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Contract No. W-7405-eng-48

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Person making change

MONTHLY PROGRESS REPORT NO. 120
March 15, 1953 to April 15, 1953

May 1, 1953

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UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

March 15, 1953 to April 15, 1953

MONTHLY PROGRESS REPORT NO. 120*

May 1, 1953

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

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High Energy Gamma Ray Spectroscopy

A pair spectrometer run was made at the neutron hole of the synchrocyclotron, using various targets with the 340 Mev proton beam. It was found impossible to obtain good data with the beam in the forward direction because of the very unfavorable ratio of neutrons to gammas entering the spectrometer. Changes are being made in the converter arrangement to cope with this problem.

With the beam in the backward direction the following results were obtained: (1) Data were secured on the neutral meson spectrum with a carbon target. The peak appeared at about 60 Mev, which is distinctly lower than the Crandall spectra maxima at 180° angle of view. (2) The peak in the 15 Mev region with a carbon target was again seen, although possibly reduced in intensity relative to π^0 photons in comparison with its contribution at 90° angle of view. (3) A very short period of operation with lithium and beryllium targets did not reveal a prominent low energy peak; but the data are insufficient to be sure of its complete absence.

The Photoproduction of Negative Pions from Deuterium

The spectrum of negative pions, produced by monoenergetic photons on deuterium, was calculated by LeLevier (Phys. Rev. 85, 771A (1952)) for pions at 120° and one of the protons at 20°. These recoil angles result when a pion is photoproduced from a free nucleon; furthermore, the correlated angles remain very nearly the same for photon energies from 240 Mev to 340 Mev. The main part of the spectrum is peaked at the free production energy. Kinematics allow the two protons to have small relative energy even though their absolute energy is comparatively large. If the final protons are in a ^1S state, the ^1S proton-proton interaction and the phase space factor causes a sharp rise in the cross section at the high energy end of the pion spectrum. Calculations are almost complete for the theoretically expected ratio of the cross sections at high pion energies to that at low pion energies. The spectra are integrated over the bremsstrahlung spectra and folded into the experimental detection efficiency.

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* Previous report UCRL-2174 (No. 119)

Production of Tritons in Deuteron-Deuteron Collisions

A run was conducted to complete the $d + d \rightarrow t + p$ differential cross section. By moving the meson port block of the cave shielding, it was possible to use an improved geometry. The triton telescope was kept at a distance of 11 feet from the target for each point and was allowed to define the solid angle. This geometry kept the multiple scattering corrections in each case to less than 10 percent. Data were obtained at center-of-mass angles from 20 to 90 degrees. The cross section curve rises steeply in the forward direction. The 20° point is higher by a factor of 1,000 than the 90° point. A pick-up analysis for this reaction is being calculated by the theoretical group to compare with these data.

The Triton Reaction, $p + d \rightarrow t + \pi^{+}$

The corrections to the angular distribution data for pion absorption, decay in flight and pion and triton multiple scattering have been completed. The efficiency of the coincidence equipment has been measured to be around one hundred percent. The corrected data is tabulated below.

Pion Center of Mass Angle	$d\sigma/d\Omega_0$ (Microbarns/Steradian)
30°	4.56 ± 1.12
50°	$2.66 \pm .18$
70°	$.92 \pm .13$
90°	$.49 \pm .05$
130°	$.49 \pm .07$
150°	$.44 \pm .12$

Internal Momentum Distributions

Satisfactory quadruple coincidence voltage plateaus on the 1P21 tubes viewing stilbene crystals were obtained in the last cyclotron run with the use of an improved EFP-60 amplifier with a pulse lengthener. A special unit is being constructed to send out gates to the 35 channel amplifier. The 35 channels have been made uniform within a range limited by statistics. Data taken on the run have not yet been evaluated.

The Photoproduction of Neutral Pions from Deuterium

A liquid deuterium chamber has been designed to fit between the pole faces of the magnet. This chamber will be used with the deuterium liquifier in the next run. The liquifier is nearing its completion stage.

