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MONTHLY PROGRESS REPORT NO. 130

January 15, 1954 to February 15, 1954

March 9, 1954

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UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

January 15, 1954 to February 15, 1954

MONTHLY PROGRESS REPORT NO. 130*

March 9, 1954

1. EXPERIMENTAL PHYSICS
(A. E. C. Program No. 5211)

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Fast Deuterons from High Energy Neutrons of Various Elements

Attempts to measure the indirect pick-up cross-section for neutrons incident on various targets by the same method used for protons have not been very successful. This method requires the measurement of H_p and range. Because of the subtraction involved (absorber out - absorber in = deuterons) the statistics were quite poor. The counting rate in the neutron beam was considerably lower than in the proton beam and because of this it has been decided to use some other method of identification of the deuterons. Two methods are being tried: $E - dE/dx$ and $H_p - dE/dx$. The $E - dE/dx$ method does not give a clean separation of protons and deuterons and whether it can be used when a spectrum of both particles is present is not certain. The $H_p - dE/dx$ method should give a good separation but with lower counting rates. From a first run using $E - dE/dx$ for identification of particles it is obvious that a calibration of the pulse heights measured must be made to obtain any separation. The effects of saturation of light output from the crystal and nonlinearity of amplifier gains make it hard to perform a separation without a calibration. A run in progress now should decide which particle identification method will be used for the rest of the experiment.

Photodisintegration of the Deuteron

An attempt is being made to measure the cross-section, as a function of energy and angle, for the disintegration of the deuteron by high energy photons. The liquid deuterium target will be used at the synchrotron. The photon energy interval to be covered is approximately 120 Mev to 300 Mev. It is considered advisable to undertake this measurement because of the poor agreement among existing data. Neither the angular distribution nor the total cross-section in this energy interval is very well known.

The proton from the above process will be identified and its energy determined by the measurement of its specific ionization and range. Specific ionization is determined by a plastic scintillator viewed by a 5819 photomultiplier. The pulse from this tube is presented on an oscilloscope sweep and recorded photographically. The range counter consists of a series of ten scintillators with appropriate absorbers for selecting the desired proton energy

*Previous report UCRL-2476 (No. 129).

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intervals. Each scintillator is viewed by a 1P21 photomultiplier. After being suitably delayed and combined, the pulses from these tubes are presented on the same oscilloscope sweep as the pulse from the specific ionization counter. The necessary information is obtained by reading the height of the specific ionization pulse and the number of pulses from the range counter.

During the past month construction of the above counters has been completed and they have been tested in the 90 Mev neutron beam. Operation was in general, satisfactory. However, modifications are being made to improve the resolution of the specific ionization counter.

The deuterium target is being modified and a scattering table is under construction for a run at the synchrotron within the new few weeks.

Comparison of the Reactions $P + D \rightarrow \begin{cases} \pi^+ + t \\ \pi^0 + He^3 \end{cases}$ as a Test of Charge Independence

During the last run these two reactions were detected, and tentative results are not inconsistent with the predicted ratio (twice as many tritons as He^3 particles). The separation was made difficult by the presence of background counts on the E vs. dE/dx plot of the results. In order to eliminate background in the next run, arrangements are being made to connect the vacuum jacket of the deuterium target onto the main cyclotron vacuum system. This would eliminate background from the foil on the exit end of the beam tube, the entrance foil of the target and the air between these two. Also holes have been cut in the heat shield which surrounds the deuterium target to allow the beam to pass through. Thus when the target is properly lined up, only the target foils which actually contain the deuterium will contribute background. Another run is planned as soon as the plumbing is completed.

Experiment on Polarization in P-N-P Double Scattering

A run has been made of a 10° initial scattering on carbon at 340 Mev bombarding energy with the counters set for a $20^\circ \pm 6^\circ$ second scattering. The main probe was used for the 0° , unpolarized beam at 330 Mev and the MTA extensible probe was used to obtain the 10° scattering. The asymmetry up to a rejection energy of 230 Mev was of the order of 4 percent \pm 3 percent. It has been suggested by Ruderman that because of the equivalent polarization of protons scattered from hydrogen and deuterium the neutron does play a part in the polarization, and that neutron polarization might be observed at angles of the order of 70° in the laboratory system. The possibility of measuring this is being investigated.

