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UNIVERSITY OF CALIFORNIA

RADIATION LABORATORY
BERKELEY 4, CALIFORNIA

August 4, 1954

Notice to Recipients of the Radiation Laboratory
Monthly Report

The monthly report series is being discontinued with the report UCRL-2668 (Monthly Progress Report No. 135) covering the period June 15-July 15, 1954. Persons interested in the progress of research at this Laboratory are referred to our quarterly reports in physics, chemistry, and medical physics.

R. K. Wakerling

R. K. Wakerling
Information Division

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MONTHLY PROGRESS REPORT NO. 135

June 15, 1954 to July 15, 1954

August 5, 1954

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Berkeley, California

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UNIVERSITY OF CALIFORNIA RADIATION LABORATORY

MONTHLY PROGRESS REPORT NO. 135*

1. EXPERIMENTAL PHYSICS UNCLASSIFIED
(A. E. C. Program No. 5200)

Photodisintegration of Deuterons at High Energy

A two week synchrotron run has been completed using the dE/dx - Range counter and the liquid deuterium target. The data were recorded on film, about two thirds of which has now been read. The data are being analyzed but no cross sections have yet been determined. It appears that most of the data will be useful, but there is some question about that taken at 24°. The electron background at this angle will make it difficult to separate out the protons.

Gamma Ray Pair Spectrometer

Data from the May and June runs with the pair spectrometer are currently being analyzed.

Work on the 15 Mev gamma line from proton bombardment of carbon was reported at the Seattle meeting of the American Physical Society. It has been decided that the threshold for producing the line by proton bombardment must be determined in order to find out whether the line arises from a 15 Mev excited level in carbon, or from a higher exicted level around 20 Mev, or possible from an excited level in Be. In this connection, one of the beam focusing magnets is being modified to take the present pair spectrometer vacuum chamber. The present pair magnet weighs 17 tons and cannot be moved conveniently from Bldg. 6 to the other accelerators. The new spectrometer will be portable, and will make use of a number of improvements in design to enhance the resolution and lower the minimum gamma energy that can be measured. In order to increase the counting rate, particularly at accelerators such as the bevatron and synchrotron which have slow repetition rates, a system to replace the present geiger tubes with plastic scintillators and high-speed electronics is under consideration.

Neutron Production by 30 Mev Protons in Various Elements

Some preliminary data have been obtained for the element beryllium. However, a modification of our neutron spectrometer was made to increase its efficiency. Tests on the new spectrometer are now being completed. Next, data on some heavy elements will be taken as well as additional data on beryllium at angles other than the distribution at 22° already obtained.

*Previous Report UCRL-2648 (No. 134).

DECLASSIFIED

Beta-Ray Neutrino Angular Correlation in Ne^{19}

A linear accelerator run was made July 1st and 2nd, using the differential pumping apparatus and a newly constructed charcoal and liquid nitrogen trap. The purpose of the trap is to purify the Ne^{19} activity produced, and to eliminate the loss in electron multiplier tube gain previously experienced upon bombarding the target.

Observations made on this run indicated that the new trap was performing these functions satisfactorily, and was not causing any appreciable loss of Ne^{19} activity at the counter.

The remaining difficulty uncovered on the previous run, a background count in the recoil counter caused by turning on the "clearing field", was alleviated by reducing the clearing field.

A data run was then made, and a significant delayed coincidence counting rate of ~1 count/min. was observed.

We are now setting up recording apparatus to measure the time delay distribution of these counts, and from it, to determine the beta ray neutrino angular correlation.

Inelastic Proton-Gamma Ray Coincidence Detection

A new, well shielded gamma ray counter for detecting high energy photons (in coincidence with inelastic protons) has been constructed, to be used with the Goldsworthy Pulse Analyzer. The proton counters are almost completed. Also, it has been arranged to clear the rear bombardment area of the linear accelerator in order to perform the experiment in a reduced neutron background.

