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MONTHLY PROGRESS REPORT NO. 116

November 15, 1952 to December 15, 1952

January 7, 1953

~~RESTRICTED DATA~~

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UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

November 15, 1952 to December 15, 1952

MONTHLY PROGRESS REPORT NO. 116*

January 7, 1953

1. BEVATRON
(A. E. C. Program No. 9500)UNCLASSIFIEDMagnet

The top yokes have been removed from all the magnet sectors in preparation for the installation of the pole pieces and vacuum tanks. This job required approximately 800 man hours. At the end of the period, assembly of the pole base slabs was just starting. Modifications made in the assembly fixture to maintain accurate straightness of the sides of the slabs were successful.

As the result of tests done on the 1/7 scale model, the slope of the magnet pole tip plates has been changed from a geometrical n value of 0.60 to 0.63. This will give a magnetic field gradient nearer $n = 0.6$ than would have been obtained with the previous shape. Alterations in the pole tip die to accomplish this change were nearing completion at the end of the period. Testing is continuing on the model to determine the effect of the pole face windings and to observe the effect of generator ripple voltage on the field in the gap. Calculations have indicated that the 24th harmonic of the generator a. c. voltage, which amounts to about 2-1/2 percent, may cause an increase in amplitude of the synchrotron oscillations when resonance occurs at about 3000 gauss.

Vacuum System

The first tangent tank is now installed in the east tangent section and is ready for pumping to start. The first curve tank was completed and vacuum tested by the end of the period. It appears that construction of the vacuum tanks will have no difficulty in keeping up with the production of magnet pole slabs.

Injector

Installation is being delayed by lack of manpower for the electrical wiring. Design work is proceeding on beam pickup probes and the inflector.

*Previous report UCRL-2039 (No. 115).

~~SECRET~~

General

On a visit to Brookhaven for the dedication of the Cosmotron, December 15 to 17, information was obtained that can be used for a preliminary estimate for the shielding required for the Bevatron. Since no shielding is included in the present budget, a proposal is to be prepared for this purpose. The results of the tests on the Cosmotron will be very valuable in obtaining best operation from the Bevatron.

2. 184-INCH CYCLOTRON OPERATION UNCLASSIFIED (A. E. C. Program No. 5741)

The cyclotron was used for research experiments approximately 97 percent of the 490 hours that the crew was on duty. The time distribution was as follows:

Operation for customers	475.00 hours	96.9 percent
Electrical troubles	10.50	2.1
Mechanical troubles	1.25	0.2
Other	4.00	0.8
Totals	<u>490.75 hours</u>	<u>100.0 percent</u>

3. 60-INCH CYCLOTRON OPERATION UNCLASSIFIED (Operated by the University of California)

During most of the past month the 60-inch cyclotron has been operating with the two pole grid feelers. Consistently low C^{+6} beam persisted, despite good performance with other particles, dictating the removal of the feelers. Usually good C^{+6} beams have been recorded since and have lead to revised thinking on this type of feeler.

The overall operation efficiency of about 65 percent was low as a result of a heat sensitive intermittent leak that has been found and repaired. Since the repair and feeler change, steady operation has been resumed.

4. SYNCHROTRON OPERATION UNCLASSIFIED (A. E. C. Program No. 5731)

Unusually consistent and high intensity operation was realized during this report period. Several different injectors were tried in the synchrotron in an attempt to correlate data obtained in the test tank with beam intensity. Experiments conducted on a modified injector geometry have been the key factor in the synchrotron's high performance during the past few months.

The electron linear accelerator, a traveling wave type of machine, was built as a high energy injector for the synchrotron. It features a very high beam current with peak energies in the region of 5 Mev. While work on modification of the synchrotron spare vacuum chamber is underway, it is planned to use this electron linear accelerator for physics research. Some experiments using this high current beam are already planned.

5. LINEAR ACCELERATOR AND VAN DE GRAAFF OPERATION

(A. E. C. Program 5751)

UNCLASSIFIED

A system of strong focussing electrostatic lenses has been installed in the drift tubes of the 40-foot linear accelerator to replace the focussing grids. Because of the limitations on space inside the drift tubes, electrostatic rather than magnetic lenses are being employed. The electrodes are sections of hyperbolic cylinders with the axial spacing between electrodes equal to the electrode length.

