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DATE:	<u>3/26/80</u>

MONTHLY PROGRESS REPORT
No. 87

June 15 to July 15, 1950

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UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

June 15 to July 15, 1950

MONTHLY PROGRESS REPORT No. 87

1. Bevatron

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Building. The concrete work remaining to be done consists of the last quarter of the magnet foundation walls, trenches and floor in the magnet room. Plumbing, wiring and interior finishing is proceeding. The mechanical engineering and procurement groups moved into the office area on July 14. Completion of the building is expected about September 15. This is six weeks later than was expected a month ago.

Magnet. Seventy-five percent of the yoke slabs and eighty-seven percent of the leg slabs are complete. Steel will start coming into the building on July 25 to be stored until the foundation is ready. Several conferences with the coil spacer supplier plus the extended completion date for the building have improved the prospects of spacer deliveries being on time. Coil winding is now expected to start November 1.

The first magnet motor generator parts were shipped during the week of July 17.

Magnet Model Tests. The effect of residual field is to reduce the width over which n is between 0.5 and 0.7 from 6 feet to 30 inches at injection. A reverse current of about 5 percent of the maximum forward current will reduce the residual field to a negligible value. The possibilities of providing reverse current pulses between the forward pulses or of reducing the residual by the use of Armco iron for the pole tips is being looked into.

2. 184-inch Cyclotron Operation

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The cyclotron was used for research experiments approximately 95 percent of the 390 hours that the crew was on duty. In addition, one day was used for the installation of a lead wall inside the vacuum tank for the purpose of reducing the radiation at the north end of the building.

The cyclotron was still operated under the reduced schedule of five and one-half days per week.

Operating statistics for the period are:

Research Operating Time	370 hours	94.8 percent
Maintenance	1-1/4 hours	.3 percent
Repairs	3/4 hours	.2 percent
Visitors	2-1/2 hours	.6 percent
New Equipment	16 hours	4.1 percent

3. 60-inch Cyclotron Operation

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A siege of deflector difficulties occurred during this period. Average beam dropped from 8-10 μ a to 1 μ a. Examination showed the deflector channel to be well eroded. Replacement of the channel and the deflector brought the beam back to about a 6 μ a average. Operation is not back to peak yet, but future adjustment should remedy this situation.

4. Synchrotron Operation

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The synchrotron magnet and vacuum system were disassembled during this report period. Thorough maintenance of the machine was accomplished, a new beam collimator was installed, and several alterations in the control circuits have resulted in better grouping of the controls and have improved and expanded the monitoring circuits.

A useable beam was quickly found after completion of the overhaul. Studies and investigations were made of the betatron acceleration phase in an effort to improve beam intensity. These studies will continue as time is available during the research program scheduled.

Following are operating statistics for the period:

Research Operating Time	108.9 hours	27.6 percent
Tests of Synchrotron	89.0 hours	22.7 percent
Maintenance	195.1 hours	49.7 percent

5. Linear Accelerator and Van de Graaff Operation

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Operations were good this month, until the Van de Graaff broke two of the top support textolite tubes. All time from then on was spent in Van de Graaff repair.

The cause of the textolite break, according to the Engineering Division, was fatigue and cold flow aided by the unfortunate placement of two of the aluminum retaining pins which hold the textolite ends in their aluminum bushings. On the advice of the engineers, the textolite tubes are being replaced with the aluminum pins left out.

It is anticipated that repair of the Van de Graaff will make the machine inoperative for the rest of the summer. The time is being used, in addition to repair of the textolite tubes, for the complete rewiring of the shell and the general overhaul of the system. New oscillators will be installed in the linear accelerator beginning next month.

Operating statistics for the period are:

Operating Time	100.7 hours, 32 percent
Repair Time	203.3 hours, 68 percent.

6. Experimental PhysicsUNCLASSIFIED

Film Program. In order to obtain high meson intensities in directed beams, calculations have been made of the focussing of mesons in the radially decreasing field of the cyclotron, and channels are being designed to measure the meson flux at the calculated foci.

An experiment is under way in which it is intended to measure more precisely the momentum and kinetic energy of the mu meson produced in the decay of the positive pi meson.

A study to obtain quantitatively the dependence of the grain density of nuclear particle tracks on the particle charge, mass, residual range and velocity for various emulsions and standard processing procedures is in progress. Thus far it has been established that for a given emulsion and processing procedure the grain density depends almost entirely, if not entirely, on the rate of energy loss of the particle. The information obtained in this study is useful for identifying tracks of particles having unusual combinations of charge and mass.