Experiments on Proton Polarization at 32 Mev

Scattering angles have been extended to 82° by means of a new plate holder. This larger angle was obtained at the expense of angular resolution. However the particular choice of 82° makes the measurement feasible. This is approximately the angle of the second maximum of the defraction pattern; hence in the vicinity of this angle the cross-section is changing slowly and the use of a target holder with $\pm 5^{\circ}$ resolution does not introduce excessive, spurious asymmetries.

Polarization Experiment Using Linear Accelerator Beam Reduced in Energy to 9.5 Mev

Two runs have been made with protons of approximately 10 Mev energy scattered in a pressurized helium target. The background is large. No further work is contemplated on this helium scattering until a more highly polarized initial beam is available or until John Williams, at the University of Minnesota, obtains information on the polarization from an initial 10 Mev proton beam scattered in helium.

Further communication with Dodder indicates that the phase shifts used for the extrapolation of the 3.5 to 4 Mev polarization up to 9.5 Mev are not unambiguous. Williams' experiments should clarify this point for us.

Polarization Experiments Using the Cyclotron Polarized Beam Reduced in Energy to Approximately 10 Mev

Two runs were made with the high pressure helium chamber filled to 750 psi. The background on the plates appears satisfactory, except that the real scattering events can be confused with short tracks due to radioactive decays in the emulsion. A batch of plates is being eradicated, and a shipment of emulsion for pouring fresh plates is being ordered from Ilford so that this difficulty can be avoided in future runs.

Analysis favors the same polarization as the 300 - 125 - 70 - 32 Mev carbon data, viz. an attractive spin-orbit coupling.

Polarization Experiment Using Cyclotron Polarized Beam Reduced in Energy to 135 Mev and 270 Mev

The polarization of the beam was observed after scattering at the above two named energies on a carbon target at angles of 10°, 15°, and 20°. The magnitude of the polarization at 135 Mev is approximately the same as that found at 300 Mev. The size of the polarization takes an abrupt drop between 135 Mev and 70 Mev but still maintains the same sign for all of the points investigated.

Polarization Experiment Using the Cyclotron Polarized Beam Absorbed to Approximately 30 Mev

The run reported in the last month's progress report has been partially scanned. The observed asymmetry is approximately 6 percent and is of the same sign that is found at 300 Mev and 30° scattering from carbon. The low magnitude of the asymmetry observed cannot be considered to imply that the polarization at 30 Mev is indeed small, because the straggling of the cyclotron beam when reduced to this energy is very large and hence there is no way of separating elastic from inelastic events.

The fact that the sign of the asymmetry does not reverse in going from 300 Mev to 135, 70, and 30 Mev may be of significance in determining the sign of the spin-orbit coupling. Heckrotte has pointed out that his preliminary calculations indicate a change in the sign of asymmetry between 30 and 300 Mev for one assumed spin-orbit sign and not for the other.

Film Program

A table has been prepared which gathers together the available theoretical and experimental information relating the measurable quantities in emulsion to each other and to the particle velocity, mass, and charge. This is expected to be a generally useful tabulation.

Synchrotron runs with the 40-inch spiral orbit spectrometer were made to measure production spectra of positive and negative pions emitted at 90° from deuterium and carbon.

The contribution to the observed photon spectra made by neutron capture gamma rays is now being investigated supplementary to observations of selective scattering of photons by nuclei.

Analysis is continuing on plates exposed for a number of other experiments. These include the analysis of the disintegration products of various nuclei under high energy bombardment, and the interaction of fast particles with nuclei.

Cloud Chamber Studies

Interactions of 28 Mev Protons with He^4. The analysis has been concluded. With the aid of Edward Vaughn of the theoretical group we have succeeded not only in computing the phase volume available to the various reactions observed, but have also succeeded in computing the phase volume and momenta spectra of the various reactions under the conditions of limited azimuthal and beam angle visibility that prevail in the cloud chamber.

The agreement between the computed and observed spectra indicates not only that there is no evidence for excited levels in He^4 for energies up to 23 Mev, but that the results agree well with the assumption of only non-resonant reactions.

With the aid of the computed available phase volume and relative yields, absolute cross sections have been assigned to the $He^4(p,pn)He^3$ and $He^4(p,2p)He^3$ reactions, and absolute differential cross section has been obtained for the $He^4(p,D)He^3$ reaction.

