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UNIVERSITY OF CALIFORNIA
Radiation Laboratory
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MONTHLY PROGRESS REPORT NO. 118
January 15, 1953 to February 15, 1953
March 6, 1953

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RESTRICTED DATA

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Berkeley, California

UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

January 15, 1953 to February 15, 1953

MONTHLY PROGRESS REPORT NO. 118*

March 6, 1953

1. EXPERIMENTAL PHYSICS
(A. E. C. Program No. 5211)UNCLASSIFIEDFast Deuterons from 340 Mev Protons on Carbon

It has been decided to use the 35 channel magnetic particle spectrometer already described in these reports to investigate the energy spectrum of deuterons having energies above 20 Mev produced when 340 Mev protons bombard various elements. The first experiments will be done looking at deuterons at 40° to the beam direction. Few deuterons from the pick-up process should be seen at this angle. However, a second order process called the indirect pick-up process can contribute deuterons at this angle. The deuteron energy spectrum should be peaked at about 50 Mev. The magnetic particle spectrometer separates particles according to their momenta. Deuterons and protons having the same momentum differ in range by about a factor of five. They can easily be separated by introducing a wedge-shaped absorber into the spectrometer which will absorb the deuterons.

A preliminary run indicated that there are few, if any, deuterons having energies above 100 Mev but that deuterons were present in the energy range 40 to 150 Mev. Probably about 10 percent of the counts in momentum channels corresponding to these energies were deuterons.

Internal Momentum Distributions

The 35 channel scintillation counter rack has been completed and tested in several runs. Certain modifications have been made in the associated gated amplifiers to convert them from geiger to phototube operation. Timing difficulties have been overcome by adding 1.3 microsecond delay boxes to each channel. The scattered incident proton and the proton knocked out of the nucleus have been detected in coincidence using a quadruple coincidence circuit with a resolving time of 3×10^{-9} sec. developed by R. Madey. One crystal in the spectrometer arm is made one-fourth inch wide to serve as the defining slit.

Rough data have been obtained for polyethylene, lithium, beryllium, and carbon with the method of observing one partner in the collision only. These indicate that the 35 channel detection efficiencies must be made more uniform.

* Previous report UCRL-2106 (No. 117).

The Triton Reaction ($p + d \rightarrow t + \pi^+$)

Further data on the angular distribution of the reaction $p + d \rightarrow t + \pi^+$ were obtained in a two-day run this last quarter. Preliminary results for pion angles of 30° , 50° , 70° , 90° , 130° , and 150° in the center of momentum system show a peak in the forward direction and a flat distribution in the backward direction. The ratio of $d\sigma/d\Omega (0^\circ)/d\sigma/d\Omega (90^\circ)$ is about six. The estimated total cross section is around five microbarns.

Ruderman has calculated an angular distribution by viewing the reaction as a two-step process: first, a $p + p \rightarrow d + \pi^+$ reaction occurs between the incident proton and the proton in the deuteron; second, the newly formed deuteron picks up the left over neutron to form a triton. The first step imposes a $\cos^2\theta$ -type distribution, while the second reduces the backward peak relative to the forward peak. This asymmetry comes from the internal momentum distribution in the target deuteron. Bludman is continuing the theoretical analysis; he thinks that by using a hard core model of the nucleon, the deuteron internal momentum distribution might be modified in such a way as to flatten out the backward peak.

High Energy Gamma Ray Spectroscopy

A run was recently made on the synchro-cyclotron with the pair spectrometer modified so as to cover photon energies from 10 Mev to 200 Mev. The target was carbon and the particle beam was protons.

The data from this apparatus are still on a tentative basis as the various characteristics of the apparatus are being identified. In the recent run the π^0 gamma spectrum from 340 Mev protons was examined from 10 Mev upwards in energy and provides a continuous band of analyzed photons from the region of nuclear gamma rays up to the region of π^0 gamma rays. A strong nuclear line was observed between 15 and 18 Mev, which can presumably be associated with the 17 Mev photons from the excited lithium nucleus.

The proton target was subsequently placed at smaller cyclotron radius, below the π^0 threshold, and the bremsstrahlung spectrum from bombardment by 150 Mev protons was analyzed. The nuclear gamma line referred to above was again seen, superimposed on what may be a characteristic bremsstrahlung spectrum whose intensity is regularly decreasing with increasing energy.

