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AEC RESEARCH AND DEVELOPMENT REPORT

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OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

September, 1951

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OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

September, 1951

W. E. Thompson

Date Issued: OCT 5 1951

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PROGRAM 1000 - RESEARCH FACILITIES

Research Laboratory Building #4500

Work on this building is approximately 71% complete. Exterior masonry walls are 99% complete. Built-up roofing on service area is 80% complete, and on Wings #1, #2, #3 and #4 is 100% complete. Air conditioning and ventilating ductwork is 80% complete. Electrical services for light and power are 65% complete. Plumbing, service and process piping are 80% complete.

Isotope Research and Unit Operations Building #4501

Exterior masonry walls are 100% complete. Interior masonry walls are 95% complete in the Unit Operations Section, and 20% complete in the Isotope Research Section. Air conditioning and ventilating ductwork is 65% complete in the Isotope Research Section and 85% complete in the Unit Operations Section. Plumbing, service piping, and electrical work are 85% complete in the Unit Operations Section and 60% complete in the Isotope Research Section. Building is 75% complete.

High Voltage Laboratory Building #4503

Exterior concrete walls of both tank rooms have been poured to approximately 835. elevation. Drain lines have been installed in basement. Erection of structural steel has been started. Building is 24% complete.

Health Physics Waste Research Building #3504

This building is approximately 99%+ complete. Contractor is completing unfinished items of work. Final inspection is being made and punch list is being written to complete all phases of work. Work shown on drawings to be done by ORNL forces includes installation of retention tank and connection of liquid waste collection system, also the connection of batching tanks on platform and extension of waste line to open ditch west of building.

Test Facilities Building #7503 (ARE)

All excavation for footings and foundation walls is complete. Concrete foundation walls, grade beam walls, pedestals are complete. First floor concrete girders, beams and floor slab are complete. Contractor will start erecting structural steel Monday, October 8, 1951. Plumbers running

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underground services and soil lines. Power poles and power lines being run from existing Building #7500. Material for six inch water line from Building #7500 to this building is at job site ready for installation. Total completion - 30%.

Chemical Isolation and Purification Laboratory Building #3508

Excavation for pedestal footings and grade beam walls is approximately 90% complete. Concrete pedestal and foundation grade beams are 40% complete. Structural steel has been delivered to job site. Total completion - 25%.

ORSORT Laboratory Building #3017

All underground services completed. Concrete footings, pedestals, foundation walls, walls, floor and roof of counter room, floor slab on grade and platforms are complete. Exterior masonry block walls and spandrel beams are 95% complete. Structural steel and bar joist for roof, roof decking and built-up roofing are complete. Plumbers, fitters and electricians installing service lines and fixtures. Window sills and metal windows are installed. Total completion - 60%.

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PROGRAM 2000 - SOURCE AND FISSIONABLE MATERIALS

Purex Process (AEC Activity 2802-3)

The results on the third Hanford level Purex run were correlated during the last month. The plutonium and uranium products met specifications with the exception that the uranium gamma activity was 150% of specification. These results were significantly better than those obtained in the first two Hanford level runs. The improvement was due to the lowering of the acid concentration in the second uranium cycle and increasing the TBP concentration in the plutonium cycle. The increase in the TBP concentration in the plutonium cycle also resulted in increasing the plutonium concentration in the process by a factor of four.

The equipment modification program in the Pilot Plant was continued. The continuous evaporator for the uranium product stream was installed and tested using a cold uranium solution feed. The evaporator condensate decontamination factor was demonstrated to be from 10^6 to 10^7 and appeared to be independent of the boil-up rate. The entrainment separator on the evaporator was a three way bubble cap column.

SCRUP Separation (AEC Activity 2344)

The equipment test program was continued during this month and the third shipment of Chalk River material was received. Process tests on the metal dissolver will be started during the next month.

23 Processing (AEC Activity 2XXX)

A program estimate has been submitted to the AEC at their request outlining the manpower and cost requirement for the recovery of U 233, protactinium and thorium from neutron irradiated thorium metal. This program is tentatively scheduled to be started in the first quarter of the fiscal year 1953.

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PROGRAM 3000 - WEAPONS

RaLa Production (AEC Activity 3982)

The remodeling of the resin column cubicle has been started and is expected to be completed in time for the next run, which is not yet firmly scheduled. Process modifications have been developed to offset the operating difficulties encountered in recent runs.