The beam through the accelerator has been more than doubled, the average beam current having been raised from 0.2 μ a to 0.5 μ a. The fields between the drift tubes produce defocussing forces in the gaps that cannot be completely compensated for by the lens system since they vary periodically. As a consequence the beam is divergent at the exit end of the accelerator. The divergence of 0.001 rad is the same as it was with the grids.

Operation for the period may be summarized as follows:

Running time	128 hours	32 percent
Installation of lens system	288	68
Totals	416 hours	100 percent

6. EXPERIMENTAL PHYSICS

(A. E. C. Program No. 5211)

UNCLASSIFIED

Film Program

Work has continued on (a) high energy electron processes, (b) disintegration products of nuclei under high energy bombardment, (c) meson mass measurements, and (d) meson spectrometer magnet development; but no new results can be reported. The following projects have led to definite results:

Large Angle Scattering of Negative Pions in Aluminum, Copper, and Lead. A new technique is used to measure the cross sections for large angle scattering of negative pions as they traverse a semi-infinite scatterer. A stripped emulsion is embedded in the scatterer, exposed to an incident beam of 50^{+15}_5 Mev π^- mesons, and scanned. Most of the mesons stop at the expected distance from the absorber edge as determined from the range-energy relation. A few mesons are found at smaller depths of penetration and are attributed to large angle scattering. Star forming mesons that enter the emulsion traveling opposite ($90-180^\circ$) to the direction of the incident beam are attributed to nuclear backscattering and are used in the cross section calculations. This method affords an effective solid angle of 2π steradians for observing nuclear backscattering. The cross section is proportional to the ratio of backward flux to incident flux, both of which are observed in the same strip of emulsion.

The conclusions of this investigation are: (a) The scattering of negative pions from complex nuclei is consistent with energy independence in

the region of 32 ± 10 Mev, (b) S- and P-waves contribute to backscattering, and (c) The cross sections for backscattering are proportional to the mass number, A , which indicates pion-nucleon collisions are observed. The calculation of the cross sections include correction for inelastic collisions. The total nuclear backscattering cross sections (elastic and inelastic) for negative pions in aluminum, copper, and lead are 59.6 ± 11 mb., 192 ± 27 mb., and 577 ± 80 mb., respectively.

Detection of High Energy Gamma Rays by Electron-Sensitive Nuclear Emulsion. Photographic nuclear emulsions at this laboratory, up to the present time, have been employed primarily to detect charged particles. To extend the applicability of nuclear emulsions to photon detection, a preliminary experiment was performed in an effort to record high energy gamma rays. The detection of high energy gamma rays is accomplished by observing electron pairs created by the traversing gamma rays in electron-sensitive emulsion. When the gammas enter near grazing incidence, the electron pairs can have sufficiently long path lengths in the emulsion to facilitate an energy determination of the electron pair by small angle scattering measurements.

The initial experiment was to detect high energy gammas, principally from π^0 decay, which originate in a Be target when bombarded by 340 Mev protons. A straight, but tapered, light tight channel was placed on the proton probe cart at right angles to the beam direction. The target was located approximately two inches in front of the 1/8 inch opening to the channel. An unwrapped G5, 100 μ nuclear plate was placed in the channel about 30 inches from the target so that the gammas would enter 3° from the plane of the emulsion. At this position the channel is one inch wide. The ends of the channel were covered with photographic tape to make it light tight.

With two-minute runs, the nuclear plates were relatively free of heavy particle background. The high energy electron pairs were easily detected by their characteristic appearance and their well defined direction. In approximately 3 mm² of area scanned, 30 electron pairs were observed. The rate of detection for these pairs was about 5/hour. No scattering measurements were made on the electron pairs.

Several experiments which will use the photographic method to record gamma rays are now under consideration.

Cloud Chamber

A run was made at the 184-inch cyclotron using the 22-inch pantograph cloud chamber for the study of mesons produced in oxygen. The 270 Mev neutron beam and a lithium-deuteride target were used.