An assessment procedure for routine comparison of emulsions has been developed.

Observations on the interaction cross section for 20-40 Mev mesons with emulsion nuclei, accumulation of evidence for or against the existence of doubly charged protons, and further meson mass measurements have continued during the month.

Cloud Chamber. Following work at Brookhaven, a lucite cylinder forming the walls of a cloud chamber was coated with polystyrene by spraying it with polystyrene dissolved in toluene and then running the lucite through pure toluene to smooth out the irregularities on the sprayed surface. This stopped the poisoning usually seen with lucite.

A new pantagraph has been made for the 22 inch chamber which now operates much more smoothly and accurately. Improvements came chiefly from a change in the bearing surfaces and more accurate machining.

The new slow timer made entirely of standard time delays has been very successful and useful.

Two projectors are now in operating condition and one projector is being used eight hours a day on the data from the neutron-deuteron scattering experiment. This projector operates more satisfactorily than before because the lenses are better matched.

A new chamber, rectangular in shape, has been designed and the engineering drawings are nearly completed. This will be used for study of photodisintegrations in a counter controlled cloud chamber in the x-ray beam from the synchrotron. Several proportional counters have been completed for this experiment.

The problem of measuring the energy of the pairs produced by γ -rays which in turn are made by the π -meson decaying in hydrogen has been studied. It appears

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that the errors in this measurement can be kept down to within one percent and it promises to be a good method for checking the mass of the π -meson. This experiment has been done with counters with an accuracy sufficient to make this look like an excellent problem.

A continuously sensitive cloud chamber has been operated successfully on methyl alcohol and argon as suggested by Cowan at M. I. T. It has been found that the chamber will work with air and carbon dioxide, using methyl or ethyl alcohols. Tracks were obtained in air and propyl alcohol. Temperatures of the top of the chamber when the bottom is in contact with dry ice have been as low as 11 degrees centigrade and as high as 37, although no systematic effort has been made to study this range carefully.

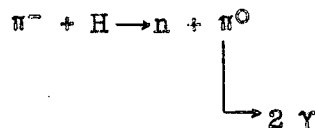
Proton-proton Scattering at 340 Mev. In the past month the experimental work on p-p scattering with the CH₂ target has been finished.

Further data can only be obtained with a liquid H₂ target.

Deuteron-Proton Scattering at 340 Mev. Studies have been pursued and d-p scattering data are being obtained.

Stopping Power of Various Materials for 340 Mev Protons. An experiment on the stopping power of H, Li, Be, C, Al, Cu, Ag, W, U for 340 Mev protons has been made. The average energy spent per ion pair formed in H₂, He, O, N, A by 340 Mev protons has also been determined.

Mass Measurement of the Neutral π Meson from the γ -ray Spectrum Resulting from the Absorption of π^- Mesons in Hydrogen. The instrument described in the last monthly report has been used to analyze the γ -ray group around 70 Mev which presumably results from the reaction:



The Doppler width of the γ -rays is a measure of the reaction energy of this process and hence of the π^0 mass. The tentative result is $\pi^- + \pi^0 = 5.7 \pm 1.7$ Mev.

Cerenkov Radiation from Protons. This experiment, interrupted last fall, has been reactivated. A more elaborate piece of equipment, partially completed last fall, is being completed and preliminary runs on it will occur in the near future. The purpose is to determine the proton velocity resolution possible using this effect. The new equipment is designed to be achromatic and should have improved resolution.

Development of Pair Spectrometer. All parts for the completion of the 350 Mev pair spectrometer have been ordered and a tentative date for the assembly of the magnet on its truck, installation of track, and testing of the completed machine in the synchrotron beam has been set for September 1.

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Proton Elastic Scattering. A bridge coincidence circuit using germanium diodes was built and tested. It gave a discrimination ratio of 8-1 on photomultiplier pulses. A run was attempted using this circuit. It was found that some of the pulses due to inelastically scattered protons were more than ten times the height of those due to elastically scattered protons. These fed through. Refinements are being made in an attempt to increase the coincidence discrimination ratio.

Neutral Meson Program on the 184-inch Cyclotron. The yield of neutral mesons from bombardment of deuterium with 345 Mev protons has been measured in the zero degree direction by the use of interchangeable targets of ordinary and heavy water. From the data thus far accumulated it appears that the region of yields from these two targets is approximately 10 to 8 or 1.25. The statistical accuracy of this region is probably 10 percent and both runs will be needed to narrow the limits of the result.