Total Proton-Proton Scattering Cross Section at 330 Mev.

As a result of considerable difficulty with previous liquid hydrogen target design this design is being altered considerably. The main change is the substitution of heliarc welded seams in place of the previously soft soldered seams at the ends of the liquid hydrogen vessel. This amounts to abandoning the advice of the metalurgists, but seems to be in accord with previous experience in other liquid hydrogen targets.

No more reliable results than those already reported can be reported until the hydrogen target is reliably tight.

Elastic Proton-Deuteron Scattering Using 345 Mev Protons

The present method of measuring the differential scattering cross section seems to be quite adequate and is being actively pursued. Since the cross section is very very small, the actual counting rate is small even when the full external proton beam intensity is used, so at least a few fairly length runs will be needed before extensive results can be given.

Proton-Proton Differential Scattering Cross Section at Small Angles (160 and 250 Mev)

A recent run is believed to be very successful, but the data are not fully evaluated at this time. If the results come out as is expected, there should be some information down to c.m. scattering angles of 10°.

Film Program

Work is being continued on the following projects: (a) gamma-ray energy spectrum from C when bombarded by 160 and 330 Mev bremsstrahlung beam; (b) gamma-ray energy spectrum of Be under 340 Mev proton bombardment; (c) disintegration products from various targets under high energy proton, deuteron, and alpha bombardment. A technique has been devised by which the high energy disintegration products may now be investigated. Initial experiments have indicated that the extension of this research to greater disintegration product energies than now detectable is possible: (d) Meson mass and energetics of meson decay; (e) high energy beta decay; (f) photoproduction of charged mesons using the large solid-angle focusing magnet.

The following researches have led to definite conclusions:

"Interactions of Fast Electrons and Positrons with Matter" (Thesis), Charles E. Violet.

From observations of high energy electron and positron tracks in nuclear emulsion, the following processes were studied: (1) electron-electron scattering, (2) positron-electron scattering, (3) the ratio of plateau to minimum grain density for electrons, (4) nuclear scattering of electrons and positrons, (5) positron

annihilation in flight, (6) pair production by electrons and positrons, and (7) inelastic electron-electron and positron-electron collisions. Experimental results pertaining to (1), (2), (4), (5), and (6) are consistent with the appropriate theories. The ratio of (3) is found to be 1.087 ± 0.010. Process (7) was not detected.

"Low Energy π Mesons from a Thin Carbon Target Bombarded by Protons", J. K. Bowker.

An extended study of the low energy positive and negative π mesons from a thin carbon target bombarded by protons has been concluded. Energy distributions from 0.5 to 10.0 Mev were obtained for two proton energies, 270 Mev and 300 Mev. The rise of the energy distribution in the center of mass system was found to vary as E^n, where n = 1 to 1.5.

The possible existence of an excited nucleon which may emit a π meson was also investigated but was not detected. This work is being prepared for publication.

Cloud Chamber Studies

A run was made at the 184-inch cyclotron using the 22-inch pantograph cloud chamber filled with helium for a study of 300 Mev neutron-induced helium stars. The total pressure in the chamber was 91.7 centimeters, of which 1.7 cm was water vapor, the presence of which accounts for the appearance of oxygen stars. as well as helium stars in the pictures.

Twelve π^- mesons were found in helium stars and two π^- mesons in oxygen stars. Because the oxygen stars do appear, it was possible to calculate the cross section for the production of π^- mesons in helium, using the previously determined cross section for oxygen made by Franklin Ford. The cross section for helium is approximately one-seventeenth of that for oxygen or $2^7 \times 10^{-29}$ cm^2.

Helium stars with π^- mesons can have either three or four prongs (including the meson). In the 3-prong category, three combinations are possible:

(1)	π^-, proton, He^3	neutron (invisible)
(2)	π^-, proton, He^4	no neutron
(3)	π^-, deuteron, He^3	no neutron.

