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UNIVERSITY OF CALIFORNIA

Radiation Laboratory

Contract No. W-7405-eng-48

MONTHLY PROGRESS REPORT

No. 100

July 15 to August 15, 1951

August 29, 1951

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UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

July 15 to August 15, 1951

MONTHLY PROGRESS REPORT No. 100

August 29, 1951

1. Bevatron
(AEC Program No.1500)

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The magnet winding reached the halfway point on July 27.

A report on the generator noise production and recommendations for acoustic treatment have been received from R. W. Leonard and I. Rudwick; retained as consultants on this program. The use of fiberglass sound absorbing grilles on the generator exhausts and fiberglass walls around the air inlets to the machines are recommended. This is to be reviewed in a meeting during the week of August 27.

2. 184-inch Cyclotron Operation
(AEC Program No. 5741)

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The cyclotron was operated 20-1/2 hours per day during this period and, consequently, the crew was on duty for a total of 618 hours. About 91 percent of this time was used for research experiments. The time distribution was as follows:

Operation for customers	566.00 hrs	91.6 %
Mechanical troubles	19.25 hrs	3.1 %
Electrical troubles	9.75 hrs	1.6 %
Installation (magnet oil lines)	22.75 hrs	3.7 %
	<u>617.75 hrs</u>	<u>100.0 %</u>

3. 60-inch Cyclotron Operation
(AEC Program No. 903)

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A summary of operations was made for May, June and July, 1951 which showed the operating efficiency to be 85.5 percent. Beam intensities for α , D^2 and p ion were more than adequate to fulfill the requests of users of the machine.

4. Synchrotron Operation
(AEC Program No.5731)

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The synchrotron beam intensity has been increased during this period to a satisfactory level. Although the intensity is 50-75 percent of

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normal, it has been consistent.

Field parameters are still different from past history. It is hoped that a series of measurements now being made may explain what has happened.

Operating statistics are as follows:

Operation for customers	262.25 hrs	58.00 %
Tests with synchrotron	158.00 hrs	35.00 %
Maintenance	31.75 hrs	7.00 %
	<u>452.00 hrs</u>	<u>100.00 %</u>

5. Linear Accelerator and Van de Graaff Operation UNCLASSIFIED
(AEC Program No. 5731)

There was no operation during the first portion of this period, because the Van de Graaff column was still being sand-blasted. Approximately the entire 30 percent repair time was devoted to this task. It was found during the overhaul of the column that the bottom quarter section of the insulator system had been covered with sputtered metal from the electrodes to such an extent that the voltage gradient across this section was only about one-half of that which it should have been. It is believed that this condition has existed for over a year. The re-assembly of the machine was completed about the middle of this period, and operation has been very satisfactory since that time.

Operating statistics are as follows:

Running time	50%
Repair time	30%
Bake-in time	16.5%
Machine research	3.5%

6. Experimental Physics UNCLASSIFIED
(AEC Program No. 5211)

Film Program. Particle Trajectories. It is essential for accurate work in the non-uniform magnetic field of the cyclotron to know the orbits of mesons and other charged particles in some detail. A program has been initiated to integrate a family of such orbits with the differential analyser utilizing the empirically known magnetic field intensity distribution.

Grain Density of C¹² Tracks. Work has continued on tracks with very high rates of energy loss. Definite evidence for the pick-up of electrons by C¹² nuclei has been found, and fairly good proportionality has been observed between the gap density in the tracks and the reciprocal of the rate of energy loss.

Meson Masses and Energetics of Meson Decay. The program of work on the measurement of masses, the decay momentum of the μ meson, and range

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straggling has been continued vigorously, but no improved results are ready for quotation yet.

Meson Scattering. The total large angle scattering cross-section for 50-70 Mev π^- mesons in aluminum, copper and lead is being obtained. Because a large volume of emulsion must be carefully studied the results do not accumulate very rapidly, but definite results are in sight from the analysis of plates now on hand.

μ^- Meson Beam. A sufficient number of μ^- mesons have now been observed to insure the success of our method of separating μ mesons from π mesons, and a spectrum of the star prongs from μ^- mesons is being made.

Cloud Chamber. The large 4 ft. by 8 ft. continuous cloud chamber is nearing completion. This chamber is to be used to study the core of showers. The chamber has been tested several times and some design changes have been made; however, the chamber has produced tracks throughout the full sensitive area of 4 by 8 feet. At present the chamber is being prepared to take some test pictures.

A cloud chamber has been designed for the study of π^+ mesons scattering on deuterium. Assembly of the cloud chamber has begun. An ion chamber has been designed. It is to be used for detecting the photo disintegration of He^3 .

In the experiment on the photo disintegration of the deuteron, the electronic equipment has been tested and some preliminary pictures have been taken, using He. These pictures show some events occurring; however, more pictures using He are to be taken before an actual data run is made. The cloud chamber setup at the synchrotron is such that all preliminary work can be done using the beam from someone else's run.