Cloud Chamber Calculations. Use of the McBee Keysort punched cards in the analysis of cloud chamber data is being continued with good results. The data of four experiments are being handled by this method, and plans are being made for a fifth experiment to be so treated.

The frequency of computational errors is estimated to be reduced by a factor of five because the cards may be ordered in such a manner that the numerical value of a given parameter that has been calculated from one or more punched values increases monotonically as one goes through a stack of the cards. Errors in the placement of the decimal point thus become very obvious, as do large errors in the numbers themselves.

In one of the experiments emphasis is not so much centered on the construction of a few histrograms concerning one reaction as on a simple analysis of the relative number and identities of the various prongs observed in each event caused by radiating O_2 with 360 Mev neutrons. Here each card represents a complete event, and is punched so as to indicate the identity, angles and energy of each observed prong. The cards are then sorted mechanically to separate each class of events. It is obvious that the classifications may be changed in almost any possible way with a minimum of effort being required to reclassify the events according to the revised scheme.

Synchrotron Studies

Synchrotron operation was good during this period. The runs were completed on both the π^-/π^+ ratio and the π^+ yield as functions of meson energy from the reaction $\gamma + D \rightarrow \pi^+ + 2n$.

A run of approximately two weeks length was made on the photodisintegration cross section of the deuteron at high energy using the liquid deuterium target. The results will be reported in a thesis by Dixon. The Cornell and Nunan ion chambers were calibrated during this run and the results were in good agreement with previous calibrations.

Various aspects of the modified π-μ gear were checked during two short runs.

Some characteristics of the new magnetic monitor scheme were checked using a temporary mock-up during a short run.

The remainder of the running time was devoted to observations of the cross section as a function of meson energy for producing π^+ mesons of 180° by the reaction $\gamma + p \rightarrow \pi^+ + n$. Carbon, CH_2 subtraction technique was employed. The high pressure gas target will also be used during this run to observe the same effect from hydrogen and perhaps other gases in the same geometry.

2. THEORETICAL PHYSICS UNCLASSIFIED
(A. E. C. Program No. 5200)

Electron geometrical optics is being studied from the variational principle point of view.

The work on the renormalization of an approximation scheme for Green's functions is being written up.

Angular and energy distributions of photo-protons and neutrons below meson threshold are new being calculated on the basis of a direct emission model.

A beginning has been made in the study of the orbits in a solenoidal beta-ray spectrometer in which the magnetic field is to be perturbed for minimization of the spherical aberration.

An investigation of phenomena in ionized media was begun.

Work is continuing on the problem of alpha-decay from a spheroidal nucleus.

The polarization of 300 Mev protons elastically scattered from aluminum has been calculated. The calculated results agree with the experimental results obtained by Chamberlain, et al. It can be shown, by the use of Tamor's calculation of the polarization phenomena, that the usual tensor force in the nucleon-nucleon interaction leads to an effective spin orbit potential for the optical model of about 1 Mev.

An approximate solution of the Boltzmann equation for a low density plasma in a magnetic field is being attempted by an expansion of the distribution functions in terms of Hermite polynomials.

A paper on "Adiabatic Theorems in Field Theory" was presented at the Seattle meeting of the American Physical Society.

An investigation on a statistical model for high energy processes has been completed and submitted for publication to the Physical Review. The possibility of including additional constants of motion in the model is currently being explored.

Some general focussing properties of arbitrary magnetic fields are under investigation with particular attention being paid to the possibility of studying aberrations in a general way.

A method has been worked out for using the differential analyzer to determine parameters in a singular nucleon-nucleon potential model. The possibility of developing a covariant phase shift analysis for two body problems by making an operator expansion of the Green's function is being investigated.

