NG OFFICE: 1952

UNITED STATES ATOMIC ENERGY COMMISSION

Thirteenth Semiannual Report

OF THE

ATOMIC ENERGY COMMISSION

January 1953

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON, D.C.

LETTER OF SUBMITTAL

WASHINGTON, D. C.
28 January 1953

SIRS: We have the honor to submit herewith the Thirteenth Semi-annual Report of the United States Atomic Energy Commission, as required by the Atomic Energy Act of 1946.

Respectfully,

UNITED STATES ATOMIC ENERGY COMMISSION,
THOMAS E. MURRAY,
H. D. SMYTH,
EUGENE M. ZUCKERT,
GORDON DEAN, *Chairman.*

The Honorable
The President of the Senate.
The Honorable
The Speaker of the House of Representatives.

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Part One

Major Activities in Atomic Energy Programs, July–December 1952

MAJOR ACTIVITIES IN ATOMIC ENERGY PROGRAMS, JULY–DECEMBER 1952

The first decade of atomic energy development by the Government of the United States came to a close in the 6 months covered by this report.

In more than a symbolic sense, this latest half-year has witnessed the crystallization of important lines of exploration, research, and development that began earlier in the decade.

The high and sombre significance of the results of the November tests at the Pacific Proving Ground in the Marshall Islands was noted by the retiring President of the Nation in his State of the Union message to the Congress earlier this month.

To meet the increased military requirements for national defense, the Congress in July authorized the largest addition yet made to the plant for production of fissionable materials and weapons. New uranium discoveries and the development of processes for extracting uranium from low-grade sources made it possible to consider an expansion of this magnitude. Construction started promptly, with ground broken in August and September for the new fissionable materials plants. When construction for which funds have been appropriated is complete, the Nation's capital investment in atomic energy will be about $7.5 billion, five times as large as 6 years ago when the Commission assumed its stewardship.

The development of reactors for the output of power made longer forward strides than in any other half-year of the decade. The theory of "breeding" was put under trial at the Reactor Testing Station, and the Materials Testing Reactor also went into operation. Assembly was substantially completed on one prototype reactor for submarine propulsion, and fabrication started on the sea-going version to power the submarine U. S. S. *Nautilus*. Work also began on the prototype of a reactor to power the submarine, U. S. S. *Sea Wolf*. A contract was entered into for developing a reactor to supply power for a large naval vessel such as an aircraft carrier. Work began on a testing facility for prototype nuclear power plants for aircraft.

Highly important for the long pull in the nuclear power field, industrial firms and leaders have evinced a solid and a growing interest in power reactor development. This interest was indicated in part by the increasing number of suggestions that the Atomic Energy Act be revised to encourage further industrial activity. These suggestions raise policy issues as atomic energy development enters

its second decade. The considerations involved are neither few nor simple. Pages could be filled with the main questions of policy and the smaller questions of detail which follow in their train.

The reports from the first round of studies of technical and economic problems of power reactor development made by four industrial teams have been studied. The AEC staff has been instructed to extract the portions of these classified reports which can be declassified and prepare them for issuance. This will help industrial managements and other interested groups to learn more about the nature of the problems inherent in power reactor development. One of the four teams, augmented by 11 associated firms, has entered a joint program of research and development with the AEC. A fifth and new team has begun its survey of reactor technology.

Industry's interest in various phases of the atomic energy program is reflected by the 225 concerns that contacted the AEC's Office of Industrial Development since its establishment last May. The firms were interested in doing research and development for the Commission, starting new businesses based on atomic energy, selling their products to AEC, and getting general and technical information on all aspects of AEC operations.

On the frontiers of nuclear science, the cosmotron at Brookhaven National Laboratory attained energies above 2 billion electron volts and new exploration into nuclear phenomena got under way with this machine. At the same time, the exciting discovery was made that through the application of a new principle, machines capable of producing greater energies could be built at relatively low cost. Plans were developing for an accelerator employing this new method to produce energies up to 100 billion electron volts.

Unclassified detail on the advances made in all phases of the program appears in Part I of this report. Part II presents the condensed annual financial report for the fiscal year 1952. Part III describes the system for assuring safety of the population and guarding against property damage in the conduct of continental atomic weapons tests at the Nevada Proving Ground, and sums up the results of the Nationwide radiation monitoring operation carried on in conjunction with the tests.

Having completed the term of service as a Commissioner which he agreed to undertake when appointed in 1950, T. Keith Glennan resigned November 1 to return to the presidency of Case Institute of Technology.

In the AEC staff, Dr. John C. Bugher was appointed Director of Biology and Medicine succeeding Dr. Shields Warren. Everett L. Hollis resigned as General Counsel and Harold L. Price, his deputy, was appointed Acting General Counsel. Don S. Burrows, formerly

with the staff of the Reconstruction Finance Corporation, was appointed Controller. David P. Herron was named Chief of the Office of Operations Analysis, succeeding Manson Benedict.

A new operations office was opened in San Francisco with John Flaherty formerly of the Chicago Operations Office as manager. The raw materials office at Grand Junction, Colo., was made an operations office with Sheldon P. Wimpfen, formerly of the Washington Raw Materials Division staff, as manager.

Raw Materials

The last half of 1952 saw initial production from two new important sources of uranium—the gold ores of South Africa and the phosphate rock of Florida. The first production plants started off with no major and few minor problems and are now up to scheduled performance.

Foreign production and procurement programs progressed at a satisfactory rate, and plans for expansion and the development of new sources are under way.

Domestic uranium production continued to increase and further increases are scheduled for the coming year. Production and exploration activities on the Colorado Plateau were consolidated in the new operations office established at Grand Junction, Colo., December 1.

Domestic Production

In September, first production of byproduct uranium from phosphoric acid began at the plant of the Blockson Chemical Co. at Joliet, Ill. Additional plants are under construction near Mulberry, Fla., by International Minerals and Chemicals Corp., and by the Virginia-Carolina Chemical Corp.; and at Texas City, Tex., by Texas City Chemicals, Inc. Construction of additional plants for this purpose is under consideration by other producers of phosphate chemicals and plant food products from the phosphate rock in Florida and in several Western States.

The construction of added facilities by a number of uranium processing mills on the Colorado Plateau was completed during the latter part of the year. Further modifications remain to be made at some of the plants. The largest expansion was at the Uravan, Colo., plant of the United States Vanadium Co. where capacity was approximately doubled. Other expansion occurred at the Salt Lake City mill of the Vitro Chemical Co. and at the Grand Junction, Colo., plant of the Climax Uranium Co. Additions to plant capacity at the Vanadium Corporation of America mill at Hite, Utah, are being considered.

The AEC started construction of a pilot plant which will test new processes for extracting uranium from ore. The plant will be located in Grand Junction and operated for the AEC by the American Cyanamid Co.

Construction of the Grants, N. Mex., ore-processing plant by the Anaconda Copper Mining Co. proceeded satisfactorily. Ore is being stockpiled in preparation for the scheduled opening of the plant in late 1953. Another new processing plant is planned at Shiprock, N. Mex., by Kerr-McGee Oil Industries, Inc. This company is arranging for acquisition of the properties of the Navajo Uranium Co., owners of the Shiprock ore-buying depot and sampling plant and of large mineral holdings in the Lukachukai Mountains in northern Arizona, where the bulk of the ore for the plant will be produced.

The new ore-buying depot and sampling plant at Edgemont, S. Dak., commenced buying ore in December and delivery began of ore stockpiled at the mines prior to the opening of the depot. The depot provides a market for the mines in the Black Hills area of South Dakota and for adjacent areas in Wyoming. It was built and is operated for the Commission by the American Smelting & Refining Co.,[1] which also operates the depots at Monticello and Marysvale, Utah, and at Shiprock, N. Mex. The construction of an ore-buying station at Greenriver, Utah, is expected to start early this year.

Oil and Gas Lease Agreement

Following discussion with the Department of Interior, the AEC in December made arrangements for the production of uranium from areas withdrawn for oil and gas leases. Under rulings of the Secretary of the Interior, the issuance of an oil and gas lease on public lands pursuant to the Mineral Leasing Act of 1920, precludes the subsequent filing of mining claims on the same ground during the term of the lease. A lease agreement has been worked out by the Commission which permits uranium miners to produce and sell uranium ore from public lands leased for oil and gas without infringing upon the rights of oil and gas lessees while also qualifying for AEC bonus payments.

Assistance to Ore Producers

Further assistance was given uranium ore producers of the Colorado Plateau in opening up new uranium producing districts. Access road construction, under the Federal Aid Highway Act of 1950 and in cooperation with the state highway agencies, now totals 850 miles,

[1] The Twelfth Semiannual Report erroneously reported the American Cyanamid Co. as the projected operator of the Edgemont plant.

costing about $4,500,000. Further road construction is planned for this year. Bonus payments for initial production of ore by the end of December exceeded $1 million. Over 875 payments have been made to some 160 certified mining properties.

Early this month the Colorado School of Mines Research Foundation submitted a report to the Commission on its study of ore-sampling methods used by various mills on the Colorado Plateau. The study disclosed no intentional irregularities, but various recommendations were made for improving sampling methods.

Foreign Production

Over a period of years, the South African government and mining industry, in cooperation with the United States and United Kingdom, have laid the groundwork for an entirely new industry which recovers uranium as a byproduct from the gold ores of the Witwatersrand. On October 8, the Prime Minister of the Union of South Africa officiated at ceremonies which officially set into operation the first uranium recovery plant for treatment of tailings from the Rand gold mines. The plant was constructed by the West Rand Consolidated Gold Mines Co., Ltd., at Krugersdorp, west of Johannesburg in the Transvaal. Additional plants under construction in the Transvaal are in various stages of completion. Plans are being laid for the erection of several more uranium plants, some of which will be in the Orange Free State.

Canada and Australia

Production of uranium from the Eldorado mine on Great Bear Lake in Canada, where additional mill facilities were recently placed in operation, has been satisfactory. In the Lake Athabaska region of northern Saskatchewan, several ore-bodies are being developed for production, and construction of the first mill unit is well along. Both private and governmental exploration is being carried out in this area with increasing intensity.

Progress is being made toward bringing the Radium Hill and Rum Jungle ore deposits in Australia into production. Plans include the construction in South Australia of a concentrator to handle the output of Radium Hill.

Domestic Exploration

The Commission's domestic exploration program, consisting principally of geological investigations, airborne radiometric surveys, and exploratory drilling, has expanded rapidly during the past several years and will be further expanded to meet the needs of the increased

production program. The exploration programs are carried out by the Commission's geological staff, by the United States Geological Survey and the United States Bureau of Mines under contract with the Commission, and by private contractors.

Important aspects of the exploration effort are the development of new and improved techniques and instruments, geological guides, and the dissemination of information designed to promote greater participation in the search for uranium by mining companies and prospectors. The Commission, in conjunction with the Geological Survey, has been largely responsible for the development of instruments and techniques used in airborne surveys.

Although the Colorado Plateau remains the most favorable for discovery of new domestic ore-bodies, broad field reconnaissance has revealed other areas of potential uranium ore production. Principal among these is the area adjacent to, and southeast of the Black Hills of South Dakota, where sufficient ore has been found and produced to warrant the establishment of an ore-buying depot. The ore occurrences in this area bear a similarity to those of the Colorado Plateau. In nearby areas in Wyoming, investigations by the AEC and United States Geological Survey are disclosing minor sources of uranium ore.

Cooperation of Federal Agencies

Since the inception of the program, the United States Geological Survey has carried out the major portion of the basic geological and mineralogical studies essential to the domestic exploration program. The Survey is the best equipped by experience and facilities to do this job, and is able to draw on a large reservoir of scientific personnel. It does about half of the physical exploration for the Commission in the Colorado Plateau area and also conducts reconnaissance surveys for uranium in the rest of the United States and Alaska. The Geological Survey operates for the Commission a large specially equipped laboratory in Washington, D. C., which offers a free examination service to uranium prospectors, and at which the USGS carries on fundamental investigations in geology and mineralogy and other special work.

The United States Bureau of Mines also maintains at various field stations a free sample examination service for uranium prospectors, and has conducted the major portion of the Commission's domestic exploration for monazite, the ore of thorium. The Defense Minerals Exploration Administration has furnished valuable assistance to uranium miners by providing funds for investigating uranium prospects.

Private Exploration

In addition to the efforts of the AEC and Geological Survey, private interests are continuing to support intensive exploration programs. Exploration programs are being conducted by the Anaconda Copper Mining Co., working in the Grants, New Mexico, area and the nearby Laguna Indian Reservation; by the Homestake Mining Co., in the South Dakota Black Hills and adjacent area in Wyoming; and by the Kerr-McGee Oil Industries Inc., in the Lukachukai Mountains of northern Arizona. Older participants in the uranium procurement program, such as United States Vanadium Co., Vanadium Corporation of America, and the Climax Uranium Co., who produce substantial quantities of uranium from their properties on the Colorado Plateau, continued extensive exploration activities. There was also widespread prospecting by individuals.

Underground exploration continues in the Colorado Front Range, where minor quantities of pitchblende were produced many years ago. Numerous mines are being investigated and several modest exploration programs are under day. Other areas of underground exploration are the Boulder Batholith section of Montana, from which several minor ore shipments have been made, and the Couer d'Alene district of Idaho. In the Marysvale, Utah area, where Vanadium Corporation of America has undertaken a major underground exploration and development program, substantial amounts of ore continue to be produced.

Airborne Exploration

During 1952 airborne exploration was carried out by the Commission and the USGS on an increasing scale. Private mining interests, including Anaconda, Homestake, Kerr-McGee, and the Hunt Oil Co., have also done considerable airborne exploration. In all, some 625 hours of flying was done by Government planes in the Black Hills area of South Dakota, in the Big Horn and Powder River Basins of Wyoming, and on the Colorado Plateau. Field reconnaissance parties of the AEC and the Geological Survey have followed up the anomalies revealed by these airborne surveys. Further airborne reconnaissance is planned for 1953.

Drilling

During the last half of 1952 nearly 600,000 feet of drilling was accomplished by the AEC, and by the Geological Survey and Bureau of Mines under contract to the Commission. Private mining interests accomplished an estimated additional 300,000 feet of drilling. Over

1,100,000 feet were drilled in 1952 by the Federal agencies as compared to 765,000 feet in 1951. Drilling in 1953 by the AEC, USGS, and USBM is planned at about 1,350,000 feet. Private drilling is estimated at the rate of some 725,000 feet, of which a predicted 225,000 feet may be accomplished with funds provided by Defense Minerals Exploration Administration loans. Among the drilling programs under way is one to determine the reserves of uranium-bearing lignites in certain areas of South Dakota, and an investigation of the continuity of thickness and grade of the Chattanooga shale in Tennessee.

Aids to Prospectors

In conjunction with the extensive airborne radioactivity surveys being carried out by the Commission, information concerning the locations of surface areas of unusual radioactivity disclosed by aircraft-borne detection instruments are being made public in the form of index maps. These maps are posted regularly at a number of places in the United States to assist prospectors in the search for uranium.[2] The existence of areas of anomalous radioactivity, i. e., departure from normal as calculated for a particular place, does not necessarily indicate the presence of uranium.

The Commission has continued to file geological and mineralogical reports on some results of domestic exploration by the AEC and Geological Survey at a number of depository libraries.[3] The sample examination service, where prospectors may submit their samples for examination for radioactive constituents without charge, is maintained at a number of laboratories in cooperation with the Geological Survey

[2] These maps are posted on the 15th day of each month (or the first succeeding working day if the 15th falls on a Saturday, Sunday, or a Federal holiday) at the following offices: New York Raw Materials Office, AEC, New York, N. Y.; Denver Exploration Branch, AEC, Denver Federal Center, Denver, Colo.; Hot Springs sub-office, AEC, Hot Springs, S. Dak.; U. S. Bureau of Mines Office, Rapid City, S. Dak.; U. S. Geological Survey Office, Custer, S. Dak.; U. S. Geological Survey Office, 305 Federal Bldg., Casper, Wyo.; U. S. Geological Survey Office, 1214 Bighorn Ave., Worland, Wyo.; Grand Junction Operations Office, AEC, Grand Junction, Colo.; Grants sub-office, AEC, Grants, N. Mex.: Salt Lake Exploration Branch, AEC, 222 So. West Temple St., Salt Lake City, Utah; Richfield sub-office, AEC, Richfield, Utah; and Butte sub-office, AEC, Butte, Mont.

[3] In addition to the depository libraries listed on p. 195 these reports may be examined at the Atomic Energy Commission Library, 1901 Constitution Ave., NW., Washington 25, D. C.; Division of Raw Materials, 70 Columbus Ave., New York, N. Y.; Division of Raw Materials, Denver Exploration Branch, Room 127–129, Building 2B, Denver Federal Center, Denver, Colo.; Division of Raw Materials, Salt Lake City Exploration Branch, 222 So. West Temple St., Salt Lake City, Utah; Division of Raw Materials, Grand Junction Operations Office, Grand Junction, Colo.; at U. S. Geological Survey Offices: U. S. Geological Survey, Room 1033 (Library), General Services Building, Washington, D. C.; Information Office, Room 468, New Customhouse, Denver, Colo.; Library and Distribution Office, Room 504, Federal Building, Salt Lake City, Utah; University of Arizona, Room 10, Mines Building, Tucson, Ariz.

and Bureau of Mines.[4] An illustrated booklet, "Prospecting for Uranium" is available from the Superintendent of Documents, United States Government Printing Office, Washington 25, D. C., for 45 cents a copy. Over 90,000 copies of this booklet have been sold to date.

Research and Process Development

The Commission continues to sponsor research in the field of raw materials directed toward: (1) development of processes for treating the various types of ore encountered on the Colorado Plateau and in other areas; (2) improvement of processes in use at the mills on the Colorado Plateau; (3) development of economic and efficient means of extracting uranium from low-grade sources; and (4) development of processes for treating ores from foreign sources. In addition fundamental studies continued in an effort to find more efficient and more economical processes which might be applied to all uranium ores. A list of the unclassified research contracts in the raw materials field is included in Appendix 5.

A substantial portion of the program has been centered in the research laboratories and pilot plants of industrial contractors. Development work and on-site plant assistance, aimed at developing domestic and foreign sources, is carried on by personnel of a Commission-owned Raw Materials Development Laboratory originally set up in the Watertown, Mass., Arsenal, but housed since December in a newly erected Commission-owned building in Winchester, Mass. This laboratory is operated by the American Cyanamid Co.

Production

The production of fissionable materials continued as scheduled during the last 6 months of 1952. Following Presidential approval in July of a supplemental appropriation for the expansion of atomic energy production capacity, work got under way on a new uranium 235 plant in Ohio, on additions to the uranium 235 plants at Oak Ridge, Tenn., and at Paducah, Ky., and on additional plutonium capacity at Hanford, Wash.

Expansion of Production Facilities

The major new facility in the expansion program is a gaseous diffusion plant which will cost an estimated $1.2 billion. In August the

[4] A list of these laboratories was published in the AEC Eleventh Semiannual Report to Congress, page 8, January 1952, available from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., 50 cents.

Commission announced selection of a site for this plant on the Scioto River in Pike County, Ohio, about 22 miles north of Portsmouth. The selection was made after considering several alternate sites in the Ohio River Valley, an area where large amounts of water are available and where large quantities of electric power can be obtained at reasonable costs.

Construction of the Portsmouth plant started in November by Peter Kiewit Son's Co., of Omaha, Nebr. It will be operated by Goodyear Atomic Corp., a subsidiary of Goodyear Tire and Rubber Co., of Akron, Ohio. These two major contractors, new to the atomic energy program, were selected after consideration of more than a score of major construction and industrial firms.

Another contractor not previously in the atomic energy program, Kaiser Engineers Div. of the Henry J. Kaiser Co., of Oakland, Calif., was selected to construct the additional production facilities at Hanford. The selection of these firms is in keeping with the Commission's policy of encouraging the widest possible industrial participation in its program. In January the Commission contracted with the Blaw-Knox Co., of Pittsburgh, Pa., to build a chemical processing plant at Hanford.

Contracts for the construction of the additional gaseous diffusion capacity at Oak Ridge and Paducah were awarded to contractors who are currently working on the sites. These selections were made after an analysis indicated that substantial savings in time and total construction costs would be realized by using contractor organizations already on the site.

F. H. McGraw and Co., of Hartford, Conn., is the general contractor for the $459 million expansion at Paducah, and the Maxon Construction Co., of Dayton, Ohio, is the contractor for the $464 million addition to the Oak Ridge plant.

Electric Power

In October the Commission contracted with the Ohio Valley Electric Corp., a group of 15 private power companies, to supply the 1,800,000 kilowatts of electric power required for the operation of the Portsmouth gaseous diffusion plant. The corporation will build and operate two steam generating plants, one to be located at Gallipolis, Ohio, and the other at Madison, Ind. Initial construction of these plants got under way in October. The two generating plants supplying this power will have a combined installed capacity of 2,200,000 kilowatts and will use about 7,500,000 tons of coal a year.

Of the additional power required for the expansion at Paducah, 235,000 kilowatts will be supplied by Electric Energy, Inc., a group

of five private utility firms, and 705,000 kilowatts by the Tennessee Valley Authority. To supply this load, Electric Energy will expand its Joppa, Ill., plant, now under construction, by adding two generators. TVA, which will also provide the 950,000 kilowatts for the expansion at Oak Ridge, will add capacity to its system at various locations to meet these demands.

Savannah River and Paducah Construction

Construction proceeded on the plants at Savannah River, S. C., and on the gaseous diffusion plant at Paducah, but E. I. du Pont de Nemours & Co., and F. H. McGraw and Co., who are building these plants, were not able to maintain scheduled construction progress due to delays in the delivery of supplies and equipment. In addition, at the Paducah plant, a large amount of time was lost through unauthorized work stoppages (see also p. 52).

Construction and Supply

The Nation's capital investment in atomic energy plant facilities as of June 30, 1952 was about $3.5 billion. The supplemental appropriation by the Congress of about $3 billion, together with regular appropriations through the 1953 fiscal year, brought total authorized expenditures for construction to about $4 billion. This has initiated the greatest single construction program so far undertaken in the atomic energy enterprise.

During the latter half of 1952, construction of new facilities overlapped work on an expansion program previously authorized by the Congress so that costs for plant and equipment incurred from June through November 1952 averaged about $90 million a month. During this period AEC construction costs accounted for approximately 5 percent of total United States construction costs. These costs are expected to increase through 1953 to a peak of about $530 million during the first quarter of 1954 and will then approximate 6.5 percent of total United States construction costs.

Contractor Employment

Average monthly contractor construction employment for all AEC administered construction projects decreased from 74,000 during July to about 66,500 during November. Construction employment is expected to continue at a fairly high level, however, and will gradually increase again until the peak of the program is reached in early 1954.

Design Criteria

Development of criteria to provide guides to insure uniformity, simplicity, and economy in the engineering design of AEC service and allied facilities continued during the last 6 months. Sixteen chapters have been issued covering architectural, structural, heating, and ventilating design, and design considerations for administration buildings, laboratories, warehouses, utilities, and other service facilities.

Small Business Participation

The AEC small business policy, consistent with the expressed intent of the Congress, requires that a fair proportion of its total supplies and services shall be procured from small business concerns. This general statement of policy is the foundation for specific AEC small business policies which were codified in an administrative bulletin during the last 6 months. Each policy deals with a specific aspect of small business participation in AEC procurement. Both AEC and its cost-type contractors have employees assigned as small business representatives to carry out the program to suit the circumstances prevailing in each area.

From July 1, 1951, to September 30, 1952, AEC contract awards totaled approximately $2.1 billion. Direct contracts placed with small business amounted to $57.9 million, 2.7 percent of the total. However, since most construction programs and the operation of major facilities are carried out by large, cost-type contractors, it is their award of subcontracts that gives a truer picture of small business participation in the atomic energy program. Subcontract figures for AEC cost-type contractors during the same period, July 1, 1951 to September 30, 1952, show awards amounting to $877 million. Small business concerns were awarded $308 million, or 35.1 percent of the total.

Priorities

During the last 6 months special attention was given to compiling the requirements for products and services essential to AEC programs and to analyzing the probable impact of these demands upon the national economy. The results of these studies were made available to the National Production Authority, the Defense Production Administration, the Defense Electric Power Administration, and the other responsible agencies.

Under the national priorities system, the AEC functions as a claimant agency with respect to allocations of steel, copper, and aluminum

required for its construction and operating programs. The quantities of materials allotted to the AEC by the Defense Production Administration were adequate to meet all program needs. Delivery problems, however, resulted in some delays in construction. Delays resulting from the steel strike during June and July were reduced to some extent by NPA actions which gave preference to AEC and Department of Defense orders for steel at mills not on strike and upon resumption of steel production.

NPA has extended special help in expediting the use of priority measures for the Savannah River project and certain urgent programs at Oak Ridge.

V-Loans

The Commission continued its program of guaranteeing V-loans. During the last 6 months, AEC guaranteed credit totaling approximately $900,000 to four small business concerns—three subcontractors and one prime contractor.

Licensing Controls

Effective December 1, 1952, the AEC regulation governing facilities for the production of fissionable material was amended to exclude X-ray generators (see Appendix 6). This action was taken following a Commission determination that X-ray generators should not be considered "facilities" within the meaning of Section 4 (e) of the Atomic Energy Act.

On November 1, 1952, the administration of the regulation governing source materials was transferred from the New York Operations Office to Washington, thus consolidating all functions dealing with licensing of materials and equipment.

Transportation

Savings in transportation costs which should approximate $2.2 million per year were accomplished through negotiations with rail carrier associations for reductions in coal freight rates, a storage-in-transit privilege on steel plates, and a 35 percent reduction on high-explosive freight rates.

Military Application

Production of atomic weapons continued at the rate authorized by the President for calendar year 1952. Research continued to be di-

rected at improvement of current weapon models and development of new models to meet the requirements of the Armed Forces.

In October, at Aberdeen Proving Ground, Maryland, the Army publicly demonstrated its 280 mm. cannon which is capable of firing an atomic projectile. The projectile was designed and developed by joint efforts of the Army and the Commission's Los Alamos Scientific Laboratory and Sandia Laboratory in New Mexico.

Construction of new facilities proceeded satisfactorily. The Pantex Ordnance Plant, Amarillo, Tex., was completed, and construction of a facility at Rocky Flats, near Denver, Colo., was largely completed. Necessary basic construction at the Nevada Proving Ground totaling $8.6 million was completed; it includes living and messing facilities, offices, warehouses, roads, control point structures for delicate instrumentation, and blast resistant structures for instruments near the firing areas. The Commission's projects at Burlington, Iowa, and Kansas City, Mo., were established as field offices under the Santa Fe Operations Office.

Test Activities

Additional experimental detonations were completed during November at Eniwetok Atoll in the Pacific. This undertaking, Operation IVY, was conducted by Joint Task Force 132 composed of personnel of the Commission, the Army, the Navy, and the Air Force. The Commission, through its contractors, was responsible for the test devices and the Department of Defense performed the supporting services. Both organizations participated in the scientific measurements. The text of the Commission announcement of completion of the IVY test series, issued November 16, 1952, follows:

> Joint Task Force 132, operating for the Department of Defense and the United States Atomic Energy Commission, has concluded the third series of weapons development tests at Eniwetok Atoll in the Marshall Islands. Like the Greenhouse series, 1951, it was designed to further the development of various types of weapons. In furtherance of the President's announcement of January 31, 1950, the test program included experiments contributing to thermonuclear weapons research.
>
> Scientific executives for the tests have expressed satisfaction with the results. The leaders and members of the military and civilian components of the Task Force have accomplished a remarkable feat of precision in planning and operations and have the commendation of the Department of Defense and the Atomic Energy Commission.

In the presence of threats to the peace of the world and in the absence of effective and enforceable arrangements for the control of armaments, the United States Government must continue its studies looking toward the development of these vast energies for the defense of the free world. At the same time, this Government is pushing with wide and growing success its studies directed toward utilizing these energies for the productive purposes of mankind.

Further tests at the Nevada Proving Ground in the spring of 1953 are planned. Construction forces are currently engaged in routine preparations for these tests. This work is largely preparing test measurement devices, and erecting towers and other expendable structures.

Community Operations

Adequate housing and community facilities and services for workers in the atomic energy program are essential if the AEC is to fulfill its responsibilities for the production of fissionable materials and atomic weapons. During the last 6 months, the Commission worked with the appropriate Federal and local agencies to assure the provision of housing and community facilities and services required for the Portsmouth plant and for the expansion of existing communities.

Housing

Oak Ridge was included in a critical defense housing area in October, and 550 housing units have been programed by the Housing and Home Finance Agency. The AEC is planning to provide schools and necessary community facilities to serve the additional employees who will live at Oak Ridge. Also, the AEC has prepared preliminary plans for a 500-unit housing project at Oak Ridge to be provided under Title VIII of the National Housing Act.

Two privately financed 500-unit Title VIII housing projects are under way at Richland; some of the units were occupied this month. At least one additional 500-unit project is needed immediately for the employees required by the expansion at Hanford, and the need for additional housing will be considered as the program advances. Plans have been made for enlarging Richland school and community facilities.

At the end of December, 3,000 of the 3,460 houses programed as rental and sales units by the HHFA at Savannah River had been

completed, and 2,600 were occupied. The last of the 4,000 trailer accommodations for construction workers with families was completed during October and were about 94 percent occupied at the end of the year.

On October 15, the dormitory accommodations for 3,000 men at Allendale and Williston, S. C., owned and operated by the Lyles and Lang Construction Co. on a revenue-guaranteed basis, were closed. On December 15, the AEC approved the cancellation of the contract for the 1,500 dormitory accommodations at Barnwell, S. C., and they were closed January 11. The costs of terminating these contracts are now being determined.

The dormitories were closed because there was not enough demand for this type of accommodation. The peak construction force was about 7,000 men less than had been anticipated, principally because of delays in delivery of materials. Furthermore, of the force on the job, only about 20 percent were single, or without their families, as compared with about 40 percent at other national defense construction projects. Also, the number of rooms and temporary accommodations provided in surrounding towns for single men was much greater than past experience elsewhere indicated would be provided.

Portsmouth Area Planning

At the request of AEC, the Chillicothe-Portsmouth area was designated a critical defense housing area, and in October the HHFA announced an initial program of 1,000 permanent family type housing units for operating personnel. The HHFA also agreed to provide temporary family-type housing accommodations for in-migrant construction workers. Four hundred such units were programed in October for immediate construction. If necessary, the AEC will provide housing accommodations for construction workers without families.

Defense Area Coordinator

At the request of the Commission, the Office of Defense Mobilization appointed a coordinator for the activities of various Federal agencies concerned with housing and community facilities and services in the Portsmouth area. The coordinator also serves as a central contact for both public and private local groups seeking information on Federal programs and activities in the area. The AEC plans to rely upon the authority under Public Law 139, Eighty-second Congress, and funds appropriated pursuant thereto, to assist with provision of community facilities and services in the Portsmouth area.

Los Alamos Community Needs

The resident community population of Los Alamos now approximates 13,000, approaching the maximum for which community facilities have been planned. It is now expected that the program requirements of Los Alamos Scientific Laboratory will result in a total resident community population of 14,500 by June 1954. A limited increase in housing and school classroom space will be required to accommodate the increased population. Most of the other community services at Los Alamos are sufficient to care for this increase.

Rent Control

The Office of Rent Stabilization in the Savannah River area ordered substantial reductions in the rental rates of dormitories and trailers that are privately owned and operated under revenue-guaranteed contracts with du Pont, the AEC contractor building the Savannah River plant. An appeal on the rollback order for the dormitories was filed by the AEC with the central office of the ORS in Washington on June 2, 1952, and a similar appeal on the trailers was filed July 14. No decision has been reached on these appeals.

In November the Richland Office of Rent Stabilization approved a 10 percent increase in the rents for family dwelling units at Richland, and a 10 percent increase in dormitory rentals with a reduction in maid service. The new rates were effective January 1.

Self-Government and Property Ownership

With a view to recommending a program for the future operation of the communities of Oak Ridge and Richland, the AEC has been reviewing the report of the Panel on Community Operations (see Appendix 2), the reactions of the residents of these communities as reported by a Bureau of the Census survey, and the views of the managers of operations and the prime contractors at these installations. The comments of the Federal Security Agency have been requested on the panel's recommendations that operating subsidies be granted the schools and hospitals at Oak Ridge and Richland by the United States Office of Education and the United States Public Health Service.

Reactor Development

Progress was made during the last 6 months in the development of nuclear reactors for power, production of fissionable materials, and

research. Work was started to develop a nuclear power plant for a large surface ship, preparation of the site for an aircraft reactor testing facility began, and some of the unique problems involved in opening the construction and operation of power reactors to private investment were identified and examined. A large reactor designed for testing materials was put into service.

The Army Corps of Engineers and the AEC began a study to determine what Army requirements might be met by portable or stationary nuclear power plants.

A new chemical processing plant for recovering uranium from irradiated fuel components of reactors was completed at the National Reactor Testing Station in Idaho, and as the year ended, the plant was being tested by the operating contractor, American Cyanamid Co.

Research and Testing Reactors

The new Materials Testing Reactor, completed last spring at the Testing Station, was put into service in August by the operating contractor, Phillips Petroleum Co. The reactor is now providing irradiation for more than a score of tests in support of the development of various types of reactors by AEC laboratories and contractors. Many more tests are scheduled. A hot cell, to facilitate work with radioactive equipment and samples, is to be built.

Experimental Breeder Reactor

Operation of the Experimental Breeder Reactor, also at the Testing Station, to gather data on the possibility of "breeding" was continued by the University of Chicago through the Argonne National Laboratory. Breeding, which means the production of more nuclear fuel than is consumed, is theoretically possible. Knowledge and experience being gained in the operation of this first small, experimental reactor power plant system will be applicable eventually to larger units.

Homogeneous Reactor Experiment

Since the Homogeneous Reactor at the Oak Ridge National Laboratory reached criticality last spring, it has been operated at low power in experiments to determine nuclear characteristics. Inasmuch as this is the first circulating fuel reactor, these data are especially important.

Though it is a pilot reactor, the HRE is designed for much higher power than the homogeneous "water boiler" research reactors which operate at power levels up to about 50 kw of heat. The Oak Ridge Laboratory is operated by Carbide and Carbon Chemicals Co., a division of Union Carbide and Carbon Corp.

New "Water Boiler" Reactors

In August, North American Aviation, Inc., Downey, Calif., announced that it is using a small water boiler type reactor as a neutron source in reactor physics studies for the AEC. The power is less than one watt. The fuel solution is contained in a one-foot diameter stainless steel sphere as in the water boiler reactor at Los Alamos and the Raleigh Research Reactor being built at North Carolina State College (see p. 37).

Naval Reactors

In July the AEC's contract with Westinghouse Electric Corp. was modified to cover development of a nuclear power plant suitable for the propulsion of large naval surface vessels such as aircraft carriers. Work has started on this project. In November, Westinghouse subcontracted with Newport News Shipbuilding and Dry Dock Co., Newport News, Va., for the design and building of the machinery for a land-based prototype, analogous to the work of the Electric Boat Division of General Dynamics Corp., on prototypes of nuclear submarine power plants. The Navy's Bureau of Ships is participating fully with the AEC in this and the other naval projects.

Submarine Thermal Reactors

Assembly of the land-based prototype of the Submarine Thermal Reactor and power plant was substantially completed during the last 6 months at the Reactor Testing Station. Also, work got under way on the second Submarine Thermal Reactor power plant which is for the USS *Nautilus*, whose keel was laid in June by Electric Boat. In work on the land-based prototype, Westinghouse, the contractor, has had the assistance of hundreds of subcontractors and suppliers in 23 States. The Argonne National Laboratory has been a partner with Westinghouse on both the prototype and sea-going reactor power plants.

Submarine Intermediate Reactors

The General Electric Co., through the Knolls Atomic Power Laboratory at Schenectady, and through subcontractors, began fabrication of the land-based prototype of the Submarine Intermediate Reactor and its power plant. Construction at West Milton, N. Y., 18 miles north of Schenectady, of the portion of the submarine hull in which the prototype nuclear power plant will be assembled and of the 225-foot diameter spherical steel building to house the hull and reactor complex was well advanced at the end of the year. The sphere's 5,400,000 cubic feet of "free space" is intended to confine hazardous material should all controls fail.

In July the Navy announced that construction of a second nuclear submarine, the USS *Sea Wolf*, to be powered by the second model of the intermediate reactor, had been assigned to Electric Boat. General Electric will supply the reactor portion of the power plant under contract with AEC and the major steam propulsion machinery under Navy contract.

Aircraft Reactors

In July the Commission and the Air Force agreed upon establishing at the Reactor Testing Station a $33 million ground test facility for prototype nuclear aircraft power plants. After consideration of proposals by several architect-engineer firms, the AEC chose the Parsons Co., of Los Angeles, to do the design work under a negotiated, fixed-price contract. Meteorological and geologic studies have been completed, and at the end of December, roads and power lines were being built to the site and the architect-engineering work was well advanced.

Meanwhile, at Lockland, Ohio, the General Electric Co.'s Aircraft Gas Turbine Division progressed on development of a power plant and propulsion units for nuclear aircraft. Work was started for two special test facilities involving small reactors. Investigations by the Oak Ridge National Laboratory on aircraft propulsion yielded promising results.

Administration of the Nation's aircraft reactor program was centralized with the appointment August 15 of Brig. Gen. Donald J. Keirn as Chief of the Aircraft Reactors Branch, Division of Reactor Development, of the AEC. General Keirn also serves as Assistant for Aircraft Nuclear Propulsion to the Commanding General, Air Research and Development Command, USAF, Baltimore, and as Assistant for Aircraft Nuclear Propulsion to the Director of Research

and Development, Deputy Chief of Staff Development, Headquarters, USAF.

Industrial Participation

Reports on dual-purpose reactors by the first four industrial teams[5] which surveyed reactor technology were studied by the Commission during the latter part of 1952. The reports indicate that large reactors might be built in a few years which could furnish economic power to the systems of the utilities in the groups if weapon-grade plutonium were produced and bought by AEC at Hanford costs. Each of the groups found a different approach attractive for this purpose.

The Dow-Detroit Edison group, the first to report on the technology survey, started an additional year of research and development last summer. In October the Commission approved the association of 11 utility and industrial concerns with Dow-Detroit Edison. They are: Cincinnati Gas and Electric Co., Cleveland Electric Illuminating Co., Consolidated Edison Co. of New York, Consumers Power Co., General Public Utilities Corp., New England Electric System, Philadelphia Electric Co., Public Service Electric and Gas Co. of New Jersey, Toledo Edison Co., Vitro Corporation of America, and Wisconsin Electric Power Co. Other companies may affiliate with this or other teams. The other three groups are continuing their studies.

In September the Commission approved a year's survey of reactor technology by a fifth team, Pioneer Service and Engineering Co. of Chicago, and Foster Wheeler Corp. of New York.

The anticipated large-scale participation by industry raises unique policy and contractual problems on such matters as ownership of plants, licensing and use of fissionable materials, secrecy, patent rights, public safety, and liability in case of disaster. Such broad questions require that decisions be reached in collaboration with other Government agencies.

Zirconium Production

In September, Carborundum Metals Co., Inc., a subsidiary of the Carborundum Co., Niagara Falls, N. Y., began construction of a privately financed $2,443,000 plant at Akron, N. Y., near Buffalo, for the production of zirconium and hafnium metals. The AEC has contracted to buy 150,000 pounds of sponge metal each year for 5 years.

[5] Monsanto Chemical Co. and Union Electric Co., both of St. Louis; Detroit Edison Co., of Detroit, and Dow Chemical Co., of Midland Mich.; Commonwealth Edison Co. and Public Service Co. of Northern Ill., both of Chicago; and Bechtel Corp. and Pacific Gas & Electric Co., both of San Francisco.

Purchase will be made on a fixed-price basis. Similar steps are being taken for the production of other special materials and reactor components. Substantial savings are expected by buying these products from industry.

Fission Product Investigations

Eight universities, three industrial firms, and Brookhaven National Laboratory now are conducting studies to develop uses for fission products, the highly radioactive wastes of nuclear reactors. Artificial sources of radiation in the form of cobalt 60 have been furnished to six universities and colleges—Michigan, Columbia, Stanford, California, Yale, and Rensselaer Polytechnic Institute. These artificial sources, which range from 500 curies to 10 kilocuries, are for use until fission product sources now being developed become available. During the period of this report, information was acquired on the possible use of fission product radiation to sterilize food and encourage chemical reactions. Work was also done to improve certain physical properties of strontium 90, a source of beta radiation, so that it will not flake.

Protecting Workers and Environment

Studies continued on the hazards incident to the operation of reactors to protect the workers and the people living near these installations.

Hazards that might grow out of reactors of new design are guarded against with the advice of the Reactor Safeguard Committee (see Appendix 2 for membership). This committee has met 3 times since July 1 and has given technical comment on hazard reports submitted by organizations designing and contemplating operation of reactors for the AEC.

Wahluke Slope

In 1951 an Industrial Committee on Reactor Location Problems (see Appendix 2 for membership) was appointed by the Commission to advise on establishing safety zones around atomic energy plants. The committee, composed largely of representatives of industries which have solved the problems of controlling operating hazards, reviews the technical and scientific data on reactor hazards developed by the Reactor Safeguard Committee and applies industrial evaluations to the location of reactors.

The Reactor Location Committee made a detailed study of the nature of hazard to the surrounding area in the event of catastrophe at

Hanford. The recommendations submitted by the committee formed the basis for the Commission's decision, announced January 8, to release restrictions on some 87,000 acres of land in the Wahluke Slope across the Columbia River from the Hanford production area.

The committee found that there is no risk of hazard in the so-called secondary zone of the Slope resulting from normal operation of the Hanford reactors or chemical processing plant. There is, however, risk of hazard to the Slope and for many miles beyond in the event that a major accident or disaster at the Hanford plant should put one or more of the reactors out of control. The chance of such a catastrophe is small. Automatic and manual safety devices are installed to shut down the reaction in each pile if it starts to go out of control; new devices are constantly being added. "There always remains the small chance, however," the Commission's statement on releasing part of the Slope acreage noted, "that all of these safety devices might fail simultaneously, or be put out of commission simultaneously by a natural disaster such as an earthquake, or by such human action as enemy attack and sabotage."

Though this risk is small, it exists. The consequences if it should occur are more fully described in the Commission's statement (see Appendix 10). The statement also outlines the actions the Commission has authorized the Hanford staff to take in order to acquaint potential settlers with the nature of the hazard and to assist in organizing and operating warning and evacuation systems. The statement points out that the considerations which apply at Hanford are not the same as those affecting other reactor installations, since the Hanford reactors are unique in design, construction, and operation. Potential hazards in case of catastrophe at other reactor locations are not so great.

In addition to withdrawing restrictions on the 87,000 acres, the Commission:

(*a*) Withdrew its objections to the construction across the Slope, including the control zone, of such roads, railways, canals, and power lines as may be required for the development of the Columbia River Basin, subject to whatever restrictions may be imposed for security or safety reasons;

(*b*) Stated that the area of the Slope known as the control zone is being made a permanent part of the Hanford Works reservation from which residents will permanently be excluded;

(*c*) Stated that for safety reasons no towns or cities should be established within 25 miles of the Hanford reactor area. Hanford reactors are unique in design and construction;

(*d*) Authorized the AEC Hanford Operations Office to establish a system for warning Wahluke Slope residents in the event of disaster and to encourage and assist in the development of an adequate evacuation plan for farm families which may settle on the newly released lands;

(*e*) Authorized the Hanford Operations Office to undertake an intensive public educational campaign to acquaint persons residing within an area where risk may exist with the nature of the hazard inherent in the plant's operation.

The lands released for settlement by the Commission comprise approximately 62,500 acres at the east end of the Slope including 23,000 acres in the Potholes Area, and approximately 24,500 at the extreme west end. The newly released acreages include an area east of the Slope which can be irrigated from the Potholes Canal. It is estimated that the Commission's action will permit the Reclamation Bureau to consider the irrigation of about 40,000 acres. The Bureau informed the Commission that immediate consideration will be given to engineering, agricultural and economic factors to determine the feasibility of bringing irrigation waters to the released areas.

Acquisition of acreage in the control zone which contains 85,500 acres is being completed.

The secondary zone, which has been reduced from 175,000 acres to 88,500 acres by the Commission's action, will remain under controls prohibiting irrigation. Total acreage over which safety restrictions will apply is 174,000 compared with the 261,000 previously withheld from public use.

Environmental Investigations

The United States Weather Bureau and the United States Geological Survey continued their studies of potential and existing reactor locations and other AEC plant sites to acquire information on the availability of water, the handling and disposal of wastes, and the ways in which the environment affects plant location, design, and operation. A Mohawk River Advisory Committee, representing the AEC, General Electric Co., and New York State and local health officials, was established and held its first meeting at the Knolls Laboratory.

Investigation continued on the properties of natural earth and rock materials as they may be related to disposal of radioactive wastes. A report on the petrography and mineralogy of earth materials at Los Alamos was completed for AEC by the Lovelace Foundation of Albuquerque, N. Mex.

At New York University, construction was essentially completed

on a full-scale wind tunnel which will be used to determine the feasibility of reproducing meterological phenomena. An attempt to duplicate data recorded by the meterological towers at Brookhaven is under way. By simulating the atmosphere and land around the model of a proposed plant, it may be possible to develop in the laboratory improved methods of disposing of radioactive gases.

A group at Harvard collected data on the concentration of radioactivity in water supply reservoirs and streams in Massachusetts following the spring 1952 Nevada weapons tests. These data will be collected as future tests are conducted to indicate the fate of radioactive materials that might be deposited following a reactor disaster or an atomic bomb explosion (see also Part III).

Low-Level Liquid Wastes

Work progressed at a number of laboratories to determine the feasibility of adapting conventional sewage and industrial waste treatment methods to the treatment of liquid wastes of low radioactivity. Treating these wastes will be considerably cheapened if conventional equipment can be used. At New York University, where the trickling filter process is being investigated, results thus far show that its operation is not affected by the special detergents used to launder contaminated clothing. NYU is conducting tests of the efficiency of this process using actual wastes from the Knolls Laboratory.

The first full-scale trickling filter plant, which will handle both domestic sewage and radioactive laundry wastes, is being built at the Reactor Testing Station. It is expected to be in operation early this year.

Studies of other low-cost methods of treating these low-level liquid wastes continued at Texas, Illinois, California, and Johns Hopkins universities. Johns Hopkins also began study of the susceptibility to radioactive contamination of various types of fabrics that might be used for laboratory clothing, and methods of decontaminating them.

Handling Solid Combustible Wastes

A full-scale incinerator, which can burn 50 pounds of solid wastes per hour, was completed by the Bureau of Mines at its Central Experiment Station in Pittsburgh. Tests are under way to compare data with the results of pilot plant operation. Such things as contaminated clothing, wiping rags, and lumber are concentrated by burning to facilitate their disposal. A problem is to remove particles from the smoke because of their radioactivity and to handle the ashes so that they do not become a source of contamination.

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The Bureau of Mines has also given valuable consulting service on incinerator problems at a number of AEC installations. Several universities and hospitals are considering the use of a unit having a capacity of 10 pounds per hour, the size of the pilot-plant incinerator.

Johns Hopkins completed laboratory studies on the results of burning radioactivity-contaminated materials in conventional institutional incinerators. It was found that while approximately 90 percent of phosphorus 32 and strontium 89 remain in the ash, about 80 percent of iodine 131 is released through the stack. However, because the level of radioactivity that can be handled by conventional incinerators is quite low, the release of even 80 percent of the radioiodine would not create an atmospheric problem.

Air Cleaning

A successful full-scale paper mill run of a new, high-efficiency glass fiber and asbestos filter medium was made by Arthur D. Little, Inc., at the mill of the Riegel Paper Co. Although additional full-scale runs will be required to work out details of production, enough work has been done to indicate that commercial manufacture is feasible. As with other filter development work, information on this high-temperature, acid-resistant air filter will be turned over to prospective commercial manufacturers. One use for the filter in the atomic energy industry will be in exhaust gas streams from laboratories and chemical plants processing reactor fuel elements.

A group at the Harvard University School of Public Health continued investigations for the Commission on a constant-pressure-drop air filter and on an electrostatic membrane type filter. The group completed a handbook on air cleaning which was published by the Government Printing Office (see Appendix 8).

The University of Illinois continued its basic studies on aerosol characteristics, and completed several technical reports. A report on electrical properties of aerosols was published.[6]

Oak Ridge School of Reactor Technology

Eighty-one students were enrolled in the Oak Ridge School of Reactor Technology last September, and will be graduated this coming August. In March about the same number will be selected for the 12-month course which begins in September. The school has graduated 132 men now engaged in reactor design and development in industry and Government agencies.

[6] "Electrification of Aerosols" by University of Illinois Experimental Station, Sept. 30, 1952, 50–1008; available from AEC depository libraries (see Appendix 8).

Of the current class, 31 are recent college graduates who attend as employees of the Oak Ridge National Laboratory and 50 are experienced men from industry and Government. Of the latter group, four are from Consolidated Vultee Aircraft Corp., three from Electric Boat Division of General Dynamics Corp., two from Monsanto Chemical Co., six from Newport News Shipbuilding and Dry Dock Co., two from Pratt and Whitney Division of United Aircraft Corp., six from Westinghouse Electric Corp., and one each from Aerojet Engineering Corp., American Gas and Electric Service Corp., Babcock and Wilcox Co., Blaw-Knox Construction Co., Boeing Airplane Co., Carbide and Carbon Chemicals Co., Duquesne Light and Power Co., Foster Wheeler Corp., Mine Safety Appliances Co., and Sperry Corp. Six are from the United States Navy, five from AEC, three from the United States Air Force, two from the United States Army, and one from the Bonneville Power Administration.

Physical Research

The purpose of the AEC physical research program is to encourage scientific progress and to help assure the Nation of adequate scientific and technical accomplishment in fields related to atomic energy. The scale and novelty of the atomic energy industry call for an extensive research effort to improve production methods, develop new applications, and increase our understanding of nuclear structure and processes. Realizing that a high level of technical competence is an important resource for national security, the Commission encourages and assists basic research in atomic energy in its own laboratories and in private institutions where research is of high quality.

In view of the almost unlimited possibilities for new technological advances, research projects are often broad in their scope and look beyond the needs of particular development projects. Many basic studies are undertaken to better understand relevant laws of nature, and the AEC relies upon the vision and insight of the scientists themselves for suggesting relevant subjects. The contractual arrangements with university laboratories are designed to foster and utilize the work of the scientists and their students.

Approximately $24.9 million was allocated to the support of basic physical research during the 1953 fiscal year. About two-thirds of this went to AEC laboratories and about one-third to universities and private research institutions. Of the latter category, $2.7 million went into contracts administered through a joint program with the Office of Naval Research. Applied research and development in the physical sciences required an additional $14 million, most of which was allocated to the national laboratories.

Research Activities

In looking forward to new applications in the field of atomic energy, the AEC research program includes investigations in relevant areas of physics, chemistry, and metallurgy. The important facts about atomic nuclei and their interactions with neutrons and other forms of radiation are being surveyed, and the areas where our knowledge is incomplete are being mapped. Earlier measurements made hastily in the rush to design the first reactor and the first atomic weapon are being repeated with greater precision in an effort to find the more exact facts which will enable the engineers to solve their complex problems of design and operation. New materials which afford desirable nuclear or structural characteristics are being developed.

Studies of the Nucleus

The minute volume of the atomic nucleus holds an intricate dynamical system endowed with enormous energy and exhibiting a complex pattern of reactions to neutrons and other nuclear constituents. Knowledge of the properties and behavior of these systems, of which more than a thousand are known, is potentially useful in the design of nuclear energy devices, and is the object of investigations in all of the national laboratories. Looking well beyond the present horizons of practical achievement, new forms of nuclear and subnuclear energy are being studied and new ways of releasing nuclear energy are being examined.

For these studies particle accelerators or nuclear reactors are used to provide subatomic particles for probing the nucleus under investigation, and ingeniously contrived electronic devices are used to detect and measure the radiations emitted as a result of the probing.

Mesons. As the energy of the probing particle is increased above a few hundred million volts, as in experiments conducted at a number of university laboratories under the sponsorship of AEC, a new and different form of nuclear response is observed in which energy is emitted from the nucleus in the form of particles called mesons. The large cyclotrons and synchrotrons at these institutions have been used to produce mesons on a limited basis for study in the laboratory, and work of the past year has been directed toward understanding the properties, behavior, and function of these particles.

New and more powerful accelerators, the cosmotron at Brookhaven and the bevatron being built at the University of California Radiation Laboratory, will add to our knowledge of this form of nuclear energy. They will enable bombardments with multibillion volt protons, with subsequent release at these energies of several new kinds of mesons

already discovered in cosmic radiation, but never before available for laboratory study. The details of the rapidly accumulating body of knowledge in this field are unclassified and are being published in the professional journals as fast as they are discovered.

Cross sections. As a basis for engineering design of reactors and atomic weapons, knowledge is required of the affinity between neutrons and all of the different kinds of nuclei making up the substance and structure of the device. This affinity often varies erratically with the energy of the neutron and it is different for each of the thousand or more different types of nuclei. A nuclear engineer's handbook should contain several thousand pages of data listing these affinities, or "cross sections," for all of the different kinds of reactions—capture, scattering, excitation, fission—between all of the various kinds of nuclei and neutrons of all energies.

This accumulation of data, even after 10 years of research, is far from complete, and a major effort is being made to complete the tables. The nuclei which serve as reactor fuels—the fissionable isotopes of uranium and plutonium—have been studied with first priority. Next in order are uranium 238, since it is the fertile material for plutonium production, and other nonfissionable isotopes of uranium which are parasitic to the operation. Of third priority are structural materials such as aluminum, carbon, zirconium, iron and chromium which enter into a reactor for one purpose or another. Finally, all of the other elements of the periodic table must be studied in detail for possible utility in the atomic energy field.

The instruments used for these studies are of various types depending upon the energy range within which the measurements are to be made. For neutrons of energy between 10,000 and several million electron volts, Van de Graaff accelerators are used. In the lower energy ranges neutrons are produced by reactors or cyclotrons and their energy is determined by measuring the time of flight from a pulsating source to a detector placed some distance away. The most advanced of these instruments is the "fast neutron chopper" recently installed at the Brookhaven reactor. It is soon to begin a 24-hour a day schedule of operation enabling the measurement of the cross sections of the nuclei of very rare materials.

