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ATC-500.914 BERKELEY
CONSTRUCTION PROGRAM REPORTS



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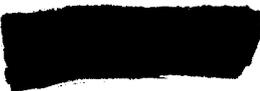
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BOX No. NB-326-87-3 (62 of 65)

FOLDER AEC-500.914 BERKELEY
CONSTRUCTION Prog. RPTS

1090817



UNITED STATES
ATOMIC ENERGY COMMISSION
BERKELEY AREA
P.O. Box 559
Berkeley, California

Refer to File No. EIDM A-4
AB-40

February 5, 1947

FIELD PROGRESS REPORT

Area Name Berkeley

Project Designation Univ. of Calif.

Period Ending 31 January 1947

A. PERSONNEL:

| | |
|----------------------|-----|
| Radiation Laboratory | |
| Project 48 | 721 |
| " 48-A | 50 |
| " 48-B | 26 |
| " 48-C | 4 |
| TOTAL | 801 |
| Area Office | |
| Officers | 4 |
| Enlisted Men | 3 |
| Civilians | 76 |
| TOTAL | 83 |

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BOX No. N3-326-87-3 (62965)
FOLDER AEC-500 914 Berkeley
Construction Prog. RPTS

B. CONTRACT DATA:

Contract No.: W-7405-eng-48
Type: CFFF
Contractor: The Regents of the University of California
Description: Research
Date of Contract: 1 May 1943 to 30 June 1947

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REGISTERED



AIR MAIL

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Subject: FIELD PROGRESS REPORT

B. CONTRACT DATA (Cont.):

Contract Appropriation: \$25,300,000.

Approximate Expense for January 1947: \$ 393,100.

Approximate Expense for January 1947 broken
down by projects:

| | |
|--------------|-------------|
| Project 48 | \$ 370,000. |
| Project 48-A | 14,200. |
| " 48-B | 6,600. |
| " 48-C | 2,300. |

Approximate Expense to 31 January 1947: \$ 19,078,600.

Estimated Cost to 30 June 1947: \$ 22,533,800.

C. NARRATIVE:

1. Laboratory Work - Project 48:

a. 184" Cyclotron - The 184" cyclotron has been operated during the month for film studies to determine the maximum radius at which the beam can be intercepted, and to determine the general cyclotron characteristics. Bombardments have also been regularly performed for the Chemistry Group and cloud chamber work has continued.

In the latter part of January, the field of the magnet was reversed, so that the neutron beam from the target now issues from the opposite side of the tank than heretofore. This has been done so that the beam will emerge from the machine on the north side and enable cloud chamber studies to continue during the time the floor on the south side of the building is being torn up.

The concrete floor in sections of the cyclotron building is presently being broken up and removed so that a thicker floor can be laid for supporting the heavy shielding which will be placed around the machine. A wall of concrete shielding five feet thick will be placed completely around the machine, and additional shielding in the form of large concrete cubes will be used in regions of greatest radiation hazard.

During the time work is being done to replace the floor, the cyclotron will be operated only during the evening shift.

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Subject: FIELD PROGRESS REPORT

b. Linear Accelerator - Due to mechanical failure of one of the two electric hoists which were supporting the recently delivered forty foot resonant cavity for the linear accelerator, one half of the cavity was severely damaged. As a result of this accident experimentation is continuing on about a twenty-foot length of the original cavity.

Tests to date on the twenty-foot section show that the cavity resonates at the desired frequency and has a Q which is high, although somewhat less than theoretical.

A new forty-foot section has been ordered and delivery is expected during the first part of March.

Considerable progress has been made on radar transmitter designs employing cavities as circuit elements. The output presently obtainable is roughly one-half megawatt.

Cold testing of the five-megawatt magnetron is continuing. A large quantity of data has been obtained on the magnetic and electric fields in the cavity and various modes have been found to exist.

Considerable effort has been expended in the past month toward completing the Van de Graaff machine and good progress has been attained.

The equipment in the high voltage shell is practically installed and connected electrically. Installation of the meters and connecting the leads to the selector switch remains to be done. The electrical cables inside the shell will also have to be shielded.

Two additional supporting braces for the textolite "A" frame have been fabricated during the month, and are presently being installed.

Some trouble has been experienced with vacuum leaks in the accelerating tubes. It will probably be necessary to remove the tubes again to correct these leaks.

About two-thirds of the circular hoops, which will encircle the mechanism and A frame, have been formed.