The phenomenological theory of Watson and Brueckner, which had been used to obtain the differential cross section for

$$(1)\quad p + p \rightarrow d + \pi^+ ,$$

was applied to

$$(2)\quad p + n \rightarrow d + \pi^+ + \pi^o$$

$$(3)\quad p + n \rightarrow d + 2\,\pi^o$$

$$(4)\quad p + p \rightarrow d + \pi^+ + \pi^o .$$

It was found to be impossible to eliminate all but one of the phase shifts, as in (1); therefore, on the basis of this approach, no simple expression for the cross section for these three processes can be given.

The consequences of a new principle of gauge invariance for meson-nucleon couplings are being examined.

2. M. T. A. PROGRAM (A. E. C. Program No. 4900) CONFIDENTIAL

At the termination of the contract between the Atomic Energy Commission and the California Research and Development Company the MTA accelerator development program at Livermore was taken over by UCRL on June 30, 1954. During the transition period leading up to the transfer the construction effort on the 49 Mc resonant cavity accelerator, known as the A-54, was limited to the first 20-foot tank. Also during this transition period UCRL initiated design work on a two-stage quarter wave stem linear accelerator to operate at 24.5 Mc.

Development work on the two injectors built for the Mark I accelerator has continued with the objective of injecting into the 3-inch diameter bore of the two linear accelerators mentioned above as large steadyproton beam currents as possible with angular divergence not greater than 5°. At present an injector geometry is in operation capable of delivering 0.48 ampere of 100 kev protons into a 3-inch aperture at a distance of about 7 feet from the injector.

Construction work on the first 20-foot tank of the 49 Mc resonant cavity accelerator is progressing well. The vacuum tank has been evacuated to a pressure of about 1×10^{-6} mm Hg and the leakage determined to be sufficiently low by measuring the rate with the flap valves closed (leakage ~ 5μCFM). The drift tubes have been completed, including all individual power load and vacuum tests and have been installed in the tank. Final alignment of the drift tubes and low level rf tests are now in progress. Operation of the A-54 machine with proton beam is anticipated some time in October.

Construction work on the 24.5 Mc, two-stage quarter wave stem accelerator has started with some components now being fabricated. The schedule for completion has not yet been determined.

During this period a cyclotron run was made using the liquid scintillator tank in an attempt to measure the differential thin-target neutron yields from various primary targets, using deuterons of 90 Mev, 190 Mev, and 320 Mev. The analysis of the data is under way and some very preliminary values of the efficiency of the liquid scintillator tank (as compared to neutron yields measured with the manganese sulfate tank) have been obtained for lead, uranium, copper, cadmium and uranium primaries, using 190 Mev deuterons. From the no-target 320 Mev deuteron films, it is evident that much better collimation will be necessary on the next run in order to cut down background from particles striking the collimators. The background from this effect seems quite low in the case of 190 Mev deuterons, and it is felt that good yield measurements can be made for non-radioactive primaries, once the problem of counting efficiency versus neutron energy is solved. In the case of uranium and thorium, most of the background is the natural γ-ray background of the elements themselves, so somewhat more precise no-beam measurements must be made in order to obtain good statistics on neutron yields after background subtraction.

A program has also been set up to investigate the feasibility of a high-current cyclotron, and calculations are well underway. Attempts to overcome space charge limitations by various means, such as electron neutralization and gap focusing, are under study. A preliminary report of this work will be made available shortly.

4. ACCELERATOR CONSTRUCTION AND OPERATION

UNCLASSIFIED

Bevatron Operation (Program No. 5761)

The bevatron has been operated on a limited scale on one generator since June 28. The damaged generator has not yet been run because all of

the protective equipment has not been installed and outgassing has not been completed. It is expected that two generator operation will be under way at the end of August.

The operation on one generator has permitted three experimental exposures of photographic plates at 3.2 Bev. However most of the time has been devoted to the program of improving operation which was interrupted by the generator failure.

The buncher on the linear accelerator injector has been run.

The injected beam as measured at the inflector is about 60 μa, an improvement of a factor of two to three.

Installation of experimental auxiliaries continues.

184-inch Cyclotron Operation (Program No. 5741)

The shutdown scheduled for this month was postponed for approximately four months. This was done to allow the bevatron to get under way and thus carry some of the research load before the cyclotron was shut down.