Another n-p scattering experiment was run at the cyclotron in the ten-atmosphere cloud chamber. The 270 Mev neutron beam and the lithium-deuteride target were used in this setup also. The collimation for this run was greatly improved, and extremely clear pictures were obtained.

n - p Scattering of "300" Mev Neutrons

A successful run has been made on the n - p scattering of "300" Mev neutrons for small neutron scattering angles. Indications are that the angular distribution of the differential elastic scattering cross section is nearly symmetrical about the 90° scattering angle in the center-of-mass system.

New Low Energy Pair Spectrometer

A new geiger tube coincidence circuit has been tested on the pair spectrometer during a run of December 6th and 7th. π^0 spectra were looked for at 0° and 180° at the cyclotron. A good spectrum was found, with the conclusion that this type of coincidence circuit is extremely useful for pair spectrometers. New mechanical arrangements on the spectrometer were also tested. It is felt that the spectrometer may now be used efficiently in a gamma energy range of 15 to 120 Mev.

Gamma-Gamma Coincidence Detection of Neutral Pions Produced by Proton Bombardment of Beryllium Pions

This experiment can now be done with Cerenkov counters. The preliminary run last month demonstrated the angular correlation. Counting rates were considerably higher than those previously obtained with the scintillation counters. The nature of the background was something of a surprise. Analysis of lead transition curves obtained at low and high beam intensity showed the background to be nuclear gamma rays, with a very crudely estimated cross section of approximately 0.3 barns..

Photoproduction of Negative Pions from Deuterium

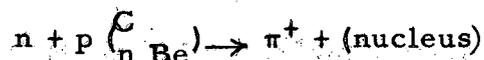
The coincidence detection of negative pions and protons is proceeding as reported previously. The high energy end of the meson spectrum is being examined for spin-flip probability. Preliminary results indicate that the number of high energy spin-flip mesons is small compared to the number in the free production peak.

Angular Distribution of Charged Mesons Produced by High Energy Neutron Bombardment

The analysis of the charged meson data reported in the September Progress Report has been completed. The experimental results for the angular distribution of π^- mesons from carbon and beryllium targets show a symmetry about $\theta = 90^\circ$ when transformed to an average center-of-mass (c. m.) frame, with $\beta_{c. m.} = 0.27$. If one takes the beryllium π^- cross section and subtracts two-thirds of the carbon cross section per nucleus, the effect due to the "extra" neutron (n') in beryllium is obtained. The c. m. data can be fitted with a $B(A - \cos^2\theta)$ curve. The neutron beam intensity was monitored by an n - p scattering monitor. It is possible to assign absolute average cross sections to the above results. The mean neutron energy for π meson reaction in carbon is 310 Mev for the 184-inch cyclotron neutron beam.

The π^+ meson angular distribution appears to be the same from C or Be, and is nearly constant in the average c. m. system.

The best estimate from this experiment for the reaction



in the same average c. m. system is

$$\left[\frac{d\sigma(\theta)}{d\Omega} \right]_{\pi^+} = [(6.1 \pm 2.2) - (0.03 \pm 0.02)\theta] \times 10^{-30} \text{ cm}^2 \text{ st}^{-1} \text{ nucleus}^{-1}.$$

The data suggests that π^- production by high energy neutrons is similar to π^+ production by high energy protons, in both magnitude and angular distribution of the mesons in a center-of-mass (c. m.) system.

Details of the experiment will appear soon in a UCRL Report.

Time of Flight Neutron Spectroscopy

Time of flight neutron attenuation experiments at flight distances of 145 feet and 489 feet using the neutrons from 180 Mev deuterons stripped on 4 in. beryllium have been carried out.

Energy resolution at 90 Mev at these distances are (in terms of equivalent probable error) respectively 2.6 Mev and 0.8 Mev, due to width of probe pulse.

Results for lead are consistent with the "Harwell-dip" but the uncertainty in counting statistics does not permit the drawing of conclusions.

A run has been scheduled at the 145 ft. distance which should provide the necessary statistics.