MTR RaLa Development (AEC Activity 3982)

The RaLa production program is now being reviewed to supply the AEC with information that will allow them to determine the most economic program for the future RaLa production. The development studies on the MTR RaLa process are being continued in the Laboratory, Unit Operations, and Design with the objective of consolidating the process information prior to discontinuing this program.

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PROGRAM 4000 - REACTOR DEVELOPMENT

MATERIALS TESTING REACTOR

LITR Operation (AEC Activity 9543)

Continuous operation at a power level of 770 KW was started during the first week in September and has continued without incident. Suitable heat exchangers and pumps have been obtained for installation to allow the LITR to operate at higher powers.

MTR Project Engineering (AEC Activity 4221)

The last of the MTR components to be supplied by ORNL has been shipped to Arco. The Laboratory's remaining responsibility is for assistance during start-up and shake-down runs of the MTR. Start-up operations are now expected to be initiated during March 1952.

HOMOGENEOUS REACTOR PROJECT

Experimental and Design Engineering (AEC Activity 4264)

The let-down heat exchanger has been tested in the HRE mock-up and approved for installation. The mock-up is still being adapted for operation with normal uranium fuel solution. It is expected that alterations will be completed and operation with soup will be started in October.

Corrosion in Homogeneous Reactors (AEC Activity 4263)

Operation of a circulating loop at 150°C indicates that corrosion of 347 stainless steel by UO_2SO_4 solutions is somewhat less at 150°C than at 250°C. Static tests of the corrosion resistance of various materials to uranyl sulfate solutions indicate that titanium and 5% tin-zirconium alloy are outstandingly resistant.

Chemical Control of Fuel (AEC Activity 4263)

The Princo Densitrol has been tested in the laboratory and gives evidence of being able to measure uranium concentration to 1% by

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a density determination provided bubbles can be removed from the solution satisfactorily.

Building 7500 - HRE (AEC Activity 4261)

The overall construction of the HRE is now about 80% complete. It is expected that, barring procurement delays, construction can be completed by the end of November.

HR Fuel and Blanket Studies (AEC Activity 4263)

A preliminary laboratory study of a boiling slurry reactor indicated that the degree of foaming increased with increased temperature and pressure. Solubility studies of uranium trioxide and magnesium diuranate were completed. Present indications are that uranium trioxide monohydrate is the most feasible slurry on the basis of its non-packing characteristics. With this slurry it was found that heat treating the uranium trioxide at 500°C tends to make it more non-reactive with water.

HR Fuel Reprocessing Studies (AEC Activity 4263)

It has been previously reported that the plutonium oxide formed in a uranyl sulfate solution reactor precipitates. Therefore, it appears that it may be feasible to remove the plutonium from the reactor fuel by straight filtration. Studies were initiated during the past period to develop procedures for dissolving the plutonium oxide precipitate from the filter using nitric or sulfuric acid. The rate of dissolution of plutonium oxide in these acids has been found to be very slow.

HRP Reactor Chemistry (AEC Activity 4263)

The laboratory and pilot plant tests, carried out with a platinum-on-alumina catalyst, have shown that a catalyst recombiner for the HRE could be used successfully, even replacing the flame recombiner if necessary. These tests have been run at pressures in the neighborhood of one atmosphere. The next phase of the work will deal with catalytic recombination at 1000 psi.

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AIRCRAFT NUCLEAR PROPULSION PROJECT

ANP Central Design (AEC Activity 4275)

The ARE pressure shell is scheduled for the October melt at the International Nickel Company and should be completed by the Lukenweld Company in February 1952. Initial shipments of beryllium oxide blocks from the Norton Company have commenced. All other major core components are on order from outside vendors. A number of outside manufactured components of the remote handling equipment, including hydraulic transmission system, saws, rubber-bonded abrasive cut-off wheels and miscellaneous tools are also on order.

The layout of the fluid circuit is well established and the procurement of its many components is in process. Griscom-Russell is the apparent low bidder on the coolant to He and He to glycol heat exchangers. A speed control system has been devised for the helium blowers to permit low revolutions per minute when the reactor is operating at low powers. The fluid circuit has been modified to permit flushing, in order to reduce the activity of the core, after draining the primary coolant.