The 10^{-8} second electronics for the γ - γ coincidence apparatus has been completed during the past month and is awaiting opportunity for a cyclotron run.

Magnetic Particle Spectrometer. The program of n-d scattering making use of this apparatus has been continued. Further results indicate that the energy spectrum of protons from the d (n,2n) p reaction lies closer to that of elastically scattered protons in n-p scattering than previously reported. The energy spectrum of the n-d proton has now been measured at two angles, and plans are being made for further measurements at these as well as at other angles.

The apparatus of the particle spectrometer, together with a new magnet of special design, has been applied to γ -ray spectrometry in other experiments at this laboratory. Considerable success has been achieved in this application, and it appears that the equipment will continue to be used in that and similar experiments.

Preliminary Results on Measurement of Proton Velocities from 184-inch Cyclotron Using a Bridge Coincidence Circuit. Two scintillation counters, each consisting of a 1P21 phototube and a rectangular stilbene crystal of 20 cm³ volume were placed in a line with the external proton beam from the 184-inch cyclotron. The phototubes were connected to a bridge coincidence circuit (described in the last monthly report) by two 50 ft. lengths of Rg 63 - u cables. Varying the distance between the counters required a change in cable length to preserve the maximum number of coincidences. A proton energy of 345 Mev requires approximately 3×10^{-9} sec. to travel 60 cm. Assuming the handbook cable velocity the percentage error in determining this time was ± 10 percent for two sets of measurements. It is hoped that this percentage error will be reduced by use of greater path differences and by possible improvements in circuit resolution.

7. Theoretical Physics

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MTA Theoretical Studies. Injection of a beam at 80 Kev required redesign of the accelerator drift tube lengths. The lower injection energy together with the desire to have the voltage gradient as small as possible has led to a machine with 8-1/2 drift tubes. This lower injection energy also indicates the trapping of a considerably larger range of phases than was possible with injection at 300 Kev.

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Particles which had a phase range of 140° at injection are compressed to a range of 35° at the end of the 8-1/2 tube machine.

Integration of the radial motion indicated a very rapid increase in radius at the start for ions under certain injection conditions. This increase is due to the electrical defocussing on entering the first gap and before the focussing magnets are effective. This would indicate that a convergent beam at injection is desirable.

General Physics. The effect of a repulsive core on n-p and p-p scattering and on scattering of high energy neutrons by nuclei is being investigated. The polarization effects in double p-p scattering are being calculated. A method has been found which is expected to give good results on the angular spread of air showers. The experiments on the capture of π^- mesons by protons indicate a slow rate of emission of neutral mesons. This is in agreement with expectations for pseudo-scalar meson with pseudovector coupling. The detailed investigation of this question is in progress.

S. M. T. A. Program

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General. Thus far, \$1,200,000 worth of work has been either contracted or awarded while an additional \$1,200,000 worth is either out for bids or bids have been received and are being analyzed. Excavation of the pit in which the accelerator will rest has been completed. The main power feed to the site has been examined and the problems of distribution have been studied. Certain large items of electric equipment have been reserved at Oak Ridge. Commission approval has been obtained for dismantling several buildings at the site and plans to recondition several others have been submitted for approval.

All orders have been placed for the copper conductor for the drift tube magnets. It is expected that most of it will be delivered in August. There has been some difficulty in getting bidders for the copper spinings that constitute the heads for the drift tubes.

Ion Source. An experimental d.c. ion source has been developed which yields 650 ma of beam, 80 percent of which is probably protons, focussed into a spot approximately 3/4 in. in diameter. It is estimated that 600 ma would supply the required 50 ma average beam with a 1/5 duty cycle and 150° phase acceptance angle. It appears from this work that the full scale source may allow the diameter of the injector beam to be reduced from 9 in. to about 3 in.

Drift Tubes. The new ion source developments, with the reduction of the injection voltage to 80 kv from the originally planned 300 kv will require the use of an additional drift tube in the Mark I accelerator i.e. 8-1/2 drift tubes and 8-1/2 gaps. The dimensions and spacing of these drift tubes have been calculated.

A considerable effort has been devoted to determining the positions of the drift tube stems on the 1/10th scale model. It was found by trying the drift tube stems in various positions that the actual positioning of the stem is not critical, so that the primary criterion for positioning the drift tube support will be mechanical suitability.