Proton-Proton Scattering at Reduced Energies (160 and 250 Mev)

During the most recent run at the cyclotron considerable attention has been given to the problem of calibrating the ionization chamber against the faraday cup at the energies used. This calibration did not give the expected ratio, by about 20 percent. Indications are that some low energy particles are still passing through the ionization chamber -- particles that emerge at wide angles from the collimator and do not hit the target. A special run is planned to study the collimation in more detail and to check whether this explanation is correct.

Total Proton-Proton Scattering Cross Section (345 Mev)

The first run has produced no directly useable result, since the liquid hydrogen target developed a small but significant leak at the moment the

liquid hydrogen was introduced. However, the run indicated that with very few changes the method will be satisfactory.

The arrangement consists of two small liquid scintillation counters (1 and 2) placed in the beam in front of the liquid hydrogen target and one large counter (3) placed behind the target. A scattering (by more than 8°) is detected as an event in which counters 1 and 2 register but 3 does not. A proton passing through the target unscattered is seen as an event registered in all three counters.

The data are recorded both by photographing the three possible pulses on an oscilloscope screen and by scaling circuits. For reasons not yet fully understood there are slight discrepancies between the numbers obtained from film and scalers, even though the actual counting rates were only of the order of two per second. However the film seems an acceptable and reliable method of recording (although somewhat tedious) and rather powerful arguments can be made indicating that the result from the photographic film should be quite correct.

Proton-Deuteron Scattering (using 345 Mev Protons)

The separation of protons from deuterons, made by observing specific ionization and total energy as pulse heights in thin and thick counters, seems quite adequate. In the most recent run, however, the background of deuterons from carbon in the CD_2 (deuterated polythene) target was larger than expected and poor cross section measurements were obtained. In the next run rather much smaller counter solid angles are to be used in an attempt to obtain a better compromise between this and other backgrounds.

Synchrotron Studies

During this period the synchrotron operated well with large beams, probably the largest steady beams in the history of the synchrotron. A long run was made to expose plates at small angles to mesons from H_2 and D_2 . Some of the plates are satisfactory and they are being examined at the present time.

Some runs have been made with a set up to determine what time delays are involved in the build-up of a shower. Some differences seem to be present between the shower particles of lower energy at large angles and those of higher energy at smaller angles. Further work is planned and will be reported.

The other main runs have been for work on the $\gamma + D \rightarrow \pi^- + p + p$ reaction. It is now possible to make some estimates of the probability of the spin-flip process.

The turn table for the pair spectrometer has been installed and operates satisfactorily. This should allow more versatile operation of the magnet.

7. THEORETICAL PHYSICS
(A. E. C. Program No. 5211)

UNCLASSIFIED

Pion Studies

A calculation of the production of positive pions by protons on complex nuclei has been prepared for numerical integration using the $p + p \rightarrow \pi^+ + d$ excitation function and angular distribution.

The calculation of negative pion production by neutrons on deuterium is being continued.

The investigation of meson production in p-d collisions is being continued.

High Energy Scattering

An investigation of the multiple scattering of waves by two fixed potentials is under way.

A calculation of the scattering of high energy neutrons by lead using a simple model is in progress.

The spectrum of neutrons from the bombardment of nuclei by protons is being investigated.

Field Theory

Work on the Tomonaga intermediate coupling scheme is continuing. In particular, the scattering of charged scalar mesons by nucleons is being investigated.

The reaction matrix for photo-pion production has been calculated in lowest order. Calculation of the higher order corrections is now in progress.

Work on meson-nucleon scattering in the Heitler damping theory continues. The reaction matrix has been calculated to lowest order, and the higher order corrections are now being investigated. It was found, as expected, that the correction to the Born approximation is large even in lowest order.

The study of the classical equations of motion for the nucleon spin in a meson field is continuing.

The possibility of application of the Schwinger Green's function technique to the meson-nucleon interaction is being investigated.

Work on the high energy photodisintegration of the deuteron in the pseudoscalar weak coupling theory continues.

Accelerators

The calculation of quantum corrections to the radiation by charged particles in circular orbits is being concluded. It was found, as expected, that for the design of electron accelerators the classical theory is adequate up to energies of about 4 Bev, thus refuting a contrary conclusion arrived at elsewhere. A detailed report is in preparation. .

