DECLASSIFIED

UCRL 168 Cy 14/A

UNIVERSITY OF CALIFORNIA

Radiation Laboratory

FOR REFERENCE

NOT TO BE TAKEN FROM THIS ROOM

BERKELEY, CALIFORNIA

DISCLAIMER

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.

UNIVERSITY OF CALIFORNIA
RADIATION LABORATORY

Cover Sheet
Do not remove

DECLASSIFIED

INDEX NO. UCRL 168
This document contains 13 pages
and 0 plates of figures.
This is copy 14 of 16. Series A

Issued to: Safe Div.

SECRET
Classification

Each person who received this document must sign the cover sheet in the space below.

Route to	Noted by	Date	Route to	Noted by	Date

R-41

UCRL 168

Copy 13 A ret. to Inf. Div. by R.K. Wakerling 4-7-50. Destroyed

Copies 2-11/A to R. Ball 9-6-48

~~Copy 12/A E. O. Lawrence 9/2/48~~ ret + dest. 1-30-56

Copies 14-16/A Info. Div. 9/2/48

Copy 1/A DESTROYED 1/49

Series B

Copy 1/B to Patent Dept. 12/22/48

Copies 2-~~7~~/B Infol Div. Extra Copy File

5/B, 6/B & 7/B dest. 9-21-54

Series C

Copy 1 to Chem. Dept. 9/2/48

DECLASSIFIED

UCRL 168

SECRET

UNIVERSITY OF CALIFORNIA

Radiation Laboratory

CLASSIFICATION CANCELLED
BY AUTHORITY OF THE DECLASSIFICATION BRANCH USAEC per TID 1113
BY B Forbett 3-31-56
SIGNATURE OF THE PERSON MAKING THE CHANGE DATE

Contract No. W-7405-eng-48

PROGRESS REPORT NO. 64

July 15 - August 15, 1948

RESTRICTED DATA
This document contains restricted data as defined in the Atomic Energy Act of 1946.

CAUTION

This document contains information affecting the National Defense of the United States. Its transmission or the disclosure of its contents in any manner to an unauthorized person is prohibited and may result in severe criminal penalties under applicable Federal laws.

Berkeley, California

SECRET

UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

July 15 - August 15, 1948

PROGRESS REPORT NO. 64

RESTRICTED

1. 184-inch Cyclotron Program

The cyclotron was used for research experiments eighty-nine percent of the four hundred and forty hours that the crew was on duty. The chemists, due to their increased personnel during the summer, used approximately one quarter of the operating time.

During this period, the cyclotron was shut down three and one-half days for the installation of new main electrical power equipment.

UNCLASSIFIED

2. 60-inch Cyclotron Operation

The latter part of the period, a shutdown was necessary due to a rupture in the west stem inner conductor. This was caused by excessive heating in a localized area. The past two weeks have been spent in correcting this difficulty.

RESTRICTED

3. Synchrotron Program

Careful measurements of the magnetic field in the synchrotron indicate that no improvement can be expected from the use of pole tip wedges with higher interlamination resistance. The azimuthal variations of field appear to originate in the magnet proper; and the installation of new wedges having a high resistance made no change in the phase variations of field.

Tests were made of the possibility of using correcting loops located between the pole base wedges and the pole tips. A 2-foot section of the orbit was compensated by a coil design of this type in which radial wires were located every ½ inch around the orbit - both ends of the wires being brought outside the magnet to a terminal strip. It was found that the use of loss currents would not completely compensate the errors in field but that working currents could be applied to these loops that would effect a substantial improvement.

On the basis of these tests, it was decided to install the radial wires in the space between the pole bases and pole tips both above and below the vacuum chamber and attempt to completely compensate the magnetic field. The working currents will be obtained by connecting a one-turn coil which encloses all of the orbit and central flux through a transformer to a series of variacs from which various voltages can be obtained. By properly combining compensating coils, it is hoped that a complete adjustment can be made using sixteen variacs. This equipment is now being installed in the synchrotron and the adjustment of the magnetic field variations is expected to start in the immediate future.