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Focussing Magnets. The magnetic field requirements for the new drift tubes have changed only slightly. The magnets for the first four drift tubes will be re-designed to allow them to fit within the redesigned drift tubes. The remaining magnets will remain as before. The power requirements for the new design of drift tube magnets have been calculated.

Measurements of the magnetic forces between adjacent drift tube magnets have been made and the maximum force found was about 1-1/2 tons between magnets 1 and 2.

Cooling. Cooling water requirements for the principal components of the machine have been estimated as well as the cost of treating the water for cooling the liner. Various water treatment systems have been considered. Calculations will be made to determine the level of radioactivity induced in the cooling water in each case. Cost estimates show that it is most economical to use distilled water for cooling the drift tubes and drift tube magnets.

Mark I Target. Design and construction work has gotten underway on a bismuth target for polonium production by the Mark I accelerator. Experimental work is being done on a laboratory scale Bi-Po separation process. These studies are being integrated with current techniques in use within the AEC.

Mark II Target. Both a primary and secondary target will be employed in order to efficiently utilize the two different neutron spectra; one produced by the stripping process on the accelerated deuterons, the other by the spallation reaction.

Tests of various target materials are being made with the 184-inch cyclotron. Materials being tested first are plain uranium and uranium bonded to steel and copper and cooled with water. Thorium will also receive study as will heavy water, which has many attractive characteristics.

Various target arrangements are under consideration as well as a number of systems of removing heat from the target. They will be carefully studied to justify the most promising ones for detailed investigation.

An added target design problem is presented by the great concentration of intensity at the center of the beam. Plans are under consideration for rotating the beam by a rotating magnetic field or crossed magnetic fields oscillating at different frequencies.

Another suggestion has been made for reducing the intensity of the central position of the beam with the aim of equalizing the beam distribution over the target. The suggestion is to inject the particles slightly off the axis and at a slight angle with the axis so that the particles would follow helical paths. Calculations of the beam distribution at the target have been made on this basis and give a ratio of maximum to average intensity of about 3.

There is a possibility of running the target at very high temperatures so that the outcoming coolant could be used to generate useful power, to offset the additional power required to increase the duty cycle, should that be desirable.

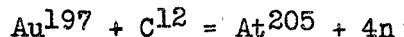
Neutron moderation and utilization, and the design of the tertiary target are also subjects of active study.

9. Chemistry

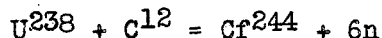
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Part A

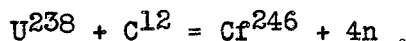
Carbon Ion Reactions. The group in Crocker has been accelerating +6 carbon ions, produced from carbon dioxide in an arc, to about 120 Mev in the 60-inch cyclotron. They have observed the reaction:



and similar reactions to produce other astatine isotopes. In cooperation with them, we have observed the reaction:



and a reaction to make a new californium isotope, probably



Other similar experiments are in progress.

Beta Spectroscopy. The beta-particles from decay of Pu^{243} have been found to have an energy limit of 0.39 ± 0.03 Mev. Two gamma rays from the same decay have energies (calculated from L conversion electrons) of 0.095 and 0.12 Mev, respectively.

Two gamma rays from Pu^{238} (following alpha-decay) have energies of 37.2 and 57.8 Kev, respectively.

X-ray Spectrometer. The 303 planes of topaz have now been used in the bent-crystal spectrometer for x-rays from radioactive isotopes. A gain in the intensity of the reflected beam of at least a factor of 5 over the previous quartz crystal is obtained. This gain will greatly increase the usefulness of the instrument.

The instrument is being used to make an extensive study of x-ray emitted by isotopes in the trans-uranium region.

Decay of Am^{242} . For some time it has been known that two isomers of Am^{242} decay independently by beta-decay to Cm^{242} . A careful study of the x-rays of the upper (16-hour) state reveal that isomeric transition and L-electron capture decays also take place. The ratios are estimated as roughly 60 percent beta-decay, 20 percent isomeric transition, and 20 percent L-electron capture. The electron capture has been confirmed by detection of the plutonium daughter. Electron capture by the ground state has not been observed.

Recoil of Spallation Products. The recoil of products from the high energy spallation of copper is being investigated by measurement of the yields found in foils placed ahead and behind the copper target. All products are found to recoil more with the beam than against it, but the ratios of the amounts in the two directions vary considerably. The interpretation of the data is not complete.