Seven 3-prong stars were found. In the 4-prong category, four combinations are possible:

(1)	π^-, 3 protons	2 neutrons (invisible)
(2)	π^-, 2 protons, 1 deuteron	1 neutron (invisible)
(3)	π^-, 2 protons, 1 triton	no neutron
(4)	π^-, 1 proton, 2 deuterons	no neutron.

Five 4-prong stars were found.

Reading of all the helium stars (with and without mesons) is now progressing.

During this run the second model of the continuous automatic film developer which is attached to the stereoscopic camera was used, and in general it performed satisfactorily. Use of an automatic developer of this type makes possible a close check on and control of the cloud chamber and all operating conditions.

In the development of the 35-atmosphere diffusion chamber, the alcohol trays have been replaced by a new vapor supply system which provides a truly continuous process because the alcohol is led through a wick system back to the top of the chamber. The chamber has been operated successfully at a pressure of 11 atmospheres. There were no leaks, and there was a good sensitive depth. The active volume of the chamber has been completely isolated from the upper volume by installing electrical and gas contacts that pass through a rubber diaphragm. As a result of this, the turbulence and most of the vapor curtains have been eliminated. The clearing field has been redesigned so that the chamber bottom and the top glass are at the same potential, and the opposite potential is supplied by means of a wire ring halfway between.

Synchrotron Studies

During this period the synchrotron has operated well and several new experiments have been started. The spiral orbit spectrometer has been brought to building 25 to look for low energy photo mesons produced in carbon and hydrogen. This spectrometer operates with a very large stray flux because the core of the magnet is well saturated. Consequently it has been necessary to spend considerable time compensating the synchrotron for this stray flux. However, satisfactory operation does seem possible with the center of the spectrometer magnet about ten feet from the collimator. With some additional magnetic shielding, a good run is expected next month.

A vacuum chamber has been designed for the pair spectrometer, based on experience with a similar chamber at Los Alamos. The chamber is equipped with three crystal counters for positrons and three for electrons. Preliminary runs indicate that with this chamber, which reduces almost to zero the background of positron-electron coincidences when the magnetic field is set too high for the most energetic gamma ray, successful accurate measurements can be made of, for example, the absorption coefficient for Be of 250 - 300 Mev gamma rays.

A preliminary test has been made to detect fission fragments from a thin uranium foil bombarded with gamma rays. It is quite possible to detect them, and work is now under way to see whether a "long" beam can be obtained at lower energies, so as to enable such counting work to be done at three-quarter or one-half energy.

The magnet group has completed accurate and extensive measurements of the field in the pair spectrometer magnet.

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

Pion Studies

A phenomenological calculation for the reaction $n + d \rightarrow \pi^- + p + d$ on the basis of charge symmetry is being extended to include interactions between nucleons in the final state.

The effect on cross sections for meson production of a meson-nucleon interaction in the final state is being investigated. It has been found that the kinematics of the process make detection of such an effect quite difficult. The study of meson-nucleon scattering in the radiation damping theory continues.

The values of resonance parameters to be used in a phenomenological study of photo-pion production have been determined so as to provide a best fit with current meson-nucleon scattering data.

Scattering

The angular distribution of high energy neutrons elastically scattered from nuclei is being investigated.

The energy distribution of the charge-exchange neutron beam produced by protons in the cyclotron is being investigated.

Work on high energy Compton scattering on nucleons has been completed, using a classical model of an extended nucleon source coupled to a pseudoscalar meson field. A symmetric theory gives rise to a resonance behavior in the cross section at $E_\gamma \sim 2\mu$ for $F^2/4\pi = 0.3$ and $0.3 < a\mu < 0.5$. The peak in the angular distribution moves from the forward to the backward direction as E_γ increases through the resonance energy. The effects of a neutral meson field plus Pauli moment have also been investigated.