It is expected that a beam may possibly be obtained from the Van de Graaff about the end of February. However, at that time the proton deflector system will not yet have been installed, nor will the control electron gun be operating, so there will be little control of the beam intensity at that early date.

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Subject: FIELD PROGRESS REPORT

c. The Synchrotron - The assembly of the diffusion pump manifolds and valves is nearing completion.

A production line method has been set up for etching, impregnating and vacuum testing the magnet wedges. The etching process includes acid, water and alkaline baths followed by a carbon tetrachloride bath to prevent corrosion.

Installation has begun on the banks of condensers. Several racks have been completed.

The concrete shielding blocks have arrived but will not be placed in position until the instrument is more nearly complete.

The delivery date for all parts being manufactured by the General Electric Company remains as the end of February.

d. Nuclear Chemistry - Metallic looking lumps of Pa have been obtained by using a mixture of K and Ba as reductants. These lumps have not as yet been definitely characterized as Pa metal.

A method for obtaining melting points of 100 microgram lumps of metal has been developed. A pellet is placed between the sprung jaws of a piece of 40 mil tungsten wire, the movement of which is observed through a microscope. Two samples of Np metal gave the melting point as 639° C. Inconclusive results were obtained with Am metal.

The formation of twelve-hour and fifty-hour Am isotopes through the action of 20 Mev deuterons on Pu^{239} has been confirmed.

Evidence for the fission of bismuth with 200 Mev, 150 Mev and 90 Mev deuterons has been obtained. There is evidence that Ba^{133} is one of the fission products. If this is confirmed it will be the first case of a fission product which decays by orbital electron capture or positron emission and would be formed through the ejection of many neutrons in the fission process.

The bombardment of copper with 200 Mev deuterons has produced Zn^{62} , Zn^{63} , Cu^{61} , Cu^{62} , Ni^{65} , Ni^{57} , Co^{55} , Co^{56} , Co^{58} , Co^{61} , Fe^{52} , Mn^{52} , Mn^{56} , and Cr^{49} . It is seen that isotopes with masses both at the heavy and light side of the stable product isotopes are produced.

e. Carbon-14 Chemistry - A series of carbon-14 labeled compounds have been prepared among which are dibenzanthracene labeled in the nine position, methyl alcohol, methyl iodide, carboxyl labeled pyruvic acid, and carboxyl labeled unsubstituted, chloro and iodo acetic acids.

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Subject: FIELD PROGRESS REPORT

Analysis is continuing on samples of irradiated beryllium nitride to determine the distribution of Carbon-14 between the various carbonaceous fractions obtained in processing.

f. XC Magnet -

1. The magnet has been lowered into position and now rests on its concrete slab. All jacks and lumber used to lower the magnet into position have been removed. The two coil tanks have been mounted in place. Electrical work is being held up indefinitely due to a general labor shortage and the low priority assigned to completion of this instrument. The building to house the completed instrument will probably not be constructed for about three months.

2. Laboratory Work - Sub-project 48-A

a. Project 48-A - Division I -

1. Bone radioautographs using radium, thorium, plutonium, strontium, cerium, and lead are in progress. These will be completed within the next two months.

2. One, four, and sixteen day curium intravenous rats have been completed. The metabolism of curium is similar to that of americium, showing 25% deposition in bone and a rather rapid excretion rate by the feces. Intravenous studies of columbium, cerium, yttrium, zirconium for four and sixteen day periods have been completed. Intravenous studies of curium, thorium, and additional cerium studies were undertaken and the data should be available for the March monthly report. In addition to these studies, the metabolism of element 43 and lanthanum will be started.

3. An improved method for preparing element 85 has been worked out. This new technique is especially suited for human investigations.

4. The decontamination and bone metabolism studies are continuing. In the experiment on the effects of rickets on the deposition of strontium, plutonium, thorium, radium, cerium, and lead in bone, data is now available for strontium. Rachitic rats retained only 8% of the dose compared with 68% deposited in the skeleton of the controls of the same age. Administration of phosphate, one hour prior to strontium, increased the retention of strontium by the rachitic rats to 45%. Radioautographs of cat bones demonstrated overlayering of the plutonium deposits.

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Subject: FIELD PROGRESS REPORT

b. Project 48-A - Division II -

1. Work is being done on a method to make visual x-ray analyses of spleens. Radioactive materials which localize in the spleen are known to reduce its size, but the extent of the reduction is difficult to determine after death. It is hoped that visual x-ray analysis will give a more convenient and accurate measure of this phenomenon.