The Photoproduction of Negative Pions from Deuterium

The negative pions and protons were detected in coincidence. Two pion counters and one proton counter were connected in triple coincidence with a resolution time and a dead time of 3×10^{-9} seconds. The laboratory proton counter angle was 20° , and the laboratory pion telescope angle was 120° . The proton counter was 31.5 in. from the target and the second pion counter was 14.3 in. from the target. This geometry allows the relatively slow protons to be separated from the $\beta = 1$ electron background by time-of-flight dispersion.

Targets of CD_2 , CH_2 and C were designed to contain an equivalent number of carbon atoms. Copper absorber was used in the pion telescope to stop low energy charged particle background and to increase the energy loss of the pions. When this absorber was placed in front of the pion telescope, both the $CD_2 - CH_2$ and $CH_2 - C$ difference counting rates were found to be real. The $CD_2 - CH_2$ difference counting rate corresponds to bombarding the neutron with a γ -ray and making a proton-negative pion coincidence. The $CH_2 - C$ difference corresponds to bombarding the proton with a γ -ray and making a proton-photon coincidence. This latter process has very nearly the same angular correlation as that for the proton and negative pion. When the copper absorber was placed between the two pion counters, then the $CH_2 - C$ difference counting rate nearly disappeared while the $CD_2 - CH_2$ difference counting rate remained the same. The reason is that the photon cannot be converted by the copper absorber until after it has passed through the first pion counter without causing a coincidence. The first counter is a very small fraction of a radiation length, while the thickness of the copper absorber varies for the conditions of the experiment from one to two radiation lengths; hence, very few γ -rays are converted in the first pion counter.

The pion scope "feed-through" problem, discussed in the penultimate quarterly report, has been eliminated by a slight modification of the coincidence circuit.

The high energy end of the negative pion spectrum has been studied. These data are now being analyzed in detail to see if a measure of the nucleon spin flip probability in the reaction $\gamma + D \rightarrow \pi^- + 2P$ can be ascertained.

Production of Tritons in Deuteron-Deuteron Collisions

An attempt was made to obtain the angular distribution for the reaction $d + d \rightarrow H^3 + p$ at the center-of-mass angles 30° and 15° . Data were obtained at 30° but the background at 15° proved to be too high. This background is presumably a high neutron flux from stripping processes in the collimator. It is felt that better geometry can overcome the situation.

Elastic Proton-Deuteron Scattering Using 345 Mev Protons

This experiment is now well enough along so that at least at some angles reliable data can now be taken. The two counters whose pulse heights represent dE/dx and E respectively give good separation of deuterons from protons when their pulses are recorded on photographic film. The use of a fast oscilloscope allows moderate counting rates with very small accidental coincidence rate. The wedge shaped absorber placed in front of the deuteron counters allows all the deuterons from elastic p-d scattering to reach the counters with the same energy, making for greatest ease of distinguishing the desired deuterons from those deuterons that result from carbon in the deuteropolyethylene targets.

Many data are not yet read from the films exposed during the last run. However, a tentative center of mass cross section for 70 degrees (center of mass angle) can be reported as $(0.028 \pm 0.009) \times 10^{-27} \text{ cm}^2 \text{ sterad}^{-1}$.

Proton-Proton Scattering at Small Angles (160 to 250 Mev)

No additional work with the cyclotron has been possible during this period during which the counters have been altered considerably. At the same time the liquid hydrogen target has been in use for other purposes.

Neutron-Proton Scattering at Small Angles (90 and 270 Mev)

The thin counter mentioned in the last monthly report is partially completed, and the large steel billet to be used for extra shielding is believed nearly finished in the shop. No further experimental work has been done in the neutron beam.

Search for Stable Tc

Some more Kennecott residues have been studied, with negative results. Some work is also in progress to determine the best separation method under various conditions.

Fission of Uranium Induced by π^- and μ^- Mesons

Details of this work (done partly by W. F. Fry of the University of Chicago) should soon be available in UCRL-2113, which is being submitted to the Physical Review.

One of the results believed significant is that the probability of fission following μ^- capture is quite comparable with the probability following π^- capture.

Beta Ray Spectrometer

All but a few minor drawings of the 180° focusing beta ray spectrometer for the linear accelerator have been completed. The shop is working on most of the parts for the vacuum box and the pole faces are finished. An aluminum stand formerly used by Val Ashby has been revised to take the beta ray spectrometer. The top of this stand has a very precise three-dimensional movement. At present the magnet yoke, coils and pole faces have been assembled. A vacuum system for pumping out the spectrometer and its counters has been assembled and is now being checked for leaks.

