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Radiation Laboratory

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MONTHLY PROGRESS REPORT NO. 119
February 15, 1953 to March 15, 1953

April 3, 1953

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UCRL-2174

UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

February 15, 1953 to March 15, 1953

MONTHLY PROGRESS REPORT NO. 119*

April 3, 1953

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

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Fast Deuterons from 340 Mev Protons on Nuclei

A second run has been made to investigate the deuteron energy spectrum from Al. Using a magnetic field such that deuterons having energies between 20 and 80 Mev would be detected, it was found that eight percent of the charged particles were stopped when an absorber thick enough to stop deuterons was introduced. With an energy range of 50-150 Mev, ten percent of the charged particles were stopped. Part of these particles stopped by the absorber are protons which suffer nuclear scattering in the absorber and do not get through to the detectors. These events must not be confused with the deuterons. Using the proton inelastic cross sections of Kirschbaum to calculate the magnitude of this effect it was found that in the energy region 50-150 Mev seven percent of the protons would be expected to be lost by nuclear scattering and in the region 20-80 Mev, three percent to be scattered. A rough energy spectrum showed that the deuterons that were present in the 50-150 Mev region were at the low end of the regions 50-80 Mev.

From this it can be said that about four percent of the heavy charged particles from 340 Mev protons on carbon in the energy range considered are deuterons and they fall in an energy range of 20-80 Mev. There are undoubtedly deuterons of less than 20 Mev but these are not conveniently detected by the apparatus and they could result from low energy processes such as evaporation from an excited residual nucleus rather than from the type of processes being considered.

The validity of this cross section was checked by measuring the nuclear scattering in the hydrogen peak using a CH₂ target.

The Photoproduction of Negative Pions from Deuterium

The spectrum of negative pions, produced by monoenergetic photons on deuterium, was calculated by LeVier 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.

* Previous report UCRL-2144 (No. 118).

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If the final protons are in a 1S state, the 1S proton-proton interaction and the phase space factor cause a sharp rise in the cross section at the high energy end of the pion spectrum. A comparison is being made of the calculated with the measured ratio of the cross section, integrated over the bremsstrahlung spectrum, at high pion energies to that at lower pion energies. The combination of pion range and proton time-of-flight separates the condition of small relative energy from the other dynamical configurations of the two final nucleons. Three millimicrosecond resolution time and dead time counting equipment, together with the pulsed character of the photon beam, was used to discriminate against electron background from the CD_2 and C targets.

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

The data on the angular distribution is being corrected for multiple scattering and various pion losses. The detection efficiency of the coincidence equipment will be measured. The result may affect the total cross section, but will not change the relative angular distribution results already given.

The Photoproduction of Neutral Pions from Deuterium

A preliminary investigation of the ratio of the cross section for the reaction $\gamma + d \rightarrow \pi^0 + d$ to that for $\gamma + d \rightarrow \pi^0 + p + n$ was made in a recent synchrotron run. A coincidence was required between the deuteron or proton and a single gamma ray from the decay of the neutral pion. Time-of-flight and a magnetic channel were used to identify the deuteron or proton. For a given magnetic channel, one reaction or the other is selected by means of the length of delay line. The use of a CD_2 target prevented the accumulation of good enough statistics to give a significant ratio. A liquid deuterium target will be used in the next run.

Proton Beam Monitor for Internal Cyclotron Target

In order to provide convenient relative measures of the proton beam current incident upon the internal cyclotron target during the studies of high energy gamma radiation in neutral meson and bremsstrahlung investigations, it has seemed wise to develop the thermocouple system which has been described by the University of Chicago workers.

For most practical targets and target support systems, the thermal time constants are many minutes long, so that it has seemed necessary to devise an electronic circuit which essentially solves the temperature-time differential equation for the target system. The ideas already set forth by the Chicago group in their recent R. S. I. article are being adapted.

$p + p \rightarrow d + \pi^+$ Cross Section at 340 Mev and 327 Mev

The $p + p \rightarrow d + \pi^+$ differential cross section has been measured by detecting the meson and deuteron in coincidence.