The cross section and angular distribution for the reaction $d + d \rightarrow H_3 + p$ are being calculated.

Field Theory

Calculations of energies and state vectors in the Tomonaga approximation have been carried out on the CPC at Livermore. Applications to scattering are being studied.

Work on the meson-nucleon interaction via Schwinger's Green's function technique is continuing.

In the study of the scattering of low energy electrons in a Coulomb field, the relativistic equations have been reduced to three-dimensional form. It was found that the reductions made by other workers are ambiguous and not unique, and that the most natural kinematic assumptions lead to effective potentials of doubtful physical significance. It was decided to re-examine the four-dimensional formulation using various simplified models.

A study of meson-nucleon scattering and the related problem of photo-meson production is being based on a completely relativistic formalism which differs somewhat from the usual perturbation theory approach.

Accelerators

The theory of the fine-structure of the synchrotron beam measured by Madey, et al. has been re-examined. The spreading in phase as the electrons spiral toward the target is considerably less than originally thought, and the measured fine structure should give an accurate picture of the bunch just before the rf is turned off.

3. MTA TARGET PHYSICS PROGRAM (A.E.C. Program No. 9200)

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During the past month most of the cyclotron runs of the MTA Target Group were devoted to measurements of σ_{1n}, the cross section for producing one neutron, for 190 Mev deuterons and 340 Mev protons on uranium. The cross sections were about the same and were clustered near 30 barns.

The new recovery system for He^3 has been completed and installed in operating condition, and one short run made with the 4 percent He^3 to check the operation of the whole system. The 2-liter flask of 95 percent He^3 was emptied into the other parallel side of the recovery system, and since the initial quantities of the 4 percent and 95 percent He^3 were the same, the present pressures of the two gases (in containers of equal volume) afford a much more sensitive measure of the amount of 4 percent He^3 lost to date. This loss is about 5 percent, in perhaps 200 hours of equivalent cyclotron running, and is, as mentioned previously, definitely maximal, being largely due to insufficient pumping out of the lines from the recovery system to the cyclotron at the end of the various runs.

Tertiary condenser standards have been constructed and calibrations begun. It is planned to use these condensers as references to detect any changes in the condensers used during the experiments. These tertiary standards will be periodically checked against a secondary standard which is to be calibrated by the Bureau of Standards at regular intervals.

An experiment designed to measure the distribution-in-number of neutrons produced in thermal and high energy fissions, by means of a large tank of liquid scintillator and a fission chamber, has been started and most of the equipment built. It is planned to use the fission chamber pulse to trigger the sweep of the new Tektronix 517 oscilloscope, and record photographically the distribution of photomultiplier pulses due to radiative capture of the fission neutrons in the scintillator liquid.

4. ACCELERATOR CONSTRUCTION AND OPERATION

Bevatron Construction (Program No. 9001)

Magnet. At the end of the period winding of the pole bases was complete, lower pole bases had been installed in all quadrants and 70 pole tips had been assembled. Tip assembly is proceeding at the rate of about six slabs per day making the estimated finish date for this operation June 10. The edges of the plates facing the ion beam are being sandblasted to remove the enamel to ensure a conducting surface. Assembly of pole face winding supporting tubes has not started due to delays in receiving materials.

Magnet model measurements are complete and the test crew is now planning for the full scale tests to be made in August. A car is being designed to move search coils through the aperture of the quadrants.

Vacuum System. The second quadrant tank was installed on May 13 in the northeast quadrant. The north tangent tank has been vacuum tested and is now being prepared for the accelerating electrode installation. The problem of outgassing of the insulation inside the vacuum appears to have been solved by baking the material to complete its curing. Whereas the pressure of the unbaked material leveled off around 2×10^{-5} mm after a weeks pumping it now comes down to the base pressure of the bare tank of 4×10^{-6} mm in about three days.