In connection with the proposed experiment on double scattering, a housing for a crystal counter and a proportional counter has been started in the shop. Several other parts necessary for this experiment are being designed.

Time of Flight Neutron Spectroscopy

The time of flight instrumentation has been employed in measuring the total cross section for lead. The results show a very close agreement with the recently published results at Harwell; i. e., the "dip" and/or "rise" in the vicinity of 70 Mev have been obtained.

The difference in cross section between the minimum and maximum is about 10 times the standard deviation at either point. The energy spread is somewhat less than that used at Harwell.

Arrangements are being made to run total cross section curves for uranium, bismuth, and tantalum.

Film Program

Meson Spectrometer Magnet Development. Effort has been placed in designing and measuring several magnetic field shapes for the 22-inch meson spectrometer. From the field plots, orbits will be examined to determine their stability and momentum resolution. Similar work has been done with the 14-inch Mozely magnet in connection with the research of high energy beta ray spectra.

Gamma Rays from Carbon Bombarded with 330 Mev Photons. An initial experiment to investigate the total spectrum of γ -ray energies emitted from a carbon target when bombarded by the 330 Mev bremsstrahlung beam has been undertaken. To date, the gamma rays that have been observed at 90° to the beam direction can be primarily attributed to the decay of π^0 mesons.

Disintegration Products of Nuclei under High Energy Bombardment. Analysis of the angular distribution of secondary particles from Be, Al, Ni, Ag, Au, and U under bombardment by 240 Mev alpha particles is nearing completion. All secondary particles up to C^{14} are being considered.

Relativistic Increase in Ionization. Comparison of the grain density of 2.8 Mev and 293 Mev electrons in emulsion has provided a precise measurement of the ratio of the saturation ionization (Fermi plateau) to minimum ionization. We find a ratio $g_{pl}/g_{min} = 1.087 \pm 0.014$. The standard deviation of the grain count distribution at 293 Mev is significantly larger than that at 2.8 Mev. The interpretation of the ratio depends on assuming that the grain density and ionization are proportional. Some uncertainty still exists in this assumption because of possible contributions to the grain density by secondary processes. These may be more important for electrons than for heavy particles.

Range-Energy Curve for Protons in Emulsion. An improvement in the range-energy curve for high energy protons has been made. From the meson mass data, as a by product, the range of 33.6 Mev protons is obtained. This reliable point together with the mean ionization potential, $\bar{I} = 270$ ev, for the emulsion enables one to compute a range-energy curve to 50 Mev or more with an error which is probably less than 0.5 percent.

Cloud Chamber Studies

A run was made at the linear accelerator using the 16-inch penta-graph-type cloud chamber filled with helium in the 32 Mev proton beam. One of the purposes of the run was to determine optimum collimation procedure.

Collimation was accomplished by an iron magnetic shield which contained brass collimators with 1/8-inch holes. Inside the cloud chamber was a brass disc with a 7/16-inch hole; the purpose of this is to remove spray from the beam. The beam was monitored continuously by an ion chamber placed between the exit end of the collimator and the cloud chamber thin window. This allowed the linear accelerator operators to tune up at all times except during pulses. During the tuning, the beam was stopped by a lead window interposed between the ion chamber and the cloud chamber. This collimation arrangement resulted in improved background conditions.

A volume-controlled rectangular cloud chamber has been assembled, in preparation for testing.

Work on the clearing field, top glass, and coolant pumping system of the 35-atmosphere diffusion chamber is progressing.

An automatic film-developing attachment for one of the short-focal-length cameras has been designed and is almost ready for testing.

Synchrotron Studies

During this period an extensive run measuring coincidences of protons and photo π^- mesons from deuterium was finished. A particular search was made for evidence of the spin-flip process in which the proton energy would be somewhat higher than in the normal non spin-flip process. A good deal of theoretical work will have to be done in order to interpret the experimental results and consequently no further runs will be done until this comparison with theoretical calculations has been made.

The pair spectrometer is being used to measure the absorption coefficient for high energy γ -rays (250 to 300 Mev) of hydrogen. It is proposed that this be done by a subtraction of the results with benzene from those with cyclohexane. This should provide information concerning the pair production cross section of the electron.