RESTRICTED

4. Linear Accelerator Operation

Van de Graaff. During the period July 15 to August 15, the Van de Graaff delivered a beam for a total of 119 hours, or 34 percent of the total working time during this period.

It has been found that while the machine can be run with a pulsed beam without the differential pumping system in operation (June 16, 1948 report), the beam current available

RESTRICTED

under this condition is at least a factor of 10 less than with the differential pumping. The recent increase of maximum beam current available from the accelerator is due to the discovery of conditions under which a larger fraction of the pulsed beam from the Van de Graaff can be focused into the acceptance area of the linear accelerator.

During the past two weeks further trouble has been encountered with the d.c. generators. These generators are unquestionable the weakest link in the machine at the present time and extensive outage from this source can be expected until these machines are replaced with a permanent magnet alternator which has no sliding contacts.

Linear Accelerator. The linear accelerator has been in use on research problems approximately 35 percent of the working time in the period from July 15 to August 15. The major experimental effort has been on proton-proton scattering. Provision has been made for taking the beam outside the building through a 30 foot extension pipe to permit the proton-proton scattering by counters experiment to operate in an area of lower x ray and stray neutron background. The use of this pipe has permitted a better measurement of the beam divergerence which confirmed theoretical estimates of approximately 10^{-3} radians.

The beam current has increased by about a factor of 4 to around 10^{-9} amperes average. Tests are under way to determine whether the machine will operate satisfactorily without liquid air trapping in the vacuum system. If this proves feasible, a major budget item will have been eliminated.

5. Experimental Physics

RESTRICTED

Film Program. A study is now in progress to determine the mass of the heavy negative mesons with better accuracy than that given by earlier determinations. A plate holder has been built with a channel which admits negative mesons from the target at angles up to ± 10° from beam direction. The advantages of this arrangement are: (1) It is possible to expose the plates without the usual black paper wrapping. This gives a better range measurement. (2) For mesons which leave the target at angles close to beam direction the angular measurement of the track on the plate is most accurate. (3) The effect of lack of uniformity of magnetic field is easier to calculate for mesons which leave the target at angles close to beam direction.

The calculation of the absolute value of the mass depends on the value of the magnetic field in the vicinity of the target, and this has not been measured recently. The magnetic field measuring group now plans to make a new measurement, which will be correct to within one percent. This measurement has not been made yet, so we are not able to give a reliable value of the mass. It might be of interest, however, to report values based on older field measurements in order to show what variation is to be expected in the individual determinations. The following five columns give masses found on five of the plates measured so far (masses in electron masses):

290	294	292	288	285
287	296	300	284	299
289	293	303	293	294
288	303	289	294	292
293	294	293	301	294
			288	287
			284	285
			292	291

RESTRICTED

The average is 293. The probable error estimated for the final measurement is ± 6.

With the "channel" plate holder more than a hundred heavy negative mesons have been observed. On the same plates only one light meson has been found. When the mesons are not restricted by the channel the ratio of light to heavy mesons is much greater. This is taken as an indication that the light mesons do not come directly from the target.

Cloud Chamber. The cloud chamber group has made a preliminary attempt to detect the neutral meson. Theoretically the neutral meson should be found in the same way as the heavy charged mesons and decays in 10^{-12} sec. into a pair of γ-rays, each with an energy of about 90 Mev. The deflected α-particle beam was stopped in a carbon block in the center of a cloud chamber. On either side of the carbon block were ¼" plates of lead in which it was hoped that the γ-rays would each produce a shower. So far the experiment has failed because of the heavy background of the particles scattered out of the carbon block that did not stop in the lead, and also because of inadequate thermal insulation of the cloud chamber.

Stopping Power Measurements. Work has been continued on the measurement of the stopping power (relative to aluminum) of the elements S, P, Te, Se, and Si. Due to the difficulty of making the powder absorbers exactly uniform, the values obtained exhibit variations from the expected values, but the deviations are not large.