The Nuclear Development Associates, Inc., have reported (Y-F5-55) detailed specifications for a supercritical water reactor. The reactor and shield comprise an 11-foot diameter sphere of water with a 2.5 foot square cylinder active core at its center. The reactor will deliver 400 megawatts with a maximum wall temperature of 1290°F and a fuel investment of approximately 25 pounds. The proposed fuel elements are of a sandwich design and the core design achieves a flat neutron flux. The pressure shell introduces some problems of weight but the overall shield weight of 180,000 pounds is within specifications.

Refined calculations of the ARE design of June 10, 1951, have yielded an estimated critical mass (after making due allowance for clearances, etc., between moderator blocks) of 28 pounds of U 235 (+ 10% - 20%). The optimum positioning of the control rods has been determined to be one in the center and six on a ring of 8.5 inches diameter, although the radius is not at all critical.

IBM calculations of kinetic behavior are being carried out over a wide range of conditions and parametric values, including the response to

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an entrance coolant temperature change. The results show an effect due to the expansion of the fuel tube walls, i.e., the power rises momentarily before it falls to a final value. The wiring of the IBM boards for a detailed analysis of the coolant movement and including an external servo-control loop is in the programming stage.

Preliminary results on a NaOH cooled and moderated reactor of 75% NaOH, 20-23% stainless steel, and 4.77% fuel have indicated a critical mass of 32 pounds for a 200 megawatt reactor of 1.25 foot core radius.

Liquid Metals Research (AEC Activity 4275)

A preliminary test in which sodium hydroxide was heated in a nickel crucible for eight hours at 550°C in carefully purified hydrogen shows no visible attack of the nickel and no mass transfer. In general the corrosion of nickel by various hydroxides is not so severe as the mass transfer effect which is observed when there is a thermal gradient over the apparatus. It now appears that barium hydroxide is least corrosive to nickel, followed by strontium hydroxide and sodium hydroxide in that order. It also appears from preliminary experiments that stainless steel and inconel cannot be used to contain any of the hydroxides except possibly potassium hydroxide.

High frequency stabilized alternating current with helium gas is now being used in the cone arc process. Indications are that this power source is better than direct current for welding tubes to thin sheet headers. Better control of penetration is obtained and less tube constriction is evident.

ANP Experimental Engineering (AEC Activity 4271)

Consideration of fused salts as possible heat transfer materials for use with ARE and/or ANP indicated that desired mixtures and purities were unavailable commercially; consequently, a program has been set up to provide sufficient amounts of these materials for research purposes. Production units have been designed for mixing and filtering eutectic mixtures of (Na Li K)F, and are to be fabricated from 316 stainless steel. Two units are planned and fabrication of the first is virtually completed. Briefly, the process involves charging various

salts into the system in proper proportions, heating to 1750°F, holding at 950°F for several hours under 50-100 microns pressure, holding at 860°F for an additional hour, and finally filtering through a 5 micron sintered stainless steel filter into a suitable container.

Tests were continued on the frozen sodium shaft seals both in seal test equipment and on a modified centrifugal pump. The total time accumulated on the seal test equipment was 1150 hours sealing under temperatures up to 1500°F in the bath metal and up to 36 psig pressure. At no time during this test was there any indication of malfunctioning of the seal. Moreover, no measurable increase in power to rotate the shaft after the seal formed was observed; and upon disassembly, no indication of shaft scoring due to sodium was found. The pump incorporating the frozen sodium seal has operated for 365 hours at temperatures from 550-1100°F and flow rates from 8-40 gpm. The temperature limit was imposed by silver solder used to seal small leaks at welded joints. Again, no evidence of seal failure has been observed.

A General Electric Type G-3 electromagnetic pump was tested in the calibration loop to determine whether GE performance curves could be reproduced in local equipment and under local conditions. Graphs of Head vs Flow show that performance compares favorably with that supplied by GE; however, the pump cell, which was only recommended for use below 750°F, failed after a short time at 1000°F. In subsequent tests using pump cells designed by ANP Experimental Engineering personnel, sodium at 1300°F was pumped for 16 hours; and approximately 160 hours pumping at temperatures greater than 1100°F was obtained.

