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MONTHLY PROGRESS REPORT NO. 128

November 15, 1953 to December 15, 1953

January 6, 1954

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UNIVERSITY OF CALIFORNIA, RADIATION LABORATORY

November 15, 1953 to December 15, 1953

MONTHLY PROGRESS REPORT NO. 128*

January 6, 1954

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

Cerenkov Radiation Counter

Two runs were made at the cyclotron exposing very thin foils to a low level beam without physical destruction. Electrons of about 150 Mev energy resulting from π^0 decay gammas were detected. This was accomplished by placing a carbon target on the extendable probe head in such a position that the electrons followed the 70 Mev charged meson orbits out of the cyclotron. The electrons then entered a Cerenkov radiation detector. It was found necessary to enclose this detector in a copper-walled box for operation on the platform, because of rf noise pickup.

Fast Deuterons from High Energy Neutrons of Various Elements

The determination of deuteron production cross sections for various elements bombarded with protons has been described previously in these reports. These cross sections varying as $A^{4/3}$ for light elements. The A dependence and the energy spectrum of the deuterons tend to support the idea that these deuterons are formed by the indirect pick-up process. In this process the beam proton is first scattered and then picks up to form a deuteron in the same nucleus. The proton scattering cross section has been measured and varies as $A^{2/3}$. This would indicate that the pick-up cross section varied as $A^{4/3}/A^{2/3} = A^{2/3}$ or that the pick-up process occurred mainly on the nuclear surface.

Because of this fact it was decided to repeat the experiment using neutrons instead of protons as the incident beam. A run has been made in the high energy neutron beam of the 184-inch cyclotron. The neutron beam has a maximum intensity at 300 Mev and a whole width at half height of 70 Mev. The cross sections for C, Al and Cu were measured and are given in the table with the corresponding proton induced cross sections.

*Previous report UCRL-2428 (No. 127).

Target Element	Differential Cross Section for Production of Deuterons at 40° (millibarns/steradian)	
	Incident Protons	Incident Neutrons
C	1.4 ± 0.2	0.55 ± 0.45
Al	3.5 ± 0.6	4.0 ± 0.8
Cu	5.3 ± 0.8	-2.0 ± 2.2

The only moderately well determined neutron induced cross section is for Al. This is statistically the same as the proton induced cross section on Al. This tends to support the idea that the pick-up process is similar for neutrons or protons. The cross section for incident neutrons on carbon is poor statistically but comparable to that for protons on carbon. The most interesting fact is that the cross section for neutrons on copper, while poor statistically, seems considerably lower than the cross section for protons on copper.

Currently there are reasons to believe that the surface of a nucleus may be predominantly neutrons instead of an equal mixture of neutrons and protons. If this is true and if the pick-up process takes place on the surface of the nucleus, then there will be fewer deuterons formed when the incident beam is neutrons than when the beam is protons. The reason for this is that the scattered nucleon which has to pick-up is usually a neutron if the incident beam is neutrons. If the pick-up takes place on the surface of the nucleus and the surface is mostly neutrons, then few deuterons will be formed. The opposite is true for protons. The scattered nucleons in this case are mostly protons and there will be a larger number of deuterons formed. This effect would be more noticeable for heavy nuclei where the surface is a more well-defined concept and, therefore might be expected to occur in Cu while not so much in C and Al.

The present data is statistically so poor that no conclusions can be reached at this time. It is planned to repeat these measurements for incident neutrons with different apparatus to get better information and also to use more target elements.

Resonance Excitation of Delayed Heavy Particle Emitters

It was found that a transparent integrator using the present proportional counter (saturating at $\sim 5 \times 10^{-8}$ amperes) was inadequate for observing delayed Alphas from Al^{24}. A photomultiplier looking directly at the light from the beam in air showed considerable promise of linearity, particularly at high beam levels. A carefully wired chassis (reducing leakage currents) is being prepared for test.