The chamber for the study of Compton scattering on protons has been received from the shop. It is now being assembled and being readied for testing.

Neutral Meson Program. Further research has been conducted on the precision measurement of the gamma-ray spectrum arising from bombardment of a target by 340 Mev protons. In particular data have been obtained at 90° in the laboratory from the direction of the incident beam at which angle the spectrum should be more indicative of the angular distribution with which the neutral mesons are emitted than would the spectra at 0° or 180° . The data from this run have not yet been reduced.

The work continues on the yield of neutral mesons from proton bombardment of various elements in the deflected beam of the cyclotron. The data appear to be approximately compatible with a $A^{2/3}$ dependence after the region of the light elements through oxygen has been passed.

Comparison of N-P and N-D Cross Sections. Theoretical considerations have indicated that a precise comparison of the total cross sections of hydrogen and deuterium with respect to high energy neutron bombardment would indicate significant facts about n-p and n-n forces. An experiment is being prepared

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involving the use of high pressure hydrogen and deuterium chambers as attenuators, followed by a liquid hydrogen vessel as the recoil proton source.

Cerenkov Radiation Counters. Currently there are three different forms of Cerenkov radiation counters being tested by three different groups at the Radiation Laboratory; one similar to that tried by Dicke (Phys.Rev. 71, 737 (1947)), another similar to one described by Marshall (Phys.Rev. 81, 275 (1951)), and another designed here similar to one described by Jelley (Proc.Phys.Soc., Lond. A, 64, 82 (1951)). The first two attempt to discriminate against particles outside a small range of velocities while the third discriminates only against particles with too low a velocity to produce Cerenkov radiation but is simpler and more compact in design.

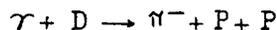
All three have given favorable preliminary results on pair electrons from the synchrotron x-ray beam. The third was tried on pair electrons from gamma-rays produced by the decay of π^0 mesons at the 184-in. cyclotron but the results indicated that a reduction in background counts would be necessary. Proof of the velocity discrimination of these counters is still lacking but all three are in stages of test and development.

Proposed Meson Detection at the 184-inch Cyclotron. A method of detecting pi mesons is being investigated. It is proposed that the pi mesons from various targets, be separated into a positive and a negative beam by means of a small circular-pole-face magnet. In the path of each beam a time of flight scintillation detector will be used to measure the meson velocity. In this way the numbers of negative and positive mesons may be compared at a given energy interval. Progress to date has been to identify pi mesons by time of flight and their range in material.

300 Mev Neutron Elastic and Inelastic Scattering. Construction is in progress on apparatus for the annular ring scatterer approach to the determination of the 300 Mev neutron elastic scattering cross-section.

Design work has been completed on the neutron shield for the crystal counter.

The Photoproduction of Negative Mesons from Deuterium. Gamma-rays from the Berkeley synchrotron impinging on a target containing deuterium nuclei produce negative pi mesons in the process



The negative pi mesons and one of the protons are looked for in coincidence using a counter arrangement consisting of two telescopes, with two counters in each telescope and a quadruple coincidence circuit with a resolving time of about 2.5×10^{-8} seconds.

The difference in counting rates between heavy water and ordinary water show a "smeared" angular correlation that would be predicted from the interaction of a gamma-ray with a nearly free neutron, using the energy and momentum conservation laws.

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Scattering of 340 Mev Protons from Nucleons in Light Nuclei. Scattered proton energy spectra have been obtained at a scattering angle of 30° from targets of H_2 , D_2 , and C $[(CH_2)_x - C, (CD_2)_x - C \text{ differences}]$. The spectra were obtained with the 35-channel magnetic particle spectrometer described previously, which now has an energy resolution of about 12 Mev at 300 Mev. The results have not yet been reduced from the data. The counting rates during the run were quite good: the peak of the carbon spectrum was obtained with 8 percent statistics in one hour of running time.

N-D Scattering. The experiments on N-D scattering at 270 Mev are now being analyzed and a report is being written. Data which has been gathered includes information on the angular distribution of protons produced in N-D collisions, together with some information on the distribution in energy of these protons at several different angles.

Cross Sections for Products from C^{12} Under 90 Mev Neutron Bombardment. While waiting for the supporting apparatus for the spinning disc and counters, a number of runs have been made to determine the self-absorption of C^{11} betas in the polyethylene disc. Pieces of polyethylene of 4.67, 9.14, 34.85, 69.90, and 143.50 mg/cm^2 were irradiated simultaneously in a scattered 340 Mev protons beam and counted for C^{11} betas. Correction back to zero time and extrapolation to zero thickness shows that the disc ($\sim 143.50 \text{ } mg/cm^2$) will permit approximately 0.315 ± 0.015 of the C^{11} betas born therein to be counted. Calculation from the ordinary absorption coefficient indicated a value of about 0.38.