A run has been made to look for the resonant scattering of γ -rays in the 15-30 Mev region. It seems possible that the use of a pulse height analyzer with a NaI crystal will give some valid results. The Film Group has also started some similar measurements.

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

UNCLASSIFIED

Pion Studies

Ruderman's cross section for the reaction $p + d \rightarrow \pi^+ + t$ has been recalculated with a hard core in the deuteron wave function and an improved triton wave function. The agreement with experiment is now satisfactory.

A 90° spectrum for the production of positive pions by 341 Mev protons on complex nuclei has been calculated using the $p + p \rightarrow \pi^+ + d$ excitation function.

A phenomenological study of photo-pion production involving the treatment of P-states of the meson by the resonance formalism has been undertaken.

The calculation of π^- meson production in n-d collisions is being concluded.

Scattering

Compton scattering on nucleons is being investigated using the classical model of an extended nucleon source coupled to a pseudoscalar meson field.

The energy distribution of the charge-exchange neutron beam, produced when the protons in the cyclotron impinge on a target, is being investigated.

The total neutron cross section as a function of element and energy is being investigated. A tentative calculation, using an energy dependent potential well, yields a fair agreement for lead in the energy region 20 - 140 Mev.

Field Theory

Work on the Tomonaga intermediate coupling scheme is continuing.

Calculation of the radiative corrections to meson-nucleon scattering in the radiation damping theory continues.

Meson scattering and related problems using pseudoscalar theory with gradient coupling are being investigated.

Work has been concluded on the enumeration of Feynman diagrams.

The problem of the scattering of low energy electrons on a Coulomb field is being continued.

Work on the meson-nucleon interaction via Schwinger's Green's function technique is continuing. The first order adiabatic potential for the isotopic spin 3/2 state has been calculated and approximate solutions to the homogeneous wave equation are being investigated. In particular, interest centers about the possibility of the existence of bound states that would represent a model for isobars.

Accelerators

The problem of determining the shape of the bevatron inflector electrode to provide a sufficiently uniform field in the channel has been completed. In the narrow tip of the inflector it is necessary to add certain ridges to the high voltage electrode above and below the beam while in the main body of the inflector a flat electrode should be sufficient. Also the tolerance on the deviation of the faces of the bevatron accelerating electrode from parallelism, found in UCRL-547 to be quite stringent, has been reconsidered by a different method which again leads to the same result.

3. ACCELERATOR CONSTRUCTION AND OPERATION
(A. E. C. Program No. 9500)

Bevatron Construction

Magnet. At the end of the period approximately 60 percent of the pole base slabs were completed and their installation was starting in the south-east quadrant. The first shipment of enameled pole tip plates was received on February 4th. It is expected that pole base assembling will be finished and enough of the pole tip plates received to start assembling pole tips about March 15th. Design of the pole tip winding is being changed to increase the mechanical support of the conductors by running them through stainless steel tubes. This will permit the use of higher currents to increase the width of useful field at high energy. Without correction the field width is only 9 inches between $n = 0.8$ and $n = 0.5$. Calculations indicate that pole face winding currents to the order of 1,000 amperes can increase this width to about 20 inches. This may be important in connection with deflecting systems.

Vacuum System. The first tangent tank installed has been pumped down to 3×10^{-6} mm with the castings and insulation to be installed in the quadrant. The bare tank has come down to 2×10^{-6} and no air leaks have been found. The second tangent tank has been installed in the north tangent section and pumps and other parts are being attached to it.

Injector. Sections of the new Cockcroft-Walton high voltage supply for the ion gun have been tested and operated satisfactorily. Completion of the ion gun and linear accelerator for test is waiting on completion of wiring and electrical installation.

184-inch Cyclotron Operation (Program No. 5741)

The cyclotron was used for research experiments approximately 97 percent of the 496 hours that the crew was on duty. The time distribution was as follows:

| | | |
|-------------------------|--------------|---------------|
| Operation for customers | 483.50 hours | 97.6 percent |
| Electrical troubles | 2.00 | 0.4 |
| Mechanical troubles | 4.25 | 0.9 |
| Other | 6.25 | 1.1 |
| Totals | 496.00 hours | 100.0 percent |

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

The operation of the 60-inch cyclotron has been usually good this month averaging 85 percent operating efficiency.

Synchrotron Operation. (Program No. 5731)

Synchrotron operations were very reliable with a high intensity beam output.