Elastic Scattering of 3.3 Mev Gamma Rays

Work has been done on voltage stabilization of all the electronic detection equipment. A system for continuous target cycling has been largely completed.

Liquid Hydrogen Bubble Chamber

Photographs of electron tracks in a liquid Hydrogen bubble chamber have been obtained using both a Co^{60} source and a Po Be source. Work is in progress to determine bubble growth rate by means of pulsed sources.

$p + p \rightarrow \pi^+ + d$ Cross Section Near Threshold

An unsuccessful attempt was made to measure the $p + p \rightarrow d + \pi$ differential cross section at 310 Mev. However, a value was obtained at 324 Mev which agreed within the statistical error of previous results.

Proton Double Scattering

Work is continuing on the pp polarization at 32 Mev. Owing to a possible 6 percent error in visually centering the plates, a method of centering using a photocell is being tried. Additional exposures have been made on calcium but have not been completely scanned yet.

μ^+ Mean Life

Investigation established that the μ^+ meson mean life could not be done with the synchrotron beam, because the shortest pulse of photons extended over about 10 μ sec (5 mean lives) and no μ^+ decay pulses could be ascertained by gating the scalers within 5 μ sec after the beam.

Resonance Excitation of Delayed Heavy Particle Emitters

The photomultiplier ionization chamber when rebuilt was found to be linear within ± 1 percent, within the limits set by the standard UCRL electrometer and the dark current of 2×10^{-9} amperes. The standard electrometers become non-linear when the instantaneous current from the photomultiplier exceeds 1.1 milliamperes. By adjusting the high voltage on the photomultiplier so that this limitation is not reached, suitable linearity is achieved.

The excitation curve of the delayed alphas from Al^{24} was re-examined in detail with the aid of this integrator. No sign of a resonance peak was found. It is believed that the previously observed resonance, which was roughly reproducible, can be explained as beta counting resulting from a rapidly increasing gain of the amplifying system as increased absorber scattered increased proportions of the beam away from the target counter.

The threshold of A^{24} relative to 20.0 Mev for N^{12} was observed to be 15.6 ± 0.2 Mev.

Film Program

Synchrotron Research. Accelerator time was employed to study the selective scattering of γ -rays from U, Ta, Ag, Cu and Al. The G5 emulsions will be scanned for electron pairs produced by the γ -rays emitted 90° from the beam. The plates are now under initial study. Work is continuing on the γ -ray scattering from Pb.

Cyclotron Research. Experimental work continued on the high energy angular distribution of spallation products from various targets under alpha and proton bombardment. To evaluate absolute cross-sections of spallation reactions in light elements, an experiment was performed to collect spalls in C2 emulsion from light elements when bombarded by the external beam. No magnetic separation was used. The reaction $3\text{Li}^7 + {}_1\text{H}^2 \rightarrow {}_1\text{H}^1 + 3\text{Li}^8$ is under continued study. Supplementary to the above experiment, the electron pickup of Li^{8+++} is now being investigated.

Other. Other research programs are the interaction of 380 Mev alpha particles in G5 emulsion and the β -ray spectrum of N^{12} .

Cloud Chamber Studies

Thirty-five Atmosphere Diffusion Chamber. The cloud chamber has been moved to the bevatron. A sensitive volume ten inches in diameter and two inches deep has been measured with 510 psi hydrogen. Work is continuing on improving photography.

Scattering of Positive π -Mesons in Lead. The 22 inch pantograph cloud chamber was used to obtain additional data for this investigation. While the general scheme of the experiment was similar to that of a previous run, some modifications were made, such as use of a higher magnetic field in the cloud chamber and reducing the number of cyclotron pulses per expansion. These data will not only improve the statistics but will round out the angular distribution of the scattered mesons and should yield more accurate energy measurements. About 800 pictures were obtained. Analysis of them is proceeding.