The liquid fuel transfer apparatus was altered by installation of a viewing tank connected to the fuel storage tank by two parallel lines. One line contained a filter while the other contained a bellows-sealed needle valve. Fuel was transferred both alternately and simultaneously through the filter line and filter by-pass line to the viewing tank and returned to the storage tank. Observations made during fuel transfers indicated that: (1) fluoride fuel wet the 316 stainless steel container walls at a recorded temperature of 1400°F, (2) a concave miniscus was formed at the interface between the molten fuel and the tank wall, and (3) unfiltered material appeared darker than filtered fuel when both were at the same temperature.

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ANP Reactor Chemistry (AEC Activity 4275)

Hydroxide Purification. Production of a limited quantity of anhydrous, high purity potassium hydroxide has been accomplished. The procedure is now being used for preparation of quantities sufficient for corrosion testing. Equipment of stainless steel has been assembled for purification of one to two pound batches of barium hydroxide.

Phase Equilibrium Studies. The systems KOH-KF and NaOH-NaF do not appear promising as moderator coolants. Preliminary experiments with NaOH-NaF-KF-LiF and KOH-NaF-KF-LiF systems indicate that low melting mixtures are available over a wide range of hydroxide concentrations.

ANP Corrosion Studies (AEC Activity 4275)

Dehydrated commercial KOH is less corrosive than pure or dehydrated commercial sodium hydroxide. The KOH shows a penetration of 1 to 2 mils in one hour at 800°C on inconel; most of the corrosion by this material seems to occur during the early portion of the tests. One-hundred hour tests under these conditions show 5 to 6 mils penetration. Tests at 700°C show less severe attack.

KOH-KF and NaOH-NaF mixtures are less corrosive than the corresponding hydroxides alone.

Viscosity of the NaF-KF-LiF eutectic was shown to be about 2.2 centipoise at 500°C and about 1.5 centipoise at 800°C.

GENERAL REACTOR DEVELOPMENT

School of Reactor Technology (AEC Activity 4590)

The 1951-1952 session of the Oak Ridge School of Reactor Technology, the second formal school session, began on September 10, 1951. The enrollment included thirty-eight ORNL employees and twenty-nine sponsored students from industry and government agencies.

The ORSORT laboratory building, now under construction, is expected to be completed and ready for use during November.

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PROGRAM 5000 - PHYSICAL RESEARCH

PRODUCTION OF RADIOISOTOPES

Radioisotope Production, Development and Operations (AEC Activity 5111)

The total accumulated KWH for pile operation during September was 2,439,476, averaging 3724 KW per operating hour. Pile down time was 9.0% as compared with 6.7% during August. There were two ruptured slugs which were located and discharged without difficulty. The total number of radioisotope shipments were 671.

PRODUCTION OF STABLE ISOTOPES

Calutron Operation and Process Development (AEC Activity 5121)

The quality of metallic lithium deposited from organic solutions was improved under controlled moisture and gas conditions. A special electrode was developed with a central heating element. This electrode provides a means of removing the collected lithium in an inert atmosphere. Samples of lithium metal were collected in lithium fused salt cells, using lithium bromide and lithium chloride, independently, as an electrolyte.

A variety of Alpha II grid type slit systems and a mechanism providing horizontal adjustment of the accelerating electrode were designed and placed in operation.

Iron collections that were started in July in the Beta channels were continued throughout this month. These runs have yielded an estimated 425 grams of isotopes. Lithium operations were in progress this month in the Alpha channels.

There were twenty-two stable isotope shipments during September.

PHYSICS

Neutron Diffraction (AEC Activity 5211)

Neutron diffraction examinations have been carried out on samples of vanadium, chromium, columbium, molybdenum and tungsten for the purpose of determining their magnetic structure. Chromium is found to be

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weakly antiferromagnetic with a Curie temperature of about 100°C, whereas none of the others seems to possess any magnetic structure at all. These findings are in accord with modern theories regarding the electron distribution in metals.

High Voltage Laboratory (AEC Activity 5211)

The 2 MV Van de Graaff now has delivered a 100-microampere proton beam at 1.7 Mev. It now appears that the tube will stand three million volts, although the machine will not yet generate this high a voltage. Using the Cockcroft-Walton accelerator it has been possible to observe the $Li^6 + H^3 \longrightarrow Li^8 + p$ and $He^3 + H^3 \longrightarrow Li^6 + \gamma$ reactions.