The electron linear accelerator has been used for physics bombardments. Preparations for using this accelerator for an injector on the synchrotron are under way. Also attempts are being made to improve the beam focusing on the electron linear accelerator.

Operating statistics are as follows:

| | | |
|------------------------------|-------------|---------------|
| Operation for customers | 223.0 hours | 76.2 percent |
| Tests with synchrotron | 25.0 | 8.5 |
| Maintenance and installation | 44.8 | 15.3 |
| Totals | 292.8 hours | 100.0 percent |

Linear Accelerator Operation (Program No. 5751)

The total operating time of 416 hours was distributed as follows:

| | | |
|--------------|-----------|-------------|
| Running time | 339 hours | 82 percent |
| Maintenance | 58 | 14 |
| Repair | 19 | 4 |
| Totals | 416 hours | 100 percent |

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

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Level Schemes of Heavy Even-Even Nuclei

The study of the fine structure of alpha spectra by means of the magnetic alpha ray spectrograph has yielded considerable information concerning the energy level schemes of the heavy even-even nuclei. There is a good correlation in several cases at least between the observed spacings of the three lowest levels and those calculated for a simple rotation; i. e., the levels are proportional to $l(l + 1)$ where l (the nuclear spin) is 0, 2, and 4.

Decay of Am^{242m}

A sample relatively rich in the 16-hour isomer of Am²⁴² has been produced by irradiation in the Arco pile. This activity is said to decay by isomeric transition, beta decay, and electron capture on the basis of extensive beta and x-ray spectroscopy. These measurements were repeated with the new sample. Certain discrepancies in the X-ray intensities cast doubt on the origin of the americium X-rays which are the basis for reporting the isomeric transition. These X-rays are probably due, at least in part, to fluorescence of americium induced by the curium X-rays following beta decay. It is therefore not certain which isomer of Am²⁴² is the ground state.

2. The first high-level bombardment from the Idaho Falls reactor, equipment for which has been described previously in the last monthly report and the July-September 1952 Quarterly Report, was processed satisfactorily. Disassembly of the six-inch and two inch caves has taken place and the areas are now ready for the setting up of subsequent experiments of this nature.
3. Processing of the Idaho-Falls-bombarded ionium sample, described previously, has been started.
4. Work continues on special equipment for use in gloved boxes for special analytical experiments to be done at Livermore.
5. Plans for the building and the equipment to be used in processing large quantities of soil samples have gotten under way; equipment completed to date include special handling tongs, teflon and glass cones; a platinum fuming vessel box and a general column chemistry box.
6. Improved equipment or models for use in the two-inch lead shield which have been completed during this period include a fume hood model, a centrifuge box layout, a ball-and-socket system and a two-piece tongs assembly, a new door system layout, a chain-drive manipulator tong connection, and improved molds for making spiral socks for tong shafts and berets for ball-sockets, made of teflon, for prevention of passage of contamination outside the box and shield.
7. Ten gloved boxes were prepared and fitted for use on request during this period.

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

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Nucleic Acid Studies

The incorporation of P-32 into the nucleic acids of tumors is being investigated at various time intervals after irradiation. Preliminary results suggest that the percentage depression in desoxypentose nucleic acid formation is lower for a mouse mammary carcinoma than for most of the normal tissues of the mouse. Tumor pentose nucleic acid formation is depressed by irradiation in contrast to liver pentose nucleic acid which is unaffected or increased.

Iron Turnover Studies

Work is continuing with iron turnover studies and analysis of the data collected. Further investigation of the change with age in the rate of plasma iron turnover is planned. From cursory inspection of data from the small number of normal subjects, there appears to be a decline with age (24 to 72) in the quantity of iron entering and leaving plasma per unit time. It is possible that the greater plasma iron turnover rate in males in the 24 to 35 age group, as compared with that of the 35 to 72 age group, is partially related to a change in muscular activity. Other studies which would be of value and which should be undertaken are further studies in normal females from pre-puberty through post-menopausal age.

Biological Effects of Radiation

The lethality of head irradiation on mice is being studied with the 184-inch cyclotron.

The effect of large and small radiation fields on nerve tissue is also being studied chiefly to determine the radiation resistance of nerve fibers compared to the body of the nerve cell and with special reference to the relative biological effectiveness of heavy particle irradiation.