Injector. Electrical installation work is continuing on the linear accelerator. The ion gun is operating well.

Accelerator. Installation of the accelerating electrode, reactors and power amplifier is proceeding. It should be possible to make preliminary tests around the first of May.

Schedule. A review of the schedule indicates that it is still possible to plan for the following dates:

Pump down complete system	July 1
Start magnetic tests	August 10
Look for beam	October 1

These dates are determined by the fastest rate at which construction can proceed with no delays in receipt of material or lack of manpower. They are the dates to which scheduling is being done. Some extension of these dates is, however, almost inevitable.

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

The cyclotron was used for research experiments approximately 92 percent of the 531 hours that the crew was on duty. The time distribution was as follows:

Operation for customers	489.00 hours	92.3 percent
Electrical troubles	12.00	2.3
Mechanical troubles (rotor bearings)	23.75	4.4
Miscellaneous	6.25	1.0
Totals	531.00 hours	100.0 percent

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

Continued work has been done with new feeler types with the aid of a remote removal system. Better target beam definition has been realized which adds to the flexability of the machine.

Beam intensity and operating conditions have been such as to fulfill all bombardment requests.

Synchrotron Operation. (Program No. 5731)

The synchrotron has continued its high performance operation during this report period.

Preparations for installing the electron linear accelerator as an injector for the synchrotron are continuing.

It has been necessary to disassemble the electron accelerator proper. This requires a considerable impedance matching before reassembly can be completed.

The spiral orbit meson spectrometers of R. Sagane and W. Dudziak have been used in an experimental set-up in the synchrotron beam. This magnet has a minimum amount of material in the iron yoke which creates considerable leakage flux. This leakage flux interacts with the synchrotron magnetic field, introducing magnetic irregularities at the orbit. It will be necessary to install shielding of some sort around the synchrotron in order to run successfully with the meson magnets. It is planned to mount all of the physics experimental magnets on trucks which will operate on rails. This rail system will connect the bombardment area of the synchrotron and the research laboratory in Building 68.

Successful pyrex donut section blanks have been molded by the glass shop.

An investigation has been made of powdered metallurgy cathodes. These cathodes containing tungsten or molybdenum with carbon and barium oxide appear to be able to produce high current cathodes.

Insulator geometry for the inflector system is still being investigated.

Operating statistics are as follows:

Operation for customers	308.0 hours	86.9 percent
Tests with the synchrotron	32.0	9.0
Maintenance	14.5	4.1
Totals	354.5 hours	100.0 percent

Linear Accelerator Operation. (Program No. 5751)

The total operating time of 480 hours was distributed as follows:

Running time (physics)	299 hours	62 percent
Research (machine)	74	15
Repair	100	21
Maintenance	7	2
Totals	480 hours	100 percent

5. CHEMISTRY

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

Americium Thermochemistry

The heat of the reaction

$$AmO_2^+ + 4H^+ + 2Fe^{++} = Am^{+++} + 2H_2O + 2Fe^{+++}$$

has been measured in 1 M perchloric acid solution with a few milligrams of americium. The results, after correction for auto-reduction of the americium, correspond to

$$\Delta H = -71.5 \pm 1.6 \text{ kcal/mole}.$$

Using the heat of oxidation of Fe^{++} and estimated entropies one obtaines E = -1.78v. for the formal oxidation potential of the half reaction

$$Am^{+++} + 2H_2O = AmO_2^+ + 4H^+ + 2e.$$

Separation of Berkelium from Americium

A fast method of separation of berkelium from americium is to oxidize the berkelium to the plus four state with sodium bismuthate and extract with tri-n-butyl phosphate. The solution is 1 M in nitric acid. Berkelium is extracted quantitatively, while the americium follows to the extend of 10 percent for each extraction with two washes.

Time-of-flight Isotope Separator

A new stainless steel tube for the time-of-flight isotope separator has greatly improved the performance, especially with regard to stability and reproducibility of the settings. The effect is due to the elimination of surface charges which collected on the oxide coated brass of the old tube. A larger diameter is also used.