Electron-Neutrino Angular Correlation in Ne^{19}

Further analysis of the data of the last run has been made in an effort to see why the counting rate from the "good" source volume was so small, as compared to that from the "bad" volume closer to the recoil counter. The calculations indicate that some preferential loss mechanism may be at work. Adsorption of the Ne^{19} on the system walls would provide such an effect. The numbers involved are reasonable, but no positive evidence for the effect has been found. Considerable effort has been given to developing tests which will ascertain if adsorption is taking place.

More refined counting rate calculations now reveal that the apparatus as it stands, is not capable of yielding a high coincidence counting rate, even if no selective loss mechanism is at work. It was therefore decided to concentrate on redesigning the apparatus incorporating differential pumping, and try a run with this new system. Tests for adsorption could then be run in the new apparatus. This redesign is now at an advanced stage.

Delayed Alpha Emitters

K^{36} should exist as a member of the series $Z = 2N + 1$, $A = 4N$ which up to Cl^{32} at least are delayed alpha emitters. Since K^{36} is the mirror nucleus of Cl^{36}, the half life cannot be estimated. A search for alpha emission in the range of milliseconds through hours by $A^{36}(P, N)K^{36}$ at a beam level of 5×10^{-8} showed no evidence of delayed alpha emission.

Experiment on Polarization in P-N-P Double Scattering

Cyclotron runs were made on Nov. 20, 21, Dec. 10, 12 and 13, on the polarization of neutrons from tantalum and carbon. Final computations have not been completed, but the results appear to indicate a close to zero polarization for both carbon and tantalum.

Proton-Proton Scattering

During this month the data on σ total for p-p scattering have been evaluated and several checks on the experiment have been performed. We have also prepared a new run on the polarization of protons by proton scattering and constructed some apparatus for it. A successful run for n-p scattering at 90 Mev and small angle has been performed.

Film Program

Study has continued in the following research projects: (a) the high energy reaction ${}_1H^2 + {}_3Li^7 \rightarrow {}_1H^1 + {}_3Li^8$, (b) the interaction of 380 Mev alpha particles in G5 nuclear emulsion, (c) spallation reactions, (d) γ-ray energy spectra from Pb, Cu, and C under bremsstrahlung bombardment, and (e) the β-ray spectrum of N^{12}.

Radioactive measurements were made on targets placed in the external beam of the cyclotron. The measurements will make it possible to evaluate absolute cross sections for the spallation reactions. An initial experiment using the 40 inch spiral orbit spectrometer was done on the focusing of 20 Mev mesons. Background and shielding requirements were investigated.

Cloud Chamber Studies

Thirty-five Atmosphere Diffusion Chamber. A series of pictures were taken of cosmic ray background showing a sensitive depth of 1 1/2 inches at 400 psi helium.

Four Foot by Eight Foot Diffusion Chamber. This chamber has been moved from the roof of LeConte Hall to the Bevatron Building. It is now being redesigned and rebuilt. Upon completion it will be gas tight.

Pion Production in Deuterium. Film analysis is continuing.

90 Mev Neutrons in Hydrogen. (N-p Scattering at 90 Mev). About 1000 events have been measured since the last month's report.

Other Studies. Film analysis continues in the following projects; 32 Mev protons in oxygen, 32 Mev protons in methane, scattering of positive pions in lead, and the interactions of 32 Mev protons with He^4.

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

Among the calculations mentioned in earlier reports, the studies of relativistic Coulomb wave functions, on the high energy neutron energy spectrum from protons on complex nuclei, and on Maxwell's equations in general coordinate systems, are continuing.

The Compton scattering from nucleons is also still under study. Attention is focused at present on difficulties connected with gauge invariance in the static limit of an extended nucleon.

A paper is being prepared for publication, and an abstract submitted to the New York meeting of the American Physical Society, concerning the investigation of the first non-adiabatic approximation to the lowest order nucleon-nucleon interaction. The principal conclusion is that the usual elimination of negative energy state wave functions is incorrect.