It is noted that self-scattering becomes important below $\sim 10 \text{ } mg/cm^2$, increasing the count rate per unit weight at $\sim 4 \text{ } mg/cm^2$ slightly over that at zero thickness.

D-P Scattering Using 190 Mev Deuterons. Both the elastic and inelastic scattering investigations at this energy are completed, and have been covered in reports UCRL-1440 and UCRL-1442. The total cross section has been measured as $(92 \pm 7) \times 10^{-27} \text{ } cm^2$. In this case we mean by the total cross section the sum of the inelastic scattering cross section and the elastic scattering cross section for scattering by more than 10° in the cm coordinate system. In this way the question of infinite coulomb scattering can be avoided.

D-P Scattering Using 345 Mev Protons. Modification of the electronic components is still in progress.

Inelastic Scattering Program. Work on the inelastic scattering of protons from heavy elements is continuing with most of the recent effort going to re-instrumentation. An attempt is being made to devise apparatus to identify the various charged particles, emitted during bombardment, besides measuring the energy distribution. Preliminary results with the new apparatus are encouraging.

Synchrotron Studies. During this month the operation of the synchrotron has been fairly satisfactory. The beam level has been high enough so that a regular schedule of experiments has been run each week. However, it has not been so high as in the Spring months.

One of the main experiments to which time has been devoted during the month is that in which the π^- -p coincidences from deuterium bombarded with gamma-rays are being investigated. The π^- mesons are observed at relatively small angles to the beam ($<45^\circ$) while the protons are observed at large angles ($>90^\circ$). Due to the spread in momentum of the neutrons in the deuterons, there is not an exact correlation of angles of the π^- and protons. Rather mesons over a range of angles may be in coincidence with protons at a given angle. The range of angles is in good agreement with that predicted by deuteron theory. Energy measurements also give good agreement with theory although the experimental data are not complete. Unfortunately it is very difficult to measure the short range protons, which correspond to high energy mesons, and whose number would give some idea of the probability of the process $\gamma + n \rightarrow \pi^- + p$ having a flip of the spin associated with it. Measurements of the energies should give an excitation function for the reaction. Further work on proton counting has showed that the counters can be successfully biased so as to count protons only or protons and mesons together. During the coming month it is hoped to have a run on a deuterium gas target to measure the yield of photo protons. Runs on the yield of protons and mesons from carbon have given reasonably good agreement with the results of others.

A number of experimenters are working on Cerenkov radiation counters. These may be useful, for example, in neutral meson experiments where high energy gamma-rays must be counted by means of the high energy electrons they produce.

Several runs have been made for experiments on the Compton effect.

Proton counters are being developed for measurements on the energy distribution of neutrons.

With the present yields, it will be very difficult to get much energy resolution.

The experiment on neutrons from the absorption of π^- mesons has not met with any success, either because of low yield or background, or a combination of both.

7. Theoretical Physics
(AEC Program No. 5211)

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MTA. Theoretical work has been continuing on the problems referred to in the last quarterly report, UCRL-1436. One phase of the differential analyzer study of particle trajectories in the central region of the cyclotron has been completed. Three-phase rf fields determined from three dimensional electrolytic plotting tank measurements were used in this study.

Particle trajectories in the fringing and external focusing magnet fields are being studied by a graphical method in the plane of symmetry, together with an approximate determination of vertical focusing forces in this region.

Other Studies. An analysis of the experimental data on 42 Mev neutron cross sections is being made to see whether the optical model of the nucleus is applicable in this energy range. An interpretation of the observed equality of cross sections for photo-production of charged and neutral mesons is being attempted from the point of view of intermediate coupling meson theory. This work is closely connected with the analysis of recent results on meson-nucleon scattering.

A general study of the dependence of photonuclear cross sections on energy and atomic number is in progress. The study of the gamma-ray spectrum from 340 Mev protons on carbon is continuing. Experimental data on photomeson production in deuterium is being analyzed.

Calculations have been started to study the interference between n-n and n-p scattered waves in high energy n-d scattering from which it is expected to determine the relative sign of the two waves and the forward scattering amplitudes. Work on the scattering of protons from carbon has been completed.

Analyses of proposed cloud chamber experiments on π -d scattering are in progress.

8. M.T.A. Program
(AEC Program No. 1500)

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Mark I Cavity. The results of tests on a 200 megacycle cavity with a sprayed aluminum interior surface have indicated that it may be necessary and desirable to treat the present aluminized surface of the Mark I vacuum tank in order to reduce the porosity of the coating and eliminate the dust. A test program was inaugurated with the samples treated in various ways tested in the 200 megacycle cavity.