Increased sensitivity measurements on Be, C, Cu, Mo, Ag, Ta, Au, and U have provided some needed statistics for error determinations, but the values found earlier are essentially unchanged by this new data.

The plans are to conclude this phase of the program with the completion of the increased sensitivity measurements.

N-p Scattering. N-p scattering experiments (including total cross sections and neutron energy distributions), done in connection with Professor Segre's group have been finished and a formal report is in progress.

The $C^{12}(n,2,)C^{11}$ absolute cross section has been measured and found to average 19±4 millibarns over both the 90 Mev and 40 Mev neutron distributions. Weak evidence for a peak in the cross section around 40 Mev has been found.

Design and construction of a pair counter for use in connection with exploring the gamma output of the cyclotron is under way.

Design and construction of a pair of balanced chambers (similar to "Chang and Eng") is going on. The chambers are scheduled to be completed and tested next month.

Neutron Scattering. Measurements of 90 Mev neutron scattering and adsorption cross sections of C, Al, Cu, Pb with carbon detectors were made and were in agreement with the scattering cross sections determined by integration of the differential scattering cross section angular distributions.

The angular distribution of scattered neutrons is being measured by a detector which detects recoil protons from a paraffin generator. Fairly complete results have been obtained for Pb, Cu and Al. C and Be are to be measured more carefully.

Fission Counter. Two shallow bismuth fission counters were completed and tested. Both new counters have two 4.5" diameter plates coated with a thin layer of bismuth separated by a collecting plate ¾" from the bismuth plates. These chambers have cathode followers

RESTRICTED

attached that are constructed for use in the magnetic field inside the cyclotron shielding. Tests using the neutron beam showed the chambers had characteristics similar to the old chambers.

The total cross section of nitrogen was measured using melamine. $\sigma_n = .570 \pm .007$. An angular scattering experiment was made with a 4" diameter, 4" long carbon cylinder and the results indicated that the relative scattering was negligible beyond 45°(lab. system) for all elements of atomic number greater than carbon. A series of experiments was made using a detector behind plates of various elements stacked to form a 45° cone with a detector at the apex. A detector was placed outside the concrete in the collimated beam so a direct measurement of the ratio of the absorption to the total cross section could be determined. The results were:

Cu: $\frac{\sigma a}{\sigma t} = .43 \pm .006$

Al: $\frac{\sigma a}{\sigma t} = .48 \pm .02$

C: $\frac{\sigma a}{\sigma t} = .63 \pm .03$

6. Theoretical Physics

RESTRICTED

Progress is being made in the understanding of the results on elastic and inelastic scattering of high energy neutrons by nuclei. The effect of well-shape on the n-p scattering calculations is being investigated. Calculations of p-p scattering at 32 Mev have been started. Some success has been obtained in explaining the N^{17} yields from different elements. Work on bevatron problems is continuing.

7. Isotope Separation Program

SECRET

JA Calutron. The present JA program is concerned with the study of an electro-magnetic separation process in which ions of two different masses are separated in time by an applied radio frequency electric field. In previous reports we have mentioned two methods of achieving this: (1) intensity modulation and (2) energy modulation.

At the present time the work is concerned with problems regarding the energy modulation method. There are essentially only two questions which need to be answered: the first is that of "drain" which determines the amount of power required to effect separation of a given amount of material; the second is a problem in ion optics in which it is necessary to decelerate and collect ions of one mass at a given phase of the rf cycle while at the same time rejecting ions of the other mass to be focused on a second collector area.