Theoretical Physics (AEC Activity 5211)

There are several cases in which a nucleus emits three successive gamma rays in cascade. The theory of the angular correlation of the three radiations has already been developed and published by this group. In order to avoid the experimental difficulty involved in triple coincidence work, the correlation between two cascade gammas with an intervening, unobserved, gamma has been worked out. Complete tables of numerical coefficients are now available to the experimentalist. It is pointed out that the 1-3 correlation can, in certain cases, resolve ambiguities which would arise from a double correlation experiment and that the former is a valuable check on the latter.

Short Lived Isomers (AEC Activity 5211)

The low energy excited nuclear states of Hf^{177} have been classified both by measurements of the directional angular correlation of successive gamma quanta and K-shell internal conversion coefficients. The excited states are 112 and 318 Kev above ground state. The lifetime of the intermediate state is less than 5×10^{-10} sec. The angular correlation measurement of the 206 and 112 Kev gamma rays in cascade is characteristic of the successive dipole-quadrupole transitions with angular momenta $5/2 \longrightarrow 7/2 \longrightarrow 3/2$ for the three states in order of decreasing excitation energy.

Measurements of the K-shell internal conversion coefficients indicate that the 206 Kev gamma ray is an electric dipole transition and the 112 Kev gamma ray is an electric quadrupole transition. It appears that both

the internal conversion data and the angular correlation are consistent with the interpretation that both transitions are pure multipoles. The crossover transition of 318 Kev is also an electric dipole transition. However, the observed intensity of the crossover transition is eighty times smaller than theoretical estimates predict.

The 86-Inch Cyclotron (AEC Activity 5261)

Overall innage (beam being received time) for the month was approximately 65%. The following bombardments were made:

Type	Number
Radiation Damage	13
Physics	21
Isotope Production	8
Experimental	10
Total:	52

The longest continuous run was in excess of 100 hours at an average beam current of 900 microamperes at 20 Mev with 95% innage. The total microampere-hours of beam for the month was approximately 200,000 or an average of 300 microamperes continuous beam at 20 Mev.

The 63-Inch Cyclotron (AEC Activity 5261)

All major components of the cyclotron have been designed and are now in various stages of fabrication. The following items have been completed and are ready for use: liner and face plate, reaction chamber, oscillator cabinet, vacuum manifold, and the power supply. The magnetic shims are in place and the field has been mapped. Alteration of existing utilities has been started.

Special Separation (AEC Activity 5261)

The U 236 separation program has been completed. The two stage separation of 1% feed material yielded 1.8 grams of 95.5% U 236. The 236:235 enhancement ratio is 1600. The program also yielded 1200 grams of 99.7% U 235 and 18 grams of 30% U 236.

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Isotope Analysis Methods Laboratory (AEC Activity 5261)

Nuclear Resonance. Studies are being made on the limiting sensitivity of the nuclear resonance equipment using H^2, O^{17}, and V^{51}. Electromagnetically concentrated ${}_{23}V^{50}$, an odd-odd type of nucleus, is available for search studies but the 30 mg of material available is expected to give an extremely weak signal.

Microwave Spectroscopy. Assignments in the vinyl iodide molecule of transitions $J = 3_{12}$ to 4_{13}, and 3_{13} to 4_{14} have been confirmed and molecular parameters calculated by first order theory. Transitions $J = 4_{13}$ to 5_{14} and $J = 4_{14}$ to 5_{15} were predicted and subsequently observed with the predicted pattern. Stark effect studies are being made on the $J = 4$ to 5 transitions.

Atomic Spectroscopy. Focal properties of the echelle spectrograph have been investigated to increase the resolving power and Zeeman resolution. Additional studies have been made on spectro-isotopic analysis of lithium and hollow cathode excitation of uranium. Direct reading photoelectric equipment is under development for assay application. Uranium spectra up to 6800 A have been obtained on about 50 microgram samples deposited on copper and gold electrodes.

X-Ray Spectroscopy. Modifications are being made in the power supply and the counting equipment of the XRD-3 unit to minimize resolving time errors. The L spectra of polonium is being rephotographed on a 25 cm Bragg-type oscillating-crystal vacuum spectrograph. Lead buildup is expected to be appreciable.