A number of calculations relative to alternating gradient focussing are in progress. A parametric study of lens systems of this type for handling accelerator output beams is under way. Certain resonant and non-linear effects are being studied, especially those of the fairly large non-linearities present in the phase-focussing linear accelerator proposed by M. Good. It appears that such effects need not lead to loss of phase stability.

8. THE M. T. A. PROGRAM
(A. E. C. Program No. 9200)

SECRET

Time Quantization in a Feedback System

Work continues on the paper "Time Quantization in a Feedback System," an abstract of which was included in last month's report. Some brief experiments have been performed to clear up doubtful points in the treatment.

On December 4, 1952, tests on Power Supply No. 1 at Livermore were performed with the object of removing difficulties which had previously hampered operations. All went well except for one item which could not be reproduced under test conditions, but is thought to have been due to maladjustments in the Power Supply No. 1. Since this power supply was "tuned up" prior to these tests, the exact cause of the difficulty remains a moot question. It is not expected that the difficulty will recur. This opinion is shared by the CRD engineers.

9. CHEMISTRY
Part A
(A. E. C. Program No. 5311)

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Decay Schemes

A one channel gamma ray scintillation pulse analyzer has been arranged so that it can be used in coincidence with alpha particles which have been deflected by the magnetic alpha spectrograph. The decay of Cm^{243} has been studied with this device. It was confirmed that the three observed alpha groups all give rise to excited states of Pu^{239} , as had been suspected from decay cycle calculations. The most energetic alpha group goes to a 67 kev state of Pu^{239} . The decay scheme correlates very well with existing data for the beta decay of Np^{239} .

It is planned to install a multi-channel analyzer before extending the work to other isotopes.

Isotope Mass Assignments

The time-of-flight isotope separator has been used to confirm the assignment of Cs^{130} (half-life 30 minutes) produced by $I^{127}(\alpha, n)$. Cs^{129} was observed in the same experiment, showing that the instrument was functioning properly. Cs^{125} (45 minute half-life) was assigned previously by the same technique.

Nuclear Properties of Cm^{245}

Decay of Bk^{245} has produced a small amount of Cm^{245} , which is observed to emit alpha particles of 5.52 Mev with a half-life estimated as 1,500 to 2,800 years. This isotope had been observed previously by means of the mass spectograph among a mixture of curium isotopes, but its radiations had not been observed.

Beta Spectrum of Fr^{223}

Preliminary measurements of the beta spectrum of Fr^{223} have been made with the double focussing beta spectograph. Two beta groups (limits 1.0 and 1.5 Mev) are indicated, with the lower one being far more abundant. The 21-minute Fr^{223} was milked from a 20 mc source of Ac^{227} .

Radiochemical Separations

Among the chemical methods for separation of radioactivities which have been studied recently are the following. Extraction of tributyl phosphate from nitric or hydrochloric acid is a method of separating lanthanide and actinide elements. Measurements have been made of the extraction coefficients of Bk, Cf, Er, Tm, Yb, Tb, and Ho to extend the data already available from the Argonne National Laboratory.

The separation of Bi from Po, Pb, and Ra has been accomplished rapidly by a combination of anion exchange from Hcl solution, coprecipitation of Bi and Pb on MnO_2 , and adsorption of radiocolloidal Bi on filter paper.

CHEMISTRY

Part B

(A. E. C. Program No. 5311)

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Metals and High Temperature Thermodynamics

Work is in progress on the following problems:

1. Refractory silicides.
2. Molybdenum chlorides.
3. Alkaline earth oxide gases.
4. Carbon fluorides.
5. Review of thermodynamic data for oxide systems.
6. Thermal conductivity of gases at high temperatures.

Basic Chemistry

The following problems are under investigation:

1. Studies involving liquid ammonia as a solvent
2. Thermodynamics of indium.
3. Ferric fluoride complex ions.
4. The hydrolytic polymerization of zirconium.
5. Thermodynamics of sulfide ion.
6. Potential of the RuO_4^- - RuO_4 couple.
7. Study of hydrates.
8. Thermodynamics of thiosulfate.
9. Bromate thermodynamics.