During the past month, the drain problem has been solved (using argon) to the extent that a pilot model has been designed and is under construction. This unit will be operated in the XC installation, accelerating ions to 35 kv energy and 18" radius with an energy modulation of ±5kv at 2.0 mc. First tests will be conducted with argon and later with UCl_4. Using argon ions of 10kv and 6" radius, modulated ±2kv at 2.0 mc. on JA, we have obtained ion beams which have been measured as six times the drain on the accelerating voltage. While these beams have been small (of the order of 1-2 mc.) the rest of the problem has shown itself to be a matter of scattering of the ions from neutral gas molecules. UCl_4 is not expected to be as bad in this respect since much of the neutral material will be condensible, further the ion beams at XC will have 3.5 times the energy

 SECRET

and will be in a region of greater pumping speed. These facts indicate that the process is practical from the standpoint of power consumption.

The more difficult problem of collecting, reflecting and focusing the ions is proceeding in an encouraging manner. The beam current pattern has appeared well modulated in energy at the selected radio frequency. Collecting the beam during one-half of the rf cycle and reflecting it on the other half to a broad faced second receiver, we have been able to observe a correctly modulated rf current pattern. D.C. measurements show that the reflection efficiency is 95 percent and that it is possible to reflect the beam to still another (third) receiver with comparable efficiency.

In order to obtain this reflection efficiency it has so far been necessary to decelerate and re-accelerate the ions through a grid structure. Omission of this grid structure causes the beam upon reflection to acquire appreciable velocities perpendicular to the plane of orbits causing a loss to the top and bottom of the liner. An attempt at focusing the reflected has been successful to the extent that a well defined pattern can be obtained at the second receiver but the work has not progressed sufficiently far as yet to determine completely the XC geometry or to enable one to eliminate the use of grids.

Grids are not impractical to use but if eliminated would remove a slight nuisance.

8. Chemistry

SECRET

Part A

Preparation of Samarium Chlorides. An apparatus has been built for preparing the halides of rare earth and actinide elements on the microgram scale. This consists of a system which can be evacuated and through which dry HCl or NH_3 may be passed at elevated temperatures. $SmCl_2$ was prepared by reducing $SmCl_3$ with NH_3 at about 400°C. The compound was identified by the x-ray diffraction pattern.

The x-ray diffraction pattern for $SmCl_3$ was determined showing it to be of the UCl_3 type with lattice constants a = 7.377 ± 0.006 A and c = 4.159 ± 0.003 A. These constants show that samarium falls on a smooth curve derived from other rare earth elements.

Praseodymium and Americium Oxides. In the study of the higher oxides of these elements a quartz bomb has been built whereby the oxides may be subjected to oxygen pressures of 100-400 atmos. Starting with Pr_6O_{11} it has been possible to convert it to PrO_2 in the temperature range 250-500° under the high oxygen pressures. It is of interest to note that, in over 30 preparations in which the over-all oxygen content corresponded to compositions between Pr_6O_{11} and PrO_2, the lattice constants of the fluorite structure fell into two distinct sets. These correspond to the constants for pure Pr_6O_{11} and pure PrO_2 having the values a = 5.467 A and a = 5.393 A, respectively. These measurements therefore failed to show a solid solution range between Pr_6O_{11} and PrO_2.

Absorption Spectrum of Am (III). Am(III) is known to have a sharp absorption band at 5035 Å as measured with a Beckman spectrophotometer. A dilute solution of Am(III) (0.0046M in 0.97M $HClO_4$) has been measured using a Baird grating spectrograph. The

SECRET

absorption peak at 5035 Å was resolved into three components at 5103.7, 5078.3 and 5030.0. This finding is of interest in that the corresponding lanthanide element, europium, has a similar group of three closely spaced peaks occurring at 3997.4, 3943.5 and 3937.3.

Radioactive Properties of the Heavy Isotopes. In earlier reports two new radioactive series starting with Pa^{227} and Pa^{228} were described. The characteristics of these series are that they decay through a series of alpha particle emissions with orbital electron capture branching in the early members. It is to be noted that these series begin with isotopes far on the neutron deficient side of beta stability and that they are collateral to the actinium and thorium radioactive series.