Three general approaches to the problem of achieving a satisfactory surface on the interior of the Mark I tank have been considered. First is the use of an appropriate type of paint over the sprayed aluminum coating to stabilize the present dusty surface. The second method is to overlay the present aluminum surface with another metal applied by vacuum evaporation

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and the third would be the mechanical treatment of the present surface to reduce the porosity and to eliminate dust. It seems unlikely that it would be possible to establish the acceptability of any paint in the period of time before a decision should be reached. Also after discussions with D.P.I. the second method was abandoned on the basis that no significant improvements would be obtained. In the third case, shot peening of test panels of sprayed aluminum with 14 mil steel shot has produced a surface which appears to be entirely satisfactory. Test panels that have undergone this treatment have been tested in the B-2 cavity and produced an x-ray level equal to or less than the best obtainable with bare steel. It is now recommended that this shot peening treatment be used for the entire aluminum surface of Mark I. This treatment appears to be the best alternative from the point of view of cost and time. The operation is expected to require about 25 working days on a three shift basis.

Mark I Vacuum Problems. A copper curtain is being designed to provide for separate pumping for the region between the liner and the vessel to insure an outward flow of air during that period when the pressure is high enough to transport dust particles. Since the work involved in making this change will, to a large extent, overlap the liner installation it is felt that the net time delay from this improvement would be only 1 or 2 weeks.

A lot of difficulty with electron emission has been traced to oil layers on surfaces exposed to high electric fields. It seems to be general experience with both rf and d.c. equipment that the emission current from surfaces can be reduced by eliminating the oil vapor from the vacuum systems. For this reason it is now recommended that the present diffusion pumps be remodeled to make use of mercury rather than oil. Initial operation will be conducted with the present liquid nitrogen trapping system until such times as two stage freon refrigeration system for -100°F can be installed. It is estimated that the change over of the pumps will take approximately three months with a net loss in the Mark I schedule of one month. In the opinion of representatives of D.P.I., the performance of the mercury pumps should equal and possibly exceed that of the present oil pumps. The change over to mercury would involve the renovation of the present jets and the installation of new baffles and condensers. Since it would appear unwise to use oil booster pumps with the mercury diffusion pumps for fear of introducing oil into the vacuum systems, it is planned to use only Kinney pumps for the booster. This modification will result in an increase in pump down time of approximately 4 hours.

A pressure of 2×10^{-6} mm of mercury has been obtained at Livermore vacuum tanks. The present leak into the cavity is between 230 and 400 micron liters per second compared to a goal of 70 micron liters per second.

A program of magna-flux testing of defective welds on the west end of the vessel is essentially done. The most difficult problem has been to chip out defective welds. Although most of the vessel welding was done in the field, the particular welds that have been found defective were shop welds.

Mark I Current Measuring Target. Several problems have come to light regarding the manufacture of a suitable test target of aluminum for the Mark I accelerator. A welded target is not desirable since it has been learned that

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welds can be expected to be only 50 percent efficient and such welds might not stand the stress of thermal cycling. Thus far it has not been possible to contract for the fabrication of a spun cone, although a supplier has recently been contacted who claims to have equipment for the job. If a spun target is not obtainable, the use of either steel target or the redesign of the aluminum target with cooling tubes attached will be investigated. A spare welded aluminum target has already been ordered.

Mark II Target Problems. Arrangements have been made with the University of Chicago for the use of their cyclotron in the study of the bombardment of the various materials with 250 Mev deuterons. It is hoped that the experiments will improve the knowledge of the neutron yield per deuteron at various energy levels. Consideration is being given to placing the scattering target within the dee, which can be done with this machine. The first project is to find out where the particles come out. This will be done by the use of photograph emulsions and a Zeus meter, after which a thin window will be placed in a face plate at a proper location.

Consideration is being given to the use of water as a moderator in producing tritium. The chief advantages of using water as a moderator are simplicity of design and cheapness. A possible design would embody a vacuum tank six feet in diameter surrounded by a 1 foot layer consisting of 50 percent water and 50 percent lithium aluminum alloy. It is estimated that 95 percent of the neutrons entering this lattice from the vacuum tank would be absorbed. Actually there would be only 40 percent water near the inside edge of the lattice and nearly 60 percent near the outer circumference because of the larger channels for the removal of the cooling medium. Calculations show that there would be a 3.5 percent loss in the lattice and 5 percent of the neutrons will pass through the outer boundary. Another 1 foot thickness of lattice that could be 3 parts water to 1 part alloy would catch the remaining 5 percent with another 1 percent loss, giving a total loss of 4-1/2 percent. There is a possibility of using lead in the outer lattice for the reason that there are some fast neutrons not stopped by the water. Since some metal shielding would be needed, economy calls for the use of this shield at the smallest possible diameter.