At 340 Mev, measurements were made at 30° , 60° and 90° in the c.m. system.

The least square fit gives:

$$\frac{d\sigma}{d\Omega}(\theta) = 30 \left[0.33 \pm 0.04 + \cos^2 \theta \right] \times 10^{-30} \text{ cm}^2 \text{ ster.}^{-1}$$

At 327 Mev, measurements were made at 90° in the c.m. Using Schulz's (UCRL-1756) excitation function at 0° and the value at 0° for 340 Mev the cross section at 0° for 327 Mev is obtained. These data give:

$$\frac{d\sigma}{d\Omega}(\theta) = 20 \left[0.38 \pm 0.11 + \cos^2 \theta \right] \times 10^{-30} \text{ cm}^2 \text{ ster.}^{-1}$$

Resonance Excitation of Delayed Heavy Particle Emitters

Examination of the excitation curve for the delayed heavy particles from Mg^{24} indicated a possible resonance about one Mev above the threshold. New apparatus for more refined measurements has been built, viz. a Ne^{20} counter for integrating the beam and a CH_4 and He counter for calibrating the beam at the target.

Electron-Neutrino Angular Correlation in Beta Decay

A recoil ion experiment is in progress to determine which of the five possible relativistically invariant interactions (scalar, vector, axial vector, tensor, pseudo-scalar) between the nucleons and the electron-neutrino fields are important in beta decay. It is planned to study the two monatomic gases He^6 and Ne^{19} . $\text{He}^6 \rightarrow \text{Li}^6$ is an allowed transition with $\Delta J = 1$ and hence can only involve tensor or axial vector interactions. $\text{Ne}^{19} \rightarrow \text{F}^{19}$ is an allowed transition with $\Delta J = 0$ (not $0 \rightarrow 0$) and can involve both Fermi and Gamow-Teller type interactions. The distribution in recoil ion momenta of decays having a fixed (within 10 percent) beta particle energy and corresponding to a range of angles near 180° between the outgoing beta particle and recoil atom will be determined.

Ne^{19} is being studied first because it has proven easy to produce an adequate amount of this activity, and because two other groups have recently reported results for He^6 whereas no results have been reported for Ne^{19} . Ne^{19} is produced by bombarding fine teflon turnings with protons from the linear accelerator, and the active gas diffuses through a tube and into the recoil chamber by molecular flow. The beta particle detector is mounted in one end of the chamber and the recoil ion detector is mounted in the other end. The beta detector is a 2-1/2 inch diameter NaI disc cemented to a lucite light pipe which is in turn coupled to an RCA 5819 photomultiplier tube. The recoil ion detector consists of the magnesium-silver dynode structure which is normally used in the RCA C-7164 photomultiplier tube. The energy of the beta particle is obtained by measuring the time between the scintillation counter pulse and the recoil counter pulse required for the ion to travel a known distance. During runs, the system is closed off from the Hg diffusion pump and impurity gases are absorbed by a charcoal trap. This trap holds the pressure in the sealed off system to 10^{-5} mm for periods of weeks, but does not absorb Ne.

All of the apparatus has been constructed. In a preliminary run, 10^{-8} amps of 32 Mev protons incident on the teflon target produced a total beta particle rate in the NaI crystal of about 10^4 counts per second. This is thought to be more than adequate. The electron multiplier tube operation has been checked by counting alpha particles incident at the first dynode and by counting single electrons released from the first dynode by an ultra-violet lamp.

The system is being prepared for the next run in which a search will be made for delayed coincidences.

p-p Scattering

During the last month the first measurement was made of σ total for p-p scattering at 340 Mev. The run was only moderately successful because the liquid hydrogen target developed a leak. The value found is 3.5 ± 0.5 mb, but this number needs confirmation.

As soon as a new liquid hydrogen target is available, it is planned to repeat and extend this measurement.

Photofission at High Energy

A run has been made with the synchrotron to test the apparatus. The results were satisfactory.

Film Program

Experiments performed were (a) momentum distribution of disintegration products arising from deuteron bombardment of Be, Li, Al, and U; (b) energy distribution of γ -rays from C when bombarded by the 330 and 162 Mev bremsstrahlung beams at 45° and 90° ; and (c) photoproduction of π mesons using the large solid angle focusing magnet. Scanning of the plates is now under progress.