Two more radioactive series have now been identified following the bombardment of Th^{232} with 120 Mev alpha particles. These start with U^{229} and U^{228}, respectively, and are collateral chains to the 4n+1 (neptunium) series and the 4n (thorium) series. Identification was made possible by observation of the previously known polonium members which are Po^{213} and Po^{212} (ThC′). The characteristics of this series as they are known at present are as follows:

$$U^{229} \xrightarrow[\sim 1\ hr]{6.36\ Mev\ \alpha} Th^{225} \xrightarrow[\sim 7\frac{1}{2}\ m]{6.57\ Mev\ \alpha} Ra^{221} \xrightarrow[<\sim 1\ s]{6.74\ Mev\ \alpha} Em^{217} \xrightarrow[very\ short]{7.77\ Mev\ \alpha} Po^{213}$$

$$U^{228} \xrightarrow[\sim 7\ m]{6.65\ Mev\ \alpha} Th^{224} \xrightarrow[very\ short]{7.17\ Mev\ \alpha} Ra^{220} \xrightarrow[very\ short]{7.45\ Mev\ \alpha} Em^{216} \xrightarrow[very\ short]{8.02\ Mev\ \alpha} Po^{212}$$

Excitation Function for a d, 7n Reaction. An excitation curve has been taken for the reaction $Th^{232}(d,7n)Pa^{227}$. Pa^{227} was readily identified by observing the entire decay series with the alpha-particle pulse analyzer. The threshold for the reaction was at about 50 Mev. If the binding energy of the deuteron is added to this, one arrives at the average binding energy for the seven neutrons of about 9 Mev per neutron. This would indicate that even the last neutron probably has a relatively low binding energy, say less than 15 Mev. From the threshold at 50 Mev the yield rose to a maximum at around 100 Mev and then began to decrease.

Bismuth Alpha Emitters of Low Mass Number. Following the irradiation of lead with high energy deuterons it has already been reported that at least three new bismuth isotopes are formed which decay partially by alpha emission. These isotopes decay with half lives of about 100 minutes, 27 minutes and 9 minutes, and from previous irradiation data it is probable that they all have mass numbers less than 203. Because of the very large amount of Geiger counter activity associated with them it has not been possible with the alpha-particle pulse analyzer to measure their energies to within a few hundred kilovolts. The energies are of interest in that an attempt is being made to correlate the alpha instability of the heavy isotopes as a function of mass number and atomic number.

Using mica absorption methods with Po^{210} and Cu^{242} as references it has been possible to measure these energies somewhat more accurately. The values obtained are: 100 minute activity - 5.30 ± 0.05 Mev; 27 minute - 5.43 ± 0.07 Mev; 9 minute - 5.6 ± 0.1 Mev.

New Astatine Isotopes. It has been noted that in irradiations of bismuth with alpha particles of about 100 Mev the astatine alpha particles were not those of pure At^{211}, since they decayed with a somewhat different half life and the short range alpha group was found in too great abundance. It has been possible to resolve this shorter range

SECRET

SECRET

alpha group into three groups using an alpha particle pulse analyzer. These are the 5.89 Mev alpha particle of At^{211} decaying with a 7.5 hour half life, a group at 5.76 Mev decaying with a 1.7 hour half life and a group at 5.66 Mev with a 4.5 hour half life. The latter two astatine isotopes both have a mass number lower than 210.

Chemistry

Part B.

RESTRICTED

Synthetic and Experimental Chemistry. The synthesis of methanol and methyl iodide from carbon dioxide by the use of lithium aluminum hydride has been investigated using vacuum line techniques. The yield is excellent and the procedure is short. Using similar techniques, the synthesis of labeled ethanol, propanol, ethyl bromide, and propyl bromide from sodium acetate and sodium propionate has been investigated using lithium aluminum hydride.

In a previous report, the preparation of labeled oxalacetic acid as an intermediate in the preparation of pyruvic acid was described. It is planned to use this compound to prepare malic, fumaric, and succinic acids. The studies on improved synthesis and purification of glycine and the synthesis of alanine, phenylalanine, choline, acetylcholine, and labeled benzene are continuing.