CHEMISTRY

Part C

(A. E. C. Program No. 6400)

UNCLASSIFIED

Organic Chemistry

Work in organic chemistry during the past month has included:

(1) research on methods to synthesize carbon-labeled morphine, codeine, 6,8-thioctic acid, cholic acid, and heptanoic acid, (2) studies on the chemical degradation of ribulose and sedoheptulose, (3) measurements of the isotope effect involved in the rearrangement of methyl-labeled pinacol, and (4) a large-scale synthesis of Δ^7 -cholestenol.

Animal Biochemistry

Research in the field of animal biochemistry is continuing with the following studies: (1) the effect of heparin on the rates of metabolism of labeled acetate, lactate, alanine, and choline, and (2) the metabolism of adenine in mouse liver slices.

Plant Biochemistry

In the field of plant biochemistry, fundamental studies on the nature of the processes of plant photosynthesis have continued. This work includes the following subdivisions: (1) investigations on the nature of the primary light-energy conversion step of photosynthesis, (2) studies on the chlorophyll-sulfur ratios in the various constituents of green algae, (3) sugar degradations in relation to short-time photosynthesis experiments, (4) separation of phosphorus-containing algae metabolites and measurement of the distribution of phosphorus radioactivity in these compounds, (5) a search of photosynthetic intermediates, and (6) fundamental studies toward the improvement of paper-chromatographic techniques in photosynthesis research.

10. MEDICAL PHYSICS
Part A
(A. E. C. Program No. 6400)

UNCLASSIFIED

Tracer Studies

The K^{42, 43} phase of the studies upon relative biological effects of beta and alpha emitters has been completed. Experiments on the effect of Versene on Cm metabolism in rats were continued.

Radioautography

Work was completed on the (human) patients injected with I¹³¹. In progress at present is the calibration of the Orthophot and the publishing of the astatine paper.

Radiation Chemistry

Radiation products formed in evacuated acetic acid solutions are being studied; non-volatile acids, hydrogen peroxide, organic peroxide, volatile non-acidic products and gaseous products are being determined. Studies of the radiolysis of aqueous formic acid and aminoacetic acid are continuing. Preliminary results in the case of aminoacetic acid indicate that several basic nitrogen-containing compounds are produced. Results from the formic acid studies show that there are four non-volatile acids formed at low radiation doses.

MEDICAL PHYSICS
Part B
(A. E. C. Program No. 6400)

UNCLASSIFIED

Carbon¹⁴ Studies

Studies are now underway in man attempting to determine what is the specific activity of glycine available for conjugation with benzoate at various time intervals following the administration of radioactive glycine. These studies are carried out by administering orally sodium benzoate and then extracting hippuric acid from the urine. An aliquot of the hippuric acid is used for the measurement of specific activity. The remaining hippuric acid is hydrolyzed and the glycine and benzoate are separated. The specific activity of the benzoate on a few samples was, as anticipated, "0"; the specific activity of the glycine is in the process of being measured. Further studies will consist of splitting the glycine into the carboxy and the methylene carbon atoms to determine whether both of these are labeled. This should give us some idea of the rate of mixing of carbon¹⁴ with the carbon atoms of the amino acid during the period following the administration of radioactive glycine. It will also be of value in determining what is the specific activity of the glycine available for hemoglobin in any given time period.

Lipoprotein Studies

Studies are continuing on the post-irradiation elevation of serum lipoproteins, which has previously been shown to be related to subsequent death in the rabbit. The dramatic clearing effect of injected heparin on lipoproteins has prompted investigation into the possible appearance of a heparin produced "active factor" in the serum following irradiation. A two stage mechanism is postulated with, first, an overproduction of "active factor", and following this, a depletion which would account for the 30 hour post-irradiation lipemia. The initial stage is being investigated by injecting standardized lipoprotein loads pre-irradiation. Preliminary results indicate a more rapid clearing of lipoprotein during the first eight hours post-irradiation.

Infrared Absorption Spectrometry. By previous ultracentrifugal techniques developed here, lipoproteins have been classified on a density scale. Work is now in progress to study the chemical constitution of these lipoproteins by infrared absorption spectrometry. Results already demonstrate that this method is potentially useful not only in the study of isolated lipoproteins but in the field of lipoprotein analysis generally.