Work is being continued in β -ray spectra, high energy electron processes, meson production, meson masses and energetics of meson decay, and the He^3/He^4 ratio from Ni under 340 Mev proton bombardment. No definite results from these experiments can be reported at this time.

The study of electron-electron and electron-positron scattering has been completed. There is good agreement between experiment and the scattering theories of Møller (electron-electron) and Bhabha (electron-positron). For large energy exchange, the ratio of the integrated cross sections $\sigma(e^- - e^-)/\sigma(e^+ - e^-)$ agrees well with theory. Also it is found that for 39 Mev electrons, the non-gaussian tail of the multiple scattering angular distribution can be described by Rutherford's scattering cross section.

Cloud Chamber Studies

Another run was made in the ten-atmosphere cloud chamber at the cyclotron on production of π^- mesons in deuterium by 300 Mev neutrons. A lithium-deuteride target was used. The first model of an automatic film

developer was tested during this run, and several improvements were worked out for incorporation into the new model which is now being developed.

The 35-atmosphere diffusion chamber has been in operation at normal atmospheric pressure, and preparations are being made to operate it at higher pressures.

Synchrotron Studies

In the month from February 15 to March 15 the synchrotron operated very well. There were a number of different experiments occupying the time but no experiments were finished. As already noted in previous reports, the experiment on the yield of π^+ photomesons at 0° has been written up and will be distributed as a project report. The cross section is very small and when combined with the results of others at larger angles do not agree with any of the current theories.

The film group has made two exposures of plates to the gamma rays emitted at 90° from a target bombarded with the full energy synchrotron beam. Results so far indicate only the gamma rays from π^0 mesons and none in the 15 to 20 Mev range where one might expect resonant scattering. Instrumentation has been completed for a search for these scattered gamma rays with a large NaI crystal and ten channel pulse height analyzer.

The spiral orbit spectrometer has been brought to the synchrotron to look for low energy photo-mesons. In the one preliminary run, a fair beam was obtained in spite of the strong stray field of this machine. A few test plates were exposed. More work on shielding will be done.

A run has been made with the pair spectrometer to measure the pair production cross section of the electron by comparing benzene and cyclohexane. A test run has also been made with the equipment for the high energy Compton effect experiment, as well as a fairly long run looking at the π^0 mesons from gamma rays on deuterium.

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

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Pion Studies

A 0° 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 continued 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.

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

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.

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 again which leads to the same results.

3. THE M. T. A. PROGRAM
(A. E. C. Program No. 9200)

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Target Physics Program

The emphasis of the MTA target physics program has continued to be placed on the 320 Mev deuteron beam obtained from stripping of He^{3++} ions, and on various properties of and experiments with this beam.

Beam attenuation measurements were carried out on this beam, using the new Faraday cage and ion chamber, and the resulting curve was subjected to a mathematical "unfolding" in an attempt to calculate the energy spectrum of the deuterons. The uncertainties inherent in the procedure are fairly large, but a peak around 320 Mev is indicated, with a fairly large low-energy tail extending down below 200 Mev. Attempts to sharpen the energy spread by means of auxiliary collimators inside the cyclotron tank have been made, and preliminary results on the resulting energy spectrum, obtained by varying the steering magnet current and measuring the external beam current, indicate a considerable reduction in the low-energy tail.

Attempts to measure the energy spectrum with photographic plates have also been made, and the analysis of these plates is under way.

An attempt was made to measure the neutron yield in the MnSO_4 water tank, but a low beam and the uncertainty in effective beam energy preclude drawing any conclusions beyond the qualitative agreement with the results obtained by the BF_3 counters.

A new vacuum seal for the shaft of the 100 CFM Kinney pump, consisting of a rotating oil-lubricated carbon disc, similar to that on the small Kinney pumps, has replaced the packing gland, and gives much better results.