High-Energy Fission Products. The study of the yields of various products from the high-energy fission of uranium is being continued. A very wide distribution among elements and among isotopes of the same element is being found.

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Ranges of Fission Fragments. A stacked foil technique has been used to measure the recoil ranges in aluminum of Ba^{140} , Sr^{91} , Sr^{89} , and 10-day Sn (mass 125?) from fission of uranium with 19 Mev deuterons. The accuracy attained was only of the order of 8 percent because of irregular thickness of the foils. Within this limit, the results are the same as those found elsewhere for slow-neutron fission.

Strontium Isotopes. The study of neutron-deficient strontium isotopes in relation to their rubidium and krypton daughters is proving fruitful.

From decay of 38-hour Sr^{83} , a considerable amount of 107-day Rb^{83} has been obtained. This has now been shown to decay to the 2-hour isomer of Kr^{83} .

The 25-minute strontium is assigned to 81 by detection of the electrons of its descendant Kr^{81} .

Francium Isotopes. Evidence for Fr^{209} , of about one-minute half-life, has been obtained by rapid removal of its emanation daughter, followed by observation of At^{209} produced by the emanation decay. The francium is produced from thorium by 350 Mev protons.

Photographic Fourier Summations for Crystal Structure Analysis. Equipment is now set up to sum two-dimensional Fourier series by a photographic method due to Huggins. The apparatus is a type of analogue computer. It will permit a great saving of time in the summation of series encountered in the present work on crystal structures.

Chemistry

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Part B

Synthetic and Experimental Chemistry. High specific activity preparations of the following compounds have been carried out during the past month (yields on the basis of the CO_2 used as starting material are indicated in parentheses): Oxalic acid- $1,2-C^{14}$ (42 percent); sodium butyrate- $1-C^{14}$ (97 percent); sodium propionate- $1-C^{14}$ (97.3 percent); sodium acetate- $1-C^{14}$ (95 percent); propyl iodide- $1-C^{14}$ (69 percent, 69 percent, 72 percent on propionate); and propyl iodide- $2-C^{14}$ (47 percent on propionate). Other compounds whose syntheses have been studied include: Vinyl acetic acid- $1-C^{14}$, glucose- $1-C^{14}$, mannose- $1-C^{14}$, methyl iodide- C^{14} , cuprous cyanide- C^{14} , succinic acid- $1-C^{14}$, succinic acid- $2-C^{14}$, aspartic acid- $2-C^{14}$, oleic acid- C^{14} , ethyl iodide-1 or $2-C^{14}$ and valine- $1-C^{14}$.

In the studies on isotope effects in the use of C^{14} , preliminary runs have been made on the decomposition of oxalic acid in sulfuric acid. Effects of the order of magnitude of 6 percent have been observed, and more accurate experiments are now underway. α -Naphthalene malonic ester has been hydrolyzed and the resulting acid found to decarboxylate at room temperature or slightly above. This material can now be prepared labeled with C^{14} and isotope effects in the decarboxylation studied.

The formation of an acetylated amino ketone from alanine- $1-C^{14}$ and acetic anhydride in the presence of pyridine has been found to give inactive amino ketone

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and active CO_2 with the same specific activity as the carboxyl group of the alanine. This checks a similar experiment done with phenylalanine.

Rapid determination of low activity C^{14} samples (0.1 to 5.0 dis./min./mg. of barium carbonate with an accuracy of 1-5 percent) from biological material is a major block in the use of isotopes in human patients. This problem is being attacked in a number of ways.

Biological Chemistry. Preliminary experiments to determine the general methods and techniques of working with labeled purines which have been recently synthesized have begun.

Another incubation of liver slices with sodium propionate- 1-C^{14} has been made in order to obtain more material for chemical tests. Recrystallizations of suspected lactic acid from paper chromatographic analysis of the labeled products have shown that this material consists of a mixture of products, one of which is lactic acid. On degradation of lactic acid from incubation experiments with sodium propionate- 1-C^{14} , 95 percent of the activity was found in the one-position. On degradation of the lactic acid from sodium propionate- 2-C^{14} experiments, 16 percent was found in the one-position and 77 percent in the $\alpha + \beta$ positions. The degradation of acetic acid from the lactic acid is being studied by the Schmidt reaction.

The paper chromatography of cholesterol has been achieved on a Quilon treated paper. Ethanol-methanol and ethanol-water, 8:2, have been used. R_f values were determined and reproduced. Cholesterol was detected on these papers by two methods, one being by a windowless counter when cholesterol was labeled with tritium and the other by color with silicotungstic acid. Work is in progress on the separation of cholesterol from cholestenone.