Four Foot by Eight Foot Diffusion Chamber. The chamber has been assembled and tested. Several designs of alcohol vapor wicks have been tried and construction of a new alcohol tray has been started.

The new cooling system has been very successful. The consumption of solid CO_2 has been decreased by at least a factor of two, and there has been no noticeable loss of the ethyl alcohol coolant since the system was filled three weeks ago. Evaporation and leak loss of the alcohol, in the past, was a significant factor in the operation of this chamber.

A preliminary pressure check of the new sealing design indicates that the chamber is gas tight. This is necessary since present plans call for filling the chamber with methane to observe the hydrogen events.

Synchrotron Studies

The synchrotron has operated satisfactorily throughout the month. A long run on low energy mesons using the spiral orbit spectrometer had been planned, but after less than a week's running, the magnet developed a short. Rather extensive repairs were necessary, and some of the released time was not called for by experimenters. Further calibration was done with about the same results as last fall; the Blocker-Kenney and Kerst methods differ by about 10 percent, with the Cornell chamber results in between.

Several runs have been made to expose plates to scattered γ -rays from Cu, Pb, and U. Initial results seem to show a resonant scattering from Pb well below 15 Mev, which is the energy at which the peak is expected. More plates have been exposed to mesons from $\gamma + H$ and $\gamma + D$. In previous runs there seemed to be some unexplained π^- mesons on plates where only π^+ should have been found. Checks on this are being made. Equipment has been built up for measuring the yield of π^+ mesons from different elements. Initial tests indicated satisfactory performance with the $\pi \rightarrow \mu$ decay gear in use. In addition, attempts were made to use the π mesons from γ -ray irradiation to get μ^+ 's, and then to measure the half-life of the μ^- meson. Electronic difficulties caused the stoppage of the run.

Other Experiments

During this month two or three experiments have been run concurrently on the 184 in. cyclotron.

The subjects investigated were:

np scattering at small angle
pp scattering total cross-section
polarization effects as a function of the scattering angle and energy.

These last measurements fit with a phenomenological theory of polarization sketched by Fermi.

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

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An approximation scheme for Green's function equations of motion has been set up and an abstract describing it has been submitted for the Washington meeting of the American Physical Society. An approximate solution for the lowest non-trivial case has been obtained.

Work on the higher approximation, which neglects the binding of two mesons to a nucleon, has been started.

The intermediate coupling approximation for meson-nucleon scattering described in report UCRL-2341 has been extended to the neutral pseudoscalar field, and agreement with perturbation theory and strong coupling theory in the appropriate limiting cases has been achieved. Numerical calculations in the intermediate region are being carried out.

A model for the nucleon has been developed which conserves charge and angular momentum density in the static limit for a nucleon of finite radius. Compton scattering on nucleons is being investigated using this model.

The investigation of the energy of the nuclear ground state configuration as a function of shape is being continued. The consequences of the lack of a pronounced energy minimum for a symmetric deformation in certain nuclei are being looked into.

The optical model of the nucleus utilizing a non-square-well nuclear potential is being studied.

The new-completely covariant approach to the calculation of probabilities for alternative processes in very high energy nucleon-nucleon encounters is still under investigation.

3. MTA TARGET PHYSICS PROGRAM CONFIDENTIAL
(A. E. C. Program No. 4900)

During this month the ninety photomultiplier tubes were installed around the large liquid scintillator tank and the space between the pyrex windows in the tank and the end-windows of the photomultiplier tubes was filled with mineral oil. Some trouble with oil leaks past the O-ring seals around the tubes has been experienced, but the O-ring seals between the toluene inside the tank and the pyrex windows have all been completely tight. At present the tank is filled with commercial grade toluene and a small bottle containing a Na^{22} source and a small amount of reagent grade toluene with terphenyl added is suspended inside the tank. Pulse-height response curves are in the process of being run for different source positions in the tank, and a short cyclotron run is planned for the near future to get some idea of background and shielding problems.

The yield of neutrons from uranium targets was measured as a function of target thickness by using the MnSO_4 tank and utilizing neutrons of mean energies of 90 Mev and 160 Mev produced by deuteron stripping and He^3 stripping, respectively. Calculations are now being made to determine the cross section for producing one neutron (σ_{1n}). The neutron beams were monitored with a scintillator counter telescope by using the published (n, p) cross section.