Instruments operating on the same principle are already in use at Argonne National Laboratory and at Oak Ridge National Laboratory, while others deriving their neutrons from particle accelerators are in operation at a number of university laboratories. The entire accumulation of data up to September 1952 has recently been compiled by the Neutron Cross Sections Advisory Group (see Appendix 2) and the unclassified portions have been made available to the public (see Appendix 8).

Cosmic rays. High-energy nuclear reactions can be studied by examining the tracks left in photographic emulsions on film or plates by the particles comprising cosmic rays. At various times in recent years members of the Brookhaven cosmic ray group have sent such emulsions to high altitudes by means of balloons, B–29s, and V–2 rockets. At these altitudes primary cosmic ray particles are more numerous than at ground level since they have not come into contact with air molecules to a significant extent. Such experiments are necessarily of short duration, and obtaining a set of meaningful tracks is largely a matter of chance.

Exposure of plates to the cosmotron beam, however, has shown that the machine produces particles that begin to compare in energy with those of primary cosmic ray particles. In addition, the ease of access to this source of highly energetic particles multiplies enormously the number of nuclear phenomena that can be successfully recorded for examination and interpretation.

A new type of cloud chamber, another device for making pictorial recordings of nuclear events, has been developed at Brookhaven in connection with cosmotron work. This chamber, with an area eight times as large as conventional chambers and capable of continuous rather than intermittent operation has an efficiency nearly 2,000 times higher than chambers of conventional size. As much data is gathered in one day's operation with the new method as could be amassed in 6 years of operation with the old method. In addition a new technique has been developed which makes it possible to scan cloud-chamber photos from a day's operation in 3 man-months compared to 36 man-years that would be required using former techniques.

Spallation. When atomic nuclei are bombarded by particles of sufficiently high energy, all sizes of pieces may be chipped off them. This chipping-off process is known as spallation. One of the AEC research programs under way in this field is at the University of Rochester. The group is studying spallation reactions resulting when various elements are bombarded in the cyclotron by protons with energies up to 250 Mev. Investigators at the Radiation Laboratory, University of California are continuing similar investigations. It is hoped that a study of the nature and yields of the products of these spallation reactions will contribute to an understanding of this phenomenon and of high energy reactions in general.

Low temperature research. At "absolute zero," 460 degrees below zero, Fahrenheit, atoms or molecules of all substances approach immobility, or "rest" state. Scientists at the Oak Ridge, Argonne, and Los Alamos laboratories, and at the Universities of Ohio, Pennsylvania, and Wisconsin, are studying the physical phenomena which

take place at temperatures near "absolute zero" as they are related to the magnetic properties of nuclear particles. These studies will be helpful in understanding the various forces at work within atomic nuclei.

Chemical Processing Studies

A number of operations in the atomic energy industry require the separation of mixtures of elements, sometimes very similar in their chemical behavior, and their isolation in an exceedingly pure state. These separations are often complicated further by extremely high levels of radioactivity, necessitating carefully shielded operations conducted by remote control. Investigations of the fundamental chemical properties and behavior of elements of interest in the AEC program are carried on at all of the national laboratories and by a number of university contractors.

The national laboratories have the additional responsibility of developing processes for separating and purifying materials to meet specific needs. These include removing uranium from natural source materials, purifying structural materials and moderators for nuclear reactors, separating the products and byproducts of various types of nuclear reactors, and processing waste materials for storage or disposal.

Isotope separations. A major portion of Commission operation involves the separation of isotopes—the separation of uranium 235 is a well-known and leading example. It has become increasingly apparent that research and development on methods of isotope separation must be maintained at a substantial level if new methods are to be developed. The Oak Ridge National Laboratory is setting up a group to investigate methods of producing separated isotopes. The Standard Oil Development Co. will examine on a continuing basis all methods of heavy water production, including those that may yet be conceived in the laboratory. Preliminary engineering and comparative economics investigation will be followed by evaluation of the most promising processes.

Rare-earth separation. Another of the separation problems of interest to the Commission is the separation of the rare-earths. These elements are similar in chemical properties to the series of elements which includes uranium, neptunium, and plutonium. In addition, they are generated in the fission process and knowledge of their chemistry is essential. Rare earths occur together in nature and are most difficult to separate in pure form.

In working on separation methods, ANL scientists recently developed and tested a new continuous countercurrent extraction technique which promises to be feasible on an industrial scale. The large-scale isolation of single rare-earth elements in high purity also appears to be economically feasible. In the present state of development, the purity of the final product is not as great as that obtained by the ion exchange method in use at Ames Laboratory, although significantly larger quantities may be processed. A combination of the solvent extraction technique and the ion exchange method could produce for the first time large quantities of high-purity rare-earth elements.

Raw materials research. Fundamental studies related to a better understanding of the location and processing of domestic uranium are being pursued as a part of the physical research program. Geological, geochemical, and geophysical studies of the type and nature of uranium occurrences are in progress by the United States Geological Survey, Argonne National Laboratory, and by various universities (see Appendix 5). These investigations should lead to a more complete knowledge of the geologic environments of known sources of uranium, and of the factors contributing to its geologic deposition and transport, information which will enable more scientific and successful prospecting. Fundamental and applied studies of physical beneficiation of uranium source materials and of new chemical processing techniques for very low grade ores are also being conducted.

Research on Reactor Materials

The structural materials of a nuclear reactor not only have to withstand high temperatures but radiation as well. The Commission is sponsoring numerous studies at all of the national laboratories and under contract with a half dozen universities throughout the country on the differing imperfections in the structure of the crystals of metals produced by bombardment with both charged and uncharged particles at various temperatures. Ways and means of removing these imperfections by annealing at varying temperatures are being investigated. The aim is to develop methods of processing structural members so they will stand up at higher temperatures and greater intensity of radiation.

One of the unclassified investigations under way on developing improved materials for shielding nuclear reactors is that at the University of Alabama. The group is investigating the possibility of developing enamel glasses containing high percentages of the oxides of cadmium, boron, hafnium, and other neutron-absorbing metals which may also absorb gamma radiation.

Astatine in Nature

Element 85, astatine, was first prepared in 1940 in this country by irradiating bismuth with 32 Mev alpha particles. The occurrence of astatine in nature has now been established by the discovery at UCRL of astatine 219 as a decay product of the actinium series. Astatine has a half-life of about 48 seconds and occurs as less than one part per million in the decay series. Its extreme scarcity together with lack of knowledge of its detailed chemistry is the reason it has never before been detected in nature.

Research Tools

Many of the tools necessary for atomic energy research—nuclear reactors, particle accelerators, and electronic computers—require an outlay of funds beyond the budget of universities and private research institutions. In addition to building up extensive research facilities at its national laboratories, the AEC, with the Office of Naval Research, has financially assisted the construction of about 85 accelerators at universities throughout the Nation. Most of the research reactors in the country are at AEC-owned installations. One privately owned reactor is already being built, and a number of other universities have expressed an interest in borrowing fissionable material from the Commission to build their own reactors. Progress in the operation and use of some of these research tools is reported below.

Particle Accelerators

After its initial run in June, the cosmotron at Brookhaven National Laboratory underwent extensive changes, additions, and related measurements to correct faults which developed in early operation and to replace temporary equipment and wiring. The cosmotron is the only machine now in operation which can accelerate nuclear particles to energies in the 2 billion electron volt range. Protons of 3 to 4 million electron volts are injected into the circular tube, or vacuum chamber, of this electromagnetic machine and whirl with increasing velocity three million times in the second required to bring them to the peak energy of 2 to 3 Bev.

Experimental equipment for the study of high-energy particles from the cosmotron is being assembled and experiments have begun. A committee has been set up at Brookhaven to review all proposed experiments and to plan the cosmotron research program.

Synchrotron. During the last 6 months, the AEC-financed synchrotron at California Institute of Technology succeeded in accelerating

electrons to energies up to 1 billion electron volts, considerably higher than any electron energies so far produced by man. The 1 Bev electron beam is used to bombard heavy metal plates which produces high-energy X-rays. These X-rays are then used to bombard various atomic nuclei in an effort to find out how these nuclei are constructed, what forces keep them together, and what particles are created.

Linear accelerator. A linear accelerator capable of accelerating electrons to energies up to 1 billion electron volts was unveiled in December at Stanford University. It is the most powerful accelerator of its type in the world. To date electrons with energies up to 350 Mev have been produced. Its construction and operation is financed jointly by the AEC and Office of Naval Research.

Van de Graaffs. A 2 Mev Van de Graaff particle accelerator was completed in October at Oak Ridge National Laboratory, and experimental runs are being made to determine its operating performance. A 5 Mev Van de Graaff machine formerly used in the Y–12 area at Oak Ridge was moved to the new high voltage building at ORNL and is being reassembled there.

60-inch cyclotron. The 60-inch constant-frequency cyclotron manufactured by the Collins Radio Co. for Argonne National Laboratory was accepted by the laboratory in July. Designed and constructed at a cost of $966,450, the cyclotron combines many outstanding features of accelerator design. The beam of electrically charged particles which emerges from the cyclotron's acceleration chamber is extremely intense, making the cyclotron especially well suited for the study of nuclear reactions and for the production of radioisotopes.

184-inch cyclotron. The preliminary engineering survey for the redesign of the 184-inch cyclotron at the University of California Radiation Laboratory was completed during the last 6 months, together with some model magnet tests. The results indicate that a proton energy of 650 Mev, a deuteron energy of 350 Mev, and an alpha energy of 700 Mev may be achieved as compared to the present energies of 350 Mev, 200 Mev, and 400 Mev, respectively. This increase will make it possible to apply higher particle energies to the study of mesons and nuclear forces. Final design work is under way, and more precise model magnet tests employing the exact geometry of the redesigned machine will be started shortly.

Alternating-gradient focusing. In studying ways to increase the efficiency of particle accelerator operation, a group of physicists at Brookhaven discovered a method of confining charged particles in a

beam of unprecedentedly small cross section. This involves passing the beam through a series of alternate strongly converging and diverging magnetic fields which turns out to have a net converging, or focusing, effect greater than the converging fields alone would have. With a more concentrated beam, the dimensions of the tube can be made smaller and the electromagnet required to guide the particles in the circular path during their acceleration can be likewise smaller and less expensive.

Plans are being developed to build a machine using this principle for energies up to 100 billion electron volts. Even at such enormous energies, its magnet would weigh less than the 2,200 ton magnet of the cosmotron and in a 10 to 15 Bev range, the weight of the magnet would be considerably less than that in the cosmotron.

Computers

An electronic digital computer at Argonne National Laboratory began operating in December. The computer was constructed by the ANL staff at a cost of $250,000 with a design based on a machine recently constructed at the Institute for Advanced Study at Princeton University. An additional machine containing new developments and improvements in design is being constructed at Argonne for use at Oak Ridge National Laboratory. It should be in full use by this summer. A UNIVAC, an electronic computer, has been purchased and will be installed and operated for the Commission at New York University.

Research Reactors

Construction of the building to house CP–5, a research reactor at Argonne National Laboratory, was completed and various components are being installed. The reactor itself is scheduled for completion this summer.

In June North Carolina State College received a small amount of normal uranium to use in mock-up tests of its research reactor. Loading of the reactor fuel, uranium 235, is expected within 6 months.

Fellowship Program

The AEC fellowship board approved 204 applications for renewals of fellowships for study during the 1952–53 school year. Of the renewals, 131 were in predoctoral physical sciences, 53 in predoctoral biological sciences, 9 in postdoctoral physical sciences, 9 in postdoctoral biological sciences, and 2 in postdoctoral medical sciences. In

view of the National Science Foundation fellowship program, this will be the last major renewal of AEC fellowships. The Oak Ridge Institute of Nuclear Studies has administered the Commission's fellowship program. The contract with the National Research Council for administration of a portion of the AEC fellowship program was terminated in October.

Isotope Program

More than 1,100 institutions in the United States had been authorized to receive AEC-produced radioisotopes by the end of 1952. More than 300 institutions had been approved to receive concentrated stable isotopes. Geographically, the greatest concentration of these institutions is on the Atlantic seaboard, although at least one institution in each of the 48 States, the District of Columbia, Alaska, Hawaii, and Puerto Rico is using isotopes. Industrial firms lead the list of users, followed in order by medical institutions and physicians, colleges and universities, Federal and State laboratories, and private research foundations (see Appendix 4). More than 32,000 shipments of radioactive isotopes and more than 2,000 shipments of concentrated stable isotopes had been made to these institutions by December 31. An additional 1,600 shipments of radioisotopes had been made to some 350 institutions in 33 foreign countries.

Polonium 210 Available

In August the Commission announced the availability of polonium 210 and polonium-beryllium neutron sources for physical and biological research. Polonium 210 is the first reactor-produced, alpha-emitting radioisotope to become available through the AEC distribution program. In addition to its uses in research, it may also be used in oil well logging and for ionization sources. It is useful—but not yet available—for luminous phosphors, static elimination devices, and other industrial purposes.

Analysis Service

Also, during the last few months, the AEC through its facilities at the Oak Ridge National Laboratory offered to industry and to other interested groups outside the Commission a routine service of neutron activation analysis. The analysis is based on the irradiation of the sample in the reactor and the subsequent identification of any unknown elements on the basis of the radioisotopes produced. It permits detection and measurement of impurities in foods, drugs, metals, and other materials and may help manufacturers improve the purity of their

final product. As little as 1/100,000 of one-millionth of a gram of some elements can be measured within an accuracy of 10 percent.

The analysis service is limited only by the physical and chemical characteristics of the sample and the element for which the analysis is being made. Depending on the type of sample to be irradiated and the element for which the analysis is made, the service costs about $20 to $70.

Biology and Medicine

The Commission program in biology and medicine is directed primarily toward the protection of atomic energy workers and the public against the harmful effects of radiation. The Commission is also vitally interested in the effects of blast and heat from atomic detonations in the event of an enemy attack with atomic weapons, and provides technical assistance in this field to the responsible civil defense agencies. The section which follows describes briefly studies aimed at protective measures against radiation, and some of the basic unclassified research aimed at achieving a better understanding of the effects of radioactive and toxic materials on plants, animals, and humans. Progress is recounted in the construction of research facilities for the AEC biomedical program, in the development of radiation detection instruments, and in the AEC training program in the life sciences.

The measures taken by the Commission to protect the public from radiation from continental tests of atomic weapons are recounted in Part III of this report.

Construction of Research Facilities

The construction of major research facilities for the biomedical program was essentially completed during the last 6 months and three of these structures were fully occupied at the end of December. No major additions are planned for the coming fiscal year.

Biology Laboratory—Argonne National Laboratory. Construction was completed in November and it is now occupied. Estimated cost was $5,259,000.

Biology Laboratory—Brookhaven National Laboratory. Construction was completed in December at an estimated cost of $989,700.

Argonne Cancer Research Hospital—Chicago. Scheduled for completion this month at an estimated cost of $4,180,000.

Aquatic Biology Laboratory—Hanford Works. Completed and occupied during this reporting period. Estimated cost was $495,000.

Biomedical Research Laboratory—Los Alamos Scientific Laboratory. Scheduled for completion in June 1953. Forty-four percent completed at the end of December with total costs estimated at $2,283,000.

Civil Defense

In view of the need for research and experimentation on the effects of atomic weapons on civilian personnel, structures, and services, as distinguished from military effects, the Commission expanded its Continental Test Organization to include a Civil Effects Test Group in addition to the Weapons Development and Military Effects Groups. The Director of the Civil Effects Test Group will coordinate the Commission program with those of interested Government agencies.

Technical assistance and guidance on civil defense were provided by the Commission to the Federal Civil Defense Administration and other Federal agencies. The program requires continual exchange and evaluation of pertinent information and close participation in a consultant capacity in various studies. During the last 6 months, the Commission gave technical assistance to the State of New York in its bomb shelter surveys for New York City, Buffalo, Rochester, Albany, Troy, Schenectady, Utica, Binghamton, Syracuse, and Niagara Falls. Shelter accommodations are planned for approximately 3 million persons, of whom 2 million reside in New York City. AEC furnished information on the effectiveness of ordinary building materials, on the most efficient structural forms to resist blast, and on shielding against heat and radiation hazards.

Loan of Radiation Instruments and Sources

The loan of instruments and radioisotopes, chiefly cobalt 60, to civil defense organizations for use in radiological defense training has continued since late 1950. Loans are made upon application of the civil defense group to the Federal Civil Defense Administration and approval by the FCDA and the Commission. Since the inception of this program, instruments have been loaned to 40 State, territorial, and local groups, as well as to the Ninth Coast Guard District, the Food and Drug Administration, and the FCDA Regional Training Center. Radioisotopes have been loaned to 34 State and local groups and to the United States Public Health Service Environmental Health Center.

During the last 6 months, radiation detection instruments were loaned to the Treasury Department, and to civil defense organizations in Delaware, Missouri, and Texas. Radioisotopes were sent to Texas, New York, and Wisconsin.

Research Activities

Basic research on the effects of all types and levels of radiation on living organisms is a continuing task of the Atomic Energy Commission. This effort is devoted to finding out what radiation does to living cells, how the changes occur, and what can be done to prevent injurious changes. In addition, the use of radiation as a research tool and as a possible means of diagnosing and treating disease is being studied at the Commission's major research centers (see Appendix 3) and under contract at hundreds of universities, colleges, and private research institutions throughout the country (see Appendix 5). Some of these basic biological and medical studies are reported below.

Neutron Studies

Since atomic weapon explosions and nuclear reactors are sources of intense neutron radiation, it has become increasingly important to investigate both the harmful and beneficial biological effects of neutrons. Studies of the effects of neutrons on animals or plants are in progress at the Commission laboratories at Los Alamos, Brookhaven, Argonne, and Oak Ridge, and at several universities. In exposing the biological material to neutrons, reactors are used as sources of slow, thermal neutrons, and accelerators such as the Cockcroft-Walton accelerator for fast, high-intensity neutron radiation.

The biological effects of thermal neutrons are being studied at Los Alamos by exposing rats and mice to a range of doses and comparing the effects with those produced by 250 kilovolt X-rays. Several indices are employed for the comparison, including determinations of the lethal dose, decrease in weight of the spleen, thymus, and testes, and the uptake of iron by the red blood cells.

Using the acute lethal dose as a criterion, it was found that thermal neutrons were approximately 1.7 times more effective biologically than 250 kilovolt X-rays. In causing cataracts in mice, thermal neutrons were about 15 times more effective than these X-rays. However, with both types of radiation, cataracts appeared more frequently as the dose of radiation increased, suggesting a similarity in the way they are produced. Similar studies are being carried out with fast neutrons.

In experiments at Brookhaven with growing barley seedlings, it was found that the number of seeds killed by X-radiation increased

with the dose, whereas with neutron radiation, either all were killed or all survived. In addition to their increased relative effectiveness, thermal neutrons also cause different biological effects. It was demonstrated that at any particular energy level, the growing seedlings from X-irradiated seeds had a wide range of heights, but those from neutron-irradiated seeds were very similar in size.

Another phase of this program is concerned with genetic changes which may be induced by neutrons, and studies are under way on mice; on the fruit fly, Drosophila; on corn and other plants; and on smuts and rusts which damage crop plants.

The medical applications of neutrons are also being explored in pioneer studies at the hospital of the Brookhaven National Laboratory. Attempts are being made at this laboratory to utilize neutron capture by boron in the treatment of tumors.

Low-Level Irradiation of Flies

In experiments with fruit flies, it has been found that radiation increased the frequency of gene mutations, many of which are deleterious. In an attempt to determine whether these changes are injurious or beneficial to whole populations, investigators at Cold Spring Harbor, Long Island, exposed breeding populations of Drosophila flies continuously to dosages of 5 roentgens per day. Although mutations increased in frequency, the population as a whole remained healthy and increased in number. The flies even appeared to be healthier than other wild fly populations not so exposed. It would appear that there is some advantage in low-level irradiation of some of the lower animals despite the increased number of mutations. Apparently some populations have a greater tolerance for low-level radiation than studies of the radiogenetic effects on the individual organism have suggested.

Sensitivity to Radiation

Investigators at New England Deaconess Hospital studying the effects of acute and chronic radiation on animals have recently reported data which describe some of the effects of radiation on the nervous system. The data indicate that there are varying periods of sensitivity to radiation during embryonic development.

Single doses of radiation, averaging 150 roentgens, were given to pregnant rats on successive days during gestation to observe effects on the developing offspring. No deformities occurred during the first 8 days of gestation. However, very striking degrees of malformation in the brain occurred between the 9th and 19th days, each day showing some characteristic malformations. Skeletal and eye de-

formities occurred during the 9- to 14-day period. The malformations produced at specific time intervals indicate that there are periods of lower resistance to radiation in the body during embryonic development. This agrees with findings in earlier studies with mice at Oak Ridge National Laboratory.

Dosage Indicators

The use of animals as indicators for the dosage of X-radiation is under continued investigation at Commission laboratories. In experiments at Brookhaven, rats exposed to sublethal doses of X-radiation showed a loss of weight for a period of time, and then gained weight at the same rate as unirradiated rats. The time required for a rat to regain the weight it lost at the time it was irradiated was found to be proportional to the radiation dose up to 600 roentgens. By means of this index, dosage in increments of 50 roentgens can be detected by the average weight changes of a group of five rats. The results demonstrate the possibilities of using biological systems as indicators of radiation dosages under certain circumstances where instruments may not be available or satisfactory.

Toxicity Studies

Knowledge of the toxic effects of radiation on people is essential in establishing effective measures of control and treatment. Experiments continued at Argonne National Laboratory on the long term toxicity of uranium 233 and plutonium 239 as compared with radium 226.

In a recent experiment, female mice were given intravenous injections of these radiosotopes for a period of 400 to 600 days. Results so far show that bone tumors produced by plutonium appeared 100 days earlier than those following radium or uranium injection; plutonium-produced tumors were also more numerous. This excess in toxicity of plutonium over radium is attributed to their different patterns of concentration in bone. In order to determine the effects of alpha and beta radiation on biological systems, it is hoped experiments may be made with radioisotopes of the same element emitting one of the types of radiation, possibly using plutonium 239 and plutonium 241.

Uptake of Fission Products

The Applied Fisheries Laboratory of the University of Washington has undertaken a research project to evaluate the uptake of fission

products by aquatic and land animals and plants in connection with the tests in the Pacific last fall. Information will be obtained on the distribution of fission products in waters of the test area; their accumulation by fish, clams, corals, and microscopic plants and animals; and the presence of radioactive material at the bottom of the ocean.

Atomic Bomb Casualty Commission

Medical studies of the delayed radiation effects on the populations of Hiroshima and Nagasaki are being continued for the Commission by the Atomic Bomb Casualty Commission. Inhabitants of the two cities, as well as their progeny, are given periodical medical examinations. Examinations are also given newborn babies whether or not the parents were within the 2,000 meter range of the explosions. Any consistent differences between those who were within the area and those outside may be expected to have been caused by the radiation. Five-year summaries on this work are now being tabulated and will determine the nature of the investigations for the years ahead. An increasing participation by Japanese medical and scientific personnel is expected.

The studies completed to date indicate slight but definite effects due to radiation. However, it is recognized that several more years of continuing clinical investigations and analytical determinations are required before firm conclusions can be established. In addition to the medical aspects of the problem, data are being accumulated which suggest that the severity of the radiation injury was correlated with the distance from the explosion, and therefore with the radiation dosage. Where differences from this rule are found, it appears that the subjects were partly shielded, and so it may be possible to evaluate the effectiveness of the different degrees of shielding experienced by people—for example, those who were in open areas, wooden houses, or concrete buildings.

During the studies, it was discovered that several Japanese inhabitants of Hiroshima went to Nagasaki immediately after the bombing and were exposed not only to the first but to the second bomb. These people are under study, but the effects of this double exposure have not yet been evaluated.

Radiation Instruments Development

The need for instruments to detect and measure radiation has grown rapidly with the increasing activity in the atomic energy field and the

construction of new facilities which will produce or handle radioactive materials.

During the last 6 months, efforts were made to improve and extend the utility of standard instruments within Commission installations, and to encourage new developments by other Government agencies and private industry. A study evaluating the status of the radiation instrument industry was recently completed. Questionnaires were sent to about 75 companies of this industry. An analysis of the 34 replies indicated that the volume of business had grown from 4.5 million dollars in 1948 to 20 million dollars in 1952; that employment had steadily risen from 130 people in 1944 to slightly more than 2,400 in 1952, and that Government contracts had accounted for about 85 percent of the market. Military procurement accounts for about 50 percent of the total market today.

Tissue Equivalent Chamber

In pursuing this program with industry and Government agencies, the Commission has made new research contracts for developing instruments and their component parts to fit atomic energy requirements. One of the new instruments is the tissue equivalent chamber, recently developed by a group at Columbia University. This instrument will measure multiple types of radiation in terms of body response. Several models are being tested which are made of various plastic materials having approximately the same ratio of hydrogen, nitrogen, carbon, and oxygen as body tissue. Measurements made with other instruments which are sensitive to only one type of radiation do not permit an accurate evaluation of total radiation effects. The tissue equivalent chamber is the first of its kind which shows promise of measuring and detecting, with considerable accuracy, the total dosage of X-rays, gamma rays, and neutrons received by the body.

Training Program

From 1948 to 1952, the Commission sponsored fellowship programs in the life sciences at the pre- and post-doctoral levels (for data on these fellowship programs see p. 37). However, in view of the National Science Foundation fellowship program, the Commission has discontinued all new awards in these fields. There is a definite need for personnel with specialized training in radiological physics, industrial medicine, and industrial hygiene, and training programs in these fields have been continued.

During the last 6 months the Commission added a center on the West Coast to train radiological physicists. The University of Washington in Seattle and the Hanford Operations Office will conduct the program in that area. Radiological training programs will be continued at Vanderbilt University in cooperation with Oak Ridge National Laboratory, and at the University of Rochester in cooperation with the Brookhaven National Laboratory. Approximately 75 fellows will be selected for work in this field for the coming academic year. The program is administered for the Commission by the Oak Ridge Institute of Nuclear Studies.

Industrial Medicine

In the field of industrial medicine, awards for a year of academic study were announced by the Commission in November. This program will provide advanced training and on-the-job experience for men and women physicians. Eight fellowships will be offered for the 1953 academic year to candidates having a M. D. degree from an approved medical school, and at least 1 year of internship. Upon completion of the academic year, a second or in-plant training year at a major AEC installation will be given to eligible candidates. The University of Rochester administers this program for the Commission.

Information on Atomic Energy

One of the Commission's responsibilities set forth in the Atomic Energy Act of 1946 is the development of a program for the control of scientific and technical information which will permit the dissemination of such information to encourage scientific progress. During the last 6 months, the Commission continued to carry out its responsibilities in this field by declassifying information for use by scientists and engineers outside the program, by speeding the dissemination of technical information to atomic energy workers, and by providing educational services and guidance in teaching atomic energy subjects.

Declassification of Information

In general, the Commission's declassification policy has strictly limited the release of technological information dealing with the production of fissionable material and atomic weapons. The only notable exceptions have been the release of fluorocarbon and radiation instruments technology.

On the other hand, essentially all information in the biological and medical sciences has been declassified and the Commission has encouraged the declassification of basic physical scientific data whenever such action would not adversly affect the common defense and security.

In keeping with its policy of continuous review and evaluation of the security significance of the information it has developed, the Commission, during the last 6 months, declassified all information on the "isotron" method of isotope separation and much of the technological information relating to the electromagnetic method of separation.

The isotron method was not developed to the stage where it could produce significant quantities of fissionable materials. The electromagnetic separation method was used during the war to produce uranium 235, but is now being used to produce stable isotopes for research.

The Commission action permits declassification of the engineering designs and operating performance of electromagnetic process units used in stable isotope production and much of the experimental and theoretical physics and chemistry underlying this process. Specifically, data on the high voltage breakdown in vacuums, research on filament and insulator failures, and design data for power supply systems can now be made available to the industry of the country. Consideration is being given to the extent to which the Commission can declassify reactor information for industrial use.

Technical Information

The demand for technical information services continued to increase during the latter half of 1952 as programs expanded at the AEC laboratories and production facilities. Approximately 15 percent more reports were prepared and reproduced for use by scientific personnel than during the first 6 months of the year. Progress was made in speeding the collection and dissemination to the laboratories of information required by their programs. Abstracting and indexing delays were reduced.

Technical Publications

The expansion of the nuclear reactor program and the growing industrial and academic interest in the field of reactor science and engineering has created a great demand for well-trained men in this

field. Training programs are needed both in the universities and in the research organizations engaged in the work. To help meet the need for educational material, the AEC sponsored the preparation of a book, *The Elements of Nuclear Reactor Theory*, based upon a course offered by the Oak Ridge School of Reactor Technology. It is designed for the use of scientists and engineers, and was written by Samuel Glasstone, who was engaged by the AEC for the editorial task, and Milton C. Edlund who conducted the course at Oak Ridge. The contract for publishing the book was awarded to the D. Van Nostrand Co. of New York on a competitive bid basis. Considerations in the bidding were the lowest retail cost, the shortest publication time, and the quality of the finished product. The book was published in November and sells for $4.80. Royalties are paid to the United States Treasury. Several other technical publications were released by the AEC during this period; they are listed in Appendix 8, together with information as to where they may be obtained.

Information to Industry

During the last 6 months the Commission and its contractors accelerated the program to provide as much AEC-developed information as possible to meet the needs of American industry. An Industrial Information Committee (see Appendix 2) representing the Commission and its major contractors, was appointed to plan and coordinate this program which will be put into effect by all contractors at their installations. Sixteen representatives of technical societies and the industrial press, comprising the Advisory Committee on Industrial Information (see Appendix 2), will continue to advise the Commission on the most effective means of publication. One of the initial projects of this group will be publication of a bibliography indicating the availability of all unclassified AEC technical reports of probable interest to industry.

Microcard Program

The recent availability of efficient, portable, and relatively inexpensive microcard readers has made it possible for the AEC and its contractors to adopt a system of reproducing technical reports on microcards. As many as 48 ordinary pages of text can be printed photographically on the face of one 3 x 5 card. The "readers" magnify the microcopy and project a readable image upon a built-in screen.

Microcards of both classified and unclassified reports are prepared at Oak Ridge and distributed to all the major laboratories. Microcards of unclassified reports are also furnished to those AEC depository libraries (see Appendix 8) requesting them. Out-of-print reports can be reproduced for a fraction of the cost of full-size reproduction. This program will make it possible to increase substantially the report holdings of the laboratories at low cost. In the case of the classified report libraries, a substantial saving is represented by the reduction in the requirements for safes and vaults for the storage of classified reports.

Educational Services

Since the Commission's initial announcement 6 months ago of the availability of approximately 100,000 feet of unedited, assembled 35 mm. black and white film footage prepared primarily for the use of educational film producers, there has been a steady demand for this form of information about atomic energy. Requests for footage have come from educational producers in both the documentary and television fields, the major newsreels, universities, the motion-picture industry, Commission contractors, and various Government agencies.

Judging from the number of requests for footage and for additional information, it appears that a considerable number of films will be produced in the relatively near future for both lay and scientific audiences.

The material covers unclassified activities in almost every phase of atomic energy research and operations at 13 installations. Made on the suggestion and with the guidance of educational motion-picture producers and educators, the footage is currently being distributed at standard Government cost rates through a Government depository in Long Island City, N. Y.

Traveling Exhibit on Atomic Energy

A traveling exhibit on atomic energy, sponsored jointly by the National University Extension Association and the American Museum of Atomic Energy at Oak Ridge, commenced its 1952–53 season in October. During the fall the exhibit was shown by the Georgia Institute of Technology, Southern Illinois University, and by the University of Nebraska. Sponsoring organizations through June are the University of Texas, University of Louisiana, University of New

Hampshire, University of Maine, Syracuse University, and the Massachusetts State Department of Education.

Radioisotope Teaching Courses.

As a result of a training course on the use of radiosotopes for New York City teachers, pupils in some of the New York City high schools started during the past fall to conduct experiments with radioactive isotopes in their school laboratories.

Loyola College in Baltimore opened a 15-week teacher training program in the use of radioisotopes for science teachers in September. The Springfield, Mass., Public School System offered a similar course for the science teachers of Springfield and the Connecticut Valley area starting in October. The AEC helped secure speakers and furnished literature and some equipment for all these programs.

Patents

Within the limits imposed by considerations of national security, the Commission has made its inventions and discoveries available for public use. More than 489 patents were made available on a nonexclusive, royalty-free basis from January 1950 to November 30, 1952. A complete list of these patents is given in Appendix 9. Abstracts of the patents are published, as they are issued, in the *United States Patent Office Official Gazette* and in a number of other journals.

The patents which the Commission has made available for licensing have been of interest to industry in many fields. The list of licensees in Appendix 9 shows that a substantial number of the licenses have been issued either to individuals or to comparatively small concerns. Since the licensing program started in January 1950, 273 nonexclusive, royalty-free licenses to use AEC-owned patents have been issued; 90 have been issued since January 1, 1952.

Patent Compensation Board

On July 26, 1952, the Patent Compensation Board denied an award to Helmut W. Schulz. The claim was based on disclosure of a theoretical design of an ultracentrifuge for the separation of isotopes. The decision of the Board is reported in *United States Patent Quarterly*, vol. 94, p. 124. Two additional patent claims have been filed since July 1, making a total of four awaiting the Board's determination.

Organization and Personnel

The total number of workers in the atomic energy program dropped from about 149,000 on July 1 to about 143,800 on December 1, reflecting the gradual decline in construction and architect-engineer contractor employment.[7] The commencement of operations in completed or partially completed plants resulted in a slight increase in operating personnel. Employment for operations and research and development rose from about 58,000 on July 1 to approximately 62,500 on December 1. Direct AEC employment remained at about 6,700. About one-third of the operating personnel in the atomic energy program is engaged in scientific and technical and other professional and managerial occupations; about one-fifth are clerical; slightly less than one-half are manual workers.

Recruiting Scientists and Engineers

In recognition of the shortage of scientific and engineering personnel, all major AEC contractors have increased recruitment efforts and taken steps to insure the most effective use of the available manpower. During July AEC offices and contractors reported recruitment of 1,349 June 1952 college graduates, 172 of whom hold master's degrees and 147, most of them scientists, hold doctor's degrees. Of this group, 665 are engineers and 510 scientists. Although recruitment of scientists and engineers has been relatively successful, demand continues to be sizable.

Military Status of AEC Personnel

Of continuing importance to the Commission is the reservist and draft status of a considerable number of key employees. Approximately 25 percent of all professional and managerial employees of the AEC and its contractors are members of Armed Forces' reserve components. About 10 percent of all scientific and engineering personnel are subject to call under the Universal Military Training and Service Act of 1951. The continued national shortage of scientific and engineering personnel coupled with the increasing demands of the atomic energy program accentuates the importance of obtaining deferments for key personnel in these groups. The AEC has stressed

[7] This figure does not include personnel employed by concerns which support the atomic energy program, e. g., the private utility firms which will supply electric power for the AEC plants in Portsmouth, Ohio, and at Paducah, Ky.

the necessity for timely and appropriate action by its contractors and operations offices in initiating deferment requests.

Labor-Management Relations

The operating installations of the Commission continued free of significant work stoppages during the last half of the year. Continuity of work on construction continued to be very good at all installations except Paducah where three work stoppages occurred during July and August. A marked improvement was shown at Paducah during the last 4 months of the year, however, and there was no time lost during September, October, and November, and only a part of one day in December. From July 1 to December 1 the percentage of time lost to potential worktime in the over-all AEC construction program was 1.5 as compared to 1.9 for the first 6 months of 1952.

Dunkirk Stoppage

On Aug. 29, 1952, the employees of the American Locomotive Co. at its Dunkirk, N. Y., plant went on strike. The company was—and still is—under contract to produce certain unique materials urgently needed for the gaseous diffusion plants under construction at Paducah and Oak Ridge, for the Savannah River project, and for repair of certain facilities at Dana, Ind. Because of the nature of these materials, it would not have been possible to develop other sources of supply in sufficient time to avert serious delays and substantial additional expense in the construction or repair of the plants affected.

On Dec. 3, 1952, by Executive Order No. 10417 the President created a board of inquiry pursuant to section 206 of the Labor Management Relations Act, 1947, to inquire into the Dunkirk dispute. On December 11 the board submitted its report to the President. A temporary restraining order enjoining continuance of the strike was issued by the United States District Court for the Western District of New York on December 12. Work was resumed the same day. The temporary restraining order has since been made permanent for the remainder of the 80-day period provided in sections 208 to 210 of the act.

Atomic Energy Labor Relations Panel

During the period from June through November, the Atomic Energy Labor Relations Panel was concerned with 15 disputes between AEC contractors and unions representing their employees.[8]

[8] The panel's report to the President on its activities during the period from June 1 to November 30 appears in Appendix 7. A report on the origin and functions of the panel appears in the Ninth Semiannual Report of the Atomic Energy Commission.

Eight of these disputes involved construction contractors. The panel participated actively in the settlement of four of these disputes, issuing written recommendations in two cases and assisting the parties through mediation in two others. Two cases were referred back to the parties and one was settled before the panel took action. The panel retained jurisdiction over the Paducah construction project and assisted the contractor and the unions in reaching agreement on a "Declaration of Policy." This policy provides that employees who engage in unauthorized work stoppages will be disciplined by both the contractor and the union.

The panel issued written recommendations in only one of the seven disputes involving operating contractors. These recommendations were rejected and settlement was reached on the basis of an improved offer by the contractor. Two cases are still open under panel jurisdiction.

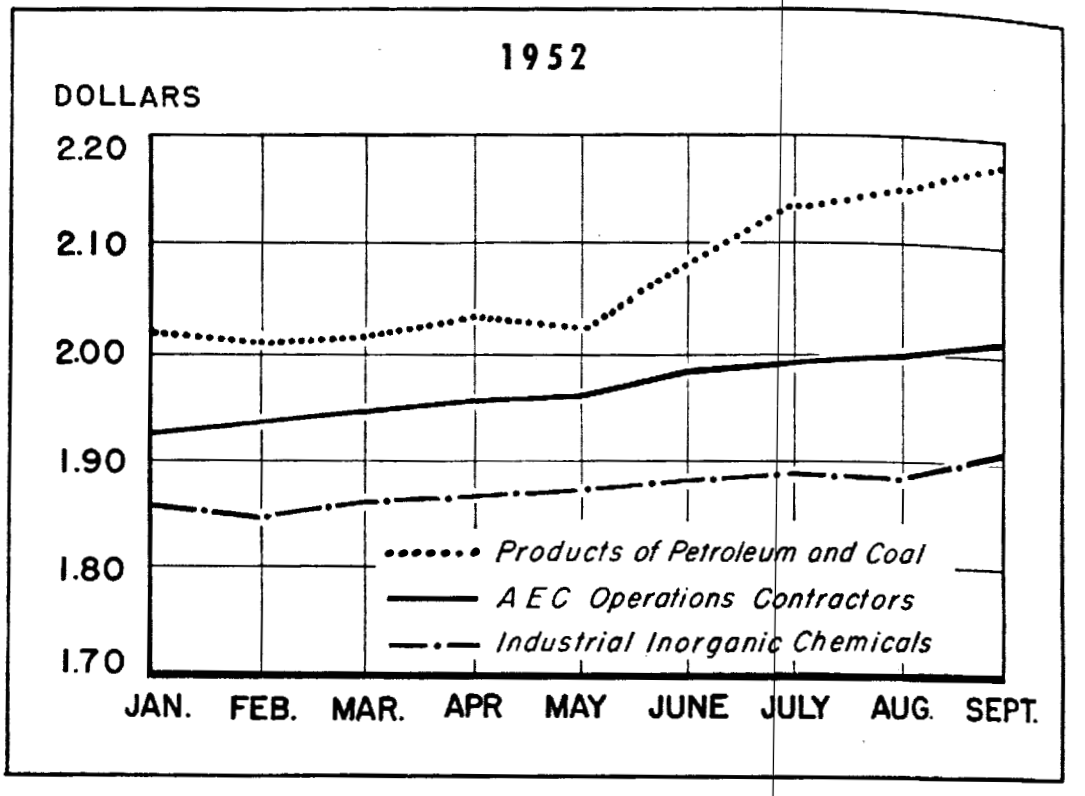
Earnings of Atomic Energy Workers

An arrangement between the Atomic Energy Commission and the Bureau of Labor Statistics this year has made it possible to compare earnings, hours, and turnover of atomic energy production workers with similar figures reported for other industries. Since AEC contractors perform a variety of operations which cross industry lines, including such activities as ore processing, laboratory research, and town maintenance and service, the Bureau of Labor Statistics, which compiles its statistics on a conventional industry basis, cannot publish a wage and hour series for an atomic energy industry as such. Some of the manufacturing operations of the Commission, however, are comparable with those in the inorganic chemicals and petroleum industries.

The following table and graph compare gross average hourly earnings of production employees of major contractors in the atomic energy program with those of employees in the inorganic chemicals and petroleum and coal-products industries during the first 9 months

GROSS AVERAGE HOURLY EARNINGS OF PRODUCTION WORKERS[9] OF AEC OPERATIONS CONTRACTORS COMPARED WITH THOSE OF EMPLOYEES OF SELECTED INDUSTRIES

1952	AEC operations contractors	Industrial inorganic chemicals	Products of petroleum and coal
January	$1.928	$1.858	$2.021
February	1.936	1.845	2.012
March	1.941	1.860	2.017
April	1.953	1.867	2.033
May	1.956	1.871	2.022
June	1.980	1.881	2.082
July	1.994	1.886	2.134
August	1.998	1.884	2.150
September	2.010	1.908	2.170



Labor Turnover

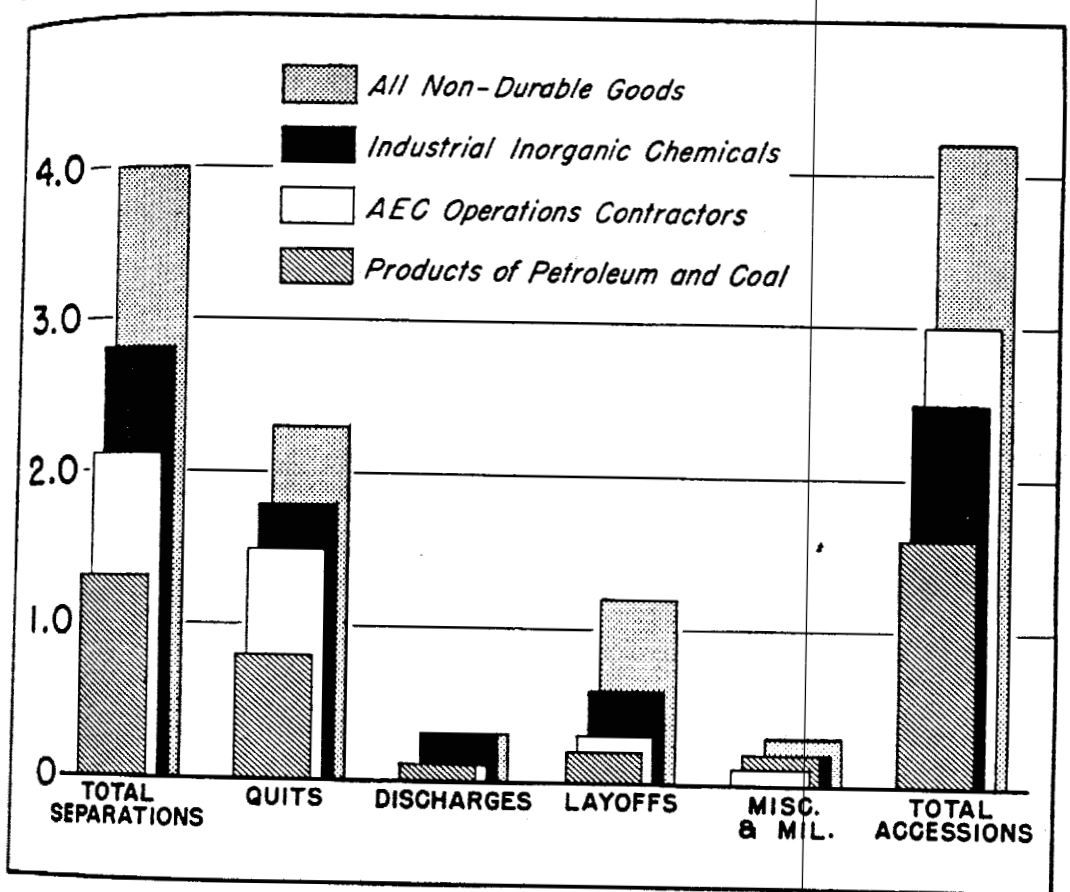
The following table and graph compare average monthly labor turnover rates per 100 employees for atomic energy operations contractors with those for selected industries and for all nondurable industries during the first 9 months of 1952. The large excess of hirings in the

[9] As defined by the Bureau of Labor Statistics, "production workers" include working foremen and all nonsupervisory workers engaged in fabricating, processing, assembling, inspecting, receiving, storing, handling, packing, warehousing, shipping, maintenance, repair, janitorial, watchman services, product development, auxiliary production for plant's own use (e. g., power plant), record-keeping, and other services closely associated with the above production operations. Personnel of AEC construction contractors are not included in this tabulation.

atomic energy industry reflects the expansion in operations. The separation rates for atomic energy contractor employees are much smaller than for manufacturing industry as a whole. They compare favorably with the inorganic chemicals industry but are higher than the turn-over rates in the petroleum and coal-products industries.

AVERAGE MONTHLY LABOR TURNOVER RATES (PER 100 EMPLOYEES) FOR AEC OPERATIONS CONTRACTORS COMPARED WITH THOSE FOR SELECTED INDUSTRIES FOR THE FIRST 9 MONTHS OF 1952.

Industry	*Total separations*	*Quits*	*Discharges*	*Layoffs*	*Miscellaneous and Mil.*	*Total accessions*
AEC Operations Contractors	2.1	1.5	0.1	0.3	0.1	3.0
Industrial Inorganic Chemicals	2.8	1.8	.3	.6	.2	2.5
Products of Petroleum and Coal	1.3	.8	.1	.2	.2	1.6
All Non-Durable Goods	4.0	2.3	.3	1.2	.3	4.2



Federal Personnel

In compliance with section 1310 (d) of Public Law 253, review was made in July of all AEC jobs to determine their necessity and the

appropriateness of their grade level. A report on this review was made to the Congress showing distribution of employees by grades as of June 30, 1952, as compared with June 30, 1950. The average grade level increased during that time from GS 7.3 to GS 7.7.

The final phase in establishing the new AEC Job Evaluation System got under way with training sessions held at all levels of operations. The analyses and evaluations of jobs proceeded on schedule with indications that only a minimum number of grade changes would result. As had been anticipated, special audits of specific positions such as those of guards and security inspectors had to be conducted on an AEC-wide basis to assure consistency. Results of the special studies are expected to be put into effect early this year.

Training

Training programs for recent college graduates in the fields of accounting, auditing, and budgeting were established in Washington and at Savannah River, Idaho, Oak Ridge, and Hanford. In addition, training programs were established for security personnel at Idaho and engineering inspectors at Sandia.

Safety and Fire Protection

The favorable downward trend in the frequency of accidents in atomic energy operations continued during the last half of 1952, with principal reductions in construction and motor vehicle accidents. The injury frequency rate in construction activities at the end of November was 2.59 injuries per million man-hours, 41 percent lower than the rate of 4.59 at the end of November 1951. Motor vehicle accidents involving Government-owned vehicles, which rose to a peak of 2.2 per 100,000 miles of operation at the beginning of the year, were reduced to 1.43 at the end of November, a reduction of 35 percent.

For the first 11 months of 1952, injury frequency rates per million man-hours for operating contractors and AEC Government offices were 2.15 and 1.90 respectively, which compares favorably with 2.62 and 1.83 for the same period in 1951. The injury frequency rate for all AEC activities declined from 3.46 at the end of November 1951 to 2.39 at the end of November 1952, a reduction of 31 percent. Eleven fatal accidents occurred in AEC activities during 1952, 10 of them on construction jobs. Twenty-four fatal accidents occurred in 1951. The total fatalities in 1952 represent a rate of 7.59 fatal accidents

per 100,000 employees as compared with 27 per 100,000 employees for all industries reported by the National Safety Council for 1951.

There was no loss of life from fires reported during 1952. The 1952 fire experience represents a fire loss of $0.017 per $100 of property evaluation, a ratio below the national average, which in well-protected industrial properties is about $0.04 per $100.

Part Two

Condensed AEC Annual Financial Report, Fiscal Year 1952

234439—53——5

CONDENSED AEC ANNUAL FINANCIAL REPORT, FISCAL YEAR 1952

The financial position of the United States Atomic Energy Commission at June 30, 1951, and June 30, 1952; the results of operations for the fiscal years then ended; and other financial data appear in the statements on pages 62 through 66. These statements and the accompanying charts and comments constitute a condensed version of the annual financial report of the Commission for fiscal year 1952.

These statements have been prepared in conformity with the generally accepted accounting principles followed by industry except that for security reasons certain data have been combined and inventories of source and fissionable materials and atomic weapons and weapons components have been excluded from the balance sheet. Costs incurred during the current year for the procurement, fabrication, and conversion of such inventories have been included in program costs in the operating statement.

AEC finances its operations from funds appropriated by the Congress. Private contractors and other Federal agencies carry out most of the operations, working on a reimbursable-cost basis under AEC direction and using AEC-owned facilities. Most of the large contracts are with organizations that maintain separate accounting records for their AEC work, and these records are an integral part of the AEC accounting system. The financial statements in this report are a consolidation of the statements of these contractors on their AEC work and those of the several AEC offices.

AEC auditors conduct a continuing examination of the financial transactions and internal controls of these contractors and of AEC offices.

The General Accounting Office has continued its audit of AEC and contractors' disbursements. It has also continued the comprehensive survey of the Commission's operations started in January 1951. The chief emphasis to date has been on AEC contracting and procurement policies and practices.

The Condensed Comparative Balance Sheet, pages 62 and 63, sets forth the assets, liabilities, and AEC equity at June 30, 1951 and June 30, 1952. Comments on this statement appear on pages 68 to 69.

The Condensed Comparative Statement of Operations, page 64, shows costs incurred for the operating programs, other expenses and other income, and adjustments applicable to prior years for the years ended June 30, 1951 and June 30, 1952. Comments on this statement appear on pages 69 to 73.

The Summary of United States Government Investment in the Atomic Energy Program, page 66, shows the amounts invested from the time the National Defense Research Council started the project in 1940.

The chart on page 67 illustrates the growth of the atomic energy program during the fiscal years 1949 through 1952. The chart on page 65 shows the resources available during the current fiscal year and their utilization.

COMPARATIVE BALANCE SHEET AS

ASSETS

	1952	1951
Cash and working funds:		
U. S. Treasury	$1,413,254,623	$1,454,005,609
Contractors	162,525,957	102,765,861
Other Federal Agencies	69,294,870	56,842,291
	1,645,075,450	1,613,613,761
Accounts receivable less reserves	8,291,845	5,412,417
Inventories at cost less reserves	82,113,931	79,587,721
Prepayments	22,453,822	12,928,112
Properties, plant and equipment at cost:		
Land and land rights	14,737,092	13,961,508
Production and research facilities	1,635,394,003	1,484,337,431
Community facilities	287,998,569	286,806,624
General facilities	195,745,587	139,706,417
Construction in progress	1,363,082,151	591,202,190
	3,496,957,402	2,516,014,170
Less reserve for depreciation and obsolescence	610,306,414	597,538,205
	2,886,650,988	1,918,475,965
Collateral funds and other deposits	47,998,386	50,315,338
Total assets	$4,692,584,422	$3,680,333,314

NOTES:

Inventories of raw source materials, fissionable materials, and weapons parts and assemblies are excluded from the balance sheet.

The balance sheet does not include the market value of 401,971,068 troy ounces of silver provided by the Treasurer of the United States for electrical connections in the Y–12 Oak Ridge plant. Its market value was $332,641,000 at June 30, 1952 and $361,774,000 at June 30, 1951. This silver is returnable in bullion form to the Treasurer of the United States for processing into commercial bars.

As part of the domestic uranium program, the Commission has guaranteed minimum prices through March 31, 1958, for refined uranium and for uranium-bearing ores and mechanical concentrates. In addition, bonuses are payable under certain circumstances to encourage the discovery of new uranium resources. (See Domestic Uranium Program Circulars No. 1 through No. 6.) The Commission also has long-term commitments for the procurement of foreign ores, and development of foreign ore sources, and for the return of residues of ores processed in this country.