Among other biological projects being studied are:

1. Chemical Separation and identification of labeled products from eggs of a hen which had been fed sodium acetate- 1-C^{14} .
2. Cholesterol isolation from carcasses of animals given radioactive materials, particularly the fatty acids. Degradation of these samples of cholesterol is underway.
3. Determination of the amino acid content of the S13 blood factor from atherosclerotic patients. So far, only the usual distribution of amino acids was observed, but it is hoped to compare these data with those from the S6 peak.

Photosynthesis Chemistry. In the earlier work the nature and identity of many of the early intermediate compounds involved in C^{14}O_2 fixation by green plants has been ascertained. The techniques and results which have developed are being used for further study of the chemical mechanism of photosynthesis.

The precursor of the α and β carbon atoms of phosphoglyceric acid has been shown closely related by reversible reactions to glycolic acid. Labeled glycolic acids have been fed to plants and the resultant glyceric acids degraded chemically. The results strongly suggest that glycolic acid is assimilated via a symmetrical two-carbon intermediate. The identity of this intermediate precursor of glycolic

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acid is as yet unknown. Possible C₂ compounds are being examined for radioactivity in short photosynthesis experiments.

The effect of iodoacetamide on the kinetics of sucrose synthesis is being reinvestigated under conditions at which photosynthesis is 50 percent inhibited. At this degree of inhibition the previous experiments show a maximum enhancement of sucrose synthesis.

The kinetics of the synthesis of the early products of photosynthesis is being investigated as a function of pH, temperature, ethanol concentration and light intensity. Integration of these results is in progress.

Ion exchange resin separation of C¹⁴-labeled phosphorylated compounds is being performed. Correspondence of C¹⁴ activity with that of the known compounds is being determined. Attempts are being made to separate the hexose monophosphates.

Phosphatase hydrolysis products of unknown photosynthetic phosphates are being identified. Possibilities of identification of sucrose phosphates are being examined.

Chemistry

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Part C

Metals and High Temperature Thermodynamics. Work is in progress on the following problems:

1. Liquid metal systems and heats of formation of intermetallic compounds.
2. Theory of refractory behavior.
3. Thermal conductivity of gases.
4. Measure and study of heat transfer coefficients in forced circulation film boiling.

Basic Chemistry. Solvent Extraction. The following problems are under investigation:

1. The chelate complex of lanthanum with TTA work has been completed. A report will be issued shortly.
2. Thermodynamic studies on rhenium.
3. Fe³⁺-Fe²⁺ electron exchange rate.
4. The thermochemistry of germanium (II).

Ore Reduction. The following subjects are completed, and a report will be issued shortly:

1. Solvent extraction using chelate process. A study of phosphate complexing.
2. A study of equilibrium in uranyl phosphate precipitation.

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10 Medical PhysicsFOR OFFICIAL
USE ONLY

Part A

Tracer Studies. Tracer studies are being continued with terbium, plutonium, tantalum, astatine, and sodium following their administration to laboratory animals.

Decontamination and Bone Metabolism Studies. Work with radio calcium is continuing. The study is being made of low phosphorus diet for decontamination of radio-strontium and radio-calcium.

Radioautographic Studies. Progress on histologic study of results of astatine injection suggests that this element is taken up by the thyroid in any of the valence states administered (negative, zero, and positive). Its damaging effect on other tissues appears to be manifested at high dose levels in the spleen, lymph nodes and kidney; and lower dose levels in the lacrimal gland, as well.

Radiochemistry. Carrier-free $Ta^{178,182}$ has been isolated from a hafnium target using a previously reported procedure. Carrier-free Be^7 has been isolated from a lithium target using a procedure based on the radio-colloidal properties of radio-beryllium. Astatine production and isolation has continued. Carrier-free procedures are being developed for the isolation of carrier-free radio-scandium from deuteron bombarded titanium.

Medical PhysicsUNCLASSIFIED

Part B

Bacteriology. The apparent increased sensitivity of E. coli to x-rays when irradiated in an atmosphere of argon, as reported in the June Progress Report, has been shown to be due to an increase in ionization received by the bacteria from secondaries generated in the argon. Very marked effects due to backscatter from this gas have also been demonstrated by exposing the organisms on agar surfaces in air immediately over a volume of argon contained in an ultra thin walled plastic chamber. More detailed studies of the importance of transition layers and backscatter in such radiobiological experiments are underway.

