SECRET
DECLASSIFIED

UCRL 200

Cy 15/A
c 2

UNIVERSITY OF CALIFORNIA

Radiation Laboratory

TWO-WEEK LOAN COPY

This is a Library Circulating Copy which may be borrowed for two weeks. For a personal retention copy, call Tech. Info. Division, Ext. 5545

BERKELEY, CALIFORNIA

UCRL-200
c2

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 200
This document contains 13 pages
and 0 plates of figures.
This is copy 15 of 17. Series A

Issued to: Supo Div.

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

DECLASSIFIED

UNIVERSITY OF CALIFORNIA

Radiation Laboratory

Contract No. W-7405-eng-48

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

Special Review of Declassified Reports
Authorized by USDOE JK Bratton
Unclassified TWX P182206Z May 79

REPORT PROPERLY DECLASSIFIED
J. B. Stuart 8-20-79
Authorized Derivative Classifier Date
J. Cohen 8-21-79
By Date

PROGRESS REPORT NO. 66

September 15 - October 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

UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

September 15 - October 15, 1948

PROGRESS REPORT NO. 66

1. 184-inch Cyclotron Operation

RESTRICTED

The cyclotron was used for research experiments ninety-three percent of the 467 hours that the crew was on duty.

Radio frequency tests on the proton conversion unit have continued and the final design has now been fixed.

2. 60-inch Cyclotron Operation

UNCLASSIFIED

Repeated efforts through adjustment of all parameters of the cyclotron at the high frequency of 11.595 mc produced no significant increase in the beam. Because of this and other more technical considerations, the frequency was decreased to its former level of 11.35 mc. Performance at this lower frequency has been much steadier. Despite this trouble we have been able to continue to satisfy the requests for bombardment throughout the month.

3. Synchrotron Program

Further investigation of the azimuthal uniformity of the magnetic field in the synchrotron has resulted in the realization that most of the inhomogeneities in magnetic field result from a residual permanent magnetism in the iron which tends to equalize in all points in the orbit in a time interval corresponding to the pulse rate, but which exhibits large variations for a time interval corresponding to a quarter cycle of the resonant frequency of the magnet. This is believed to be caused by the necessity for flux lines crossing the plane of laminations and causing eddy currents which tends to delay the equilization. This conclusion points to the desirability of using the first quarter cycle of each magnet current pulse for acceleration (instead of the third), thereby allowing adequate time for the residual field to become uniform and greatly simplifying the task of compensating the azimuthal variations. Measurements of the field uniformity were made on this principle, and it was found that except for a second harmonic variation which is expected because of the asymmetry of the magnet, the field is quite uniform. The only difficulty which appeared to exist with this type of operation was the presence of a starting transient which made the measurement of magnetic field difficult and might possibly have interfered with injection into a betatron orbit.

This difficulty has been largely overcome by providing a separate bias winding around the magnet through which direct current is passed to provide a 30 gauss d.c. bias. This permits the starting transient to decay before injection time is reached and permits careful measurement of the field. It was observed that even with this small bias, some non-uniform residual field was present, however, and it was necessary to make use of a few of the radial compensating wires in order to obtain reasonable azimuthal uniformity.

At present, the total variation in magnetic field is about .4 gauss at the time of injection, with a peak field of 5000 gauss. It was observed that the presence of the d.c. bias moved the time

RESTRICTED

RESTRICTED

during which the betatron flux condition is fulfilled away from the time of injection, and it was, therefore, necessary to backwind the flux bars, placing this winding in series with the magnet bias coil in order to establish the betatron flux condition at the proper time.

All dimensional errors on the quartz doughnut are believed to be corrected, and the final plating and vacuum testing operations have been completed. The vacuum chamber and magnet are now being re-assembled, and an attempt will be made to observe a betatron beam as soon as this assembly is complete.

4. Linear Accelerator and Van de Graaff Operation

Van de Graaff. The Van de Graaff generator was shut down on September 23 for installation of a permanent magnet field, 5 kva, 110 volt, 400 cycle generator, to replace the two combination 400 cycle, 110 volt a.c., 28 volt d.c. generators. Rapid brush and commutator wear on the d.c. components of the old generators was responsible for the major portion of our maintenance problems. The new generator had no brushes or slip rings. Also the rotational speed is less than one-half that of the old generators so the likelihood of bearing failure should be reduced. Other incidental improvements made during this shutdown include the installation of an activated charcoal trap to reduce the amount of oil vapor in the ion source differential pumping system, and a No. 60 opening for escape of ions from the arc (increased from No. 65.).