OF JUNE 30, 1952, AND JUNE 30, 1951

LIABILITIES AND AEC EQUITY

	1952	1951
Liabilities:		
Accounts payable	$169,897,580	$95,501,835
Accrued annual leave of AEC employees		3,588,688
Working funds from other Federal agencies	39,273,311	18,834,712
Employees' and other funds on deposit	7,242,604	4,713,050
Deferred credits	287,717	411,028
Total liabilities	216,701,212	123,049,313
AEC equity:		
Equity, beginning of year	3,557,284,001	2,151,558,625
Additions:		
Appropriated funds (net)	1,605,756,473	2,032,143,000
Transfers from other Federal agencies without reimbursement	3,036,606	4,093,772
	5,166,077,080	4,187,795,397
Deductions:		
Net cost of operations and prior years' adjustments (See Comparative Statement of Operations)	682,079,187	622,051,692
Transfers to other Federal agencies without reimbursement	2,673,511	3,461,505
Collections paid to U. S. Treasury	5,441,172	4,998,199
	690,193,870	630,511,396
Equity, end of year	4,475,833,210	3,557,284,001
Total liabilities and AEC equity	$4,692,584,422	$3,680,333,314

NOTES—Continued

In addition to the liabilities shown on the balance sheet, AEC had (a) a commitment for unfunded accrued annual leave of AEC employees at June 30, 1952, of $4,552,167; (b) known commitments represented by unpaid obligations as follows:

Unpaid obligations against:	June 30, 1952	June 30, 1951
Appropriated funds	$1,306,486,279	$1,393,609,112
Unfunded contract authority	57,000,000	397,635,623
	1,363,486,279	1,791,244,735
Less amounts included in liabilities above	60,202,364	31,025,463
Net unpaid obligations	$1,303,283,915	$1,760,219,272

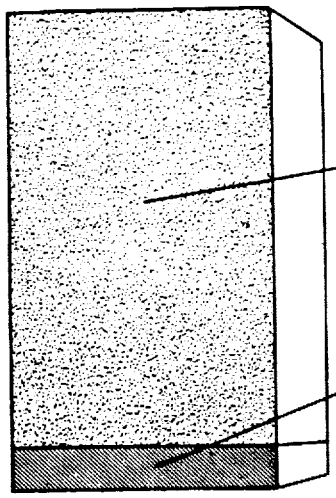
COMPARATIVE STATEMENT OF OPERATIONS FOR THE YEARS ENDED JUNE 30, 1952, AND JUNE 30, 1951

	1952	1951
Production, research, and development:		
Source and fissionable materials	$225,313,197	$138,272,654
Weapons	202,355,404	141,515,021
Reactor development	60,576,273	40,572,011
Physical research (net)[1]	35,649,774	31,488,918
Biology and medicine	23,864,710	20,615,908
	547,759,358	372,464,512
Community Operations:		
Operating costs	20,632,199	21,030,405
Less revenue	18,071,958	16,993,319
	2,560,241	4,037,086
Program direction and administration	31,794,739	23,800,838
Total program costs and expenses	582,114,338	400,302,436
Other expenses and income:		
Depreciation	101,746,638	93,734,815
Projects abandoned	147,126	860,727
Other charges	676,782	1,072,429
	102,570,546	95,667,971
Less other income	2,129,415	1,331,955
	100,441,131	94,336,016
Net cost of operations	682,555,469	494,638,452
Prior years' adjustments (net)	(476,282)	127,413,240
Net cost of operations and prior years' adjustments	$682,079,187	$622,051,692

[1] Costs have been reduced by proceeds from sales of isotopes aggregating $604,901 for the fiscal year ended June 30, 1952, and $453,352 for the fiscal year ended June 30, 1951.

EAR 1952
RS ENDED
1951
138, 272, 654
141, 515, 021
40, 572, 011
31, 488, 918
20, 615, 908
372, 464, 512
21, 030, 405
16, 993, 319
4, 037, 086
23, 800, 838
400, 302, 436
93, 734, 815
860, 727
1, 072, 429
95, 667, 971
1, 331, 955
94, 336, 016
494, 638, 452
127, 413, 240
622, 051, 692
$604.901 for
une 30, 1951.

RESOURCES IN F.Y. 1952 WERE . . .



$1,605 Million Appropriated by Congress

$144 Million–Reimbursements, community revenue, refunds, etc.

TOTAL $1,749 Million

USED FOR . . .

CONSTRUCTION	$1,082

OPERATIONS	601

REIMBURSABLE WORK	38

INCREASE IN INVENTORY	10
OTHER	18
	$1,749

U. S. GOVERNMENT INVESTMENT IN THE ATOMIC ENERGY PROGRAM FROM JUNE 1940 THROUGH JUNE 1952

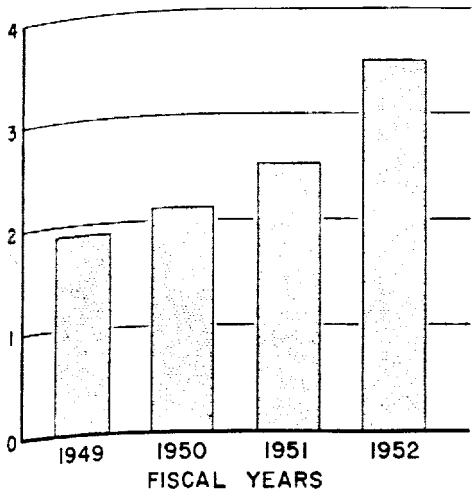
Appropriated funds disbursed, net of reimbursements:		
National Defense Research Council	----------	[1] $468,000
Office of Scientific Research and Development	----------	[1] 14,624,810
War Department (Manhattan Engineer District):		
Fiscal year 1943	$77,098,355	
Fiscal year 1944	730,321,470	
Fiscal year 1945	858,571,646	
Fiscal year 1946	366,355,447	
Fiscal year 1947 (part)	186,337,067	
		2,218,683,985
Atomic Energy Commission:		
Fiscal year 1947 (part)	146,092,939	
Fiscal year 1948	478,986,553	
Fiscal year 1949	627,873,553	
Fiscal year 1950	534,308,839	
Fiscal year 1951	920,467,872	
Fiscal year 1952	1,669,386,036	
		4,377,115,792
Net disbursements		6,610,892,587
Unexpended balance of appropriations, June 30, 1952		1,370,972,639
Total appropriated funds		7,981,865,226
Less:		
Collections paid to U. S. Treasury	[2] 16,372,552	
Property and services transferred to other Federal agencies without reimbursement, net of such transfers received from other Federal agencies	[3] 2,119,138	
		18,491,690
Total investment through June 30, 1952		[4] 7,963,373,536
Less:		
Cost of operations and cost of inventories of source and fissionable materials and weapons components on hand at June 30:		
June 1940 through June 1951	2,805,411,139	
July 1, 1951 through June 30, 1952 per Statement of Operations	682,079,187	
		3,487,490,326
AEC equity at June 30, 1952		$4,475,883,210

[1] Based on published reports.
[2] From January 1, 1947, to date. Prior data not available.
[3] For the fiscal years 1949 through 1952. Prior data not available.
[4] The total investment through June 30, 1952, represents only the funds appropriated to agencies that have been charged specifically with the responsibility of administering the atomic energy program.

AEC GROWTH

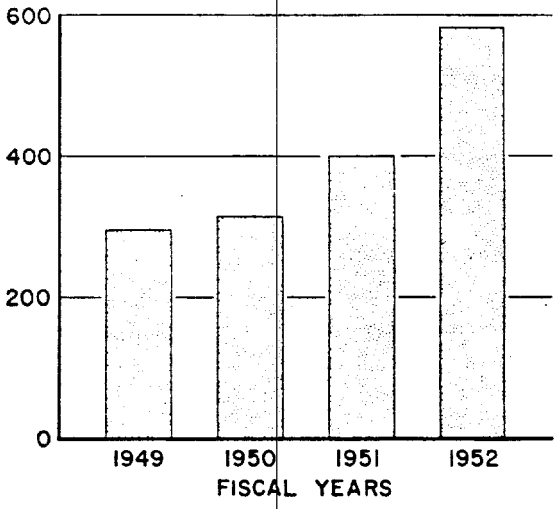
PLANT

Billions of Dollars



OPERATIONS

Millions of Dollars

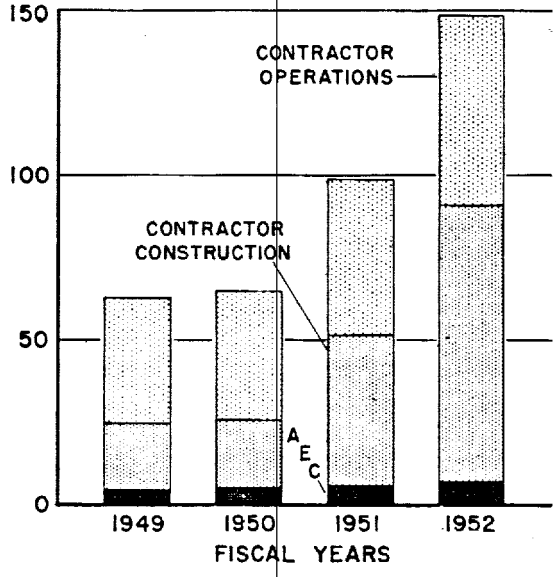


SUMMARY

ITEMS	FISCAL YEARS 49	50	51	52
		(BILLIONS)		
PLANT (JUNE 30) including (const. work in prog.)	$1.891	2.104	2.516	3.497
		(MILLIONS)		
OPERATIONS Program Costs	$293	311	400	582
MANPOWER (Employment - June 30)				
Total Contractor	57,951	58,798	93,480	142,709
Operations	38,253	39,095	47,745	58,101
Construction	19,698	19,703	45,735	84,608
Total AEC	4,578	4,941	5,646	6,662

MANPOWER

Thousands of Employees



Comments on the Comparative Balance Sheet

The following comments cover significant changes in the comparative balance sheet.

Cash With Contractors

The balance in the hands of contractors increased $59,760,096. This increase represents primarily the balance of additional funds advanced to contractors engaged in recently initiated construction projects. In addition, the number of contractors with advances increased from 78 in 1951 to 87 in 1952.

Properties, Plant and Equipment at Cost

The investment in properties, plant and equipment increased a net amount of $980,943,232 during the fiscal year. This net increase resulted from additional construction of $1,082,174,192 less retirements of $94,570,439 and other adjustments of $6,660,521. The construction costs were more than twice the $459,192,206 incurred in the previous fiscal year. The major retirements were facilities at Oak Ridge which had been declared obsolete in fiscal year 1951. The adjustments consisted of a provision for extraordinary obsolescence, plant revaluation, and a reclassification of costs.

The net increase in the Reserve for Depreciation of $12,768,209 resulted from the provision for depreciation during the year of $101,746,638 and other adjustments of $5,592,010 less the retirements of $94,570,439.

Collateral Funds and Other Deposits

Collateral funds and other deposits consist chiefly of funds invested in United States securities and held by trustees for the protection of certain contractors against financial loss in the event of a catastrophe. These funds were established early in the atomic energy program when the hazards of atomic energy work were unknown and normal casualty insurance could not be purchased. The balance in these funds was further reduced during the current year as it became more apparent that safeguards set up by AEC for protection against personal injury and property damage were effective.

Accounts Payable

The balance in this account increased $74,395,745 as a result of the acceleration in both operating and construction activities.

Accrued Leave

Accrued leave was shown as a liability at June 30, 1951, but not at June 30, 1952, because of an administrative determination to remove it from the accounts and carry it in memorandum records only.

Working Funds From Other Federal Agencies

The increase of $20,438,599 reflects the increased participation of other Federal agencies in the activities of AEC.

AEC Equity

The net increase in AEC equity was $918,599,209 in fiscal year 1952. The principal increase represented appropriated funds, which are listed below, and the principal reduction was the cost of operations during the fiscal year.

	Amount appropriated	*Approval date*
Congressional appropriations:		
Independent Offices Appropriation Act, 1952	$1,139,932,750	Aug. 31, 1951
Supplemental Appropriation Act, 1952	265,965,000	Nov. 1, 1951
Second Supplemental Appropriation Act, 1952	200,000,000	Nov. 1, 1951
	1,605,897,750	
Less funds transferred or rescinded (net)	141,277	
	1,605,756,473	

The first supplemental appropriation provided primarily for the acceleration of operating programs, chiefly those for producing fissionable materials; designing, developing, and testing atomic weapons; and developing new types of reactors.

The second supplemental appropriation was for construction at Savannah River.

Comments on the Comparative Statement of Operations

The Comparative Statement of Operations shows the cost of the various AEC operating programs for fiscal years 1951 and 1952. For reporting purposes the production, research, and development activities of the Commission have been classified into five programs—source and fissionable materials, weapons, reactor development, physical research, and biology and medicine. In addition, AEC incurred costs for operating communities at three of its offices and for administering

all programs. The total cost of all of these programs in 1952 amounted to $582,114,338 or 45 percent over similar costs for 1951. The net cost of all 1952 operations and prior years' adjustments was $682,079,187, an increase of 9 percent over 1951. However, the net cost of 1951 operations and prior years' adjustments included approximately $120 million representing a provision for obsolescence of certain facilities at Oak Ridge. Only minor similar charges occurred in 1952.

Source and Fissionable Materials and Weapons

The operating costs for the source and fissionable materials program cover procurement of materials and certain processing operations. The atomic energy program utilizes foreign and domestic programs for exploration for ores, and procurement of uranium ores and concentrates. These ores and concentrates are processed through a complex manufacturing chain into feed materials which are converted into fissionable materials. The production of fissionable materials continued to increase in 1952, and further production improvements were sought by conducting development work in all phases of the manufacturing process.

The weapons program comprises weapons research and development and the manufacturing, testing, storing, custody, and surveillance of atomic weapons.

The operating costs of these two programs in 1952 amounted to $427,668,601, approximately 73.5 percent of the total AEC program costs and expenses, and constituted an increase of $147,880,926, or 53 percent over 1951.

Reactor Development

The costs of reactor development include research on, and development of, reactors, and the operation of reactors and processing plants, including the National Reactor Testing Station in Idaho. Work continued on developing nuclear reactors for producing fissionable materials, generating power, and propelling ships and aircraft. Although the specific reactors are being developed for military purposes, the knowledge thus obtained can be applied to the use of atomic energy for peaceful purposes. The cost of research and development on reactors and the cost of operating reactors and processing plants during 1952 amounted to $60,576,273, an increase of 49 percent over the previous year. The annual operating costs of the main segments of this program for the past 2 years were as follows:

	1952	1951
Specific reactor projects	$45,832,504	$32,583,388
General reactor research and development	10,056,946	6,342,336
Operation of reactor testing station, reactors and other facilities (net)	4,686,823	1,646,287
	60,576,273	40,572,011

Physical Research

The program of research in the physical sciences is designed to increase our understanding of physics, chemistry, metallurgy, and mathematics as they relate to atomic energy. Although much of the basic research is performed in the Commission's national laboratories, a substantial portion of it is carried on at universities and other institutions. Work toward the application of new theories and devices for production uses contributed to the increase in costs. The program also includes production of radioisotopes at Oak Ridge for use in research, medical therapy, and industrial processes. The fellowship program in the physical sciences continued at about the same scale as in 1951. The following table shows the costs of the major activities that make up the physical research program:

	1952	1951
Physics	$17,607,359	$16,614,038
Chemistry	12,192,485	9,790,583
Metallurgy and materials	4,236,761	3,078,114
Isotope production, research, and development (net)	515,095	850,978
Mathematics and computations	79,798	140,795
University training and cooperation	1,011,011	961,056
Research reactor and accelerator operations (net)	7,265	53,354
	35,649,774	31,488,918

Biology and Medicine

The Commission's biology and medicine program covers research in the life sciences. The primary concerns in this activity are to evaluate the extent of radiation and other atomic energy hazards, to prescribe adequate protective measures against radiation in atomic energy operations, and to provide related information to other Government agencies responsible for civilian and military defense. Research is conducted on such problems as the radiation and toxic effects of materials used and produced, the effects of ionizing radiation on living organisms, and flash burns and other phenomena of nuclear explosions. Roughly two-thirds of the research is carried out at a dozen Commission laboratories, and the remainder is supported at approximately 160 universities, colleges, hospitals, and private labora-

tories throughout the country. The development by industry of instruments for detecting and monitoring radiation is actively encouraged.

Radiation sources are used in Commission hospital research facilities for the study and treatment of cancer; for this purpose radioisotopes are also furnished to other qualified users at a small fraction of their cost. Use also is made of radioactive materials in other medical, biological, and agricultural research. Scientists are trained in radiation protection, industrial medicine, industrial hygiene, and the techniques essential to radiobiological research and civilian defense.

Total biology and medicine costs rose 16 percent to $23,864,710 in fiscal 1952 chiefly because of the marked increase in biological research and some increase in medical research. Costs of biological and medical research at AEC facilities increased by 9 percent to $16,343,547. Costs of off-site research, chiefly at universities, increased 33 percent to $6,493,629.

All activities in the biology and medicine program increased in 1952 as shown by the following table:

	1952	1951
Cancer research:		
Medical research	$1,159,856	$964,684
Free distribution of isotopes	521,307	386,585
	1,681,163	1,351,269
Medical research—general	6,832,344	6,301,037
Biological research	10,822,294	8,771,079
Biophysics research	3,725,641	3,415,294
Fellowships	506,227	487,731
Special training	297,041	289,498
	23,864,710	20,615,908

Community Operations

The Commission operates the towns of Oak Ridge, Tenn.; Richland, Wash.; and Los Alamos, N. Mex., and in addition provides some housing at other locations. The gross cost of this program includes the cost of providing housing, commercial facilities, and all of the usual municipal and utility functions, off-set for the most part by revenues. In 1952, as in previous years, the net cost of operating the AEC communities declined as revenues continued to increase and gross costs continued to decrease. Net costs in 1952 were $2,560,241 as compared with $4,037,086 in 1951, and $5,805,387 in 1950. Depreciation is not included in these or other operating program costs but appears under other expenses and income in the comparative statement of operations. Comparative data for each of the communities

and for each of the major services provided are shown in the following table:

	1952			1951
	Gross costs	Gross revenue	Net costs (net revenue)	Net costs (net revenue)
By office:				
Oak Ridge	$9, 302, 107	$7, 967, 233	$1, 334, 874	$1, 544, 160
Richland	6, 166, 491	5, 151, 355	1, 015, 136	1, 412, 650
Los Alamos	4, 872, 540	4, 555, 283	317, 257	1, 209, 957
Sandia	257, 631	339, 557	(81, 926)	(109, 059)
Colorado	33, 430	58, 530	(25, 100)	(20, 622)
	20, 632, 199	18, 071, 958	2, 560, 241	4, 037, 086
By service:				
Real estate operations	6, 936, 764	11, 639, 018	(4, 702, 254)	(3, 696, 971)
Utility services	3, 227, 200	3, 859, 955	(632, 755)	(404, 799)
Hospital services	3, 057, 002	2, 265, 168	791, 834	840, 687
Municipal services	7, 411, 233	307, 817	7, 103, 416	7, 298, 169
	20, 632, 199	18, 071, 958	2, 560, 241	4, 037, 086

Program Direction and Administration

Costs incurred for the general management, executive direction, and technical supervision of program operations; the negotiation and administration of contracts; and the supporting administrative services totaled $31,794,739 in 1952. The costs of this program increased 33 percent over such costs for the previous year as compared with an increase of 45 percent in total program costs and expenses. The costs of this program for the past 2 years were as follows:

	1952	1951
Salaries	$23, 039, 245	$18, 176, 005
Other	8, 755, 494	5, 624, 833
	31, 794, 739	23, 800, 838

The total salary cost includes full-time employees, part-time employees, consultants, overtime, holiday pay, and other miscellaneous items of personal service. Other costs consist of travel, office supplies, rents, and such services as communications, printing, shipping, certain guard services, and utilities. Also included in 1952 is $1,328,027 for personnel background investigations by the Federal Bureau of Investigation.

Other Current Expenses and Income

The expenses not distributed to operating programs consisted of depreciation of plant and equipment, write-off of abandoned projects, and special charges. Depreciation of plant and equipment is recorded on the basis of engineering estimates of the useful service life of each type of facility. These estimates are periodically reviewed and revised. The income not applicable to programs increased to $2,129,415 in 1952 and included interest on collateral funds, proceeds from miscellaneous sales, and mining royalties.

Part Three

Public Safety in Continental Weapons Tests

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PUBLIC SAFETY IN CONTINENTAL WEAPONS TESTS

Twenty nuclear devices or weapons have been exploded since early 1951 at the United States Atomic Energy Commission's Nevada Proving Ground, a 640-square-mile tract of desert land 65 miles northwest of Las Vegas, Nev. These explosions have been tests, conducted for the purpose of developing new and improved atomic weapons and determining the effects of atomic detonations.

In large part, the energy released in these detonations has expended itself upon the barren ground of the test area and the instruments, pieces of equipment and structures placed there for experimental purposes. However, it is impossible to confine the effects of the explosions entirely to the proving ground. Blast waves have caused minor damage as far away as Las Vegas. Radioactive particles in the cloud following a detonation may fall back to earth virtually anywhere within the United States. The brilliant flash of light accompanying a detonation is potentially a source of hazard to persons as far as 30 miles away.

For these reasons, the public has a direct interest in the precautions taken by the United States Atomic Energy Commission to prevent damage to the public health and safety from continental test detonations.

"Fall-out"—the name given to the descent back to earth of the radioactive particles in the cloud following an explosion—already has caused a degree of public concern in some communities. The increase in natural radiation caused by fall-out may be measured on the sensitive instruments used for radiation detection. Improper use of these instruments, or faulty interpretation of their readings, can result in an inaccurate report that residents of a community are being exposed to dangerous levels of radioactivity. In addition, many persons, not realizing that they are continuously exposed to radiation from natural sources, may become alarmed by reports of any level of fall-out radioactivity, no matter how small.

This report will explain the precautions taken against hazard to the public from blast or fall-out. It will describe the Nation-wide system of monitoring fall-out radioactivity, and it will assess the possible effect of recorded fall-out levels upon the public health.

The Commission's Division of Biology and Medicine is responsible for the coordination and evaluation of data resulting from monitoring

and research activities relating to fall-out. This evaluation forms the basis for the establishment of policies to insure the protection of the public.

Effects of Weapons Tests

The following general statements may be made concerning the effect of the 20 nuclear detonations held within the continental United States to date:

(*a*) No person has been exposed to a harmful amount of radiation from fall-out. In general, radioactivity resulting from fall-out has been many times below levels which could cause any injury to human beings, animals, or crops. The highest level of fall-out radioactivity detected as a result of any of the detonations—recorded at a mine a few miles from the boundary of the Proving Ground—was within the safety limits recommended by an advisory committee formed to study the radiation hazard involved in test detonations.

(*b*) Successive tests have not resulted in the accumulation of a hazardous amount of radioactivity in the soil. Uptake of radioactive material in the soil by plants has not created dangerous levels of radioactivity in food.

(*c*) Fall-out radioactivity is far below the level which could cause a detectable increase in mutations, or inheritable variations.

(*d*) No person has been injured by blast waves, although blast has cracked plaster and broken windows in communities near the proving ground.

The United States Atomic Energy Commission decided to hold nuclear test detonations within the boundaries of the United States only after the most careful evaluation of potential hazards, both by Commission scientists and others acting in an advisory capacity. Experience to date has borne out their conclusion that nuclear tests can be held at the Nevada Proving Ground without serious hazard to persons, animals, crops, property, or industry.

Establishment of the Nevada Proving Ground

The Nevada Proving Ground has proved to be of great value in the Commission's program for developing improved atomic weapons. Test detonations are an essential part of this development program, and tests in this country have several advantages over ones held overseas. Continental tests have been less expensive than ones in the

Pacific. At least as important as this saving of public funds has been the shortening of the period which elapses between development of a device and incorporation of the test results into weapons designs. The Nevada tests have greatly increased the rate of acquisition of knowledge of weapon design and weapon effects, and thus have materially strengthened the national security.

The following section will describe in further detail the need for testing nuclear devices, the decision to establish the Nevada Proving Ground, and the advantages resulting from continental tests.

The Need for Nuclear Test Detonations

The United States Atomic Energy Commission has conducted six series of test atomic explosions. Three series have been held at Eniwetok (spring 1948, spring 1951, and fall 1952), and three at the Nevada Proving Ground (January–February 1951, October–November 1951, and April–May–June 1952). Each of the tests involved a major expenditure of money, manpower, scientific effort, and time. Nevertheless, in accelerating the rate of weapons development, they have saved far more than their cost. They have proved to be of great importance in fulfilling the Commission's responsibility for developing, manufacturing, and storing a stock of efficient and militarily useful atomic weapons to meet the needs of the military services.

It is possible to evaluate many weapons principles and designs in the laboratory or by mathematical computation. However, under certain circumstances, the only practical method of evaluation is that of actually detonating a nuclear "gadget," or device, to test the design or principle involved. Often the device to be tested is not itself a useful weapons design. However, the information obtained from the test may be utilized in improving the design of stockpile weapons.

There are other motivations for field tests. A final version of a device may be proved-in, or a fundamental problem in weapon technology may be explored. Tests may give the Department of Defense information regarding the effects of a weapon under certain conditions, or may answer questions of concern to the Federal Civil Defense Administration or other agencies. Most field tests are primarily developmental in nature, but their costs in material and effort is so great that each test is designed and used to answer as many questions as possible.

The Decision To Establish a Continental Test Site

The world's first nuclear explosion—the test detonation near Alamogordo, N. Mex., in July 1945—occurred within the continental limits

of the United States. The next test nuclear detonation within the United States occurred nearly 6 years later, on January 27, 1951.

Between these two dates, the United States exploded seven nuclear weapons or devices overseas. Two weapons were detonated over Hiroshima and Nagasaki in 1945 for military purposes, two test detonations were held at Bikini Atoll in mid-1946, and three test detonations were held at Eniwetok in the spring of 1948.

The Bikini detonations were conducted primarily to answer military questions as to the effects of overwater and underwater bursts, and there was no possibility of their being held in this country. When the need for further tests became apparent in late 1947, however, scientists proposed that they be conducted in the United States.

The advantages of continental testing were obvious. The Bikini tests had demonstrated the cost of an overseas operation in money, time, and manpower. Continental testing would not involve the heavy expense of transporting and maintaining thousands of persons overseas. Even more important was the saving of time and scientific effort which continental tests would make possible. Scientists could return to their laboratories between detonations, instead of interrupting their other work to spend months overseas.

Possible Hazard From Fall-Out

These factors weighed heavily in favor of the establishment of a continental test site. On the other side of the balance, however, was the question of whether the blast or the radioactive fall-out from test explosions might injure persons or damage property off the site.

The Alamogordo test had demonstrated the possibility of hazard from fall-out. Cattle near the test site suffered skin burns and subsequent graying of hair on their backs as a result of radioactive fall-out from this detonation.[1] Water containing fall-out particles was used in the manufacture of strawboard, which later was used to package photographic film. As film is extremely sensitive to radiation, a quantity of it was fogged by the contaminated paper.

A rapid survey of possible locations for a continental proving ground was made in 1947, but the Commission felt that tests should be held overseas until it could be established more definitely that continental detonations would not endanger the public health and safety. The 1948 test series, the first since the creation of the Atomic Energy Commission, was held at Eniwetok Atoll in the Pacific.

[1] These cattle have been under observation since shortly after their exposure. There has been no detectable damage to their health or reproductive ability as a result of the radiation they received.

Increasing Need for Continental Site

The need for a "backyard" test site became increasingly apparent during late 1949 and 1950. The pace of weapons development had been stepped up, and it become clear that the program would require more frequent tests than could be conducted feasibly in the Pacific. The rate of development of new and improved nuclear weapons depended on whether or not a continental site could be utilized.

Available locations were surveyed again, and the Nevada site, then a portion of an Air Force bombing and gunnery range, was selected as the most feasible one. This site had several advantages. One was that it is only 3 hours distant by air from the Los Alamos Scientific Laboratory, at Los Alamos, N. Mex., and the Sandia Laboratory, at Albuquerque, N. Mex.—both key points in the nuclear weapons development program. In addition, the location and relative isolation of the Nevada site provided safety factors in relation to blast and fall-out, particularly because the prevailing winds blow from the test site for many miles across a relatively unpopulated region.

Careful review of all available research and test data relating to fall-out indicated that, under the controls planned, there was adequate assurance of public safety. The decision to establish a continental test site was made late in 1950, and the Nevada Proving Ground was first used in January 1951.

Pacific Proving Ground

Since the larger test detonations could not be held within the United States with the requisite degree of safety, construction of firing areas and supporting facilities at the Pacific Proving Ground at Eniwetok proceeded, and tests were held there in the spring of 1951 and the fall of 1952.

Value of the Nevada Proving Ground

Three test series in Nevada during 1951 and 1952 have demonstrated that the continental test site is even more valuable to the nuclear weapons program than had been anticipated. The Los Alamos and Sandia Laboratories' backyard workshop in Nevada has permitted tests to be set up quickly and conducted frequently, and has resulted in major savings of time, manpower, and money.

These savings become obvious in a comparison of the cost and effort involved in the three test series in Nevada during 1951 and 1952 and in the two test series at Eniwetok during the same years. Each of the Eniwetok series involved all of the transportation, sup-

ply, and technical problems created by a continental test series, multiplied many times by the distance to the overseas location. Work on the spring 1951 series, for example, began in 1950, and approximately 9,000 military, civilian contractor, and Commission personnel were tied up for many months.

The Nevada tests have been much less costly in manpower and time. The spring 1952 series in Nevada, for example, required the services of fewer than 2,500 individuals, including construction workers. Scientists and technicians were able to participate in a test on one day and return to their laboratories on the next. As a result, it was possible to evaluate the data from one detonation in time for the results to affect the next test. Fully evaluated results were incorporated into the development and manufacturing program much more rapidly than has been possible with overseas tests. There is no question that the Nevada Proving Ground has materially cut the time lag between the scientific projection of a new weapon or weapons principle and its entry into the weapons program.

Savings in manpower and time obviously result in saving of public funds. Continental tests have proved to be much less costly than overseas operations. When total costs are related to the number of detonations, the savings are even more impressive.

The Nevada Proving Ground also has made it possible for military field units to participate more fully in developmental and effects tests. A new value has been the use of test detonations by the services to conduct simulated combat maneuvers, to indoctrinate thousands of personnel in the effects of atomic explosions, to orient staff and instructional personnel, and to study various tactical implications.

Value to Civil Defense

The Nevada Proving Ground has been of value to civil defense officials, both at national and at State and local levels. Through cooperation with the Federal Civil Defense Administration, it has been possible for civil defense personnel from FCDA and State and local organizations to participate in weapons tests in such capacities as radiological safety monitors or as technical observers. Use of the Nevada Proving Ground also provides opportunity to study the effects of an atomic detonation on civil structures and equipment. Public understanding of radiation hazards has been improved by the continental test program. At least one State civil defense organization has collected and analyzed fall-out particles as a practice operation in radiological defense.

Operating Controls

Operating controls to prevent hazard to the public have been successful. There has been no instance of harmful exposure of human beings to radiation from fall-out, and only a single reported instance of observable radiation effects on cattle (grazing immediately adjacent to a firing area). While blast has broken windows and cracked plaster as far away as Las Vegas, it has not injured anyone. Information obtained on the propagation of blast waves under various atmospheric conditions now makes it possible for the test organization to select detonation times which will reduce the possibility of blast damage to surrounding communities.

Effects of Weapons Tests

A nuclear detonation releases tremendous energy, equivalent in a so-called "nominal" burst to approximately 20,000 tons of TNT.[2] However, the impressive energy released in nuclear detonations is dwarfed by the energies involved in natural forces. For example, a strong earthquake involves about as much energy as would be released by a million nominal atomic bombs. About 1,000 nominal bombs would be required to match the kinetic energy of a moderate hurricane.

While nuclear explosions have not changed the weather nor caused tidal waves or earthquakes, the forces they release are exceedingly powerful within a limited area surrounding the point of detonation. The area of effective destruction varies with the amount of energy released by the nuclear device. Under the operating controls used in Nevada, thousands of military personnel have occupied fox holes 7,000 yards distant from detonations without casualty. Other participants and observers, with no protection other than goggles, have witnessed tests from a distance of 10 miles without injury.

Characteristics of a Nuclear Detonation

An atomic explosion releases energy as heat, light, and nuclear radiation. The heat energy, which is released instantaneously, produces very hot gases at a high pressure, and the outward movement of these gases creates a shock wave, which is capable of severe destructive effects.

[2] This was approximately the energy release of the atomic bombs exploded over Hiroshima and Nagasaki. In discussing the effects of atomic deonations, this report will have reference to those of "nominal" energy yield.

A portion of the nuclear radiation is released at the time of detonation as each reacting atomic nucleus fissions, or splits into two parts. The remainder is emitted by these parts, called fission products, over a period of time. These radioactive fission products are components of the cloud which follows a nuclear detonation.

The phenomena following the aerial detonation of a nuclear device of nominal yield may be summarized as follows:[3]

Within a few thousandths of a second after a detonation, the heat, light, and instantaneous nuclear radiations sweep the target area, and a luminous sphere or "fireball" appears as the air is heated to incandescence by temperatures approaching a million degrees centigrade. At the end of 1 second, the fireball reaches its maximum radius of 450 feet and begins to rise like a gas balloon, and the shock front of the air blast is visible 600 feet ahead of the fireball.

Formation of the Cloud

By the end of 10 seconds, the intense luminosity of the fireball has almost died out, the shock wave has traveled 12,000 feet and passed the region of maximum damage, and formation of the cloud has begun. The immediate effects of the explosion have run their course, leaving only the delayed effects of residual radiation and the possibility of more distant air blast effects. The cloud, containing sucked-up dirt and debris, and radioactive oxides of fission products, rises high into the air. The base of the cloud's stem settles back onto the firing area, while the cloud itself is carried downwind. It may remain visible as a cloud for an hour or more before dissipating into an invisible mass of air and particles of debris.

Range of Effects

Neither heat nor the nuclear radiation released at the moment of the detonation is hazardous outside of the limits of the proving ground. Beyond about 7,000 feet, the nuclear radiation is virtually harmless. The heat resulting from a detonation will burn skin seriously and will ignite combustible materials 2 miles from the target area, but is noticeable only as a wave of warmth at a distance of 10 miles.

[3] A more detailed and technical description of a detonation and of its physical effects is contained in "The Effects of Atomic Weapons," prepared under the direction of the Los Alamos Scientific Laboratory for and in cooperation with the U. S. Department of Defense and the U. S. Atomic Energy Commission (see Appendix 8).

The other three effects of an atomic explosion—light, blast waves, and residual radioactivity in the cloud—can present a safety hazard outside of the proving ground under certain conditions. These effects will be discussed below.

Light Effects

Viewed at a distance of about 6 miles, the brilliant flash of light from a nominal detonation is 100 times brighter than the sun. Flashes from Nevada tests have been brightly visible in broad daylight in Las Vegas, 80 miles away, and one was reportedly seen as far away as Kalispell, Mont.

The hazard from flash is confined to the test site and the immediately adjacent region up to 30 miles from the target area. The brilliant light could temporarily blind or confuse motorists or airplane pilots in this area. In addition, exposure of the unprotected eye at too close proximity would result in a blind spot which might be permanent. The danger decreases with distance from the detonation, but is greater during predawn shots, when observers' eyes are adjusted to night vision.

Various precautions are taken to protect site personnel and the public from flash. Observers and workers at the test site either turn their backs before a detonation or wear special high-density goggles. Observers off the site are warned not to look toward the proving ground during periods when tests are anticipated unless they are wearing sun glasses.

Cautions are issued against the use of binoculars at any point within the site region. Nonofficial air traffic over the site is prohibited, and warnings against flight in the region are issued to pilots through the Civil Aeronautics Authority. Roadblocks have been maintained on occasion to prevent hazard to motorists, but the usual precaution is the general warning of an imminent operation which is issued in the site region.

Air Blast Effects

The air shock wave produced by an aerial nuclear detonation of nominal yield is the most important agent in producing destruction. Most of the blast damage from an explosion of this size occurs within a radius of 12,000 feet during the first 10 seconds after the detonation. By 30 seconds, at a distance of about 7 miles, almost all of its immediate energy has been dissipated and only light damage, such as to plaster and windows, results. At a distance of 7 or 8 miles an

observer may feel a jolt or a strong push from the air blast, accompanied by one or more sharp slaps of sound.

Outside the definable area of immediate effect, air blast may behave erratically because of meteorological conditions. Blast waves which have bounced over observers only 10 miles from ground zero, creating little noise or shock, have broken windows and cracked plaster 80 miles away in Las Vegas. The blast waves from one detonation were registered on equipment and distinctly heard more than 600 miles away in Albuquerque, N. Mex.

Effect of Weather

The intensity of blast waves at any locality depends more upon various weather phenomena than upon the energy yield of the detonation. At the instant of detonation, blast waves start out in all directions. Those which strike the ground are reflected into the air. In traveling through air, sound waves are affected by two weather factors—temperature and wind. Under ideal atmospheric conditions for a test, there would be no winds and air temperature would decrease with height above earth. Since blast waves travel more slowly in cool air than in warm air, under such conditions all blast waves would bend upward.

Above desert land, however, the air sometimes is warmer at an altitude of 1,000 to 2,000 feet than it is at the earth's surface, creating a "temperature inversion." The warmer layer of air bends the blast waves back down to earth, from which they bounce again. Each time they strike the earth they create a zone of noise, losing energy with each reflection. The heavy focus of energy occurring at the inner limit of each noise zone is known as a "focal point."

Wind accounts for the fact that shock waves in one direction from an atomic explosion may be stronger than those in the opposite direction. Wind can aid or deter the atmospheric temperature pattern in the formation of blast foci.

The Troposphere

The troposphere is the name which meteorologists apply to the bottom 6 miles of the earth's atmosphere. It was the temperature inversion in this layer that bent back damaging blast waves from the explosions of February 2 and 6, and again on November 1, 1951. At the time of the November 1 detonation, a double focus was created at Las Vegas. The blast rays starting in the northwest direction were

all bent upward, overpassing Goldfield, 80 miles away. But in the opposite direction, toward Indian Springs, Boulder City, and Las Vegas on the southeast, two focal points occurred, one at 6.6 miles and one at 40 miles. After one reflection of the focus at 40 miles, and 11 reflections of the focus at 6.6 miles, the blast waves reached Las Vegas in sufficient strength to break 11 plate glass store windows and knock dishes off the shelves of a resort hotel storehouse.

The Ozonosphere

Another, higher atmospheric layer also affects blast—the ozonosphere, extending from 25 to 40 miles above the earth. It bends back to earth some of the blast waves which escape through the troposphere. The focal points it creates are farther apart, varying from 60 miles in winter to 120 miles in summer. Several communities in Nevada and Utah have received small shocks from the first return to earth of waves reflected by the ozonosphere. Subsequent ozonosphere reflections of the shock waves have been felt or heard by residents in Arizona, California, and New Mexico.

The Ionosphere

Still another high atmospheric layer called the ionosphere extends farther upward from an altitude of 50 miles. Focal points created by the ionosphere may be much further apart than those created by lower atmospheric layers. No damage has been reported from ionosphere shocks, although blast waves have been recorded at St. George, Utah.

Settlement of Claims

The Commission anticipated that Nevada tests might produce minor blast damage outside the exclusion area. By contract with the General Adjustment Bureau, it provided for the prompt local recording and investigation of claims. The Bureau's investigation is supplemented by those of engineers, architects, and other experts in construction in the community from which the claim originates. The investigation is extensive enough to determine whether or not the damage actually resulted from the test, and in a considerable number of cases it has shown that damage was solely or materially due to aging or to construction. The Tort Claims Act enables the Commission to make

prompt settlements of justifiable claims which do not exceed $1,000. No claims for blast damage have exceeded that figure.[4]

Meteorological Studies

Prior to the second test series (October–November 1951), the Commission established in August 1951 a study of the effects of meteorological conditions on blast phenomena to make possible the prediction of where the blast would strike and the resulting shock strength.

The extensive weather service net centering at the proving ground was utilized to record pre-shot conditions, and to forecast and subsequently record detonation-time conditions.

Manned microbarographic recording stations were set up in eight communities surrounding the proving ground at distances of from 25 to 135 miles (seven in Nevada, one in Utah). Beginning in August, a number of high explosive charges was fired and shock levels were recorded. During the October–November 1951 test series, a charge of high explosive was fired one hour prior to each nuclear detonation, permitting a blast pressure report to be received from each recording station before the nuclear detonation finally was ordered. The data obtained from the high explosive detonations were utilized to make predictions of wave patterns from the nuclear detonation.

Blast Wave Predictions

A fair degree of accuracy was attained in predicting the pattern of blast waves, with the accuracy depending primarily on whether the forecast of weather conditions was accurate. Variations in meteorological conditions between the time of the high explosive shot and the nuclear detonation were found to affect the pattern materially.

The program was continued through the spring 1952 test series, and the timing of several detonations was changed because of meteorological predictions. Officials of the test organization believe that the blast predictions have provided good indications of possible blast and shock patterns and have helped to avoid damage from air shock. However, the many variables still cannot be fully anticipated, and there is no certainty that property damage always can be avoided.

[4] The initial continental series in January–February 1951 resulted in 132 claims, with settlements totaling $15,000 allowed on 113. Eighteen were for major window breakage, principally plate glass windows in downtown Las Vegas resulting from the February 2 and 6 shots, and 95 were primarily for cracked plaster inside or cracked stucco outside, but also included minor window breakage. A total of 294 claims resulted from the second series (October–November 1951), of which 268 were settled for a total of $27,929.59. All resulted from the November 1 blast. Ten allowed claims were again for plate glass windows in Las Vegas, the balance being for cracked stucco, plaster, and smaller windows. Twenty-seven claims resulted from the spring 1952 series, all for cracked plaster and including claims from Modesto and Sacramento, Calif. All were disallowed. For the 3 series, 453 claims were filed, settlements were reached on 381 or 89 percent and payments totaled $42,929.

Blast predictions have provided a basis for pre-test warnings to people in specific communities to take such precautions as opening doors and windows and staying away from large glass windows. Warnings have been issued on numerous occasions, and public cooperation has been good. The recordings of blast pressures resulting from detonations have been useful in evaluating damage claims.

Blast Damage in Las Vegas

Although the Nov. 1, 1951, detonation shattered 11 plate glass windows in downtown Las Vegas, the shock wave pressures measured in Las Vegas were very low, only 0.04 pound per square inch. This is equivalent to the pressure of a 40-mile-an-hour wind, considerably less than Las Vegas windows frequently withstand. The damage can be explained by the fact that in air blast a direct compression wave, which would push inward on windows, is followed by a rarefaction wave, which has the opposite effect. Store windows are protected by steel beams on the inside but are held in place only by thin strips of bronze on the outside. All of the windows broken in Las Vegas on November 1, were pushed outward by air pressure inside the buildings when the rarefaction wave struck. The damage might have been prevented if doors or windows had been opened to allow pressure equalization.

Radiation Effects

It has been noted that part of the nuclear radiation produced by an atomic explosion is released at the moment of the detonation and the remainder is set free in the course of time.

The instantaneous radiation is released in the form of neutrons and gama rays, emitted by each reacting atomic nucleus as it fissions. The residual radiation is emitted by the fission products. These fission products, radioactive forms of a variety of elements, emit radiation at a rate which is inversely related to their half-lives.[5]

[5] Radioactive atoms release particles or rays from their nuclei in order to reach a more stable energy state. Each emission is spoken of as a disintegration. By definition, half-life is the period of time it takes for half of a given number of radioactive atoms to disintegrate. For example, a quantity of iodine 131 will lose one-half its radioactivity in 8 days, one-half of the remaining activity in the next 8 days, and so on. Iodine 131, therefore, is said to have a half-life of 8 days. Other radioactive elements have longer or shorter half-lives. Following are radiological half-lives of some of the fission products which occur in fall-out.

Fission Product:	*Half-life*
Cesium 137	37 years.
Strontium 90	25 years.
Ruthenium 106	1 year.
Cerium 144	275 days.
Strontium 89	53 days.
Barium 140	12.8 days.
Iodine 131	8 days.

A downtown Las Vegas window, showing how the glass was sucked out by the rarefaction wave, rather than pushed in by the compression wave resulting from the November 1, 1951, nuclear test at the Nevada Proving Ground.

The fission products and other components of the nuclear device are vaporized by heat and become part of the "fireball" following the detonation. As it rises, the fireball draws up varying amounts of dust from the ground. Some of this dust may have been made radioactive by the neutrons released by the detonation, but most of it is inert. The radioactive fission products condense as they cool, forming part of the cloud originating from the fireball. The large amount of

initial radioactivity in the cloud decreases rapidly, since many of the fission products have short half-lives. At the end of 1 hour, the radiation emitted is only about five percent of the radiation level 5 minutes after detonation, and at the end of 1 day, the level drops to 0.1 percent. However, some radioactivity remains for many years.[6]

The radioactive particles within the cloud initially are of a wide range of sizes. Particles from less than 1 micron [7] to about 10 microns in diameter are often composed entirely of fission products; larger particles are more likely to consist of fission products condensed on dust sucked up from the ground. Dust particles may be more than 100 microns in diameter.

Settling of Dust Particles

As the radioactive particles begin to descend to earth, they also are carried transversely by wind. The larger particles tend to settle first. Fall-out—the descent of the particles back to earth—may occur in the immediate vicinity of the detonation or as far as several thousand miles away, although it is heaviest near the site. The manner in which the particles descend through various layers of the atmosphere, each characterized by individual turbulent properties, is not well understood. However, it is likely that the turbulent behavior of the atmosphere is a more important factor than gravitational settling in the descent of relatively small particles.

Rainfall hastens the descent of particles of all sizes, and also may cause the particles to penetrate the surface of the ground after they have settled. This penetration may be caused either by the simple transport of particles into the ground or by dissolving action, although the particles are only slightly soluble.

We have seen that the residual radioactivity in the cloud is the only characteristic of an atomic explosion which has an effect at any great distance from the site. Fall-out of particles carrying some of

[6] At any subsequent time, the remaining activity can be approximated by the relationship: activity $= A_1 t^{-1.2}$, where A_1 is the activity at one unit of time (t) after detonation. Thus from a nominal weapon, the gamma activity of the fission products is estimated to be:

Time after detonation:	*Fission product gamma activity in millions of curies*
1 minute	820,000
5 minutes	120,000
1 hour	6,000
1 day	133
1 week	13
1 month	2.3
1 year	0.11
10 years	0.08
100 years	0.006

[7] The micron, a unit of length, is equal to one-thousandth of 1 millimeter, or 0.000039 inch.

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this residual radioactivity, however, may occur in virtually any portion of the United States. The characteristics of fall-out, methods of measuring it, and its possible effects on human beings, animals, crops, and industry will be discussed in later sections of this report. However, an understanding of some basic facts concerning radiation is necessary before these questions can be evaluated.

What Is Radiation?

Light, heat, and radio waves are familiar kinds of radiation. Although nuclear radiations are less familiar to most people, all of us are subjected to them constantly without our being aware of them. They are invisible and undetectable by the unaided senses. However, their effects can be measured, just as a thermometer measures the effects of heat, and various instruments have been developed for this purpose.

Nuclear radiations are of two general types: (a) bits of nuclear matter—neutrons and alpha and beta particles; and (b) electromagnetic waves of the same general type as light, heat, and radio waves, but of very short wave length—the gamma rays.[8] (X-rays are similar to gamma rays, but they come from the outer parts of atoms, not the nuclei.)

Although man always has lived in a sea of nuclear radiation, he knew nothing about it until less than 60 years ago. In 1896, a French scientist, Becquerel, discovered natural nuclear radiation when he noted that film placed near chunks of an ore of uranium showed darkening after development, although it had not been exposed to light. Radium, another naturally radioactive substance, was discovered by Pierre and Marie Curie in 1898.

In only a few years subsequent to Becquerel's discovery, scientists in many countries learned a great deal about nuclear radiation. They identified the positively charged alpha particles, the negatively charged beta particles, and the uncharged gamma rays, and they discovered that the ability of these kinds of radiation to penetrate matter varies greatly. They began to apply nuclear radiation to the diagnosis and treatment of disease.

Shortly after the turn of the century, another kind of nuclear radiation was discovered—the cosmic rays. These high-energy rays have their origin outside the earth's atmosphere, but their exact source still is unknown.

[8] Neutrons are uncharged penetrating particles. Depending on their speed, they can penetrate up to several feet of tissue. Alpha particles are relatively large, positively charged nuclei of helium atoms. They are unable to pentrate the unbroken skin, but can cause damage if an alpha-emitting substance is deposited within the body. Beta particles are small, negatively charged particles. Those emitted by fisson products will penetrate a maximum of about a third of an inch of tissue. Gamma rays are uncharged electromagnetic waves which are highly penetrating.

Radiation Measurement

In order to study nuclear radiation, scientists had to develop instruments capable of measuring the effects of radiation. Of course, units of measurement also had to be established.

Nuclear radiation can be measured because it causes ionization in substances through which it passes or in which it is absorbed. In other words, the radiation causes atoms and molecules, which carry no electrical charge in their normal state, to separate into charged parts, called ions. In large measure, it is through this process of ionization that nuclear radiation can cause damage to our bodies.

Special instruments, such as the geiger counter and the ionization chamber, amplify the very small electrical currents caused by ionization and indicate them upon a meter. Instruments used for the detection of radioactive fall-out are described in a later section of this report. The units for measuring the ionizing effect of radiation are the roentgen (r), named in honor of the discoverer of X-rays; the roentgen equivalent physical (rep); and the roentgen equivalent mammal (rem).[9] A milliroentgen is one-thousandth of 1 roentgen.

Another unit by which radioactivity is measured is the curie, named for the discoverers of radium.[10] The curie is a measure of the number of disintegrations occurring in the radioactive substance itself, rather than of the ionization it produces in other substances. It is not possible to translate curie units into roentgen, rep, or rem units unless the energy and nature of the particles emitted by the radioactive substance are known, as well as other factors such as its distance from the substance irradiated.

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[9] By definition a roentgen is the quantity of gamma or X-rays that will produce 2 billion (2×10^9) ion pairs in a cubic centimeter of air under standard temperature and pressure; it will deliver 93 ergs of energy per gram of tissue. A rep is a quantity of any radiation that will deliver an equivalent amount of energy (93 ergs) to 1 gram of soft tissue. This amount of radiation energy will produce about 1.6 million million ion pairs in tissue. A rem is a measure of the damage caused in tissue by 1 rep of gamma or X-rays. One rep of another type of radiation, delivering an equivalent amount of energy, may create more rems of damage than would 1 rep of gamma or X-rays. Estimates of the comparative effects of different types of radiation are as follows:

Gamma or X-rays	1 r=1 rep=1 rem.
Beta particles	1 rep=1 rem.
Protons, fast neutrons	1 rep=10 rem.
Slow neutron	1 rep=5 rem.
Alpha particles	1 rep=20 rem.

[10] Originally the curie was defined as the number of disintegrations occurring every second in 1 gram of radium. However, the accepted definition today is that a curie is that quantity of radioactive material in which 37 billion disintegrations per second occur. Thus, the curie, rather than some unit of mass, is used to define the quantity of radioactive material. Curies of different radioactive materials may vary greatly in weight. For instance a curie of radium weighs nearly 1 gram, a curie of uranium 238 weighs 2,900,000 grams, and a curie of iodine 131 weighs only 0.0000078 gram.

Background Radiation

As scientists learned to detect and measure nuclear radiation, they learned that we constantly are being exposed to radiation from a variety of sources in the air, water and the earth. A number of radioactive substances occur naturally, and they are widely distributed in the earth's crust. It is estimated that a layer of soil 1 foot thick and 1 square mile in area will contain, on the average, more than 1 gram of radium, 3 tons of uranium, and 6 tons of thorium. In addition, cosmic rays constantly bombard the earth. Cosmic rays and the nuclear radiation from uranium, thorium, radium and other radioactive materials in the earth's crust and in the air constitute what is called background radiation.

Background radiation varies in intensity depending upon time of day, altitude, the geology of the area, and, to a minor extent, latitude. For example, at sea level in the northeastern part of the United States, about 6.5 cosmic-ray particles per minute cross a horizontal surface 1 square inch in area. At 15,000 feet above sea level, about five times that number will be observed, and at 55,000 feet elevation the rate is about 75 times that at sea level.

Rainfall also may increase background radiation. The exact mechanism causing this increase is unknown, but it is believed that either the falling rain droplets absorb the minute radioactive particles naturally occuring in the air, or the downward air flow accompanying the rainfall blows these particles toward the earth's surface. Background radiation may increase as much as tenfold as a result of rain or snow.

Alpha, beta, gamma and cosmic radiations are included in "background," but because of the penetrating properties of the latter two, they are the principal components to be considered.

Human beings receive between 80 and 800 milliroentgens (0.08 to 0.8 r) per year from natural background sources.

Radioactivity in Plant and Animal Tissue

Since radioactive materials are widely distributed in the earth, air and water, it is not surprising that they occur naturally in the tissues of human beings, animals and plants. Radioactive isotopes [11] of such essential elements as carbon and potassium are incorporated into body tissue along with the more common stable forms. Water from many natural sources contains traces of radium, which accumulates in the

[11] Isotopes are forms of an element having the same atomic number but different atomic weight. Isotopes may be radioactive or stable. Radioactive isotopes often are called radioisotopes.

skeleton once it is taken into the body. The radioactivity normally present in tissue is minute and not harmful to health, but it may be measured in the laboratory.

Radiation from Other Sources

Since the discovery of X-rays and radium, the penetrating power of radiation has been used increasingly in medicine and in industry. Many thousands of persons have been exposed to X-rays as an aid in the diagnosis of diseases such as tuberculosis, to determine the extent of body injuries, such as broken bones, or to locate foreign objects within the body.

The amount of radiation to which the patient is exposed is many thousands of times the level of background radiation, but generally is well below the level considered harmful. These exposures are usually to one part of the body, rather than to the whole body. Much larger exposures can safely be given to body parts than can be given to the whole body. Typical exposures during X-ray examinations are:

Routine chest X-ray	0.05 to 0.3 r.
Routine gastro-intestinal X-ray	1.0 r per exposure.
X-ray of extremities	0.25 to 1.0 r.
Fluoroscopic examination	10 to 20 r per minute.

As we have seen, normal background radiation ranges from 0.08 to 0.8 r per year.

X-rays, radium, and radioisotopes produced in nuclear reactors also are used in the treatment of certain kinds of skin diseases, tumors, cancer and allied diseases. In these instances, the ionizing effect of radiation is used to destroy diseased tissues. The exposures normally are much greater than are used for diagnostic purposes. A small skin cancer may be exposed to 4,000 r of X-rays of relatively low energy with little effect on the patient except for damage to the cancer cells and some scarring of adjacent tissue. A single exposure of only one-tenth that amount of penetrating X-rays, given simultaneously to all parts of the body, would be likely to result in death to one-half the persons so exposed.

Industrial uses of radiation are varied, ranging from inspection of castings through the use of high-voltage X-rays to the use of radium-containing paint on watches and instrument dials. The radium dial on a good wrist watch contains about one-millionth of a gram of radium. This produces considerable beta radiation at the outer surface of the watch crystal. Through the back of the instrument, however, there will be only gamma radiation, amounting to

about 1 milliroentgen per hour to the wrist. Instrument dials in aircraft also are frequently marked with radium-containing paint. At the face of these instruments, levels of from 5 to 10 milliroentgens per hour sometimes occur, and in some aircraft the pilot is exposed to about 1 milliroentgen per hour.