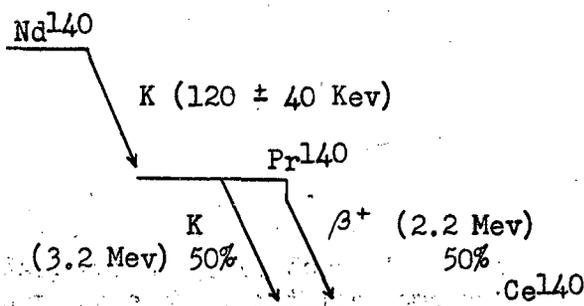
9. Chemistry

Part A

(AEC Program No. 5311)

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Decay of Nd¹⁴⁰ and Pr¹⁴⁰. The decay of Nd¹⁴⁰ and Pr¹⁴⁰ has been studied by means of the beta spectrograph, gamma ray spectrometer, and the bent crystal x-ray spectrometer. The results are explained by the following scheme, with all transitions allowed:



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Alpha Spectroscopy. The magnetic alpha spectrograph has been used to examine the alpha particles from decay of Cm²⁴², Pu²⁴⁰, Pu²³⁸, and U²³⁴. All these even-even nuclei show two groups, separated by 40 to 50 Kev. The several odd-even and even-odd nuclides which have been examined have had much more complicated spectra, but they also include level separations of about 40-50 Kev.

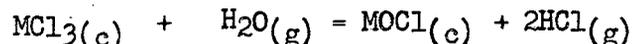
Vapor Pressure of Americium Fluoride. The vapor pressure of a sample of AmF₃ containing 0.5 percent La, 0.2 percent Al, 0.2 percent Ca, and 0.2 percent Pu as the only impurities detectable by spectrographic analysis has been measured in the temperature range 1015-1273°K by the effusion method. The sample was contained in a tantalum vessel, which was heated by a wolfram coil embedded in beryllia. Temperatures were measured with a platinum, 90 percent Pt - 10 percent Rh, thermocouple inserted into a thermometer well drilled into the bottom of the effusion vessel. A temperature calibration was established by observations of the melting points of a series of pure salts of known melting point.

Within the experimental region the vapor pressure was observed to obey the relation:

$$\log_{10} P_{\text{mm Hg}} = (10.95 \pm 0.2) - \frac{20,090 \pm 200}{T}$$

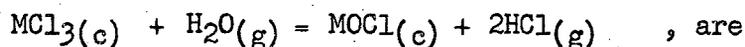
The results indicate the AmF₃ is somewhat less volatile than PuF₃, if the measurements of Simpson et al (T. E. Phipps, R. L. Seifert, and O. C. Simpson, Metallurgical Laboratory Report CN-3223, September 26, 1945) are accepted for the latter compound. Since a higher rather than a lower volatility is expected from the decrease in ionic radius in going from PuF₃ to AmF₃, and since there is no obvious explanation for the discrepancy, it is planned to carry out measurements of the vapor pressure of PuF₃ in our own apparatus.

Vapor Phase Hydrolysis of Rare Earth and Actinide Trichlorides. Measurements of the equilibrium constant of the type reaction:



as a function of temperature have been carried out for LaCl₃ and AmCl₃, by a refinement of a method previously described (Broido and Cunningham, U. S. Atomic Energy Commission declassified document AECD-2918, July 14, 1950).

Thermodynamic constants for the reaction



Element	ΔH_0	ΔH_{785}	ΔS_{785}	ΔH_{298}	ΔS_{298}
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for La, ΔH_0 is 27.9, ΔH_{785} is 25.6, ΔS_{785} is 30.8, ΔH_{298} is 27.0, and ΔS_{298} is 33.5;

for Am, ΔH_0 is 22.2, ΔH_{785} is 19.9, ΔS_{785} is 30.5, ΔH_{298} is 21.3, and ΔS_{298} is 33.3.

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Crystal Structures of Sodium Superoxide. The compound NaO_2 has a disordered cubic structure at room temperature. At about -40°C it goes into the cubic pyrite structure. At about -80°C it changes into a third structure, stable down to liquid nitrogen temperatures. The lattice of this third structure has been shown to be orthorhombic with dimensions:

$$\begin{aligned}a &= 4.25 \text{ \AA} \\b &= 5.55 \\c &= 3.44\end{aligned}$$

A tentative structure has been deduced from packing considerations, but the calculations have not been completed to show that it is in agreement with the diffraction intensities. This structure is a distortion of the cubic structure, related to but different from the orthorhombic low temperature form of sodium cyanide.

Crystal Structure of AmOCl . A reliable preparation of americium oxychloride showed a diffraction pattern corresponding to the LaOCl structure. This result confirms the structure of AmOCl and the identification of a previous sample which was called AmOCl on the basis of x-ray data alone.