Studies in Regional Blood Flow

Radioactive sodium has previously been used with the "in vivo" counting technique for the measurement of regional blood flow. Two general methods have been employed in evaluating the circulation in the extremities. The build up of activity in a region following an intravenous injection and the rate of removal (clearance) of a local injection into tissue have both been used. It has been found that the local injection method is sensitive to the volume of the injection. By injecting radioactive sodium ion into an artery, a large portion of the injected material can be localized in the region supplied by the vessel due to the rapid exchange which occurs with the local sodium pool. Following such an intra-arterial injection, the rate of removal of this residual material gives an interesting picture of the regional blood flow. The rate of removal is not constant and is much more rapid than in the case of local injection. The variation of the removal rate with time can be explained on the basis of differing degrees of vascularity in the tissue. As might be expected, the systemic administration of epinephrine greatly increases the rate of removal of the radioactive sodium ion.

Biological Effects of Radiation with the 184-inch Cyclotron

The first monkey was irradiated during the past month as a beginning of a study of action of deuterons on the brain, hypothalamus and pituitary.

Activation Analysis

Procedure for separation of Cu^{67} was developed for isolation from deuteron irradiated isotopically enriched Zn^{67} , and this copper isotope is being used in initial tracer experiments on rats. It is believed that this is the first biological use of the relatively long lived copper (half life 60 hours).

Mechanism of Radiation Effects on Microorganisms

It has been found that β -thiolethylamine gives some protection to haploid yeast cells against x-rays. Previously, this same substance was reported by Z. Bacq and others to be a protective substance for rats. More extensive experiments are planned both on yeast cells and animals to determine the mechanism of action of several available protective substances.

For about a year we have been carrying out work on the shape of the haploid yeast survival curve which until recently showed two exponential functions of the dose; the first less resistant, to which 90 percent of the cells belong, and second much more resistant, to which 10 percent of the cells belong. In last month's report we showed that the resistant tail is due to cells undergoing cell division. Since then we have developed a technique to arrest cell division and to uniformize the state of division of the cells in the colony. The technique consists of having the cells live on a medium containing carbon source but no nitrogen source. After several days the yeast cells are examined and they contain no buds. The x-ray survival curve of these cells is exponential for six logarithmic cycles. Our technique was developed after having received information on a method used by Wood at the University of Chicago for accomplishing the same final result with a different technique. The new technique makes it possible to obtain survival curves for different ploidy cells with quite high accuracy and most all the cell types previously examined will now be rerun to obtain a more complete quantitative picture of the dose effect relationship.

Instrumentation

Our 10-phototube scintillation counter scanner is being used for iodine distribution studies, and during the past month the scanner has detected several new metastases of thyroid carcinoma not otherwise seen on the diagnostic x-ray picture.

Iron Turnover Studies

The two most recently observed cases of hemochromatosis have been studied by combined blood and tissue serial radioactivity measurement technique after labeling of the circulating plasma iron with Fe^{59} globulin. It is believed that this is the first time that iron turnover studies with simultaneous blood and tissue measurements have been done in this disorder.

11. HEALTH CHEMISTRY
(A. E. C. Program No. 5311)

UNCLASSIFIED

The Equipment Development Group has been engaged in work on the following major items:

1. Work continued on equipment being readied for use in the 6-in. and 2-in. lead caves, in which bombardments from Idaho Falls will be processed. This is the major job being worked on by the group.

2. The one-hundred-curie cobalt source was placed in its permanent housing in Bldg. 4A; the cobalt pellets were loaded into their container through use of the 6-inch lead cave in Bldg. 5.
3. Work continues on the equipment for processing Hanford waste solution from which americium is extracted.
4. Modifications are being made in the equipment set up for processing plutonium cows, both for the americium extraction and the preparation of the remaining plutonium for shipment from this area.
5. Health Chemistry's services at Livermore increased considerably during this period.
6. Fifteen gloved boxes were assembled, fitted and delivered on request.