Radiation from Nuclear Weapons Tests

Radioactive fall-out may cause a detectable increase in background radiation. Fall-out can have a damaging effect on certain materials which are especially sensitive to radiation, such as are used in the manufacture of photographic supplies or radiation detection instruments. Fall-out also may affect measurements of radiation in exploration for uranium ores or in scientific research involving low levels of radioactivity.

One of the principal purposes of the fall-out monitoring system maintained across the country during test periods is to keep sensitive industries and laboratories informed of fall-out levels. With adequate warning, they may be able to take precautions to prevent fall-out from interfering with their operations.

Pre-test Precautions

The decision to detonate a nuclear device at the Nevada Proving Ground sets into motion a series of activities designed to assure the safety of persons on the site and throughout the Nation. The most important of these is the forecasting of weather conditions at the scheduled time of the detonation. If weather forecasts are unfavorable, the test is postponed.

Pre-test warnings are issued to nearby communities and to individuals who may be in the vicinity of the site. The Civil Aeronautics Authority is notified so that air lines and private pilots may be warned away from the projected path of the radioactive cloud. These precautions are described in further detail below.

Weather Determination

It has been noted that weather conditions affect the direction and intensity of blast waves. Weather also is the major factor affecting the direction and intensity of fall-out. Such conditions as precipitation, cloud cover, temperature, temperature inversions and wind directions and velocities must be taken into consideration before a test is held.

Accuracy in forecasting the direction and velocity of wind is particularly difficult at ground surface in the mountain-surrounded valley where the detonations occur, since winds may circle the compass in a few moments. Following one detonation last spring, the radioactive cloud column was sheared by wind into three clouds—one low-level, one medium-level, and one high-level—each of which moved away from the proving ground in a different direction. The pre-detonation forecast had predicted this, and had anticipated that precipitation would occur downwind in one direction.

The usual weather report contains only a fraction of the data necessary to make such predictions. In order to obtain more comprehensive data, the United States Air Force Air Weather Service has established a permanent weather unit at the proving ground. This unit receives full reports on hemispheric and localized weather conditions from the hundreds of stations of the Air Weather Service and the United States Weather Bureau. Additional information on weather in the site area is provided by a network of stations ringing the test site.

Pre-Detonation Forecasts

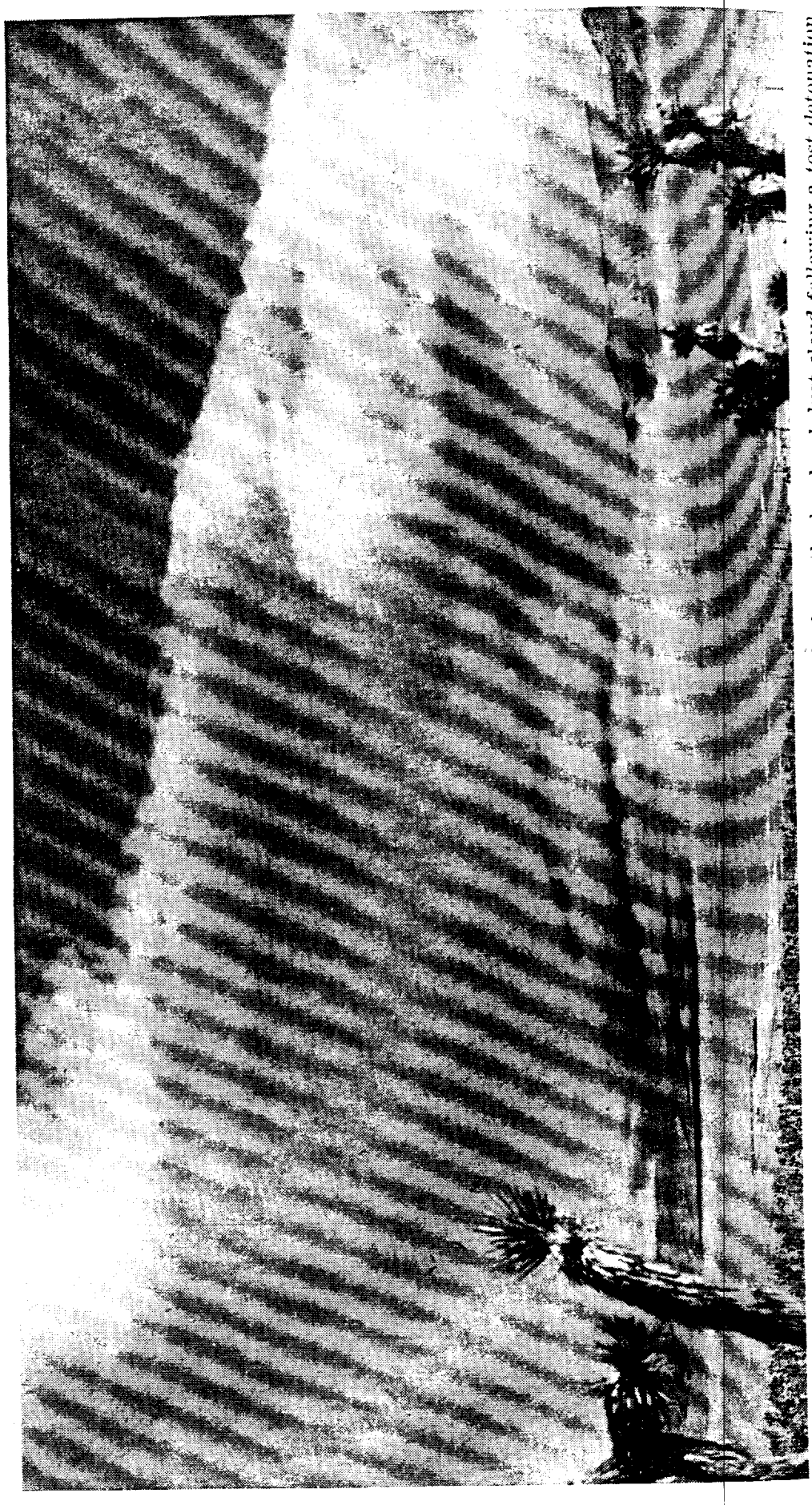
Forecasts for the test hour and date are made 72 hours in advance of the scheduled time. If the outlook 24 hours in advance remains favorable, the operational sequence is begun. On the evening before a test, all factors pertaining to the operation and to public safety are reviewed and evaluated by the test manager, the test director and their scientific advisors, including an advisory panel consisting of experts in the fields of biology and medicine, public health, meteorology, and blast. At this meeting, detailed consideration is given to factors affecting radioactive fall-out. These include the following:

(a) The type of detonation. A high air burst, for example, probably would not result in significant amounts of fall-out.

(b) The probable maximum height of the cloud, and wind speed and velocity at that altitude. If the cloud moves slowly, its radioactivity will have diminished greatly before it reaches any populated areas. On the other hand, fast winds tend to spread the cloud and disperse the radioactivity through the atmosphere more quickly.

(c) The possibility of downwind rain or snow. If there is a probability of precipitation anywhere downwind toward communities within 200 miles of the site, the detonation probably would be postponed.

(d) The pattern and nature of fall-out within a 200-mile radius. If there is any likelihood of unusually heavy fall-out on a nearby community, the test would be postponed.



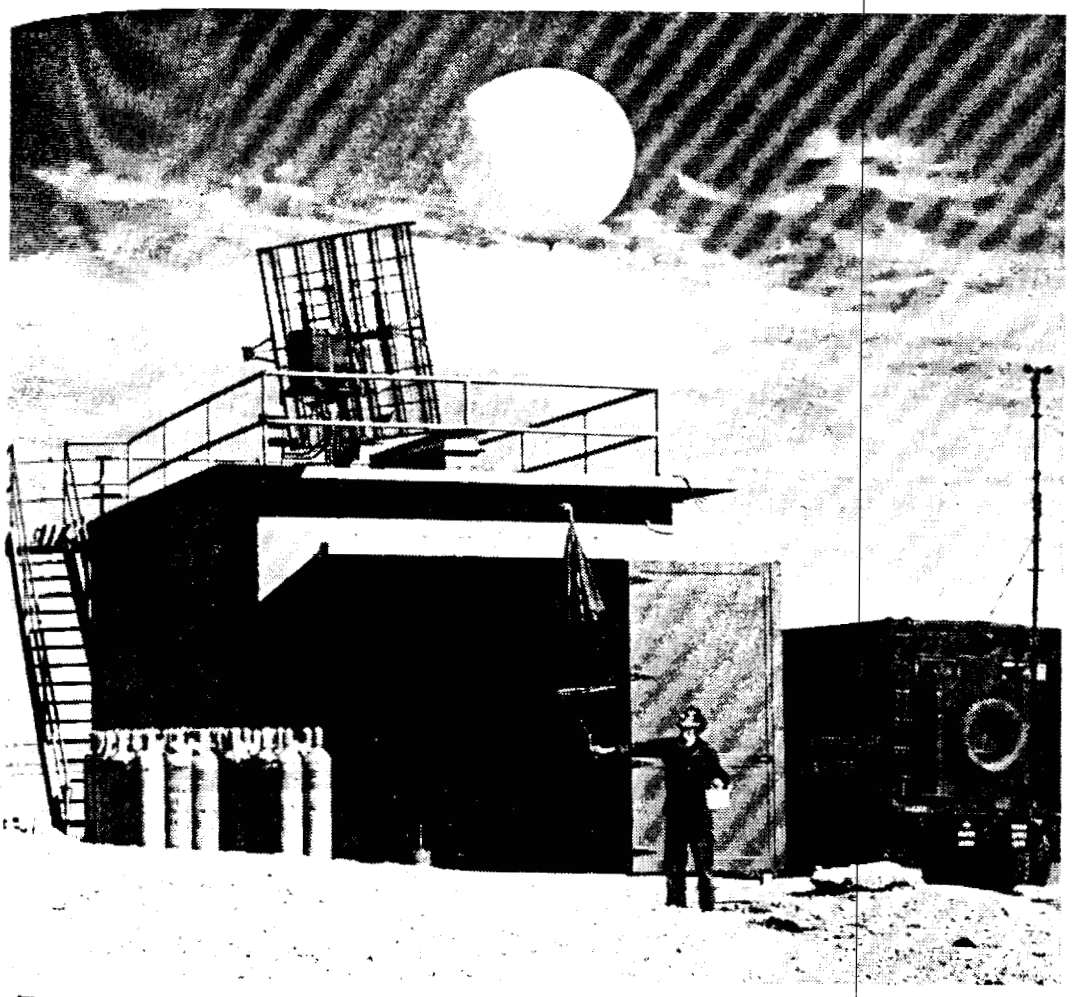
The shearing effect of wind is illustrated by the above photograph, which shows the low-level dust cloud following a test detonation as it is spread in several directions by wind at different altitudes.

(e) The commercial air line flight areas which may be affected.
(f) The placing of monitoring equipment and of monitoring and warning personnel along the projected path of the fall-out.

These and other factors must be considered both from the standpoint of public safety and that of conducting a successful test operation. If conditions are favorable, the order to proceed with the test is issued. Adverse developments, however, can cause a postponement at any time up until 10 minutes before the detonation. Evaluation meetings may be held at various hours through the day or night if there is any uncertainty regarding weather forecasts.

Pre-Test Warnings

Various pre-test warnings are issued. Advance notice of each test series is made, and before each detonation it is announced that a test



The United States Air Force weather station shown above is located near the Control Point at the Nevada Proving Ground. During continental tests, weather personnel send many helium-filled Raob (radar-observer) balloons to the upper atmosphere to check on temperatures, dew points, humidity and wind velocities. The radar tracking instrument, located on top of the test weather station, charts wind velocities and directions to determine cloud paths after detonations.

The shearing effect of wind is illustrated by the above photograph, which shows the low-level dust cloud following a test detonation as it is spread in several directions by wind at different altitudes.

is expected to occur within a stated period of time. Helicopter and ground patrols and posted notices are used to warn desert migrants and hunters to avoid the proving ground region. Officials of communities around the proving ground and cattlemen using adjoining ranges are notified a few hours before a test. Other notifications are issued following the detonation. News media are advised of the height of the cloud and its general speed and direction. Health officers of Nevada and of adjacent states in the path of the cloud are advised by telephone so that they will be prepared to report and to interpret fall-out levels in their localities. In some instances, Civil Defense organizations have been notified so that their monitoring personnel might gain field experience.

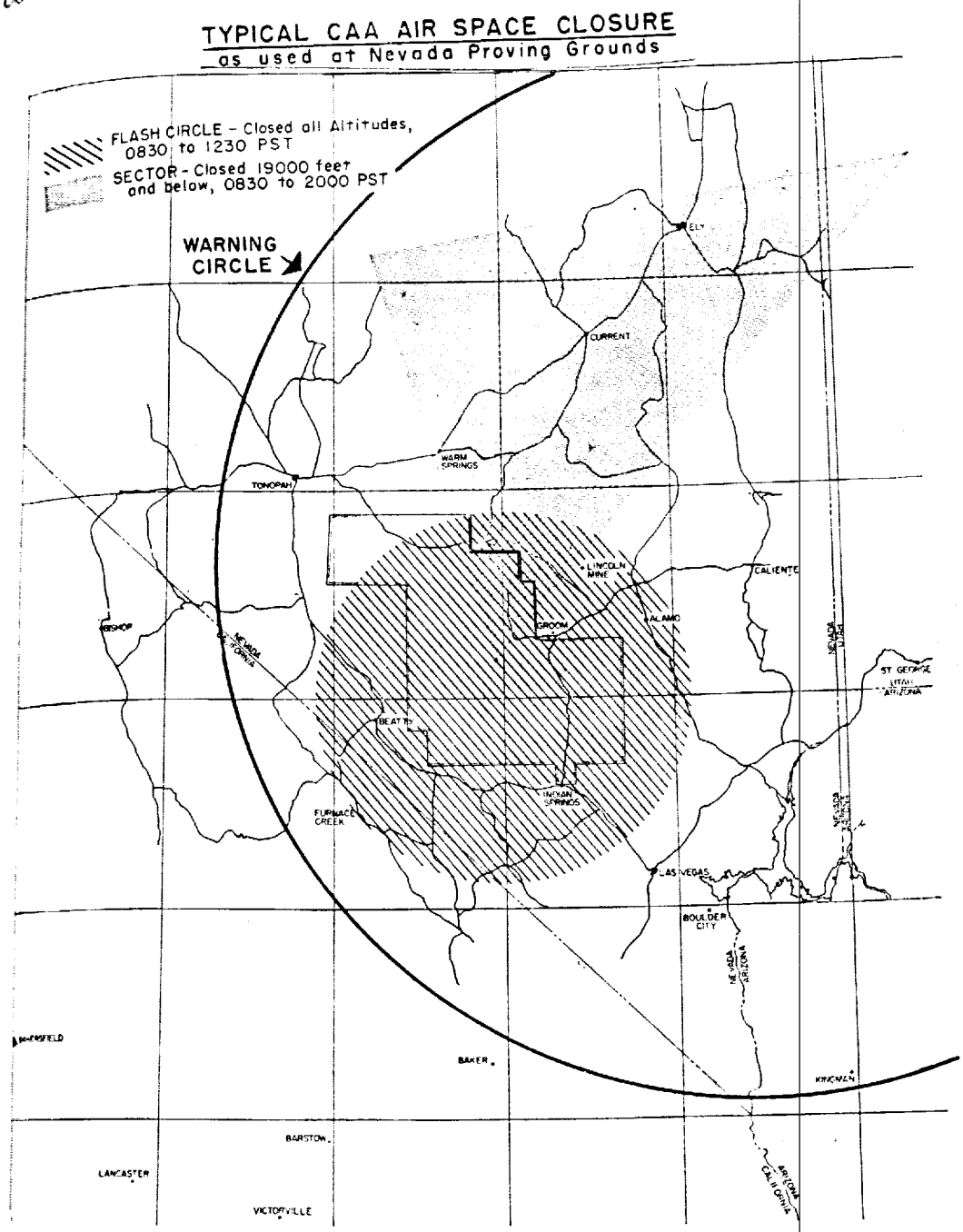
Care is taken to prevent airplanes from flying into the radioactive air mass. Before each shot, a general broadcast is made through Civil Aeronautics Authority facilities, warning anyone who plans to fly anywhere within a specified circle within specified hours to request a safe routing from the CAA. The specified area is called the warning circle. The CAA is advised of a zone within the warning circle which will be closed to air traffic. A typical air space closure is shown on page 101.

The Radiation Monitoring System

Fall-out radioactivity following test detonations is recorded by a monitoring system which extends across the Nation. Its principal purpose is that of protecting test personnel and the public by determining the radioactivity deposited in various localities by fall-out. The monitoring system also provides information regarding the relation of fall-out to weather conditions, the type of burst, and properties of the radioactive cloud. In addition, the collected data are used for the guidance of industries which are sensitive to minute increases above normal background radiation. Monitoring also provides meteorologists with a new method of studying the movement of large masses of air at varying altitudes.

The Radiological Safety Group of the test organization monitors fall-out within a 200-mile radius of the test site. The Armed Forces operate additional monitoring teams when military personnel participate as fox-hole observers or in tactical exercises. Military units man helicopters and other aircraft used for sampling and tracking the radioactive cloud over the site and out to a distance of 600 miles.

On the ground, the responsibility for monitoring fall-out outside the 200-mile zone rests with the National Monitoring System, operated by the New York operations office of the Atomic Energy Com-



mission. This system includes two types of monitoring operations. Two-man mobile monitoring teams operate at varying locations within the 200–500-mile zone, and a total of 121 fixed monitoring stations, located at United States Weather Bureau Stations, monitor at various locations across the Nation.

Instruments Used in Monitoring

Various instruments are used by monitors to take samples of radioactive dust and to measure its activity. Airborne dust is collected

on filters through which air is drawn as it is through a household vacuum cleaner. Settled dust is collected on flat trays covered with gummed paper. Special instruments may be used to sort out the particles in relation to their weight, permitting a determination of the particle size distribution.

The distribution of particle sizes in fall-out on a locality may affect the relationship between radioactivity in the air and in settled dust. Large particles fall relatively rapidly, and very small particles tend to remain suspended in air. Therefore, measurement of both airborne and settled radioactivity is useful in determining fall-out in an area.

Different types of instruments may be used to measure the activity of dust samples or the general level of external radiation in a locality. Ionization chamber types of instruments collect the very small electrical currents caused by the ionizing action of radiation and amplify them so that they may be read on a microampere meter. A geiger counter is a special type of ionization chamber, which counts individual particles or gamma rays.

Interpreting Instrument Readings

Care must be exercised to interpret the instrument readings correctly. In using a geiger counter, which is sensitive to both gamma and beta radiation, both a gamma-beta reading and a gamma-only reading should be taken to determine the relation of the beta activity to the total radiation level. (Since the beta particles are relatively nonpenetrating, they may be shielded out when a gamma-only reading is taken.)

Beta particles are of little importance in determining exposure from external radiation because of their limited ability to penetrate tissue. Since the beta radiation level as measured by monitoring instruments may be several times greater than the gamma level, failure to discriminate between the two can result in a reading which appears alarmingly high to an untrained observer. A similar result may be obtained from reading only the "hottest" spots in an area. For example, fall-out from a large area may be collected in a puddle of water, which will show a much higher radiation level than the surrounding terrain.

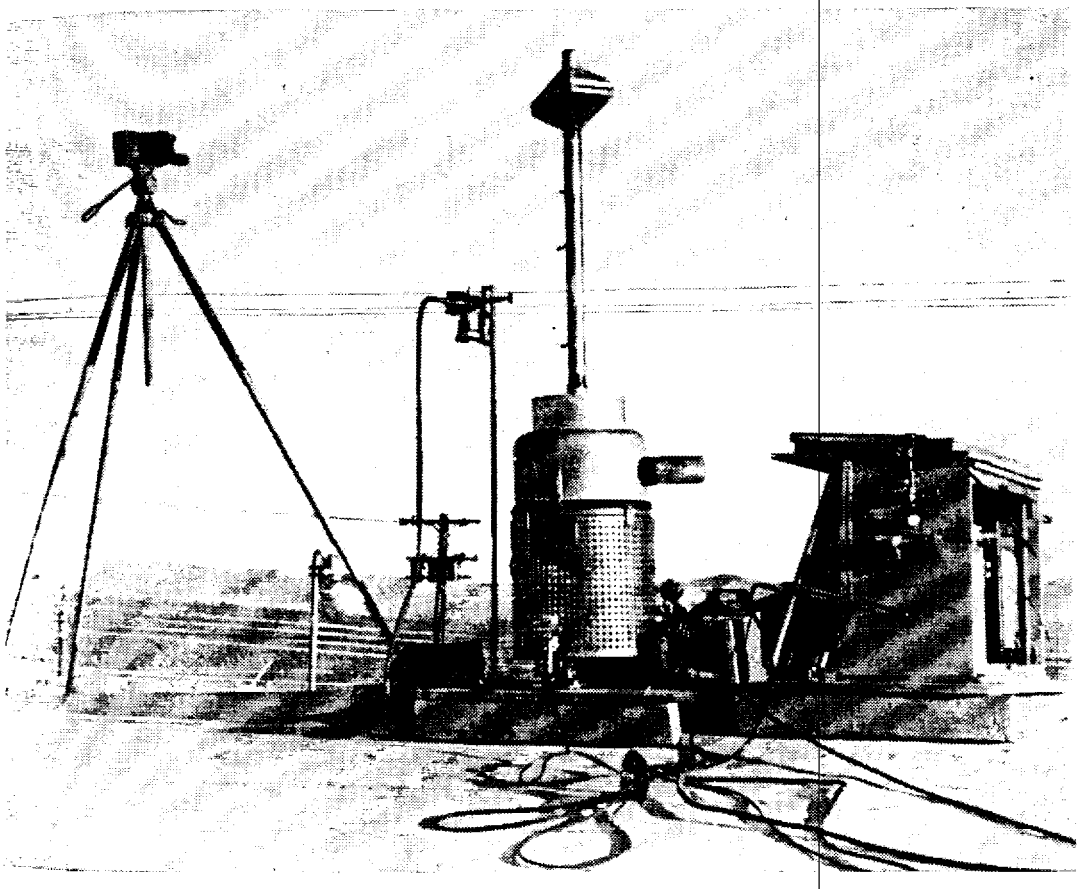
In interpreting the effects of fall-out radiation, it also must be remembered that the radioactivity decays rapidly. A reading taken immediately after the fall-out must be interpreted properly to determine total exposure for the following week or month. To take an accurate reading, the normal background for the locality should be

known, and the instrument should be checked against a standard radiation source to determine its accuracy.

Monitoring Within the 200-Mile Zone

During the spring 1952 test series, the radiological safety group of the test organization consisted of 180 persons drawn from the staff of the Commission, its contractors, the United States Public Health Service, and the Armed Forces, including an Army Chemical Corps Company. The work of this group after a typical test is as follows:

As soon after detonation as visibility permits, a radiological survey is made from two helicopters or L–20 type aircraft. At approximately the same time, ground survey teams move toward the target area in jeeps. They monitor radiation intensities, establish safe operating procedures, and insure that test personnel are not overexposed to radiation. Their findings are used by military commanders to determine when military groups may move forward for tactical exercises.



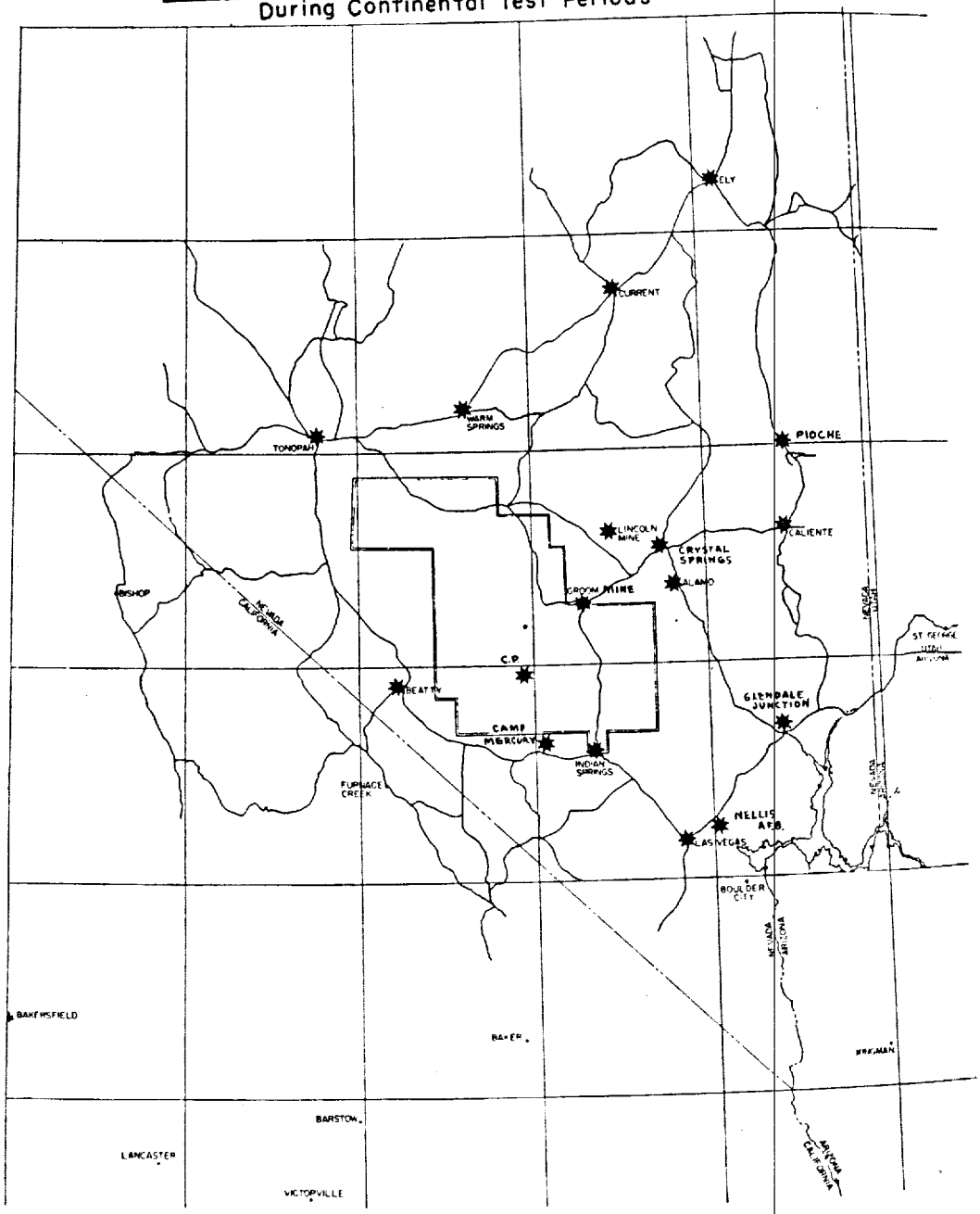
One of the air-sampling stations established at 15 inhabited locations within the 200-mile zone during test operations at the Nevada Proving Ground.

Other members of the group monitor the area up to 200 miles from the site, using aircraft and motor vehicles. They are in radio communication with the proving grounds control point. Fixed air sampling stations are established at approximately 15 inhabited locations, as shown on the map below, and other sampling is performed in areas immediately adjoining the site through collection of dust particles.

Cloud-tracking aircraft teams follow the radioactive air mass for approximately 600 miles in order to determine its path. This determination facilitates ground measurements and provides data for controlling air lanes.

The off-site monitoring teams are prepared to advise the residents of communities near the site if any precautionary measures should be

MAP OF ROUTINE AIR SAMPLING STATIONS
During Continental Test Periods



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taken as a result of fall-out. The most important of these, which would reduce radiation exposure appreciably, would be to have the residents remain inside their homes or business places for a few hours. If radiation approached a level which might be hazardous, the monitoring teams would advise authorities in the community and would assist in evacuation of residents. Such measures never have had to be taken. Prior to one test in the spring 1952 series, 11 persons living at the Groom mine, 20 miles from the firing area, were asked in advance to leave. They spent one night away from the mine and returned shortly after the detonation.

Mobile Monitoring in the 200–500-Mile Zone

Mobile teams of the National Monitoring System operate within the 200–500-mile zone. During the spring 1952 test series, the constitution of the mobile monitoring force was typical. It included 2 AEC specialists, who directed operations, 16 enlisted men of the Army Chemical Corps under command of a Chemical Corps officer, and 2 Air Force C–47 aircraft and crews. The permanent field headquarters of the mobile force was Hill Air Force Base at Ogden, Utah, but the field headquarters was shifted to Air Force bases at Albuquerque, N. Mex., for one test and to Sacramento, Calif., for another in order to be nearer the projected path of the cloud.

When the weather forecasts are made before a test, the field headquarters issues instructions for deployment of the two-man mobile teams. They are flown to their assigned locations, and on arrival establish communication with the field headquarters by phone or CAA Airways Communication System. Then they set up their monitoring equipment and begin to take measurements, with the objective of establishing the level of background radiation before the cloud arrives.

Each team takes samples of settled and of airborne dust. Special samplers separate the airborne dust according to its particle size. In addition, the general radiation level at each locality and the radiation level of certain of the dust samples are measured periodically with three different types of portable survey instruments, one of which differentiates between the beta and gamma components.

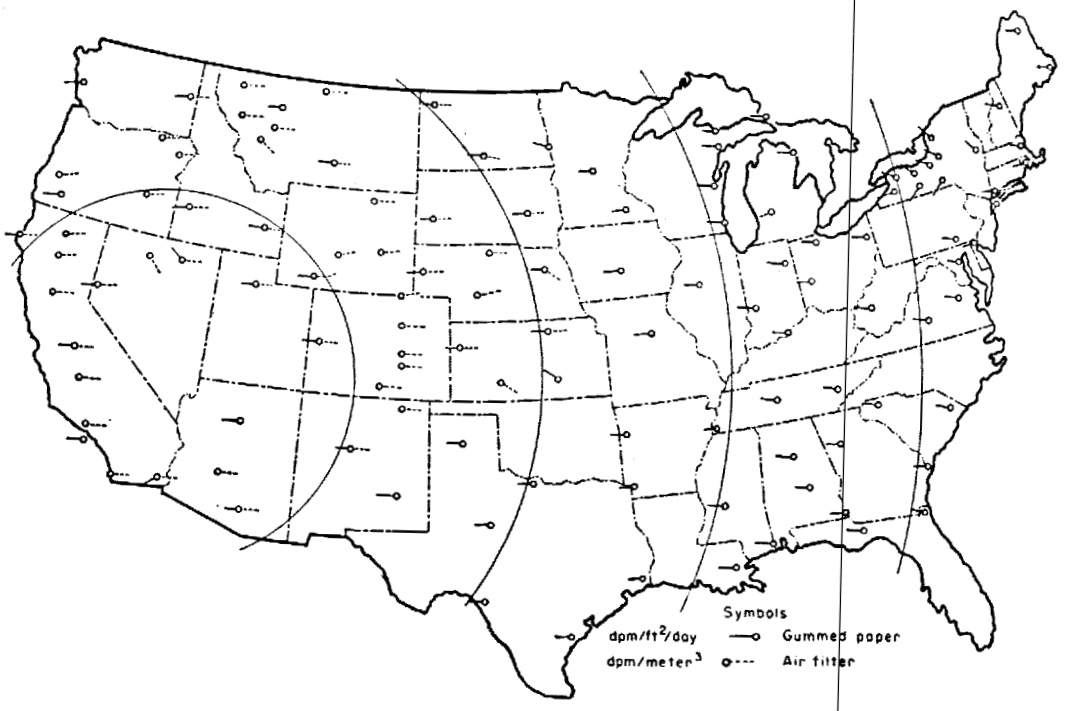
Sampling continues for 36 hours after the shot or until any rise in the radiation level has dropped to approximately the background level. The teams record weather as well as radiation data during the sampling period.

Instrument readings are transmitted periodically to the field headquarters, from which they are relayed to the test organization. Filter paper and gummed paper samples are sent to the New York operations office for counting.

Fixed Monitoring Stations

The fixed monitoring system which covers the entire United States 200 miles from the test site to each coast, operates continuously during the test periods. Fixed monitoring stations make no on-the-spot measurements; all samples are sent to New York for counting.

Two methods of sampling are used. Each of the 121 United States Weather Bureau stations in the fixed monitoring network collects gummed paper samples of settled dust daily. About one-half the stations also collect high-volume filter paper samples of airborne dust, using the same kind of sampling equipment as the mobile teams. Each station records the weather observed during the sampling period and transmits this information with the samples daily to New York.



Locations of the 121 fixed monitoring stations are shown on the above map. The symbols indicate whether the stations use air filters, gummed paper or both to collect fall-out samples. The arcs are 500 miles apart.

Counting of Samples

When the samples are received in New York, the weather information is recorded on a special punch card, and a number given to the sample. The sample is dry ashed in an electric furnace, and the ash is placed in a plastic planchet marked with the sample number.

These planchets are sealed between two vinyl plastic tapes and assembled into rolls of 100 samples each. The rolls are then placed on especially designed automatic beta counting instruments, and the activity of each sample is counted for 20 minutes or 640 counts, which-

ever comes first. The sample number and count are printed automatically on a paper strip, and the count later is transferred to the original punch card for centralization of data and ease of study.

On the basis of the previously determined rate for fission product decay, activities measured at the time of counting are extrapolated to the midpoint of the sampling day and marked on the punch card as "disintegrations per minute per square foot per 24 hours" (d/min/ft² 24 hr) in the case of gummed paper samples, or as "disintegrations per minute per cubic meter of air" (d/min/m³) in the case of filtered air samples.

Cooperation With Other Groups

In carrying out the National Monitoring System, the AEC has received cooperation and assistance from many agencies of Federal and State Government from industrial associations, and from private institutions and citizens. The collection of samples at the 121 fixed stations is done by personnel of the United States Weather Bureau. Weather Bureau scientists are active in interpreting the fall-out data in an attempt to correlate it with weather phenomena. The United States Chemical Corps has provided personnel for the mobile monitoring teams, and the United States Air Force supplies air transportation for the teams.

State and Federal public health departments have assisted the National Monitoring System in the collection of samples on occasion, and have interpreted data in response to inquiries for the press and public, as have universities and private laboratories.

Close liaison has been maintained with the National Association of Photographic Manufacturers to assure that that industry is informed of test programs. This procedure has assisted the photographic industry in planning and monitoring operations involving radiosensitive products. Similarly, laboratories and other industries that may be inconvenienced by slight increases in background radiation have been kept informed of the levels found, and have been given as much prior notice of test programs as national security would allow.

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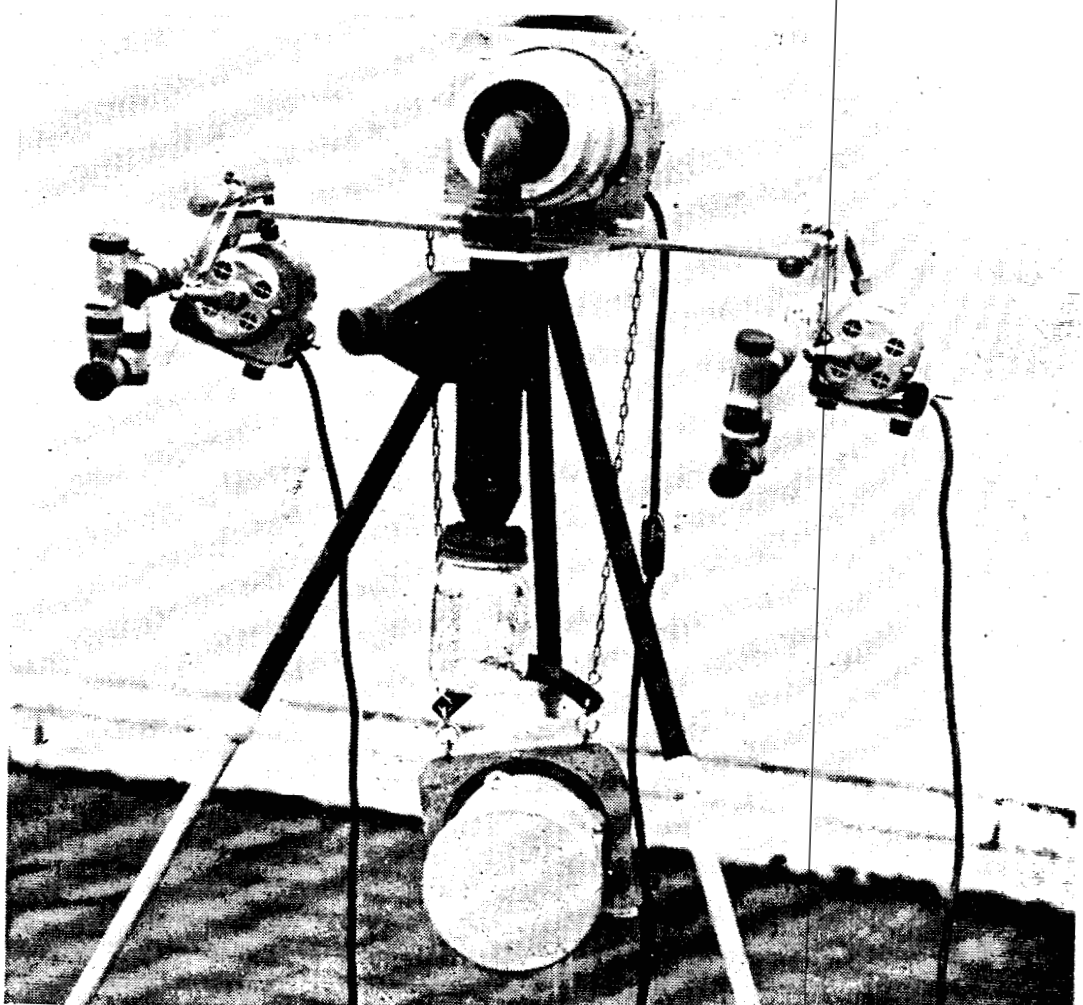
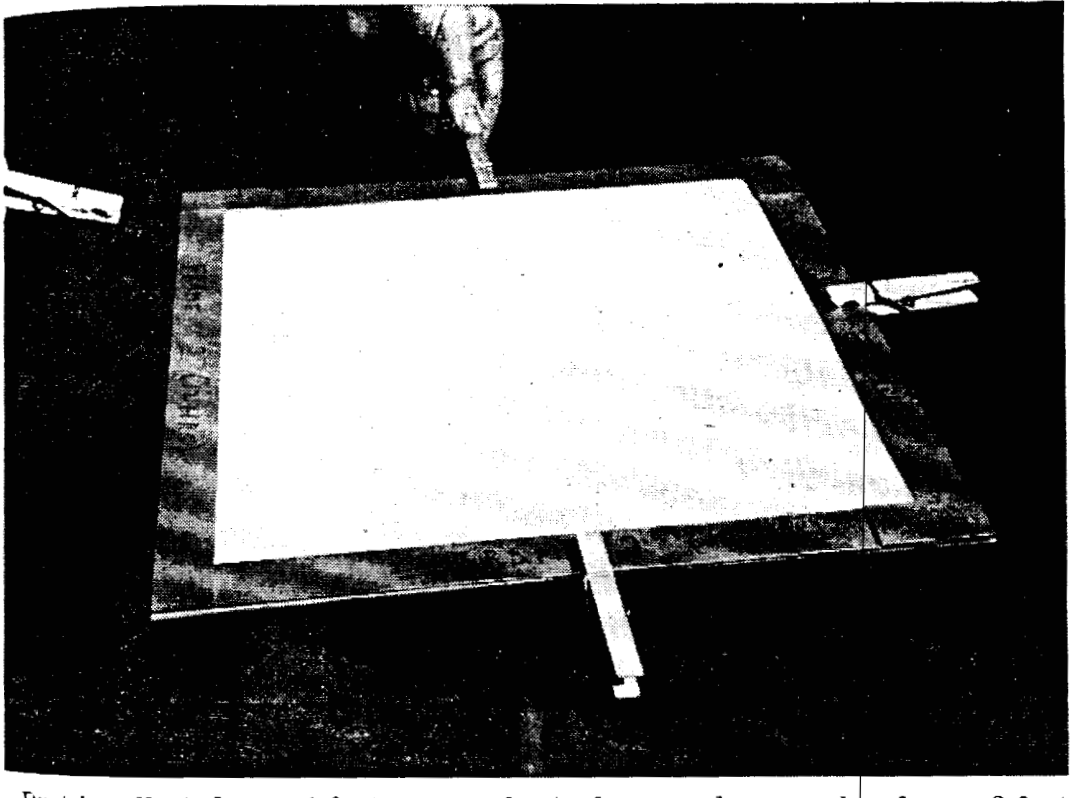
The National Monitoring System

The following photographs illustrate the methods used by the National Monitoring System to measure radioactivity deposited across the Nation by fall-out. The pictures show how samples of settled dust are collected on gummed paper, and how vacuum devices are used to collect samples of air-borne dust on filter paper. Also illustrated are the steps taken to measure and record the radioactivity of each sample.



The "Christmas Tree" is used by the mobile teams to sample dust which is suspended in the air. Samples are taken for periods of 20 minutes to 2 hours during the 48 hours after a test. At either end of the crossbar is a low volume particle size sampler through which air is pulled at the rate of one-half a cubic foot per minute. As they are drawn through the sampler the dust particles are separated according to size and collected in different bottles. At top and center are high-volume samplers which draw a cubic meter of air per minute and sample the total concentration of dust.

A suction device called an air sampler, through which an air flow of 40 cubic feet a minute is maintained, is used at some of the fixed monitoring stations. The filter paper and wire retainer at left are fastened on the front of the sampler and are protected by a metal cap (center). The air is drawn in around the edges of the cap and the suspended particles are deposited on the filter paper.

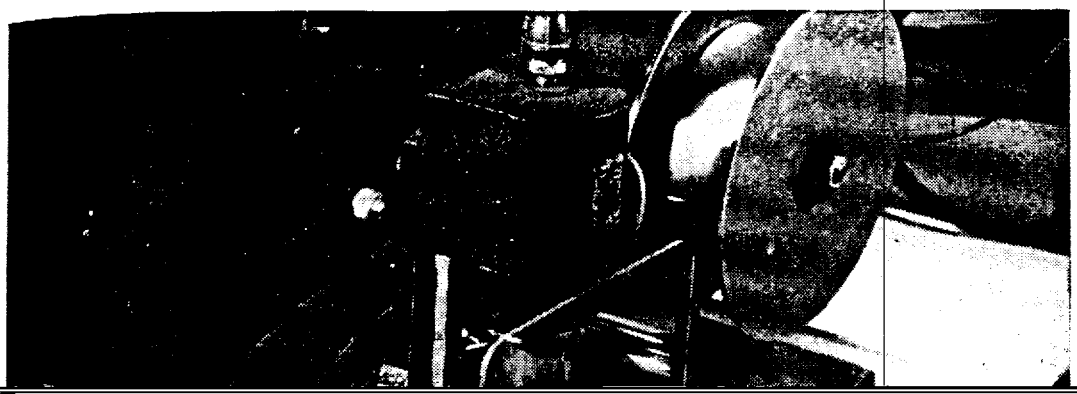


Dust is collected on a 1-foot square sheet of gummed paper placed on a 3-foot high stand in one of the two sampling methods used at fixed monitoring stations. The sheets are changed every 24 hours.

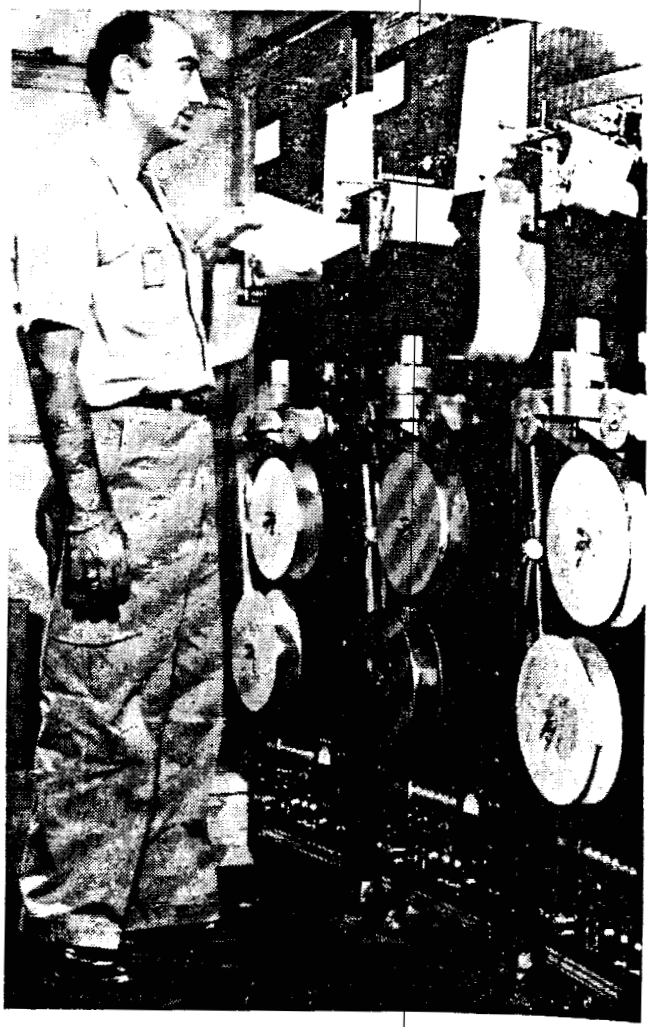
Duplicates of an identifying number are placed on the sample when it is received from the field, on the planchet in which it will be measured and on the data card where the measurement will ultimately be recorded.

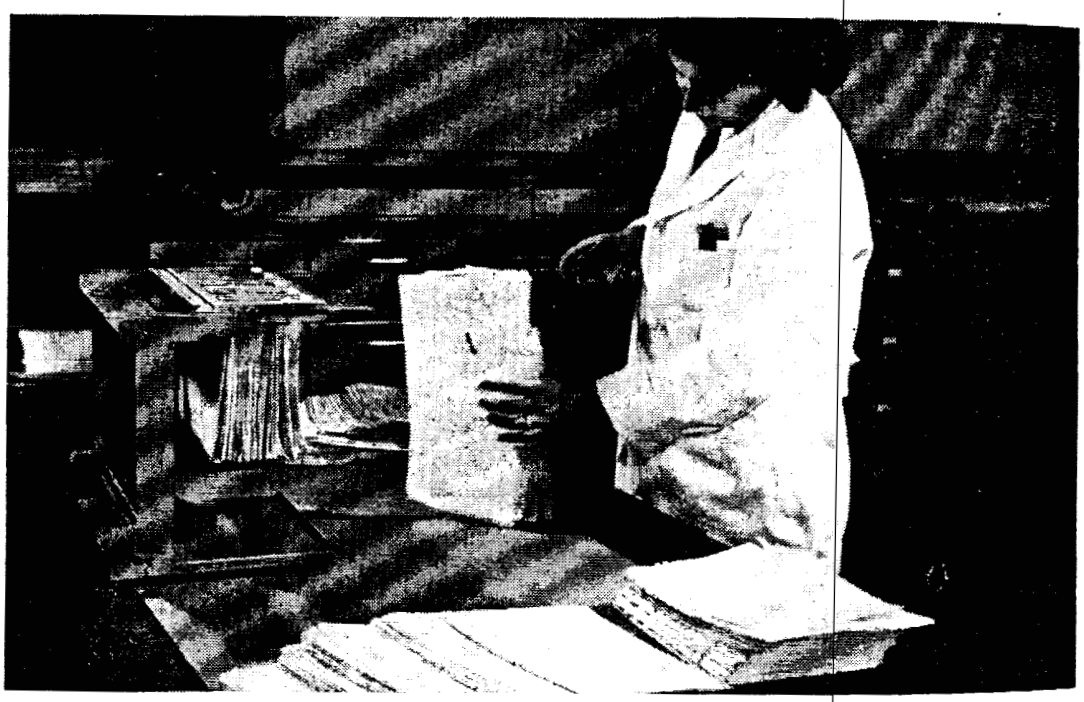
The technician at left folds samples and places them in crucibles for ashing in the furnace. At right, a technician grinds the ashes and places them in the numbered planchets for measuring.

The crucibles containing the folded samples are placed in an oxygen-fed furnace for ashing.



Rolls of 100 samples each are loaded on an automatic counting apparatus. Each sample is counted for 20 minutes or 640 counts, whichever comes first. The sample's position on the tape, the count and the counting time are stamped out on the paper roll by the printing recorder. The equipment used in the processing of samples makes possible the counting of 400 to 600 samples per day.





Data from the counting room are transferred to the data cards. Various methods for punching and sorting the cards make the development of specific subject data possible.

Fall-Out and Public Health

The body may safely receive a small dose of radiation because the effects are repaired virtually as rapidly as they are produced. A large number of small doses may be given over a period of time, as the body is able to repair itself between doses. Over a period of many years, a human being may safely receive a total amount of radiation which would cause a fatal illness if administered to his whole body within a period of a few minutes.

The body's ability to repair radiation damage has been taken into account in the establishment of maximum permissible radiation doses by two scientific bodies—the National Committee on Radiation Protection and the International Commission on Radiological Protection. The maximum permissible levels recommended by these groups include safety factors; that is, they are considerably lower than the radiation level which causes any observable bodily change.

In the following section, radiation exposures resulting from fall-out will be evaluated in the light of the maximum permissible doses for both external and internal radiation. It will be seen that of all the tens of thousands of measurements taken, none has shown a dangerous concentration of radioactive materials outside the proving ground.

Maximum Permissible Levels for External Radiation

Roentgenologists have been exposing themselves to X-rays for the past half-century, not always realizing their danger. Through long study of the effects of such exposures, it has been determined that a dose of 0.3 roentgen per week may be delivered to the whole body for an indefinite period without hazard.

The maximum permissible weekly rate of exposure is designed to assure safety for persons regularly exposed to penetrating radiation over periods of many years. It does not mean that 0.3 roentgen is the largest exposure which may be incurred in 1 week without hazard. The lowest dose which will produce detectable effects on the blood when given in a few minutes or hours is about 25 roentgens. But even this dose, so far as is known, will not cause any damage which the body cannot repair. An individual could not safely receive such a dose daily, and probably not even monthly, but occasional exposures well above 0.3 roentgen will have no detectable bodily effect.

An ad hoc committee composed of authorities in the fields of medicine and roentgenology has given careful study to the exposures which may be safely received by the public as a result of nuclear test detonations. This committee advised the United States Atomic Energy

Commission that a total dose of 3 roentgens in any period of 10 weeks would not exceed safe levels. The dose of 3 roentgens may be received as a result of a single exposure or a number of successive, smaller exposures, but the total exposure during the 10 weeks should not exceed 3 roentgens.

External Radiation from Fall-Out

None of the measurements of fall-out radioactivity outside the Nevada Proving Ground has exceeded the recommended maximum of 3 roentgens per 10 weeks. Nearly all the measurements have been far below this level.

The highest radiation level detected anywhere outside the proving grounds was at one of the two mines located nearby. Here, measurements showed a radiation level which would deliver an estimated dose of 1.75 roentgens during the first 10 weeks following fall-out and 2.25 roentgens during a lifetime. This level, the highest recorded as a result of any series of tests, is well within the limits recommended for public safety during nuclear tests.

Monitoring teams were stationed at both mines during the tests because of their proximity to the test site. As has been noted previously, persons living at one of the mines were asked to leave prior to one test, but returned the next day.

The highest gamma radiation levels recorded in cities and towns in the 200–500-mile zone were between 1 and 2 milliroentgens per hour. These levels rapidly decreased because of the radioactive decay of the fall-out material. Calculations show that if an individual remained over the material for an entire lifetime, he would receive a total dose of about 50 milliroentgens—one-sixth of the maximum permissible dose for 1 week.

Measurements in towns within the 200-mile zone, with one exception, showed only slightly higher values. The lifetime dose in this one community would be approximately 0.5 roentgens.

Although some radioactivity from fall-out has been detected at all of the 121 fixed monitoring stations across the Nation, fall-out levels generally have decreased with distance from the test site. For example, radioactivity resulting from fall-out in the Northeastern States, has been only about one-tenth as great as that in Nevada and surrounding States.

Radiation Damage to Cattle

Although beta particles cannot penetrate deeply, they may cause damage if a sufficient quantity of fall-out material is retained on or

near the skin for sufficient time. About 100 of a herd of 500 cattle suffered beta burns from fall-out following one of the 1952 tests. The cattle were grazing within the controlled area surrounding the proving ground. They suffered minor skin lesions which caused splotches of discolored hair, but neither their health nor their reproductive ability was impaired.

Maximum Permissible Levels for Internal Radiation

Radioactive materials may be inhaled or taken into the body in food and water. It has been noted that minute amounts of radioactivity occur naturally in the tissues of plants, animals, and human beings. Above certain concentrations, however, radioactivity in the body is dangerous.

Evaluation of the health hazard from internal radiation involves several factors which need not be taken into account in the case of radiation from an external source. For example, alpha and low-energy beta particles emanating from radioisotopes outside the body are not significant external radiation hazards, since they cannot penetrate the skin. When these radiations originate from radioisotopes which have been taken into the body, however, they may damage tissues.

Some radioisotopes are eliminated from the body rapidly, while others concentrate in one or another body organ. For example, radium, calcium and strontium are concentrated primarily in the skeleton; cesium in the muscles, and iodine in the thyroid gland. Some organs are more sensitive to radiation than others. Concentration in the bones is of particular importance, since the period of retention is long and the vital blood-forming tissues in the skeleton are sensitive to radiation.

The maximum permissible concentrations of a radioisotope which concentrates in organs or tissues other than the skeleton generally is defined as the amount which will deliver a dose of 300 millirems per week to the organ in which the isotope is concentrated.

The maximum permissible concentrations of radioisotopes which are concentrated in the skeleton generally are determined by comparison with radium. The effects of radium are well-known, since hundreds of persons carry appreciable concentrations of radium in their skeletons as a result of accidental intake or therapeutic administration by physicians. Studies of persons who have carried radium in their skeletons for many years have shown that quantities as large as 1 microgram (one-millionth of 1 gram) produce no observable damage. To provide a safety factor, 0.1 microgram has been established as the maximum permissible body content of radium.

Using the maximum permissible body content of radium as a standard, maximum permissible concentrations of other bone-seeking radioisotopes may be determined through comparing their effects with the effects of radium.