The above shutdown was completed on schedule and the machine was back in operation at 4 Mev when, due to an unfortunate combination of circumstances, the accelerating tube was let up to air while running. The accelerating tube was badly contaminated with oil which necessitated its disassembly for cleaning.

Linear Accelerator. The linear accelerator was in operation a total of 35 hours during the first 8 days after Sept. 15. Since that time the machine has been undergoing changes which should result in improved operation. The major changes include new focussing grids with higher transparency, rebuilding of the drift tube water manifold to eliminate more than 50 soldered joints which were no longer needed, and re-alignment of drift tube spacings.

In addition tests are under way to determine the feasibility of operating the machine with increased pulse length and repetition rate, as well as to explore other means of increasing the beam current.

5. Experimental Physics

Film Program. A study is being made of the number of negative mesons produced as a function of the energy of the bombarding alpha-particles. Alpha-particles of various energies are obtained by placing the target at various radii in the cyclotron. Photographic plates receive mesons over a region from 4-1/4 to 7-1/4 inches from the target. The energy range is not well defined, but is of the order of 2-5 Mev. The region scanned is from the leading edge of the plate to a depth of 2 mm. The beam intensity is monitored by the activity on the carbon targets.

The numbers of mesons counted are shown in the following table. The values shown in the "relative abundance" column have been corrected for beam intensity and variation in emulsion thickness from plate to plate.

RESTRICTED

DECLASSIFIED

Energy (Mev)	No. of Mesons counted	Relative Abundance
380	339	100 per cent
342	164	32.8 per cent
304	38	7.37 per cent
266	7	0.68 per cent

As a continuation of this study, it is planned to measure the energy distribution of the mesons at full bombarding energy by exposing plates at various distances from the target.

Cloud Chamber. The cloud chamber group has been spending most of its time working on the pantograph cloud chamber. This involved perfecting the expansion mechanism, illumination system, and the timing of the various events in sequence.

The measurement of the energy distribution of the delayed neutrons from 0^{17} has been completed.

Study of Protons Emitted By Targets in High Energy Neutron Beam. The secondary protons emitted when 90 Mev. neutrons bombard carbon, copper and lead are being investigated. There appears to be a large discrepancy between the experimental results and the theoretical predictions based on single nucleon-nucleon interactions in the nucleus.

High Energy Gamma Radiation From Cyclotron Target in Alpha Bombardment. Four runs have been made with the pair counter referred to last month. The existance of γ-radiation from the target extending up to the region of 70 Mev. has been established with 90 Mev. deuteron bombardment. The counting rate with α-bombardment is so slow as to make accumulation of data very difficult. This, coupled with the question of the purity of the α-beam with respect to deuteron contamination, has limited the amount of effort placed on study of α-bombardment.

Comparison of the distribution of γ yield vs. γ energy for a Be target and a Pb target has indicated that both distributions extend up to high energies, but the Pb is relatively more intense at lower energies below 30 Mev.

Neutron Scattering Studies with Proton Recoil Proportional Counters. Absorbers of 16 different elements have been made for measurement of relative differential cross sections at 1°. A new set of coincidence counters is partially constructed for this experiment. Using the old tubes which were used to obtain angular distribution data we have measured total cross sections of Be, C, Al, Cu, Ag, and Pb. These total cross sections will be used to correct the angular distribution data for absorption in the scatterer.

A new beam defining system has been completed and tested. This system reduced the beam to rectangular cross section of $1'' \times 2''$ (at the region of the experiment) which makes it more suitable for small angle measurements.

Neutron Cross Section Studies with Bi Fission Chambers. Improved performance on the Bi fission counting chambers has been achieved by lowering the argon pressure from about 1.6 atmospheres down to 0.5 atmospheres. This gives a more favorable response to fission fragment ionization as compared with ionization due to the large numbers of alpha particles and protons which are emitted from nuclear processes also produced by the pulsed beam. It is now possible to obtain excellent plateaus in plots of counting rate vs. pulse height. These characteristics remain good at counting

DECLASSIFIED

RESTRICTED

rates up to 40 per sec. in the pulsed neutron beam.