Additional results have been obtained on the physical-chemical experiments on the relative rates of rupture of the C^{12}-C^{12} and C^{12}-C^{14} bonds, but the data have not been analyzed and this information will be presented in a later report. The synthesis of low-activity stilbamidine has been completed.

Biological Chemistry. A preliminary experiment on the excretion of stilbamidine labeled with C^{14} has been carried out on a dba mouse. After intravenous injection, a trace of activity appeared in the breath, about 2 percent of the administered dose in the urine, and the rest of the activity was eliminated with the feces. The respiratory and the urinary excretions were not measurable after forty-eight hours. The fecal excretion, however, continued at a rate of about 5 percent per day. The activity of the stilbamidine used in these experiments was too low to permit investigation of tissue activities. A 2 mg. dose of the compound was well tolerated by the mouse. Further experiments will be carried out when the high activity material is prepared.

A study has been carried out on the relationship of tyrosine to glycogen formation.

The experiment consisted of the administration of 500,000 counts of dltyrosine labeled in the beta position to a normal, unfasted white rat. At the end of five hours the rat was killed and the liver was taken. The impure glycogen isolated from the liver showed a slight activity which rose moderately on repeated reprecipitation. The glycogen was then hydrolyzed to glucose which was also active, but its specific activity was less than that of the glycogen. Formation of the diacetone derivative remained active, and the osazone of the glucose was active. The final specific activity was of the order of ½ count per minute per milligram. The amount of glucose obtained was too small to permit degradation experiments. From the very small amount of activity incorporated it seems likely that it arises simply from incorporation of carbon dioxide. This process, of course, does not involve any net increase in carbon fixed as glycogen.

Isolation of tyrosine from the hydrolyzed liver showed that only slightly more than half of the total activity in the liver was present as unchanged tyrosine. In view

RESTRICTED

RESTRICTED

of this extensive metabolism it seems probable that the failure to observe activity in the glycogen did not result from killing the animal too early, particularly in view of the fact that previous investigators have frequently taken their animals from four to six hours after the administration of test substances.

Photosynthetic Chemistry. Paper chromatography is being used extensively as a major tool in the analysis of radioactive photosynthetic and other metabolism products in plants. Since the separation of compounds by this method is a function of distribution between liquid phases and not adsorption, it is applicable to the separation of tracer amounts of metabolic intermediates. With this technique, complex mixtures of compounds can be unequivocally analyzed in a few days with little labor. With classical methods, the same results can be obtained only with months of labor, and in many cases the results are very uncertain. It is felt the importance of this technique in this type of research cannot be overemphasized.

SCENEDESMUS have been allowed to photosynthesize in methyl-labeled pyruvate. The radioactive compounds are being separated according to solubility properties prior to identification. Using ion exchange resins it has been possible to separate the amino acids, alanine from serine. Partial separation of alanine and glycine has also been obtained using the same technique. Work is under way to separate by elution techniques the radioactive phosphorylated photosynthetic intermediates using exchange resins. Phosphoglyceric acid has been removed in a narrow band, and further work is being done to purify the other constituents.

SCENEDESMUS have been allowed to photosynthesize one hour in P^{32}. The extract of the cells has been separated by paper chromatography, and approximately nine major and as many minor products have been obtained. These are being separated using ion exchange resins prior to co-crystallization with known compounds for identification.

Chemistry

Part C. Subproject 48B SECRET

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

1. Thermodynamics of CN and CH.
2. Heats of dissociation of F_2 and HF.
3. Vapor pressure of metals.
4. Gaseous oxides and hydroxides.
5. Thermodynamics of gaseous molybdenum and copper halides.
6. Absorption coefficients of species in sun.
7. Low melting metal alloys.
8. Refractory studies.
9. Construction of 4000° furnace.
10. Structure of solids.