Effect of X-rays on the Frog Retina. A study of the effect of x-rays on the retina was completed. Particularly the visual response to small doses of x-rays were studied. Measurements were made for the threshold intensity of the bull frog needed to elicit a light stimulus and the adaptation and recovery after small doses of x-rays. It was found that electrical response could be measured on the retina after 0.6 r, that during exposure to x-rays the sensitivity to light was reduced, and that recovery of the retina after an x-ray stimulus was slower than after a light stimulus. This recovery phenomenon indicates that the effect is to a large extent reversible and the phenomenon is one of the smallest reversible responses observed today with penetrating radiations. A detailed report will be issued.

Radiation Sensitivity and State of Cell Division. In previous monthly progress reports we have reported that haploid yeast cells show a diphasic survival curve. Ten percent of the cells are much more resistant to x-rays than the majority of the population. It was shown that the cells become resistant when they exhibit a visible bud, that is during the cell division process. A new process was developed to get most of the cells in the same phase by keeping them in a medium lacking nitrogen source but supplied with glucose. After several hours in this medium most of the resistant cells disappear and all the cells show uniform radiosensitivity.

Following the above pre-treatment, the cells can be placed on a nutrient medium. They start dividing and arrive at the first cell division more or less in phase. Two hours after placing the cells in a nutrient medium as

much as 55 percent of the cells are found in the resistant stage exhibiting approximately seven times greater radiation resistance (50 percent LD 21,000 instead of 3,000) than those in the resting stage. It is hoped that this technique will enable us to study the biochemical and biophysical factors which make the yeast cells resistant during cell division.

Experiments with Trace Analysis

A method was developed to separate Cu, Gallium and Zn on Dowex-1 resin. A study of Cu metabolism is beginning using carrier free Cu.

Tracer Studies

Studies upon the removal of curium by the use of Versene in rats is continuing. The relative biological effects of beta and alpha emitters is being studied. Work on the deposition of aerosols in the lungs of primates is progressing.

Radioautography

Studies concerning astatine²¹¹ are being continued.

Radiation Chemistry

Studies of the radiolysis of aqueous acetic, amino acetic and formic acids are being continued.

Organic Chemistry

Studies have been made on the extent of the radiation decomposition of several C¹⁴-labeled organic compounds which has occurred since the time of syntheses. Varying amounts of decomposition have been found in the cases of valine, norvaline, norleucine, choline chloride, calcium glycolate and cholesterol. No discernible decomposition has been observed in C¹⁴-labeled glycine, guanine, azaguanine, adenine, azaadenine, stilbamidine, thyroxine and succinic acid. Attempts are being made to correlate the effects of the self-irradiation of these compounds with the effects observed after irradiation with comparable doses of γ -radiation from a Co⁶⁰ source.

The synthesis of sodium heptanoate-7-C¹⁴ has been completed. This compound was prepared in 30 percent overall yield from C¹⁴O₂ by the addition of labeled methyl iodide to dihydroresorcinol, followed by alkaline splitting of the methyl derivative and reduction of the keto acid to the desired heptanoic acid.

Studies have continued to find methods to synthesize C¹⁴-labeled thioctic acid, morphine, codeine and cholic acid.

A large-scale synthesis of Δ^7 -cholestenol is still in progress.

The chemical actinometry of a new 110 curie Co^{60} γ -ray source has been completed. This source is being used to determine the chemical effects of the radiation on choline and pyrrole aldehyde.

Work is continuing on the chemical degradation of ribulose and sedoheptulose.

The synthesis of sodium pyruvate-2- C^{14} has been completed. This compound has a specific activity of 18 $\mu\text{c.}/\text{mg.}$ and was prepared in 10 percent overall yield from C^{14}O_2 via the labeled intermediates acetic acid, acetyl chloride and pyruvitrile.

Animal Biochemistry

Research is in progress to determine the effect of heparin on the rate of metabolism of fatty acids and other compounds.

Studies are continuing on the metabolism of adenine in mouse liver slices.

Plant Biochemistry

Investigations are in progress which are designed to determine if the pyruvic acid oxidase factor (thioctic acid) is involved in the conversion of light energy to chemical energy in green plants.

Studies are underway on the effect of thioctic acid upon the rate of the Hill reaction.

Separations of phosphorus-containing algae metabolites are being carried out on ion-exchange columns and measurements are being made of the distribution of radioactivity in these compounds.

Determinations are being made of the chlorophyll-sulfur ratios in various green algae constituents.

The search for photosynthetic intermediates is being continued.