Thulium Isotopes

The isotopes of thulium of masses 165, 166, and 167 have been separated with the time-of-flight isotope separator. Thulium 165 is a previously unreported activity with a half-life of 29 hours. Thulium 166 and Tm^{167} are the 7.7 hour and 9.6 day activities previously reported. The decay curve of the sample from mass 166 shows a longer lived component which is probably due to contamination by Yb^{166} which is produced in high yield in the bombardment and which is ionized more efficiently than thulium.

The radiations of Tm^{167}, produced in pure form by milking from Yb^{167}, have been studied with the gamma scintillation counter. Five gamma rays are found:

Energy (kev)	Relative abundance
49	1.00
115	0.02
202	.29
515	.09
720	.18

Metals and High Temperature Thermodynamics

Work is in progress on the following problems: refractory silicides, molybdenum chlorides, alkaline earth oxide gases, carbon fluorides, and the thermal conductivity of gases at high temperatures.

Basic Chemistry

The following problems are under investigation: studies involving liquid ammonia as a solvent, the thermodynamics of indium, ferric fluoride complex ions, the hydrolytic polymerization of zirconium, the thermodynamics of sulfide ion (See UCRL-2108), the oxidation-reduction chemistry of $RuO_4^{=}$, RuO_4^{-} and RuO_4, (Work completed. Results to be published shortly.), a study of hydrates, the thermodynamics of thiosulfate, and bromate thermodynamics.

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, the mass transfer in agitated liquid systems, gas phase mass transfer studies, and the thermal diffusion in liquids.

Health Chemistry

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

1. Equipment to be used in mass analysis work on materials from Livermore projects is complete and ready for assembly.

2. Equipment to be used in processing large quantities of special soil is essentially complete. The first steps in the process are actually under way.

3. Parts for the low geometry counter to be used in Laboratory 107, Bldg. 5 (Cave Room) are completed and ready for assembly.

4. Preparation of equipment for opening and dissolving irradiated sample from the Idaho Falls reactor is essentially complete. The slug itself was prepared, loaded and shipped to Idaho during this period.

5. The shield for use with beta-radiation spectrometer pippette is complete.

6. A furnace box for use in processing bombarded mesothorium was completed.

7. The Berkeley Box group prepared and delivered nine gloved boxes on special request, did routine repair and maintenance of gloved boxes and auxiliary equipment and centrifuges. This group lined 120 feet of airduct used in conjunction with the soil processing in Point 2 above.

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

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Biological Effects of Radiation

X-ray Studies. Thiolethylamine has been observed to protect Long Evans rats, of both sexes, when it is administered after irradiation provided the liver is shielded during the irradiation. This is in confirmation of the original experimental work of J. Maisin of Belgium. This verification is contrary to a previous report (See monthly report February 15 - March 15, 1953).

Yeast Studies. The more radiation resistant fraction of the haploid yeast cells (reported in monthly progress report January 15 - February 15, 1953) was observed to have a multiple hit type survival curve. Studies of radiosensitivity versus stage of cell division are planned to ascertain the nature of the cellular changes contributing to the increased radioresistance.

Tetraploid yeast obtained by mating newly obtained cells with different biochemical labels were studied. These new tetraploid yeast were found to have survival curves similar to the tetraploids studied earlier. The tetraploids were more radiosensitive than diploids observed previously. This consistency in results supports the view that the effects earlier observed are a general phenomenon.

An investigation of the effect of hydrostatic pressure on the radiosensitivity of yeast has been undertaken. Working with neurospora, W. McElroy has shown that 10,000 P.S.I. applied after treatment with ultraviolet or nitrogen mustard inhibits the appearance of certain mutations.