Data were taken to measure the excitation functions $\text{C}^{12}(\text{d}, 2\text{pn})\text{C}^{11}$ and $\text{C}^{12}(\text{He}^3, 2\text{n}2\text{p})\text{C}^{11}$, using the known excitation function $\text{C}^{12}(\text{p}, \text{pn})\text{C}^{11}$ and using a stacked foil technique.

The angular distribution of neutrons stripped from He^3 by carbon was measured with carbon foils placed on the tank wall of the cyclotron. The energy distribution was measured with the counter telescope. The $\text{C}^{12}(\text{n}, 2\text{n})\text{C}^{11}$ cross section was measured relative to the $\text{C}^{12}(\text{p}, \text{pn})\text{C}^{11}$ cross section, also.

Stripping cross sections for neutron production from He^3 particles and deuterons incident on carbon were measured by using carbon foils as neutron and particle detectors. The measured $\text{C}^{12}(\text{x}, \text{xn})\text{C}^{11}$ cross sections then were used to determine the stripping cross section. Further details and final results will be included in the quarterly report and in separate UCRL reports covering the individual experiments.

4. ACCELERATOR CONSTRUCTION AND OPERATION

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Bevatron Construction and Operation. (Program No. 9001)

Construction. The principal construction work on the bevatron came to an end on January 21 when the vacuum pumping started preparatory to the first test operation. Equipment still to be completed was mainly that concerned with the control of the radio frequency and the moving probes and targets. Work on the shielding (not part of the original proposal) is also under way.

Shielding. The foundation piles were completed and concrete for half of the floor that had been cut through was poured on February 12. The second half is scheduled to be poured the first of the following week which will complete the work on the shielding foundation. All the light concrete blocks, about two-thirds of the total, have been received.

Operation. The operating staff under Dr. E. J. Lofgren took over operation of the bevatron magnet on January 21. During the week of January 25 it was found that the inflector would hold only 60 kv whereas 80 kv is required to deflect. The inflector was removed to clean and sandblast the insulators, improve the shielding of their attachments to the supports and to smooth off sharp edges. After this change the required 80 kv was held without sparking.

The period from February 1 to February 15 was spent in looking for beam and improving steadiness of operation. The first turn was observed with direct current in the magnet on February 2 by watching florescence of a probe and evidence of several turns was observed on February 3. On February 4 this was repeated with the magnet pulsed. On February 10 after some time spent in completing the installation of controls and instruments and in trouble shooting evidence of the unaccelerated beam coasting to an inside radius probe was seen. Finally on February 15 beam was accelerated for approximately 18 milliseconds to a calculated energy of about 20 Mev.

The bevatron is operated on swing shift only for five nights per week. Repair work on the inflector and magnet power supply was done over the week-end, however. In all, about five shifts have been used in looking for and observing the beam.

184-inch Cyclotron Operation. (Program No. 5741)

The cyclotron was used for research experiments approximately 95 percent of the 505 hours that the crew was on duty. The time distribution was as follows:

Operation for customers	480.2 hours	95.1 percent
Electrical troubles	6.8	1.3
Power shutdown	9.0	1.8
Miscellaneous	9.2	1.8
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Totals	505.2 hours	100.0 percent

184-inch Cyclotron Modification. (Program No. 4900.02)

Magnet. Winding of the auxiliary coil proceeded somewhat faster than during the previous month. It is now believed that it is possible for Westinghouse to meet their most recently promised schedule of delivery of both coils by May 1. The pole face shim cost as determined by the first bids was considerably higher than the estimates due to the necessity of machining on a large boring mill. It was determined that the arcs could be flame cut with sufficient precision and this change will reduce the shim cost to an acceptable amount.

RF Design and Vibrating Condenser. Fabrication of all components in these categories is proceeding satisfactorily with the exception of the vibrating blade machining at Mare Island. This work is held up pending delivery of a magnetic chuck and gun drill holder. These parts may consequently be later than planned. This delay, however, will probably not effect the shutdown since many rf tests can be made before the blades are assembled.

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

There were 382 hours available for cyclotron bombardments during January, 1954. 328 hours were used in performing bombardments for other groups - the remaining time was used for maintenance and adjustments.

Twenty hours of time was used to install the third harmonic stub lines in anticipation of test work on this principle. The addition of the lines lowered the operation frequency by .2 megacycles which functioned to decrease the energy of the beam. Under these conditions, 90 microampere of external alpha beam was recorded, which is the largest beam recorded to date.

Synchrotron Operation. (Program No. 5731)

No difficulties were experienced in operating the synchrotron during this report period. It continued to produce a high intensity beam for physics research in this interval.

Periods of erratic intensity and energy in the final beam were experienced. This is normal and can be traced to the lack of regulation in the magnet energizing circuit. Solution of this problem has been studied many times before; however, due to cost considerations and the random nature of the erratic behavior, no definite action has been taken. At the present time, the problem is again being studied.

The major effort of the synchrotron group during this interval has been devoted to assembly of the Livermore electron linear accelerator.

Following are the operating statistics for the period.

Operation for customers	144.5 hours	47.5 percent
Tests	140.0	46.1
Maintenance	19.5	6.4
Totals	<u>304.0</u> hours	<u>100.0</u> percent

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

The linear accelerator and Van de Graaff were operated routinely through the period January 15 to February 15. The installation of the deuterium gas system for the Van de Graaff ion source is complete and awaits test. The new pre-exciter work continues.

Operating statistics follow.

Operation	295 hours	84.0 percent
Van de Graaff maintenance	39.5	11.0
Linear Accelerator maintenance	17.5	5.0
Totals	352.0 hours	100.0 percent

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

UNCLASSIFIEDThe Spin of Am²⁴³

The arc spectrum of americium has been obtained on two samples (~ 30 μg) of americium containing different amounts of Am²⁴³ and Am²⁴¹. If it is reasonably assumed that the multiplicity is spin determined (i. e., $I < J$) then the observed isotopic shifts fix the spin of Am²⁴³ the same as that of Am²⁴¹, namely 5/2.

Electron Capture in Shielded Nuclei

Electron capture has been looked for in both Sb¹²² and Sb¹²⁴. As expected from the estimated decay energy and the spins of the nuclei involved, very little (limit ≤ 0.1 percent) was found in Sb¹²⁴. In Sb¹²², however, it appears that as much as ~ 2 percent electron capture may be present.

Decay Schemes

Cs^{127, 125}. -- The decay schemes of Cs¹²⁷ and Cs¹²⁵ and their isomers have been studied by scintillation spectrometry and coincidence measurements and have been shown to have similar gamma ray levels. The fact that both isomers are comparable in half-life but with much different decay energies has not yet been resolved, however.

Am²³⁸. -- Additional levels in Pu²³⁸ have been seen from the electron capture of Am²³⁸ over those which have been reported in the literature from the beta decay of Np²³⁸. The levels are at 1240 and 1800 kev. It is possible that the level at 1800 kev may correspond to a second "vibrational" level, as compared to the first "vibrational" levels around 1 Mev seen in other isotopes in agreement with the Bohr-Mottelson interpretation.

Np^{241} . -- The neptunium fraction prepared by low energy alpha bombardment of U^{238} has been examined by coincidence scintillation spectrometry. Higher energy gamma rays of 1000, 920, 580, and 440 kev and ~ 1 hour half-life were observed than can be fitted into the decay scheme of Np^{241} from its estimated decay energy (1.1 Mev) and known beta energy (0.9 Mev). It therefore seems reasonable that at least some of the gamma transitions are, in fact, due to levels involved in the decay of an isomer of Np^{240} .

Fission and Spallation Competition in Pu^{239} Alpha Bombardments

The (α , xn) cross sections for Pu^{239} have been determined from 20 to 40 Mev. While all of the cross sections are low, as expected from competition of fission, the (α , 2n) cross section is relatively high when compared to the (α , n) and (α , 3n) values. From the limited amount of data available it is difficult to say whether the relative values are controlled entirely by the Z^2/A of the parent compound nucleus, or to some odd-even effect. Preliminary data obtained on Pu^{238} and Pu^{242} seem to indicate that both effects are important.

Chemistry of Actinides

The solubility of AmF_3 has been measured in various concentrations of HF solutions to determine the formulas of any aqueous complex fluorides formed. Data are also being obtained at more than one temperature to allow an evaluation of the thermodynamic functions involved. Preliminary results indicate that the principal species formed on solution of AmF_3 in acidic solutions is AmF_3^0 , aq., although there are also lesser amounts of AmF_2^+ , aq.

Ion Exchange Separations

Dowex-50 has been used to separate milligram amounts of Cd^{++} , Zn^{++} , Cu^{++} , Mn^{++} , Hg^{++} , Co^{++} , Ni^{++} , Sr^{++} , Ba^{++} , Cr^{+++} and Fe^{+++} by using 3 M HCl and HCl-methanol mixtures at room temperatures. The separations are much better than those obtained with citrate (pH 3.32) at the same temperature, and the reproducibility is good enough to make the method seem promising from an analytical point of view.

Process Chemistry

Work is in progress on the following problems: the preparation of titanium metal, film boiling from subcooled liquids, thermal diffusion in liquids, the capacity of perforated plate liquid-vapor contacting columns, gas-phase mass transfer studies, vacuum flow through annular sections, solubility studies, the agitation of liquid-liquid system, and the thermal conductivity of gases at high temperatures.

Metals and High Temperature Thermodynamics

Work is in progress on the following problems: heats of formation and absolute absorption coefficients of high temperature molecules, gaseous carbon species, magnesium oxide gas, reflection coefficients of molecular beams, sodium carbonate vapor, molybdenum chloride vapor, and refractory silicides.

Basic Chemistry

In this field work is being done on the hydrate complexing of Cr^{+++} .

Health Chemistry

The Equipment Development group has been engaged in continuing to rework the cruds from the recent Livermore operation involving large quantities of highly active alpha emitters, plus more work on re-encapsulation of the separated material.

The group has partially completed equipment for use in processing the so-called "napkin ring" type irradiated samples from the MTR. These samples are so described because of the provisions for thermal heat escape during irradiation. They will be processed in the six-inch lead cave in Room 107, Bldg. 5. Both of these jobs included much drafting design and shop and plastic design time.

Other members of the Equipment Development group have completed modifications and adjustments of the target holders for the 60-inch cyclotron. Work on hydraulic slugs for the Idaho Falls MTR has been finished. The group encapsulated large quantities of americium for irradiation in the MTR.

In the liquid waste disposal work, plans for disposal and liquid waste monitoring for Bldg. 70, Livermore, were submitted to Health Chemistry by Plant Engineering and were approved. Approval was also given to plans for the acid waste tank farm for Bldg. 101, Livermore. Most of the liquid wastes from Livermore are now being taken care of at that site.

6. BIOLOGY AND MEDICINE (A. E. C. Program Nos. 6300-6500)

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Liver Blood Flow Changes in Thermal Injury

In a cooperative project of the laboratory and the Physiology Department, during a study of shock following thermal injury in dogs, measurements of the liver blood flow by use of the colloid disappearance rate have been made. The half-time disappearance of intravenously injected colloidal chronic phosphate in normal dogs anaesthetized with sodium pentobarbital is quite constant averaging about 1.4 min. In dogs in whom the disappearance curve has been determined within the first half-hour after thermal injury, there is a consistent prolongation of the half-time disappearance to about 2.7 min. This prolongation is noted before any of the usual signs of secondary shock have appeared. Further increase in the disappearance half-time to as much as 6 to 7 minutes has been uniformly noted after the classic signs of shock are well developed. Direct measurements of the efficiency of colloid removal by the liver show no impairment of this function in the first hour after thermal injury. The prolongation of the disappearance half-time noted early is therefore the result of depressed liver blood flow and not the consequence of faulty removal. However, after several hours, there is a progressive reduction in the removal efficiency by the reticulo-endothelial system. The greatly increased half-times observed in this later period probably represent a summation of combined decrease in liver blood flow and impairment of phagocytic efficiency.