Measurements of the ratio of inelastic to total cross section for carbon were made, yielding:

$$\frac{\sigma_i}{\sigma_t} = 0.45 \pm .02$$

The constancy of amplification was checked frequently throughout the run with a pulse generator. Its variation was not appreciable.

6. Theoretical Physics

Work is proceeding on the 32 Mev p-p scattering, and some thought is being given to high-energy p-d and n-d scattering. Calculations are being made of the probability of deuteron formation on bombardment of nuclei with 90 Mev neutrons.

The yield of mesons as a fuction of α energy agrees fairly well with the predicted yield. This, plus the fact that stars are formed on π meson capture, fixes the π meson spin as integral. It is expected that the μ meson decays by β emission into an electron and two neutrinos, and calculations of the energy distribution of the decay electrons have been made.

The Monte Carlo method has been tried on the problem of the production of small electron-positron showers, and it looks very promising. Similar attacks on nuclear reaction problems are also being considered.

Good progress has been made on the interpretation of the data on scattering of 90 Mev neutrons by nuclei.

7. Isotope Separation Program

Calutron. The new 360° calutron unit was completed and some preliminary tests made. Argon was used initially and it was possible to obtain a beam of 65 ma. at 30-40 kv. TCl_4 was then used and gave beams of up to 55 ma. at 30 kv. For both of these tests the length of the J slit was 4". The cut-off characteristic of the beam at the first receiver was determined to be very good, a bias of only 1.5 kv. being required to collect more than 95 percent of the beam. The beam current to power supply drain ratio was good. For a beam of 50 ma. the drain was about 80 ma. In the above tests no r.f. voltage was applied because the r.f. accelerator and associated equipment had not been completed. Tests will proceed almost immediately using this equipment.

Nier Spectrometer. A study of the background level from a random selection of radio tubes for the preamplifier stage of the electrometer circuit showed a marked dependence on tube manufacture. By a careful selection of this tube the background was reduced to the order of 10^{-15} amperes. Further improvements in the circuit using the Hall Effect developed in a germanium crystal for measurement of the magnetic field were incorporated. A new mounting for the crystal was found to give improved stability.

Mass spectrographic analysis of carbon samples derived from algae were carried out to determine possible isotopic effect. An analysis was also made of argon used in Geiger tubes to determine its oxygen content. The analysis of tin samples derived from various calutron processes was begun to

determine isotopic enrichment.

8. Chemistry

Part A

Short-Lived Bismuth Alpha Emitters. The neutron deficient bismuth isotope which decays with a one hour half-life and emits some alpha particles has been tentatively assigned to Bi^{201}, which is 8 mass numbers lighter than stable bismuth. It is the only one of the four short lived bismuth alpha emitters which is seen upon irradiation of lead with 60 Mev deuterons. The orbital electron capture branching (predominant mode of decay) gives a lead isotope of 5-8 hours half-life which in turn decays to a 75-hour thallium isotope. This thallium period cannot be produced from gold with alpha particles; therefore, it is probably of mass number >200. From previous work it is thought that Pb^{202} is long-lived because of the failure to see it in Po^{206} alpha-decay and from the irradiation of thallium with 20 Mev deuterons. As a result, the best assignment appears to be mass 201 for the decay series of 1-hr bismuth, 5-8-hr lead and 75-hr thallium.

A Method for Determining Short Lived Members of Alpha Decay Series. In the several new radioactive decay series that have been found from the irradiation of thorium with high energy deuterons and alpha particles, some of the members probably decay with half-lives of the order of a second. This lifetime is too short to measure by isolating the product and too long for coincidence type measurements. An instrument devised to measure such periods consists of a rotating metal disc with an alpha-particle ionization chamber open to the disc near its circumference. By placing an alpha-emitting sample in a position facing the disc and applying a few hundred volts potential on the disc, recoils from alpha emission are caught on the disc and carried through the ionization chamber. By varying the time over which the recoil products are allowed to decay before they are brought into the ionization chamber a measure of the half-life can be obtained from the resulting counting rates. In this manner Ra^{221} which is a descendant in the α decay chain

$$U^{229} \xrightarrow{1\ hr} Th^{225} \xrightarrow{7.8\ min} Ra^{221}$$

has been shown to have a half-life of 30 seconds. This device was also used to confirm the 20 millisecond half-life for Fr^{219}. The region from several milliseconds to several seconds appears to be the range of maximum usefulness for a device of this type.