2. Research is continuing on the preparation of colloidal UO_2 . Improved methods of preparation which eliminate the soluble fraction have increased the LD50 dose of this colloid to about six milligrams per mouse.

3. A study is in progress on the retention of radioactive materials in the liver and blood following the removal of the spleen.

4. Investigations are continuing on the development of radio-resistant strains of bacteria.

c. Project 48-A - Division III -

1. The final report on the decontamination of the Achimowi and the LST-881 is being prepared as well as a summary of the various decontamination procedures used at the Hunters' Point Shipyard.

3. Laboratory Work - Sub-project 48-B

a. Investigation of the gross acid dissociation constant and rate of hydrolysis of TTA shows that, for process purposes, acid solutions of TTA may be considered to be essentially stable with respect to hydrolysis.

b. A satisfactory method of analysis for plutonium, accurate to better than 0.5%, has been developed. The Pu is reduced in a Jones reductor and then titrated with Ce(IV) in sulfuric acid, using ferrous orthophenanthroline as indicator.

c. Investigations of the structure of uranyl acetylacetonate indicate that a compound containing three ketone radicals is produced when the precipitation is made in the presence of excess ketone. A compound containing two ketone groups is obtained in excess uranyl ion.

d. Studies of the Raman spectra of uranyl perchlorate solutions confirm previous investigations of the structure of the uranyl ion.

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Subject: FIELD PROGRESS REPORT

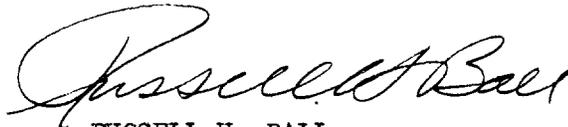
4. Laboratory Work - Sub-project 48-C

a. In January ten new patients who were treated for arthritis with weekly injections of radioactive phosphorus were observed by project personnel for the effects of irradiation. Five of the patients previously treated with x-rays returned for follow-up studies. A total of 48 blood counts, including differential counts, were done. In addition, thirteen prothrombin time determinations, nine blood cholesterol determinations, and fifteen lobation studies were done. During the month of January 57.8 millicuries of radioactive phosphorus were received for project work.

b. In January thirteen people to whom radioactive iodine was administered were studied in the planned way. One received a particularly high dose, and was studied with extra care, both before and after surgery. Further studies were carried out on calibration procedures.

c. The effort expended on each of the two parts of the 48-C program was about equal.

ATOMIC ENERGY COMMISSION



RUSSELL H. BALL
Chief, Research Branch

1090824

This document consists of 9 pages.
2 of 7 copies. Series A.

WAR DEPARTMENT
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Office Of The Area Engineer
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BERKELEY, CALIFORNIA

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AE 2481 UC

2 January 1947

REPOSITORY NARA-Wash DC
MEDIAEC Central Files FIELD PROGRESS REPORT
COLLECTION Oak Ridge

BOX No. U3-326-87-3 62065

Area Name Berkeley

FOLDER AEC-500.914 Berkeley
Construction Prog. Rpts

Project Designation Univ. of Calif.

Period Ending 31 December 1946

A. PERSONNEL:

| | |
|------------------------|-----|
| Radiation Laboratory | |
| Project 48 - - - - - | 641 |
| " 48-A - - - - - | 50 |
| " 48-B - - - - - | 23 |
| " 48-C - - - - - | 6 |
| TOTAL - - - - - 720 | |
| Area Engineer Office | |
| Officers - - - - - | 3 |
| Enlisted Men - - - - - | 3 |
| Civilians - - - - - | 73 |
| TOTAL - - - - - 79 | |

B. CONTRACT DATA:

Contract No.: W-7405-eng-48
Type: CPFF
Contractor: The Regents of the University of California
Description: Research
Date of Contract: 1 May 1943 to 30 June 1947

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AEC-500.914 Berkeley

B. CONTRACT DATA (Cont.):

Contract Appropriation: \$25,300,000.

Approximate Expense for December 1946: \$ 399,700.

Approximate Expense for December 1946 broken down
by Projects:

| | |
|------------|-------------|
| Project 48 | \$ 385,000. |
| " 48-A | 15,500. |
| " 48-B | 7,000. |
| " 48-C | 1,500. |

Approximate Expense to 31 December 1946: \$ 13,705,200.