A. Sparrow opines that x-ray breakage of the chromosomes of trillium must involve the rupture of the protein backbone of the chromosome - such a reaction would be similar to ordinary protein denaturation, or perhaps would involve a gel → sol transformation. In either case, a large molecular volume change occurs, and the process would be expected to be pressure sensitive.

Experiments employing various combinations of temperature and pressure before, during and after irradiation with 50 kv x-rays are in progress. The results so far indicate that the radiation sensitive sites of resting haploid yeast (SC-7) are neither protected nor made vulnerable by application of pressures up to 10,000 P.S.I.

Iron^{59} Studies

A method which may be of value for approximate determination of the erythrogenesis rate in experimental animals as compared to control animals has been and is being used. It is not a true iron turnover procedure but attempts to combine data from five different tissues. Sampling of plasma and whole blood is done serially after labeling the plasma iron. Within ten to fifteen minutes time of his minimal whole blood radioactivity the animal is lightly anesthetized with ether, the major portion of his blood volume is removed, the vasculature is perfused with 0.9 percent sodium chloride solution. The radioactivity in each of the following at this minimum point on the blood radioactivity graph is recorded as a percent of that of the whole rat.

1. Entire liver
2. Spleen
3. Carcass stripped of thoracic and abdominal organs (essentially bone marrow, bone muscle, nervous system, integument)
4. The removed viscera
5. Blood (the normal rat, unlike the normal human being, in all those studied exhibits so prompt an appearance of labelled cells in the blood that at the minimum the blood contains 12 to 18 percent).

The radioiron is bound in vitro to fresh plasma from a rat of the same highly inbred strain. The iron binding capacity of an aliquot of plasma is determined by titration with a standard iron solution. The serial samples of whole blood and plasma are taken in calibrated glass capillaries and assayed in a gamma-flourescence

counter. The plasma volume and blood volume are easily determined. The time at which the whole blood radioactivity exceeds that of plasma may be as early as three hours in a normal rat. It occurs much later in some experimental animals by other means known to have a longer maturation time of erythroid cells. The ratio of carcass radioactivity to liver radioactivity at minimal blood tracer concentration differs between control and such experimental animals. But factors other than differences of erythrogenic function are being considered before assuming that this is always of significance.

Tracer Studies

The studies on the removal of curium from rats by the use of the chelating agent Versene and the relative biological effects of alpha and beta emittors based on sodium space are being continued. Experiments on a means of deposition of aerosols in the lungs of primates are in the final stages of development.

Radiation Chemistry

The effect of specific ionization on radiation yields in acetic acid solution is being studied. Analytical procedures are being developed for the determination of volatile products.

Organic Chemistry

Research work has been continued during the past month on the following subjects: (1) Determinations have been made of the amounts of self-irradiation which have occurred to various C^{14}-labeled compounds since their times of synthesis. Similar determinations are being made for organic compounds exposed to heavy doses of γ-radiation. (2) An investigation is being carried on to find a suitable procedure for preparing S^{35}-labeled thioctic acid. (3) Methods of synthesize C^{14}-labeled diethyl malonate, palmitic acid, cholic acid, morphine and various peptides are being studied. (4) Chemical degradations of ribulose and sedoheptulose are under investigation.

Animal Biochemistry

Research in animal biochemistry has taken place on the following topics: (1) C^{14}-labeled adenine is being used to determine the turnover rates of nucleotides and nucleic acids in mice. (2) C^{14}-labeled glucose is being used to determine the "glucose space" in the dog. (3) The differences between lathosterol and cholesterol metabolism in atherosclerotic rabbits are being determined. (4) The sodium acetate metabolism of pantothenic acid deficient rats is being studied.

Plant Biochemistry

The main projects underway in the studies which are being made on the nature of plant photosynthesis are the following: (1) The "steady-state" reservoir sizes of important algae metabolites are being determined. (2) A flow system is being employed to determine the compounds into which radiocarbon is incorporated

during very short periods of photosynthesis. (3) The role of 6-thioctic acid in the transfer of light energy to chemical energy in photosynthesizing plants is under investigation. Syntheses of S^{35}-labeled thioctic acid are being made by means of an exchange reaction of the unlabeled compound with radioactive sulfur. (4) A search is continuing for the important sulfur and phosphorus containing metabolites of plant photosynthesis.

