of lipids. Careful control of acidity in extraction appears essential to avoid hydrolysis of phospholipids.

The quantitative light-scattering photometer recently completed is being utilized now for the study of independent molecular weight determinations of isolated lipoproteins.

The chemical changes accompanying the lipoprotein alterations observed in rabbits, rats and dogs subjected to total body x-irradiations are being determined at this time.

Efforts are being made to evaluate a precipitation method for isolation of heparin-active factor in order to determine whether this procedure will be of use in looking for active factor in the serum of individuals who have not received parenteral heparin.

Iron⁵⁹ Studies

The blood volume of the highly inbred albino rabbit used here has been measured by the iron⁵⁹ labeled cell technic. The normal red cell volume of the rabbit by this procedure appears to be considerably less than that of the rat per 100 gms. of body weight. Indeed, it falls within the range for the hypopsysectomized rat. Such rabbits are being employed as test animals in a variety of substances being tested for erythropoietic stimulatory activity.

Iron turnover studies in patients with various hematopoietic disorders continued and three more patients have been studied by the iron turnover technic before and after splenectomy studies. The changes observed seem to be a function of the kind of disorder for which the splenectomy was performed.

Studies of Tissue O₂ Utilization

Some preliminary trials have been made of an apparatus for determining the skin oxygen tension by a method related to polarography. Should this procedure prove to be as reliable as it is hoped there are a number of interesting problems to which it may be applied. Anemias would be studied for example to determine whether there exists a true inadequacy in delivery of oxygen to tissues when low hemoglobin and red cell concentrations are present or whether in certain instances some failure in oxygen utilization by tissues results by some subnormal mechanism in stimulus erythropoiesis.

Tracer Studies

The deposition of aerosols in the lungs of primates for long term effects are continuing.

Long and short term tracer studies are being done with europium, thulium, cerium, iron and astatine in rats.

Experiments on the relative biological effects of alpha and beta emitters using astatine, iodine and radium in toxic amounts on a long and short term basis are continuing using rats and monkeys.

Radiation Chemistry

Radiation chemical studies of acetic acid in D₂O have been made. The qualitative and quantitative effects of oxygen are being studied. The chemistry of glycolic acid and glyoxalic acid is being investigated. These products are apparently formed in oxygen saturated acetic acid solutions and in formic and oxalic solutions.

Radiation studies of formic, oxalic and amino acetic acids are continuing.

Histology

Radioautographs were made on two series of At²¹¹ animals using bone marrow, liver and spleen to test for the presence (or absence) of colloidal particles as demonstrated by the appearance of stars rather than straight line alpha tracks. Another series of tissues on At²¹¹ animals with I¹³¹ uptakes were run.

Bio-Organic Chemistry

Following is an outline of the current research projects:

1. Rearrangement of 4, 5-diphenylpyrrolidinedione-2, 3.
2. Preparation and radiation decomposition of choline and several choline homologs including ethyltrimethyl ammonium chloride and 3-hydroxypropanyl trimethyl ammonium chloride.
3. Preparation of carbon-14-labeled thioctic acid, 4, 7-dithiol heptanoic acid, dithiol isobutyric acid, heptanoic-7-C¹⁴ acid, uric-8-C¹⁴ acid, methanol, methyl iodide, acetic acid, and leucyl alanine-1-C¹⁴.

4. A determination of the products of gamma irradiation of solid glycine.
5. The metabolism of acetate-2-C¹⁴ in rabbits with and without the addition of heparin.
6. The metabolism in rats and mice of acetate-2-C¹⁴ in the presence of variables, such as, irradiation and added CoA.
7. The metabolism in normal and pantothenic acid-deficient rats of heptanoic-8-C¹⁴ with and without added CoA.
8. The metabolism of C¹⁴-labeled adenine in mice with an emphasis on the soluble nucleotide fraction and the objective of finding the maximum number and type of these soluble nucleotides, such as, 5 ANP, ADP, ATP, DPN and others.
9. The synthesis and metabolism of morphine and related substances.
10. The development of improved multi-channel scintillation counters for low level C¹⁴ and T assays.
11. The degradation of sedoheptulose with special emphasis on the C-6 carbon.
12. The mechanism of ribulose diphosphate carboxylation in plants.
13. Carbon dioxide dependence of biochemical reactions of photosynthesis and the effects thereon of steady state changes.
14. The mechanism of shikimic acid biosynthesis by E. coli.
15. The Hill reaction stimulation by thioctic acid and its analogs.
16. The mechanism of the formation of the thiazine ring in glutathione.