Estimated Cost to 30 June 1947: \$ 22,533,800.

C. NARRATIVE:

1. Laboratory Work - Project 48:

a. 184" Cyclotron - The operation of this instrument has been satisfactory during the month with the exception of trouble experienced from a short circuit to ground in the upper coil tank. This difficulty has resulted in a shutdown for approximately ten days. It is expected that operation will begin again about 2 January 1947.

The rotary condenser has functioned satisfactorily since the clearance in the by-pass condensers was increased to 0.041". New by-pass condenser plates have been ordered but have not yet been installed.

A 400 Mev alpha particle beam was produced during the month. The instrument has also been operated for the purpose of studying the character of the neutron beam for shielding experiments. Several targets have been bombarded for the chemistry group.

b. Linear Accelerator.-

1. The forty foot resonant cavity has been delivered and is now being installed in the vacuum chamber.

2. The Van de Graaff generator has shown marked advancement. The mounting of equipment in the high voltage shell has been almost completed. The corona ring system has been completed except for the outer rings that tie the system together.

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3. Considerable strain has been noted in the high voltage shell loading. The distortion is not expected to interfere with the operation of the generator. Tests are being conducted, however, to determine the size and type of additional supports which may be required.

4. The high pressure storage tank system for the generator is almost complete.

5. An improved radar transmitter design has been developed which gives a peak output of 250 kilowatts of power. The new design increases the efficiency of the present transmitters from fifteen to fifty percent. This improved design is important since the output of the radar transmitters will be improved about three-fold.

6. Calculations are being made on still another transmitter design in which the transmitter tube will be made an integral part of the resonant cavities.

7. Cold tests of the five megawatt magnetron are proving quite interesting since it has been found possible to obtain much information concerning the functioning of such tubes which it has not been possible to obtain from other magnetrons due to their small size. The cavities of the large magnetron are being probed to determine the shape and magnitude of the fields threading them. The fundamental mode of the magnetron has been determined.

8. The cavity of the magnetron has been found to tune to a slightly higher frequency than desired, but it can be brought to the desired range by increasing the capacity of the tuning rings.

9. The preparation of beryllium foils has been put on what may be considered a production line basis. Foils of proper thickness and of good strength are obtainable with the present system. It is believed that foils made by evaporating beryllium on collodion will be used although a final decision on this is still pending.

c. Synchrotron -

1. The control room, office and photographic rooms of the synchrotron building were painted during the month and the floor coverings were laid. The frame of the control console has been fabricated.

2. The assembly of the vacuum system was begun during the month. The diffusion pump support frame has been installed over the pit and assembly of the diffusion pump manifolds and valves has begun.

3. Fifty pole piece segments have been made to date. Jigs are being readied for assembly of one of the pole piece rings which will require forty of the segments.

4. Six of each of the dee grids have been etched and completed.

5. An engineer from the Laboratory has been at the General Electric plant for the past month to expedite delivery of the synchrotron parts being fabricated there. The General Electric Company has fallen behind schedule in production of the magnet parts and plastic vacuum chamber parts. The latest information is that delivery of all parts will not be complete before the end of February, 1947.

6. Preliminary calculations on the shielding requirements of the synchrotron indicate that a four-foot iron pre-concrete wall will be required.

d. Three-foot X-ray Cavity -

1. Maximum output of the cavity has been 1.5 Mev and this value appears to be the limit. This energy was obtained by using four radar transmitters. The design of the cavity has been changed somewhat to take advantage of the recent work on shunt impedance. Cones were added to the base ends of the drift tubes with the expectation that the output would be increased. No appreciable effect has been noted, however.

e. Isotope Separation -

1. The small (JA) calutron is now in continuous operation. Development of operational techniques and modification of the ion source have brought the instrument to a usable stage.

2. A satisfactory technique has been developed for work on the element Indium.

3. Identification has been made of Cu^{60} as the 24.5 minute copper activity. Other copper activities have been observed but have not yet been definitely identified.

f. Health Physics -

1. Data has been completed on the absorption of fast neutrons in concrete. The results indicate that the present design of concrete shielding for the 184" cyclotron will be adequate. It is planned, however, to use some additional shielding in the form of concrete ballast blocks.

2. Radiation surveys have been conducted in and around the 184" cyclotron using both x-ray films and electrometers. The radiation level has been plotted and proper safety precautions have been taken to insure workers against over-exposure.