Hematology - Double nucleated lymphocytes. Strain A mice have been exposed to 250 rep doses of 190 Mev deuterons, and blood samples taken at intervals from a few minutes to a few hours after irradiation in order to determine the early portion of the curve of incidence of double nucleated lymphocytes. The blood smears are being counted at the present time.

Double nucleated cell counts are being continued on certain of the laboratory personnel.

Metabolism of Carbon¹⁴ Labeled Glycine. The third and fourth patients have been given 100 microcuries of carbon¹⁴ labeled glycine for the determination of life of the red blood cell, the turnover of plasma protein and the excretion of carbon¹⁴ in the breath. There have been no additional data on the first two patients since the last Progress Report was written.

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Stilbamidine. The data from the patient with multiple myeloma is still being analyzed and there has been no new information since the last monthly Progress Report. Mice with various types of malignant tumors were injected with carbon¹⁴ labeled stilbamidine; four days after injection the animals were autopsied. The concentration of carbon¹⁴ in the tumors was very small, not over one percent of the injected dose in any tumor. A significant concentration of the activity was found in the liver of each of the six tumor bearing mice. The total liver concentration ranged from twelve to forty percent of the injected dose. There seems to be a rough correlation between liver concentration and tumor weight; the liver with the twelve percent concentration having come from a mouse with a small amount of tumor tissue. In five normal mice, four days after injection, the liver concentration ranged between five and eight percent of the injected dose. Further studies are in progress.

Biological Effects of Radiation. The effect of tumors on the turnover of the normal liver, spleen and kidney of the host animal has been reported. This effect is marked; an 80 milligram tumor in the mouse is sufficient to increase the turnover of desoxypentose nucleic acid two or three fold. The effect is also a function of the size of the tumor, but a tumor weighing one to two grams only increases the turnover of this nucleic acid by fivefold. This effect is also observed by us for the tissues of gravid female mice and rats, and the effect has been observed with respect to two mouse tumors and two rat tumors. Both direct and indirect irradiation produces the opposite effect, a decrease in the nucleic acid turnover, as was first reported by Hevesy. Considering the rather obvious apparent relationship between these general observations and the activity of proliferative processes in these tissues, we have recently studied the turnover of desoxypentose nucleic acids in these tissues as a function of the age of mice. The results point to a direct relationship between animal weight (a function of mouse age) and the P³² specific activity of this nucleic acid in the liver and spleen when it is measured two hours after the administration of radioactive phosphate.

11. Health Physics and Chemistry

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Shielding for the 184-inch Cyclotron. The new concrete blocks for the deflected beam cave have been installed thus liberating a sufficient number of concrete blocks to allow the construction of a supplementary wall in the region of the north door. Under these conditions it is possible to run a reversed beam on the cyclotron even during working hours.

The high efficiency bismuth fission ionization chamber which has been under development for survey use in the region of very high energy neutrons has been completed and shows satisfactory operation. No surveys have yet been made with it.

Projects Completed by the Research and Development Group. The activities of the Research and Development Group are summarized as follows:

1. In preparation for the sample from the Chalk River reactor, the equipment has been completed and dry runs are in progress.
2. The box for the North American Aviation group in ORL for processing and studying bombarded steel in inert atmosphere has been completed.
3. The box for use in spectral studies of transuranic elements has been completed.

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During this period, 53 drums, 1 box, 4 packages and 6 gas cylinders were disposed of at sea.

12. Plant and Equipment

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Bevatron. The building is approximately 93 percent complete. The office and control room floor of the shop and office wing is now in use by a staff of engineers, although the heating plant for this portion of the building has not yet been completed. The roofing is now complete and the painting has been finished in all areas but in the shop floor and the magnet room. Half of the magnet walls have been poured and stripped. The electricians have installed about 40 percent of the fixtures in the building. Wiring raceway gallery steel is being delivered to the switchgear room preparatory to erection. Switchgear is being set in place over the trenches in the switchgear room by the erection contractor. Fine grading for the upper parking lot has been started.

Construction of Cafeteria. The cafeteria has been completed and operation commenced on July 17, 1950.

Construction of Animal House. The architects have been authorized to commence with working drawings which are in process.

Construction of Sheetmetal and Salvage Shop. Preliminary drawings have been completed and cost estimates are being prepared.

Radiological Laboratory at the University of California Medical School. The contractor began construction on July 5, 1950.