An examination of the two-meson equation in the adiabatic limit has been commenced. It is of interest to see whether a virtual V_2^0 state exists. An abstract has been submitted for the New York meeting.

The next step in the continuing program of study of intermediate coupling, now in progress, is the treatment of meson-nucleon scattering for a neutral pseudoscalar meson field. It is hoped that the experience gained in studying this problem, which is much more difficult than the previously studied scalar fields, will be applicable to the ultimate objective of treating the charged and charge symmetric pseudoscalar fields. Two abstracts have been submitted to the New York meeting reporting the earlier work with scaler meson fields.

A UCRL report titled "Theoretical Study of a Source of Intermediate Energy Neutrons" has been prepared to summarize work over the past several months on a proposal due to E. Teller.

A report, UCRL-2386, has been written on calculations constituting improvements on Fermi's statistical theory of very high energy nucleon-nucleon encounters. In addition to the more accurate tabulations of relative probabilities of production of π mesons and of nucleon-antinucleon pairs, there are presented in tabular form data on relative production probabilities of particles of mass $\sim 900\ m_e$ as predicted by this theory.

An abstract has been submitted for the New York meeting presenting a different approach to the calculation of probabilities for alternative

processes in very high energy nucleon-nucleon interactions. This new approach, which is completely covariant, is now being used to calculate results of the type discussed in the preceding paragraph.

Numerical calculations on polarization effects in high energy proton-deuteron scattering are now under way, along the lines of the formalism developed in UCRL-2313, which is scheduled in the January 1, 1954 issue of the Physical Review.

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

The cross section for producing one neutron, σ_{1n}, has been measured for 340 Mev protons and 190 Mev deuterons incident on aluminum, copper, cadmium, thorium, and uranium. The results for uranium are in agreement with previous measurements, but this was the first measurement of σ_{1n} for the lighter elements. These cross sections are needed to calculate the neutron yield to be expected from a target, and as a function of energy should be useful in calculating yield extrapolations. The values will be reported at a later date.

The external or free yield of neutrons per incident deuteron was measured for a 10 1/8 in. by 12 in. by 12 in. target of uranium for 315 Mev deuterons produced by stripping 490 Mev He^3 particles. The deuteron energy was determined from the Bragg curve in uranium. The average of four bombardments gave a yield of 9.1 ± 0.3 neutrons per deuteron. The error quoted is a relative standard statistical error.

A uranium fission chamber has been constructed to serve as a monitor in the neutron beam. Tests will begin shortly to determine the operating characteristics and reliability of the chamber. The monitor is needed to determine neutron yields and σ_{1n} for the various energy neutrons available (90, 160, and 270 Mev).

A critical study of the properties of strong focusing systems as applied to linear accelerators has been carried out. This study has shown that, as compared with solenoid focusing, a strong focusing system is much more critically dependent upon adjustment of the local focusing fields and upon mechanical alignment. In a high current accelerator, in which loss of beam may cause damage to the machine, these disadvantages of strong focusing systems are judged to be so serious that a solenoid system should be used if at all possible.

A study of the beam dynamics of various drift tube geometries for the low energy end of a production accelerator has shown that both a $2\beta\lambda$ geometry at full frequency (49 Mc) and a $3/2\ \beta\lambda$ geometry at half frequency are well behaved and in addition lend themselves to either magnetic strong focusing or to solenoid focusing.

Testing of the high frequency power output of the latest model RCA A2332 tube with a ceramic envelope has continued at 49 megacycles/second. After a sequence of circuit improvements continuous high frequency

power output of 600 kw at an efficiency of 78 percent could be sustained indefinitely. However, a brief period of operation at 650 kw resulted in loss of emission, presumably due to excessive outgassing of the tube elements and bombardment of the cathode.