The cyclotron operated very consistently this month with an innage time of about 99 percent of the 532 hours that the crew was on duty.

The time distribution was as follows:

Operation for customers	527.5 hours	99.0 percent
Maintenance, filament changes, etc.	5.3	1.0
Totals	532.8 hours	100.0 percent

184-inch Cyclotron Modification (Program No. 4900.02)

Magnet. The second auxiliary coil has been vacuum tested. The terminal boxes are assembled, but the connections between the terminal boxes and the coils have not been made. Design is proceeding on leads to auxiliary coils.

The pole shims and pole extension discs are complete.

RF Design and Vibrating Condenser. Incomplete preliminary RF tests with dummy blades on the full scale test set-up of the RF system in Bldg. 6 indicate agreement with previous model tests.

The status of the blades is as follows:

1st Pair - Copper plating too thick, must be replated. On project being tested.

2nd Pair - Copper plated. On project being tested.

3rd Pair - Delivered for copper plating July 27.

4th Pair - On project being tested to be plated about Aug. 1.

5th Pair - Being machined at Mare Island
& 11th Blade

General. Manifolds for diffusion pumps are completed but not vacuum tested.

Design work is progressing on shielding changes, ion cource, trimming coils, moveable scatterer in dee, and misc. minor items.

The probable date for the shutdown in now October 10 but is subject to change depending on Bevatron Operation achieved by that time.

60-inch Cyclotron Operation (Operated by the University of California)

The re-assembly of the 60-inch cyclotron was completed during this month, and the entire unit has been vacuum tested. Attempts to accelerate ions has produced representative beams at 24-inch radius. To date, 140 μa of alpha-particles have been realized internally, although efforts to extract them externally have not been rewarding.

Synchrotron Operation (Program No. 5731)

The synchrotron has operated reliably with a high intensity output during this report period.

The portable electron linear accelerator has worked successfully and is now in the process of being aligned and adjusted.

Operating statistics for the period are:

Operation for customers	357.0 hours	97.0 percent
Maintenance	11.0	3.0
Totals	368.0 hours	100.0 percent

Linear Accelerator and Van de Graaff Operation (Program No. 5751)

The linear accelerator and Van de Graaff have been operated without major change throughout the month. Due to the impending shotdown of the main cooling water systems, provision for operation on City water has been made. Some progress on the Van de Graaff belt life problem has been made. It was discovered that sparks occurred between the section of accelerator tube nearest ground and the belt. A set of ties were installed to connect the individual elements of the column to corresponding equipotential points on the main corona system. This seems to have cured the sparking. Two runs were made with helium in an attempt to produce 32 Mev helium ion beams with the linac. In the first beam of He^{++} was accelerated. The beam current was only 2×10^{-13} amps at 32 Mev. It was limited by the very small He^{++} output of the Van de Graaff. In the second run, an attempt to accelerate He^{+} to 4 Mev and then to strip these to He^{++} with a Be foil before RF acceleration was made. This proved unsuccessful for reasons not understood. It is intended that further work on this problem will be done.

The experimental 4W20000 pre-excited developed earlier this year was installed on the bevatron 10 Mev injector, where it has operated steadily for many hundred hours. The parts for the final models of this pre-exciter are now coming out of the shop, and one of these will be installed on the 40' linac as soon as possible.

Operating statistics for the period are:

Operation for customers	302.5 hours	90.0 percent
Van de Graaff maintenance	18.75	5.6
Linear accelerator maintenance	14.75	4.4
Totals	336.0 hours	100.0 percent

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

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Fission of Uranium with N^{14} Ions

Preliminary results on the N^{14} (from the 60" cyclotron) induced fission of uranium have been obtained and indicate, roughly, the expected symmetrical fission product mass distribution centered about mass ≈ 115-120. Fragments observed in this first run were isotopes of Sr, Ba, Pd, Te and Ag.