The 100 CFM pump is being moved outside the cyclotron building and has been out of operation for several weeks, while the necessary modifications are being made. During this period, most of the cyclotron runs have been made with the 190 Mev deuteron beam with 2 ft. x 2 ft. targets in the large water tank.

A new purification system, to enable the use of the 95 percent He^3 , is completed and vacuum tested and is awaiting the installation of the large Kinney pump outside the cyclotron building.

The time-of-flight neutron spectrometer has been investigated thoroughly using the artificial pulser, and a cyclotron experiment to try to measure the spectrum of the 320 Mev deuteron beam is planned for the near future, as a test of the equipment.

4. ACCELERATOR CONSTRUCTION AND OPERATION

Bevatron Construction (Program No. 9001)

Magnet. At the end of the period all the pole base slabs had been assembled and three-fourths of the lower slabs (three-eighths of the total) had been installed in the magnet. The bias windings were still to be placed on about one-fourth of the slabs.

Pole tip plates have been arriving and it is expected that the first assembly of the slabs will start about March 20th.

The measuring equipment is being designed to check the accuracy of the magnetic field. It is planned to measure the value of "n", and the verticality and the uniformity of the field over the entire circle. Model testing is substantially finished except for some stray field measurements. The effect of currents in the pole base windings have been studied on the model and it is found that the shape of the field as a function of current in these windings can be predicted with good accuracy.

Vacuum System. The first curved tank has been installed in the south-east quadrant. Top and bottom covers for the remaining three tanks are almost complete and construction of the sides of the second tank should start about the end of March. There appears to be no difficulty with the vacuum tanks keeping up with the magnet assembly. Pumpdown tests of the first tangent tank showed that liquid nitrogen would be needed to handle the gas evolution from the bakelite insulation to be used on the pole assembly. Experiments have indicated that it may be possible to reduce this gassing by baking the insulation before use and thus reducing or eliminating the liquid nitrogen requirement.

The second tangent tank has been installed in the north tangent area and should be pumping by March 23. The third tank has been received and is being prepared for installation on the west side.

Injector. The Cockcroft-Walton power supply for the ion gun is complete and has been operated at 460 kv. The ion gun has produced a beam of about 1.6 ma of unseparated ions. Completion of the electrical installation for the linear accelerator is expected around the end of the month at which time it should be possible to accelerate to 10 Mev.

Accelerator. The accelerating electrode, power amplifier and saturable reactor parts are nearing completion. It is planned to start the installation in the north tangent tank around April 1. A new frequency monitoring system in which the oscillator frequency is measured by counting cycles at points determined by pulses received from a peaking transformer in the magnet circuit is being developed. A control room for the accelerating equipment has been completed inside the magnet ring.

Miscellaneous. It has been decided to move the main control room from the second floor to a room on the magnet floor level directly below its original

position. This is to provide more convenient access and to increase the effectiveness of the shielding. The counting equipment will be adjacent to the control room.

It is now planned to make the center eight feet of height of the shielding wall of iron ore concrete with a density about fifty percent greater than ordinary concrete. The lower four feet of the wall will be in the form of a permanent cast sill. Removable blocks will be used above this height.

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

The cyclotron was used for research experiments approximately 97 percent of the 457.5 hours that the crew was on duty. The time distribution was as follows:

Operation for customers	448.00 hours	97.8 percent
Electrical troubles	3.25	0.7
Mechanical troubles, etc.	<u>6.25</u>	<u>1.5</u>
Totals	457.50 hours	100.0 percent

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

Continued good performance has been experienced with the 60-inch cyclotron. Installation of new feelers, although changing the beam geometry, did not interfere with bombardment commitments.

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. Ceramic donut sections have been obtained to accommodate the necessary inflector mechanism. Some difficulties have been encountered in the inflector insulators breaking down under high voltage. It is desirable that these insulators hold off 60,000 volts d.c. Space is at a premium inside the inflector sections so that insulators cannot have any lengthy leakage path.

Experiments with different insulating materials and geometry peculiar to this particular application indicate that this problem can be solved.