Yields of Nuclear Isomers Through Different Modes of Production. It has been found possible to deduce certain features of nuclear reactions by measuring the yields of an isomeric pair when prepared by different nuclear reactions. For example, the independently decaying Cd^{115} isomers can be prepared in a number of different ways and the yields indicate which reactions go through similar mechanisms. The table presented here lists the ratio of 2.3-day Cd^{115} to 42-day Cd^{115} formed by the indicated reactions. It can be deduced here that the fission reaction of uranium with slow neutrons and thorium with 40-Mev alpha particles both produce a parent of the cadmium isomers as the primary fission product. Conversely, high energy induced fission with both uranium and bismuth produce the two isomers as primary fission products predominantly. The other data, some taken from the literature, are shown for comparison and indicate other possible differences in mechanism of formation.

[redacted]

	2.33 d/43 d	
U + n_{slow} (fission)	14	This ratio probably represents branching in β^- decay of Ag^{115}
Th + $He^{++}_{(40\ Mev)}$ (fission)	12-14	
U + $He^{++}_{(380\ Mev)}$ (fission)	1.9	Mostly, if not all, formed as primary fission products.
Bi + $D^{+}_{(190\ Mev)}$ (fission)	1.4	
Cd + n_{slow} (n, γ reaction)	5.3 7.5	
In + n_{fast} (n, p reaction)	0.75	(Estimated from data of Seren, Engelkemeier and Sturm, Report CP-1903.)
Sb + $He^{++}_{380\ Mev}$ (spallation)	0.3	
Sb + $D^{+}_{190\ Mev}$ (spallation)	0.2, 0.3	
Sb + $D^{+}_{100\ Mev}$ (spallation)	0.24	
Sb + $D^{+}_{75\ Mev}$ (spallation)	0.44	
Sb + $D^{+}_{50\ Mev}$ (spallation)	0.42	These ratios represent formation by direct reaction at high energies
Sn^{120} + $D^{+}_{190\ Mev}$ (spallation)	0.42	

Separation of Hafnium and Zirconium. The elements hafnium and zirconium, which are difficult to separate, can be separated with high efficiency making use of a Dowex 50 adsorption column. Twelve mg of HfO_2 and 30 mg of ZrO_2 were placed in solution and crystallized as the oxychlorides, dissolved in 2 M $HClO_4$ and placed on the top of a Dowex 50 column 30 cm x 1 cm^2 cross section. Upon eluting with 6 M HCl the hafnium and zirconium came off in two well defined peaks, the hafnium coming off first. At the top of the hafnium peak the hafnium/zirconium ratio was 800 while on the zirconium peak the zirconium/hafnium ratio was >1000. About 66 percent of the starting hafnium was recovered in >99.9 percent purity.

Another method that shows some promise for the separation of these two elements is the extraction into benzene of the chelate complex of the elements with TTA. At constant acidity of 2 M $HClO_4$ the equilibrium constant, C, is 8.6×10^7 for zirconium and 3.6×10^6 for hafnium where C

[redacted]

SECRET

is defined by the expression:

$$C = \frac{(MK_4)^4}{M(CH)_3^{+}\ (\text{aqueous})\ (HK)^4(\text{benzene})}$$; HK is the symbol used for the TTA ,

Preparation and Identification of Am_2O_3. The compound Am_2O_3 has been prepared by the action of hydrogen (1/3 atmos.) for 30 minutes on AmO_2 at 688°C. The compound produced was reddish brown in color and further treatment with hydrogen at about 800° produced no further visual change. Examination on the final product by x-ray diffraction analysis showed the compound to possess a "c" type lattice similar to that of a number of the rare earth sesquioxides. The lattice constant was found to be 11.036 ± 0.008 A.

Heat of Solution of Pr_2O_3. Thermal data on the different oxidation states of the actinide and lanthanide elements are being taken in order to estimate the oxidation-reduction potentials between the states. The heat of solution of Pr_2O_3 in 6 M HNO_3 has been determined on several samples of highly purified material which were prepared by reducing the higher oxides with hydrogen at about 500°C. The data, which have not yet been completely analyzed, give a value for the heat of solution of 106.2 ± 0.2 Kcal/mole.