Fall-out material includes a number of radioisotopes, some of which are of more concern than others as internal radiation hazards. A maximum permissible air concentration for mixed fission products following a nuclear detonation has been established by the United States Atomic Energy Commission upon the recommendation of an advisory panel of experts. This concentration is 100 microcuries per cubic meter of air, averaged over a 24-hour period. Since particles between ½ micron and 5 microns are most likely to be retained in the lung, the maximum permissible concentration is 1 microcurie per cubic meter of air if the radioactivity is associated with particles less than 5 microns in diameter.

Safe concentrations of a mixture of fission products in drinking water depend upon the composition of the mixture and upon the period of time over which the water is used. It is estimated that water containing total fission product activity amounting to 0.005 microcurie per milliliter 3 days after the fission products were formed could be used safely for any period of time. To determine whether radioactivity measured in water at any other time after fall-out is safe, the measurement may be extrapolated to 3 days after formation and compared to the safe concentration noted above. If the water were to be used for only a few days or weeks, the concentration could be much higher without hazard.

Fall-Out As a Source of Internal Radiation

Fall-Out Radioactivity in Air

The highest concentration of airborne fall-out radioactivity observed within the 200-mile zone during the spring 1952 tests was 0.19 microcuries per cubic meter, averaged over a 24-hour period. The median diameter of this dust was approximately 2 microns, which is in the size range most likely to be retained in the lung. However, the concentration is less than a fifth of the maximum permissible concentration of 1 microcurie per cubic meter for dust of this size. It is estimated that the lungs would receive a total dose of about 200 millirem from this concentration of airborne radioactivity. This is approximately equal to the dose normally received by the lungs in 20 days from normal background radioactivity in the air.

Monitoring of airborne fall-out particles has shown that radioactivity is likely to remain significantly above background levels only

for about a day. The levels noted above, therefore, quickly decrease to background levels.

The following table shows the highest airborne concentrations measured outside of the 200-mile zone. The highest concentration is between two- and three-hundredths of the maximum permissible level for dust in the size range most likely to be retained in the lung.

AIRBORNE RADIOACTIVITY IN LOCATIONS AT WHICH MAXIMUM FALL-OUT WAS OBSERVED OUTSIDE THE 200-MILE ZONE

Detonation	*Locality*	*24-hour average concentration (Microcuries per cubic meter*
May 7, 1952	Ogden, Utah	0. 020
May 25, 1952	Price, Utah	0. 001
June 1, 1952	Elko, Nevada	0. 024
June 5, 1952	Elko, Nevada	0. 014

Fall-out Radioactivity in Water

The number of uncovered water sources in the area surrounding the proving ground is small. Measurements of radioactivity in such lakes and streams as exist in the area have shown no levels approaching the maximum permissible level for water consumed over an indefinite period. The table below shows results of measurements made during the spring 1952 test series. (Several other samples, including water from Lake Mead and drinking water at Las Vegas, Pioche, and Camp Mercury, did not contain detectable radioactivity.)

WATER ANALYSIS FOR RADIOACTIVITY NEAR NEVADA TEST SITE

Date	*Source*	*Approximate distance from ground zero (air miles)*	*Analysis (microcuries per milliliter at 3 days after detonation)*	
May 1, 1952	Crystal Springs Pond	63	0. 5 x 10^{-8}	microcuries
May 1, 1952	Pahranagat Lake	56	1. 0 x 10^{-8}	microcuries
May 2, 1952	Caliente—Drinking Water	95	0. 28 x 10^{-8}	microcuries
May 2, 1952	Creek North of Caliente	97	1. 1 x 10^{-8}	microcuries

Fall-out in Water Supply Systems. Various studies have been conducted under Commission sponsorship to determine the fate of fall-out material deposited in reservoirs and the ability of treatment plants to remove radioisotopes from water.

Harvard University has studied fall-out material in surface waters of Massachusetts and in reservoirs which supply water to the city of Boston. It has been found that the radioactive particles tend to settle

to the reservoir bottom. Further studies will be carried out to determine whether the spring and autumn "turnover" of water in reservoirs (a common occurrence resulting from water temperature differentials) disturbs settled radioactive particles.

Radioactivity in samples of Merrimac River water from the Lawrence, Mass., water treatment plant was measured in another series of experiments conducted independently by the Massachusetts State Department of Health. It was found that the plant removed 84 percent of the observed radioactivity, the largest drop occurring in passage through the rapid sand filters.

Experiments at the Oak Ridge National Laboratory and at the Massachusetts Institute of Technology over a period of several years indicate that water treatment plants remove some radioisotopes more effectively than others. Certain conventional water treatment methods are relatively ineffective in removing strontium, but removal of this isotope can be increased substantially by using phosphate and lime in the treatment process.

Studies also have shown that fall-out radioactivity disappears more rapidly in surface waters than may be accounted for by nuclear decay alone. Evidently other factors, such as deposition, biological uptake and absorption, are involved. These factors will be given further study.

Long-Term Effects of Fall-Out

In determining that nuclear tests could be held at the Nevada Proving Ground without serious hazard to the public, the Commission gave consideration to the possibility that hazardous levels of radioactivity might be built up as a result of a number of successive tests.

Because of the rapid decay of fission product activity, the fall-out residue from successive tests would be extremely unlikely to build up to levels which could be considered an external radiation hazard. The uptake of fission products by food and field crops is of greater potential concern, since these crops may be eaten by human beings or animals. Radioactive materials in plants, like those in air and water, are hazardous only when they are present in amounts which would produce concentrations in the body well above accepted maximum permissible concentrations.

Long-term effects of successive tests, both from the standpoint of external radiation and uptake by plants, are discussed in greater detail below.

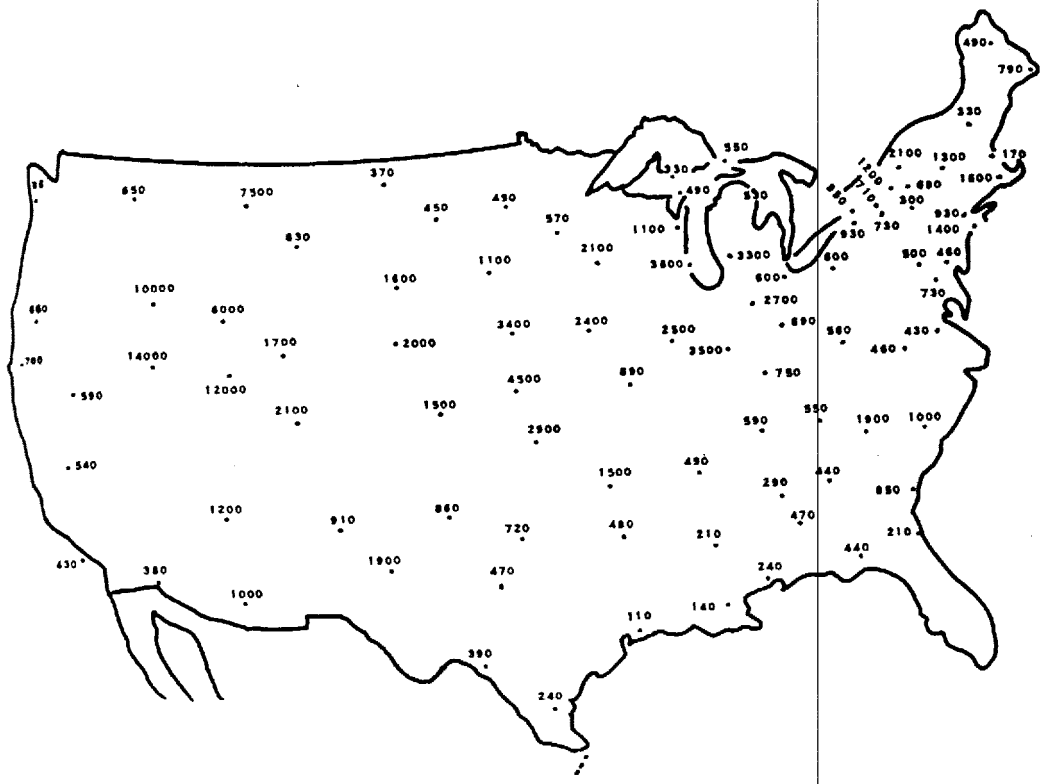
External Radiation. Total radioactivity estimated to be remaining on January 1, 1953, in communities inside the 200-mile zone as a result of the eight detonations in the spring 1952 series is shown in the

following table. The units used are disintegrations per minute per square foot for a sample collected over a period of 24 hours.

Location:	D/M/ft²
Las Vegas	21, 000
Crystal Springs	5, 400
Alamo	9, 000
Caliente	8, 300
Beatty	18, 000
Tonopah	740
Ely	117, 000
Indian Springs	44, 000

The highest figure in the above table—that for the sample taken at Ely, Nev.—represents gamma exposure estimated to be less than that resulting from normal background radiation.[12]

Radioactivity remaining on January 1, 1953, in other parts of the Nation as a result of the Spring 1952 test series is shown on the accompanying map. The map shows residual activity varying from 100 to 14,000 disintegrations per minute per square foot, depending on location. Exposure resulting from such levels of radioactivity would be far less than that received from normal background. It is apparent that the radioactivity resulting from the spring 1952 test



[12] The data in this table, as on the map on this page, are valuable in estimating the relative distribution of fall-out and in assessing the long-term effects of radioactive materials in the soil. These figures, however, represent beta counts, which cannot be converted into terms of external gamma exposure with a good assurance of reliability. The rough estimates which are possible, however, indicate that none of the activities shown in the table would result in gamma exposure greater than the normal background.

series has decayed to levels which have no significance as a source of external radiation.

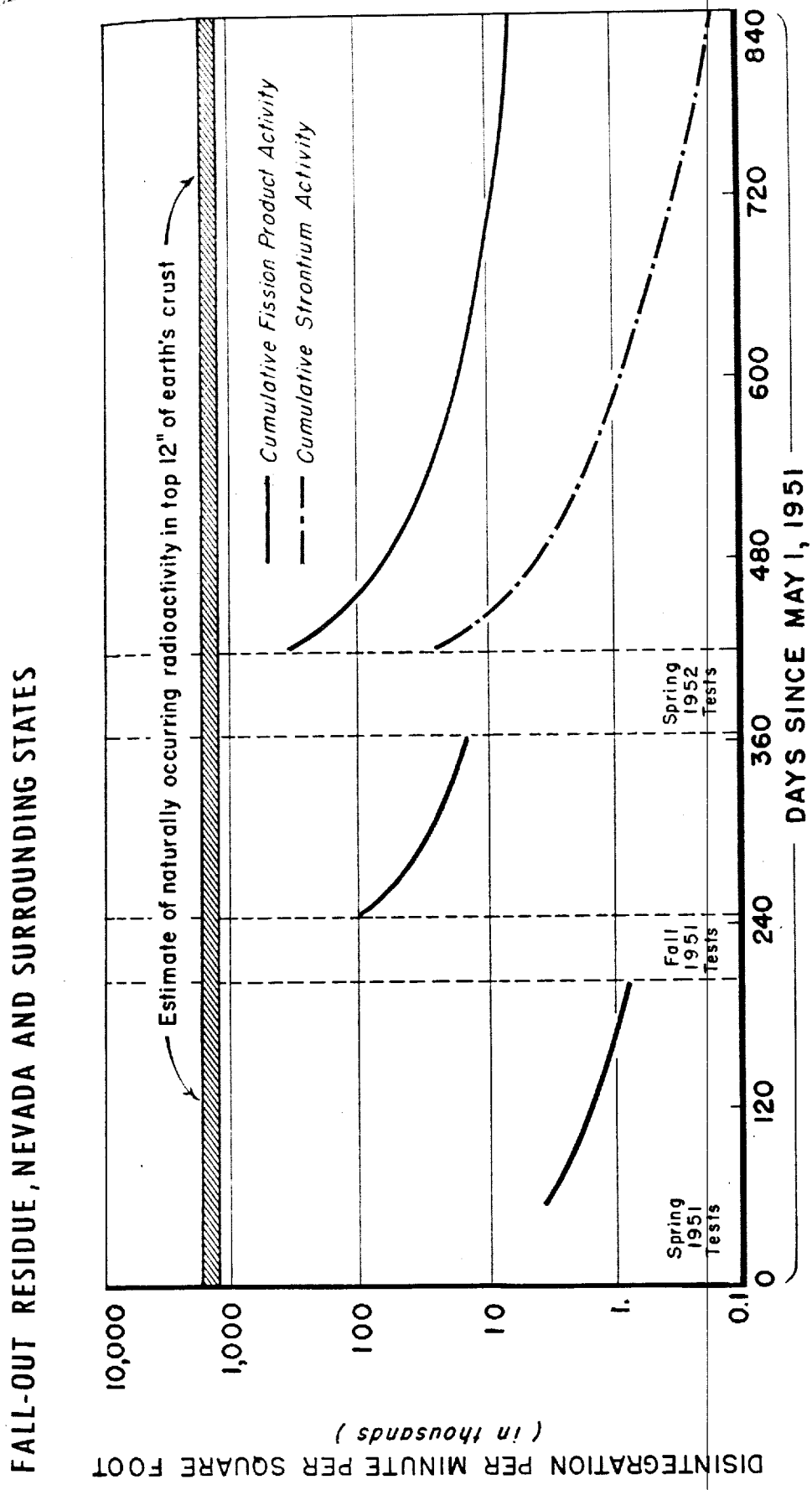
Soil Radioactivity. The radioactivity remaining in the soil in Nevada and surrounding states as a result of the three test series held to date is indicated on the chart on page 121. As the chart shows, the activity rapidly decays to levels considerably below the natural radioactivity present in the top 12 inches of the ground.

The unbroken curve at the left of the chart shows the increase in radioactivity in the soil resulting from the spring 1951 tests. Some activity from these tests still remained in the soil when the next series of tests was begun in the fall of 1951. The unbroken curve in the middle of the chart, therefore, represents both this activity and the new activity added by the fall tests. The unbroken curve at the right shows the total activity resulting from the spring 1951, fall 1951 and spring 1952 tests. The broken curve shows the total strontium activity resulting from the three series.

The mixture of radioactive materials in fall-out differs from that of the radioisotopes which occur naturally in the soil. The proportion of plant uptake also differs, as does the biological importance of the materials taken up by plants. Therefore, comparison of the fall-out curves on the chart with the level of natural soil radioactivity cannot be considered a direct comparison of the relative hazards involved in plant uptake. However, experimental growth of plants in soil containing thousands of times the residual fission product activity represented by the curves on the chart has indicated that there is no hazard from residual activity outside of the Proving Ground. These experiments are described below.

Plant Experiments. Plants have been grown in soil containing a concentration of fission products equivalent to that produced by the maximum fall-out observed in the immediate vicinity of the point of detonation. Radishes, barley, oats, cowpeas, and ryegrass were used in these experiments. The principal fission product taken up by the plants was radioactive strontium. Experiments with soils of varying calcium content showed that the strontium uptake is much less for soils rich in calcium.

One to two hundred pounds of these plants, grown in the very high concentrations of fission products which might be found in the immediate vicinity of the detonations on the proving ground, could be eaten by an individual without acquiring the maximum permissible body burden of radioactive strontium. The maximum radioactive content of plants grown at a distance of a few miles from the point of detonation would be considerably lower.


FALL-OUT RESIDUE, NEVADA AND SURROUNDING STATES
DISINTEGRATION PER MINUTE PER SQUARE FOOT
(in thousands)
10,000
1,000
100
10
1.
0.1
Estimate of naturally occurring radioactivity in top 12" of earth's crust
Cumulative Fission Product Activity
Cumulative Strontium Activity
Spring 1951 Tests
Fall 1951 Tests
Spring 1952 Tests
0
120
240
360
480
600
720
840
DAYS SINCE MAY 1, 1951

Uptake by Animals. Cattle and other animals may eat plants which contain radioactive materials from fall-out. Studies have been made of the possibility of hazard to humans as a result of eating meat from such animals. These studies indicate that the bone-seeking radioisotopes are of greatest potential concern, and that the chief among these is radiostrontium.

Cattle absorb 25 to 30 percent of the ingested strontium, with about 25 percent reaching the bone. A few days after entrance of radiostrontium into the body, about 99 percent of the remaining amount will be in the bones. The only potential hazard to human beings would be the ingestion of bone splinters which might be intermingled with muscle tissue during butchering and cutting of the meat. An insignificant amount would enter the human body in this fashion.

Fission products distributed in water may be accumulated by aquatic animals and plants. Here again, data gathered at Bikini and Eniwetok as well as in this country indicates that there is no radiation hazard to human beings from this source.

The amount of fall-out radioactivity in water decreases rapidly because of radioactive decay and dilution by water from outside the fall-out area. The rate of decrease is illustrated by the amount of radioactivity in fish in the lagoon at Eniwetok. The average radioactivity of the various fish caught was relatively high on the day following a detonation, although it did not reach dangerous levels. Two months later, the radioactivity in fish in the lagoon had decreased to a fraction of 1 percent of the initial amount.

The amount of radioactivity accumulated by water life also decreases rapidly with distance from a detonation. Fish caught in areas 7 to 14 miles distant from the test site 2 months after tests at Eniwetok had an average radioactivity amounting to only 5 percent of that in fish caught near the site.

Genetic Effects of Radiation

The preceding sections of this report have dealt with the somatic effects of radiation; that is, bodily changes which are not inherited, but which disappear with the death of the individual. However, radiation also can affect the germ cells in animals and plants and thus affect the characteristics passed on from one generation to the next.

Mutations, or changes in the units of heredity in the germ cells which eventually may appear as new or different characteristics in offspring, occur spontaneously under natural conditions in all kinds of animals and plants. Background radiation is one factor in the natural mutation rate, but apparently it is a minor one.

It is important to recognize that radiation does not cause any mutations which are not produced naturally in other ways. Radiation, however, increases the frequency of mutations above the normal rate, and the increase seems to be in direct proportion to the dosage. Since most mutations are disadvantageous, large increases are considered undesirable.

We have noted that low levels of radiation produce no detectable somatic effect; that is, the body is able to repair the damage virtually as quickly as it occurs. Such low-level exposure can be continued indefinitely without any detectable bodily change. This does not seem to be the case for the germ plasm. Evidence accumulated to date indicates that mutations are in proportion to the dose, with no repair or recovery process at work. It follows that small doses are cumulative in their genetic effects, and that daily or weekly repetitions of such doses over a long period could produce a noticeable increase in the numbers of mutations among offspring.

Studies have been made of the increase in the mutation rate among mice as a result of exposure to radiation. If these data can be applied to human germ cells, it may be calculated that the natural rate of human mutation would be doubled by exposing the germ cells to about 80 roentgens. This is 1,600 times higher than the lifetime exposure level of 50 milliroentgens noted in communities surrounding the test site as a result of fall-out. It is 35 times more than the lifetime exposure which would result from the highest fall-out radioactivity noted outside the test site itself—the reading taken at one of the nearby mines.

The natural human mutation rate is so low that it is doubtful that a doubling would be noticeable in one generation since a large proportion of the mutations are recessive. Data collected by the Atomic Bomb Casualty Commission in Japan indicate an insignificant increase in the number of detectable mutations in the children of persons subjected to radiation hundreds or thousands of times greater than that from fall-out. On the basis of experiments and observations so far made, it appears that over a number of generations radiation from fall-out from Nevada tests would have no greater effect on the human mutation rate in the United States than would natural radiation in those parts of the Nation where the background levels are high.

Future Monitoring and Research Programs

Although the precautions taken to prevent hazard to the public from continental weapons tests have proved to be adequate, there is a continuing need for monitoring levels of fall-out radioactivity. The

monitoring program will be continued in connection with future tests at the Nevada Proving Ground for the following reasons:

(a) Monitoring of future tests will provide a continuing record of residual soil radioactivity from fall-out. This record will give ample warning of any possibility of a dangerous accumulation of radioactivity at any future time as a result of numerous successive tests.

(b) Monitoring of future tests should provide additional information regarding the relation of fall-out to weather conditions and to the type of burst. Such information will be of use in making even more precise the protection of the public.

(c) Monitoring in communities near the Nevada Proving Ground will assure that proper precautions are taken by residents should fall-out radiation ever reach the maximum permissible level.

(d) Monitoring will continue to provide guidance to industries affected by slight increases above the normal background radiation level.

Various research projects relating to fall-out also should provide valuable information in the future. These studies include further research into uptake of various radioisotopes by food and field crops and into methods of removing radioistopes from water supply systems. Various studies of the effect of radiation on the human body also should provide data of use in evaluating possible effects of fall-out.

Conclusion

It has become evident from the studies on fall-out from the clouds produced by 20 explosions of atomic bombs at the Nevada Proving Ground that these explosions created no immediate nor long range hazard to human health because of fall-out outside the proving ground. The studies have shown:

(a) *As to external exposure due to gamma radiation from fall-out material.* The greatest exposure measured at any inhabited point was below the maximum permissible exposure, with only a few towns and cities showing even an appreciable fraction of this value.

(b) *As to radioactivity in the air following any of the 20 shots.* The maximum concentration measured at any inhabited locality was about one-fifth as great as the maximum permissible concentration, and this activity remained in the air for less than 24 hours.

(c) *As to radioactivity present in water sources near the proving ground.* The maximum at any location was several thousand

times below the amount that could be safely consumed for an indefinite period.

(d) *As to the taking up of radioactivity by plants.* The maximum taken up in experiments with plants grown on soils containing several thousand times the radioactivity that was occasioned by fall-out off the proving ground was so small that a human being would have to eat 200 pounds of the plant material to reach a maximum permissible concentration in the body.

(e) *As to the taking in of radioactivity by animals eating plants grown in soil affected by the fall-out from the tests.* Experiments have indicated that there is no hazard to human health from this source.

(f) *As to possible changes in mutation rate of humans exposed to radioactivity from fall-out.* It would take 1,600 times the average radioactivity deposited by fall-out in communities surrounding the proving ground and 35 times the highest radioactivity deposited from fall-out to bring about a doubling of the number of mutations occurring naturally in human beings from one generation to another.

To sum up, the experience with 20 experiments with atomic devices at the Nevada Proving Ground has been that there is negligible hazard to property from blast; that proper warnings and patrolling have prevented any injury to humans from heat, light, or blast; and that the highest levels of radioactivity released by fall-out of particles are well below the very conservative standards fixing the amounts of radiation that can be received externally or internally by the human body without harming the present or later generations.

The AEC is continuing to refine and strengthen the system of warning, monitoring, and reporting. The agency is now making arrangements with public health officers of local Governmental units so that they may be kept apprised of the levels of radioactivity resulting from fall-out from the explosion clouds. It is the Commission's hope that in the near future there will be no occasion for alarm through lack of knowledge of the facts about levels of radiation and their degree of hazard, just as there is now no reason in actuality for alarm, since the radioactivity released by fall-out has proved not to be hazardous.

APPENDIX 1

Organization and Principal Staff of U. S. Atomic Energy Commission

Atomic Energy Commission	Gordon Dean, *Chairman.* Thomas E. Murray. H. D. Smyth. Eugene M. Zuckert. (Vacancy)
General Manager	M. W. Boyer.
Deputy General Manager	Walter J. Williams.
Assistant to Deputy General Manager	James L. Kelehan.
Controller	Don S. Burrows.
General Counsel	Harold L. Price, *Acting.*
Secretary to Commission	Roy B. Snapp.
Director, Office of Classification	James G. Beckerley.
Director, Office of Industrial Development	William L. Davidson.
Director, Office of Intelligence	Walter F. Colby.
Chief, Office of Operations Analysis	David P. Herron.
Chief, Office of Special Projects	John A. Hall.
Director, Division of Biology and Medicine	Dr. John C. Bugher.
Director, Division of Engineering	Lawrence R. Hafstad, *Acting.*
Director, Division of Military Application	Brig. Gen. K. E. Fields.
Manager, Santa Fe (Albuquerque, N. Mex.) Operations Office	Carroll L. Tyler.
Burlington (Iowa) Field Office	E. W. Giles.
Eniwetok Field Office (Albuquerque, N. Mex.)	Paul W. Spain.
Kansas City (Mo.) Field Office	James C. Stowers.
Las Vegas (Nev.) Field Office	Seth R. Woodruff, Jr.
Los Alamos (N. Mex.) Field Office	Frank C. Diluzio.
Pantex (Amarillo, Tex.) Field Office	Walter W. Stagg.
Rocky Flats (Colo.) Field Office	Gilbert C. Hoover.
Sandia (N. Mex.) Field Office	Daniel F. Worth, Jr.
Director, Division of Production	R. W. Cook.
Manager, Hanford (Wash.) Operations Office	David F. Shaw.

Director, Division of Production—Con.	
Manager, New York (N. Y.) Operations Office	WILBUR E. KELLEY.
Brookhaven (Long Island, N. Y.) Area Office	E. L. VAN HORN.
Cleveland (Ohio) Area Office	BUFORD SPARKS.
Fernald (Cincinnati, Ohio) Area Office	C. L. KARL.
St. Louis (Mo.) Area Office	J. PERRY MORGAN.
Manager, Oak Ridge (Tenn.) Operations Office	S. R. SAPIRIE.
Dayton (Miamisburg, Ohio) Area Office	JOHN H. ROBERSON.
Paducah (Ky.) Area Office	ERNEST A. WENDE.
Portsmouth (Ohio) Area Office	KENNETH A. DUNBAR.
Manager, Savannah River (Augusta, Ga.) Operations Office	CURTIS A. NELSON.
Dana (Terre Haute, Ind.) Area Office	CHARLES W. REILLY.
Wilmington (Del.) Area Office	D. EWING IRONS.
Director, Division of Raw Materials	JESSE C. JOHNSON.
Manager, Grand Junction (Colo.) Operations Office	SHELDON P. WIMPFEN.
Director, Division of Reactor Development	LAWRENCE R. HAFSTAD.
Manager, Chicago (Ill.) Operations Office	A. TAMMARO.
Ames (Iowa) Area Office	W. W. LORD.
Lockland (Ohio) Area Office	E. M. VELTEN.
Pittsburgh (Pa.) Area Office	LAWTON D. GEIGER.
Manager, Idaho (Idaho Falls) Operations Office	L. E. JOHNSTON.
Manager, San Francisco (Calif.) Operations Office	JOHN FLAHERTY.
Manager, Schenectady (N. Y.) Operations Office	JON D. ANDERSON.
Director, Division of Research	THOMAS H. JOHNSON.
Director, Division of Construction and Supply	E. J. BLOCH.
Director, Division of Information Services	MORSE SALISBURY.
Director, Division of Organization and Personnel	OSCAR S. SMITH.
Director, Division of Security	JOHN A. WATERS, Jr.

APPENDIX 2

MEMBERSHIP OF COMMITTEES

STATUTORY COMMITTEES

Joint Committee on Atomic Energy—Eighty-second Congress

This committee was established by the Atomic Energy Act of 1946 (sec. 15) to make "continuing studies of the activities of the Atomic Energy Commission and of problems relating to the development, use, and control of atomic energy." The committee is kept fully and currently informed with respect to the Commission's activities. Legislation relating primarily to the Commission or to atomic energy matters are referred to the committee. The committee's membership is composed of nine members of the Senate and nine members of the House of Representatives.

Representative CARL T. DURHAM (North Carolina), *acting chairman.*
Senator RICHARD B. RUSSELL (Georgia).
Senator EDWIN C. JOHNSON (Colorado).
Senator CLINTON P. ANDERSON (New Mexico).
Senator LYNDON B. JOHNSON (Texas).
Senator JOHN O. PASTORE (Rhode Island).
Senator BOURKE B. HICKENLOOPER (Iowa).
Senator EUGENE D. MILLIKIN (Colorado).
Senator WILLIAM F. KNOWLAND (California).
Senator JOHN W. BRICKER (Ohio).
Representative CHET HOLIFIELD (California).
Representative MELVIN PRICE (Illinois).
Representative PAUL J. KILDAY (Texas).
Representative HENRY M. JACKSON (Washington).
Representative W. STERLING COLE (New York).
Representative CHARLES H. ELSTON (Ohio).
Representative CARL HINSHAW (California).
Representative JAMES E. VAN ZANDT (Pennsylvania).
WILLIAM L. BORDEN, *executive director.*
HAROLD BERGMAN, *deputy director.*

Military Liaison Committee

Under sec. 2 (c) of the Atomic Energy Act of 1946, as amended, "there shall be a Military Liaison Committee consisting of a Chairman, who shall be the head thereof, and of a representative or representatives of the Departments of the Army, Navy, and Air Force, detailed or assigned thereto, without additional compensation, in such number as the Secretary of Defense may determine. Representatives from each of the three Departments shall be designated by the respective Secretaries of the Army, Navy, and Air Force. The committee Chairman shall be appointed by the President, by and with the advice and consent of the Senate, and shall receive compensation at a rate prescribed by law for the Chairman of the Munitions Board. The Commission shall advise and consult with the committee on all atomic energy matters which the committee deems

to relate to military applications, including the development, manufacture, use and storage of bombs, the allocation of fissionable material for military research, and the control of information relating to the manufacture or utilization of atomic weapons. The Commission shall keep the committee fully informed of all such matters before it and the committee shall keep the Commission fully informed of all atomic energy activities of the Department of Defense. The committee shall have authority to make written recommendations to the Commission on matters relating to military applications from time to time as it may deem appropriate. If the committee at any time concludes that any action, proposed action, or failure to act of the Commission on such matters is adverse to the responsibilities of the Department of Defense, derived from the Constitution, laws, and treaties, the committee may refer such action, proposed action, or failure to act to the Secretary of Defense. If the Secretary concurs, he may refer the matter to the President, whose decision shall be final."

Hon. ROBERT LEBARON, chairman.
Col. KENNER F. HERTFORD, United States Army.
Brig. Gen. HARRY MCK. ROPER, United States Army.
Rear Adm. GEORGE C. WRIGHT, United States Navy.
Capt. JAMES S. RUSSELL, United States Navy.
Maj. Gen. JAMES E. BRIGGS, United States Air Force.
Maj. Gen. HOWARD G. BUNKER, United States Air Force.
Capt. R. P. HUNTER, United States Navy, executive secretary.

General Advisory Committee

This committee was established by the Atomic Energy Act of 1946 (sec. 2 (b)). The nine civilian members are appointed by the President to advise the Commission on scientific and technical matters relating to materials, production, and research and development. Under the Atomic Energy Act, the committee shall meet at least four times in every calendar year; the committee held its first meeting in January 1947, and to date has averaged six meetings a year.

Dr. I. I. RABI, chairman; professor of physics, Columbia University, New York, N. Y.
Dr. OLIVER E. BUCKLEY, former chairman, Bell Telephone Laboratories, New York, N. Y.
Dr. J. B. FISK, director of research, Bell Telephone Laboratories, Murray Hill, N. Y.
Dr. W. F. LIBBY, professor of chemistry, University of Chicago, Chicago, Ill.
EGER V. MURPHREE, president, Standard Oil Development Co., New York, N. Y.
Dr. JOHN VON NEUMANN, professor, school of mathematics, Institute for Advanced Studies, Princeton, N. J.
Dr. J. C. WARNER, president, Carnegie Institute of Technology, Pittsburgh, Pa.
WALTER G. WHITMAN, chairman, Research and Development Board, Department of Defense, Washington, D. C.
Dr. EUGENE P. WIGNER, professor of physics, Princeton University, Princeton, N. J.
Dr. RICHARD W. DODSON, secretary; chairman, department of chemistry, Brookhaven National Laboratory, Upton, Long Island, N. Y.

PATENT COMPENSATION BOARD

This board was established in April 1949 pursuant to section 11 of the Atomic Energy Act of 1946, which provides that upon application for just compensation or awards or for the determination of a reasonable royalty fee certain proceedings shall be held before such a board. To date the board has held 10 sessions; 12 cases have been filed, of which 7 have been finally determined by the board; 1 claim has been awarded and 1 claim has been withdrawn.

CASPER W. OOMS, chairman; firm of Casper W. Ooms, Chicago, Ill.
ISAAC HARTER, of Babcock & Wilcox Tube Co., Beaver Falls, Pa.
JOHN V. L. HOGAN, consulting engineer, Hogan Laboratories, Inc., New York, N. Y.

PERMANENT PANEL APPOINTED BY THE PRESIDENT—ATOMIC ENERGY LABOR RELATIONS PANEL

The members of this panel were appointed by the President in 1949 and in 1950 to take jurisdiction and mediate labor-management disputes which threaten to interfere with essential operations of the Atomic Energy Commission. The panel operates under procedures designed to safeguard continuity of operations while not inhibiting free collective bargaining between AEC contractors and unions. It reports semiannually to the President on its activities (see Appendix 7).

WILLIAM H. DAVIS, chairman; of Davis, Hoxie & Faithfull, New York, N. Y.; chairman, Patent Survey Committee, U. S. Department of Commerce.
FRANK P. DOUGLASS; of Douglass & Douglass, Oklahoma City, Okla.
JOHN T. DUNLOP, professor of economics, Harvard University, Cambridge, Mass.
AARON HORVITZ, lawyer and arbitrator, New York and New Jersey.
GODFREY P. SCHMIDT, lawyer, New York, N. Y.
EDWIN E. WITTE, chairman, department of economics, University of Wisconsin, Madison, Wis.

COMMITTEE OF SENIOR REVIEWERS

The Committee of Senior Reviewers appointed in 1946 by the Manhattan District and reaffirmed by the AEC has been increased from four to six members to meet the expanding scope of the Atomic Energy Commission's technical activities. The committee reviews the major phases of the Atomic Energy Commission program and is the principal adviser to the Commission on classification and declassification matters, making recommendation for formulating and modifying the rules and guides for classifying scientific and technical information. The committee members are appointed for a term of 5 years on a rotating basis. The next new appointment will be made on July 1, 1953.

Dr. WARREN C. JOHNSON, chairman; associate dean of physical sciences, University of Chicago, Chicago, Ill.
Dr. R. H. CRIST, director of physical research, Carbide & Carbon Chemicals Co. Plant, Charleston, W. Va.
Dr. THOMAS B. DREW, head, department of chemical engineering, Columbia University, New York, N. Y.

Dr. JOHN P. HOWE, research associate, General Electric Co., Schenectady, N. Y.
Dr. J. M. B. KELLOGG, division leader, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.
Dr. J. R. RICHARDSON, associate professor of physics, University of California, Los Angeles, Calif.

ADVISORY BODIES TO THE ATOMIC ENERGY COMMISSION

Advisory Committee on Biology and Medicine

The Advisory Committee on Biology and Medicine was created in September 1947, on the recommendation of the Commission's Medical Board of Review. The committee reviews the AEC programs in medical and biological research and health and recommends to the Commission general policies in these fields. The committee has held 34 meetings and reports to the Commission on each meeting.

Dr. ALAN GREGG, chairman; director for medical sciences, Rockefeller Foundation, New York, N. Y.
Dr. EDWARD A. DOISY, director, department of physiology and biochemistry, St. Louis University School of Medicine, St. Louis, Mo.
Dr. GIOACCHINO FAILLA, head, department of radiology, Columbia University Medical School, New York, N. Y.
Dr. E. C. STAKMAN, chief, division of plant pathology and botany, University of Minnesota, Minneapolis, Minn.
Dr. CURT STERN, professor of zoology, University of California, Berkeley, Calif.
Dr. SHIELDS WARREN, pathologist, New England Deaconess Hospital, Boston, Mass.
Dr. JOSEPH T. WEARN, dean, school of medicine, Western Reserve University, Cleveland, Ohio.

Advisory Committee on Chemistry

This committee was appointed in June 1949 to advise on policy concerning the AEC program of supporting basic unclassified chemistry research in universities, and the relationship of this program to the AEC's own chemistry research program. Most of the work of the committee is accomplished by individual consultation as specific problems arise.

Dr. FARRINGTON DANIELS, professor of chemistry, University of Wisconsin, Madison, Wis.
Dr. G. B. KISTIAKOWSKY, professor of chemistry, Harvard University, Cambridge, Mass
Dr. JOSEPH E. MAYER, professor of chemistry, University of Chicago, Chicago, Ill.
Dr. DON M. YOST, professor of chemistry, California Institute of Technology, Pasadena, Calif.

Community Operations Panel

This committee was appointed in July 1950 to study the problems of introducing private ownership of real property and self-government in the AEC

communities at Los Alamos, N. Mex.; Richland, Wash.; and Oak Ridge, Tenn. The committee has visited the three communities and made detailed reports to the Commission relating to these problems.

RICHARDSON G. SCURRY, chairman; of Scurry, Scurry & Pace, Dallas, Tex.
FREDERICK M. BABCOCK, private consultant in construction finance and housing, Washington, D. C.
GEORGE E. BEAN, city manager, Grand Rapids, Mich.
GEORGE GOVE, former vice president for housing projects, Metopolitan Life Insurance Co., New York, N. Y

Advisory Board of Contract Appeals

This board was established in February 1950. One or more of its members hears contract appeals arising under the "disputes articles" of AEC contracts and subcontracts and makes recommendations to the General Manager concerning their disposition.

HENRY P. BRANDIS, Jr., dean of the law school, University of North Carolina, Chapel Hill, N. C.
SHELDON D. ELLIOTT, director of institute for judicial administration, New York University, New York, N. Y.
ROBERT KINGSLEY, dean, school of law, University of Southern California, Los Angeles, Calif.
EDMUND R. PURVES, executive director, American Institute of Architects, Washington, D. C.
HERBERT F. TAGGART, dean, school of business administration, University of Michigan, Ann Arbor, Mich.

Advisory Committee on Industrial Information

This committee was reconstituted and expanded in April 1952 to replace an ad hoc committee appointed in 1949 to advise the AEC on disseminating unclassified technological information to industry. The members will visit a number of AEC sites to identify information of use to industry which should be submitted for declassification and will recommend arrangements for the widest possible publication and distribution of such declassifiable information.

SIDNEY D. KIRKPATRICK, chairman; vice president and director of editorial development, McGraw-Hill Book Co., Inc., New York, N. Y.
JOHN BEALL, manager of publications, The American Institute of Mining and Metallurgical Engineers, New York, N. Y.
H. E. BLANK, editor, Modern Industry, Magazines of Industry, Inc., New York, N. Y.
DR. ALLAN G. GRAY, editor, Steel, Penton Publishing Co., Cleveland, Ohio.
GENE HARDY, National Association of Manufacturers, Washington, D. C.
KEITH HENNEY, editor, Nucleonics and Electronics, McGraw-Hill Publishing Co., Inc.; American Institute of Radio Engineers, New York, N. Y.
DR. ELMER HUTCHISSON, editor, Journal of Applied Physics, American Institute of Physics, New York, N. Y.
WALTER E. JESSUP, editor, Civil Engineering, The American Society of Civil Engineers, New York, N. Y.

ANDREW W. KRAMER, editor, Power Engineering, The Technical Publishing Co., Chicago, Ill.

EVERETT S. LEE, American Institute of Electrical Engineers, New York, N. Y.

Dr. WALTER J. MURPHY, editor, Chemical and Engineering News, American Chemical Society, Washington, D. C.

KARL T. SCHWARTZWALDER, The American Ceramic Society, Inc., Columbus, Ohio.

GEORGE F. SULLIVAN, managing editor, The Iron Age, Chilton Publications, Inc., New York, N. Y.

E. E. THUM, editor, Metal Progress, American Society for Metals, Cleveland, Ohio.

S. A. TUCKER, publications manager, American Society of Mechanical Engineers, New York, N. Y.

F. J. VAN ANTWERPEN, editor, Chemical Engineering Progress, American Institute of Chemical Engineers, New York, N. Y.

Dr. ALBERTO F. THOMPSON, secretary; chief, technical information service, division of information services, AEC, Washington, D. C.

N. H. JACOBSON, assistant secretary; technological information officer, division of information services, AEC, Washington, D. C.

Industrial Information Committee

This committee, representing AEC operating divisions and offices of operations and the major contractors, was appointed this year to guide the dissemination of AEC-developed information to industry. Meetings are held three times a year.

Dr. ALBERTO F. THOMPSON, chairman; chief, technical information service, division of information services, AEC, Washington, D. C.

CORBIN ALLARDICE, director of public information service, New York Operations Office, AEC, New York, N. Y.

Dr. BREWER F. BOARDMAN, head, technical information branch, Idaho Operations Office, AEC, Idaho Falls, Idaho.

GEORGE L. BROWN, manager of public relations, General Electric Co., Hanford Works, Richland, Wash.

Dr. F. L. CUTHBERT, technical director, National Lead Co. of Ohio, Cincinnati, Ohio.

H. W. DAVIS, Jr., deputy director, technical and production division, Savannah River Operations Office, AEC, Augusta, Ga.

W. E. DREESZEN, administrative aide to director, Ames Laboratory, Ames, Iowa.

R. G. ELLIOTT, director of information, Santa Fe Operations Office, AEC, Albuquerque, N. Mex.

LESTER C. FURNEY, assistant to director, Argonne National Laboratory, Lemont, Ill.

J. F. HAGGERTY, biochemist, medical branch, division of biology and medicine, AEC, Washington, D. C.

WILLIAM H. HAMILTON, staff assistant to assistant manager, Westinghouse Atomic Power Division, Pittsburgh, Pa.

W. L. HARWELL, head, patents and declassification department, Carbide & Carbon Chemicals Co., div. of Union Carbide & Carbon Corp., (K–25), Oak Ridge, Tenn.

EDWARD L. HILL, supervisor, technical services, General Electric Co., Lockland, Ohio.

JOHN F. HOGERTON, technical reports director, Vitro Corp. of America, New York, N. Y.

F. R. KELLER, assistant to general manager, American Cyanamid Co., New York, N. Y.

DAVID P. KUNTZ, organization and methods examiner, division of raw materials, AEC, Washington, D. C.

FRANK R. LONG, supervisor, technical information group, atomic energy research department, North American Aviation, Inc., Downey, Calif.

Dr. DONALD F. MASTICK, technical assistant, division of military application, AEC, Washington, D. C.

Dr. A. R. MATHESON, head, technical operations division, Schenectady Operations Office, AEC, Schenectady, N. Y.

GORDON R. MOLESWORTH, assistant to manager for public education, Oak Ridge Operations Office, AEC, Oak Ridge, Tenn.

Dr. DANIEL J. PFLAUM, chief, materials and information branch, division of research, AEC, Washington, D. C.

Dr. FRANK K. PITTMAN, acting chief, fissionable materials branch, division of production, AEC, Washington, D. C.

DENNIS PULESTON, head, technical information division, Brookhaven National Laboratory, Upton, Long Island, N. Y.

D. P. RUDOLPH, director, technical services division, Chicago Operations Office, AEC, Lemont, Ill.

Dr. H. W. RUSSELL, coordinating organization director, Battelle Memorial Institute, Columbus, Ohio.

Dr. RALPH CARLISLE SMITH, assistant director for classification and security, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.

Dr. JOHN R. STEHN, physicist, theoretical physics division, Knolls Atomic Power Laboratory, Schenectady, N. Y.

Dr. R. K. WAKERLING, chief, information division, Radiation Laboratory, University of California, Berkeley, Calif.

WILLIS H. WALDO, technical editor, Mound Laboratory, Miamisburg, Ohio.

R. M. WALLACE, assistant project manager, Phillips Petroleum Co., Idaho Falls, Idaho.

H. J. WALLIS, superintendent, development staff services, Sandia Corp., Albuquerque, N. Mex.

Dr. JOHN C. WOODHOUSE, director, technical division, atomic energy division, E. I. du Pont de Nemours & Co., Wilmington, Del.

J. W. YOUNG, technical information officer, division of reactor development, AEC, Washington, D. C.

N. H. JACOBSON, secretary; chief, industrial information branch, division of information services, AEC, Washington, D. C.

Industrial Committee on Reactor Location Problems

The committee will assist and advise the Commission in determining the criteria to be used in the location of atomic energy plants with regard to populated areas and in evaluating the adequacy and necessity for the isolation of such plants. It will balance carefully the technical and scientific aspects of reactor hazards, which have been thoroughly developed by the Reactor Safeguard Committee, against the nontechnical aspects of reactor locations. Consideration will be given to such matters as the social and economic impact on adjacent communities of large scale Government acquisition of land.

C. ROGERS MCCULLOUGH, chairman, general development department, Monsanto Chemical Co., St. Louis, Mo.

W. P. CONNER, Jr., manager, physics division, research department, Hercules Powder Co., Wilmington, Del.
R. L. DOAN, manager, atomic energy division, Phillips Petroleum Co., Idaho Falls, Idaho.
K. R. OSBORN, manager of industrial development, general chemical division, Allied Chemical and Dye Corp., New York, N. Y.
D. A. ROGERS, manager, central engineering, Allied Chemical & Dye Corp., Morristown, Pa.
REUEL C. STRATTON, supervising chemical engineer, engineering and loss control division, The Travelers Insurance Co., Hartford, Conn.

Advisory Committee on Isotope Distribution

This committee was originally appointed by the Manhattan District to advise on the off-project distribution of isotopes. The Commission approved its continuation in December 1947 to aid in establishing new policies on distributing radioactive materials and to review existing policies. The committee reviews all initial applications for use of radioisotopes in human beings, and all other requests for their use in research, education, and industry which are referred to it by the Commission.

Dr. ROBLEY D. EVANS, chairman; professor of physics, Massachusetts Institute of Technology, Cambridge, Mass.
Dr. SIMEON T. CANTRIL, Tumor Institute of the Swedish Hospital, Seattle, Wash.
Dr. RICHARD CHAMBERLAIN, University of Pennsylvania Medical School, Philadelphia, Pa.
Dr. JOHN E. CHRISTIAN, associate professor, department of pharmaceutical chemistry, Purdue University, Layafette, Ind.
Dr. SAMUEL E. EATON, A. D. Little, Inc., Cambridge, Mass.
Dr. STERLING B. HENDRICKS, head chemist, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture, Beltsville, Md.
Dr. DONALD E. HULL, research chemist, process division, California Research Corp., Richmond, Calif.
Dr. LEON O. JACOBSON, associate dean, division of biological sciences, University of Chicago, Chicago, Ill.
Dr. EDITH H. QUIMBY, associate professor of radiology, College of Physicians and Surgeons, Columbia University, New York, N. Y.
Dr. HOWARD E. SKIPPER, associate director, Southern Research Institute, Birmingham, Ala.
Dr. JOHN E. WILLARD, professor of chemistry, University of Wisconsin, Madison, Wis.
Dr. PAUL C. AEBERSOLD, secretary; chief, isotopes division, AEC, Oak Ridge, Tenn.

Neutron Cross Sections Advisory Group

This group is appointed on a yearly basis to make a continuing review of the AEC program of neutron cross section measurements, and to evaluate the needs for cross section information in the various activities of the AEC. The following members were appointed to serve from July 1952 to July 1953.

Dr. DONALD J. HUGHES, chairman; department of physics, Brookhaven National Laboratory, Upton, Long Island, N. Y.

Dr. TOM W. BONNER, department of physics, Rice Institute, Houston, Tex.
Dr. JOSEPH L. FOWLER, physics division, Oak Ridge National Laboratory, Oak Ridge, Tenn.
Dr. WILLIAM W. HAVENS, Jr., department of physics, Columbia University, New York, N. Y.
Dr. ALEXANDER S. LANGSDORF, physics division, Argonne National Laboratory, Chicago, Ill.
Dr. CARL O. MUELHAUSE, department of physics, Brookhaven National Laboratory, Upton, Long Island, N. Y.
Dr. G. ROY RINGO, physics division, Argonne National Laboratory, Chicago, Ill.
Dr. ARTHUR H. SNELL, physics division, Oak Ridge National Laboratory, Oak Ridge, Tenn.
Dr. THOMAS M. SNYDER, physics division, Knolls Atomic Power Laboratory, Schenectady, N. Y.
Dr. JOHN R. STEHN, physics division, Knolls Atomic Power Laboratory, Schenectady, N. Y.
Dr. RICHARD F. TASCHEK, department of physics, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.
Dr. CARROLL W. ZABEL, department of physics, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.
Dr. GEORGE A. KOLSTAD, vice-chairman; physics branch, division of research, AEC, Washington, D. C.
Dr. IRA F. ZARTMAN, division of engineering, AEC, Washington, D. C.
Dr. HERBERT GOLDSTEIN, secretary; Nuclear Development Associates, Inc., White Plains, N. Y.

Patent Advisory Panel

This panel was appointed in January 1947 to make a general review and appraisal of the problems raised by the patent provisions of the Atomic Energy Act of 1946. It makes informal reports and recommendations to the Commission and its staff on various questions of policy and procedure relating to patents and inventions.

H. THOMAS AUSTERN; of Covington & Burling, Washington, D. C.
WILLIAM H. DAVIS; of Davis, Hoxie & Faithfull, New York, N. Y.; chairman, Patent Survey Committee, U. S. Department of Commerce.
JOHN A. DIENNER; of Brown, Jackson, Boettcher & Dienner, Chicago, Ill.
HECTOR M. HOLMES; of Fish, Richardson & Neave, Boston, Mass.
CASPER W. OOMS; firm of Casper W. Ooms, Chicago, Ill.

Advisory Committee on Personnel Management

This committee of leading authorities from government, industry, and education was named in September 1948 to provide the Atomic Energy Commission with a continuous review of its personnel management practices and to evaluate the best personnel methods of government and industry in determining over-all AEC policies. The committee usually meets once a month.

ARTHUR S. FLEMMING, chairman; assistant to the director of manpower, Office of Defense Mobilization, Washington, D. C.; president, Ohio Wesleyan University, Delaware, Ohio.

L. CLAYTON HILL, professor of industrial relations, University of Michigan, Ann Arbor, Mich.
ROBERT RAMSPECK, chairman, U. S. Civil Service Commission, Washington, D. C.
WALLACE SAYRE, professor of public administration, school of business and civic administration, City College of New York, N. Y.
THOMAS G. SPATES, professor of industrial administration, Yale University, New Haven, Conn.
(Vacancy)

Personnel Security Review Board

This board was appointed in March 1949 primarily to review specific personnel security cases which arise under the Commission's administrative review procedure and to make recommendations concerning them to the General Manager. The board, in its monthly meetings, also advises the Commission on the broader considerations regarding personnel security, such as criteria for determining eligibility for security clearance and personnel security procedures.

GANSON PURCELL, chairman; of Purcell & Nelson, Washington, D. C.
ARTHUR S. FLEMMING, assistant to the director of manpower, Office of Defense Mobilization, Washington, D. C.; president, Ohio Wesleyan University, Delaware, Ohio.
WILLIAM E. LEAHY, president, Columbus University, Washington, D. C.

Committee on Raw Materials

This committee was appointed in October 1947 to review the Atomic Energy Commission's raw materials program and to advise on questions of exploration, development, and procurement. The committee has met 11 times since its formation.

Dr. DONALD H. MCLAUGHLIN, chairman; president, Homestake Mining Co., San Francisco, Calif.
EVERETTE L. DEGOLYER, petroleum geologist; DeGolyer & McNaughton, Dallas, Tex.
THOROLD F. FIELD, consulting mining engineer, Duluth, Minn.
J. K. GUSTAFSON, consulting geologist, M. A. Hanna Co., Cleveland, Ohio.
IRA B. JORALEMON, geologist, San Francisco, Calif.
ERNEST H. ROSE, chemical engineer, Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.
WALTER O. SNELLING, director of research and consulting chemist, Trojan Powder Co., Allentown, Pa.
ORVIL R. WHITAKER, consulting mining engineer, Denver, Colo.
CLYDE E. WILLIAMS, director, Battelle Memorial Institute, Columbus, Ohio.

Reactor Safeguard Committee

This committee was established in the fall of 1947 to advise the Commission on the hazards of the operation of reactors. The Committee reviews safety studies made by the contractors on proposed reactors for completeness and accuracy and may make recommendations for modifications or further study. This com-

mittee of experts in the fields of physics, chemistry, sanitary engineering, meteorology, and medicine meets whenever problems arise which require its consideration. In the past this has been about four times a year.

Dr. EDWARD TELLER, chairman; Radiation Laboratory, University of California, Berkeley, Calif.

Dr. MANSON BENEDICT, professor of chemical engineering, Massachusetts Institute of Technology, Cambridge, Mass.

Dr. HYMER L. FRIEDELL, director, department of radiology, Lakeside Hospital, Western Reserve University, Cleveland, Ohio.

Dr. I. B. JOHNS, assistant director, central research department, Monsanto Chemical Co., Dayton, Ohio.

Dr. MARK M. MILLS, atomic energy research department, North American Aviation, Inc., Downey Calif.

Dr. FREDERICK SEITZ, professor of physics, University of Illinois, Urbana, Ill.

Dr. HARRY WEXLER, chief, scientific services division, U. S. Weather Bureau, Department of Commerce, Washington, D. C.

Dr. ABEL WOLMAN, head, department of sanitary engineering, Johns Hopkins University, Baltimore, Md.

Stack Gas Problem Working Group

The appointment of this group was authorized in May 1948 to advise the Commission in connection with problems in the control of gaseous effluents from AEC installations. Although the group has held five formal meetings, it has more recently rendered assistance in this field through specific research and development projects directed by individual members and by individual consulting advice.

Dr. ABEL WOLMAN, chairman; head, department of sanitary engineering, Johns Hopkins University, Baltimore, Md.

Dr. PHILIP DRINKER, professor of industrial hygiene, Harvard University School of Public Health, Boston, Mass.

Dr. LYLE GILBERTSON, administrative manager, research and engineering department, Air Reduction Sales Co., New York, N. Y.

Dr. H. FRASER JOHNSTONE, professor of chemical engineering, University of Illinois, Urbana, Ill.

Dr. MOYER D. THOMAS, department of agricultural research, American Smelting & Refining Co., Salt Lake City, Utah.

Dr. WILLIAM P. YANT, director of research, Mine Safety Appliances Co., Pittsburgh, Pa.

Technical Information Panel

This panel, representing the major AEC research contractors, was appointed in June 1948 to advise the Commission on all aspects of its technical information services. Meetings are held three times a year to work out better methods of disseminating technical information.

Dr. ALBERTO F. THOMPSON, chairman; chief, technical information service, division of information services, AEC, Washington, D. C.

Dr. HENRY A. BLAIR, director, Atomic Energy Project, University of Rochester, Rochester, N.Y.

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Dr. BREWER F. BOARDMAN, head, technical information branch, Idaho Operations Office, AEC, Idaho Falls, Idaho.