3. An experiment has begun to determine the effects on mice of the neutron beam from the 184" cyclotron. One group of mice is living directly in the path of the beam while a control group has been placed outside of the beam. Blood count checks have shown a decrease in the blood count of the exposed mice. Similar studies using fast neutrons are also to be conducted around the 60" cyclotron.

g. Nuclear Chemistry -

1. Bombardment with 200 mev deuterons on the 184" cyclotron.

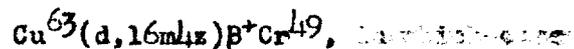
(a) A new method of presenting nuclear reactions:

(1) The major effect of the nuclear chemistry group has been directed toward investigating several elements which have been bombarded with 200 Mev deuterons in the 184" cyclotron.

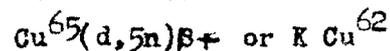
(2) The production of isotopes far removed from the target isotope upon bombardment with high energy particles has lent emphasis to the need for a shorthand method for presenting a nuclear reaction when the pathway for the reaction is not known. A method, which will be adhered to for the present, is best explained by an illustration using the preparation of Cr^{49} from the deuteron bombardment of Cu^{63} .



Here, "16m" refers to the ejection of 16 mass units and "5z" to finding that the product nucleus has five less units of charge or an atomic number five less than the target element. If it were definitely known that Cr^{49} was not formed in the primary reaction, the reaction would be written



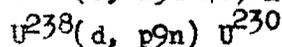
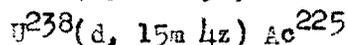
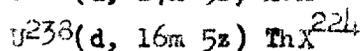
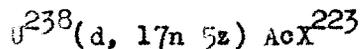
in which case the β^+ signifies that Cr^{49} arose from β^+ decay of Mn^{49} (not known at present). An actual case that is known is as follows:



Here, Cu^{62} was not observed but it was found to grow in from a longer lived Zn^{62} which must have been formed in the primary reaction.

(b) Bombardment of Uranium:

(1) The following reactions have been observed:



(2) Most of these activities have been substantiated through the identification of their decay products. The Np fraction contained a 2.5 d Geiger activity which was mostly soft electrons or beta-particles and in the uranium fraction there was found a 7-day activity which could be U^{237} or U^{231} .

(c) Bombardment of Lead:

(1) Three alpha emitters have been found in the bismuth fraction upon resolution of the decay curve. The half-lives found were 9 min., 27 min., and 70 min. The accompanying Geiger counter activity was such that the alpha particles must represent only a small branching in the orbital electron capture decay. Only very crude α -particle range determinations were made and these indicated that a range of about 4 cm was present. It is probable that all of these activities belong to bismuth isotopes of mass lower than 203.

(2) In the hg fraction Geiger counter activities were resolved from the decay curve corresponding to half-lives of 15 min., 1 hr., 8 hr., 22 hrs., and 65 hrs. The last two activities may be the two isomers of Hg^{197} . Similarly four different activities each were found in the Bi, Pb, Tl and Au fractions with no definite genetic relationships noted for any of the isotopes.

(d) Bombardment of Copper:

(1) The elements Zn, Cu, Ni, Co, Fe, Mn and Cr have been examined for activity and one or more isotopes were found in each fraction. A new Zn isotope of 9.5 hr half-life was found and this was assigned to ${}^{62}\text{Zn}$ since it was found to be the parent of 10 min. Cu^{62} . The reaction involving greatest mass change is: $\text{Cu}^{63}(\text{d}, 16 \text{ m } 6\text{z}) \text{Cr}^{49}$ or $\text{Cu}^{65}(\text{d}, 18 \text{ m } 6\text{z}) \text{Cr}^{49}$.

Examples were found where isotopes of a given element both at the heavy and light sides of the stable isotopes were found. In the case of Mn, the isotopes

Mn⁵⁶ and Mn⁵² were found and these lie on either side of stable Mn⁵⁵. In the case of Mn⁵⁶ it would have to be formed by the ejection of charged particles in a reaction like: $\text{Cu}^{63}(\text{d}, \text{p}2\alpha) \text{Mn}^{56}$. Mn⁵², on the other hand, would be formed from a reaction in which neutrons are predominantly ejected.

h. Carbon-14 Chemistry -

1. Some growing barley plants have been exposed to an atmosphere containing C¹⁴O₂ and an investigation has been started on the specific molecular activities of the pigment fractions and on sugar so produced. The carotenoid fraction seems to have a higher specific activity than the sugar. The chlorophyll fraction is much less active than either of these.