4. ACCELERATOR CONSTRUCTION AND OPERATION

UNCLASSIFIED

Bevatron Construction. (Program No. 9001)

Magnet. The magnet has continued to run for magnetic measurements during the month. The quadrants have been completely explored for variation in the strength of the field and in the height of the median plane as a function of the magnet current. Explorations of the strength of the residual field and the position of the median plane of the residual field have been completed in about half the quadrants. Special measurements of the effects of pole face windings at high and low fields and in the fields in the tangent sections have also been made. It is expected that all measurements will be completed by December 21.

The magnet current to which the field measurements are referred is indicated by pulses from the peaking transformers. The pulse equipment is now operating satisfactorily. Thirty pulses are produced as the magnet current rises.

The ripple in the magnetic field due to the operation of the magnet power supply rectifiers has been studied in much detail. The ripple is found to be different in the various quadrants apparently due to the effect of capacities to ground. A device is being developed to synchronize the two generators at any phase relation desired through regulation of the generator field excitations. A filter has also been installed but has not yet operated satisfactorily. It may be necessary to use both synchronization and filtering to reduce the ripple to the point where it will not affect the beam. Without correction there will probably be jitter in the beam pulses due to the ripple.

The value of "n" is close to the design figure of 0.6 except near the outer edge of the field where it dips to less than 0.4 at injection. Pole face winding currents will be used to correct this. With this exception the useful width of the magnetic field is about as expected from model tests.

Injector. The ion gun and linear accelerator have been tested in line without the 40° deflecting magnet previously used in the hope of improving the linear accelerator output beam. It was found that the focusing action of the deflecting magnet is still desirable and the next test will be made with a 20° deflection.

Assembly of the deflector has been completed in the shop and it is about to be installed in the extension of the east tangent tank. This can be done with the extension removed from the tank.

Accelerator. All the components of the frequency tracking and amplifier system have been installed and preliminary tests are to be made between the 15th and 21st of December. The frequency monitoring system

which compares the bevatron frequency with that of crystal controlled oscillators at the 30 points at which magnet current pulses are produced is also ready for test.

Schedule. Work started on the first third of the foundation for the shielding on December 7th. Cutting through the concrete floor was completed by December 14th. The shutdown during which the remaining pole face windings are to be installed is expected to start December 21 and it is hoped to be back in operation again for injection experiments between Jan. 15 and Feb. 1.

184-inch Cyclotron Operation

The cyclotron was used for research experiments approximately 83 percent of the 490 hours that the crew was on duty. Trouble was again experienced with the vacuum tank oil leak and temporary repairs had to be made once more to enable the cyclotron to operate until the major shutdown for the conversion to a higher energy. The time distribution was as follows:

Operation for customers	405.75 hours	83.0 percent
Mechanical troubles (incl. oil leak)	73.75	15.0
Radioactive contamination	4.50	0.9
Others	6.00	1.1
Totals	490.00 hours	100.0 percent

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

Magnet. The defective silicone tape for wrapping the auxiliary coil conductor is to be replaced by the supplier with new tape.

The winding operations on the auxiliary coil have not yet started because of a series of difficulties with soldering technique and procedure. These difficulties have been resolved and it is anticipated that the winding will start immediately. Both pole tip disc blanks have been machined and preliminary inquiries are out on the shim machining order. A number of small parts remain to be ordered, such as the auxiliary coil knee braces which order should be released during the next month.

Rf Design. Model work using the half scale model has been substantially completed and the data are on hand for the final design of all rf components. Many of these, for example the dee, dee frame, liner, and oscillator parts, have been released to the shop and the detail design on the additional parts is very nearly complete.

Vibrating Condenser. The order for machining the vibrating blades was finally placed with Mare Island whose delivery schedule appeared considerably better than any other possible vendor. The first pair of blades is due in approximately a month. After receipt of these blades the other steps in the manufacture will be tested to determine if any additional development is necessary.

Deflector. Theoretical work indicates that the first harmonic in the azimuthal variation of magnetic field must be removed to a precision of 0.01 percent. Since it is impractical to make measurements to this precision it is planned to install pole face windings capable of producing plus or minus 0.01 percent first harmonic field and thus experimentally produce the best field for allowing the beam to spiral out through the regions of instability to a radius corresponding to n equals one.