Dr. F. L. CUTHBERT, technical director, National Lead Co. of Ohio, Cincinnati, Ohio.

W. E. DREESZEN, administrative aide to director, Ames Laboratory, Ames, Iowa.

WILLIAM H. HAMILTON, staff assistant to assistant manager, Westinghouse Atomic Power Division, Pittsburgh, Pa.

SYLVAN HARRIS, manager, documents department, Sandia Corp., Albuquerque, N. Mex.

W. L. HARWELL, head, patents and declassification department, Carbide & Carbon Chemicals Co., div. of Union Carbide & Carbon Corp. (K–25), Oak Ridge, Tenn.

EDWARD L. HILL, supervisor, technical services, General Electric Co., Lockland, Ohio.

JOHN F. HOGERTON, technical reports director, Vitro Corp. of America, New York, N. Y.

FRANK R. LONG, supervisor, technical information group, atomic energy research department, North American Aviation, Inc., Downey, Calif.

GLENN MAYNARD, head, technical information center, California Research and Development Co., Livermore, Calif.

Dr. E. J. MURPHY, assistant to research director, Carbide & Carbon Chemicals Co., div. of Union Carbide & Carbon Corp. (ORNL), Oak Ridge, Tenn.

Dr. G. M. MURPHY, professor of chemistry, New York University, New York, N. Y.

Dr. DANIEL J. PFLAUM, chief, materials and information branch, division of research, AEC, Washington, D. C.

DENNIS PULESTON, head, technical information division, Brookhaven National Laboratory, Upton, Long Island, N. Y.

Dr. RICHARD F. RILEY, chief, radiation chemistry section, Atomic Energy Project, University of California, Los Angeles, Calif.

D. P. RUDOLPH, director, technical services division, Chicago Operations Office, AEC, Chicago, Ill.

Dr. CHARLES SLESSER, director, division of technical information and declassification, AEC, New York Operations Office, New York, N. Y.

Dr. RALPH CARLISLE SMITH, assistant director for classification and security, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.

Dr. JOHN R. STEHN, physicist, theoretical physics division, Knolls Atomic Power Laboratory, Schenectady, N. Y.

C. G. STEVENSON, head, technical information, technical section, engineering department, General Electric Co., Richland, Wash.

Dr. R. K. WAKERLING, chief, information division, Radiation Laboratory, University of California, Berkeley, Calif.

WILLIS H. WALDO, technical editor, Mound Laboratory, Miamisburg, Ohio.

Dr. JOHN C. WOODHOUSE, director, technical division, atomic energy division, E. I. du Pont de Nemours & Co., Wilmington, Del.

Dr. H. D. YOUNG, director, information division, Argonne National Laboratory, Chicago, Ill.

APPENDIX 3

MAJOR RESEARCH AND DEVELOPMENT INSTALLATIONS OF THE U. S. ATOMIC ENERGY COMMISSION

Ames Laboratory (Iowa State College, contractor), Ames, Iowa

Director ..... Dr. FRANK H. SPEDDING
Associate Director ..... Dr. H. A. WILHELM
Assistant to Director ..... Dr. E. F. FULMER

Argonne National Laboratory (University of Chicago, contractor), Chicago, Ill.

The participating institutions are:

Battelle Memorial Institute
Carnegie Institute of Technology
Case Institute of Technology
Illinois Institute of Technology
Indiana University
Iowa State College
Kansas State College
Loyola University (Chicago, Ill.)
Marquette University
Mayo Foundation
Michigan College of Mining and Technology
Michigan State College
Northwestern University
Ohio State University
Oklahoma Agricultural and Mechanical College
Purdue University
St. Louis University
State University of Iowa
Washington University (St. Louis, Mo.)
Wayne University
Western Reserve University
University of Chicago
University of Cincinnati
University of Illinois
University of Kansas
University of Michigan
University of Minnesota
University of Missouri
University of Nebraska
University of Notre Dame
University of Pittsburgh
University of Wisconsin

Director ..... Dr. WALTER H. ZINN
Deputy Director ..... Dr. NORMAN HILBERRY
Business Manager ..... JOHN H. MCKINLEY
Associate Director for University Relationships ..... Dr. JOSEPH C. BOYCE
Assistant Director ..... JOHN T. BOBBITT

Bettis Plant (Westinghouse Electric Corp., Atomic Power Division, contractor), Pittsburgh, Pa.

Manager, Westinghouse Atomic Power Division ..... C. H. WEAVER
Assistant Manager ..... JOHN W. SIMPSON
Director of Development ..... Dr. W. E. SHOUPP
Contract Manager ..... W. DEE SHEPHERD

Brookhaven National Laboratory (Associated Universities, Inc., contractor), Upton, Long Island, N. Y.

The participating institutions are:

- Columbia University
- Cornell University
- Harvard University
- Johns Hopkins University
- Massachusetts Institute of Technology
- Princton University
- Yale University
- University of Pennsylvania
- University of Rochester

Chairman, Board of Directors—P. STUART MACAULAY
President, AUI—LLOYD V. BERKNER
Vice President, AUI and Laboratory Director—Dr. LELAND J. HAWORTH
Deputy Laboratory Director—Dr. GERALD F. TAPE
Assistant Director, University Liaison—Dr. ROBERT A. PATTERSON

Knolls Atomic Power Laboratory (General Electric Co., contractor), Schenectady, N. Y.

General Manager, Operating Department—K. R. VAN TASSEL
Manager, Technical Department—Dr. K. H. KINGDON

Los Alamos Scientific Laboratory (University of California, contractor), Los Alamos, N. Mex.

Director—Dr. NORRIS E. BRADBURY
Technical Associate Director—Dr. DAROL K. FROMAN

Mound Laboratory (Monsanto Chemical Co., contractor), Miamisburg, Ohio

Project Director—Dr. N. N. T. SAMARAS
Laboratory Director—Dr. JOSEPH J. BURBAGE

Oak Ridge Institute of Nuclear Studies (contractor), Oak Ridge, Tenn.

The sponsoring universities of the Institute are:

- Agricultural and Mechanical College of Texas
- Alabama Polytechnic Institute
- Catholic University of America
- Clemson Agricultural College
- Duke University
- Emory University
- Florida State University
- Georgia Institute of Technology
- Louisiana State University
- Mississippi State College
- North Carolina State College
- Rice Institute
- Tulane University of Louisiana
- Vanderbilt University
- Virginia Polytechnic Institute
- University of Alabama
- University of Arkansas
- University of Florida
- University of Georgia
- University of Kentucky
- University of Louisville
- University of Maryland
- University of Mississippi
- University of North Carolina
- University of Oklahoma
- University of Puerto Rico
- University of South Carolina
- University of Tennessee
- University of Texas
- University of Virginia

Chairman of Council ..... Dr. GEORGE H. BOYD
Vice Chairman of Council ..... Dr. W. W. GRIGORIEFF
President of Institute ..... DR. PAUL M. GROSS
Vice President of Institute ..... Dr. J. W. BEAMS
Scientific and Educational Consultant ..... Dr. GEORGE B. PEGRAM
Executive Director of Institute ..... Dr. WILLIAM G. POLLARD

Oak Ridge National Laboratory (Carbide & Carbon Chemicals Co., div. of Union Carbide & Carbon Corp., contractor), Oak Ridge, Tenn.

Director ..... Dr. C. E. LARSON
Research Director ..... Dr. A. M. WEINBERG
Deputy Research Director ..... Dr. J. A. SWARTOUT
Assistant Research Director ..... Dr. E. H. TAYLOR
Assistant Research Director (Y–12) ..... Dr. E. D. SHIPLEY

Radiation Laboratory (University of California, contractor), Berkeley, Calif.

Director ..... Dr. ERNEST O. LAWRENCE
Associate Director ..... Dr. DONALD COOKSEY
Business Manager and Managing Engineer ..... WALLACE B. REYNOLDS
Assistant Director ..... WILLIAM M. BROBECK
Director, Crocker Laboratory—Medical Physics ..... Dr. JOSEPH G. HAMILTON
Director, Donner Laboratory of Medical Physics ..... Dr. J. H. LAWRENCE
Assistant Director, Donner Laboratory ..... Dr. HARDIN JONES

Raw Materials Development Laboratory (American Cyanamid Co., contractor), Winchester, Mass.

Director ..... DANIEL M. KENTRO
Assistant Director ..... HUGH H. BEIN

Rochester Atomic Energy Project (University of Rochester, contractor), Rochester, N. Y.

Director ..... Dr. HENRY A. BLAIR
Assistant Director for Education ..... Dr. J. NEWELL STANNARD
Business Manager ..... C. M. JARVIS

Sandia Laboratory (Sandia Corp., contractor), Sandia Base, Albuquerque, N. Mex.

President ..... DONALD A. QUARLES

University of California, Los Angeles, Atomic Energy Project (University of California, contractor), Los Angeles, Calif.

Director ..... Dr. STAFFORD WARREN
Business Manager ..... ROBERT J. BUETTNER

University of California Medical Center, Radiological Laboratory (University of California, contractor), San Francisco, Calif.

Director ..... Dr. ROBERT S. STONE

APPENDIX 4

Isotope Distribution Data

	Number of Shipments [1]			
	Aug. 2, 1946, June 30, 1951	July 1, 1951, June 30, 1952	July 1, 1952, Nov. 30, 1952	Total to Nov. 30, 1952
Shipments classified by kind of isotope:				
Radioactive isotopes:				
Iodine 131	6,982	3,486	1,590	12,058
Phosphorus 32	5,674	2,308	802	8,784
Carbon 14	904	331	146	1,381
Sodium 24	813	245	160	1,218
Sulfur 35	392	211	77	680
Gold 198, 199	421	366	176	963
Calcium 45	290	129	49	468
Iron 55, 59	237	129	49	415
Cobalt 60	348	214	72	634
Potassium 42	333	124	49	506
Strontium 89, 90	116	83	35	234
Other	2,395	1,183	455	4,033
Total	18,905	8,809	3,660	31,374
Stable Isotopes:				
Deuterium oxide (heavy water)	480	128	14	622
Deuterium (hydrogen 2)	406	97	54	557
Boron 10 and 11	119	21	17	157
Helium	8	8	3	19
Oxygen 18	80	27	40	147
Electromagnetic concentrated	460	129	35	624
Argon 38		1		1
Total	1,553	411	163	2,127
Shipments to AEC Installations:				
Radioactive	4,349	1,353	426	6,128
Stable	1,055	282	102	1,439

[1] Shipments from Oak Ridge National Laboratory, Oak Ridge, Tenn.

LOCATION AND TYPE OF ISOTOPE USERS[1]

Aug. 2, 1946-Nov. 30, 1952

States and Territories	Medical institutions and physicians		Colleges and universities		Industrial firms		Federal and State laboratories		Foundations and institutes		Other		Total	
	Radioactive	Stable	Radioactive	Stable	Radioactive	Stable	Radioactive	Stable	Radioactive	Stable	Radioactive	Stable	Radioactive	Stable
Alabama	4		2	1	2		2		1	1			11	2
Alaska	1		1										2	
Arizona			1				1						2	
Arkansas	2		1	1	1								4	1
California	53	4	9	8	45	10	17	3	1				125	25
Colorado	9	1	3	2	4	1	3		1		1		21	4
Connecticut	8	1	5	3	17	2	2						32	6
Delaware			1		5	2			1	1			7	3
District of Columbia	7	3	3	4	6		7	4					23	11
Florida	3		4	1	1		4						12	1
Georgia	2		4	2	2	1	5						13	3
Hawaii	2						1		2				5	
Idaho	1		1		1	1						1	3	2
Illinois	25	3	5	5	23	6	5	1	1	1	1	1	60	17
Indiana	5		3	3	19	5					1		28	8
Iowa			2	2	2								4	2
Kansas	5		2	2	3								10	2
Kentucky	3		1	1	3	1	2						9	2
Louisiana	3	1	3	2	4	2							10	5
Maine	1		3		3		1						8	
Maryland	8	5	4	3	5	1	7	5					24	14
Massachusetts	18	6	9	6	35	7	2	2	3	1	1		68	22
Michigan	9		5	3	17	4	1						32	7
Minnesota	6	2	4	1	6		1						17	3
Mississippi	2		1				3	1					6	1
Missouri	13	1	4	3	3		1						21	4
Montana	3	2	1	1									4	3
Nebraska	2		1				1						4	
Nevada					1								1	
New Hampshire	1		2	1									3	1
New Jersey	5		4	2	43	11	3	1	4	2			59	16
New Mexico	4		1	1			1					1	6	2
New York	57	12	23	17	54	9	9		6	1			149	39
North Carolina	7	1	5	3			2						14	4
North Dakota	2		2				1						5	
Ohio	14	2	8	3	50	5	7	3	2	2			81	15
Oklahoma	5		1	1	11	5	1		2				20	6
Oregon	3		3	3	1		1						8	3

[1] Users are either institutions or individuals receiving isotopes authorized through the Commission's distribution program.

LOCATION AND TYPE OF ISOTOPE USERS—Continued

States and Territories	Medical institutions and physicians		Colleges and universities		Industrial firms		Federal and State laboratories		Foundations and institutes		Other		Total	
	Radioactive	Stable	Radioactive	Stable	Radioactive	Stable	Radioactive	Stable	Radioactive	Stable	Radioactive	Stable	Radioactive	Stable
Pennsylvania	26	5	9	6	50	13	6	3	3	3			94	30
Puerto Rico	2						1						3	
Rhode Island	1		2	1	4								7	1
South Carolina	2		2				1						5	
South Dakota			2										2	
Tennessee	11	1	4	3	3	1	3	1		1			21	6
Texas	22	5	3	3	26	7	3	1	3				57	17
Utah	3	1	3	1	1		2						9	2
Vermont	2				1								3	
Virginia	3		3	1	4	1			6				16	2
Washington	7		3	2	5		2						17	2
West Virginia	5		2	1	1	1							8	2
Wisconsin	6	1	1	1	16		2						25	2
Wyoming			1										1	
Total	383	57	167	104	478	96	111	25	36	13	4	3	1,179	298

FOREIGN SHIPMENTS OF RADIOISOTOPES [3]

Country	Radioactive	Stable
Argentina	82	
Australia	99	
Belgium	118	
Bermuda	16	
Brazil	119	
British West Africa	1	
Canada	151	
Chile	62	
Colombia	5	
Cuba	47	
Denmark	184	
Dominican Republic	1	
Egypt	1	
England	121	
Finland	8	
France	64	
Ireland	4	
India	8	
Israel	2	
Italy	17	
Japan	132	
Lebanon	5	
Mexico	12	
Netherlands	49	
New Zealand	11	
Norway	40	
Pakistan	3	
Peru	10	
Portugal	1	
Spain	4	
Sweden	167	
Switzerland	47	
Trieste	2	
Turkey	5	
Union of South Africa	28	
Uruguay	9	
Total	1,635	
KIND OF ISOTOPE		
Phosphorus 32	603	
Iodine 131	396	
Carbon 14	185	
Sulfur 35	81	
Iron 55, 59	67	
Cobalt 60	96	
Calcium 45	49	
Strontium 89, 90	29	
Other	129	
Total	1,635	

[3] Total number of shipments to Nov. 30, 1952.

APPENDIX 5

CURRENT AEC UNCLASSIFIED RESEARCH CONTRACTS IN PHYSICAL AND BIOLOGICAL SCIENCES, RAW MATERIALS, AND REACTOR DEVELOPMENT[1]

PHYSICAL RESEARCH CONTRACTS

Chemistry

Alabama, University of. J. L. Kassner and E. L. Grove, Principles, Theory, and Practice of High Frequency Titrimetry.

Arkansas, University of. R. H. Arndt and P. E. Damon, Radioactivity of Thermal Waters and its Relationship to Geology and Geochemistry of Uranium.

Arkansas, University of. R. R. Edwards, Chemical Effects of Nuclear Transformation.

California Institute of Technology. Harrison Brown, Fundamental Geochemistry.

California Institute of Technology. Norman Davidson, Complex Ions and Reaction Mechanisms in Solution.

California, University of. C. S. Garner, Isotopic Exchange Reactions.

California, University of. J. H. Hildebrand, Studies in Intermolecular Forces and Solubility.

Canisius College. R. H. Schuler, Use of Iodine as a Radical Detector in Radiation Processes.

Carnegie Institute of Technology. T. P. Kohman, Nuclear Chemistry Research.

Catholic University of America. F. O. Rice, Thermal Production and Identification of Free Radicals.

Chicago, University of. W. F. Libby, Radiochemical and Radiobiological Research.

Chicago, University of. Anthony Turkevich and Nathan Sugarman, Operation of Synchrocyclotron.

Chicago, University of. Anthony Turkevich and Nathan Sugarman, Nuclear Chemical Research.

Chicago, University of. H. C. Urey, Natural Abundance of Deuterium and Other Isotopes.

Colorado, University of. J. R. Lacher and J. D. Park, Thermochemical Studies of Organic Fluorine Compounds.

Columbia University. J. L. Kulp, Uranium-Lead Method of Age Determination.

Columbia University. V. K. LaMer, Fundamental Investigation of Phosphate Slimes.

Columbia University. J. M. Miller, Basic Chemical Research.

Columbia University. R. M. Noyes, Photochemical Reactions of Iodine.

Columbia University. W. A. Selke, Ion Exchange Chromatography.

Columbia University. T. I. Taylor, Separation of Isotopes by Chemical Exchange.

Connecticut, University of. Roland Ward, Trace Element Distribution Between a Melt and Solid.

[1] Contracts listed as of November 30, 1952.

Cornell University. J. L. Hoard, Structure of Fluorocarbons, Elementary Boron and Boron Compounds.

Duke University. D. G. Hill, Some Chemical Reactions at High Temperatures.

Emory University. R. A. Day, Jr., Study of Stability of Complex Ions.

Emory University. W. H. Jones, Mass Distribution in Proton-Induced Fission.

Florida State University. R. E. Johnson, Exchange Between Labeled Halogens and Certain Inorganic Halides.

Florida State University. Raymond Sheline, Search for Long-Lived Radioactivities; and Theoretical Nuclear Studies.

Florida, University of. G. B. Butler and L. R. Phillips, Preparation and Properties of Quaternary Ammonium Ion Exchange Resins.

Fordham University. Michael Cefola, Formation of Complexes by Thenoyltrifluoroacetate and Other Chelating Agents.

George Washington University. C. R. Naeser, Fluorides of the Rare Earth Elements.

Georgia Institute of Technology. Jack Hine, Occurrence and Rate of Certain Deuterium Exchange Reactions.

Illinois Institute of Technology. R. B. Bernstein, Studies in the Field of Stable Isotopes.

Illinois Institute of Technology. George Gibson, Fundamental Chemistry of Uranium.

Illinois Institute of Technology. H. E. Gunning, Decomposition of Organic Molecules by Metal Photosensitization.

Illinois Institute of Technology. Martin Kilpatrick, Fundamental Chemistry of Ozone.

Illinois Institute of Technology. S. E. Wood, Properties of Non-electrolytic Solutions.

Illinois, University of. H. G. Drickamer, Mechanism of Molecular Motion Determined from Diffusion and Thermal Diffusion Measurements.

Illinois, University of. P. E. Yankwich, Studies in Radiochemistry.

Indiana, University of. L. L. Merritt, Studies with Radioactive Tracers.

Iowa, State University of. R. E. Buckles, Mechanisms of Addition of Halogen and of Halogenation Arising from the Action of Polyhalogen Complexes on Organic Molecules.

Iowa, State University of. LeRoy Eyring, Preparation of Rare Earth Oxides.

Iowa, State University of. Karl Kammermeyer, Separation of Gases by Diffusion Through Permeable Membranes.

Iowa, State University of. Stanley Wawzonek, Behavior of Organic Compounds at the Dropping Mercury Electrode.

Johns Hopkins University. W. S. Koski, Nuclear Chemistry.

Kansas, University of. P. W. Gilles, High Temperature Research.

Kansas, University of. P. W. Gilles, Hot Laboratory Assistance.

Kansas, University of. J. O. Maloney, Application of Radioactive Tracers to the Design of Distillation Columns.

Louisville, University of. R. H. Wiley, Synthesis and Properties of Ion Exchange Resins.

Massachusetts Institute of Technology. C. D. Coryell, D. N. Hume, and J. D. Roberts, Nuclear Chemistry Research.

Massachusetts Institute of Technology. A. M. Gaudin, Techniques in Mineral Engineering.

Massachusetts Institute of Technology. P. M. Hurley, Isotopic Abundances of Strontium, Calcium, and Argon in Certain Minerals.

Michigan State College. M. T. Rogers, Physico-Chemical Investigation of Interhalogen Compounds.

Michigan, University of. P. J. Elving, Polarography of Organic Compounds.

Michigan, University of. W. W. Meinke, Nuclear Chemical Research.

Michigan, University of. E. F. Westrum, Jr., Low Temperature Chemical Thermodynamics.

New Hampshire, University of. H. M. Haendler, Inorganic Fluorides.

New Hampshire, University of. H. M. Haendler, Infrared Spectroscopy of Inorganic Fluorides.

New York State Teachers College. O. E. Lanford, Concentration of Nitrogen 15 by Chemical Exchange.

New York, University of. C. V. King, Measurement of Metal Dissolution Rates.

North Carolina State College. F. P. Pike, Performance of Contactors for Liquid-Liquid Extractors.

Northwestern University. Fred Basolo, Mechanism of Substitution Reactions of Inorganic Complexes.

Northwestern University. J. N. Pitts, Jr., Investigation of the Photo-chemistry of Organic Acids, Ethers, and Ketones.

Notre Dame, University of. Milton Burton, Research in Radiation Chemistry.

Oklahoma Agricultural and Mechanical College. T. E. Moore, Separation of Inorganic Salts by Liquid-Liquid Extraction.

Oklahoma, University of. J. R. Nielsen, Spectroscopic Properties of Fluorocarbons and Fluorinated Hydrocarbons.

Oregon State College. A. V. Logan, Mechanism of the Jacobsen Rearrangement.

Oregon State College. T. H. Norris and J. L. Huston, Study of Generalized Acid-Base Phenomena with Radioactive Tracers.

Oregon State College. Joseph Schulein, Separation of Deuterium from Hydrogen by Means of Zirconium Metal.

Oregon, University of. D. F. Swinehart, Construction of Mass Spectrometer for Use in Studying Chemical Reaction Kinetics in the Gas Phase.

Pennsylvania State College. T. F. Bates, Mineralogy and Petrography of Uraniferous Shales and Lignites.

Pennsylvania State College. W. C. Fernelius, Stabilities of Coordination Compounds and Related Problems.

Pennsylvania State College. B. F. Howell, Jr., Dielectric Constant of Rocks and Minerals.

Pennsylvania State College. C. R. Kinney, Chemical Nature of Organic Matter in Uraniferous Shales.

Pennsylvania State College. W. W. Miller, Chemical Reactions Induced in Condensed Systems by Beta Decay.

Pittsburgh, University of. Henry Freiser, Development of Organic Reagents in Inorganic Analysis.

Pittsburgh, University of. Robert Levine, Synthesis of Beta-Diketones and Beta-Ketoesters with Heterocyclic Nuclei.

Princeton University. N. H. Furman, Research in Analytical Chemistry.

Princeton University. John Turkevitch, Study of Nucleation Processes.

Purdue University. H. C. Brown, Chemistry of Polyvalent Metal Halides.

Purdue University. W. W. Brandt, Metal Ion Chelate Complexes.

Purdue University. Thomas DeVries, Polarographic Studies in Nonaqueous

Purdue University. M. G. Mellon, Spectrophotometric Studies of Complex Molecules.

Reed College. A. F. Scott, Atomic Weight of Bismuth.

Rensselaer Polytechnic Institute. L. G. Bassett, Solvent Extraction of Inorganic Ions.

Rochester, University of. E. O. Wiig, Radiochemistry.

Rutgers University. E. R. Allen, Polar Inorganic Compounds.

Rutgers University. W. Rieman III, Analytical Chemistry of the Polyphosphates.

Southern California, University of. H. L. Friedman, Solutions of Inorganic Electrolytes in Solvents of Low Dielectric Constant.

South Carolina, University of. O. D. Bonner, Ion Exchange Equilibria.

South Carolina, University of. H. W. Davis, Use of Carbon 14 in Study of Allylic Fluorination.

Syracuse, University of. B. P. Burtt, Mechanism of Gaseous Radiation Chemical Reactions of Electrons.

Syracuse, University of. Louis Gordon, Coprecipitation from Homogeneous Solutions and Analytical Chemistry of Thorium.

Syracuse, University of. Henry Linschitz, Photochemical Reactions of Complex Molecules in Condensed Phase.

Tennessee, University of. G. K. Schweitzer, Study of Radiocolloids.

Tennessee, University of. H. A. Smith, Rates of Catalytic Reactions Involving Deuterium, and Relative Vapor Pressures of Water and Deuterium Oxide in the Presence of Certain Salts.

Tennessee, University of. P. B. Stockdale, Chattanooga Black Shale as a Source of Uranium.

Texas, University of. G. H. Ayres, Spectrophotometric Quantitative Determination of the Platinum Metals.

Utah, University of. Henry Eyring, Research on Surface Chemistry and Zirconium Corrosion Studies.

Utah, University of. A. L. Wahrhaftig, Ionization and Dissociation of Molecules by Electron Bombardment.

Utah, University of. B. J. Zwolinski, Induction of Chemical Reactions by High Frequency Discharges in Gases.

Vanderbilt University. E. W. Jones, Raman Spectra of Some Inorganic Compounds.

Vanderbilt University. M. D. Peterson, Radiation Stability and Inorganic Radiochemistry.

Virginia Polytechnic Institute. N. F. Murphy, Mass Transfer Studies in Liquid-Liquid Extraction.

Washington, State College of. H. W. Dodgen, Formulae and Stability of Complex Ions in Solution.

Washington University (St. Louis). J. W. Kennedy, Separation of Lithium Isotopes.

Wayne University. K. H. Gayer, Solubility of Uranium and Thorium Oxides in Dilute Acid and Base.

Wayne University. R. B. Hahn, Analytical Chemistry of Radioactive Elements.

Western Reserve University. E. L. Pace, Thermodynamic Properties of Gases Adsorbed on Solids.

Wisconsin, University of. W. J. Blaedel, High Frequency Titrations.

Wisconsin, University of. Farrington Daniels, Uranium Exploration and Recovery from Low Grade Ores.

Wisconsin, University of. E. L. King, Rates and Mechanisms of Oxidation Reactions Involving Cerium (IV).

Wisconsin, University of. J. E. Willard, Application of Radioactive Isotopes to Chemical Problems.

Yale University. H. S. Harned, Diffusion Coefficients of Electrolytes and Molecules.

Metallurgy

Alabama, University of. T. N. McVay, Investigations of Enamels on Metals.

Alfred University. V. D. Frechette, Graphitization of Carbon.

Arkansas, University of. W. T. Smothers, Recrystallization of Aluminum Oxide.

Armour Research Foundation. Max Hansen, Phase Diagrams of Zirconium.

Bausch and Lomb Optical Co. N. J. Kreidl, Irradiation Damage to Glass.

California, University of. E. R. Parker, Creep of Alloys.

California, University of. J. A. Pask, Mechanics of Metal Ceramic Bonding.

Carnegie Institute of Technology. George Derge, Electrochemical Studies of Nonaqueous Melts.

Carnegie Institute of Technology. Roman Smoluchowski, Studies of Grain Boundaries and Lattice Imperfections.

Carnegie Institute of Technology. Roman Smoluchowski, Radiation Damage Studies.

Chicago, University of. Lothar Meyer, Structure and Properties of Graphite.

Columbia University. G. L. Kehl, Mechanism of Metallographic Etching.

Columbia University. H. H. Kellogg, Electrolytic Production of Zirconium.

Columbia University. T. A. Read, Diffusionless Phase Changes in Solid Metals and Alloys.

Columbia University. W. A. Selke, Thermodynamic Properties of Sodium Vapor.

Dow Chemical Co. J. C. McDonald, Effect of Nonmetallic and Alkali Metal Impurities on the Corrosion Characteristics of Magnesium.

General Electric Co. J. H. Holloman, Development of Zirconium Alloys.

General Electric Co. J. D. Nisbet, Fundamental Metallurgical Research.

Graham, Crowley, and Associates. C. A. Crowley, Electrowinning of Zirconium.

Great Lakes Carbon Corp. L. H. Juel, High Density Graphite.

Horizons, Inc. M. A. Steinberg, Preparation of Thorium Metal.

Horizons, Inc. Eugene Wainer, Electrodeposition of Zirconium Metal.

Illinois Institute of Technology. T. J. Neubert, Imperfections in Solids.

Illinois, University of. P. A. Beck, Annealing of Cold Worked Metals.

Illinois, University of. Frederick Seitz, Mechanism of Substitutional Diffusion in Metals.

Illinois, University of. Frederick Seitz, Experimental and Theoretical Investigation of Radiation Damage in Solid Materials.

Iowa, State University of. N. C. Baenziger, Structure and Properties of Intermetallic Compounds.

Massachusetts Institute of Technology. M. B. Bever, M. Cohen, B. Averbeck, Thermodynamics of Metal Solutions; Solid Solutions and Grain Boundaries; and Fundamentals of Cold Working and Recrystallization.

Massachusetts Institute of Technology. S. C. Collins, Mechanical Properties of Metals at Low Temperatures.

Massachusetts Institute of Technology. F. H. Norton, Metal-Ceramic Interactions.

Massachusetts Institute of Technology. F. H. Norton, Refractories Research.

Massachusetts Institute of Technology. B. E. Warren, Studies of Radiation Damage.

North Carolina State College. K. O. Beatty, Thermal Properties of Nonmetallic Materials at High Temperatures.

Ohio State University. C. H. Shaw, Soft X-ray Absorption and Emission Spectra.

Oregon, University of. Pierre VanRysselberghe, Polarographic Studies on the Corrosion of Zirconium.

Pennsylvania State College. H. J. Read, Corrosion of Zirconium.

Pittsburgh, University of. W. E. Wallace, Thermochemistry of Alloys.

Purdue University. Karl Lark-Horovitz, Radiation Damage Studies.

Rensselaer Polytechnic Institute. H. B. Huntington, Anisotropic Self-Diffusion in Metals.

Stanford University. O. C. Shepard, Resistance of Materials to Environment of Molten Lead and Bismuth.

Sylvania Electric Products, Inc. W. E. Kingston, Self-Diffusion and High Temperature Phenomena.

Tennessee, University of. E. E. Stansbury, Energy Changes from Plastic Deformation.

Wichita, University of. Luther Lyon, Permeability Methods of Determining Surface Areas of Finely Divided Materials.

Physics

Alabama Polytechnique Institute. Howard Carr, Research with Mass Spectrometer.

Bartol Research Foundation. W. F. G. Swann, Cosmic Ray Showers and Counters.[2]

Brown University. R. A. Peck, Jr., 500 Kev Cockroft-Walton.

California Institute of Technology. C. D. Anderson, Cloud Chamber Cosmic Ray Studies.[2]

California Institute of Technology. R. F. Bacher, One Billion Volt Electron Synchrotron.

California Institute of Technology. J. W. DuMond, Precision Nuclear Spectroscopy.

California Institute of Technology. W. A. Fowler, Energy Levels in Light Nuclei.[2]

California, University of. R. B. Brode, Mesons and Showers.[2]

California, University of. J. R. Richardson, Proton Range Energy Studies.[2]

Carnegie Institute of Technology. Edward Creutz, Nuclear Research Using 400 Mev Cyclotron.

Case Institute of Technology. R. S. Shankland and E. F. Shrader, Gamma Ray Spectra Produced from 30 Mev Betatron.

Chicago, University of. S. K. Allison, Interactions of Light Nuclei.

Chicago, University of. H. L. Anderson, High Energy Proton Studies.[2]

Chicago, University of. Marcel Schein, High Energy Primary Interactions.[2]

Columbia University. W. W. Havens, Jr., Nuclear Physics Research.

Columbia University. L. J. Rainwater, High Energy Proton Studies.[2]

Columbia University. C. H. Townes, Nuclear Moments and Masses by Microwave Spectroscopy.

Connecticut, University of. S. S. Friedland, Mass Spectrometry.

Cornell University. R. R. Wilson, Photon-Meson Reactions.[2]

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[2] Contract administered through the Office of Naval Research, Washington, D. C.

Duke University. H. W. Newson, Nuclear Physics with 4 Mev Electrostatic Generator.

Duke University. W. M. Nielsen, Cosmic Ray Stars.[2]

Florida, University of. D. O. Swanson, Low Energy p-d Scattering.

George Washington University. Zoltan Bay, Short Life-Times.[2]

Harvard University. Norman Ramsey, High Energy Particle Interactions.[2]

Illinois, University of. G. M. Almy and F. W. Loomis, Nuclear Disintegration Schemes.[2]

Indiana, University of. A. C. G. Mitchell, Beta and Gamma Spectra.[2]

Iowa, State University of. J. A. Jacobs, Research with Electrostatic Generator.

Iowa, State University of. J. A. Van Allen, Ultra High Altitude Cosmic Rays.[2]

Johns Hopkins University. G. H. Dieke, Molecular Spectra of Tritium and Fluorescent Spectra of Solid Uranium Compounds.

Johns Hopkins University. S. S. Hanna, Neutron Cross Section Measurements.

Kansas State College. C. M. Fowler, Precision Beta Ray Spectrometry.

Kansas, University of. J. D. Stranathan, Precision Proton Reactions.[2]

Massachusetts Institute of Technology. G. R. Harrison, Echelle Spectroscopy.

Massachusetts Institute of Technology. M. S. Livingston, Energy Levels and Radioactivity.[2]

Michigan, University of. J. M. Cork, Beta and Gamma Ray Spectra.[2]

Michigan, University of. H. R. Crane, 300 Mev Racetrack Synchrotron.

Michigan, University of. W. E. Hazen, Cosmic Ray Showers and Penetrating Particles.[2]

Michigan, University of. W. C. Parkinson, Nuclear Research with 42-inch Cyclotron.

Minnesota, University of. C. L. Critchfield, Heavy Particle Component.[2]

Minnesota, University of. J. H. Williams, Precision Particle Scattering.[2]

Minnesota, University of. J. H. Williams, 50 Mev Ion Accelerator.

Nebraska, University of. Theodore Jorgenson, Jr., Energy Losses of Low Energy Charged Particles.

New York University. S. A. Korff, Relative Neutron Intensities.[2]

North Carolina, University of. A. V. Masket, Nuclear Disintegrations in Photographic Plates.

North Carolina, University of. E. D. Palmatier, Studies of Narrow Showers and Intensity Fluctuations.

Northwestern University. J. H. Roberts, Use of Photographic Emulsions Enriched in Lithium 6.

Notre Dame, University of. Bernard Waldman, Energy Spectra of Excited Nuclei.[2]

Nuclear Development Associates. Herbert Goldstein, Fast Neutron Data.

Ohio State University. J. N. Cooper, Nuclear Spectroscopy with Van de Graaff Generator.

Ohio State University. J. G. Daunt, Low Temperature Physics and Nuclear Paramagnetism.

Ohio State University. Herschel Hausman, Modification of 42-inch Cyclotron.

Oregon State College. E. A. Yunker, Construction of 37-inch Cyclotron.

Pennsylvania, University of. W. F. Love, Solid State Physics at Low Temperatures.

Pennsylvania, University of. W. E. Stephens, Beta and Gamma Ray Studies.[2]

Pittsburgh, University of. A. J. Allen, Precision Particle Scattering.[2]

Princeton University. G. T. Reynolds, Meson Energy Spectra Stars and Bursts.[2]

Princeton University. M. G. White, Nuclear Research using 17 Mev Cyclotron.

[2] Contract administered through the Office of Naval Research, Washington, D. C.

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Puerto Rico, University of. Letitia Del Rosario, Meson Studies at Low Altitudes.[2]
Purdue University. Ernst Bleuler, Research with Cyclotron.
Purdue University. Karl Lark-Horovitz, Modification of the Cyclotron.
Purdue University. F. F. Rieke, Electron Accelerator Development.
Purdue University. R. M. Whaley, Research with Synchrotron.
Rensselaer Polytechnic Institute. G. N. Glasoe, High Speed Coincidence Circuits and Beta Ray Spectrometry.
Rice Institute. T. W. Bonner, Nuclear Physics of Light Elements.
Rochester, University of. R. E. Marshak, High Energy Nuclear Physics.
Rutgers University. F. G. Dunnington, Nuclear Moments.[2]
Stanford University. Felix Bloch, Nuclear Moments.[2]
Stanford University. E. L. Ginzton, Billion Volt Electron Reactions.[2]
Syracuse, University of. Kurt Sitte, Cosmic Ray Research.
Texas, University of. E. L. Hudspeth, Fast Neutron Interactions.
Vanderbilt University. S. K. Haynes, Beta Ray Spectroscopy.
Vanderbilt University. D. L. Hill, Neutron Spectroscopy with Specific Ionization Techniques.
Washington, University of. J. E. Henderson, Meson Momenta and Positive Excess.[2]
Washington, University of. A. L. Hughes, Nuclear Structure and Shell Structure.[2]
Washington, University of. J. H. Manley, 60-inch Cyclotron Program.
Washington, University of. R. D. Sard, Meson Production and Disintegration.[2]
Wisconsin, University of. J. R. Dillinger and C. K. McLane, Low Temperature Physics.
Wisconsin, University of. R. G. Herb, Nuclear Research with Electrostatic Generator.
Wisconsin, University of. R. G. Sachs, Theory of Light Nuclei.
Yale University. Gregory Breit, Theory of Nuclear Structure.[2]
Yale University. Henry Kraybill, Atmospheric Showers.[2]
Yale University. E. C. Pollard, Energy Levels, High Speed Counting Techniques.[2]
Yale University. H. L. Schultz, Neutron Cross Section Measurements.
Yale University. W. W. Watson, Radioactivity Studies.

BIOLOGY, BIOPHYSICS AND MEDICINE RESEARCH CONTRACTS

Biology

Agriculture, Department of. H. R. Bird, Embryonic Metabolism and Internal Radiations.
Agriculture, Department of. F. W. Parker, The Improvement of Soil Management and Crop Production Through Investigations with Isotopes.
Agriculture, Department of. Berley Winton, Study of the Effects of Radiation on Chickens.
American Meat Institute Foundation (Chicago). B. S. Schweigert, Relation of Vitamin B_{12} to Nucleic Acid Metabolism.

[2] Contract administered through the Office of Naval Research, Washington, D. C.

Amherst College. P. T. Ives, Research in Radiobiology and Biochemical Genetics Using Radioactive Isotopes.

Amherst College. G. W. Kidder, Studies on Nucleic Acid and Free Nucleotide Synthesis in Normal Tissue and in Tumor Tissue Using Carbon 14.

Arizona, University of. W. H. Fuller and W. T. McGeorge, Utilization of Phosphorus from Biological Material and Uptake of Strontium by Various Type Crops.

Arkansas, University of. Jacob Sacks, Study on the Phosphorylation Cycle in the Intact Animal Using Radioactive Phosphorus.

Arkansas, University of. J. M. Siegel, Investigation of Intermediary Metabolism of the Photosynthetic Bacteria.

Battelle Memorial Institute. K. S. Chester, The Nutrition of Obligate Parasites in Plants.

Battelle Memorial Institute. K. S. Chester, The Use of Radioactive Indicators in the Study of Mode of Action of Fungicides.

Boston University School of Medicine. W. C. Boyd, Blood-Group-Specific Hemagglutinins from Plant Sources.

Boyce Thompson Institute (Yonkers). G. L. McNew, Use of Tracer-Labelled Fungicides in Determining the Mechanics of Protecting Plants from Fungus Diseases.

Brown University. J. W. Wilson, The Role of the Intestinal Flora in Radiation Injury.

California Institute of Technology. G. W. Beadle, The Genetic and Cytological Effects of High Energy Radiation.[2]

California Institute of Technology. Henry Borsook, Biological Synthesis of Protein with Use of Isotopes.[2]

California, University of. H. A. Barker, W. Z. Hassid, and C. O. Delwiche, Tracer and Enzymatic Studies on the Metabolism of Plants and Bacteria.

California, University of (Davis). A. S. Crafts, The Use of Radioactive Isotopes and Other Indicators to Study Absorption and Distribution of Herbicidal Chemicals in Plants.

California, University of (Davis). G. H. Hart, The Effect of Radiation on Work Capacity and Longevity of the Dog.

California, University of. Louis Jacobson and Roy Overstreet, Study of the Internal or Metabolic Factors and the External or Environmental Factors Influencing Ion Absorption by Plants.

California, University of (Davis). Max Kleiber, Intermediary Metabolism of Organic Compounds and Biological Synthesis in Farm Animals.

California, University of. P. R. Stout, Micronutrient Element Nutrition of Plants as Determined by Essential and Non-Essential Soil Borne Heavy Metals of Importance in Plant Nutrition.

California, University of (Riverside). F. M. Turrell et al., Use of Radioactive Tracers in Studies of the Mode of Action of Organic Insecticides.

California, University of, at Los Angeles. T. A. Geissman, The Sites and Mechanisms of Action of Physiologically-Active Substances, with Particular Application to Drugs upon the Autonomic Nervous System.

California, University of, at Los Angeles. S. G. Wildman, The Study of Plant Virus as Approached by the Study of the Normal Plant Proteins.

Chicago, University of. Hans Gaffron, Effect of Blue and Dark Red Light upon Reactivation of Ultraviolet Treated Photosynthetic Micro-organisms.

Chicago, University of. E. M. K. Geiling, Biosynthesis of Radioactive Drug Compounds.

[2] Contract administered through the Office of Naval Research, Washington, D. C.

Clemson Agricultural College. J. G. Dinwiddie, Jr., Investigation of the Mode of Action of Maleic Hydrazide as a Plant Growth Regulator.

Columbia University. Theodore Dobzhansky, The Population Genetics of Species of Drosophila.

Columbia University. C. G. King and H. B. Burch, To Identify Precursors and End-Products Containing Radiocarbon, in Studies of the Role of Glucose, Ascorbic Acid, etc., in Metabolism.

Columbia University. J. H. Taylor, Nucleic Acid and Protein Synthesis in Individual Cells and Chromosomes Studied by Radioactive Tracers and Autoradiographs.

Connecticut Agricultural Experiment Station. J. G. Horsfall and A. E. Dimond, Therapy of Plant Disease by Nuclear Radiations.

Cornell University. M. R. Zelle, Cytological and Genetic Studies of Bacteria as Related to Effects of Radiation.

Delaware, University of. A. M. Clark, Radiation Effects upon Haploids and Diploids of Habrobracon.

Duke University. I. E. Gray, (A) Studies on Synthetic Potentialities of Liver Nuclei *In Vitro;* (B) Shell Formation in Mollusks as Studied by Radioisotopes.

Duke University. P. J. Kramer, Study of the Factors Affecting the Absorption of Radioactive Phosphorus by Mycorrhizal and Non-Mycorrhizal Roots of Pine.

Emory W. Thurston Laboratories (Los Angeles). B. H. Ershoff, Comparative Effects of the Known B Vitamins and an Unidentified Antitoxic Factor in Liver on Radiation Injury in the Rat.

Emory University. A. V. Beatty, Studies of the Influence of Oxygen Level and Temperature on the Effects of Ionizing Radiation.

Florida, University of. G. K. Davis, J. P. Feaster, and A. M. Pearson, Concentration of Mineral Elements in the Fetus and the Relationship to Placental Transfer of these Elements.

Fordham University. E. V. Brown, Fate of Thiamine and Thiamine Analogs in the Animal Body. Mechanism of Thiamine Inhibition by Thiamine Analogs.

Fordham University. F. F. Nord, Investigation on Enzymatic Degradation of Native and Chemically Modified Proteins.

Georgia, University of. E. P. Odum and J. J. Paul, An Ecological Study of Land-Use, Succession, and Indicator Invertebrate and Warm-Blooded Vertebrate Populations of the Savannah River Operations Areas.

Harris Research Laboratories (Washington, D. C.). Milton Harris, The Chemistry of Biosynthesized Isotopically Labelled Cellulose and Allied Polysaccharides.

Harvard University. Karl Sax, Intensity of Radiation and Chromosome Breakage.[3]

Howard University. L. A. Hansborough, The Effect on Fertilization and Development of Labelling the Germ Cells.

Idaho, University of. W. K. Ferrell, and E. E. Hubert, A study of Absorption and Translocation of Mineral Elements in Diseased and Healthy Western White Pine by the Use of Radioactive Materials.

Illinois, University of. I. C. Gunsalus, Intermediary Metabolism of Carbohydrates.

Illinois, University of. R. G. Hansen, Utilization of Carbon 14 in Studies of the Metabolism of Lactose.

[3] Contract administered through the Office of Naval Research, Washington, D. C.

Illinois, University of. B. C. Johnson, Nutritional Biochemistry on the Metabolism of Vitamins and Amino Acids.

Illinois, University of: H. H. Mitchell, Content in Human Tissues of Eleven Trace Elements.

Indiana University Foundation, Felix Haurowitz, The Mechanism of the Combination of Antigen and Antibody.

Indiana University Foundation. H. J. Muller, The Influence of Radiation in Altering the Incidence of Mutations in Drosophila.

Indiana University Foundation. T. M. Sonneborn, Specific Immobilization Substances (Antigens) of *Paramecium Aurelia.*

Indiana University Foundation. W. J. van Wagtendonk and W. A. Mitchison, Immunochemistry of *Paramecium Aurelia.*

Interior, Department of. W. A. Chipman, Survey of the Accumulation of Radioactivity in Marine Invertebrate Animals.

Iowa State College. Samuel Aronoff, Metabolism and Physiology of Roots.

Iowa State College. J. W. Gowen and Janice Stadler, Quantitative Study of Lifetime Sickness and Mortality and Progeny Effects Resulting from Exposure of animals to Penetrating Irradiation.

Iowa State College. Fritz Schlenk, Nucleic Acid Metabolism.

Iowa State College. L. A. Underkofler, Combined Biochemical and Physiological Action of Tyrosine and Vitamin B_{12}.

Iowa State College. C. H. Werkman, Synthesis and Dissimilation of Bacterial Nucleic Acids.

Johns Hopkins University. Robert Ballentine and W. D. McElroy, Metabolism and Functional Significance of Cobalto-Protein.

Johns Hopkins University. B. F. Chow, Purification of Intrinsic Factor in Gastric Juice.

Johns Hopkins University School of Medicine. Theodore Enns and Francis Chinard, A Study of Relative Diffusion Rates of Isotopes from Capillaries.

Johns Hopkins University. R. M. Herriott, (A) Transformation of E. Coli B from Virus Sensitive to Virus Resistant or Vice Versa; (B) Chemical and Nutritional Studies of Bacterial Viruses.

Johns Hopkins University. W. D. McElroy and C. P. Swanson, Modification through the Use of Supplemental Environmental Factors of the Frequency of Gene and Chromosome Changes Induced by X-rays, Ultraviolet Light and Nitrogen Mustard.

Johns Hopkins University. C. P. Richter, Part Played by the Adrenals in the Ability of Rats to Withstand Radiation Effects.

Kansas State College of Agriculture and Applied Science. P. A. Dahm, Studies of Insects and Insecticides with Tracers.

Kansas, University of. C. A. Leone and A. B. Leonard, The Hemopoietic Physiology of Native Rodents.

Kentucky, University of. H. P. Riley, The Protective Effect of Certain Chemicals on the Sensitivity of Plant Chromosomes to Ionizing Radiation.

Long Island Biological Association, Inc. Bruce Wallace, Adaptive Value of Experimental Populations Exposed to Radiations.

Louisiana State University and Agricultural and Mechanical College. H. J. Bennett, The Effects of Radioisotopes on the Developmental Stages of Trematodes.

Louisiana State University and Agricultural and Mechanical College. J. F. Christman and Virginia Williams, The Effect of Biotin on Acetate Utilization and Lipide Synthesis by Micro-organisms.

Louisiana State University. H. E. Wheeler, Investigations of the Physiology, Genetics and Host-Parasite Relationships of Plant Pathogenic Fungi by the Use of Radioisotopes.

Marine Biological Laboratory, Woods Hole, Mass. P. B. Armstrong, (A) Studies on the Physiology of Marine Organisms Using Radioisotopes; (B) Investigation of the Biochemistry of Cell Nuclei Using Radioisotopes.

Maryland, University of. J. C. Shaw, The Metabolism of Radioactive Carbon Compounds in Lactating Ruminants.

Maryland, University of. Edward Steers, The Nature and Function of the Replacement of P-Amino-Benzoic Acid by D-Lysine as a Growth Factor for *Lactobacillus Arabinosus 17–5.*

Massachusetts, University of. P. A. Swenson, Effects of Ultraviolet Radiations on Phosphate Turnover of Yeast Cells in the Presence of Galactose.

Michigan State College. R. U. Byerrum and C. D. Ball, A Study of Transmethylation in Plants Using Carbon 14 as a Tracer.

Michigan State College. Bergene Kawin, The Metabolism in Animals of Some Radionuclides Derived from Fission.

Michigan State College. H. B. Tukey, The Absorption and Utilization of Radioactive Minerals Applied to the Leaves of Plants.

Michigan State College. L. F. Wolterink and E. P. Reineke, Hormonal and Nutritional Factors which Influence the Biological Half Lives of Calcium and Strontium in Animals (Including Studies of Intestinal Absorption).

Michigan, University of. J. V. Neel, The Estimation of the Rate of Mutation of Certain Human Genes.

Minnesota, University of. R. T. Holman, Studies in Lipid Metabolism by Means of Radioactive Tracers.

Minnesota, University of. W. E. Peterson *et al,* Study of Milk Formation by the Use of Radioactive Carbon Compounds.

Minnesota, University of. E. C. Stakman, Effects of Radioctive Substances on Plant Pathogens and Other Micro-organisms.

Missouri Botanical Gardens. Edgar Anderson, Investigation of Natural and Radiation-Induced Mutations in *Nicotiana.*

Missouri, University of. Samuel Brody, Determination of Thyroid Activity in Farm Animals by the Use of Radioactive Tracers.

Missouri, University of. Jacob Levitt, Translocation of Mineral Substances in Plants.

Missouri, University of. L. J. Stadler, The Genetic Nature of Induced Mutations.

Nebraska, University of. E. F. Frolik and Rosalind Morris, The Genetic Effects of Thermal Neutron Irradiation of Crop Seeds.

New York Medical College. Carl Neuberg, Factors Influencing the Solubility of Heavy Metal Compounds and Their Metabolism.

North Carolina State College. W. C. Gregory, Effects of Nuclear Reactor Radiation upon Genetic and Physiological Characteristics of Peanuts.

North Carolina State College. N. S. Hall, Study of the Movement of Ions Through Soil Systems.

North Carolina State College. S. B. Tove, A Study of the Effect of the Diet on Lipid Metabolism Using Carbon 14.

North Carolina State College of Agriculture and Engineering. D. S. Grosch, The Genetic and Developmental Effects of Ingested Radioactives.

North Carolina, University of. D. P. Costello, The Effects of Radiations of Specific Energies on Mitosis.

North Carolina, University of. Maurice Whittinghill, The Partial Elimination of Lethal Genes Before Reproduction in Drosophila by the Use of Environmental Agents.

Northwestern University. G. H. Mickey, Comparison of the Delayed Effects Produced by Chemical Mutagens and by X-rays.

Notre Dame, University of. C. S. Bachofer, Study of Protection of Virus Systems Against Irradiation.

Oberlin College. G. T. Scott, Studies on the Physiology of Ion Accumulation and Electrolyte Balance in Living Cells.

Ohio Agricultural Experiment Station. Thor Kommedahl, The Physiology and Genetics of Plant Pathogenic Micro-organisms When Grown in the Presence of Various Radioisotopes.

Oklahoma Agricultural and Mechanical College. R. M. Chatters, Effects of Radiation on Plant Growth.

Oklahoma Agricultural and Mechanical College. Robert MacVicar, Isotope Investigation of the Mechanism of Nitrate Reduction in Bacteria.

Oklahoma Research Institute, University of. R. W. Goff, Study of the Effects of Isotopic Irradiation on Embryonic Capillaries.

Oklahoma Research Institute, University of. Lawrence Rohrbaugh and E. L. Rice, Study of the Translocation of Tagged 2, 4–D and Other Growth Regulators in Plants in Light and Darkness.

Oregon State College. V. H. Cheldelin and B. E. Christensen, Vitamin-Amino Acid and Carbohydrate-Amino Acid Interrelationships, Using Isotopic Tracers.

Oregon State College. S. C. Fang, The Mode of Action of Labelled 2, 4-Dichlorophenoxyacetic Acid and Similar Agents.

Oregon, University of. F. J. Reithel, An Investigation of Lactose Synthesis in Mammary Gland Homogenates.

Pennsylvania, University of. E. D. DeLamater, Studies on the Cytology and Cytochemistry of Micro-organisms.

Pennsylvania, University of. D. R. Goddard and William Stepka, A Study of Sulfate Reduction and the Biosynthesis of Organic Sulfur Derivatives in Higher Plants.

Pennsylvania, University of. Stuart Mudd, The Internal Organization of Normal and Phage-Infected Bacterial Cells, With Especial Reference to Activation of Latent Phage Infection by Ultraviolet Radiation.

Pennsylvania, University of. D. W. Wilson, Synthesis of Isotopic Carbon Compounds Used in Biochemistry.

Pittsburgh, University of. Ralph Buchsbaum, The Effects of Radiation on Living Cells in Tissue Culture in Perfusion Chambers.

Pittsburgh, University of. M. A. Lauffer, Study of the Correlation of Radiation Effects With Physical and Chemical Changes in Viruses.

Purdue Research Foundation. Henry Koffler and P. A. Tetrault, Use of Radioactive Isotopes in Studying Mold Metabolism With Emphasis on the Assimilatory Mechanisms of Penicillium Chrysogenum and Other Representative Molds.

Purdue Research Foundation. Henry Koffler and D. M. Powelson, The Physiology of Hydrogen Bacteria.

Reed College. F. P. Hungate, The Application of the Radioactive Tracer Technique in the Field of Cellular Metabolism.

Reed College. A. H. Livermore, The Biochemical Synthesis of Peptide Bonds.

Reed College. A. F. Scott and A. H. Livermore, The Effect of Ionizing Radiation on Biochemical Compounds.