Mass Spectrometer Laboratory (AEC Activity 5261)

Thermal dissociation studies of UF_3 were completed this month. It has been found that UF_3 dissociates at all temperatures from 750°C upward. The rate of dissociation increased steadily with rising temperature to yield UF_4 and uranium metal. No evidence of the sublimation of unaltered UF_3 could be found with temperatures in the range of 750°C to 1000°C. These conclusions agree well with the rather limited information available in the literature. Final check of these properties is now being made with the mass spectrometer. The new Winn-Nier emission regulator has been placed in operation.

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CHEMISTRY

Chemical Physics (AEC Activity 5311)

Work has continued on the pure quadrupole spectra of solid chlorine compounds. This is a new field, and the work to date has clearly demonstrated that quadrupole couplings determined in crystalline solids have great significance in elucidating some of the properties of chemical bonds. Measurements of the pure quadrupole spectra of substituted methanes and of vinyl chloride show the marked correlation of couplings with chemical composition and also demonstrate that in many cases the effects of near neighbors in crystal lattices and the role of lattice vibrations are small.

Calorimetric Measurements (AEC Activity 5311)

This group has recently completed a precise determination of the power generated by a given amount of C^{14}. The determination consisted of measurements on a mixture of $C^{14}O_2$ and $C^{12}O_2$ of (1) the heat liberated by a given amount of the mixture and (2) the abundance of $C^{14}O_2$ in the mixture. The thermal measurements were made using the helium calorimeter which has been developed by the group. The ratio of $C^{14}O_2/C^{12}O_2$ in the mixture was measured by means of a small gas density balance which was constructed for that purpose. From the results, the average decay energy can be found if the half-life is known. Conversely, the half-life can be found if the average decay energy is known.

In order to provide a tie-in between the results of these measurements and half-life values which have been determined elsewhere, we are attempting to interest Dr. Inghram of the Argonne National Laboratory in measuring samples of our gas mixture mass spectrographically. Dr. Inghram collaborated in the half-life determination which was made at Chicago. In addition to providing the tie-in, such a measurement would provide a calibration of the mass spectrograph in terms of the gas density measurements which should be absolute.

Chemical Separation of Isotopes (AEC Activity 5361)

The HCl (gas) - Cl^- system was operated for a 22-hour period in the 20-foot column before the run had to be terminated because of operational difficulties. Mass spectrographic assays of samples taken during this run indicate enrichment of ^{37}Cl in the gaseous phase.

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Mass spectrographic assay results were received from the samples of the 10-stage LiSCN (aq) - LiSCN (TBP) system. No isotopic separation was found.

A study has been started to determine whether the water molecules associated with lithium ions in aqueous solution exchange freely with the other water molecules of the solution. This exchange will be followed using O^{18} labeled water. Mass spectrographic standards of both normal and O^{18} enriched water have been prepared.

An exchange study between ClO_3^- and ClO_4^- was begun. Using tracer technique and $Cl^{36}O_3^-$ it was found that no exchange occurs between the chlorine atoms of the ions in a neutral solution within two minutes. Later results will indicate the effect of a longer exchange time as well as acidity effects.

Chemistry of Uranium Raw Materials (AEC Activity 5361)

Results from further investigations in the carbonate-uranium chemistry have been reported in document Y-794, "Studies in the Carbonate-Uranium System. Part III. Spectrophotometric Investigation of the Carbonate-Uranyl Complexes."

A topical report on the studies made to date with anion exchange resins has been prepared and will be issued within the next month.

Limited studies are being made in the system K_2O - UO_3 - CO_2 - H_2O. Further measurements of solubility in the Na_2O - UO_3 - CO_2 - H_2O system are also being conducted at high temperatures and CO_2 pressures.

In the investigations of organic complexing agents which are capable of effecting the precipitation of uranium and/or its extraction into organic solvents, it has been found that o-aminophenol is a promising reagent for effecting the extraction of uranium from nitrate solutions.

The effectiveness of HNO_3, H_2SO_4, H_3PO_4, and Na_2CO_3 in extracting uranium from Bartow Clay has been studied. Methods for gaining uranium from the resultant leach liquor are also under investigation.

Electrochemical Studies (AEC Activity 5311)

A laboratory study of an electrochemical process for the separation

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uranium and plutonium from irradiated metal is in progress. This is an extension of work carried out previously at K-25. The initial step in this process involves the anodic dissolution of uranium metal in a sodium bicarbonate solution. Preliminary studies have indicated that greater than 99% of the plutonium may be separated from the uranium in this step.