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

1. The aqueous chemistry of zirconium.

2. Complex ion formation of lanthanum.

3. The basic chemistry of ruthenium.

SECRET

Investigations on the formation of the uranyl-TTA chelate in aqueous solutions are being prepared in report form.

9. Medical Physics

Part A. Project 48A - I

RESTRICTED

Radioautographs of bone have been obtained with praseodymium and protoactinium. Europium and cadmium in liver radioautographs have been set up.

Tracer studies with Pa^{233}, prepared in this laboratory, have been completed for four and sixteen days after intramuscular administration. The major part of this radioelement remained at the site of injection. That which was absorbed was primarily deposited in the skeleton. Tracer studies using praseodymium have been completed as well as studies in which radio-praseodymium was administered with Pr carrier and also carrier-free Pr as the citrate complex. This material is being calculated and the data will be reported later. Four and sixteen day intramuscular studies with carrier-free columbium have been completed. Metabolic tracer studies with carrier-free radio-arsenic have been set up with rats. In addition to this, extensive in vitro studies of rat red blood cells with carrier-free arsenic and with added amounts of carrier are being continued.

A number of very clear anthracine crystals for use in counting gamma rays have been produced by methods developed by Mr. Alley and have been supplied to interested groups within the project.

The effect of immediate treatment with sodium citrate or zirconium citrate on the distribution and excretion of intravenously injected Ce^{144} was investigated, but results are not yet available. The effect of zirconium citrate therapy combined with massive doses of parathormone on the excretion of Y^{90} and Pu is also being studied.

Work has progressed in development of a method for the separation of radio-tin, radio-indium, and indium from radio-tin decay, prepared by alpha bombardment of a cadmium target. Incidental to this problem investigation is being made for Sn which would arise from an alpha 3 n reaction on Cd110. Radio-arsenic was separated from germanium by the method previously reported. Investigations have been started on the separation of radio-tantalum from the deuteron bombardment of hafnium.

Medical Physics

Part B. Project 48A-II

Effect of High Energy Deuteron and Alpha Particles on Tradescontia Chromosomes. A study was undertaken with the use of the deflected beam to obtain the dependence of chromosomal breaks and aberrations on specific ionization. The genetic part of the study is being carried out by Dr. Norman Giles, of the Clinton Laboratories, Oak Ridge, Tennessee, who

RESTRICTED

visited in Berkeley. The exact results at this date cannot be given, but it is clear that the highly ionizing portions of the alpha and deuteron beam (near the end of the the range of these particles) have a relatively larger effect than low ionizing portions of the beam. It is hoped that quantitative information can be obtained on the dependence of chromatid as well as chromosome changes. The cross section for the process involved will be calculated for several regions of specific ionization.

Effect of the Cyclotron Beams on Mouse Tumors. Using type A mice and mammary carcinomas, two sets of experiments were carried out. In each of these experiments the animals which had tumors were bombarded by the deuteron beam in such a way that the beam had to go through the animal body before reaching the tumors. The results reached are encouraging and they indicate that the high energy particle beams may be useful in deep therapy or for producing biological effects in irradiating well defined regions of the body. The mice and some absorbers were placed in order that the peak of the Bragg ionization curve of the deuteron beam was in the region of the tumor mass. In 30 percent of the mice (bombarded six weeks ago) tumors completely regressed and these mice appear to be quite healthy. In future repetition of this type of experiment, there is some hope that a larger fraction of the mice treated will have complete regressions.

Activation Analysis. A new set of ash samples has been sent to Hanford for neutron irradiation. The samples contain fractions of blood for normals, leukemics, anemics, and polycythemics. A study of ion exchange methods is in progress for separating certain radioactive components of the irradiated ash.