Synchrotron Operation. (Program No. 5731)

As indicated in last month's progress report, difficulties were experienced in adjusting the synchrotron magnetic field to compensate for the new resonator section. A full energy beam had been obtained, however the adjustments were so critical that it was impossible to maintain a dependable beam current. The new resonator section worked well in the machine as a beam accelerator. None the less, the copper coating made magnetic field compensation critical during the betatron phase of the acceleration cycle.

It was then necessary to disassemble the synchrotron magnet in order to install the original resonator section which had been repaired in the interim. After reassembly, the full energy beam was quickly regained. Full beam current output has not yet been realized, but is improving. The machine was made ready for physics research at the close of this report period.

Prior to full scale operation, some beam time was allocated to adjustments of the machine in order to compensate for the high leakage fields of the spiral orbit meson magnet.

Following are the operating statistics:

Operation for customers	96.1 hours	28.6 percent
Maintenance	239.9	71.4
Totals	336.0 hours	100.0 percent

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

During the month of November the operation efficiency of the 60-inch cyclotron was 80.3 percent of the time available. In addition 81 hours were spent in removing and cleaning the magnet oil heat exchanger in preparation to replacing the magnet oil.

Part of the operation time was spent in performing bombardments with the N_{14}^{+6} which had recently been successfully accelerated and worked up to a beam level that makes work on transuranic reactions possible.

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

The linear accelerator and Van de Graaff were operated routinely through the month. A two day shutdown was made to permit silver plating of all contact surfaces used in the new control system, including the variac contact areas. During this shutdown the charging belt was replaced.

A larger power supply was installed for operating the oscillator test setup, replacing the old parallel RA-38's used previously. The new pre-exciter has delivered 100 kw on 150 μ sec. pulses to the test cavity, but performance is not yet adequate to permit its use on the 40 ft. machine.

Operating statistics for the period are as follows:

Operation	295 hours	88 percent
Van de Graaff repair	35	10
Linear Accelerator repair	6	2
Totals	336 hours	100 percent

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

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Nitrogen Ion Bombardments. It is now possible to accelerate ions of N^{14} with charged of +6 in the Crocker Laboratory cyclotron and to produce substantial beams of these ions. Transmutations with these ions can increase the atomic number of the target atom by seven units, and this has been accomplished in several cases. Bombardment of indium (49) has resulted in two new isotopes of barium (56) which are best assigned to Ba^{126} and Ba^{124}. Isotopes of polonium (84) have been produced from indium (77). Bombardments of uranium are described in the next paragraph.

Reactions of U^{238} with Nitrogen Ions. Several isotopes of the elements 97, 98, and 99 have been produced recently by two different methods. In the first, U^{238} was bombarded with N^{14} (+6) ions accelerated in the Crocker Laboratory cyclotron. Among the transmutation products, besides copious amounts of fission products, were identified 99^{247}(?), 99^{246}, Cf^{244}, Cf^{246}, Cf^{247}(?), Cf^{248}, Bk^{243} and other berkelium isotopes whose assignments are unknown. The identification of the elements was definitely established by chemical procedures which, though very rapid, resulted in good separation of adjacent actinide elements.

The isotope 99^{246}, with half-life of a few minutes, is observed only through growth of its daughter, Cf^{246}. The activity which is assigned tentatively to 99^{247} on the basis of the nuclear systematics emits 7.35 Mev alpha particles with half-life 7.3 minutes.

Reactions of Plutonium with Neutrons. The second experiment which has led to isotopes of elements up to 99 is the irradiation of plutonium with a high flux of neutrons in the Materials Testing Reactor. Extensive chemical separations separated the heaviest elements from plutonium, fission products, americium and curium. Separation of the transcurium elements from each other yielded an element 99 fraction which emitted alpha particles of energy 6.6 Mev. The half-life is longer than one week. This activity is logically assigned to 99^{253}, which can be predicted to have such a disintegration energy with half-life of the order of a month. Its production requires the successive capture of 14 neutrons, with several beta decays interspersed.