7. PLANT AND EQUIPMENT UNCLASSIFIED

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

All of the lower pole bases have been installed. The second curve tank has been permanently placed in the magnet. Approximately 50 percent of the steel for the pole tips has been delivered. On week of the 23rd, assembly of pole tips began and approximately 25 percent of the pole tips have been assembled. Three or four tangent tanks are now installed. The accelerator electrode has been fabricated. The injector is approximately 80 percent complete.

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

The general contract for Building No. 70 was signed and recorded on April 14. Swinerton and Walberg, the General Contractors, were located on the construction site on April 13. Ariss-Knapp, the Grading Sub-contractors for Swinerton and Walberg, started the grading contract on April 15. The other contracts for Building No. 70 are presently being processes by the University agencies.

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

The building is presently being reconsidered by the Bureau of the Budget.

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

Working drawings and specifications are being prepared for the construction of the Gamma House and Destructor, and these should be completed in the near future. Specifications and drawings have been completed for the sprinkler system for Building No. 14 and work will be started in the near future.

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MAN-MONTHS EFFORT REPORT

SCIENTIFIC PERSONNEL

Program No.	Subdivision	Man-Months Effort	Comments
Operations			
4000 M. T. A.	Design and Development	18.64	
5211 Basic Physics Research	General Physics Research	53.00	
	Theoretical Studies	15.39	
	Film Detection	15.08	
	Cloud Chamber	10.75	
	Magnetic Measurements	2.55	
	General Instrument Design	6.94	
		103.71	
5261 Applied Physics Research	Special Cyclotron Development	.10	
5311 Basic Chemistry Research	Chemistry of Heavy Elements	3.99	
	Nuclear Properties of Heavy Element Isotopes	6.65	
	Transmutations with 184-inch and 60-inch Cyclotrons	3.83	
	Analytical and Services	22.66	
	Mass Spectroscopy, Beta Ray Spectroscopy	1.50	
	Instrument Development and Services	3.82	
	X-Ray Crystallographic Measurements	2.83	
	Radiation Chemistry	1.00	
	High Temperature and Special Chemistry	6.50	
	Health Chemistry Research	8.45	
		61.23	
5361 Applied Chemistry Research	Process Chemistry	5.18	
5731 Electron Synchrotron	Operations	9.44	
5741 184-inch Cyclotron	Operations	10.90	
5751 Linear Accelerator	Operations	19.67	
5761 Bevatron	Operations	2.24	

MAN-MONTHS EFFORT REPORT

SCIENTIFIC PERSONNEL

Program No.	Subdivision	Man-Months Effort	Comments
6300 Biology and Medicine	Health Medicine	2.00	-
	Metabolic Ward	-	-
	Internal Irradiation	5.13	1.72 Consultant Man Months
		7.13	
6400 Biological Research	Miscellaneous	3.30	2.02
	Instrumentation	2.21	-
	C_{14} Metabolism	5.27	.22
	Use of Radioactive Material in Human Physiology	11.68	3.74
	Trace Elements	3.25	.50
	Physical Biochemistry	12.23	3.85
	Biochemical Response to Radiation	4.13	.48
	Metabolism of Lipo-proteins	5.82	10.60
	Iron Metabolism Hematopoises	3.84	.48
	Biological Effects of Cosmic Radiation	2.29	.12
	Radiation and Mutation Rate	2.10	.25
	Bio-organic Chemistry	26.30	-
	Metabolism of Fission Products	16.44	-
	Animal Colony	3.00	2.97
6500 Biophysics Research	Health Physics	4.46	-
	Irradiation Studies	3.70	1.13

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