Decay Scheme of Cf^{246}

L X-ray alpha coincidence measurements have been made on Cf^{246} to deduce its decay scheme. From these measurements and those of the alpha-ray spectrograph, a structure similar to the other heavy element even-even isotopes has been derived, in which at least three alpha groups populate two levels at 43 and 143 kev in the Cm^{242} daughter. A comparison of the departure factors

$$\left(\frac{T_{1/2\ \mathrm{exp.}}}{T_{1/2\ \mathrm{calc.}}}\right)$$

of the decay to 4+ levels in the heavy isotopes indicates a trend toward a maximum in going from Th to Cm^{242}, dropping again for Cf^{246}. Such a maximum has been predicted from the Bohr-Mottelson collective model. There is also some evidence that another closed shell is being approached.

Quadrupole Moment and Nuclear Spin Measurements

Preliminary experiments have been made on the quadrupole moment apparatus to test its design and operation. The Cl^{35} resonance in chloroform and chlorobenzene has been measured; two lines were observed in the former, indicating a spin of 3/2 and two non-equivalent chlorine positions in the molecule. The apparatus will be used to study spins, quadrupole moments and field gradients in heavy element isotopes.

Thiocyanate Ion-Exchange Columns

The elution behavior of lanthanides and actinides by thiocyanate solutions from Dowex-1 columns has been studied and the following order is typical: Lu, Ce, Y, Tm-Pm, Eu, Sm, Am, Pu(III). For another run the detailed order for heavy elements alone was: Cm, Am-Pu, 99, Bk, 100 and Cf. The NH_4SCN was 1 M and the temperature held at 87° C.

Some static Kd measurements as a function of the thiocyanate concentration are being studied as well as the temperature coefficient, in order to elucidate the nature of the complex species and their thermodynamic functions.

Molecular Species in Silver Vapor

The molecular species of silver emitted from a hot filament source have recently been investigated. Ions corresponding to Ag^+ and Ag_2^+ in the ratio of 30,000 to 1 were initially seen when an electron beam was used to ionize the species. However, at a temperature between 1000°-1400° C., enough ions were produced by thermal ionization that no electron beam was required, and under these conditions large relative abundances of high polymer species were observed: $Ag^+/Ag_2^+/Ag_3^+/Ag_4^+ \approx 15/7/30/1$. Under these conditions the molecular beam would seem to correspond to an average molecular weight of between 2 and 3 times the atomic weight; such results are in very good agreement with recent vapor pressure results of Searcy and Freeman at Purdue. Previously silver vapor has been thought to be monotomic, and the Stern-Gerlach experiment seemed to confirm this. It would now appear that such is not the case. It would also now appear that the reported thermodynamic data for the $Ag_{(c)} = Ag_{(g)}$ equilibrium will need revising.

Process Chemistry

Work is in progress on the following problems: thermal diffusion in liquids (See UCRL-2618), the capacity of perforated plate liquid-vapor contacting columns, gas-phase mass transfer studies, the vacuum flow through annular sections, and the thermal conductivity of gases at high temperatures.

Metals and High Temperature Thermodynamics

Work is in progress on the following topics: a determination of ground states of gaseous molecules, the vaporization and condensation coefficients of molecular beams, gaseous carbon species, King furnace testing, study of vapor species, and refractory silicides.

Basic Chemistry, Including Metal Chelates

Results have been achieved in recent fluoride complexing experiments. Studies continue on the chemistry of ruthenium, and the chemistry of titanium (II) ion.

Health Chemistry

Equipment for processing a large quantity of neptunium which had been irradiated in the Materials Testing Reactor at Idaho Falls was set up by the Equipment Development group and the sample was successfully processed. A two-inch lead cave, with auxiliary equipment, has been readied for a second irradiated depleted uranium sample, also from Idaho Falls.

The training program for selected personnel in Health Chemistry, whose goal is to indoctrinate these individuals to undertake the responsibilities in planning with the chemists any radioactive work, has been completed; the course will be repeated when additional Radioisotope Control Chemists or Engineers are needed.

The Berkeley Box group assembled and fitted thriteen gloved boxes on request by researchers.