Chemistry

Part B

RESTRICTED

Synthetic and Experimental Chemistry. During the past month a number of high activity preparations of C^{14}-labeled compounds have been completed, and paper work for a number of other labeled compounds has begun. Among the labeled compounds prepared are stillbamidine (4,4'-stibenedicarboxamidine), sodium propionate -2-C^{14}, alanine -1-C^{14}, and methylene labeled calcium glycolate.

An additional high specific activity preparation of glucose-1-C^{14} and mannose-1-C^{14} is in progress. The procedure is the same as for the low-activity run previously reported.

C^{14}-labeled compounds whose synthesis are at present being studied or investigated are: lactic acid-1-C^{14}; lactic acid-2-C^{14}; codeine; morphine; demerol (N-ethyl-1-C^{14}-labeled); succinic acid-2-C^{14}; ring-labeled bromobenzene; malic acid-2-C^{14}; fumaric acid-2-C^{14}; β-labeled phenylalanine; valine; leucine; stilbesterol; and butadiene.

The exchange reaction between labeled acetic acid and acetyl peroxide is being studied. Preliminary data for one-hour contact time without any heating indicate that no exchange occurs, but the experiments will be extended to see if some reaction will occur under more drastic conditions.

Preliminary experiments have been undertaken to perfect a synthesis of diiodofluorescein containing I^{131}. This substance is desired for an investigation of its possible use to locate tumors. The biological experiments will not be done in these laboratories.

Biological Chemistry. High activity stilbamidine has been administered to a mouse for the purpose of obtaining preliminary information on its distribution and excretion as a guide to its contemplated use in human multiple myeloma. No results from this experiment have been obtained yet, however.

RESTRICTED

DISTRIBUTED

A series of experiments have been undertaken to determine the effect of dietary amino acids on the economy with which an administered dose of tyrosine is utilized by the mouse. One milligram of tyrosine-β-C^{14} mixed with 20 mg. of fortified casein hydrolysate has been administered by stomach tube. The rate of respiratory excretion of radioactive carbon dioxide in particular will be closely observed.

Studies on the fate of methylene-labeled glycine in mice are in progress. A considerable uptake of C^{14} in most parts of the body has been observed, and the rate of decrease of this activity is being determined.

A series of experiments have been carried out to determine the rate of respiration of $C^{14}O_2$ by mice injected with $C^{14}O_2$ by mice injected with C^{14}-labeled compounds. Thus far, rate curves have been determined for sodium acetate-1-C^{14}, sodium acetate-2-C^{14}, glycine-1-C^{14}, glycine-2-C^{14}, sodium formate-C^{14}, sodium propionate-1-C^{14}, and potassium pyruvate-3-C^{14}. At least ten mice were checked in each group. In general, when the percent of initial dose injected appeared in the breath as carbon dioxide is plotted versus time on semi-log paper, the rate curve appears to be composed of three first-order reactions.

This work is being done with both tumor-bearing and normal mice. In all cases determined, except that of the pyruvate, there has been observed no difference in tumor-bearing and normal mice. In the latter case, the second first-order reaction seems to be faster in cancer-bearing mice than in normal mice. This effect is being investigated further.

Photosynthetic Chemistry. Fructose-1,6-diphosphate has been synthesized from radioactive phosphate by fermentation of glucose by dried yeast extract. From the medium, glucose-6-phosphate and fructose-6-phosphate have been isolated by standard procedures. These biological intermediates, apparently pertinent to photosynthesis, are being used to determine their position on filter paper chromatograms which, in turn, will permit identification of photosynthetic intermediates.

The preparation of a series of chromatograms of the radioactive products of photosynthesis with $C^{14}O_2$ by algae, Chlorella and Scenedesmus, is being continued. Differences in relative amounts of the intermediates involved are being observed, but the molecular species involved are apparently identical. The solvent commonly used for preparation of paper chromatograms, 2,4-lutidine, has been found to catalyze decomposition of labeled phosphate esters and has been replaced by a solvent developed in this laboratory which is free of such objectionable properties. This is a solution of butanol, propionic acid, and water. High water content of the solution is essential for separation of the phosphorylated intermediates of photosynthesis.