Chemistry

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Part B
(AEC Program No. 5311)

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

1. Oxide phase diagrams.
2. Gaseous hydroxides of Mo and W.
3. High temperature x-ray studies.
4. Refractories
5. Stability of gaseous CN at high temperatures.
6. Heat transfer in forced convection film boiling.
7. Thermal conductivity of gases at high temperatures.

Basic Chemistry. The following problems are under investigation:

1. Germanium chemistry.
2. Thermodynamics of rhenium.
3. Solubility of the rare earth fluorides.
4. Thermodynamics of indium.
5. Thermodynamics of thiosulfates.
6. The hydrolytic polymerization of zirconium.
7. Electron exchange rate between Fe^{2+} and Fe^{3+} .

Chemistry

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Part C

(AEC Program No. 6400)

Synthetic and Experimental Chemistry. The preparation of a number of compounds has been carried out or investigated during the past month. These include valine-4,4'-C¹⁴, chloroacetic-2-C¹⁴ acid, aspartic- β and - γ -C¹⁴, guanine-8-C¹⁴, vinyl-1-C¹⁴, glucose-1-C¹⁴ (separation by boric acid complex), methyl-C¹⁴ iodide (200 mc), acetic-2-C¹⁴ acid (130 mc), phenylalanine-2-C¹⁴, cholesteryl laurate, tristerine-T, cholesterol-23-C¹⁴, testosterone-3 and -4-C¹⁴, cholesterol-T, phthalylglycine-1 and -2-C¹⁴, phthalylglycyl-C¹⁴-glycine (1 and 2 labeled), glycyl-C¹⁴-glycine (1 and 2 labeled).

In addition, investigations have been made on the (1) separation of amino acids by alkaline displacement from Dowex 50, (2) low-level carbon 14 measurement from large animal experiments, (3) radiation decomposition of glycyl-1-C¹⁴-glycine and (4) irradiation induced reactions in simple organic compounds.

Biological Chemistry. During the past month investigations have been made on the following studies: (1) metabolism of sugar and acetic acid in the normal and hypophysectomized rats; (2) isolation of steroids from algae; (3) cholesterol studies including a) feeding of tritium labeled cholesterol to human beings, b) comparative feeding of carbon and tritium labeled cholesterol to rabbits and c) feeding of carbon 14-labeled cholesterol to rats; (4) isolation and degradation of glycerol from eggs produced by hens fed labeled acetate; (5) studies of distribution, metabolism and conjugation of labeled stilbamidine; (6) distribution and excretion of carbon 14 from humans fed glycine-2-C¹⁴ and (7) body distribution and mode of elimination of labeled purines in mice.

Photosynthesis Chemistry. The study of the role of sedoheptulose and ribulose in photosynthesis is being continued. Periodate and lead tetra acetate degradation methods for ribulose are being perfected and the results previously obtained have been more firmly established. Ribulose, as well as sedoheptulose, is labeled in central carbon atoms in the shortest times. A major portion of activity in short C¹⁴O₂ photosynthesis appears to be in C-2 and C-3.

A study of the pentose, tetrose and triose monophosphates of soy bean extracts is being continued. Evidence for two different sedoheptulose monophosphates in all the plants investigated is being accumulated.

Ion exchange analysis of phosphorylated compounds from algae (Scenedesmus) has been carried out. Identification of the major components is in progress.

Kinetics of C¹⁴ accumulation in the intermediates of steady state photosynthesis has been determined for the major components. Compilation of the results is in progress.

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10. Medical PhysicsUNCLASSIFIEDPart A
(AEC Program No. 6000)

Tracer Studies. Tracer studies are being continued on rats investigating the fate of isotopes of gold, thulium, plutonium and wolfram.

Radiochemistry. Carrier-free W^{181} and Au^{196} have been prepared using previously reported procedures. Studies have been continued on the radiation induced oxidation and reduction of dilute aqueous solutions.

Medical PhysicsUNCLASSIFIEDPart B
(AEC Program No. 6000)

Biological Effects on Animals (184-inch Cyclotron). The studies of irradiation of the hypothalamus of the rat are being continued.

Activation Analysis. Elution characteristics of wolfram and ruthenium from Dowex 50 ion exchange column have been determined.

Biological Effects of Radiation. Bacteria. Dessicated E. coli when irradiated in vacuo with x-rays shows great resistance to radiation. The response of such dehydrated bacteria to irradiation is being compared to that of organisms grown and irradiated anaerobically (but in an aqueous medium).

Bi-lobed nuclear lymphocytes. Blood smear counts from fast neutron irradiated dogs are almost complete, with rabbit work just started. It is doubtful that the irradiation of these cells will demonstrate a positive effect as the result of this experiment.

Biological Effects of 100 Mev C^{6+} Particles. Physical properties of the carbon ions are currently being studied. These include specific ionization range and stopping power. Further modification of the ionization chambers is being done. The 60-inch cyclotron crew is working to increase the beam intensity.

Instrumentation. The pinhole camera, using a crystal of thallium-activated sodium iodide as an intensifier for photographic recording of gamma-rays, has been tested and an in vivo radioautograph of an I^{131} -bearing tumor in a patient has been taken with the camera.

C^{14} -Labeled Glycine Metabolism. Autopsy on the first patient to receive C^{14} labeled glycine showed, at 526 days after administration, that most of the tissues has activities of approximately 0.02 d/min/mgm $BaCO_3$. This represents approximately 2 percent of the administered dose. Comparison with the autopsy data on three other patients indicates that there are probably two components of C^{14} elimination from the tissues fifty days or more after administration. The first has a half-time of about fifty days

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and the second cannot be estimated from the available data. The fifty day component has a counter-part in urinary excretion of C^{14} but the longer component may be too weak to see in the urinary excretion with the most sensitive of our available instruments.

Study of Lipoprotein Structures and Transformation. The study of lipoprotein structures and transformations, with especial reference to those classes involved in the radiation injury sequence continues. The exact mechanism by which heparin injection produces a sequence of lipoprotein transformations in the reverse direction from that produced by total body irradiation is being investigated, with the view of determining whether radiation injury in the early phase actually operates to induce a heparin deficiency. The nature of the factor active in lipoprotein transformations, and which is induced in animals and humans by heparin administration, is being studied actively by the physical chemistry group. Preliminary data indicate this "active factor" to be a high-density lipoprotein (of the X-type), quite sensitive to salt and heat. Further isolation studies are awaiting arrival of D_2O^{18} for density fractionation without necessity of using high salt concentrations.

11. Health ChemistryUNCLASSIFIED

(AEC Program No. 5311)

Equipment Development Group Activities. Work in progress is listed below:

1. Equipment for the Fe-Co Extractor was rebuilt, tested and used successfully.
2. Equipment for use in the 2-in. lead cave for processing bombarded americium from the Hanford pile was completed.
3. Improved equipment for processing pile-irradiated animal ash was completed and ready for assembly.
4. Equipment and box for washing the 60-in. cyclotron target assembly containing a U-graphite column for North American Aviation was completed.
5. Small equipment for use in processing radioactive chemicals, for use in gloved boxes, etc., completed included two cold bath units, a model for a capper control for use in the Yt-preparation box, redesign of the chain drive manipulator used in the remote control lead boxes, and one lead glass window.
6. Slug assemblies in accordance with new Hanford specifications were completed and loaded with animal ash for pile irradiation.
7. A new simplified target-carrying box for transportation of all three types of targets bombarded on the 184-inch cyclotron was completed.
8. A new isolated water circulation system for cooling 60-inch

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targets containing large quantities of alpha emitters was completed.

9. An initial design for an internal foil target probe for use in the 60-inch cyclotron was completed and used.

10. A special container to supply carbon ions to the ion source of the 60-inch cyclotron was completed and used.

11. Members of Health Chemistry met with Radiation Laboratory chemists and architects for planning and discussion of the new chemistry building.

12. Gloved and other boxes made for various experiments included a box for preparation of samples for the x-ray spectrometer, special boxes for fast processing of bombarded heavy elements, replacement and improvement of old boxes for Am and Cm processing, a box for a high-level alpha source, a box to be used in connection with the processing of pile-irradiated animal ash, and a box for vaporization and loading samples for the alpha ray spectrometer.

Airborne Activity Control Group. Extensive air movement inspections were made on hoods and Berkeley Boxes. Exhaust and supply filters were replaced on hoods and Berkeley Boxes. Blower inspections were made and filter queens were oiled. Mercury vapor surveys were made.

12. Plant and Equipment

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Bevatron Instrument. (Program No. 1500. 5-424-9001) The winding of Quadrant No. II was completed July 30. Winding of Quadrant No. III started August 10.

M.T.A.-Mark I. (Program No. 1500. 5-424-9004) Development and design continuing.

M.T.A.-Mark II. (Program No. 1500. 5-424-1004) Development and design continuing.

Miscellaneous Construction. (Program No. 1500. 5-424-1001)

Corporation Yard Development. This was started on March 26, 1951 and is 85 percent complete.

Waste Oil Tank. This work was started May 2, 1951 and is 100 percent complete as of July 19, 1951.

Building 29 and 30 Sprinkler System. This work was started on May 1, 1951 and the job was completed on July 17, 1951.

North Gate House, Building 65. Plans and specifications are out for bid and bid opening is scheduled for Friday, August 17, 1951.

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OFFICIAL
USE ONLYMiscellaneous Construction (Continued)

Slope Stabilization, Bevatron Site Area. The earthwork on the slope above the Bevatron Building is complete. Work on forming the concrete gutter on the bench midway up the slope has commenced. Work is progressing on slide No. 6. Grubbing of plant life from the toe of the slope near the outlet to the 48-in. storm sewer has started, and some rip-rat delivered to the site.