Rice Institute. A. C. Chandler and R. V. Talmage, Physiological Action of Relaxin and Related Studies on Cellular Metabolism.

Roscoe B. Jackson Memorial Laboratory (Bar Harbor, Maine). E. S. Russell and W. S. Murray, The Maintenance of a Genetically Controlled Colony of Mice for Research.

Rutgers University. J. E. Gunckel, Histological and Physiological Effects of Irradiation on *Tradescantia Paludosa.*

Rutgers University. H. H. Haskin, Distribution and Accumulation of Radioisotopes of Physiological Importance in Shellfish.

Smith College. A. F. Blakeslee, Studies on Effects of Neutron Radiation on Chromosome and Gene Changes in Datura.

Smithsonian Institution. R. B. Withrow, A Biochemical Investigation of Radiant Energy as it Affects Photomaturation in Green Plants.

South Carolina, University of. W. E. Hoy, An Ecological Study of the Land Plants and Cold-Blooded Vertebrates of the Savannah River Project Area Before and After Installations Have Been Completed.

South Dakota State College. E. I. Whitehead and O. E. Olson, Metabolism of Selenium and Radioactive Sulfur in Plants.

Southern California, University of. H. J. Deuel and A. L. S. Cheng, Effects of Radiation on Intestinal Absorption and Metabolism of Fats and Carbohydrates.

Southern Illinois University. C. C. Lindegren, The Effects of X-Irradiation on a Polyploid Series of Yeast Cultures Containing Determined Amounts of DNA.

Southern Research Institute. H. E. Skipper. Body Retention of Carbon 14.

Southern Research Institute. H. E. Skipper and L. L. Bennett, Jr., Use of Radioactive Isotopes for Study of Certain Chromosome-Coenzyme Relationships.

Stanford University. A. C. Giese, Studies on Photoreactivation Following Ultraviolet Irradiation Injury.

Syracuse University. B. S. Strauss, The Study of Intermediate Carbohydrate Metabolism in Neurospora Using Radioactive Carbon and Biochemical Mutants.

Tennessee Agricultural and Industrial State College. H. B. Crouch, Radiation and Tracer Element Studies on Certain Pathogenic Protozoa and Nematodes of Rodents.

Texas Agricultural and Mechanical College. J. H. Quisenberry, Effects of X-ray Irradiation on Reproduction of the Domestic Fowl (Gallus Domesticus).

Texas, University of. J. W. Foster, Studies of the Metabolic Processes in Molds and Fungi with Carbon 14.

Texas, University of. Jack Myers and L. O. Morgan, Study of the Relationships of Algae to the Disposal of Radioactive Wastes.

Texas, University of. W. S. Stone, Research on Direct and Indirect Effects of Radiations on the Genetic Systems of Organisms.

Union College. L. B. Clark and G. Heidenthal, (A) Biological Effects of High Voltage Radiation; (B) Radiation Genetics of Habrobracon.

Utah State Agricultural College. Clyde Biddulph, Use of Radioisotopes in the Study of Reproduction.

Utah State Agricultural College. D. W. Thorne, Use of Radioiron in Studying Lime-Induced Chlorosis.

Utah, University of. L. P. Gebhardt and L. T. Samuels, Use of Labelled Phosphorus in the Study of Nerve Tissue Metabolism During Invasion of Neurotropic Viruses.

Utah, University of. J. D. Spikes and R. W. Lumry, Studies of Photosynthetic Processes in Cell-Free Preparations Using Radiation.

Virginia Polytechnic Institute. E. P. Johnson, Radioactive Isotopes to Trace Leucosis and Newcastle Disease in Fowls.

Washington, State College of. Orlin Biddulph, Absorption, Translocation and Deposition of Radioactive Elements in Plants.

Washington, State College of. Orlin Biddulph, The Zinc Nutrition of Plants in Calcareous Soils.

Washington, State College of. Noe Higinbotham, The Rate of Movement of Ions Into and Through Parenchma Tissue as Affected by Rate of Water Uptake.

Washington, State College of. H. B. Milne, The Effect of X-rays Upon the Optical Specificity of Papain.

Washington, State College of. R. A. Nilan, A Study of Factors Influencing the Biological Effects of X-rays.

Western Reserve University. H. G. Wood and L. O. Krampitz, Intermediary Metabolism of Carbohydrates by Bacteria.

Wisconsin, University of. R. H. Burris, M. J. Johnson and P. W. Wilson, Metabolism of Organic Acids in Higher Plants and Micro-organisms.

Wisconsin, University of. R. H. Burris and P. W. Wilson, Biological Nitrogen Fixation with Isotope Tracers.

Wisconsin, University of. D. E. Green, Effects of Radiation on Enzymes in the Cyclophorase System.

Wisconsin, University of. Joshua Lederberg, Cytogenetic Effects of Radiations on Bacteria.

Wisconsin, University of. P. H. Phillips, Long-Time Effects of Intermittent Radiation on Dogs.

Wisconsin, University of. A. J. Riker and J. E. Kuntz, The Use of Radioactive Isotopes in Determining the Role of Root-Grafting in Forest Trees.

Wyoming, University of. Irene Rosenfeld and O. A. Beath, Investigations of the Interrelationship of Sulphur, Phosphorus and Calcium in Selenium Metabolism in Plants and Animals.

Yale University. D. M. Bonner, Relationship of Genes to Biochemical Reactions in Neurospora.

Yale University. M. I. Bunting, The Genetics of Serratia as Revealed by Radiation.

Yale University. N. H. Giles, Jr., Investigations on the Cytogenic Effects of Radiations.

Yale University. E. C. Pollard, Irradiation of Viruses and Large Molecules.

Howard University. Herman Branson, Kinetic and Mass Spectrometric Studies of Biophysical Systems with Radioactive and Stable Isotopes.

Idaho State College. C. W. McIntosh and A. E. Taylor, Determination of Quantities of Certain Radioactive Materials in Ground Water and Soil of Areas in and Adjacent to the National Reactor Testing Station.

Illinois, University of. G. A. Bennett and R. A. Harvey, Distribution and Effect of Radioactive Calcium and Strontium in Bone Development.

Kansas University. F. E. Hoecker, Studies of Bone Metabolism Using Radium and Plutonium.

Marquette University. W. A. D. Anderson, The Pathological Effects of Radioactive Isotopes of Calcium and Strontium on Bone and Soft Tissue.

Massachusetts Institute of Technology. R. D. Evans, Radium and Mesothorium Poisoning, and Dosimetry and Instrumentation Techniques in Applied Radioactivity.

Michigan, University of. H. J. Gomberg, High Resolution Detection of Radioactive Isotopes.

New York University. M. B. Sulzberger and V. H. Whitten, Effects of Thorium-X in Selected Vehicles Applied to the Skin of Man, and the Effects of Selected Pure Beta Emitters on the Skin of Man.

Northwestern University. E. L. Hess, The Separation of the Proteins of Lymphoid Tissue and Their Characterization as Regards Radiation Sensitivity.

Oregon, University of. F. B. Queen, Evaluation of Body Content of Radium in Individuals with no Known Exposure.

Pittsburgh, University of. A. J. Kammer and T. F. Hatch, Hazard from Inhaled Particulate Matter.

Sloan Kettering Institute, Memorial Center for Cancer and Allied Diseases. J. S. Laughlin, Equivalence of Absorbed Radiation Energy and Cavity Ionization.

Utah, University of. J. Z. Bowers, Toxicity Studies of Plutonium and Other Radioactive Substances in Animals.

Vanderbilt University. J. I. Hopkins, Elementary Particle Scattering and Studies of Decay Schemes.

Washington University (St. Louis). W. M. Allen, W. B. Seaman, and Michel Ter-Pogossian, Comparative Study of the Biological Effects of X-rays and Ionizing Radiation from Radioisotopes.

Washington University (St. Louis). H. G. Schwartz, W. B. Seaman, and Michel Ter-Pogossian, Study of Alteration in the Blood-Brain-Barrier Associated with Pathological Conditions of the Central Nervous System.

Washington, University of. F. I. Badgley and R. G. Fleagle, Determination of Relationships Between Temperature Lapse Rate, Wind Speed and Wind Shear (Atmosphere Turbulence Study).

Washington, University of. P. E. Church, Changes of Wind Speed and Direction with Height in Relation to the Vertical Temperature Distribution.

Wisconsin, University of. D. M. Angevine and J. J. Lalich, Development and Application of Historadiography in Relation to the Distribution of Mass and Localization of Elements in Normal and Pathological Tissues.

Medicine

Arkansas Medical School, University of. P. L. Day and Isadore Meschan, Studies on the Biochemical and Nutritional Aspects of X-radiation Injury.

Beth Israel Hospital Association (Boston). Herrman Blumgart, The Use of I 131 in Treatment of Heart Diseases and Follow-up Studies on Biological Effects of Radiation.

Boston University School of Medicine. Isaac Asimov, Radiation-Induced Changes in Nucleic Acids and Their Hydrolysis Products.

Boston University School of Medicine. W. W. Jetter, The Effects of Sublethal Doses of Ionizing Radiation on Physical Performance of Dogs. Related Biochemical and Pathological Studies.

Boston University. B. R. Lutz, The Effects of Irradiation on the Functions of Small Blood Vessels of the Hamster and the Frog.

Boston University. L. C. Wyman, The Effects of Irradiation on the Growth and Functioning of Transplanted or Regenerated Adrenocortical Tissue in the Rat.

California, University of (San Francisco). Herman Becks, Investigations of the Dietary Effects of Radioactive Strontium, Calcium and Phosphorus. (Dental)

California, University of. I. L. Chaikoff, Studies on the Induction of Thyroid Cancer Following Administration of Radioactive Iodine.

Cedars of Lebanon Hospital, University of Southern California. N. B. Friedman, Effects of Radiation and Chemical Agents on Differentiation of Normal and Neoplastic Tissues.

Chicago Medical School. Philippe Shubik, A Study of the Latent Tumor Cells as Produced by Beta Radiation and a Comparison of the Latent Tumor State with that Produced by Chemical Carcinogens.

Chicago, University of. H. S. Anker, Investigation of the Mechanism of Antibody Synthesis by the Tracer Technique.

Chicago, University of. E. S. G. Barron, Studies on the Mechanism of Action of Ionizing Radiations.

Chicago, University of. P. P. H. DeBruyn, Radiosensitivity of the Lymphocyte.

Chicago, University of. C. P. Miller, Bacteriological Aspects of Radiation Sickness.

Chicago, University of. W. L. Palmer, A Study of the Effects on Gastric Tissues of Irradiation Therapy in Peptic Ulcer.

Chicago, University of. W. H. Taliaferro, The Effect of Localized X-irradiation on Antibody Formation and Antigen Localization. The Site of Antibody Formation.

Children's Hospital (Boston). L. K. Diamond, Study of the Possible Factors in Regeneration of Hematopoietic Tissue in the Aplastic Anemias, Both Idiopathic and Secondary to Radiation Injury, in Human Subjects.

Children's Hospital of Buffalo. C. U. Lowe, Nucleic Acid Metabolism in the Liver and Effects of Radiation.

Children's Medical Center (Boston). Sidney Farber, The Nature of Bleeding in Pancytopenia with Special Regard for Thrombocytopenia and the Vascular Defect.

Cincinnati, University of. R. A. Kehoe, F. R. Dutra, and E. J. Largent, Research on the Biological Effects of Beryllium and Its Compounds.

Colorado, University of. J. D. Park, Research on the Infra-Red Absorption Spectra of Nucleic Acids, Amino Acids, and Related Compounds.

Colorado, University of. T. T. Puck, Bacteriophage and Radiation Mechanisms.

Columbia University. Aubrey Gorbman, Biological Effects of Radiation from Excessive Amounts of Radioiodine.

Columbia University. Harry Grundfest and David Nachmansohn, Study of Changes in Permeability of Normal, Poisoned, and Irradiated Nerve Fibers.

Columbia University College of Physicians and Surgeons. P. B. Hudson and J. M. Reiner, The Turnover of Specific Proteins, Protein Fractions, and Nucleic Acids in Normal and Malignant Human Testis and Kidney.

Creedmore Institute for Psychobiologic Studies (New York.) Co Tui, Investigations on the Relationship of Human Skin Types to Blood Types and Related Studies in the Mechanism of Thermal Injury.

Duke University. Philip Handler, (A) Localization of Brain Tumors Using Positron-Emitting Isotopes; (B) Renal Function and Metabolism.

Duke University. J. S. Harris, A Study of Potassium Metabolism in Isolated Tissue.

Duke University School of Medicine. R. W. Rundles, Study of the Metabolism of Human Bone Marrow.

Emory University. H. W. Ades, (A) Effect of Radiation on Learned Behavior, Problem-Solving Ability and Neural Mechanisms of Rhesus Monkeys; (B) Effect of Radiation on Ground Substance of Loose Connective Tissue.

Florida, University of. F. E. Ray, The Use of Isotopes in the Study of the Metabolism of Aromatic Amines.

Fordham University. E. V. Brown, Metabolism of a New Carcinogen Using Radioactive Carbon.

Georgetown University. C. F. Geschickter, A Study of the Redistribution of Bivalent Metallic Ions in Bone Metabolism and in Bone Disease and Neoplasms Through the Use of Radioisotopes and Novel Chelating Compounds.

George Washington University. P. K. Smith and E. L. Alpen, Studies of the Effects of Radiation on the Biosynthesis and Degradation of Nucleoproteins and its Modification by Various Agents.

Georgia, University of. S. A. Singal, The Effects of Nutritional Deficiencies on the Synthesis of Phospholipids and Nucleoproteins in the Rat.

Hahnemann Medical College and Hospital. J. S. Roth and M. J. Boyd, A study of Nutritional and Other Factors Involved in Radiation Injury and Resistance to Radiation Injury.

Harvard University. J. C. Aub, Study of Metabolic Activities of Living Organisms by Means of Suitable Isotopes.

Harvard University. D. G. Cogan and R. D. Evans, Production of Cataracts by Neutrons and Other Radiations.

Harvard University. A. B. Hastings, Use of Isotopes in Study of Metabolism of Organic Substances in Mammalian Tissue.

Harvard University. A. K. Solomon, Use of Isotopes on Medical Problems.

Harvard University, Bussey Institute of. J. L. Tullis, (A) Investigation of Factors Regulating the Formation, Maturation, and Liberation of Formed Blood Elements from Bone Marrow; (B) Further Studies of the Separation and Utilization of Formed Blood Elements.

Haskins Laboratories, Inc. S. H. Hutner, The Microbiological Assay of Nucleic Acid Constituents Produced by Radiation Injury.

Institute for Cancer Research, Philadelphia, Pa. Sidney Weinhouse and Grace Medes, Origin and Fate of Amino Acids in Plants and Animals.

Iowa, State University of. T. C. Evans and P. J. Leinfelder, A Quantitative and Morphologic Study of Radiation-Induced Cataracts.

Jefferson Medical College of Philadelphia. F. W. Sunderman, Metabolic and Cytologic Changes Induced by Metallic Carbonyls.

Johns Hopkins University School of Medicine. C. L. Conley, (A) Studies of the Absorption, Utilization, and Excretion of Vitamin B–12, Using B–12 Containing Radioactive Cobalt; (B) Synthesis of Compounds with Vitamin K Activity Labeled with Radioactive Carbon for Use in Tracer Studies with Vitamin K.

Johns Hopkins University. J. S. Friedenwald, Enzymatic Histochemistry of the Ocular Lens.

Johns Hopkins University. J. E. Howard, Investigation of the Mechanism of Bone Deposition and Related Physiological Studies.

Johns Hopkins University. T. G. Ward, Metabolism of Phosphorus in Virus-Host Systems.

Kansas, University of. R. E. Stowell, Cytochemical, Microchemical and Biophysical Studies of Tumors and Effects of Radiation upon Cells.

Kresge Eye Institute (Detroit). V. E. Kinsey, Effects of Neutrons and Other Radiations on the Ocular Lens.

Lovelace Foundation for Medical Education and Research (Albuquerque). W. R. Lovelace, et al, Indirect Blast Injuries.

Maryland, University of. T. E. Woodward, Studies on Monkeys Following Exposure to Large Doses of Total Body Irradiation.

Massachusetts General Hospital. J. C. Aub, I. T. Nathanson and P. C. Zamecnik, A Biochemical Study of the Effects of Radiation on Cells.

Massachusetts General Hospital. Stanley Cobb, Effect of Radiation on Learned Skill and Judgment.

Massachusetts General Hospital. Oliver Cope, Effects of Radioactive Iodine on Biology of Thyroid Gland.

Massachusetts General Hospital. Alexander Forbes and E. L. Gasteiger, The Effects of Ionizing Radiation on Peripheral Nerve.

Massachusetts General Hospital. H. L. Hardy, Establishment of a Beryllium Case Registry.

Massachusetts General Hospital. W. H. Sweet, The Use of Thermal and Epither-

Montefiore Hospital for Chronic Diseases. Daniel Laszlo and K. G. Stern, The Relationship of Stable and Radioactive Lanthanum to Nucleic Acid Synthesis in Normal and Neoplastic Tissue.

National Institutes of Health, National Cancer Institute. Egon Lorenz, The Physiological Effects of Ionizing Radiations.

New England Center Hospital. William Dameshek and Mario Stefanini, Physio-Pathology of Platelets and Development of Platelet Substitutes.

New England Deaconess Hospital. S. P. Hicks, et al, Acute and Chronic Radiation Injury.

New England Deaconess Hospital. S. P. Hicks, The Effects of Ionizing Radiations on the Developing Mammalian Nervous System.

New York University. Anna Goldfeder, Studies on the Nature of, and Protection from Radiation Injury.

New York University. Norton Nelson, Influence of Particle Size on the Retention of Mist Particles in the Human Respiratory System.

New York University. H. W. Smith, Study of Body Fluid Distribution in Hypertensive and Renal Disease and Collateral Physiological Studies.

New York University. W. S. Tillett and Robert Soberman, The Influence of Ionizing Radiation on Enzyme Systems.

New York University, Bellevue Medical Center. J. M. Converse, Mario Gaudino. (A) The Effect of Refrigeration of Human and Animal Skin Upon its Use in Skin Grafts Following Thermal Injury; (B) A Study of Antibodies Produced by Homologous Skin Grafts in Animals and in Man.

New York Research Foundation, State University of (Albany). J. H. Ferguson, and M. F. Hilfinger, Experimental Transfusion of Bone Marrow into Rabbits after Total Body Irradiation.

North Carolina, University of. Arthur Roe, Effect of Carbon 14 on the Course of Certain Organic Reactions.

North Carolina, University of. C. D. Van Cleave and C. T. Kaylor, Radioautographic Study of Distribution and Retention of Beryllium in the Rat.

North Dakota, University of. W. E. Cornatzer, The Effects of Whole-Body Radiation on Various Enzyme Systems in the Liver.

Northwestern University. J. A. D. Cooper and H. L. Alt, The Diagnostic and Therapeutic Use of Radioisotopes in Experimental Medicine.

Northwestern University. Loyal Davis, Further Development and Utilization of Radioactive Dyes in the Diagnosis and Localization of Brain Tumors.

Northwestern University. Smith Freeman, Studies on Radiation-Induced Cataracts.

Northwestern University. R. W. Schayer, Studies of the Metabolism and Biogenesis of Histamine.

Notre Dame, University of. J. A. Reyniers, Study of the Effect of X-radiation on Germ-Free (GF) Rats.[2]

Ohio State University Research Foundation. J. L. Morton, Use of Radioisotopes for Cancer Therapy.

Oklahoma Medical Research Institute and Hospital (Oklahoma City). C. D. Kochakian, Metabolism of Radioactive Sex Hormones.

Oklahoma Research Institute, University of (Norman). S. H. Wender, Isolation and Identification of Flavonoid Pigments of Use in the Control of Radiation Injury.

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[2] Contract administered through the Office of Naval Research, Washington, D. C.

Oregon Medical School, University of. E. E. Osgood and A. J. Seaman, The Effects of Adrenocortical Hormones upon the Cultivation and Transplantation of Human Blood Cellular Elements, and Follow-up Studies of Radiation Therapy Patients.

Oregon Medical School, University of. E. S. West, Studies on the Metabolism of Cholesterol and Ketone Bodies.

Peter Bent Brigham Hospital (Boston). F. D. Moore, Intracellular Changes in Trauma, Depletion and Repair; Biochemical Studies in the Human Being with the Aid of Isotopes.

Philadelphia General Hospital. H. P. Schwarz, The Effects of X-ray Radiation on the Infra Red Spectra of Neural and Radiosensitive Visceral Tissue.

Pittsburgh, University of. F. S. Cheever, The Effect of Radiation on the Virus-Host Cell Relationship.

Pittsburgh, University of, School of Medicine. F. J. Dixon, The Study of the Effects of Radiation on the Immune Response with Special Reference to Factors which Increase the Radioresistance of the Immune Response.

Pittsburgh, University of, School of Medicine. M. A. Fischer, Mechanism of Protection Against Radiation.

Rochester, University of. L. H. Hempelmann, A Program for Patient Care in Radiation Therapy.

Rochester, University of. G. H. Whipple, Plasma Proteins with Labeled Amino Acids.[3]

Sloan Kettering Institute, Memorial Center for Cancer and Allied Diseases. C. P. Rhoads, et al., Biological Effect of Radiation and Related Biochemical and Physical Studies.

South Carolina, Medical College of. M. H. Knisely, Development of Methods for Rapid Demineralization of Bone While Maintaining Soft Tissue Relationships and Good Histological Staining Qualities (Studies of Bone Demineralization).

St. Louis University. Henry Pinkerton, Study of the Relation of Rickettsial and Viral Infections to Radiation Injury.

St. Louis University School of Medicine. E. A. Doisy, Sr., Metabolism of Steroids Utilizing Radiocarbon Labeled Compounds.

St. Louis University School of Medicine. E. A. Smolik, The Blood Volume and Blood Turnover in Cases of Head Injury as Determined by Phosphorus 32 Labeled Red Blood Cells.

Syracuse University. E. L. Lozner, Body Defenses Against Hemorrhage in Health and Disease.[3]

Temple University. Robert Robbins, Investigation of the Breakdown Products of Para-Aminobenzoic Acid After Radiation with X-rays.

Tennessee, University of. C. E. Nurnberger and A. H. Lipscomb, Study of the Effect of Radioactive Iodine on Patients with Carcinoma of the Thyroid and with Hyperplastic Thyroids.

Tennessee, University of. R. R. Overman, Mechanisms of Ionic Imbalance in Pathophysiologic States.

Tennessee, University of. Lester Van Middlesworth, Thyroid Metabolism and Study of the Metabolism of Radioactive Methionine in Tissues.

Tennessee, University of. E. F. Williams, Jr., Absorption and Intermediary Metabolism of Calcium.

Tennessee, University of. J. L. Wood, The Origin and Fate of Thiocyanate Ion in Metabolism.

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[3] Contract administered through the Office of Naval Research, Washington, D. C.

Tennessee, University of. D. B. Zilversmit, The Metabolism of Radioactive Colloids.

Tennessee, University of. College of Medicine, R. R. Overman, Physiology of Water and Ionic Balance in Monkeys Subjected to Whole-Body Radiation.

Trudeau Foundation, The (Saranac Lake, N. Y.). L. D. Scheel, Biochemical Aspects of Pulmonary Granulomatosis.

Trudeau Foundation, The (Saranac Lake, N. Y.) A. J. Vorwald, Clinical and Experimental Investigations Concerning the Biological Hazards of Beryllium.

Tufts College. David Rapport, Study of the Relation of Radiation on Reactions Associated with Growth.

Tulane University of Louisiana. G. E. Burch, Jr., Turnover Rates of Chlorine and Rubidium under Controlled Dietary and Therapeutic Conditions in Patients with Chronic Congestive Heart Failure and in Control Subjects.

Tulane University of Louisiana. R. H. Turner, The Influence of Radiation Injury upon Physiology of Serum Lipids with Particular Reference to the Function of the Liver.

Tulane University of Louisiana. W. S. Wilde, The Metabolic Exchange of Tissue Electrolytes.

Utah Medical School, University of. P. B. Price and R. E. McDonald, The Effects of Ionizing Radiation upon Electrolyte and Water Balance, Blood Volume and Nitrogen Metabolism in Dogs. Studies of the Therapy of Acute Radiation Injury.

Utah, University of. M. M. Wintrobe and G. E. Cartwright, Metabolism of Trace Elements in Animals and Men with Special Reference to Their Role in Erythropoiesis.

Vanderbilt University School of Medicine. W. J. Darby, Study of the Absorption and Metabolism of Lipids and the Alterations which Occur in Acute Radiation Injury.

Virginia, University of. Alfred Chanutin, Effects of Ionizing Irradiation on Mammals.

Virginia Medical School, University of. C. L. Gemmill, The Metabolic Exchange of Radioactive Phosphorus and Potassium in Isolated Cell Systems.

Wake Forest College. Camillo Artom, Formation of Tissue Phospholipides.

Wake Forest College. G. T. Harrell, Jr., Distribution and Turnover of Sodium and Potassium in Acute Infections.

Wake Forest College. G. T. Harrell, Jr., et al, Toxicity of Radiation as Related to Previous Damage and the Functional Capacity of an Organ; The Effect of P-32 and X-rays on Liver and Marrow.

Washington University (St. Louis). W. M. Allen, Use of Gamma Ray as a Therapeutic Agent of Carcinoma.

Washington University (St. Louis). G. T. Cori, Enzymatic Mechanisms of Glycogen Synthesis.

Washington University (St. Louis). David Lipkin, Synthesis of Nucleotides and Related Compounds.

Washington University (St. Louis). I. L. Shechmeister, Investigations of the Relationship Between Radiation Damage and the Immune State.

Washington, University of. H. J. Dauben, Synthesis of Carbon 14—labeled Diethylstilbestrol and a Study of its Metabolism in the Body.

Washington, University of. C. A. Finch, Studies Related to Blood Preservation.

Washington, University of. C. A. Finch, Isotope Study of Hematopoiesis in Man.

Washington, University of. R. D. Ray, Mobilization of Radioactive Emitters from Bone.

Washington, University of. R. H. Williams and N. D. Lee, Studies on Endocrine and Other Factors Governing the Incorporation of Radioactive Amino Acids into Tissue Proteins *in vivo*.

Western Reserve University. C. E. Carter, The Effects of Ionizing Radiation on the Content and Metabolic Functions of Ergothioneine in Hematopoietic Tissue.

Western Reserve University. B. M. Dobyns, (A) The Chromatographic Separation (starch column) of Iodinated Compounds of Normal and Abnormal Thyroid Tissue; (B) A Study of the Physiological Function and Histological Changes of Thyroids Irradiated with Radioactive Iodine.

Western Reserve University. H. L. Friedell, Investigations of the Biological Effects of Internally Deposited Radioisotopes and Related Radiobiologic Studies.

Western Reserve University. L. A. Manson and L. O. Krampitz, Effect of Incorporated Radioactivity on the Biological Activity of Bacteriophage.

Western Reserve University. A. R. Moritz, Physiological and Pathological Aspects of Thermal and Flash Burns.

Western Reserve University. H. G. Wood, A Study of Intermediary Metabolism with Isotopically Labeled Compounds in Perfused Organs, Whole Animals, and Humans.

Wisconsin, University of. H. F. Harlow and P. H. Settlage, The Effect of Various Forms of Irradiation of the Brain on Learned and Unlearned Behavior of Monkeys and of Chimpanzees.

Worcester Foundation for Experimental Biology (Shrewsbury, Mass.). Hudson Hoagland and Gregory Pincus, Investigation of the Effects of Radiation on the Biosynthesis and Metabolism of Adrenocortical Steroids.

Yale University. J. H. Heller, Factors Increasing the Radiosensitivity of Malignant Neoplasms.

RAW MATERIALS RESEARCH CONTRACTS

Amherst College. G. W. Bain, Conditions Requisite for Concentration of Uranic and Uranyl Compounds into Uranium Ore Bodies.

Armour Research Foundation of the Illinois Institute of Technology. E. P. Flint, Geochemical Studies of Multi-component Systems Containing Uranium.

Armour Research Foundation of the Illinois Institute of Technology. D. F. Humphreys, Development of Analytical Techniques for Evaluating Uranium Content.

Arizona, University of. W. F. McKee, Sedimentation Studies on the Shinarump Formation.

Colorado School of Mines Research Foundation. V. C. Mattson, Study of Uranium-bearing Ore Sampling Procedures.

Columbia University. W. H. Bucher and Arthur Gilkey, Fracture Pattern Study of the Zuni and Lucero Uplifts.

Columbia University. Paul F. Kerr, Alteration Studies at Marysvale, Utah.

Harvard University. Clifford Frondel, Mineralogic Research on the Synthesis of Secondary Uranium Minerals.

Harvard University. Russell Gibson, Reconnaissance Studies in the Big Bend Region of Texas.

Iowa State College. T. A. Bancroft, The Application of Statistical Methods to Geology.

Jones & Laughlin Ore Co. L. P. Barrett, Survey of Pre-Cambrian Sedimentary Rocks in the States of Michigan, Minnesota, and Wisconsin.

Mining Research Corp. C. W. Livingston, Leaching of Uranium Ores in Place.

Minnesota, University of. J. W. Gruner, Mineralogical Investigations with Respect to Certain Types of Uranium Ores on the Colorado Plateau.

Minnesota, University of. T. D. O'Brien, Determination of the Relations between Uranium and Hydrocarbons in the Asphaltite Ores of Temple Mountain, Utah.

Nevada, University of. J. E. Moose, Development Studies on the Beneficiation of Uranium Ores, and Extractive Metallurgy for Recovery of Uranium from Ores.

Pennsylvania State College. J. C. Griffiths, Petrology Studies of the Rocks Surrounding Uranium Ore Bodies in the Salt Wash Formation.

Pennsylvania State College. Harold Wright, Study of Primary Uranium Deposits in the Boulder Batholith Area.

Sonic Research Corp. C. B. Horsley, Design, Construction, Modification, and Test Operation of a Working Model of Equipment for the Dewatering of a Solid-liquid Suspension System.

Stanford University. C. O. Hutton, Heavy Detrital Minerals in the Placer Deposits of the Snake River Area and other Areas in Idaho with Special Emphasis on Thorium Mineralogy.

Utah, University of. M. A. Cook and C. J. Christensen, Flocculation and Deflocculation in Slime Pulp Circuits.

Utah, University of. W. L. Stokes, Sedimentation Studies on the Salt Wash Formation.

REACTOR DEVELOPMENT RESEARCH CONTRACTS

Arcos Corp. R. D. Thomas, Welding of Austenitic Stainless Steel. Study of micro-fissuring and other characteristics, with the objective of improving structural usefulness of these steels.

California, University of. Robert Bromberg and W. L. Martin, Liquid Systems Engineering Research. Studies of bubble and gas formation in liquid systems and transient behavior of high-temperature, high-pressure water systems.

California, University of. H. B. Gotaas, Research and Development on the Use of Sewage Treatment Processes on Radioactive Wastes. Investigating use of sanitary engineering methods for disposal of high-volume, low-level radioactive wastes.

Carnegie Institute of Technology. Gerhard Derge, Electrochemical Separations in Nonaqueous Solutions.

Chicago, University of—American Meat Institute Foundation. H. R. Kraybill, Utilization of Fission Products. Study of food preservation.

Chicago, University of—Food Research Institute. G. M. Dack, Utilization of Fission Products. Study of food preservation.

Chicago, University of. L. S. Skaggs, Utilization of Fission Products. Study of food preservation.

Columbia University. E. L. Caden and C. G. King, Utilization of Fisson Products. To study possibilities of a commercial process of food preservation, utilizing the bactericidal properties of penetrating X- and gamma radiation, including mixed fission products.

Columbia University. J. R. Dunning, Neutron Cross Section Measurements.

Columbia University. W. A. Selke, Utilization of Fission Products. Research and development on the effect of radiations from fission products, particularly the effect of gamma radiation on chemical reactions.

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Commerce, Department of, National Bureau of Standards. Franz Alt, Shielding Calculations. Detailed calculations of gamma ray attenuation in various media, covering a wide range of gamma energies.

Commerce, Department of, National Bureau of Standards. Ugo Fano, Penetration and Diffusion of High-Energy Gamma Rays. Analytical and experimental studies to provide knowledge basic to design of gamma ray shields.[2]

Designers for Industry. C. H. Standish, Engineering and Fabrication of Mobile Flame-Spray Prototype Equipment.

General Electric Co. Laboratory. M. A. Edwards and W. W. Schultz, Utilization of Fission Products. Development of high level radiation sources.

Harvard University. Philip Drinker, Air Cleaning. Research and development on air cleaning, including improved methods and equipment, sampling methods, and training of personnel.

Harvard University. H. A. Thomas, Waste Disposal. Determination of distribution and disposition of radioactive material introduced into fresh water reservoirs and streams.

Illinois, University of. B. B. Babbitt, Effects of Radioactive Elements on Anaerobic Digestion of Sewage Sludges. Investigation of feasibility of concentrating radioactivity using sludge digestion process.

Illinois, University of. H. F. Johnstone, Aerosol Research and Development. Investigation of fundamental properties of aerosols as related to air cleaning.

Interior, Department of, U. S. Bureau of Mines. R. C. Corey, Incineration of Radioactive Wastes. To develop a practical incinerator for disposal of solid combustible radioactive wastes.

Johns Hopkins University. Abel Wolman, Disposal of Liquid and Solid Radioactive Wastes. Adsorption of radioactive material on natural waterborne silts; circulation of estuarial waters; distribution of radioactivity charged into institutional incinerators; and treatment of contaminated laundry wastes.

Johns-Manville Co. H. T. Coss, Thermal Insulation Matter. To develop insulations with better insulating properties than those now available and with characteristics suitable for reactor use.

Little, Arthur D., Inc. Earl Stafford and W. J. Smith, Filter Research and Development. Development of high-efficiency, high-temperature, acid-resistant filters for removal of aerosols from gaseous effluents.

Massachusetts Institute of Technology. Rolf Eliassen, Water Decontamination. Removal of radioactivity from water supplies by modified water-treatment methods.

Massachusetts Institute of Technology. B. E. Proctor, Utilization of Fission Products. An investigation of uses for fission products in the sterilization of foods, pharmaceuticals, and tissues.

Michigan, University of. L. E. Brownell, Industrial Utilization of Fission Products. Investigate possible use of fission products and identify areas within which (a) industrial uses of such products are technically and economically feasible, and (b) further research and development would be useful.

Minnesota, University of. H. S. Isbin and N. R. Amundson, Reactor Cooling Investigations to Study Pressure Drop and Transient Flow Characteristics in Two Phase, Water-steam Systems.

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[2] Contract administered through the Office of Naval Research, Washington, D. C.

New York University. Gail P. Edwards and William E. Dobbins, Waste Disposal. Feasibility of trickling filter for treatment of dilute radioactive wastes.

New York University. Gordon Strom, Atmospheric Disposal. Investigation of feasibility of using wind tunnels in evaluating disposal of gaseous effluents.

Nuclear Development Associates. Herbert Goldstein, Shielding Studies. Broad review of field, including evaluation of sensitiveness of calculated attenuations to physical data employed, comparison of theoretical methods, collation of experimental results, and development of engineering formulae.

Powder Weld Process Co. R. A. Wiese, Protective Coatings. To provide for development of methods of applying special metals on odd shapes.

Rand Corp. Herman Kahn, Shielding Research. Theoretical approach to attenuation problems, emphasizing Monte Carlo and numerical integration methods.

Rensselaer Polytechnic Institute. L. G. Bassett, Development of Isotope Separation Methods.

Rensselaer Polytechnic Institute. J. O. Hougen, Liquid-Liquid Extraction Studies. Research in liquid-liquid extraction; experimentation with pilot-plant size extraction column.

Stanford Research Institute. P. W. Cook, Feasibility Study of Solar Evaporation. To evaluate feasibility of using energy content in sun's rays to evaporate, reduce volume, and decontaminate liquid radioactive wastes.

Stanford Research Institute. Nevin Hiester, Development of a Continuous Ion-Exchange System.

Stanford Research Institute. P. J. Lovewell, Industrial Survey. To stimulate industry in investigating uses of fission products and to determine areas of desirable research and development.

Texas, University of. E. W. Steel, Disposal of Low Level Radioactive Wastes by Algae Concentration. Studies of practicality of handling low-level wastes through concentration capacities of algae.

Tufts College. T. R. P. Gibb, Research on Light Metal Hydrides as Shielding Components for Nuclear Reactors.

Yale University. R. H. Bretton, Utilization of Fission Products. Research on effect of radiations from fission products, particularly gamma radiation on chemical reactions.

APPENDIX 6

REGULATIONS OF THE U. S. ATOMIC ENERGY COMMISSION [1]

PART 50—CONTROL OF FACILITIES FOR THE PRODUCTION OF FISSIONABLE MATERIAL

GENERAL PROVISIONS

Sec.

GENERAL RESTRICTIONS

APPLICATIONS FOR AND ISSUANCE OF LICENSES

TYPES AND CONDITIONS OF LICENSES

REPORTS

VIOLATIONS

INTERPRETATIONS, PETITIONS, COMMUNICATIONS

SCHEDULES

EFFECTIVE DATE

AUTHORITY: §§ 50.1 to 50.80, inclusive, issued pursuant to the Atomic Energy Act of 1946 (Pub. Law 585, 79th Cong., 60 Stat. 755-ff).

GENERAL PROVISIONS

§ 50.1 *Basis and purpose.* The regulations in this part, for the control of facilities for the production of fissionable material, are promulgated by the United States Atomic Energy Commission pursuant to the Atomic Energy Act of 1946 (60 Stat. 755; 42 U. S. C. 1801 *et seq.*) to effectuate the policies and purposes of the Act.

§ 50.2 *Definitions.* (a) As used in this part, the term "facilities for the production of fissionable material," means (1) any equipment or device capable of such production and (2) any important component part especially designed for such equipment or devices as determined by the Commission. All such facilities are, for the purposes of the regulations in this part, classified as follows:

(1) Class I: Any facility (other than a Class II facility) capable of producing any fissionable material, including items listed in Schedule A (§ 50.70);

(2) Class II: Any item listed in Schedule B (§ 50.71). The Commission has determined that such items are important component parts especially designed for equipment or devices capable of the production of fissionable material.

(b) The term "person" means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, the United States or any agency thereof, any government other than the United States,

[1] Policies and regulations of the U. S. AEC announced prior to July 1952 can be found in Appendix 4, Fifth Semiannual Report to Congress; Appendix 10, Sixth Semiannual Report to Congress; Appendix 4, Ninth Semiannual Report to Congress; Appendix 6, Tenth Semiannual Report to Congress; Appendix 6, Eleventh Semiannual Report to Congress; Appendix 6, Twelfth Semiannual Report; and in the *Federal Register*.

any political subdivision of any such government, and any legal successor, representative, agent, or agency of the foregoing, or other entity, but shall not include the Commission, or officers or employees of the Commission in the exercise of duly authorized functions.

(c) The term "Commission" means the Atomic Energy Commission created by the Atomic Energy Act of 1946, or its duly authorized representative.

(d) The term "United States", when used in a geographical sense, includes all Territories and possessions of the United States and the Canal Zone.

(e) The term "fissionable material" means plutonium, uranium enriched in the isotope 235, any other material which the Commission determines to be capable of releasing substantial quantities of energy through nuclear chain reaction of the material, or any material artifically enriched by any of the foregoing, but does not include source materials, as defined in the Atomic Energy Act of 1946.

(f) The term "electronuclear machines" does not include X-ray generators.

GENERAL RESTRICTION

§ 50.10 *License required.* Unless authorized by a license issued by the Commission, no person shall manufacture, produce, transfer, or acquire facilities for the production of fissionable material. Licenses issued by the Commission are of two basic types, general and specific (see § 50.30), depending on the nature of the activity to be authorized.

§ 50.11 *Activities incident to export.* A specific license must be obtained to authorize export from the United States of facilities for the production of fissionable material, or to authorize the manufacture, production, transfer, or acquisition of such facilities for export.

§ 50.12 *Domestic activities.* (a) A specific license must be obtained (except as indicated in paragraph (c) below) to authorize manufacture, production, transfer, or acquisition of Class I facilities.

(b) A general license is hereby issued for manufacture, production, transfer and acquisition of Class II facilities which takes place within the United States and is not for export. This general license shall be deemed to include manufacture, production, transfer, and acquisition of Class II facilities for incorporation into other Class II facilities prior to export of the latter. Each person acting under authority of this general license remains subject to the reporting requirements of §§ 50.40 and 50.41 below.

(c) No license is required for activities expressly excepted from the licensing requirements of the Atomic Energy Act of 1946; that is, for manufacture, production, transfer, or acquisition of Class I or Class II facilities incident to or for the conduct of research or development activities in the United States of the types specified in section 3 of the Act.

§ 50.13 *Other activities.* A specific license must be obtained to authorize manufacture, production, transfer, or acquisition of facilities for the production of fissionable material in cases other than those specified in §§ 50.11 and 50.12 above.

APPLICATIONS FOR AND ISSUANCE OF LICENSES

§ 50.20 *Applications for licenses.* License applications for the activities covered by § 50.11 above shall be filed in duplicate with the United States Atomic Energy Commission, on Form AEC–17, copies of which may be obtained from the Commission. License applications for all other activities shall be filed by letter.

§ 50.21 *Issuance of licenses.* Upon a determination that an application meets the requirements of the Atomic Energy Act of 1946 and of the regulations of the Commission, the Commission will issue a license by approving,

upon such conditions as it deems appropriate and in accordance with law, the application filed, forwarding a copy of the license to the applicant.

§ 50.22 *Standards for issuance of licenses.* In making the determination mentioned in the preceding section, the Commission will be guided by the following standards:

(a) Assuring the common defense and security;

(b) Assuring an adequate supply of facilities for the production of fissionable material;

(c) Preventing the use of such facilities in a manner inconsistent with the national welfare;

(d) Effectuating the policies and purposes of the Atomic Energy Act of 1946.

So far as consistent with these standards, licenses will be granted for the conduct of normal business activities.

TYPES AND CONDITIONS OF LICENSES

§ 50.30 *Types of licenses.* A general license has been issued in the cases specified in § 50.12 (b) above and in such cases the filing of an application with the Commission is not necessary. Specific licenses are issued to named persons in response to applications filed with the Commission. So far as consistent with the Atomic Energy Act of 1946, licenses will be designed to fit the normal business requirements of the licensee.

§ 50.31 *Conditions of licenses.* Each license will require the licensee to comply with certain conditions, including the filing of reports with the Commission. Willful failure of a licensee to file any such report which truthfully sets forth all information required, or willful failure to comply with any other condition of the license, shall constitute a violation of the regulations in this part.

§ 50.32 *Revocation, suspension, modification of licenses.* Any license may be modified, withdrawn, suspended, revoked or annulled at any time in the discretion of the Commission upon a determination by the Commission that the public health, interest, or safety requires such action, or that the licensee has willfully failed to comply with any condition of the license. In the absence of such a determination, no modification, withdrawal, suspension, revocation or annulment of any license will be made except upon application therefor by the licensee or unless, prior thereto, facts or conduct warranting such action have been called to the attention of the licensee in writing and the licensee has been accorded opportunity to demonstrate or achieve compliance with all lawful requirements. Nothing in this part shall limit the authority of the Commission to issue or amend its regulations in accordance with law.

§ 50.33 *Transfer of licenses.* Licenses shall be non-transferable.

REPORTS

§ 50.40 *Reporting possession or title.* (a) Any person (whether or not a licensee) who, on the effective date of the regulations of this part, has possession of or title to any Class I facility for the production of fissionable material (including those listed specifically in Schedule A, § 50.70) shall, not later than 60 days after such date, file with the Commission a reasonably detailed statement of:

(i) The location of the facility;

(ii) Its present use;

(iii) Its proposed use;

(iv) Its engineering specifications, including capacity;

(v) The name, title, and address of the persons having control of the facility.

(b) The requirement of this section does not apply to any facility held under authority of a contract or an arrangement with the Commission.

NOTE: The term "person" as defined in section 18 (c) of the Atomic Energy Act of 1946 and in § 50.2 does not include the Commission or officers or employees of the Commission in the exercise of duly authorized functions. Consequently, the requirement of this § 50.40 does not apply in such cases.

§ 50.41. *Reports.* Reports in addition to those called for in licenses may be required by the Commission from time to time, subject to approval by the Bureau of the Budget in certain cases, with respect to the ownership, possession, manufacture, production, export, shipment, transfer, acquisition or other handling of facilities for the production of fissionable material, as the Commission may deem necessary.

VIOLATIONS

§ 50.50 *Penalties for violations.* A violation of the regulations in this part shall be deemed to be a violation of the Atomic Energy Act of 1946, and shall subject the violator to the penalties therein prescribed. In addition, the Commission may take such action with respect to the facilities involved in any violation as it deems appropriate and in accordance with law.

INTERPRETATIONS, PETITIONS, COMMUNICATIONS

§ 50.60 *Valid interpretations.* Except as specifically authorized by the Commission, no interpretation or explanation of the meaning of the regulations in this part issued by any officer or employee of the Commission other than one issued by the General Counsel in writing will be recognized to be valid and binding upon the Commission.

§ 50.61 *Petitions.* Petitions for relief from any restrictions imposed under the regulations in this part may be made by filing a letter, in duplicate, with the Commission, stating the reasons why the petition should be granted.

§ 50.62 *Communications.* All communications concerning the regulations of this part or any license issued under them should be addressed to the United States Atomic Energy Commission, Washington 25, D. C., Attention: Licensing Controls Branch.

SCHEDULES

§ 50.70 *Schedule A: Class I facilities* (see §§ 50.2, 50.20, and 50.40). As defined in § 50.2 above, a Class I facility is any facility (other than a Class II facility) capable of producing any fissionable material, such as (a) nuclear reactors or piles, (b) facilities capable of the separation of isotopes of uranium, and (c) electronuclear machines(*e. g.*, cyclotrons, synchrocyclotrons and linear ion accelerators) capable of imparting energies in excess of 1 Mev each to positively charged nuclear particles or ions.

NOTE: Under section 4 (c) (1) of the Atomic Energy Act of 1946 the Commission, as agent of and on behalf of the United States is made the exclusive owner of all facilities for the production of fissionable material *other than* facilities which (A) are useful in the conduct of research and development activities in the fields specified in section 3 of the Act, and (B) do not, in the opinion of the Commission, have a potential production rate adequate to enable the operator of such facilities to produce within a reasonable period of time a sufficient quantity of fissionable material to produce an atomic bomb or any other atomic weapon. The listing of a facility for the purposes of the regulations in this part shall not be deemed to be an expression of the opinion of the Commission as to ownership of any such facility for the purposes of section 4 (c) (1) of the Act.

§ 50.71 *Schedule B: Class II facilities* (see §§ 50.2 and 50.20). A Class II facility is any item listed in this Schedule B. The Commission has determined that the following items are important component parts especially designed for equipment or devices capable of the production of fissionable material:

(a) Radiation detection instruments, and their major components, designed, or capable of being adapted, for detection or measurement of nuclear radiations, such as alpha and beta particles, gamma radiation, neutrons and protons, including the following:

(i) Geiger Mueller, proportional, or parallel plate counter scalers.

(ii) Geiger Mueller or proportional counter rate meters.

(iii) Scalers (adaptable to radiation detection).

(iv) Geiger Mueller, proportional audio, or mechanical detectors.

(v) Integrating ionization chamber meters and ionization chamber rate meters.

(vi) Geiger Mueller, proportional, or parallel plate counter detector components.

(vii) Electrometer tube circuits and dynamic condenser electrometers (vibrating reed, vibrating diaphragm, etc.) capable of measuring currents of less than 1 micromicroampere.

(viii) Counter pulse rate meters.

(ix) Amplifiers designed for application in nuclear measurements, including linear amplifiers, preamplifiers and distributed (chain) amplifiers.

(x) Geiger Mueller quenching units.

(xi) Geiger Mueller or proportional coincidence units.

(xii) Dosimeters and electrometers, pocket and survey types, including electroscopes incorporating radiation measurement scales.

(xiii) Chambers, pocket type, with electrometer charger-reader.

(xiv) Electrometer tubes designed to operate with grid currents of less than 0.1 micromicroampere.

(xv) Resistors, values above 1,000 megohms.

(xvi) Scintillation counters incorporating a photomultiplier tube.

(xvii) Photomultiplier tubes having photocathode sensitivity of 10 or more microamperes per lumen, and an average amplification greater than 10^5.

(b) Mass spectrometers and mass spectrographs, of all mass ranges, and their major components, including the following:

(i) Leak detectors, mass spectrometer, light gas type.

(ii) Mass spectrometers or mass spectrographs.

(iii) Ion sources, mass spectrometer or spectrograph type.

(iv) Acceleration and focussing tubes, mass spectrometer and spectrograph types.

(v) Ionization chambers, mass spectrometer detector types.

(vi) Micromicroammeters capable of measuring current of less than 1.0 micromicroampere.

(vii) Electrometer tubes designed to operate with grid currents of less than 0.1 micromicroampere.

(viii) Resistors, values above 1,000 megohms.

(c) Vacuum diffusion pumps 12 inches diameter and larger (diameter measured inside the barrel at the inlet jet).

(d) Electronuclear machines, and their basic component parts, capable, with or without modification, of sustaining potential differences in excess of 100,000 volts against the discharging action of positive ion currents in excess of 10^{-7} amperes, such as belt type electrostatic generators (Van de Graaff machines).

§ 50.72 *Schedule B: Exemptions.* The listing in Section 50.71 above of electrometer-type electronic tubes and resistors (see Section 50.71 (a) (xiv) and (xv) and Section 50.71 (b) (vii) and (viii)) shall not be deemed to constitute such items component parts of radiation detection equipment or mass spectrometers when they have been actually incorporated into (or packaged as spares for shipment with) instruments (such as, but not limited to, pH meters, spectrophotometers, moisture meters, and kilovoltmeters) not capable of detection or measurement of nuclear radiation or not capable of use as mass spectrometers.

§ 50.80 *Effective date.* The regulations in this part shall become effective at midnight, November 20, 1947, this effective date, which is less than 30 days, subsequent to publication, is found necessary and appropriate by the Commission for assuring the common defense and security.

(60 Stat. 755–775; 42 U. S. C. 1801–1819. Interprets or applies sec. 4, 60 Stat. 759; 42 U. S. C. 1804)

Dated at Washington, D. C., this 21st day of November 1952.

By order of the Commission.

M. W. BOYER,
General Manager.

APPENDIX 7

Report to the President by the Atomic Energy Labor Relations Panel

June 1 to December 1, 1952

The Atomic Energy Labor Relations Panel was established by you during the spring of 1949 in accordance with recommendations contained in the Report of the President's Commission on Labor Relations in the Atomic Energy Installations. In this report, it was suggested that the panel procedures "or something substantially equivalent to them should be given a trial for a period of two or three years." The third anniversary of the panel was passed last spring. On May 15, 1952, members of the panel met with the Atomic Energy Commission to report on its activities during these three years. The Commission decided at that time to continue the panel plan.

The panel is now 3½ years old. During its life, it has taken official jurisdiction of 59 cases, has helped unofficially in the resolution of many additional disputes, and has been called upon frequently for advice by the Atomic Energy Commission, by union officials and by contractors. The methods of the panel have been kept flexible and, for a government agency, the amount of informality has been unusual, approaching at times the personal relationships found in private industry between the parties and a permanent impartial umpire. We believe that this has been a healthy development consistent with the policy of the Congress and the Atomic Energy Commission to move in the direction of more private and less government control of the government-owned privately operated Atomic Energy Commission facilities.

When this panel began its activities in the spring of 1949, it recognized two opposing dangers: its procedures could be too attractive to the parties, thus short-cutting the collective bargaining process and putting the determination of atomic energy wages and working conditions into the hands of government-appointed arbitrators; on the other hand, its procedures might become so unacceptable to the parties that they would be unsuccessful in avoiding harmful strikes. The panel has sought to steer a course between these dangers. Today, there are no fundamental differences between the practice of collective bargaining within and without the atomic energy installations. There have been no interruptions in those production facilities considered by the Atomic Energy Commission to be of vital concern to the national welfare. In construction alone have harmful strikes occurred, and these have largely been concentrated in one site where there were problems of an exceptional nature. In this one instance, the panel believes substantial progress has been achieved toward more stable relations.

We believe that the panel procedures have served the purpose for which they were designed and that they have the necessary flexibile to change with the rapid and unforeseeable future developments of the atomic energy industry.

Since it began operations in 1949, the panel has completed 55 cases. Because of the flexible procedures employed by the panel in handling these cases, it is difficult to provide with accuracy a statistical picture of their composition. For example, in all cases in which recommendations were issued before a settlement was achieved, these recommendations were preceded by mediation efforts—in some cases over a very long period of time. In other instances, the

panel referred the dispute back to the parties or to an existing agency established for handling the type of dispute involved. For example, there was an instance of a dispute over the appropriate bargaining unit which was referred to the National Labor Relations Board. Several cases were finally settled by a decision of The Wage Stabilization Board or the Construction Industry Stabilization Board, and others were referred to the National Joint Board for Settlement of Jurisdictional Disputes. Many others were referred back to the Federal Mediation and Conciliation Service and to the parties for more bargaining. Allowing for these limitations in any classification system that might be used, we believe that the following table provides a picture of the activities of the panel:

	Construction	Production	Total
Recommendations issued	6	13	19
Referred back to parties or to another agency (e. g., NLRB or Jurisdictional Board)	15	7	22
Mediated settlement	5	8	13
Jurisdiction not taken—no-strike pledge lifted	0	1	1
Total	26	29	55

During the 6-month period covered by this report, as was true in the previous period, much of the panel's activities were devoted to construction disputes at two sites: Paducah and Hanford. The panel was active in 15 cases, eight of which were in construction.

Of the seven disputes in production, three were at the Argonne National Laboratory, one at the Knolls Laboratory, one at the K–25 plant in Oak Ridge, one at the X–10 and Y–12 plants in Oak Ridge, one at the Bendix Kansas City Plant. Recommendations were issued in three cases during this period. In one of them, the union turned down the recommendations and management improved the offer before the strike deadline. Mediation produced a settlement in seven cases. In two cases the issue was referred back to the parties where it was settled in direct negotiation. Three cases remain open as of December 1.