The majority of the published physical properties of the phosphorylated metabolic intermediates involves their hydrolyses rates under acid conditions. A series of experiments of varying hydrolysis times is being prepared. The preliminary results on radioautographs of paper chromatograms demonstrates that certain compounds are being hydrolyzed to glucose as evidenced by appearance of a radioactive glucose spot and disappearance of the ester spot. The technique of separation of organic compounds on ion exchange resins has been extended to include the phosphorylated sugar intermediates. Fructose-1,6-diphose, glucose-1-phosphate, 3-phosphoglyceric acid, and inorganic phosphate have been shown to be separable. This method will be used to separate photosynthetic intermediates containing P^{32} or C^{14}.

DISTRIBUTED

[redacted]

Chemistry

Part C. Subproject 48B

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

1. Thermodynamics of CN, N_2, and CH.
2. Absorption coefficients of CN, C_2, and CH.
3. Thermodynamics of gaseous molybdenum halides.
4. Refractory studies.
5. Thermodynamics of gaseous oxides and hydroxides.
6. Vapor pressures of metals.
7. Structure of solids.

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

1. Complexing of lanthanum by TTA.
2. Chemistry of ruthenium.
3. Polymerization of iodic acid.

Engineering Development of Plutonium Separation. The following subjects are being investigated:

1. Solvent extraction using chelate process.
2. Pilot-scale synthesis of TTA.

Ore Reduction. Familiarity with needed analytical methods is being established by the one chemist who has been available on a restricted clearance basis for two weeks.

9. Medical Physics

[redacted]

Part A. Project 48A -I

Radioautographic studies are continuing with strontium and europium. Overlayered radioautographs with cadmium in liver are also being prepared. A certain percentage of time is being devoted to the analysis of slides with the assistance of Doctor Asling of the Department of Anatomy.

Metabolic studies in rats are being continued with the following radio-elements: yttrium, arsenic, samarium, carrier-free europium and europium with carrier, and tin. The status of these studies has been reported quite completely as of October 1, 1948, and the experiments described but not yet completed in the Quarterly Report, are being continued.

A study is being made of the rate of uptake of radioyttrium and plutonium by bone during the first few hours following intravenous injection including effect of zirconium citrate treatment on this rate, and on urinary excretion. The studies on severe rickets and on endocrine factors in bone metabolism are being continued.

During the month ending 15 October the work accomplished in the chemistry section consisted of the separation of approximately a millicurie of radio-columbium from radio-zirconium; 120 microcuries of radio-tin were isolated from a cadmium target and complexed with citrate. Research work at present consists of the investigation of electrical transference of carrier-free activities. Data indicate that this method may be valuable in separation of activities from targets.

[redacted]

Medical Physics

Part B. Project 48A-II

RESTRICTED

Methods for separating various radioactive isotopes from irradiated tissue ash are being improved. A study of ion exchange methods for the separation of various components of the radiated biological material is in progress.

A study of the metabolism of Zn in mice is underway with special reference to the amount of Zn found in rapidly metabolizing tissues and in nuclear material taken from various tissues.

Some experiments were initiated for evaluating the mechanism of the action of deuteron and alpha beams in producing H_2, O_2, and H_2O_2, and in oxidation or reduction of enzymes.

Studies on the effectiveness of deuteron beams in killing bacteria have been continued.

10. Health Chemistry and Physics

A balanced-chamber (BF_3 and argon) type of slow neutron survey meter has been constructed and calibrated. Standard indium foils were employed in making the calibration. A survey of the slow neutron field outside the 184-inch cyclotron shield gave values ranging from 50-100 per cm^2 per sec, in essential agreement with previous data for equivalent cyclotron operation with 1/2 microampere of 190 Mev. deuterons. The flux density increases with elevation in the building due to the shielding roof being thinner than the walls, so that at about 30 ft. above floor level the flux is about 50 percent more intense.

The radium standards bench has been moved and reinstalled in a location and arrangement which should be better from the standpoint of scattered radiation.

The projects currently in progress in the Research and Development Section of the Health Chemistry Section are listed below.

1. S. G. Thompson interceptor run: the Webb target assembly, awaiting the 3-day trial on the 60-inch cyclotron with a cerium target, has had the circulating air pump and target assembly reworked and tested. The holdup is due to the lack of production of a sufficiently intense beam from the cyclotron.