12. PLANT AND EQUIPMENT

OFFICIAL USE ONLY

Chemistry Laboratory Building. (Project No. 9500. 5-271-1002)

The mechanical engineering consultant is unable to deliver his portion of the work to the architect within the next six weeks. The architect's plans are 95 percent complete and are awaiting this delayed detail.

Synchrotron Research Building. (Project No. 9500. 5-271-2001)

The contract for the Synchrotron Research Building is 99 percent complete; minor painting, hardware installation, and clean-up remain.

Electronics Research Building. (Project No. 9500. 5-271-2002)

Preliminary programming is complete and all is in readiness for negotiations for preliminary plans with the architect.

Bevatron Instrument. (Project No. 9500. 5-271-9001)

The top yokes of the magnet have been removed for the installation of the pole pieces and the curved vacuum tanks. One curved tank has been completed and temporarily installed. Another curved tank is under construction. Production has started on the pole pieces. The first tangent tank has been installed and is being vacuum tested. The injector system is being fabricated and tested.

Miscellaneous Construction. (Project No. 9300. 3-271-3001)

The block house is complete as are also the pits in and around Building 153. The foundations of the Computer Building are in, the walls erected, and the framing for the roof underway. The contract with S and Q Construction Co. was reworked as of 12/19/52. The cost will be \$91,265. The work is to start before 1/1/53 and be finished within 90 days.

MAN - MONTHS EFFORT REPORT
SCIENTIFIC PERSONNEL

Program No.	Subdivision	Man - Months Effort	Comments
9500	Construction	11.26	
<u>Operations</u>			
2000	M. T. A.	25.49	
3000	Weapons Research	98.84	
5211	Physics Research	13.50	
	Experimental Physics	48.99	
	Cloud Chamber	4.36	
	General Physics Research	3.45	
	Instrument for General Use		
	Magnetic Measuring		
	General	13.85	
	Theoretical Physics		
	Photographic Film Detectors	14.81	
5261	Applied Physics Research		
	Mark III Cyclotron	1.51	
	Electron and X-C Models		
<u>Chemistry Research</u>			
5311	Basic Chemistry Research,	2.75	
	Part A	8.31	
	Chemistry of Heavy Elements	4.84	
	Nuclear properties of Heavy Element Isotopes	14.22	
	Transmutations with 184" and 60" Cyclotrons	6.23	
	Analytical and Services	1.46	
	Special Chemistry Development	3.13	
	Mass Spectroscopy, Beta Ray Spectroscopy	2.75	
	Instrument Development and Services	9.30	
	X-Ray Crystallographic Measurements		
	Health Chemistry Research		
	Metals and High Temperature Thermodynamics)		
	Basic Chemistry, including Metal Chelates)	7.39	
	General		
Part B	Basic Chemistry Research		

MAN-MONTHS EFFORT REPORT
SCIENTIFIC PERSONNEL

Program No.	Subdivision	Man-Months Effort	Comments
5361	Applied Chemistry Research Process Chemistry	5.1	
<u>Reactor and Accelerator Operation</u>			
5731	Electron Synchrotron Operation	8.90	
5741	184-inch Cyclotron Operation	8.27	
5751	Linear Accelerator Operation	16.41	
<u>Biological Research</u>			
6300	Biology and Medicine Internal Irradiation and Hematological Response Health Medicine	6.60	1.69 Consultant Man-Month
6400	Biological Research Instrumentation for Quantitative Measurements of Radiation C14 Metabolism Use of Radioactive Materials in Human Physiology and Experimental Medicine Trace Elements and Irradiation Studies Radiation and Mutation Rate Physical Biochemistry Biochemical Response to Irradiation Miscellaneous Metabolism of Lipo Protein and Lipids Iron Metabolism Hematopoiesis Synthetic and Experimental Organic Chemistry Metabolism of Fission Products	2.16 3.84 13.21 3.03 1.55 13.79 4.01 7.23 4.95 3.37 23.07 17.08	.39 .24 2.60 .48 - 3.25 .48 3.66 11.46 .45 - - 1.12 .60
6500	Biophysics Research Biological Effects of Cosmic Radiation Health Physics Irradiation Studies	2.23 - 3.25	

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