Investigations are also underway to determine the feasibility of a magnetic shielding tube through which the electron beam can be introduced. This would serve to lower the required inflector voltage, or at least lessen the area over which it would be applied. However, there are some difficulties

readily apparent due to field disturbance by the magnetic shield and the heating due to eddy currents. Some interesting proposals have been made for minimizing some of these undesirable effects.

One interesting result of the inflector design program is the success of metal to ceramic bonds that have been accomplished. This procedure is not new to industry or science but may be new to this laboratory.

A number of experimental resin plastic castings have been made here, both for our own use and other projects. These castings are used as a potting compound for high voltage transformer windings. This program is important to other laboratory projects because needed characteristics are not available from industry as yet.

A program for focusing the electron linear accelerator beam with a simple magnetic lense has been successfully completed. Additional studies are planned in conjunction with the inflector assembly.

Some physics bombardments have been made with the linear accelerator. An effort is being made to allow beam energy to be controlled. The conditions necessary for maximum beam intensities at various energies are not immediately obvious.

Operating statistics are as follows:

Operation for customers	208.8 hours	68.7 percent
Tests with the synchrotron	41.0	13.5
Maintenance and installation	<u>54.2</u>	<u>17.8</u>
Totals	304.0 hours	100.0 percent

Linear Accelerator Operation (Program No. 5751)

The total operating time of 384 hours was distributed as follows:

Running time (physics)	219.0 hours	58.0 percent
Research (machine)	112.0	28.0
Repair	50.0	13.0
Maintenance	<u>3.0</u>	<u>1.0</u>
Totals	384.0 hours	100.0 percent

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

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Atomic Spectrum of Plutonium

The optical spectra of plutonium atoms are being studied by emission from the vapor in a furnace containing plutonium oxide. The variation of intensities with temperature is being used to determine which lines are due to the spectrum of neutral plutonium atoms. The magnet for the Zeeman studies is almost ready for delivery. An objective of this work is the determination of the ground state electron configuration.

Calorimetric Assay of Radioactive Materials

A semi-adiabatic microcalorimeter with isothermal environment has recently been used for the assay of samples of americium and curium. The samples were enclosed in a silver container immersed in water which served as a heat transfer medium in the calorimeter.

The best results were obtained by a dynamic method in which the variation of temperature with time was observed with the radioactive sample or with electrical heating. Reproducibility of about ± 1 percent was obtained for samples producing 0.01 to 0.2 calorie per minute. The technique is of great interest because the assay by counting of such intense samples is very difficult.

Radioactivity of Sm¹⁴⁶

The alpha radioactivity of Sm¹⁴⁶ has been looked for by means of the nuclear emulsion technique with samarium produced by helium ion bombardment of neodymium, but it has not been observed. A lower limit of 10⁶ years has been set for the half-life. After the beta activity of other samarium isotopes has decreased by decay, it will be possible to extend the sensitivity to 10⁹ years. The absence of Sm¹⁴⁶ in nature implies that the half-life is less than this value.

Mass Spectrometer

Most of the shop work on mass spectrometer V has been completed. This instrument is designed for heavy isotope abundance measurements.

Development work is being done on apparatus for ratio recording, in which an isotope is measured by comparison with the total ion current. A multiple filament source has been developed for mass spectrometer II.

Metals and High Temperature Thermodynamics

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

Health Chemistry

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

1. Improved equipment for use in connection with the two-inch lead shield, described on last month's progress report, is being drawn.
2. Plans and drawings for a low-geometry counter to be assembled in the Cave Room of Bldg. 5 are under way. This counter is being created so as to minimize transportation of high-activity counting discs from this laboratory to the counting rooms and thereby reduce the hazard of contamination possibly created by these movements, both in the halls and in the counting rooms. With the higher levels of activity now handled in the laboratories, these discs sometimes go as high as 10^8 counts/minute. A two-inch lead shield sampling system is being built for this assembly.
3. The major efforts of this group have been on the plans and creation of equipment to be used in processing large quantities of special soil.
4. Six gloved boxes were assembled and fitted for special work on request. The Berkeley Box group also was engaged in the usual reassembly of centrifuges, reconditioning of certain equipment, and spent much time on equipment for Livermore.