2. Specially equipped box for Dr. Gofman's yttrium and strontium processing: delivery of the stirring motor and redesign of flexible-shaft finger tongs are being awaited. Drawings of the major equipment in the box are being made.

3. Controlled atmosphere arc stand for Dr. Conway's spectrum analysis of radioisotopes: the electrode lead insulation, which burned out on tests, was rebuilt. The pyrex window collapsed and is in process of being rebuilt with a smaller cross-section.

4. One-inch lead manipulator panel, portable: drawings of the lead glass window are completed and further steps will be taken on delivery of the lead glass.

5. Glass blowers' safety bellows: bellows are completed and have been delivered to the glass blowing shop.

6. Air alarm counter: probes in operation; work is progressing on the pre-amplification section.

7. Gloved boxes: the vacuum chamber and other equipment for new Werner box are completed; modification of fluorescent lights is being effected on ten units; a new microscope front has been drawn and is on order; an improved top panel, eliminating the necessity for a metal frame and permitting the window to be installed in the carpenter shop has been designed.

APPROXIMATE DISTRIBUTION OF EFFORT

PROGRAM	SUBDIVISION	MAN-MONTHS EFFORT	COMMENTS
1. 184-inch Cyclotron	Operation	12.3	
2. 60-inch Cyclotron	--	--	Non-Project
3. Synchrotron	R.f. System	1.4	
	General	.4	
	Injection	2.1	
	Miscellaneous Equipment	.2	
	Magnet Tests and Operation	4.9	
	Vacuum Chamber	1.7	
4. Linear Accelerator	Linear Accelerator - General	5.0	
	Van de Graaff - General	5.4	
5. Experimental Physics	Cloud Chamber	4.4	
	Film Program	5.7	
	Ionization Chamber and Crystal Counter	7.9	
	Neutron-proton Scattering	.5	
	Proton-proton Scattering	2.4	
	Neutron Diffraction	1.7	
	Meson Range and Decay Measurement	2.7	
	Absolute Cross Section Measurements	1.6	
	Neutron Half Life	1.0	
	Bevatron Design Studies	3.2	
	General Physics Research	10.3	
	Magnetic Measuring Equipment	1.2	
	Bevatron Magnet	3.2	
	Bevatron 1/4 Scale Model	1.1	
6. Theoretical Physics	Bevatron	2.0	
	General Physics Research	12.7	
7. Isotope Separation	JA Conversion	1.9	
	Nier Spectrometer	2.5	
	Low Mass Spectrograph	1.5	

DECLASSIFIED

PROGRAM	SUBDIVISION	MAN-MONTHS EFFORT		COMMENTS
8. Chemistry, Part A	Chemistry of Transuranic Elements	10.2		
	Nuclear Properties of Transuranium Elements	3.8		
	Transmutations with the 184-inch Cyclotron	9.9		
	Transmutations with the 60-inch Cyclotron	1.0		
	Analytical and Service	17.3		
	Chemistry of Astatine	1.5		
Chemistry, Part B	Synthetic and Experimental Chemistry	6.9		
	Biological Chemistry	4.2		
	Photosynthetic Chemistry	5.0		
Chemistry, Part C	Metals and High Temperature Thermodynamics	3.5		
	Basic Chemistry, including Metal Chelates	2.0		
	Engineering Development of Plutonium Separation	2.0		
	Ore Reduction	1.0		
	General	4.5		
9. Medical Physics, Part A, Div. I	Evaluation of Metabolic Properties of Plutonium and Allied Materials	10		
	Decontamination Studies	7		
	Radiochemistry	2		
	Radioautography	1		
Medical Physics, Part B -Div. II	Uranium Research	3.9	.65	Consultant Man-Months
	Tumor Metabolism	.9	.75	
	Special x-ray studies, Radioactive Measurements, etc.	1.9	2.30	
	Radioactive Carbon Studies	2.1	.70	
	Fundamental Medical Research	2.9	1.50	
	Hematology	.2	1.00	
	Medical Work with 184-inch Cyclotron	2.2	.80	
	Fly Genetics	3.0	.30	
	60-inch Cyclotron Bombardments	.3	.20	
10. Health Physics and Chemistry	Monitoring and Special Problems	7.4		
	Salvage, Decontamination, Disposal, etc.	6.9		
	Research and Development	3.9		

DECLASSIFIED

SECRET