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PROGRAM 6000 - BIOLOGY AND MEDICINE

BIOLOGY

Cytogenetics (AEC Activity 6400)

It has been found that oxygen alone can break chromosomes it it enters the cell in sufficient concentration. This has been observed in the Tradescantia pollen gain. It can be recognized only if more than 50% oxygen is present in the atmosphere; the chromosome breaks have not been observed with the other gases tested. Similar results have been obtained with maize pollen. This is a very important finding, since it opens possibilities for the investigation of the mechanism of mutation production.

It has also been found possible to make certain strains of bacteria recover to a fairly high degree after exposure to X rays by keeping them inside narrow temperature levels for a few hours after X-ray exposure. For one strain of bacteria the temperature at which maximum recovery occurs is 17°C, whereas for other strains this temperature for maximum recovery after X-ray exposure may vary between 12° and 37°C. This is a rather interesting finding since it shows that recovery after exposure to X rays is possible; and it might be of considerable practical importance.

Mammalian Genetics (AEC Activity 6400)

It has been found previously that the embryo inside a pregnant mouse is extremely sensitive to X radiation during certain periods of its development, especially around the 11th day. As little as 50 R of X rays might have very harmful effects on the embryo during this period. It has been observed that if the pregnant mother is irradiated with X rays at about the 11th day of pregnancy in an atmosphere of 5% oxygen (in place of normal air containing 21% oxygen), it is necessary to give three to four times the amount of radiation to get the equivalent effect which one produces in normal air. This opens the possibility that one could protect pregnant women against X-ray damage when taking an X-ray photograph of the embryo. A line of investigation is now planned to determine, on the basis of results obtained with bacteria, whether it is possible to produce an equivalent protective effect by means of chemicals.

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Biochemistry (AEC Activity 6400)

The work on the isolation of nucleic acid breakdown products which has been coming out of this Laboratory received the highest praise and was discussed frequently when the subject of nucleic acids came up at the 75th Anniversary Meeting of the ACS and at the International Congress for Pure and Applied Chemistry in New York.

BIOPHYSICS

Waste Disposal Research (AEC Activity 6532)

A program of measurement of radiation intensities on bottom muds in TVA lakes downstream from ORNL has been undertaken. In general, the muds in the main channel were found, by means of a river bottom scanning detector, to have a higher radiation level than the more shallow areas as far downstream as Watts Bar Dam (58 miles from ORNI). From Watts Bar to about the middle of Guntersville (~175 miles downstream) higher intensities were found from mud in shallow rather than in deep water. Intensities had decreased to barely above background in Guntersville Reservoir. The highest radiation level measured during this survey was about five times background, and in most areas the radiation level was of the order of twice background.

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PERSONNEL SUMMARY

	Number of Employees September, 1951	New Hires September	Terminations September
Administration	96	1	1
Operations*	119	1	0
Engineering, Shops and Mechanical	878	7	32
Laboratory and Research	1347	58	45
Protection	171	2	1
Service	376	10	5
Total:	2987	79	84

* This includes Electrical Distribution and Steam Plant as well as the Operations Division.

RADIOISOTOPE SALES

Sales	July	August
Transfer within AEC	$ 6,439.55	$ 3,322.75
Cash Sales	22,272.47	27,097.20
Foreign	1,038.90	397.50
Cancer Program (Free)	41,272.53	34,647.00
Technical Cooperation Plan	460.00	12.00
Total Sales and Transfers to Date	1,808,386.49	1,846,047.09
Total Cancer Program (Free) to Date	938.681.31	973,328.31
Technical Cooperation Plan (Shipments to Date)	12,073.04	12,085.04

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GROSS OPERATING COSTS
(Including X-10 & Y-12)

(a)	Actual Cost for August 1951	$ 2,780,808.00	
	Construction Program "H"	$ 30,953.00	
	Total Operating and Const. Cost for August 1951		$ 2,811,761.00
(b)	Estimated Operating Cost for September 1951		$ 2,700,000.00
(c)	Actual Accumulative FY 1952 Operating Costs thru August 1951	$ 5,139,768.00	
	Actual Accumulative FY 1952 Construction Costs thru August 1951	$53,066.00	
	Total Actual Accumulative FY 1952 Operating and Const. Cost thru August		$5,192,834.00
(d)	Estimated Operating Cost FY 1952 thru September 1951		$7,892,834.00

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