M. T. A. Project. Development and design continuing.

Measurements Project. Development and design continuing.

Miscellaneous Construction. Power Distribution. Work on 12 kv line was completed on April 30, 1950. Work on the associated power extensions is continuing.

Fire Protection. Work is proceeding on the 8 in. section of pipe line across the Bevatron area, which will complete the loop tying in the two main feeder lines.

Alterations to Synchrotron Building. Construction of the counting room in the synchrotron building is approximately 40 percent complete.

Cyclotron Improvements. Motor generator house for the increased magnet excitation is 87 percent complete.

Security Fencing. Directive for this work has not as yet been issued.

Building 8 Demolition and Re-construction. The demolition of the fire damaged sections of this building have been completed and the work of restoring

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sections of the building is getting underway. It is hoped that approximately 1/3 of the building space can be restored on a temporary basis until the Engineering and Service Building is completed in 1952.

Roads and Parking Areas. The grading for the open storage area has been completed and bids are being solicited for the paving.

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MAN-MONTHS EFFORT REPORT

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<u>PROGRAM</u>	<u>SUBDIVISION</u>	<u>MAN MONTHS EFFORT</u>	<u>COMMENTS</u>
184-inch Cyclotron	Operation	10.0	
60-inch Cyclotron	- -	-	
Synchrotron	Operation	8.6	
Linear Accelerator	Linear Accelerator - General	6.4	
	Van de Graaff - General	6.0	
	Development	.8	
Bevatron	Building	.2	
	Injector	-	
	Magnet	3.4	
	Vacuum System	-	
	Miscellaneous	-	
Experimental Physics	Cloud Chamber	6.0	
	Film Program	12.1	
	Ionization Chamber and Crystal Counter	-	
	Neutron-proton Scattering	.3	
	Proton-proton Scattering	.5	
	Absolute Cross Section Measurements	.8	
	General Physics Research	10.5	
	Meson Experiments with Synchrotron	2.0	
	Scintillation Counters - Research Experiments	.6	
	Pair Counter Experiments	6.7	
	Particle Momentum and Energy Analysis	2.5	
	Proton Elastic Scattering	.9	
	Magnetic Measuring Equipment	-	
	Meson Counting at the Synchrotron	1.0	
	Cryostat - Preparation of Liquid Targets	2.0	
	Instruments for General Use	2.3	
Theoretical Physics	Bevatron	-	
	General Physics Research	14.5	
Isotope Separation	Nier Spectrometer	.5	
Radioactivity Physics	General	3.1	
	Crystal Program	.4	

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PROGRAM	SUBDIVISION	MAN-MONTHS EFFORT	COMMENTS
Chemistry, Part A	Chemistry of Transuranic Elements	7.4	
	Nuclear Properties of Transuranium Elements	6.0	
	Transmutations with the 184" Cyclotron	16.7	
	Analytical and Service	14.0	
	Process Chemistry	11.7	
	Special Chemistry Development	1.0	
Chemistry, Part B	Synthetic and Experimental Chemistry	6.3	
	Biological Chemistry	6.8	
	Photosynthesis Chemistry	5.3	
Chemistry, Part C	Metals and High Temperature Thermodynamics	3.5	
	Basic Chemistry, including Metal Chelates	4.5	
	General	2.5	
	Ore Reduction	1.0	
Biology and Medicine Part A	Metabolism of Plutonium and Allied Materials	11.0	
	Decontamination Studies	7.0	
	Radiochemistry	4.0	
	Radioautography	2.0	
Biology and Medicine Part B	Tumor Metabolism	1.0	1.3 Consultant
	Special X-ray Studies, Radioactive Measurements, etc.	7.4	3.2 Man-Months
	Radioactive Carbon Studies	2.0	.3
	Fundamental Medical Research	8.4	4.2
	Hematology	.4	.6
	Medical Work with the 184" Cyclotron	1.5	-
	Fly Genetics	2.3	.3
	60" Cyclotron Bombardments	.2	-
	Physical Chemistry	12.6	8.0
	Specific Irradiation	2.6	-
	Donner Animal Colony Expense	1.5	1.9
Biology and Medicine, Part C	Synthetic and Experimental Organic Chemistry	19.0	
Health Chemistry, Physics	Monitoring and Disposal	7.5	
	Research and Development	24.8	
	Film Badge Program	7.3	
	Medical Examination Time	1.1	
Measurements Project Development	General	3.8	
M. T. A.	Design and Development	39.0	

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