Several alpha activities observed in the californium fraction must belong to isotopes heavier than 248, produced by capture of at least 10 neutrons.

Soft beta particles were observed in the berkelium which on the basis of nuclear systematics are probably due to Bk^{249}. If this assignment is correct, then there are no beta stable berkelium isotopes.

Structure of the Pervanadyl Ion. The entropy of pervanadyl ion, VO_2^+, has been determined calorimetrically from the reaction

$$V_2O_5 + 2H^+ = 2VO_2^+ + H_2O \qquad \Delta S = -25 \text{ e.u.}$$

and has the value -5 ± 1 e.u. This value is close to the value of zero reported for NpO_2^+, and this agreement is taken as evidence that the formula is VO_2^+ rather than $V(OH)_4^+$ or some other hydrated species. The Raman spectra of pervanadyl perchlorate are being investigated to give additional evidence of the structure.

Crystal Structure of Auric Chloride. The crystal structure of monoclinic $AuCl_3$ is being studied by x-ray diffraction. It is monoclinic, space group $P2_1/c$, with about the same size unit cell as monoclinic YCl_3 but a completely different atomic arrangement. The x and y parameters have been determined by a projection on (001), but the z parameters have not yet been investigated.

Absorption Spectrum of PuF_3. Ninety lines have been observed and measured in the absorption spectrum of hexagonal PuF_3 at 77°K. Additional experiments are planned for liquid hydrogen and liquid helium temperatures in the hope of working out the energy level scheme.

Process Chemistry

Work is in progress on the following problems: 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 systems, 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, the reflection coefficients of molecular beams, sodium carbonate vapor, molybdenum chloride vapor, and refractory silicides.

Basic Chemistry

Studies are being made on the hydrate complexing of Cr^{+++}.

Health Chemistry

The Equipment Development group and the Airborne Activities Control group, in conjuction with the Nuclear Chemistry group, completed the processing of a highly active irradiation received during the last period from the MTR at Idaho Falls. The work took place at Livermore. Subsequent treatment of samples of the irradiation--decontamination and further encapsulation--was done in Bldg. 4, Berkeley, by Health Chemistry operators. Residue from the Livermore operation has also been brought to Berkeley for further recovery of certain fractions. Considerable time has been spent in the dismantling and decontamination of the equipment used in the Livermore phase of the work.

Maintenance, repair, modification, etc., continues to be done on local equipment.

The Berkeley Box group assembled and fitted eleven boxes on request during the period October 15 to November 15 (not reported last period) and nine boxes during the present period. This group devoted approximately half its time on the assembly of special boxes for a Livermore project; this work on the boxes is being done in the Optometry Shed annex.

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

Physical Chemistry of Lipoproteins

Light scattering studies are now progressing with the recently completed quantitative scattering photometer to determine the molecular weights of the several lipoprotein entities of interest. A major problem involves the preparation of homogeneous lipoprotein entities in solutions with either (a) absolutely no decomposition or (b) with defined decomposition product and small molecule background. It appears that differential ultracentrifugation in solutions of graded densities may successfully provide the requisite materials.

The quantitative infrared spectroscopic analysis of chromatographically separated lipid fractions from purified lipoproteins appears to be giving excellent reproducibility and accuracy when compared with micro chemical procedures. By this approach the quantity of required lipid is much reduced and it is possible to determine all the major lipid constituents within the lipoproteins (including cholesterol, cholesterol ester, fatty acids, triglyceride and phospholipid). With this approach the study continues to determine the constancy of composition chemically of the various ultracentrifugally defined lipoprotein calsses.

Radiation Studies with the 184-inch Cyclotron

Delayed effects of hypothalamic and cerebellar irradiation are being studied with rats. So far the following abnormal physiological observations have been noted apparently as a direct sequence of such radiation:

failure to gain weight, abnormal food intake and water intake, hyperexcitability, exophthalmus, failure of temperature control, abdominal bleeding and ulceration. These studies are in preliminary stages.