Health Chemistry has acquired a Chevrolet Carryall for use in the increased radioactivity transportation work, both at Berkeley and for movements to Livermore. This vehicle has been lined with polyethylene and at present a plywood floor covered with mastopave is being used for floor covering, which surface will be decontaminated with ease in case of escaped activity.

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

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Biological Effects of Radiation

184-inch Cyclotron Studies. Localized radiation of the hypothalamus region of Long-Evans male rats was continued. Several groups of weanling animals were irradiated with 190 Mev deuterons at various dose levels. It is hoped that in addition to contributing to the knowledge of the biological effects of radiation some knowledge of the function of this gland may be obtained since surgical hypohalaectomy is not possible.

X-ray Studies. J. Maisin, et al, of Belgium have reported that the compound Thiolethylamine (2 thiolethylamine) is protective against the lethal effects of 180 kev x-rays when administered after irradiation provided the liver is shielded with lead. Experiments carried out in this laboratory have not been confirmatory in result. However, it has been observed that the same substance, in common with other mercaptans, is protective when administered immediately before irradiation. Furthermore, it has been found that this protective effect is cumulative with that afforded by liver lead shielding during irradiation.

60-inch Cyclotron. Some brain irradiation studies were made on hamsters in collaboration with the University of Minnesota.

Instrumentation

This work is being continued.

Biological Use of the Six-Times Ionized Carbon

This work has progressed beyond the instrumentation development stage. Survival curves have been made on haploid yeast cells using this technique.

Activation Analysis

This work is being continued.

Iron⁵⁹ Studies

For sometime the method of Kitzes, Elvehjem and Schuette (J. Biol. Chem. 155:653-60, 1944) has been used for determining the amount of iron in plasma. The plasma samples contain tracer amounts of radioactive iron; and on checking the precipitated proteins for radioactivity, it has been found that about 10 percent (6.9 to 11.0 percent, average = 9.5 percent) of the activity is trapped in the precipitate and therefore 10 percent of the non-radioactive iron must also be trapped. The method assumes that all the iron is removed from the precipitate. Many variations of this method have been tried along with other methods in order to remove all of the iron from the precipitate, but the same difficulty was still encountered.

Recently a new method devised by Ramsay (Biochem. J. 53:227-231, 1953) was tried and was found to solve the problem. The color reagent (2-2 dipyridyl) is added to the plasma before denaturation of the proteins and reabsorption or rereaction of the iron with the proteins is thereby avoided. In addition, the solution is diluted to a fixed volume before, rather than after, filtration. Some of the filtrate is trapped with the precipitate, but the filtrate trapped is of the same iron concentration as the filtrate which passes through the filter. On checking the precipitate for activity by this method, it was found that the amount of radioactive iron present is what would be expected for a homogeneous iron solution throughout trapped and untrapped filtrate.

Tracer Studies

Experiments on the deposition of aerosols in the lungs of primates and the relative biological effects of beta and alpha emitters are being continued. The removal of curium from rats by the use of Versene is nearing completion.

Radioautography

The radioautography studies are being resumed and particular attention is to be paid to preparing photomicrographs of a large number of sections which have accumulated over a period of several months.

Radiation Chemistry

Studies of the radiolysis of aqueous solutions of acetic acid, formic acid and glycine are being continued.

Plant Biochemistry

Studies on the nature of the processes of plant photosynthesis are being continued. During the past month research has been pursued in the following projects: (1). Through the use of radioactive sulfur, a search is being made to find what sulfur compounds are involved in plant metabolism. (2). A quantitative bio-assay for thiocetic acid has been developed. (3). A flow system for algae has been constructed which will permit determinations of the compounds appearing during very short exposures of algae to radiocarbon. (4). In order to learn more about the possible role of thiocetic acid in the transfer of light energy into chemical energy in the process of photosynthesis, studies are being made of the physical, chemical and photochemical properties of the related substance, trimethylene disulfide. (5). Investigations are underway to determine steady-state reservoir sizes in photosynthesizing algae.