Hematological Effects from Low Dose Radiation Studies

In a study of the significance of double-nucleated lymphocytes as a function of ionizing radiation exposure, a group of six healthy young men who receive not infrequent doses of x- and gamma rays near maximum permissible levels (accelerator crews) were compared with a group who do not receive known exposure (theoretical physicists.) The number of leukocytes examined per person in the exposed group ranged from 50×10^3 to 660×10^3 , a total of one million having been examined in this group. 50×10^3 to 140×10^3 leukocytes per person were examined in the control group, the total number being one half a million. The mean incidence of double-nucleated lymphocytes (expressed as doubles per 50×10^3 leukocytes) in the exposed group was 5.25, in the control group 1.42. This appears to be a significant difference. It is of interest that there was much less difference between the groups in the incidence of bilobed lymphocytes, viz. 2.66 compared to 1.23.

Detailed serial counts are being carried out on persons newly joining the accelerator crews in order to clarify the quantitative relationship between exposure and the appearance of double-nucleated cells.

Tracer Studies

Long term tracer studies on rats employing actinium, cerium, europium, terbium, and thulium are continuing.

Experiments on the deposition of aerosols and long term astatine effects in primates are progressing as planned.

Data are still being gathered on the relative toxicity and relative biological effectiveness of astatine, iodine, radium and x-rays on rats.

Radiation Chemistry

Radiation chemical studies are continuing with the following aqueous systems: (1) acetic acid, (2) acetic acid-oxygen, (3) glycine, and (4) formic acid.

Histology

Another series of tissues from At^{211} animals given varying dosages has been taken. Initial studies on human thyroids having begun, tissue sections are now being prepared, both from I^{131} and At^{211} patients.

Bio-Organic Chemistry

Although our minor scientific objectives change markedly from quarter to quarter, our major scientific goal remains fairly constant from year to year. This major goal may be summarized as fundamental studies in the chemistry of plants and animals with emphasis on tracer organic chemistry as the primary research tool.

As indicative of the changing but important immediate scientific goals we can list some of the more active projects of the past month. Plant biochemistry was represented by numerous sugar studies: separation and identification of mannoheptulose phosphate; preparation of sedoheptulose from Sedum phosphate; organic synthesis of ribulose diphosphate; enzymatic phosphorylation of ribulose monophosphate; and synthesis of pentulose diphosphate by aldolase condensation of diose and triose phosphates. The important role of disulfides in photosynthesis was studied via thiocetic acid stimulation of the Hill reaction as well as via photolysis and persulfate oxidation reactions.

Not greatly changed, but nonetheless active, were the animal biochemistry studies in nucleic acid metabolism, with emphasis on the soluble nucleotide fraction and in acetate and amino acid oxidation rates to CO₂. New projects here include better instrumentation in metabolism rate studies and preliminary studies on brain activity using K⁴², K⁴³ or choline esterase as critical component.

Organic chemistry was advanced by a large scale synthesis of 5,7-dithioheptanoic acid, 40 mc. of sodium acetate-2-C¹⁴, 50 mc. of methyl-C¹⁴ iodide and some choline analogues. The attempted synthesis of 25-methyl-cholesterol continues and radiation decomposition chemistry was active.

7. PLANT AND EQUIPMENT REPORT UNCLASSIFIED

Bevatron. (Account No. 5-271-9001)

This machine is being operated on the swing shift in an attempt to obtain a steady beam, but to date just a small beam at irregular intervals has been produced. The modifications to the control room are just about complete except for the counting equipment. The final pour for the foundation for the bevatron shielding was made so that this job may be considered complete.

Chemistry Laboratory Building 70. (Account No. 5-271-1002)

All the main building concrete work has been completed except for part of the first floor slab yet to be poured. The rock fill for the first floor slab has been installed and one-third of this floor slab has been poured. The roof slab has been finished, the penthouse is completed and work has been started on the installation of light weight fill on the roof. Miscellaneous iron screen frames have been erected on the second floor. Plumbing and electrical work is progressing and as yet no heating, ventilating or elevator work has been done. The entire project is approximately 44 percent complete.