CASE NO. 45. AEC INSTALLATION: Chicago, Ill.; PARTIES: Argonne National Laboratory; International Guards Union of America, Local.

The history of this case prior to June 1 was summarized in our previous report. The panel met with the parties at the Argonne Laboratory on June 6. The immediate issue was a question of workload for the night watchmen, but underlying this issue was a broader misunderstanding between the parties with respect to the grievance machinery and handling of disputes. After full discussion the parties reached an understanding on the handling of grievances and a joint study was proposed for reaching a solution with respect to the specific workload dispute.

During July the officials of the International Guards Union called upon the panel to aid in expediting a case pending before the Wage Stabilization Board, and also to aid in explaining the delay in processing this case to the union membership which was growing restive. The panel members met with the union representatives at the Argonne Laboratory on July 11 and discussed informally the Wage Stabilization Board procedures. At this meeting Dr. Witte aided the parties in preparing a statement in support of their Wage Stabilization Board petition.

CASE NO. 46. AEC INSTALLATION: Chicago, Ill.; PARTIES: Argonne National Laboratory; International Association of Machinists, Lodge #742.

On May 29 the panel received a re-

quest from the president of Local 742 asking for a meeting with the panel to help settle a dispute which was threatening to develop into a strike. The panel informed the international president of the union of this telegram and received an official request from him to enter the dispute.

A panel member met with the parties on June 6 and found that there were various grievances at issue. Most of the time, however, was spent in discussing general relationships between the parties. At the conclusion of the conference, both sides agreed to renew their efforts to adjust their own grievances and told the panel that they expected that these efforts would be successful.

The panel has heard nothing further concerning this matter.

CASE NO. 47. AEC INSTALLATION: Hanford, Wash.; PARTIES: Atkinson-Jones Construction Co.; International Brotherhood of Teamsters, Local 839.

On June 12 the panel received a telegram from the company stating that the Teamsters were on strike at the Hanford production site. The panel advised President Tobin of the Teamsters' Union of this matter and called upon him to return the men to work and follow the established procedures for settling disputes.

On the following day the panel was advised that the men were back at work. The panel understands that this was a jurisdictional dispute which was settled by a decision of the National Joint Board for Settlement of Jurisdictional Disputes.

CASE NO. 48. AEC INSTALLATION: Chicago, Ill.; PARTIES: Argonne National Laboratory; Argonne Council, AFL.

On June 24 the panel received a telegram from the council requesting that the panel assume jurisdiction over a dispute involving a new contract.

The panel members met with the parties on July 10 and 11 at the Argonne Laboratory. The unresolved issues were an increase in the basic hourly rates and the term of a new agreement. Mediation sessions were conducted by the panel for two days and at the end of the second day an agreement was reached.

The panel thereupon aided the parties in preparing their petition to the Wage Stabilization Board for approval of the wage increase.

CASE NO. 49. AEC INSTALLATION: Paducah, Ky.; PARTIES: F. H. McGraw Co.; AFL Building Trades.

On December 6, 1950, the F. H. McGraw Co., was awarded the contract to build a new atomic energy plant at Kevil, near Paducah, Ky. The earliest possible completion of this project was and still is considered a matter of extreme urgency, and so, relatively little time was afforded the contractor for preliminary organization before actual construction was commenced. On January 2, 1951, the first ground was broken.

Western Kentucky was known as an area of labor unrest even before the Paducah atomic project was begun. By tradition this has been a southern community and as such has normally reflected the lower wage rates of the South. Across the river lie Illinois and Indiana, and the industrial center of Evansville which is under the influence of nothern customs and wage rates. As a result intense rivalries have grown up between Kentucky and Illinois laboring groups and a reflection of this rivalry was the organizing of the Kentucky Engineers for Local Autonomy and their success in sponsoring and pushing special legislation through the Kentucky Legislature. As far back as the early 1920's the Illinois-Kentucky rivalry was a contributing factor in the strikes and bloodshed in the mine fields.

One of the largest construction jobs in Paducah prior to 1951 was the erection of a levee along the banks of the Ohio. During the several years it took

to complete this relatively small job, there were frequent strikes. Within the last few years, the Modine Manufacturing Co. has experienced 26 strikes. With extraordinarily few exceptions, every other manufacturing concern in Paducah has been faced with labor trouble leading to work stoppages.

There was an atmosphere of crisis in the late fall of 1950. On the eve of the Korean War the Nation's armament schedule had been "stretched out" and the target for maximum production had been set further ahead. With the outbreak of fighting these schedules were drastically compressed and this sense of urgency had a profound effect on the Paducah project. In the rush to get started there was inadequate planning and preparation which helps to explain the difficulties that have since arisen. There was insufficient housing; roadways to and from the plant could not adequately accommodate the increased traffic, and the hiring of supervision was hastily completed.

The McGraw Co. ran into its first labor difficulty on March 3, 1951, just 3 months after construction began. Between then and September 2, 1952, there have been 59 strikes which have cost the project 3,158,278 man-hours. Virtually every craft has been instrumental in initiating one or more of these interruptions, and several of the strikes have resulted in complete shut-downs of the project. According to Atomic Energy Commission estimates, "total loss of job progress due to work stoppages is approximately 11½ percent."

The compressed schedule for this project severely taxed the McGraw organization. There was very little time allowed for advanced planning. Once construction began, the pressure for making jurisdictional assignments was intense and the company found difficulty both in enforcing its decisions and in settling disputes that arose over them. There were also questions of conflicting jurisdiction between locals of the same craft organization which in turn led to an abnormal number of disputes over the identity of the "going" wage rates and working conditions. Not knowing in many cases which local contract was applicable for this job, the company was unable to examine the local practices carefully for their effect on a job of this size.

The various craft unions also were caught with little prior notice in an inrushing tide of new members and the attending administrative problems such union expansion can cause. Local business agents who ran offices designed to service several hundred members suddenly found themselves running organizations of several thousands. Many of these business agents were soon swamped with difficulties of a size and kind never before encountered by them. Craft rivalries became intensified, dissident groups within the crafts became organized, and wildcat strikes beyond the control of local or international officers were not uncommon.

The early history of the panel's activities in Paducah were summarized in our previous report under cases 35, 37, 38, 40 and 41. It will be recalled that on January 6, [1952] the F. H. McGraw Co. and officials of the various craft unions signed a memorandum of understanding for the settlement of grievances. Meanwhile, the panel told the parties that it would retain jurisdiction over labor relations at Paducah, rather than follow the more general practice of assuming jurisdiction over each individual dispute only after a preliminary investigation had been completed.

Between January 6 and June 30 the panel was invoked in four other disputes which had either threatened to cause or had caused work interruptions. In each case in which an actual work interruption had occurred the international office took steps to end the strike and informed the panel that it had been unauthorized and was of wildcat origin. The panel was also told the strike had occurred before the business agent had knowledge of it and that once under way the business agent was powerless to stop it.

In the spring of 1952 the Atomic Energy Commission had to make plans for further expanding its gaseous diffusion facilities. With this in mind an AEC committee was sent to Paducah to survey the practicability of further expansion at that site. This committee reported that the Paducah area was subject to more than normal labor unrest, but that at the AEC site the situation appeared to be greatly improved. Accordingly, taking labor relations into consideration, along with many other factors, plans were made for further expanding the Paducah facilities.

During the summer of 1952 a sharp upturn occurred in the number of strikes and man-hours lost. On August 17 the panel returned to Paducah. On that trip the panel was told by union officials that virtually all of the recent strikes had been unauthorized wildcats. At the panel's suggestion the parties discussed methods for curtailing these wildcat interruptions. The discussions led to a Memorandum of Understanding of August 20 for joint action in disciplining participants of all unauthorized work stoppages. It was agreed that the local unions and the Building Trades Council should use all possible means of communication to advise their members when a work stoppage is unauthorized and to direct their members to return to work. The unions agreed to discipline all members who disobeyed these instructions. The company on its part agreed to use the communications available to it to notify employees when a work stoppage was unauthorized and to terminate or discipline those who failed to report for work at the next regular shift starting time. Again all business agents and international representatives signed this agreement with the company. The full text of this agreement follows:

"August 20, 1952

DECLARATION OF POLICY

This declaration of policy is made in order to promote responsibility and harmony among the Building Trades crafts employed at the atomic energy project by F. H. McGraw and Company and by other contractors doing work at the atomic energy project, Kevil, Kentucky and in order to eliminate any strike or work stoppage that is not authorized by the Building Trades Unions employed on the project. All provisions of collective bargaining agreements will be complied with by the signatories to those agreements.

In accordance therewith the following procedure shall be followed by the Unions and the Companies:

1. When a stoppage of work by any union member, or members, affiliated with any Building Trades Union occurs, the Company shall ascertain from the craft Business Agent or International Union whether the strike or work stoppage is authorized by the union. If a work stoppage is unauthorized and in violation of contract, the following steps shall be taken.

2. (a) The local union and the Building Trades Council shall use radio, newspapers, and other means of notice necessary to advise all union members that the work stoppage is unauthorized and shall direct all union members to return to work immediately. Union members failing to carry out instructions to return to work, and to remove picket lines, if any, shall be disciplined by the craft unions of which they are members according to the constitution and by-laws of the union.

2. (b) The Company shall take steps by radio, newspapers, and other appropriate notice to notify all employees participating in the work stoppage that such employees should report for work at their respective work positions on the project at the next regular shift starting time, or they shall be declared

terminated or disciplined from the project.

3. This policy may be extended by consent of the parties to other projects for the atomic energy program in the vicinity."

Shortly after the August 20 meeting two more short work stoppages occurred. Both of these apparently had the approval of at least the authorized local union leadership. One strike, involving the Operating Engineers, arose over layoff procedures which had been inaugurated by the company. The company feared that it would be charged with an unfair labor practice if it laid off any members of the Kentucky Operating Engineers, the rival organization of the certified Operating Engineers, A. F. of L. To meet this problem the company introduced a system of laying off according to seniority—a most unusual procedure in the construction industry. At the request of the panel the international officers of the union terminated this strike and several days later company and union officials came to New York where, with the aid of the panel, a new set of layoff procedures, more in accordance with construction customs, was negotiated.

The other stoppage was called by the International Brotherhood of Electrical Workers. The immediate issue was the dismissal of eight electrical foremen. This matter was resolved, again with the aid of the panel, after production was resumed.

When the panel was in Paducah on August 20 it was recognized that further study and negotiations would be required before the basic causes of the labor trouble could be rectified, and a further visit of the panel was therefore contemplated. The two work stoppages referred to above, following so closely upon the heels of the August 20 panel trip to Paducah, expedited these plans. This time arrangements were made for panel secretary Donald B. Straus to make a preliminary, on-the-spot study. Mr. Straus preceded the panel members by a week, arriving in Paducah on Sunday, September 21. During this week he interviewed 15 local business agents, various Atomic Energy Commission officials, a number of trailer camp residents who work at the project, officials of the "Engineers of Kentucky for Local Autonomy", officials of the McGraw Co. and sub-contractors, newspaper men and many prominent citizens of Paducah in all walks of life. On Sunday and Monday, September 28 and 29, he reported his findings to the panel members. In the ensuing discussions, the panel sought to analyze the many varying ingredients of labor unrest at Paducah. The panel concluded that it was confronted in Paducah with no ordinary labor situation. The causes of unrest came from several different directions and were deep-rooted.

It is noteworthy that at no time during its stay in Paducah did the panel hear about difficulties arising out of rates of pay (other than delayed Construction Industry Stabilization Commission approvals). Nor did other common causes of labor discord, such as seniority, union security, welfare plans and the like, come into the discussions. Both unions and the company spoke of their differences in terms of personalities, attitudes or the failure of the other party to follow the established procedures. To the question "what seems to be wrong down here", the panel heard over and over again this sort of response: "darned if I know. Never saw a situation like this before—you can't seem to put your finger on the trouble but there is constant bickering". Either outspoken or implied distrust was found on all sides: distrust of rank and file for the union leaders and for the company management, distrust of one craft for another, distrust of the community for the migrant workers and vice versa, distrust of local union leaders for their international superiors and vice versa, even marked differences of opinion within the management officialdom.

That this unique situation of confused and mutual distrust was rooted in many

diverse causes which had been investigated and reported by Mr. Straus to the panel and analysed and discussed by the panel members, was apparent. The panel in its conferences not only with the parties but with various groups and interests in the community, continued its discussion of these causes. However, in the final conferences with the parties themselves the panel directed attention more particularly to the future and sought to develop mechanism and procedures which would lead from the old and undesirable relationship to a new relationship of mutual understanding and confidence.

Meetings were held on September 29, 30 and October 1. While both the panel and the parties agreed that no further written memoranda should be drawn up and signed, the following understandings were reached:

1. The agreements of January 6 and August 20 were reaffirmed.

2. The international representatives assumed full responsibility for the avoidance of further authorized stoppages and agreed to utilize the established grievance, Federal Mediation, and panel procedures.

3. The duties and responsibilities of the McGraw labor department were redefined, with authority for making decisions centered in one named individual.

4. The international representatives of every craft decided to hold meetings in Paducah every third Tuesday of the month for the purpose of settling existing grievances, to avoid the causes for future ones, and to promote harmony and better labor relations between the unions and the company. Joint meetings with the company and the international representatives were scheduled on these same dates.

5. The company agreed to review existing grievance machinery with each international union and to add arbitration as a final step wherever agreement on this procedure could be reached.

No further work interruptions at Paducah occurred between October 1 and December 1, the date of this report. At the second monthly meeting of international officers on October 21, many grievances were settled. One grievance over shift differentials involving several crafts could not be resolved, and this dispute was referred to the panel. It is reported below as Case 56.

CASE NO. 50. AEC INSTALLATION: Oak Ridge, Tenn.; (K–25 Plant) PARTIES: Carbide and Carbon Chemicals Co.; The United Chemical Workers, CIO (Local 288).

On June 30 the panel was asked by the Atomic Energy Commission to take jurisdiction of a dispute between these parties over the terms of a new contract. The panel thereupon issued telegrams to the parties advising them that it had taken jurisdiction.

The panel met with the parties on July 19 in Oak Ridge. Many of the clauses in the contract were still unresolved, including wage rates. Prior to the panel's arrival in Oak Ridge, the company had concluded agreements with A. F. of L. unions in two other Oak Ridge facilities; the X-10 Laboratory and the Y–12 Plant.

The agreements reached at these two other plants called for no wage increase and the company's position was that there should be no wage increase granted at the K–25 Plant.

The recent background of wage history in Oak Ridge has been in the direction of uniformity between all three plants. In its recommendations issued last year (cases 25, 26 and 27), the panel proposed a uniform wage structure and the parties accepted these proposals. Since then, in a wage reopening on February 25, 1952, a further general wage increase of 4¢ per hour was put into the wage structure at all three plants. This increase was based

on the rise in the Consumers' Price Index between June 1951 and December 1951. The Index in May 1952 was one-tenth of a point below that of December 1951. Accordingly, under the self-administering regulations of the Wage Stabilization Board, no further wage increase was permissible.

The union's demand at K–25 was for a 10¢ per hour wage increase justified as follows: 2¢ per hour based on a forecasted rise in the Consumers' Price Index, 4¢ for increased productivity in 1951, and 4¢ for increased productivity in 1952.

The panel heard the arguments of the parties in this case and on its departure asked that written briefs supplementing the oral arguments be submitted by August 4.

The panel met on August 6 and again on September 16 to discuss its recommendations. On September 19 the panel mailed out its recommendations, covering twelve separate issues, to the parties. With respect to wages, the panel recommended no general wage increase.

On September 25 the panel received a telegram from the union rejecting the recommendations and from the company accepting them.

On October 15 a strike vote was conducted by the union with the majority voting to strike. Shortly thereafter the company offered the union a 10¢ per hour general wage increase effective on the date an agreement could be reached. The union accepted this offer and a contract was signed.

CASE NO. 51. AEC INSTALLATION: Schenectady, N. Y.; PARTIES: General Electric Co.; International Union of Electrical Workers, Local 301.

The panel was requested by the international office of the union to take jurisdiction over a dispute between the parties on July 12. In its routine check with the Federal Mediation and Conciliation Service the panel learned that there still remained some chance of further progress under the aegis of that Service, and accordingly postponed official action on its part. On July 14 Commissioner Rooney, of the Federal Mediation and Conciliation Service, advised the panel that a sit-down demonstration by the Instrument Mechanics had been called off and that the parties had agreed to two weeks of further study and negotiation in an effort to resolve their differences. Accordingly, the panel further postponed assuming jurisdiction.

On August 1 the union again asked the panel to hear the dispute. Federal Mediation and Conciliation Service Commissioner Rooney told the panel that he could be of no further service at that time. The panel met with the parties in Schenectady on August 22. After discussions which lasted throughout the day the parties agreed that further negotiations, aided by the services of Commissioner Rooney, might break the deadlock. The panel thereupon withdrew from the case, sending to Commissioner Rooney a summary of the discussions of August 22. Commissioner Rooney reported on October 22 that a settlement had been reached.

CASE NO. 52. AEC INSTALLATION: Hanford, Wash.; PARTIES: Atkinson-Jones Construction Co.; United Brotherhood of Carpenters (Millwrights) Local 1699.

On July 29 the panel received a telegram from the company advising it that a strike of Millwrights was in progress and asking that the panel take jurisdiction. The panel advised the international office of this matter.

On July 3 the Federal Mediation and Conciliation Service entered the dispute, but the strike continued.

On August 5 the panel took jurisdiction of the dispute and the strike was ended. The panel met with the parties on August 26 in Richland, Wash. The issues in dispute involved the subcontracting by Atkinson-Jones of work claimed by the Millwrights.

Discussions with the panel present resulted in an agreed procedure for set-

tling disputes of this kind, including the specific one which was the basis of the July 29 strike.

CASE NO. 53. AEC INSTALLATION: Hanford, Wash.; PARTIES: Atkinson-Jones Construction Co.; The United Association of Sheet Metal Workers, Local 99.

When the panel was in Hanford on August 26 on another matter, it was informed of a dispute between the Sheet Metal Workers and Atkinson-Jones involving wage rates and certain fringes.

The panel met with the parties and suggested that action on its part be deferred until a master agreement presently being negotiated by the parties was completed. Both sides agreed to this procedure.

On October 17 the panel received a telegram from the union advising that no agreement with respect to wages could be reached and requesting that the panel issue recommendations in conformance with the understanding reached on August 26.

On October 20 the panel took jurisdiction. On October 27 recommendations were issued for a wage rate of $2.65 per hour effective August 1, 1952, and for a vacation allowance of 5 days per year.

The panel has been informed that these recommendations have been accepted.

CASE NO. 54. AEC INSTALLATION: Hanford, Wash.; PARTIES: Atkinson-Jones Construction Co., International Association of Machinists, Local 1743.

While the panel was in Hanford on another matter it was asked by the International Association of Machinists to hear a dispute between that union and the Atkinson-Jones Co., over the matter of wages. Involved in this dispute were the wage relationships and other contract items between the Machinists and the Millwrights at this project.

The panel suggested that action on its part be deferred until a master agreement presently being negotiated by the parties could be completed. Both sides agreed to this procedure.

On October 6 the panel received telegrams from both parties advising that a deadlock still existed and requested that the panel take jurisdiction. The union further advised the panel that it was preparing and would submit a written statement of its current position.

The panel thereupon took jurisdiction of this dispute and issued its recommendations on November 13, 1952. On November 17, the panel received a telegram from the company requesting a clarification of the panel recommendation. In telephone conversations with both parties, the panel secretary learned that both parties were agreed on the desired interpretation.

As of December 1 the panel has heard nothing further concerning this case, and so considers it closed.

CASE NO. 55. AEC INSTALLATION: Hanford, Wash.; PARTIES: Atkinson-Jones Construction Co. and Newberry-Neon Electric Co.; International Brotherhood of Electrical Workers, Local 112

On October 3 the panel was notified by Atkinson-Jones Co. that the electricians were on strike. The dispute involved the application of a new area agreement between the International Brotherhood of Electrical Workers and National Electrical Contractors Association, contractors in the region which the union claimed should cover its members at the Hanford project. The Company's position was that a project agreement was still in existence and was controlling.

Efforts to mediate the dispute over the telephone failed although the strikers were returned to work. A meeting for October 10 in Washington, D. C., was arranged.

At the October 10th and 11th meetings, with the aid of the panel, the parties decided that there should be a Hanford addendum to the area agree-

ment providing for certain exceptions to the area agreement.

CASE NO. 56. AEC INSTALLATION: Paducah, Ky.; PARTIES: F. H. McGraw Co.; Paducah Building Trades Council.

At a meeting on October 1, with the panel in attendance, the international representatives of the various craft unions decided to hold monthly meetings. One of the purposes of these meetings was to review unsettled grievances which had arisen during the previous 30 days (see Case 49).

At the October 21 meeting, the international representatives of the Carpenters, Laborers, Operating Engineers, Painters, Sheet Metal Workers, and Roofers Unions sent the panel a telegram, asking that it take jurisdiction over an unsettled dispute involving pay for second and third shifts. Upon receipt of this telegram, the panel advised the parties that it would take jurisdiction of the dispute and asked that a short statement outlining the issues be forwarded to it.

These statements were received from both parties by November 15. Shortly thereafter, the panel understood that the parties were planning further direct negotiations on this matter. On November 26 the panel received the following telegram which closes the case:

> "With reference to material submitted to Davis Panel recently by F. H. McGraw and Company and various unions concerning disparities of shift differentials being paid on Paducah area project this is to advise that the matter has been settled here between the company and the unions. William A. Henry, Director of Employee Relations for McGraw, sought and obtained approval from Atomic Energy Commission to make uniform shift differentials on project on the basis of eight hours pay for seven hours worked in order to provide for uniform basic treatment of all crafts. Ironworkers and Cement Masons are excepted from the above because they desire to continue with their own traditional practices which vary to some degree. Both parties want to thank members of the Davis Panel for their past service in this and other matters.
>
> F. H. McGraw and Co. W. A. Henry and Edgar F. Smith, Spokesman for International Unions represented at Paducah Area Project."

CASE NO. 57. AEC INSTALLATION: Oak Ridge, Tenn.; PARTIES: Carbide and Carbon Chemical Corp.; AF of L Council.

On September 19 the panel issued recommendations for the settlement of a dispute between Carbide and Carbon Chemical Corp. and Local 288 of the United Chemical Workers, CIO. These recommendations were rejected by the Union and on October 15 the Company made an improved offer to the Union which was accepted (see Case 50).

At Oak Ridge there has been a close relationship between the bargaining at the K–25, X–10 and Y–12 Plants. Through mediation and recommendations the panel has worked toward a uniform rate structure at all three of these facilities. Immediately upon making its improved offer to the CIO at K–25, the company made a similar offer to the two AF of L Unions at X–10 and Y–12.

On October 24 the panel received a request from James A. Brownlow, President of the Metal Trades Department, AF of L, to take jurisdiction of a dispute between the Carbide and Carbon Chemical Corp. and the AF of L at Oak Ridge. On October 27 the panel acknowledged this request and informed both parties that it would "proceed forthwith to investigate this matter in accordance with its regular procedures. The panel kept in touch with the parties throughout November, but no meetings before the panel were scheduled.

As of December 1, this case remains open.

CASE NO. 58. AEC INSTALLATION: Kansas City, Mo.; PARTIES: Bendix Aviation Corp.; International Association of Machinists.

In September of 1950 the panel mediated settlement over a first contract between the Bendix Aviation Corp. and Local 314 of the International Association of Machinists at the Kansas City atomic energy plant. Since then these parties had successfully negotiated all subsequent changes in this contract until the negotiations over a wage reopener in the fall of 1952.

On October 24, 1952, the parties sent to the panel a joint request that it take jurisdiction over the matter of a general wage increase, individual classification adjustments and the continuation of the present cost-of-living plan.

The panel accepted jurisdiction on October 30 and asked the parties for a concise statement of the issues in dispute. A panel meeting was scheduled for November 21 in Kansas City. At the Kansas City meeting, Dr. Witte and Mr. Straus represented the panel. Mediation sessions were held on November 21 and 22, during which time the wage issue was clarified. Since no agreement seemed possible at that time, the panel asked the parties to prepare further data for a later, more formal hearing to be held in New York City on December 12 and 13. The specific nature of the data required was discussed with the parties and in most instances agreed to. Subcommittees of the management and union representatives will confer in the preparation of this data.

As of December 1 this case remains open.

CASE NO. 59. AEC INSTALLATION: Savannah River Project, Aiken, S. C.; PARTIES: DuPont Co.; International Brotherhood of Teamsters, AF of L, Local 509.

On November 19 the panel received a request from the International Brotherhood of Teamsters, AF of L, to take jurisdiction of a dispute between its Local 509 and the DuPont Co. at the Savannah River Project. The panel immediately took jurisdiction of the dispute because of the critical nature of the project, and then proceeded to investigate the nature of the controversy.

Conversations with top representatives of both the company and the Union lead the panel to believe that further direct negotiation might be fruitful. Accordingly, the panel arranged such meetings without a panel representative present.

As of December 1, 1952, this case remains open.

WILLIAM H. DAVIS, *Chairman*
FRANK P. DOUGLASS, *Member*
JOHN T. DUNLOP, *Member*
AARON HORVITZ, *Member*
GODFREY P. SCHMIDT, *Member*
EDWIN E. WITTE, *Member*
DONALD B. STRAUS, *Secretary*

APPENDIX 8

Publications of the U. S. Atomic Energy Commission [1]

In general, the AEC encourages project scientists to make their own arrangements for the publication of nonsecret research results in the established scientific and technical journals. There are, however, a number of special publications concerning atomic energy which the AEC has sponsored or helped sponsor that are available to the general public.

SEMIANNUAL REPORTS TO CONGRESS [2]

The semiannual reports that the AEC is required to make to the Congress are also made available to the public. These describe the progress in various phases of the Commission's program. An alternate title, indicating the principal subject of the report, has been given to each of the later reports. Indexes to all except this, the Thirteenth Semiannual Report, are now available.

First Semiannual Report, January 1947.
Second Semiannual Report, July 1947.
Third Semiannual Report, January 1948.
Fourth Semiannual Report, *Recent Scientific and Technical Developments in the Atomic Energy Program of the United States*, July 1948. 35 cents.
Fifth Semiannual Report, *Atomic Energy Development, 1947–1948*, January 1949. 45 cents.
Sixth Semiannual Report, *Atomic Energy and the Life Sciences*, July 1949. 45 cents.
Seventh Semiannual Report, *Atomic Energy and the Physical Sciences*, January 1950. 50 cents.
Eighth Semiannual Report, *Control of Radiation Hazards in the Atomic Energy Program*, July 1950. 50 cents.
Ninth Semiannual Report, *AEC Contract Policy and Operations*, January 1951. 40 cents.
Tenth Semiannual Report, *Major Activities in the Atomic Energy Programs, January-June 1951*, July 1951. 35 cents.
Eleventh Semiannual Report, *Some Applications of Atomic Energy in Plant Science*, January 1952. 50 cents.
Twelfth Semiannual Report, *Major Activities in the Atomic Energy Programs, January-June 1952*, July, 1952. 35 cents.
Index to the Semiannual Reports to Congress, January 1947–January 1951, April 1951. 20 cents.
Index to the Tenth Semiannual Report to Congress, November 1951. 10 cents.
Index to the Eleventh Semiannual Report to Congress, May 1952. 10 cents.
Index to the Twelfth Semiannual Report to Congress, November, 1952. 10 cents.

[1] Listed as of November 30, 1952.
[2] Available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

GENERAL REPORTS AND GUIDES [2]

Selected Readings on Atomic Energy, August 1951, is a bibliography of official publications, books, magazines, pamphlets and teaching units for educators, and indexes and bibliographies on atomic energy, 23 pages, 15 cents.

Isotopes—A 3-Year Summary of Distribution—With Bibliography of Uses, August 1949, summarizes the Oak Ridge isotopes production, distribution, and training program, with statistics on the distribution and use of isotopes by State and institution, by field of use, by foreign country, and contains an extensive bibliography of published literature on isotopes, 201 pages, 45 cents.

Isotopes—A 5-Year Summary of Distribution, August 1951, is a detailed account of isotope utilization during the first 5 years of the Commission's distribution program, 451 pages, $1.00.

Prospecting for Uranium, revised October 1951, is a nontechnical booklet prepared by the United States Geological Survey and AEC describing the uranium-bearing minerals, where to look for them, and instruments to use in prospecting and in laboratory testing and analysis of ores. It contains six color plates of principal minerals. Laws, regulations, and price schedules for uranium-bearing ores are included, 128 pages, 45 cents.

Contracting and Purchasing Offices and Types of Commodities Purchased, revised March 1951, lists the types of items the AEC must procure, procurement officers, and location of the purchasing offices. Included are responsibilities of the AEC operations offices and major research centers for whom the materials are procured, and security requirements that must be met by firms supplying certain materials to AEC, 20 pages, 15 cents.

A Guide for Contracting of Construction and Related Engineering Services, revised January 1951, gives AEC policy on awarding contracts for construction and architect-engineering services, procedures followed when requests for bids are formally advertised and when contracts are negotiated. Operations offices and officials responsible for letting such contracts are listed, 16 pages, 15 cents.

TECHNICAL PUBLICATIONS, PERIODICALS, AND CATALOGS

The items listed below, together with the National Nuclear Energy Series described in the next section, are the publications of scientific and technical interest. In addition to those reports published in the NNES or in the scientific and technical journals, there are approximately 1,200 technical reports available at nominal prices from the Office of Technical Services, Department of Commerce, Washington 25, D. C. A list of the titles and prices of these reports may be obtained from the Office of Technical Services.

The Elements of Nuclear Reactor Theory, by Samuel Glasstone and Milton C. Edlund, D. Van Nostrand Co., N. Y., 1952, is written for scientists, engineers and advanced students interested in the field of nuclear reactors. It explains the physical concepts and processes involved in a nuclear chain reaction and the methods for calculating critical conditions for chain reacting systems, 416 pages, $4.80.

Sourcebook on Atomic Energy, Samuel Glasstone, D. Van Nostrand Co., N. Y., 1950, presents a comprehensive, technical description of the theory, history, development, and uses of atomic energy. Chapters are included on the structure of the atom, radioactivity, isotopes, neutron research, acceleration of charged particles, and other phases of nuclear science, 546 pages, $3.40.

[2] Available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

The Effects of Atomic Weapons, 1950, prepared for the Department of Defense and the AEC by a board of editors under the direction of the Los Alamos Scientific Laboratory, presents a technical summary of the results to be expected from the detonation of atomic weapons, with chapters describing an atomic explosion, the shock from air, underwater, and underground bursts; blast, radiation, and fire effects; methods of protecting personnel; and decontamination methods, 456 pages, $1.25.[2]

Handbook on Aerosols, 1950, contains chapters from the National Defense Research Committee Summary Technical Report, Division 10, declassified by the Army at the request of AEC, on the properties and behavior of aerosols, principals and instruments used in meteorology studies, and information useful in studies of the disposal of gaseous radioactive wastes, the dispersal of insecticides, the disposal of industrial gases, etc., 147 pages, 60 cents.[2]

Handbook on Air Cleaning—Particulate Removal, Sheldon K. Friedlander, Leslie Silverman, Philip Drinker and Melvin W. First, Harvard University, 1952, a compilation of data resulting from the study of air cleaning equipment and procedures. Such studies applied principally to the removal of radioactive dust and contamination from exhaust gases, etc., 89 pages, 45 cents.[2]

Liquid-Metals Handbook, revised June 1952, R. N. Lyon, et al., compiled by the Department of the Navy and AEC, summarizes current information on the physical and chemical properties of liquid metals, their present industrial uses, and their use and potentialities as heat-transfer media, 188 pages, $1.25.[2]

Neutron Cross Sections (AECU 2040), May 15, 1952, a compilation of data in tabular and graphic form prepared by the AEC Neutron Cross Section Advisory Group. Cross section values for a number of nuclides, elements and compounds are given for neutrons ranging in energy from 0.0001 electron volts to 100 Mev., $1.00.[3]

Manual of Analytic Methods for the Determination of Uranium and Thorium in Their Ores, C. J. Rodden and J. J. Tregoning, 1950, presents a number of tested methods of analyzing ore samples for their uranium and thorium content. It is intended to be an aid to assayers, commercial laboratories, and others interested in raw material assay work, 55 pages, 20 cents.[2]

Handling Radioactive Wastes in the Atomic Energy Program, revised August 1951, reports on the sources and types of radioactive wastes in atomic energy operations, methods developed for their safe handling and disposal, and methods specified for the safe handling of radioisotopes by private users, 30 pages, 15 cents.[2]

Trilinear Chart of Nuclear Species, W. H. Sullivan, John Wiley & Sons, Inc., N. Y., 1949, shows physical data for all the nuclear species known as of June 1949, $2.50.

Periodicals and Catalogs

Nuclear Science Abstracts, issued twice a month by the AEC Technical Information Service, contains abstracts of all current AEC declassified and unclassified reports, of non-AEC reports related to atomic energy, and of articles appearing in both the foreign and domestic periodical literature, $6 per year.[2]

Isotopes—Catalog and Price List, Isotopes Division, AEC, Oak Ridge, Tenn., March 1951, lists and describes radioactive and stable isotopes available from Oak Ridge, and includes prices and instructions for ordering the isotopes.

[2] Available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

[3] Available from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

Isotopics, a quarterly journal of announcements issued by the Isotopes Division, AEC, Oak Ridge, Tenn., concerning the availability, utilization, and handling of isotopes, 35 cents per copy, $1.00 per volume.[2]

THE NATIONAL NUCLEAR ENERGY SERIES

These volumes were written by the scientists who performed the research and development on the atomic energy enterprise under the Manhattan Engineer District and later under the Atomic Energy Commission. The following volumes have been published for the AEC by the McGraw-Hill Book Co., New York, N. Y.

Division I: The Electromagnetic Separation Process

Vacuum Equipment and Techniques, vol. 1, edited by A. Guthrie and R. K. Wakerling, 1949, describes the development and study of high vacuum equipment and high vacuum systems for the large-scale separation of isotopes by the electromagnetic process, 264 pages, $3.75.

The Characteristics of Electrical Discharges in Magnetic Fields, vol. 5, edited by A. Guthrie and R. K. Wakerling, 1949, cover most of the significant studies by the University of California Radiation Laboratory on electrical discharges with emphasis on studies of electrical discharges in vapors of uranium compounds, 376 pages, $5.00.

Division II: Gaseous Diffusion Project

Engineering Developments in the Gaseous Diffusion Process, vol. 16, edited by M. Benedict and C. Williams, 1949, describes a number of mechanical, electrical, and chemical engineering developments related to the operation and handling of materials used in the gaseous diffusion process—principally special plant instruments, vacuum engineering, development of heat-transfer equipment, and absorption of uranium hexafluoride and fluorine, 129 pages, $2.00.

Division III: Special Separations Project

The Theory of Isotope Separation, vol. 1B, by Karl Cohen, 1951, presents the theory of cascades as generally applicable to the problems of isotope separation. Different types of centrifuges and other methods of separation are also discussed, 165 pages, $2.50.

Spectroscopic Properties of Uranium Compounds, vol. 2, edited by G. H. Dieke and A. B. F. Duncan, 1949, presents data compiled from a comprehensive study of the absorption and fluorescence spectra of uranium compounds and describes the experimental techniques used in the studies, 290 pages, $4.25.

Physical Properties and Analysis of Heavy Water, vol. 4A by I. Kirschenbaum, 1951, describes the physical properties of heavy water, chemical equilibria or exchange reactions and methods of isotopic analysis, 438 pages, $6.00.

Bibliography of Research on Heavy Hydrogen Compounds, vol. 4C, compiled by A. H. Kimball, edited by H. C. Urey, and I. Kirschenbaum, 1949, contains about 2,000 references to published literature on research with heavy hydrogen. References are arranged by subject with an index of the hydrogen compounds and authors, 350 pages, $4.75.

[2] Available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Division IV: Plutonium Project

Radiochemical Studies: The Fission Products, vol. 9, edited by C. D. Coryell and N. Sugarman, 1951, presents 336 original research papers on the techniques and results of radiochemical studies of uranium and plutonium fission products, 2,086 pages (in 3 parts), $27.75.

The Transuranium Elements, Research Papers, vol. 14B, edited by G. T. Seaborg, J. J. Katz, and W. M. Manning, 1949, includes 163 research papers on neptunium, plutonium, americium, curium, and several of the heavy elements related to them, and historical summaries of transuranium element research, 1,733 pages (in 2 parts), $23.75.

The Chemistry and Metallurgy of Miscellaneous Materials; Thermodynamics, vol. 19B, edited by L. L. Quill, 1949, contains 10 research papers on the thermodynamic properties of the elements and several of their compounds, 329 pages, $4.50.

Industrial Medicine on the Plutonium Project, vol. 20, edited by R. S. Stone, 1951, describes the medical program established for the care and protection of workers on the plutonium project, 511 pages, $7.00.

Biological Effects of External Beta Radiation, vol. 22E, edited by R. E. Zirkle, offers a collection of original reports on the effects of beta rays applied to the surface of the mammalian body, 242 pages, $3.50.

Histopathology of Irradiation from External and Internal Sources, vol. 22I, edited by W. Bloom, 1948, is an advanced treatise on the histopathological and cytological effects of total-body irradiation, 808 pages, $10.75.

Toxicology of Uranium, vol. 23, edited by A. Tannenbaum, 1950, describes the studies made on the distribution, accumulation, excretion, and chemical and physiological effects of uranium and uranium compounds in the animal body, 323 pages, $4.75.

Division V: Los Alamos Project

Electronics: Experimental Techniques, vol. 1, edited by W. C. Elmore and M. L. Sands, 1948, describes a number of complete circuits and circuit elements developed at Los Alamos for making nuclear and other physical measurement, 417 pages, $5.50.

Ionization Chambers and Counters: Experimental Techniques, vol. 2, edited by B. Rossi and H. Staub, 1949, describes the physical principles of ionization chambers and counters, and includes previously unpublished project developments by scientists at the Los Alamos Laboratory, 243 pages, $3.25.

Miscellaneous Physical and Chemical Techniques of the Los Alamos Project, vol. 3, edited by A. C. Graves and D. K. Froman, describes a variety of laboratory techniques used at Los Alamos in early studies. Drawings and diagrams of the laboratory and apparatus are given, 323 pages, $4.25.

Division VI: University of Rochester Project

Pharmacology and Toxicology of Uranium Compounds, parts I and II, vol. I, edited by C. Voegtlin and H. C. Hodge, 1949, summarizes the results of 3 years' research on the toxicity of uranium compounds and the mechanism of uranium poisoning, and includes a section on the toxicology of fluorine and hydrogen fluoride, 1,084 pages (in 2 parts), $14.25.

Biological Studies with Polonium, Radium and Plutonium, vol 3, edited by R. M. Fink, 1949, describes the studies made of the biological effects of these alpha-

emitting elements in the animal body, air monitoring precautions, and equipment used in atomic energy laboratories where work with these elements is carried on, 411 pages, $5.50.

Division VII: Materials Procurement Project

Preparation, Properties, and Technology of Fluorine and Organic Fluoro Compounds, vol. 1, edited by C. Slesser and S. R. Schram, describes development in the large-scale manufacture of fluorine, and purifying and handling fluorine. It describes the preparation and the chemical and physical properties of various fluorocarbon compounds, 868 pages, $11.50.

Division VIII: Manhattan Project Chemistry

Analytical Chemistry of the Manhattan Project, vol. 1, edited by C. J. Rodden, 1950, describes methods of analyzing the many different materials used in the atomic energy project—with emphasis on analytical methods for the determination of uranium and thorium, 748 pages, $10.00

Chemistry of Uranium. Part I. The Element, Its Binary and Related Compounds, vol. 5, by J. J. Katz and E. Rabinowitch, 1951, is a detailed discussion of the physical and chemical properties of uranium, its occurrence in nature and extraction from ores, and preparation and physical properties of its binary compounds, 609 pages, $8.25.

DEPOSITORY LIBRARIES

In order to make the nonclassified results of AEC research and development available to the public, the following libraries serve as depositories for essentially all of the Commission's nonclassified reports. A number of other libraries also receive from the AEC copies of the reports that are sold by the Office of Technical Services.

CALIFORNIA
- Berkeley, University of California General Library
- Los Angeles, University of California Library

COLORADO
- Denver, Denver Public Library

CONNECTICUT
- New Haven, Yale University Library

DISTRICT OF COLUMBIA
- Washington, Library of Congress

GEORGIA
- Atlanta, Georgia Institute of Technology Library

ILLINOIS
- Chicago, John Crerar Library
- Chicago, University of Chicago Library
- Urbana, University of Illinois Library

INDIANA
- Lafayette, Purdue University Library

IOWA
- Ames, Iowa State College Library

KENTUCKY
- Lexington, University of Kentucky Library

LOUISIANA
- Baton Rouge, Louisiana State University Library

MASSACHUSETTS
- Cambridge, Harvard University Library
- Cambridge, Massachusetts Institute of Technology Library

MICHIGAN
- Ann Arbor, University of Michigan Library
- Detroit, Detroit Public Library

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MINNESOTA
- Minneapolis, University of Minnesota Library

MISSOURI
- Kansas City, Linda Hall Library
- St. Louis, Washington University Library

NEW JERSEY
- Princeton, Princeton University Library

NEW MEXICO
- Albuquerque, University of New Mexico Library

NEW YORK
- Buffalo, Lockwood Memorial Library
- Ithaca, Cornell University Library
- New York, Columbia University Library
- New York, New York Public Library
- Troy, Rensselaer Polytechnic Institute Library

NORTH CAROLINA
- Durham, Duke University Library
- Raleigh, North Carolina State College Library

OHIO
- Cincinnati, University of Cincinnati Library
- Cleveland, Cleveland Public Library

OHIO—Con.
- Columbus, Ohio State University Library

OKLAHOMA
- Stillwater, Oklahoma Agricultural and Mechanical College Library

OREGON
- Corvallis, Oregon State College Library

PENNSYLVANIA
- Philadelphia, University of Pennsylvania Library
- Pittsburgh, Carnegie Library of Pittsburgh

TENNESSEE
- Knoxville, University of Tennessee Library
- Nashville, Joint University Libraries

TEXAS
- Austin, University of Texas Library

UTAH
- Salt Lake City, University of Utah Library

WASHINGTON
- Seattle, University of Washington Library

WISCONSIN
- Madison, University of Wisconsin Library

APPENDIX 9

AEC Owned Patents and Licensees

PATENTS ISSUED TO THE COMMISSION WHICH ARE AVAILABLE FOR LICENSING [1]

The following 489 U. S. Letters Patents owned by the United States Government as represented by the United States Atomic Energy Commission have been made available for licensing at periodic intervals since December 1949. Licenses are granted on a non-exclusive, royalty-free basis. Abstracts of patents available for licensing are published in the Patent Office Official Gazette.

PATENT NO.	TITLE	PATENTEE
2,410,384	Furnace Control System	H. W. Lindsay, Oakland, Calif.
2,417,392	Torsion Balance	R. C. & R. Q. Boyer, Berkeley, Calif.
2,418,523	Method and Apparatus for Producing Radiographs.	S. H. Neddermeyer, Pasadena, Calif. and D. W. Kerst, Urbana, Ill.
2,419,915	Apparatus for the Storage of Fluorine	H. F. Priest, New York and A. V. Grosse, Bronxville, N. Y.
2,421,649	Method of Welding or Cutting Metal by Hydrogen-Fluorine Flame.	H. F. Priest, New York and A. V. Grosse, Bronxville, N. Y.
2,422,500	Production of Fluorine	W. C. Schumb, M. and A. J. Stevens, Hollis-ton, Mass.
2,422,907	Purification of Acid Potassium Fluorides	P. R. Johnson, Claymont, Del.
2,422,921	Adjustable Capillary Leak	A. O. C. Nier, New York, N. Y., E. P. Ney, Charlottesville, Va., and M. G. Inghram, New York, N. Y.
2,423,173	Safety Pipette	E. L. Brady and L. E. Glendenin, Oak Ridge, Tenn.
2,431,732	Locating & Welding Fixture	E. Colbert, Chicago, Ill.
2,431,905	Quick Locking Furnace Base Plate	P. J. Anicetti, Beverly, Mass.
2,431,969	Fluorination of Perchlorohexatriene	W. S. Struve, Carneys Point, N. J.
2,431,975	Method of Welding Carbon to Molybdenum	H. P. Yockey, Oakland and J. M. Nudding, Berkeley, Calif.
2,436,083	Sedimentation Tube	J. W. Williams, Madison, Wis., and E. M Bevilacqua, Rutherford, N. Y.
2,436,084	Ionization Chamber	G. L. Weller, Chicago, Ill.
2,436,476	Differential Twin Chamber Neutron Meter	H. M. Parker, Oak Ridge, Tenn.
2,440,167	Differential Ion Chamber	J. W. Broxon and W. P. Jesse, Chicago, Ill.
2,440,999	Compressed Neutron Source	H. L. Anderson, Chicago, Ill.
2,441,042	Calibrating Means for Pitot Venturi Tubes	H. W. Stoll, Rochester, N. Y
2,441,044	Switching & Timing Unit for Pneumatic Relays.	K. L. Tate, Rochester, N. Y.
2,442,314	Geiger Counter Improvement	A. F. Reid, New York, N. Y.
2,442,589	Purification of Perfluoroheptane by Azeotropic Distillation with Methyl Ethyl.	L. R. Evans, Wilmington, Del., and H. B. Hass, West Lafayette, Ind.
2,442,599	Glass Magnetic Stopcock	C. E. Herrick, Jr., New York and L. C. Liberatore, Woodside, N. Y.
2,442,622	Seal	A. M. Starr, Piedmont, Calif.
2,442,625	Packless Valve	J. B. Thomas, Jackson Heights, N. Y.
2,443,365	Support for Geiger-Mueller Counters	E. H. Wakefield, Chicago, Ill.
2,444,613	Low Humidity Meter	H. R. McCombie, Pittsburg, Pa., and C. D. Wilder, Berkeley, Calif.
2,446,251	Joint Fillers	T. W. Stricklin, Gordon Heights, Del.
2,446,385	Adjusting Arrangement for Pneumatic Relays of the Force-Balance Type.	F. B. Newell, Rochester, N. Y.
2,446,780	Method of Preparing Uranium Hydride	A. S. Newton, Ames, Iowa.
2,446,997	Molecular Distillation Process	A. K. Brewer, Richland Center, Wis. and S. L. Madorsky, Chicago, Ill.
2,448,479	Uranium Monocarbide and Method of Preparation.	H. S. Wilhelm and A. H. Daane, Ames, Iowa.
2,451,953	Meter Protection Circuit	C. S. Ingram, Fairfax, Calif.
2,452,139	Method of Preparing Uranium Deuteride	A. S. Newton, Ames, Iowa.
2,452,156	Float Position Indicator	D. S. Schover, Chicago, Ill.
2,452,913	Method of Producing Calcium Hydrides by Distillation.	D. Duffey, La Fontaine, Ind.
2,455,718	Direct Current Amplifier	B. L. Weller, Richland, Wash.

[1] Patents listed as of November 30, 1952. Applicants for licenses should apply to the Chief, Patent Branch, Office of the General Counsel, U. S. AEC, Washington 25, D. C., identifying the subject matter by patent number and title.

PATENT NO.	TITLE	PATENTEE
2,456,426	Mass Spectrometer System	A. O. C. Nier, New York, N. Y., and E. P. Ney, Charlottesville, Va.
2,458,632	Ionization Chamber	J. H. Parsons, Oak Ridge, Tenn.
2,461,661	Preparation of Alkali Metal Compounds	H. I. Schlesinger, Chicago, Ill. and H. C. Brown, Detroit, Mich.
2,461,662	Preparation of Alkali Metal Compounds	H. I. Schlesinger, Chicago, Ill. and H. C. Brown, Detroit, Mich.
2,461,663	Preparation of Alkali Metal Compounds	H. I. Schlesinger, Chicago, Ill. and H. C. Brown, Detroit, Mich.
2,462,935	High Stability Voltage Regulator	W. R. Baker, Berkeley, Calif.
2,462,997	Attachment for Milling Machines	J. L. Roush, Oak Ridge, Tenn.
2,465,018	Valve	W. C. Hein and L. W. Winchester, Chicago, Ill.
2,465,886	Electrical Measuring Apparatus	O. G. Landsverk, Chicago, Ill., and E. O. Wollan, Oak Ridge, Tenn.
2,465,938	Radiation Measuring Device	F. R. Shonka, Chicago, Ill.
2,466,118	Precipitation of Ammonium Biuranate	A. J. Miller, Oak Ridge, Tenn., and G. M. Armstrong, Providence, R. I.
2,468,678	Regulator	K. R. MacKenzie, Richmond, Calif.
2,468,681	Purification of Hydrogen Fluoride	R. H. McBride, Gary, Ind.
2,469,916	Process of Producing Uranium Tetrabromide	J. M. Carter, Pasadena, Calif.
2,470,895	Impulse Type Power Supply	E. W. Marlowe, Chicago, Ill., and H. A. Wilcox, Los Alamos, N. Mex.
2,472,365	Alpha Particle Counting	C. J. Borkowski, Oak Ridge, Tenn.
2,472,456	Crucible and Method of Making Crucibles	R. J. Anicetti, Beverly, Mass.
2,474,042	Vibration Eliminating Apparatus	E. J. Egle, Jr., Woodside, N. Y.
2,474,773	Radiation Detector	W. R. Baker, Berkeley, Calif.
2,475,138	Device for Measuring Thermal Conductivity	C. B. Hood, Jr., W. Jones and H. L. Johnston, Columbus, Ohio.
2,476,249	Remote-Control Manipulator	J. H. Payne, Jr., Ballston Spa, N. Y.
2,477,924	Method of Preparing Uranium Trioxide	S. M. Fried, Chicago, Ill., and N. R. Davidson Sierra Madre, Calif.
2,479,271	Ionization Chamber Circuit	F. R. Shonka, Chicago, Ill.
2,479,600	Ionization Chamber	C. J. Borkowski, Oak Ridge, Tenn.
2,479,699	Apparatus for Magnetic Measurements	W. M. Powell, Berkeley, Calif.
2,481,320	Magnetic Pump	S. L. Madorsky, Washington, D. C.
2,481,506	Fast Neutron Meter	C. C. Gamertsfelder, Jr., Oak Ridge, Tenn.
2,481,964	Fast Neutron Meter	E. O. Wollan, Chicago, Ill.
2,483,981	Dynamic Condenser	H. Palevsky, Urbana, and R. K. Swank, Chicago, Ill.
2,483,991	Radiation Exposure Meter	E. O. Wollan and L. A. Pardue, Oak Ridge Tenn. and N. Goldstein, Chicago, Ill.
2,485,469	Method and Means for Detecting Ionization	J. S. Allen and B. B. Rossi, Chicago, Ill.
2,485,470	Method and Apparatus for Control of Beam Energy.	C. P. Baker, Ithaca, N. Y.
2,485,507	Chlorinated Hydrocarbon	M. A. Perkins, Wilmington, Del.
2,485,516	Shallow Plane Proportional Counter	R. W. Thompson, Minneapolis, Minn.
2,486,207	Liquid Level Measuring Apparatus	M. K. Richards, Wilmington, Del.
2,486,955	Producing Thin Film of Metal Oxide	K. E. Langwill, New York, N. Y.
2,486,976	Pressure Measuring Device	W. R. Perret, Vicksburg, Miss.
2,487,360	Nitrogen Purification Process	A. S. Newton, Ames, Iowa.
2,487,510	Current Integrating Network	W. R. Baker, Berkeley, Calif.
2,489,028	Positive Shutoff Dispensing Nozzle	C. B. Graham and V. D. Carver, Oak Ridge Tenn.
2,490,298	Radiation Detecting Apparatus	A. Ghiorso, Berkeley, Calif., and C. M. Gordon, San Pablo, Calif.
2,491,220	Neutron Detector	E. G. Segre, Santa Fe, N. Mex., and C. E. Wiegand, Berkeley, Calif.
2,491,320	Neutron Detector and Method of Making Same.	P. G. Koontz, Fort Collins, Colo.
2,492,365	Dispensing Nozzle	O. E. Miller, Oak Ridge, Tenn.
2,493,137	Voltage Doubling Circuits	W. W. Hansen, Palo Alto, Calif.
2,493,935	High-Energy Neutron Counter	C. E. Wiegand, Oakland, and E. G. Segre, Berkeley, Calif.
2,494,267	Surface Hardening of Ferrous Metals	H. I. Schlesinger and G. W. Schaeffer, Chicago, Ill.
2,494,641	Radiation Counter	H. L. Anderson, Hartford, Conn., and P. G. Koontz, Fort Collins, Colo.
2,494,834	Mounted Specimen	R. S. Ringheim, San Gabriel, Calif.
2,494,968	Alkoxy Borohydrides and Their Method of Preparation.	H. I. Schlesinger, Chicago, Ill., and H. C. Brown, Detroit, Mich.
2,495,081	Packless Valve	J. B. Thomas, Jackson Heights, N. Y.
2,495,497	Method of Liquid Stabilization of Nickel Catalysts.	J. E. Ahlberg and C. F. Hiskey, New York, N. Y.
2,495,650	Coincidence Proportional Counter	J. M. Blair, Stillwater, Okla., and J. M. Hush, Lincoln, Nebr.
2,496,115	Stabilization of Perfluoro Oils	W. B. Burford, III, Baltimore, Md., and C. E. Weber, Schenectady, N. Y.
2,496,123	Ionization Chamber	J. K. East and S. G. English, Oak Ridge, Tenn.
2,496,819	Pulse Generator	A. R. Simpson, Knoxville, Tenn.
2,496,886	Radiation Alarm and Measurement Device	E. W. Molloy, Pasadena, Calif., and W. H. Hinch, Denver, Colo.

PATENT NO.	TITLE	PATENTEE
2,497,823	Radiation Measuring Device for Air Filters	E. W. Molloy, Pasadena, Calif.
2,498,841	Ion Source	L. D. P. King, Santa Fe, N. Mex.
2,499,288	Vacuum Analyzer	J. G. Backus, Los Angeles, Calif.
2,499,289	Ion Generator	J. G. Backus, Los Angeles, Calif.
2,499,320	Ion Generator	R. Loevinger, