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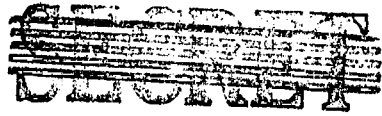
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Radiation Laboratory

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MONTHLY PROGRESS REPORT

No. 83

February 15 to March 15, 1950

March 28, 1950

Classification changed to **DECLASSIFIED**
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Berkeley, California

UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

February 15 to March 15, 1950

MONTHLY PROGRESS REPORT No.83

1. BevatronUNCLASSIFIED

Magnet. Approximately 54 percent of the steel required for the frame has been received from the mill and 30 percent of the plates have been machined. Leg assembly has started and 9 of the 288 leg slabs are assembled. Yoke assembly is expected to start next week.

Drawings of the principle remaining magnet coil parts are expected to be completed during the next month.

Building. About half of the structural steel is erected and the roofing of the magnet room has begun. The magnet foundation will be started when the roof is completed overhead to prevent rain reaching the excavation. The completion date of the building has been advanced one month until August 1 but some magnet erection work can be done on the night shift before that date.

Injector. The ion gun and rectifier were tested at high voltage on March 16. Calibration of the voltmeters and polishing to stop corona is proceeding. Pending installation of the oil cooling system for the rectifier operation is limited to about fifteen minutes per hour.

The linear accelerator design is well along with completion of the drawings expected in about a month. Tests on the oscillator using the Eimac XM15W tube are continuing for the 32 Mev Linac to replace the present radar oscillators. The bevatron injector oscillator will be practically identical to the one used for the 32 Mev machine.

Accelerator. Development of the ferroxcube reactors for the oscillator and amplifier has been delayed by procurement troubles but experimental work is going on continuously. The oscillator can be made to follow the required curve of frequency vs. magnet current within better than 1 percent without trimming adjustments. Two amplifier stages are planned between the oscillator and the accelerating electrode.

Magnet Model Tests. No error has been found in the result that 16 Kilogauss can be obtained with change of the poles only to the 1 x 4 aperture design. Tests are continuing on the 2 x 6 aperture poles to obtain the best shape.

Magnet Power Supply. The Westinghouse Co. reported that the first generator tested (for delivery to Brookhaven) had a large 24th harmonic ripple and requested our opinion of its importance. They were advised that the higher harmonics should not exceed the 12 phase ripple which had been specified. Manufacture of the machines is now proceeding. Installation drawings which have

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been prepared by the San Francisco office of Westinghouse are nearly complete. These are to be sent out for bids to electrical contractors.

2. 184-inch Cyclotron Operation

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The cyclotron was used for research experiments approximately ninety-six percent of the 476 hours that the crew was on duty.

The cyclotron is under operation an additional ten hours a week to help meet the demand for more experimental time. This is obtained by operating eighteen hours on week days instead of the usual sixteen.

3. 60-inch Cyclotron

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During the month of February, the operation set an all-time record with productive bombardment reaching an average of 85 percent. Trouble occurred with the deflector assembly during the first week in March. This was due to shorting of the plates of the large deflector by-pass condenser. The trouble was cured by making the deflector condenser assembly more rigid, and a new deflector and exit strip were installed. The old exit strip was intact but had warped due to the heat of the beam.

4. Synchrotron Operation

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The average beam intensity during the past month has been approximately 3750 R/hr at 1 meter from the target measured with an ionization chamber behind 1/8 inch of Pb. The peak intensity recorded was 6000 R/hr.

Further simplification of the azimuthal compensation has been invoked with no apparent loss in gamma intensity or stability of operation. Only 5 of the original 16 magnetic flux loops are in use.

Preliminary investigations have been started on the effect of a second fast pulse orbit contractor. An attempt is being made to damp radial oscillations. Contractor coils receiving a fast pulse during injection time and placed axially above and below the orbit 90° from the injector give a slight beam intensity improvement. Pulse shaping experiments on this device will continue.

The new dispenser cathode injector is now undergoing high voltage tests. The gun has held 140 kv so far and some ground shield design changes are being made to help surpass this voltage limitation.

5. Linear Accelerator and Van de Graaff

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During the time covered by this report a number of repairs were made. A new selector switch was installed in the high voltage end. The shells were cleaned and polished. The tank was sand-blasted and glyptuled. Lead shielding

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was put on the Van de Graaff tank. These repairs have effected a reduction in the bake-in time from 6 to 8 hours to approximately 2 hours. Since the belt current was not reduced by these measures, it appears that use will have to be made of the other half of the belt, for which a regulator system is necessary. The lead shielding seems to have reduced x-radiation from the Van de Graaff by at least a factor of 2. No exact measurements have as yet been made. Operating statistics for this period were as follows:

Hours		Percentage	
Running time	159.8	Running time	45 percent
Repair	35.4	Repair	10 percent
Linac Research	5.5	Linac Research	1.5 percent
Install, Bake-in and paint	152.8	Install, Bake in and paint	43.5 percent
Total Hours	353.5		

6. Experimental PhysicsUNCLASSIFIED

Film Program. Meson Mass Measurements. Approximately one half of the plates required for the meson mass measurement program have now been exposed on the cyclotron. Microscope study of the plates is now in progress. In this measurement the plates are exposed on the cyclotron in such a way that π^+ , π^- , and μ^+ mesons and protons, all of approximately the same velocity, strike the plates simultaneously. The protons are used to obtain a calibration point on the range energy curve. It is thought that this study will yield values of π and μ meson masses which will have probable errors of about 1 percent.

π - μ Decay Energy. Apparatus is now being constructed for a measurement of the energy received by a μ^+ meson when a π^+ meson decays at rest. The method is simply that of measuring the lengths in photographic emulsion of the μ^+ meson tracks associated with π - μ decay. Calibration of the plates is accomplished by using π^+ mesons of approximately the same velocity as that of μ^+ mesons of π - μ decay.

Cloud Chamber. The cloud chamber group has been measuring the tracks in the n,d scattering experiment as well as working on the 16 inch pantagraph and radial expanding cloud chambers. In addition, we are preparing a cloud chamber to measure the energy spectrum of the electrons from the decay of the μ -meson.

High Energy Photons. During the past month the experiments on the high energy photons from nucleon-nucleon collisions have been devoted to the measurement of photon yield versus bombarding proton energy. For the purpose of evaluating these relative yields it has been necessary to obtain more accurate data on the photon spectrum at various proton energies and angles of view.

The magnet for the new pair spectrometer and the problems of instrumentation associated with it are nearing completion.

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Neutron Induced Stars in Photographic Plates Outside the 184-inch Shielding. The observation of fast-neutron induced stars in photographic emulsion placed outside the cyclotron shielding in chosen locations is being studied as reported in the previous month. Sufficient data have now been obtained for operation with the deflected proton beam, but the exposure of the films for other types of beam operation is not yet completed. It is possible to say, however, that the order of magnitude of the star-producing neutron flux outside the shielding is at most a few per square centimeter per second in rough agreement with previous estimates by bismuth fission counter surveys.

Electronic Equipment for High Energy Pair Spectrometer. The direction of the work in the past month has been toward assembling "a complete coincidence channel". The first such complete coincidence channel, which will be tested, consists of two scintillation counter units, including light pipes and distributed preamplifiers, Hewlett-Packard distributed amplifiers, and a suitable coincidence circuit. Each of the component circuits of this coincidence channel has been constructed and tested.

Three different dual-type coincidence circuits, which have been tested with the pulse generators, appear to provide resolving times of the order of 5×10^{-8} seconds or better.

Proton Elastic Scattering. In the previous runs, counting rate has been limited by the speed of the electronic circuits between the photomultipliers and the coincidence mixer. Because of the scarcity of cyclotron time, it has been thought advantageous to spend some time trying to increase the speed of the equipment before making another run. In an attempt to obtain signals from the photomultipliers which are large enough to be mixed in crystal diode coincidence mixers without amplification, high voltage pulsing circuits have been constructed. The signals thus far obtained from this system are not large enough to operate the coincidence circuits. The circuits are being investigated in an attempt to improve the signal height.

Delayed Neutron Emitters. One run was made on the cyclotron. Results indicated possible emitters besides N^{17} , but BF_3 counter sensitivity was too low to give quantitative data. Shorter delay times were indicated.

Efficiency of chambers was tested. A new preamp, negative capacity type, is being constructed to improve signal to noise ratio. A crystal counter to detect 1-5 Mev neutrons is also under construction.

Relative Angular Yield of Neutrons from Light Elements under 31 Mev Proton Bombardment in Linear Accelerator. During this period, attention was paid the problem of neutron background and accordingly some changes in target supports and proton beam collimator were made. The one experimental run made to date which incorporated the changes gave inconclusive evidence of improvement because of the low beam intensity available at the time.

Particle Spectrometer. Further measurements of the energy distribution of the neutron beam produced by proton bombardment of a beryllium target in the 184-inch cyclotron were made together with various experimental checks on the

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behavior of the apparatus.

Total Cross Sections. Total cross sections of various elements for neutron energies between 110 and 270 Mev were measured with bismuth fission chambers. The neutrons were formed by bombarding a 1/2 inch Be target with protons for several probe positions. The neutron energy distribution resulting is peaked at a value about 70 Mev less than the proton energy for a given probe radius. The total cross sections for light elements such as carbon and aluminum are flat over a neutron energy interval about 100 Mev wide from about 170 to 270 Mev (the highest energy obtainable). The flat interval breadth decreases with atomic number, dropping to perhaps 50 Mev for lead.

The n-p cross section is apparently flat near 270 Mev also. For 220 Mev neutrons the value obtained is 41 ± 4 millibarns compared to 38 ± 1.5 millibarns at 270 Mev.

Capture of π^- Mesons in Hydrogen. The resolving power of the pair spectrometer used for analyzing the gamma rays arising from the capture process has been improved and new spectra have been taken. As a result of these measurements it becomes more likely that there are actually two groups of gamma rays, one centered at 70 Mev and one centered at 130 Mev. If the interpretation by Marshak is accepted, then these two peaks represent gamma rays arising from a neutral meson and a single gamma ray arising from the capture process directly, respectively. The spectrum then permits placing limits on the mass of the neutral meson. These limits correspond to $1.3 \text{ Mev} < M_{\pi^0} < 2.7 \text{ Mev}$. Also the relative magnitudes of the two groups give an indication of the coupling constants pertaining to interactions of the neutral meson. It must be pointed out that this interpretation is quite conjectural and further data are needed.

Analysis of Photographic Plates Exposed to Mesons from Proton-Proton Collisions. The analysis of the plates obtained by exposing plates to mesons produced by bombarding a liquid hydrogen target in the external beam of the 184-inch cyclotron has yielded some interesting information. The energy distribution at 30° is highly peaked towards the high energy end. This indicates that the reaction possibly leads to the production of a deuteron rather than a neutron and a proton separately. If this were true the energy distribution would be monochromatic at the high energy end. Actually it is probably true that this process does not occur entirely but that sometimes neutrons and protons are emitted separately.

Meson Production by Protons on Protons. The magnetic channel method of looking at the mesons produced by the proton beam on a given target is working out very satisfactorily. The polyethylene-carbon difference is being investigated. Indications are that the question of the meson production by protons on protons will be answered satisfactorily.

P-p Scattering at 340 Mev. During this month two runs have been made on p-p scattering to improve the precision of the measurements and eliminate systematic errors.

D-p Scattering at 340 Mev. One preliminary run has been made on scattering of

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180 Mev deuterons on protons. On this occasion an external beam of deuterons was obtained by scattering for the first time. The current was about 8×10^{-13} amperes. No effort was made to maximize it. It was apparent that d-p elastic scattering can be satisfactorily measured by a coincidence system using the same apparatus as p-p scattering.

Half-life of $\pi^- \rightarrow \mu$ Meson Decay. A run in cooperation with Steinberger and Moseley at the synchrotron on an electronic measurement of the half-life of the $\pi^- \rightarrow \mu$ meson decay was made. Results are not yet satisfactory but there is every reason to believe that with some modifications of the apparatus it will be possible to obtain a quantitative result. The principle of the method is to stop a π meson in a stilbene crystal and record photographically the ionization pulse on a cathode ray oscilloscope. This π meson transforms into a μ meson and later into an electron. The $\mu \rightarrow e$ decay is detected and in this way we recognize that the particle stopped must have been a π meson. The recorded pulse must then show a double peak the first corresponding to the stoppage of the π meson, the record to the $\pi \rightarrow \mu$ decay and the average time interval between the peaks is the $\pi \rightarrow \mu$ mean life.

Synchrotron Studies. In the meson program data recheck runs have been made on the positive meson energy spectrum from hydrogen targets.

Work has been started on the detection of neutral mesons by gamma-gamma coincidence and will continue.

Some preliminary experiments have been completed to prove and develop equipment for measuring $\pi \rightarrow \mu$ half-life and mean life. The electronics used is being improved since the original work gave support to the experimental principle involved but the resolving time of pulses and their shapes must be improved before any accuracy can be obtained in measuring the time between pulses on oscillograms.

Additional bombardments have been made of Zn and Ag in the gamma induced activity program, and the work on meson stars in nuclear plate emulsion has continued.

One bombardment of a lithium target in the photon beam has been made in an experiment designed to produce "hook and fork" particles. The "hook" is described as being one interpretation advanced so far of cosmic ray cloud chamber evidence of an excited proton decaying into a positive particle plus a neutral particle, while the "fork" is theorized as being an excited neutron decaying into a negative meson and a proton. In spite of the rarity of such evidence in cosmic ray cloud chamber work, it was deemed advisable to set up an experiment to look for these particles in the synchrotron. The plates are being scanned for evidence of these interesting events.

Work has also been started on the energy spectrum of the decay electron from positive mesons by triggering the cloud chamber from the same positive meson detection equipment used in meson counting experiments so far.

UNCLASSIFIED7. Theoretical Physics

Meson Theory. Considerable work has been done comparing strong and weak coupling theory. The influence of the strong neutron-proton interaction on the spectrum of mesons produced in p-p collisions is being studied; in particular the probability of formation of a deuteron seems very large.

Machines. Numerous calculations of orbits in the linear accelerator and cyclotron have been done. A study has also been made of the cyclotron target problem.

8. ChemistrySECRET

Part A

Element 98. Definite identification has been made of an element with atomic number 98 produced through irradiation of Cm²⁴² with 35 Mev helium ions in the Berkeley Crocker Laboratory 60-inch cyclotron. The isotope which has been identified has an observed half-life of about 45 minutes and probably has the mass number 244. It is observed to decay through the emission of 7.1 Mev alpha-particles, in agreement with predictions. Other considerations involving the systematics of radioactivity in this region indicate that it should also be unstable toward decay by electron capture.

The chemical identification of this element is based on ion exchange adsorption methods employing the resin Dowex-50. Element 98 precedes berkelium and curium off the column just as dysprosium precedes terbium and gadolinium.

The new element has been named californium, for the state and university where it was discovered.

Low Mass Isotopes of Radium. One manifestation of a closed nuclear shell at 126 neutrons is the occurrence of relatively long-lived alpha-emitters of Bi, Po, At, Em and Fr with 126 neutrons or less as compared with the respective isotopes having a few more than 126 neutrons. In a search for similar light isotopes of radium, strong evidence was found for Ra²¹² by isolation of Fr²¹² and Em²¹² daughters from a purified radium fraction. The activity was produced by irradiation of thorium with 340 Mev protons, followed by isolation of the radium within 12 minutes. Thus Ra²¹² has a half-life of at least a few minutes, as compared to the microsecond half-lives expected for some of its heavier isotopes.

Bi²⁰⁷. Long-lived Bi²⁰⁷ has now been observed as the daughter of the electron-capture decay of Po²⁰⁷ and also of the alpha decay of At²¹¹. A similar activity was produced over two years ago by irradiation of lead with deuterons on the 60-inch cyclotron, but in that case the assignment was uncertain. The yield of Bi²⁰⁷ from At²¹¹ corresponds to a half-life of 100x years for Bi²⁰⁷ if its counting efficiency is x.

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Bent-Crystal X-ray Spectrometer. The x-ray spectrometer has been used to observe plutonium L x-rays produced in the decay of Cm²⁴². The results are as follows:

Pu L α_2	14.14 \pm 0.01 Kev
Pu L α_1	14.31 \pm 0.01 Kev
Pu L β_2	17.28 \pm 0.02 Kev
Pu L β_1	18.37 \pm 0.02 Kev
Pu L γ	21.46 \pm 0.04 Kev

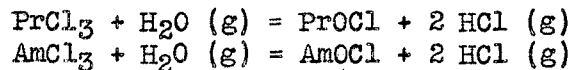
Search for Pu²³⁹ in Pitchblende Ores. We have begun a determination of the amount of Pu²³⁹ in pitchblende from various locations, to try to determine the mechanism for production of this 2.4×10^4 year isotope. The results are as follows:

Colorado pitchblende (no determination yet for uranium, probably ~50 percent of U₃O₈): 1 part Pu²³⁹ in 3×10^{11} parts pitchblende.

Canadian pitchblende (16 percent U₃O₈): 1 part Pu²³⁹ in 1.4×10^{12} parts pitchblende.

Belgian Congo pitchblende (45 percent U₃O₈): 1 part Pu²³⁹ in 2.3×10^{11} parts pitchblende.

Vapor Phase Hydrolysis. The equilibrium constants for the reactions:



have now been measured at several temperatures by the method previously described for the La and Sm compounds. The numerical results will be reported later.

Heats of Solution of Metals. The heat of solution of americium metal in 1.5M HCl has been determined at 25°C in a microcalorimeter. In order to test the method, lanthanum and praseodymium metal were also tested. The results are:

Am	164.8 \pm 1.5 Kcal/mole
La	166.7 \pm 1.2 Kcal/mole
Pr	165.0 \pm 2.5 Kcal/mole

The results for La and Pr are 10 and 8 Kcal lower than the respective values reported by Bommer and Hohmann.¹ Repetition of the measurements with larger amounts of lanthanum in a different calorimeter confirmed our results.

Chemistry of Curium. Experiments are in progress on about 70 micrograms of curium which was recently isolated from neutron irradiated americium. It has been shown that the potential for the Cm⁺³ \rightarrow Cm⁺⁶ couple is more negative

¹Bommer and Hohmann, Z. Anorg. Allgem. Chem. 248, 357 (1941).

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than -1.6 volts. A fluoride was prepared by precipitation. The magnetic susceptibilities of the fluoride and of curium oxide are being investigated.

Crystal Structures of Niobium Borides. We have observed some new phases in the niobium-boron system. NbB_2 has the AlB_2 structure and occurs over a composition range. Dimensions of the hexagonal lattice are as follows:

$$\begin{aligned} a &= 3.085, c = 3.311 \text{ (high boron content)} \\ a &= 3.110, c = 3.264 \text{ (low boron content)} \end{aligned}$$

Nb_3B_4 has the Ta_3B_4 structure with the orthorhombic cell:

$$a = 3.30, b = 14.1, c = 3.13$$

NbB has the CrB structure with the orthorhombic cell:

$$a = 3.92, b = 8.71, c = 3.165$$

ChemistryUNCLASSIFIED

Part B

Synthetic and Experimental Chemistry. Among the new and continuing synthetic problems being studied by the organic chemistry laboratory are the preparation of the following labeled compounds: Methanol- C^{14} , methyl iodide- C^{14} , ethanol- $1-C^{14}$, propanol- $1,2$ or $3-C^{14}$, propyl bromide- $1,2$ or $3-C^{14}$, cuprous cyanide- C^{14} , diethylmalonate- $2-C^{14}$, fumaric acid- $2-C^{14}$, fumaric acid- $1-C^{14}$, tartaric acid- $2,3-C^{14}$, tartaric acid- $1,4-C^{14}$, malic acid- $1-C^{14}$, succinic acid- $1-C^{14}$, glucose- $1-C^{14}$, mannose- $1-C^{14}$, vinyl acetic acid- $1-C^{14}$ and valine-methyl- C^{14} .

The direct reduction of heavy metal and mixed heavy metal salts (chromium, nickel, lead, etc.) of the fatty acids by high pressure hydrogenation is being investigated, and thus far results look encouraging. The simplicity of the preparation is most promising.

Possible methods for the synthesis of aspartic acid labeled in the two position, and lysine labeled in the six position are being studied. It is hoped to develop high yield preparations of these compounds so they may be used in large scale feeding experiments.

Biological Chemistry. The work on the preparation of a number of purines and nucleic acids for biological studies is continuing. Low activity runs are nearly completed; guanine, guanazole, adenine and its triazolo analog are being prepared. A number of other purine and nucleic acid derivatives and isoteres are being made in inactive preparations for antagonism studies of cancer inhibition. Toward this end the synthesis of adenine, guanine and 2,6-diaminopurine homologs of $[3^o, 2^o h]$ thiazolidinopurine, 7-thiapurine and 9-thiapurine has been undertaken.

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Tritium labeled cholesterol has been prepared by treating cholesterol with tritium gas in the presence of platinum oxide and glacial acetic acid according to the classical deuterium experiments. Thus far, 5.4 grams of cholesterol labeled with tritium have been prepared and more runs are in progress.

In the work on the paper chromatography of cholesterol and its derivatives, one test using silicotungstic acid has been found applicable. Work is now in progress to find a solvent system suitable for paper chromatography.

The in vitro liver metabolism studies have continued with particular attention directed toward the identification of possible dicarboxylic acids. The degradation of alanine from a number of bicarbonate and acetate experiments has been completed.

Photosynthesis Chemistry. Intermediates of Photosynthesis. The work of this laboratory on the identification of the early products of photosynthesis has been continued. The organic phosphoric acid esters which can be separated by filter paper chromatography have been subjected to the action of barley malt phosphatase. The hydrolysis products have been chromatographed for identification. Previous experiments have indicated presence of phosphates of glucose, mannose, fructose, a number of other neutral compounds and a strong hydroxylated carboxylic acid; the identity of these compounds is under investigation.

The presence and role of volatile acids and aldehydes in photosynthesis is being investigated.

Chromatography of Volatile Acids. The sodium salts of formic, acetic and propionic acids were applied to Whatman No. 1 filter paper in phosphate buffer at pH 8-9 and developed with phenol saturated with aqueous phosphate buffer (one volume of 0.8 M buffer pH 8-9, shake with water-saturated phenol). Exposure of the dried paper to an x-ray film gave excellent radiograms; no volatility was noted.

Iodoacetamide Inhibition Experiments. Experiments have been conducted to study the effect of iodoacetamide on the path of carbon in photosynthesis.

Carbon Dioxide Fixation Experiments. Carbon dioxide fixation by a variety of organisms is being investigated to study the evolutionary development of these organisms. The following organisms are under investigation: Hansenula anomalia, Tetrahymena geleii, Lactobacillus casei, Allomyces arbuscula, Blastocladia Pringshemii, Azotobacter agilis, Butyribacterium Rettgeri and Clostridium thermoacticum.

ChemistrySECRET

Part C - Project 48B

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

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1. Thermodynamics of CN and N₂ gases.
2. Gaseous hydroxide species.
3. Liquid metal systems and heats of formation of intermetallic compounds.
4. Theory of refractory behavior.
5. A report has been issued entitled, "The Higher Fluorides of Plutonium", UCRL-633.

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

1. The chelate complex of lanthanum with TTA.
2. Thermodynamic studies on rhenium.

Ore Reduction. The following subjects are under investigation:

1. Solvent extraction using the chelate process. A study of phosphate complexing.
2. A study of equilibrium in uranyl phosphate precipitation.
3. Work on micro amperometric titration of uranyl ion with chromous ion has been completed.

9. Medical Physics

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Part A

Tracer Studies. The fate of Ta¹⁸² is being studied in rats after intravenous and intramuscular administration, complexed and not complexed with citrate. Several groups of animals have been set up with aerosols containing Ta¹⁸² in order to determine lung distribution.

Decontamination and Bone Metabolism Studies. Work is continuing on the effects of plutonium deposits in the skeleton on the alkaline phosphatase of bones and serum. It has been found possible by hourly intravenous injections of purified alkaline phosphatase to maintain the serum level at five times the normal value. The effect of this on bone metabolism is being investigated.

The mechanism of calcification is being studied in growing, rachitic and adult rats with the aid of radiocalcium.

Radioautographic Studies. The study of the effectiveness of radioactive At²¹¹ in the destruction of thyroid tissue using dose levels ranging from 1.2 microcuries is nearing completion.

An experiment has been set up with At²¹¹ using the Curtis-Dunning inbred strain of rats weighing between 180-200 grams. The amounts of At administered to the animals were 0.5, 1, 10, 50, 100, and 150 microcuries with 5 animals in each group. The post injection period will be approximately 41 days. Complete blood counts and weights will be taken on the groups injected with 50-100 and 150 microcuries at 1, 2, 5, 8, and 13 day intervals and at 7 day intervals thereafter. The three low level groups were weighed weekly. All rats will be

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injected with 10 - 20 microcuries of radioactive I^{131} twenty-four hours prior to autopsy. A portion of the trachea will be removed with both thyroids intact and a gamma count taken of this area. One thyroid will be taken for histological work and radioautographs wherever possible.

Radiochemistry. Astatine studies have continued. A simplified procedure for astatine analyses have been developed based on the observation that the element deposits quantitatively on silver from 3N $HClO_4$. Millicurie amounts of At^{211} can now be prepared with a modified target design using alpha beam intensity up to 10 microamperes. Preliminary results indicate that astatine may be introduced into organic compounds using procedures conventionally used in the preparation of the iodine derivatives.

Re^{184} has been separated from a tantalum target using a carrier-free procedure previously reported. Mg^{27} , produced by deuterons on aluminum, has been isolated using a technique based on the formation of a radio-colloid of the carrier-free Mg^{27} . Millicurie quantities of Nb^{95} have been separated from $Nb^{95}-Zr^{95}$ fission product mixture.

Medical PhysicsUNCLASSIFIED

Part B

Biological Effects of Radiation. Deuteron irradiation of rats. Work is being continued with selective irradiation of specific body regions in animals using the collimated deuteron beam of the 184-inch cyclotron.

Yeast. Studies of both the haploid and diploid yeasts show a significantly greater resistance to the effects of radiation in a nitrogen atmosphere as compared to bombardment in an atmosphere of oxygen.

Bacteriology. Irregular deviations from simple one-hit and multiple-hit phenomena have been found in the survival curves of E.coli to ultraviolet light. Investigations are in progress testing the hypotheses that these deviations are due to (1) photodesensitization of the organisms during the course of ultraviolet survival experiments by visible light in the laboratory or by the visible components of the ultraviolet lamp, (2) a mixture of cells in the original culture resulting in at least three variations in response to ultraviolet light.

Hematology- double nucleated lymphocytes. Additional counts made on Radiation Laboratory personnel do not change the incidence figures reported last month.

Two persons with acute infectious mononucleosis have been counted and show 2/15,000 and 0/8,000 respectively of double nucleated lymphocytes.

Four patients with chronic lymphatic leukemia, two without therapy, and two before and after treatment have been counted. The former showed incidences of 1/10,000 and 38/10,000, the latter before treatment 1/5,000 and 15/5,000, and

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after treatment 3/5,000 and 20/5,000. It is interesting to note that the two patients showing a high incidence had white counts of only about 50,000 and those with the lower figures had white counts greater than 200,000.

Metabolism of Simple Carbon Compounds Labeled with Carbon 14. The efforts of the entire group working on this problem are still temporarily transferred to the lipoprotein and atherosclerosis problem.

Studies of Carbon 14 Labeled Stilbamidine. Further studies on the patient with multiple myeloma, in addition to those which were reported in the previous progress report, show that during the first twenty-four hours following the injection of the carbon 14 labeled stilbamidine approximately 2 percent of the injected carbon 14 was excreted in the urine. During the third and fourth weeks after injection the urinary excretion of carbon 14 had changed little from day to day; each twenty-four hour excretion contained about 0.5 percent of the injected carbon 14. At the present time too few fecal samples have been analyzed to permit any conclusion regarding excretion by this route as compared with urinary excretion.

Trace Analysis. Activation analysis of tissues is being continued. The efficiency of a gamma-ray counter using a stilbene crystal has been increased to approximately 10 percent for one Mev gamma-rays. Studies of zinc metabolism in rats show uptake in both the pancreas and the parotid glands. In the pancreas there is an inverse effect between the expected ratios of the uptake of carrier free zinc and larger quantities of zinc; with carrier free zinc there is less uptake than when using larger amounts of zinc. This is thought possibly to be a manifestation of some type of toxicity reaction to zinc. In the parotid gland there is a significant uptake and concentration of zinc. This is probably related to the excretion of saliva, and related to the enzyme carbonic anhydrase in the role of salivary secretion.

Physical Chemistry. The ultracentrifugal studies on the serum of individuals with a variety of diseases are being continued, as has been reported in the immediate past progress report. At the present time tritium labeled cholesterol and P³² labeled phospholipids are now available. The labeled cholesterol and phospholipids will be utilized for studies of experimental atherosclerosis in animals. Ultracentrifugal preparation of various blood fractions is now in progress and will be continued.

Metabolism of Iron. The group of investigators studying metabolism of iron in secondary polycythemia found in the Peruvian Andes is still in Peru.

Glycine. Carbon labeled glycine has been administered to a patient with lymphatic leukemia. Results so far indicate that the major portion of the carbon 14 will be excreted in the breath. A small portion will be excreted, about 6 percent, in the urine and a negligible amount in the feces. A satisfactory uptake in hemoglobin and the plasma proteins has been observed which will permit measurement of the life span of the red blood cell and the turnover time of the plasma proteins.

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Tritium Studies. The equipment for the preparation and measurement of tritium in biological fluids has now been completed and is in routine operation. Studies have been started of measurement of the total body water in both normals and in patients with leukemia and polycythemia.

10. Health Physics and Chemistry

UNCLASSIFIED

A number of projects have been completed by members of the Research and Development group. These include:

1. An enclosure for a vac line box.
2. An interchange box for gloved boxes.
3. Cone hot baths with special baskets for particular jobs.
4. A turret pipettor.
5. Six Berkeley Boxes, 3 interchange boxes, 10 lucite centrifuge tube holders, and work on 9 Berkeley Boxes partially completed.

Preparations for x-ray diffraction of americium are being made.

11. Plant and Equipment

UNCLASSIFIED

Bevatron. Structural steel for the Bevatron Building is approximately 50 percent erected and riveted. Progress on the Bevatron magnet is as follows: steel received approximately 5,000 tons or approximately 55 percent; fabrication 32 percent; and assembly of magnet wedges just starting. On the Bevatron equipment \$1,000,000 order, the contractor has reported approximately 70 percent completion and several units have been received at the site.

Construction of Cafeteria. Foundations as well as the structural steel framing have been completed. Work is continuing on utilities and wood framing.

Construction of Animal House. Preliminary design of the animal house is proceeding.

Construction of Sheetmetal and Salvage Shop. Design has not been started.

Warehouse. This is essentially complete except for some equipment items and associated open storage area.

Radiological Laboratory at the University of California Medical School. The architects are continuing with working drawings.

Miscellaneous Construction. Alterations to Laboratory Buildings. Alterations to Room 203E in the Chemistry Building are essentially complete.