Animal Biochemistry

Research in animal biochemistry is in progress on these subjects:
(1). The sodium-acetate metabolism of pantothenic acid deficient rats is being studied. (2). Carbon-labeled adenine is being used to determine the "turnover"

rates of nucleotides and nucleic acids in mice. (3). The possible importance of lathosterol in atherosclerosis is being investigated by means of a rabbit-feeding program. (4). Labeled glucose is being used to determine the "glucose space" in the dog.

Organic Chemistry

The following research in organic chemistry has taken place during the past month: (1). Determinations have been made of the amounts of self-irradiation decomposition which have occurred to twelve C¹⁴-labeled compounds since their times of synthesis. (2). Methods to synthesize C¹⁴-labeled cholic acid, diethyl malonate and various peptides have been studied. (3). The chemical degradations of ribulose and sedoheptulose have been under investigation. (4). An investigation has been pursued to find ways to accomplish the synthesis of S³⁵-labeled thiocetic acid.

7. PLANT AND EQUIPMENT

UNCLASSIFIED

Bevatron. (5-271-9001)

All the pole bases have been completed. Approximately 3/8ths of all the lower pole bases have been installed and the first curved tank has been permanently installed. About 1/5th of the steel for the pole tips was delivered and actual assembly is about to begin.

Chemistry Laboratory Building. (5-271-1002)

Bids were opened on Friday, March 20th, and construction should start within about two months.

Electronics Research Building. (5-271-2002)

A preliminary proposal has been sent to the AEC.

Miscellaneous Construction. (5-271-2001)

Preliminary plans are being developed for the Gamma House and Destructor. The Sprinkler System for Building 14 should be started within approximately six weeks.

MAN-MONTHS EFFORT REPORT
SCIENTIFIC PERSONNEL

Program No.	Subdivision	Man-Months Effort	Comments
<u>Operations</u>			
2000 M. T. A.	Design and Development	16.26	
5211 Basic Physics Research	General Physics Research	48.51	
	Theoretical Studies	15.11	
	Film Detection	14.89	
	Cloud Chamber	10.53	
	Magnetic Measurements	2.84	
	General Instrument Design	4.94	
		96.82	
5261 Applied Physics Research	Special Cyclotron Development	1.04	
5311 Basic Chemistry Research	Chemistry of Heavy Elements	3.02	
	Nuclear Properties of Heavy Element Isotopes	5.53	
	Transmutations with 184-inch and 60-inch Cyclotrons	6.59	
	Analytical and Services	12.41	
	Mass Spectroscopy, Beta Ray Spectroscopy	1.45	
	Instrument Development and Services	3.88	
	X-Ray Crystallographic Measurements	2.59	
	Radiation Chemistry	.96	
	High Temperature and Special Chemistry	6.50	
	Health Chemistry Research	8.34	
		51.27	
5361 Applied Chemistry Research	Process Chemistry	5.43	
5731 Electron Synchrotron	Operations	6.70	
5741 184-inch Cyclotron	Operations	11.38	
5751 Linear Accelerator	Operations	18.66	
5761 Bevatron	Operations	1.84	

MAN-MONTHS EFFORT REPORT
SCIENTIFIC PERSONNEL

Program No.	Subdivision	Man-Months Effort	Comments
6300 Biology and Medicine	Health Medicine	1.88	-
	Metabolic Ward	-	-
	Internal Irradiation	5.67	2.11 Consultant
		<u>7.55</u>	Man Months
6400 Biological Research	Miscellaneous	3.26	1.90
	Instrumentation	2.19	.38
	C14 Metabolism	3.80	.24
	Use of Radioactive Material in Human Physiology	11.97	3.40
	Trace Elements	3.53	.46
	Physical Biochemistry	11.84	3.51
	Biochemical Response to Radiation	4.01	.48
	Metabolism of Lipo-proteins	5.90	10.58
	Iron Metabolism Hematopoiesis	3.49	.45
	Biological Effects of Cosmic Radiation	2.25	.12
	Radiation and Mutation Rate	2.03	.24
	Bio-organic Chemistry	25.14	-
	Metabolism of Fission Products	15.38	-
	Animal Colony	2.79	2.81
6500 Biophysics Research	Health Physics	2.66	-
	Irradiation Studies	4.31	.59

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