Experiments are being carried out for acute effects of pituitary irradiation in rats on liver fat metabolism and thyroid function.

Instrumentation

A twenty-five channel scintillation counter scanner for measurement of gamma ray distributions *in vivo* is under construction.

Cellular Radiobiology Using Saccharomyces Cerevisiae

It was established that the delay in cell division time caused by x-rays is a radiation effect which does not depend on the ploidy of the cells. A given dose of radiation causes a greater delay if it is administered before visible bud formation. When a bud is present the cell becomes much more resistant to delay in all division caused in the next generation.

Tracer Studies

Long and short term tracer studies using europium, thulium, cerium, iron and astatine in rats; and the deposition of aerosols in the lungs of primates are continuing.

Experiments on the relative biological effects of alpha and beta emitters using astatine, iodine, radium, and x-rays for long and short term toxicity studies on rats and monkeys are also continuing.

Radiation Chemistry

Radiation chemical studies during the last month have included studies of (1) the mechanism of radiation induced reaction in acetic acid and formic acid at low beam intensities. (2) The effect of dissolved oxygen on radiation yields in these systems and (3) determinations of the radical pair yield in water for 35 Mev helium ions.

Histology

A number of animals from the I^{131} toxicity study were taken for histological sections, along with autographs for their thyroids. Three animals given high astatine dosage were taken for tissue preparation. Ten control rats were sacrificed to get a broad picture of normal tissues to compare with At^{211} treated animals. Tissues taken included fermur, liver, lung, spleen, kidney, adrenal, mesenteric lymph node, and lacrimal gland.

Bio-Organic Chemistry

The Bio-Organic Group of the Radiation Laboratory is organized primarily for development of fields of research which involve the use of radioisotopes of interest to organic and biological chemistry, such as C^{14}, tritium, S^{35}, and P^{32}, and thus represents one of the major significant and important peacetime applications of atomic energy.

In continuance of previous research we have worked on the synthesis of morphine and codeine metabolites, of choline analogues, of labeled cholchicine, dipeptides and plant acids. We have continued biological studies on rats, mice and guinea pigs to determine the effect of substances such as heparin, Coenzyme A and other drugs and metabolism of adenine and fatty acids.

We have worked to improve instrumentation, including radioassay techniques of scintillation counting for low-level T and C^{14}, using easily synthesized organic compounds. Of special note are projects in infrared spectrometry, photospectrometry of plant cells, continuous monitoring of metabolic rates and factors in plants and animals, and actinometry of radiation sources.

An initial goal in plant biochemistry, namely the defining of the path of carbon in photosynthesis, has been furthered by studies on degradation of sugars, by studies on shikimic acid biosynthesis, and by studies on thioctic acid (lipoic acid) and its role in the photosynthesis cycle, with emphasis on the thiazine ring formation in glutathione. The carboxylation reaction of photosynthesis is also being investigated using several methods of attack.

7. PLANT AND EQUIPMENT REPORT

UNCLASSIFIED

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

The magnet tests are practically complete, and the inflector assembly is complete and ready to install. The schedule calls for moving the injector into its final position so that trial runs may be made by the 15th of January. The bevatron shielding foundation work began December 1st and is proceeding on schedule. The floor just outside the magnet from the middle of quadrant 2 to the middle of quadrant 3 has been removed and excavated to the bottom of the proposed cap, and caissons are now being drilled in this area. AEC authorization to proceed with modifications to the control room and installation of the louvres outside the generator room has been received.

Chemical Laboratroy Building 70. (Account No. 5-271-1002)

The second floor slab has been poured and the second story walls are being formed. The plumbing and electrical work is proceeding at an even pace with the general construction work but as yet no heating or ventillating work or elevator work has been done. The entire project is approximately 34 percent complete.