Decontamination Unit. The construction of this project has been completed.

Power Distribution. Work on the 12 kv line to the hill substation is nearly complete. Work on the other sections is continuing.

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UNCLASSIFIED

Fire Protection. The first phase is completed; work on second phase has been suspended.

Alterations to Synchrotron Building. Shop extension is complete; plans for counting room are still in preliminary stages.

Roads and Parking Areas. Work reported in progress last month is completed. A new section of reinforced paving is in progress north of Building 6.

Alterations to Building 16. This job has been in progress for approximately one month and is nearing completion.

Cyclotron Improvements. Preparations are being made for construction of the motor generator house for the increased magnet excitation.

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UNCLASSIFIEDMAN-MONTHS EFFORT REPORT

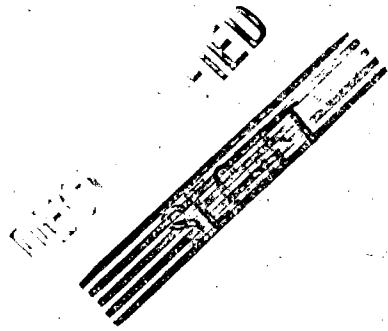
SCIENTIFIC PERSONNEL

PROGRAM	SUBDIVISION	MAN-MONTHS EFFORT	COMMENTS
184-inch Cyclotron	Operation	10.3	
60-inch Cyclotron	- -	-	Non-Project
Synchrotron	Operation	8.1	
Linear Accelerator	Linear Accelerator - General	3.5	
	Van de Graaff - General	3.6	
	Development	.9	
Bevatron	Building	.1	
	Injector	2.5	
	Magnet	2.6	
	Vacuum System	.2	
	Miscellaneous	.1	
Experimental Physics	Cloud Chamber	6.0	
	Film Program	11.2	
	Ionization Chamber and Crystal Counter	2.3	
	Neutron-proton Scattering	.4	
	Proton-Proton Scattering	1.8	
	Meson Range and Decay Measurement	-	
	Absolute Cross Section Measurements	.6	
	General Physics Research	10.9	
	Meson Experiments with Synchrotron	2.9	
	Scintillation Counters -Research		
	Experiments	.8	
	Pair Counter Experiments	6.5	
	XC Cyclotron	2.3	
	Particle Momentum and Energy Analysis	1.1	
	Proton Elastic Scattering	1.0	
	Magnetic Measuring Equipment	1.3	
	Meson Counting at the Synchrotron	1.3	
Cryostat- Preparation of Liquid Targets	1.0		
Theoretical Physics	Bevatron	.4	
	General Physics Research	11.7	
	Linear Accelerator	4.1	
Isotope Separation	Nier Spectrometer	.2	

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MAN-MONTHS EFFORT REPORTSCIENTIFIC PERSONNEL
(Continued)UNCLASSIFIED

PROGRAM	SUBDIVISION	MAN-MONTHS EFFORT	COMMENTS
Chemistry, Part A	Chemistry of Transuranic Elements	4.5	
	Nuclear Properties of Transuranium Elements	5.0	
	Transmutations with the 184" Cyclotron	13.9	
	Analytical and Service	17.5	
	Process Chemistry	9.9	
Chemistry, Part B	Synthetic and Experimental Chemistry	6.0	
	Biological Chemistry	6.8	
	Photosynthesis Chemistry	5.7	
Chemistry, Part C	Metals and High Temperature Thermodynamics	3.0	
	Basic Chemistry, including Metal Chelates	1.5	
	Ore Reduction	2.5	
Biology and Medicine Part A	Metabolism of Plutonium and Allied Materials	12.0	
	Decontamination Studies	7.0	
	Radiochemistry	4.0	
	Radioautography	2.0	
Biology and Medicine Part B	Tumor Metabolism	.6	1.1 Consultant Man-Months
	Special X-ray Studies, Radioactive Measurements, etc.	10.3	1.6
	Radioactive Carbon Studies	.6	-
	Fundamental Medical Research	6.1	2.6
	Hematology	.4	.7
	Medical Work with the 184" Cyclotron	1.5	.1
	Fly Genetics	2.3	.3
	60" Cyclotron Bombardments	.2	-
	Physical Chemistry	12.1	2.0
	Specific Irradiation	4.0	-
Donner Animal Colony Expense	.5	1.0	
Biology and Medicine Part C	Synthetic and Experimental Organic Chemistry	20.2	
Health Physics, Chemistry	Monitoring and Disposal	5.9	
	Research and Development	16.2	
	Film Badge Program	1.0	
	Medical Examination Time	2.2	



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