Building 67, Compression House. Work started May 10, 1951 and is 99 percent complete.

Building 29, Alterations for Purchasing Department. Work was started on July 23, 1951 and is 90 percent complete.

Animal House. (Program No. 1600. 6-424-9007) Structural tile facing and partitions are being installed and are approximately 75 percent complete. Metal lath and plaster partitions are in progress and are being erected. Approximately 67 percent of the general construction contract is complete. Bids are out for built-in laboratory furniture. Design of animal runs, fencing and indoor floor covering is essentially complete.

Radiological Laboratory at the U. C. Medical School. (Program No. 1600. 6-424-9008) Work on this building is virtually complete, outside paving having been finished yesterday. Furniture installation is finished. Electrical fixtures have been hung. Final inspection is planned for the week of August 20. It is expected that the 70 Mev medical synchrotron built by General Electric will arrive in San Francisco during the week of August 20.

Miscellaneous Construction. (Program No. 1600. 5-424-1001) Paving for 184-in. Cyclotron Site. Plans and specifications are in the hands of prospective bidders and bid opening is scheduled for Thursday, August 16. The plans call for concrete paving adjacent to some eight buildings on the hill, execution of the work to be done in such a way that communications between buildings will not be seriously hampered. It is anticipated that the work will be completed before the fall rains begin, and will cost about \$45,000.

MAN-MONTHS EFFORT REPORT

Scientific Personnel

PROGRAM	SUBDIVISION	MAN-MONTHS EFFORT	COMMENTS
9200 MTA - Mark I	Design and Development	9.6	
9200 MTA - Mark II	Design and Development	51.3	
9500 Bevatron	Miscellaneous	.2	
<u>Operations</u>			
<u>Physics Research</u>			
3000 Weapons	General	8.0	
5211 Thomas Cyclotron	Electron and XC Models	19.1	
Experimental Physics	Cloud Chamber	22.9	
	General Physics Research	55.6	
	Instrument for General Use	2.4	
	Special Development	13.5	
	Magnetic Measuring Equipment	1.7	
	Charge-Exchange Accelerator	.5	
Theoretical Physics	General	8.7	
Photographic Film Detectors	General	17.5	
Isotope Separation	General	-	
Radioactivity Physics	General	5.9	

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PROGRAM	SUBDIVISION	MAN-MONTHS EFFORT	COMMENTS
<u>Chemistry Research</u>			
5311 Basic Chemistry Research, Part A	Chemistry of Heavy Elements	6.0	
	Nuclear Properties of Heavy Element Isotopes	15.9	
	Transmutations with 184" and 60" Cyclotrons	10.9	
	Analytical and Services	14.6	
	Special Chemistry Development	2.0	
	Mass Spectroscopy, Beta Ray Spectroscopy	.8	
	Instrument Development and Services	4.0	
	X-Ray Crystallographic Measurements	3.0	
	Health Chemistry Research	11.2	
	Basic Chemistry Research, Part B	Metals and High Temperature Thermo- dynamics	6.0
Basic Chemistry, including Metal Chelates		6.0	
5361 Applied Chemistry Research	Process Chemistry	12.5	
<u>Reactor and Accelerator Operation</u>			
5731 Synchrotron	Operation	11.7	
5741 184-inch Cyclotron	Operation	13.9	
5751 Linear Accelerator and Van de Graaff Generator	Operation	10.8	

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PROGRAM	SUBDIVISION	MAN-MONTHS EFFORT	COMMENTS
6000 Biology and Medicine Part A	Metabolic Properties of Various Materials	11.0	
	Radiochemistry	4.0	
	Radioautography	2.0	
6000 Biology and Medicine Part B	Instrumentation for Quantitative Measurements of Radiation	2.0	Consultant 1.0 Man-Months
	¹⁴ C Metabolism	3.4	.8
	Use of Radioactive Materials in Human Physiology and Experimental Medicine	7.3	8.1
	Trace Elements & Irradiation Studies	5.0	2.2
	Radiation and Mutation Rate	1.6	.3
	Physical Biochemistry	12.8	3.0
	Biochemical Response to Irradiation	3.4	1.0
	Miscellaneous	1.0	-
	Donner Animal Colony Expense	1.5	2.0
	Metabolism of Lipo Protein and Lipids	6.1	8.7
	Iron Metabolism Hematopoiesis	2.8	.5
	Internal Irradiation and Hematological Response	1.8	.3
	Biological Effects of Cosmic Radiation	1.8	.5
	Health Medicine	4.3	-
	6400 Biological Research	Synthetic and Experimental Organic Chemistry	6.3
Biological Chemistry		7.1	
Photosynthesis Chemistry		5.6	
Metabolism of Fission Products		12.3	
6500 Biophysics Research	General	1.2	

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