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

Preliminary work on the design of this building is now being done by Corlett and Anderson and it is hoped that these plans will be ready for review about a month hence.

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

Material for the Destructor has begun to arrive and construction is expected to start about the first of January. The Purchase Order Contract with Hugo Muller Jr. for erection of this building has not been approved by the Atomic Energy Commission. Alterations to Building 50 are 98 percent complete. The east parking lot has been paved and is 90 percent complete. Equipment has been moved into the Accelerator Technicians Shop in the north end of Building 64 and the carpentry and plumbing work is complete. The electrical work will be done when the material to do this work has been received. The Breiderts on the roof of the south end of Building 64 are being installed.

MAN-MONTHS EFFORT REPORT

SCIENTIFIC PERSONNEL

Program No.	Subdivision	Man Months Effort	Vac. & Sick Leave
Operations			
3000 Weapon's Research	General	284.66	23.94
4000 Reactor Development - MTA	Design and Development	13.62	0.86
5000 Physical Research			
5200 Basic Physics Research	General Physics Research	50.37	9.35
	Theoretical Studies	12.76	2.97
	Film Detection	15.04	1.81
	Cloud Chamber	9.54	0.69
	Magnetic Measurements	1.94	1.10
	Sub-Total	89.65	15.92
5311 Basic Chemistry Research	Chemistry of Heavy Elements	5.42)	
	Nuclear Properties of Heavy Element Isotopes	11.65)	
	Transmutations with 184" and 60" Cyclotrons	5.82)	
	Analytical and Services	9.19)	
	Mass Spectroscopy, Beta Ray Spectroscopy	2.06)--	5.04
	Instrument Development and Services	8.71)	
	X-Ray Crystallographic Measurements	2.70)	
	Radiation Chemistry	-)	
	Office and Travel	5.58)	
	High Temperature and Special Chemistry	4.63	0.19
	Health Chemistry Research	7.07	
	Sub-Total	62.83	5.23
5361 Applied Chemistry Research	Process Chemistry	4.40	
5731 Electron Synchrotron	Operations	6.07	
5741 Synchro Cyclotron (184")	Operations	8.30	
5751 Linear Accelerator	Operations	9.65	
5751 Proton Synchrotron-Bevatron	Operations	11.08	
TOTAL PHYSICAL RESEARCH		191.98	21.15

MAN-MONTHS EFFORT REPORT

SCIENTIFIC PERSONNEL

Program No.	Subdivision	Man Months Effort	Vac.& Sick Leave	Com-ments	Vac.& Sick Leave
6000 Biology & Medicine Research					
Medical Research	Health Medicine	1.35			
	Internal Irradiation	5.24		0.72	Consultant Man Months
	Sub-Total	6.59			
6400 Biological Research	Miscellaneous	3.91)		3.55)	
	Instrumentation	3.05)		-)	
	C_{14} Metabolism	3.69)		0.73)	
	Use of Radioactive material in Human Physiol.	9.58)		4.87)	
	Trace Elements	4.28)		-)	
	Physical Biochemistry	10.15)	7.58	3.36)	1.86
	Biochemical Response to Radiation	2.91)		1.17)	
	Metabolism of Lipo-proteins	6.76)		9.23)	
	Iron Metabolism Hematopoiesis	2.18)		-)	
	Biological Effects of Cosmic Radiation	2.20)		-)	
	Radiation and Mutation Rate	1.99)		0.50)	
	Bio-organic Chemistry	26.74	2.52		
	Metabolism of Fission Products	16.69	1.31		
	Animal Colony	2.77	0.23	3.81	
	Sub-Total	96.90	11.64	27.22	1.86
6500 Biophysics Research	Health Physics	5.18			
	Irradiation Studies	2.68		1.03	
	Sub-Total	7.86			
TOTAL BIOLOGY AND MEDICINE RESEARCH		111.35	11.64	28.97	1.86
GRAND TOTAL - OPERATIONS		601.61	57.59	28.97	1.86

Information Division
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