2. Algae have been exposed to C¹⁴O₂ and a study made of the dark acceptor compound. Preliminary qualitative experiments show it to be a low molecular weight carboxylic acid, probably oxalic acid.

2. Laboratory Work - Subproject 43-A:

a. Division I -

1. Radio-autographs of strontium, yttrium, zirconium, columbium, cerium, radium, thorium, and americium are being made from normal growing, rachitic, and phosphorus deficient animals. Tracer studies with curium have been started. Materials are being made ready for human studies by intravenous administration. The radio-elements being prepared for this purpose include strontium, yttrium, zirconium, cerium, thorium, plutonium, americium, and curium. A preparation of element 43 is being made ready for animal experiments.

2. Decontamination studies are being continued with specific reference to the deposition of plutonium in the bones of growing dogs and cats. Also the effect of various conditions on the distribution of certain elements in the skeleton and tissues are being studied.

b. Division II -

1. A new method of preparing colloidal UO₂ has been devised which will increase the LD50 dose from about one milligram to about three milligrams per mouse.

2. A request has been made to obtain an increased amount of U²³⁵O₂ for the pile bombardment experiment to allow the laboratory to take advantage of this development in the proposed experiments at Clinton Laboratories.

3. Counters are being set up to assay H^3 . It is planned to conduct a series of experiments with this tracer material to study the water balance in animal systems as a guide in the study of the chronic effects of neutron and x-ray exposures.

c. Division III -

1. Analytical data concerning the decontamination of Crossroads vessels is being compiled for a comprehensive report.

3. Laboratory Work - Sub-project 48-B:

a. Chelation Extraction Process--

1. A three-cycle recovery run at Hanford Plutonium concentration (125 mg/liter of 2 molal $UO_2(NO_3)_2$ solution) has been carried out. The results show that in all steps the ^{239}Pu recovery was somewhat less than that obtained using about one-fifth Hanford Pu concentrations. In the reduction steps this lowering of recovery was shown to be due to a change in the kinetics of the reaction. It is felt that a study of the factors involved will improve the recovery to a satisfactory point. It is also felt that slight modifications of the process conditions will effect a corresponding improvement in the extraction steps.

2. The above experiment concludes the research on this recovery process at Berkeley. A final report is in the process of publication.

b. Basic Chemistry of Plutonium -

1. An apparatus for the simultaneous extraction and re-extraction of Pu was designed and tested. Two aqueous phases, separated by a glass wall, are covered with a layer of hexone. By circulating the hexone the Pu is extracted from the first aqueous phase containing ammonium nitrate and is re-extracted from the hexone into the second aqueous phase, which contains sulfuric acid.

2. A solution of Pu^{IV} in perchloric acid has been prepared which contains some barium ion.

c. High Temperature Thermodynamics -

1. Work is continuing on the method and apparatus for measuring the vapor pressure of graphite.

2. $CuCl$ and Cu_2Cl_2 have been identified in the vapor of copper chloride at high temperatures.

4. Laboratory Work - Sub-project 4B-C:

a. Total Body Irradiations with X-ray and with p³² -

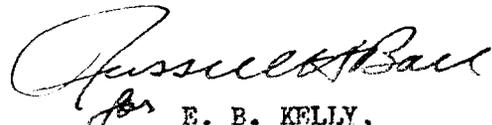
1. In December patients previously treated with x-ray were followed with regard to their blood count including lobation studies, sedimentation and differential counts.

2. Lobation studies were carried out on the blood smears of patients who were studied before the lobation study was under way. Three patients were started under the program of general body irradiation with radioactive phosphorus that have been given the phosphorus and their initial blood studies have been made. Dr. Low-Beer spent part of the month in Chicago discussing problems of radiation with various members of the Argonne National Laboratory.

b. Radio-Iodine Studies -

1. During December twelve people were given radio-iodine; three of these were given small tracer doses, the others larger amounts. The usual program was followed with these people, in that attempts were made to establish the amount of iodine in the thyroid and in the remainder of the body, and the amount excreted. Other studies were done on these patients to determine the changes, if any, brought about by the radio-iodine during the month.

2. Thirty-three millicuries of radio-iodine were received and used on this particular problem.


E. B. KELLY,
Lt. Col., Corps of Engineers,
Area Engineer.