6. BIOLOGY AND MEDICINE UNCLASSIFIED
(A. E. C. Programs No. 6300-6500)

Pituitary Irradiation Studies with Large Animals with the 184-in. Cyclotron

Recent evidence is available to indicate that certain malignant tumors in animals and man depend for their growth on hormones mediated by the pituitary gland. Among these tumors are, particularly, carcinoma of the prostate and adenocarcinoma of the mammary gland.

In order to study this effect in details, pituitary irradiation is being carried out in normal dogs, as well as in a few dogs with mammary cancer. It is attempted to destroy the pituitary gland without materially affecting the important surrounding brain tissues. In an experiment with 20 dogs, preliminary information is available indicating that at 16,000 rep dose delivered selectively to the pituitary gland decreased pituitary function results within a period of six weeks. This effect is particularly evidenced by a regression in the testes and the development of mild diabetes insipidus. Animals which receive 20,000 rep units show greater endocrinological after-effects and with the present technique employed they also show nerve and brain damage in areas adjacent to the pituitary. The third and sixth nerves are most affected. Two animals with mammary carcinoma were given doses of 12,500 rep and 16,000 rep units. In one of these animals lactation was stopped within 10 days after irradiation and the tumor growth was arrested for a period of at least three months. Separate experiments are being carried out to study the effect of local irradiation on brian tissues in the dog.

Use of Protamine as a Precipitant for Embryonic Nucleoproteins

Use has been made of streptomycin sulfate to selectively precipitated 12 day chick embryo nucleoproteins, especially those with growth promoting properties *in vitro*. When protamine sulfate was substituted for the streptomycin it was found that a similar precipitation occurred and that the supernatant contained no more material precipitable with streptomycin. This would indicate that the growth-active nucleoproteins can be precipited by protamine, as well as by stroptomycin. Further work is in progress on investigating the characteristics of this precipitation.

Tracer Studies

Toxic iodine studies and tracer studies using actinium, terbium, europium, and promethium in rats are continuing as are the chronic astatine studies in rats and monkeys.

Studies on the chemical state of astatine in the human body are still under investigation.

Radiation Chemistry

Determination of products of irradiation in aqueous solutions of acetic acid, formic acid and glycine has continued. Some effort has been directed towards developing new methods for determination of suspected products not previously measured.

Histology

Azure-eosinate staining of nitrocellulose - embedded Zenker-fixed bones - has been worked out, but as yet, a satisfactory staining for Formalin-fixed bones has not been evolved. Work on this problem is continuing.

Bio-Organic Chemistry

The synthesis of high specific activity leucyl-alanine-2-C^{14} has been completed in 30-60 percent yield from labeled alanine.

The effects of ionizing radiation on choline and its analogues, benzoic acid, napthoic acid, and on the respiratory metabolism of labeled compounds in mice has been continued.

The preparation of analogues of thioctic acid for photosynthetic studies has continued.

The investigation of scintillation counting for C^{14} and tritium via versatile procedures is being studied.

The rate of metabolism of labeled adenine in mice has been investigated using the new continuous recording apparatus.

A study of the details of the ribulose diphosphate carboxylation reaction which produces phosphoglyceric acid is in progress. It is hoped to determine intermediates in the reaction, dependence on cofactors and activities of fractions obtained by purification of the cell-free extract.

A minimum requirement of 6.4 quanta per molecule of oxygen evolved was attained with chlorella at 6300 Å light. An added blue light produced no decrease in the quantum requirement.

A definitive identification of the primary product of photosynthesis as either 2- or 3-phosphoglyceric acid is now progressing using molybdate treated papers.

The separation of phosphorylated compounds from photosynthetic intermediates using P^{32} as an analytical tool has continued.

Various algae are being grown to find specific species for specific purposes such as for use in continuous oxygen evolution systems.

7. PLANT AND EQUIPMENT REPORT

UNCLASSIFIED

Chemistry Laboratory Building 70 (Account No. 5-471-1002)

The installation of the plastic distilled water fittings has started. As the water system is installed, the various finish jobs which were delayed by the plumbing may be completed. The water still has been installed and is being connected. Escutcheon plates are being installed on the various lab services. Low pressure steam lines are being installed to the fan coils and exposed ductwork is being painted. The electric panel boards are being installed in the labs. Grinding and sacking of the cement block finish is going on and the sheetrock is being taped and patched. The project is approximately 80 percent complete.