Electronics Research Building 80. (Account No. 5-271-2002)

The Architect-Engineer Subcontract No. 80 has been approved by the AEC and put into effect. Preliminary plans will be submitted for approval at the February Regents meeting.

Miscellaneous Construction. (Account No. 5-271-2001)

Construction of the Destructor was delayed but is expected to start in the next two weeks. The Gamma House is complete except for finish hardware and painting. The interior alterations to Building 50 are complete. Wiring of the accelerator technicians shop in Building 64 is about 90 percent complete.

MAN-MONTHS EFFORT REPORT
SCIENTIFIC PERSONNEL

Program No.	Subdivision	UCRL Man-Months Effort	UCRL Vac. and Sick Leave
<u>Operations</u>			
3000	Weapon's Research General	314.15	21.59
4000	Reactor Development - MTA Design and Development	16.98	-
5000	Physical Research		
5200	Basic Physics Research General Physics Research	49.35	11.58
	Theoretical Studies	11.93	3.24
	Film Detection	16.37	1.57
	Cloud Chamber	9.56	0.74
	Magnetic Measurements	3.73	0.94
	Sub-Total	90.94	18.07
5311	Basic Chemistry Research Chemistry of Heavy Elements	4.84)	
	Nuclear Properties of Heavy Element Isotopes	9.73)	
	Transmutations with 184" and 60" Cyclotrons	5.50)	
	Analytical and Services	9.06)	6.49
	Mass Spectroscopy, Beta Ray Spectroscopy	1.49)	
	Instrument Development and Services	5.08)	
	X-Ray Crystallographic Measurements	2.57)	
	Office and Travel	12.29)	
	High Temperature and Special Chemistry	4.54	0.28
	Health Chemistry Research	6.64	
	Sub-Total	61.74	6.77
5361	Applied Chemistry Research Process Chemistry	4.17	
5731	Electron Synchrotron Operations	4.02	
5741	Synchro Cyclotron (184") Operations	7.71	
5751	Linear Accelerator Operations	9.62	
5761	Proton Synchrotron-Bevatron Operations	11.76	
	Sub-Total	37.28	
TOTAL PHYSICAL RESEARCH		189.96	24.84

MAN-MONTHS EFFORT REPORT
SCIENTIFIC PERSONNEL

Program No.	Subdivision	UCRL Man- Months Effort	UCRL Vac. & Sick Leave	Consultants Man-Months Effort	Consultants Vac. and Sick Leave
6000 Biology & Medicine Research					
6300 Medical Research	Health Medicine	1.41			
	Internal Irradiation	4.65		0.68	
	Sub-Total	6.06			
6400 Biological Research	Miscellaneous	3.80)		2.59)	
	Instrumentation	2.70)		-)	
	C ₁₄ Metabolism	3.03)		0.71)	
	Use of Radioactive Material in				
	Human Physiology	10.51)		5.32)	
	Trace Elements	3.77)		-)	
	Physical Biochemistry	9.86)--	6.07	3.10)--	3.15
	Biochemical Response to				
	Radiation	3.44)		1.05)	
	Metabolism of Lipo-proteins	6.86)		8.57)	
	Iron Metabolism Hematopoiesis	3.20)		-)	
	Biological Effects of Cosmic				
	Radiation	2.46)		-)	
	Radiation and Mutation Rate	1.59)		0.24)	
	Bio-organic Chemistry	25.84	2.06		
	Metabolism of Fission Products	15.91	1.55		
	Animal Colony	2.08	0.33	3.79	
	Sub-Total	95.05	10.01	25.37	3.15
6500 Biophysics Research	Health Physics	6.04			
	Irradiation Studies	3.01		0.92	
	Sub-Total	9.05		0.92	
TOTAL BIOLOGY AND MEDICINE RESEARCH		110.16	10.01	26.97	3.15
GRAND TOTAL - OPERATIONS		631.25	56.44	26.97	3.15

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