7. PLANT AND EQUIPMENT REPORT

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

The air shrouding is complete, and the fans have been tested. Magnet tests are being made at night, and the Bevatron will operate as soon as the injector is moved into its final position. The bevatron shielding foundation subcontract has yet to be signed by the Atomic Energy Commission, but it is hoped that the subcontractor, O. C. Jones and Sons, will be able to start work by November 20, 1953.

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

The first floor walls on the east end of the building have been poured and stripped of forms so that the backfill work against the southeast corner could be completed last week. The second floor reinforcing steel is being placed, and the electrical, mechanical, and plumbing contractors are installing the cans in this floor. The entire project is approximately 28 percent complete.

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

The architectural firm of Corlett and Anderson have been assigned the subcontract to design this structure, and the subcontract is now being negotiated.

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

The Gamma House and Incinerator foundation is complete, and subcontracts have been let for the building and destructor to Hugh Muller Jr. and Morse Boulger Destructor Company respectively. Alterations to Building 50 are 98 percent complete. The east parking lot is ready for paving by Independent Construction Company which will start November 16th and be complete, weather permitting, by November 23rd. Work has just been started on the Accelerator Technician Shop in the north end of Building 64, and the moving of equipment, installation of the dividing wall, and plumbing work is 50 percent complete while no electrical work has been done except for the removal of lighting fixtures.

MAN-MONTHS EFFORT REPORT
SCIENTIFIC PERSONNEL

Program No.	Subdivision	Man Months Effort	Vac. & Sick Leave	
<u>Operations</u>				
3000	Weapon's Research	General	298.33	5.68
4000	Reactor Development - MTA	Design and Development	17.60	-
5000	Physical Research			
5200	Basic Physics Research	General Physics Research	54.62	4.21
		Theoretical Studies	14.48	0.91
		Film Detection	15.53	1.16
		Cloud Chamber	10.74	0.49
		Magnetic Measurements	2.02	0.61
		Sub-Total	97.39	7.38
5311	Basic Chemistry Research	Chemistry of Heavy Elements	5.66)	
		Nuclear Properties of Heavy Element Isotopes	11.57)	
		Transmutations with 184" and 60" Cyclotrons	7.02)	
		Analytical and Services	10.74)	
		Mass Spectroscopy, Beta Ray Spectroscopy	1.67)--	1.18
		Instrument Development and Services	9.66)	
		X-Ray Crystallographic Measurements	2.69)	
		Radiation Chemistry	0.32)	
		Office and Travel	6.74)	
		High Temperature and Special Chemistry	4.35	
		Health Chemistry Research	7.97	
		Sub-Total	68.39	
5361	Applied Chemistry Research	Process Chemistry	4.60	
5731	Electron Synchrotron	Operations	5.81	
5741	Synchro Cyclotron (184 in.)	Operations	9.80	
5751	Linear Accelerator	Operations	12.59	
5761	Proton Synchrotron-Bevatron	Operations	9.73	
TOTAL PHYSICAL RESEARCH			208.31	8.56

MAN-MONTHS EFFORT REPORT
SCIENTIFIC PERSONNEL

Program No.	Subdivision	Man Months Effort	Vac. & Sick Leave	Com- ments	Vac. & Sick Leave
6000 Biology & Medicine Research					
6300 Medical Research	Health Medicine	1.48			
	Internal Irradiation	7.27		1.72 Consultant	
	Sub-Total	<u>8.75</u>		Man Months	
6400 Biological Research	Miscellaneous	3.53)		2.02)	
	Instrumentation	2.23)		-)	
	C ₁₄ Metabolism	2.82)		0.75)	
	Use of Radioactive material in Human Physiol.	11.39)		5.19)	
	Trace Elements	3.57)		0.85)	
	Physical Biochemistry	12.22) --	3.14	2.85) --	1.37
	Biochemical Response to Radiation	4.10)		0.75	
	Metabolism of Lipo-proteins	5.47)		9.75)	
	Iron Metabolism Hematopoiesis	2.42)		-)	
	Biological Effects of Cosmic Radiation	2.21)		-)	
	Radiation and Mutation Rate	1.80)		0.30)	
	Bio-organic Chemistry	28.70	0.73		
	Metabolism of Fission Products	17.17	0.83		
	Animal Colony	2.57	0.03	3.50	
	Sub-Total	<u>100.20</u>	<u>4.73</u>	<u>25.96</u>	<u>1.37</u>
6500 Biophysics Research	Health Physics	5.07			
	Irradiation Studies	4.58		1.15	
	Sub-Total	<u>9.65</u>			
TOTAL BIOLOGY AND MEDICINE RESEARCH		<u>118.60</u>	<u>4.73</u>	<u>28.83</u>	<u>1.37</u>
GRAND TOTAL - OPERATIONS		<u>642.84</u>	<u>18.97</u>	<u>28.83</u>	<u>1.37</u>

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