10. Health Chemistry

In addition to the routine monitoring, decontamination, and disposal activities of the group, research and development work was carried out on the following projects.

a. Specially equipped box for Dr. Gofman, for processing yttrium and strontium with a minimum of exposure. In process of being constructed.

b. Controlled atmosphere arc stand for Dr. Conway's spectrum analysis of radioactive isotopes. Being assembled.

c. Model electric motorized dolly for decontamination chamber. Ready for trial runs.

d. The Webb 60" target assembly. In process.

e. A portable 1-inch lead manipulator panel is being designed. This panel may be used by itself or in connection with other panels, depending on the use to which it is put. The lead glass viewing window frame for this panel is finished and is to be mounted with glass within the week.

f. 60" recoil target assembly design is about ready for construction.

g. The study of strip coatings is complete except for aging study. Twenty-six products have been tested; six of these are being carried in the aging tests. Two of these six appear to be highly satisfactory for the purposes to which they will be put.

h. Five gloved boxes being assembled, upon requests from chemists. A vacuum box is in process for L. Werner's quartz balance.

PROGRAM	SUBDIVISION	MAN-MONTHS EFFORT	COMMENTS
1. 184-inch Cyclotron	Operation	11.0	
2. 60-inch Cyclotron	- - -	- -	Non-Project
3. Synchrotron	R.f. System	2.7	
	General	0.5	
	Injection	1.3	
	Miscellaneous Equipment	1.5	
	Magnet Tests and Operation	5.0	
	Vacuum Chamber	1.0	
4. Linear Accelerator	Linear Accelerator-General	5.8	
	Van de Graaff-General	6.0	
	General, Development, etc.	1.0	
5. Experimental Physics	Cloud Chamber	5.2	
	Film Program	5.5	
	Ionization Chamber and Crystal Counter	3.8	
	Neutron-proton Scattering	0.5	
	Proton-proton Scattering	3.5	
	Neutron Diffraction	0.7	
	Meson Range and Decay Measurement	1.3	
	Absolute Cross Section Measurements	3.0	
	Neutron Half Life	1.0	
	General Physics Research	11.7	
	Magnetic Measuring Equipment	0.5	
	Cyclodrome Magnet	6.0	
6. Theoretical Physics	Synchrotron	0.2	
	Cyclodrome	1.3	
	Cyclotron	.4	
	General Physics Research	13.3	
7. Isotope Separation	JA Conversion	4.3	
	Nier Spectrometer	0.5	

RESTRICTED

PROGRAM	SUBDIVISION	MAN-MONTHS EFFORT	COMMENTS
8. Chemistry. Part A	Chemistry of Transuranic Elements	12.5	
	Nuclear Properties of Transuranium Elements	4.0	
	Transmutations with the 184-inch Cyclotron	12.0	
	Transmutations with the 60-inch Cyclotron	1.0	
	Analytical and Service	15.5	
	Chemistry of Astatine	1.5	
Chemistry. Part B	Synthetic and Experimental Organic Chemistry	7.6	
	Biological Chemistry	3.3	
	Photosynethetic Chemistry	7.5	
Chemistry. Part C	Metals and High Temperature Thermodynamics	6.5	
	Basic Chemistry, including Metal Chelates	7.5	
	General	2.0	
9. Medical Physics. Part A	Evaluation of Metabolic Properties of Plutonium and Allied Materials in Animal and Man	10.0	
	Decontamination Studies	7.0	
	Radiochemistry	1.5	
	Radioautography	1.5	
Medical Physics. Part B (Project 48A-II)	Uranium Research	2.5	4.0 Consultant Man-Month
	Tumor Metabolism	0.5	0.5 "
	Special x-ray Studies, Radioactive Measurements etc.	0.5	-
	Radioactive Carbon Studies	1.3	-
	Fundamental Medical Research	0.5	1.0 "
	Hematology	- -	- "
	Medical Work with 184-inch Cyclotron	1.0	1.0 "
	Fly Genetics	.8	-
10. Health Physics and Chemistry	Monitoring and Special Problems	9.3	-
	Salvage, Decontamination, Disposal, etc.	6.2	-
	Research and Development	8.3	-

RESTRICTED

SECRET