Electronics Research Building 80 (Account No. 5-471-2002)

Bids have been opened but the contract has not been awarded. Relocation of utility lines at the site is 95 percent complete.

Miscellaneous Construction (Account No. 5-471-2001)

The incinerator is operating but plans are underway to add a loading mechanism. The Accelerator Technicians' Shop in Building 64 is complete except for the removal of the siding by the new rolling door. The bevatron rain shields are now complete. The contract for the 184-in. cooling tower is still in a suspended status but will be re-activated in September or October. Building 10 alterations are approximately 50 percent complete. The control room is nearly complete; the pump room is being framed and the women's rest room has been moved. The rest rooms in Building 6 have been completed.

MAN-MONTHS EFFORT REPORT
SCIENTIFIC PERSONNEL

Program No.	Subdivision	UCRL Man-Months Effort	UCRL Vac. and Sick Leave
Operations			
3000 Weapon's Research	General	306.25	24.49
	Arc Research	25.14	-
		331.39	24.49
4000 Reactor Development - MTA	Design and Development	46.00	0.47
5000 Physicsl Research			
5200 Basic Physics Research	General Physics Research	61.76	10.48
	Theoretical Studies	16.33	2.72
	Film Detection	15.64	1.13
	Cloud Chamber	12.04	1.23
	Magnetic Measurements	1.51	0.59
	Physics Projects	7.64	
	Sub-Total	114.92	16.15
5311 Basic Chemistry Research	Chemistry of Heavy Elements	4.97	
	Nuclear Properties of Heavy Element Isotopes	11.01	
	Transmutations with 184" and 60" Cyclotrons	6.80	
	Analytical and Services	9.54	8.81
	Mass Spectroscopy, Beta Ray Spectroscopy	0.45	
	Instrument Development and Services	5.24	
	X-Ray Crystallographic Measurements	3.23	
	Office and Travel	7.95	
	High Temperature and Special Chemistry	7.06	0.42
	Sub-Total	56.25	9.23
5361 Applied Chemistry Research	Process Chemistry	4.77	
5731 Electron Synchrotron	Operations	8.30	
5741 Synchro Cyclotron (184")	Operations	8.81	
5751 Linear Accelerator	Operations	9.23	
5761 Proton Synchrotron-Bevatron	Operations	14.25	
	Sub-Total	45.36	
TOTAL PHYSICAL RESEARCH		216.53	25.38

Program No.	Subdivision	UCRL Man-Months Effort	UCRL Vac. and Sick Leave	Consultants Man-Months Effort	Consultants Vac. and Sick Leave
6000 Biology and Medicine Research					
6300 Medical Research	Health Medicine	1.15			
	Internal Irradiation	6.71		0.75	
	Sub-Total	7.86		0.75	
6400 Biological Research	Miscellaneous	5.93		3.02	
	Instrumentation	2.23		-	
	C_{14} Metabolism	4.01		1.50	
	Use of Radioactive Material in Human Physiology	10.39		3.72	
	Trace Elements	4.83		-	
	Physical Biochemistry	13.41	4.57	3.75	0.92
	Biochemical Response to Radiation	2.50		1.63	
	Metabolism of Lipo-proteins	4.32		10.31	
	Iron Metabolism Hematopoiesis	3.04		-	
	Biological Effects of Cosmic Radiation	3.11		-	
	Radiation and Mutation Rate	1.97		0.25	
	Bio-organic Chemistry	28.60	1.08		
	Metabolism of Fission Products	15.76	2.97		
	Animal Colony	1.72	0.28	3.97	
	Sub-Total	101.82	8.90	28.15	0.92
6500 Biophysics Research	Health Physics	5.25			
	Irradiation Studies	1.64		1.05	
	Sub-Total	6.89		1.05	
TOTAL BIOLOGY AND MEDICINE RESEARCH		116.57	8.90	29.95	0.92
GRAND TOTAL - OPERATIONS		710.49	59.24	29.95	0.92

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