6. PLANT AND EQUIPMENT UNCLASSIFIED

Bevatron Instrument. (Project No. 9500. 5-271-9001)

Eighty-eight percent of the pole bases have been completed. All lower pole bases are installed in the first quadrant and the first curved tank is to be installed permanently as soon as the final positioning of the bases is complete. The top and bottom panels are finished for the second and third curved tanks. As soon as the first tank is finally installed, the internal bracing can be removed and the second tank can be completed. Pole base retaining hardware has been installed in the fourth quadrant. East and north tangent tanks have been installed. The enclosure for the accelerating electrode controls has been installed in the central pit.

Chemistry Laboratory Building. (Project No. 9500. 5-271-1002)

Bids are to be solicited on Friday, February 20, 1953.

Electronics Research Building. (Project No. 9500. 5-271-2002)

Preliminary proposal is to be sent to AEC by February 20, 1953.

Miscellaneous Construction. (Project No. 9500. 5-271-2001)

- a) Fireproofing 12 kv line from campus - 100 percent complete.
- b) Paving between Buildings 55 and 64 - 100 percent complete.
- c) Calgon Pump installation - 80 percent complete (awaiting shutdown of 184-inch Cyclotron to complete remaining work).

MAN-MONTHS EFFORT REPORT
SCIENTIFIC PERSONNEL

| Program No. | Subdivision | Man-Months Effort | Comments |
|---------------------------------|--|----------------------|----------|
| <u>Operations</u> | | | |
| 2000 M. T. A. | Design and Development | 17.80 | |
| 5211 Basic Physics Research | General Physics Research | 37.95 | |
| | Theoretical Studies | 14.10 | |
| | Film Detection | 14.41 | |
| | Cloud Chamber | 10.84 | |
| | Magnetic Measurements | 2.62 | |
| | General Instrument Design | 3.98 | |
| | | <u>83.90</u> | |
| 5261 Applied Physics Research | Special Cyclotron Development | 1.27 | |
| 5311 Basic Chemistry Research | Chemistry of Heavy Elements | 2.41 | |
| | Nuclear Properties of Heavy Element Isotopes | 7.70 | |
| | Transmutations with 184-inch and 60-inch Cyclotrons | 5.40 | |
| | Analytical and Services | 12.54 | |
| | Mass Spectroscopy, Beta Ray Spectroscopy | 1.41 | |
| | Instrument Development and Services | 3.26 | |
| | X-Ray Crystallographic Measurements | 2.43 | |
| | Radiation Chemistry | 0.96 | |
| | High Temperature and Special Chemistry | 6.50 | |
| | | <u>42.61</u> | |
| 5361 Applied Chemistry Research | Process Chemistry | 4.57 | |
| 5731 Electron Synchrotron | Operations | 9.21 | |
| 5741 184-inch Cyclotron | Operations | 9.03 | |
| 5751 Linear Accelerator | Operations | 16.56 | |

MAN-MONTHS EFFORT REPORT
SCIENTIFIC PERSONNEL

| Program No. | Subdivision | Man-Months Effort | Comments | |
|-------------|---|---------------------|-----------------|--|
| 5761 | Operations | 1.17 | | |
| 6300 | Health Medicine | 0.41 | - | |
| | Metabolic Ward | - | - | |
| | Internal Irradiation | 6.23 | 2.07 Consultant | |
| | | <u>6.64</u> | Man Months | |
| 6400 | Miscellaneous | 3.84 | 0.94 | |
| | Instrumentation | 2.01 | 0.37 | |
| | C ¹⁴ Metabolism | 3.69 | 0.22 | |
| | Use of Radioactive Material in Human Physiology | 12.35 | 3.30 | |
| | Trace Elements | 2.72 | 0.44 | |
| | Physical Biochemistry | 12.16 | 3.37 | |
| | Biochemical Response to Radiation | 3.89 | 0.44 | |
| | Metabolism of Lipo-protein | 5.45 | 10.24 | |
| | Iron Metabolism Hematopoiesis | 2.69 | 0.39 | |
| | Biological Effects of Cosmic Radiation | 2.14 | 0.10 | |
| | Radiation and Mutation Rate | 0.93 | 0.23 | |
| | Bio-organic Chemistry | 22.58 | - | |
| | Metabolism of Fission Products | 15.44 | - | |
| | Animal Colony | 3.66 | 2.73 | |
| | 6500 | Health Physics | 2.03 | |
| | | Irradiation Studies | 3.55 | |

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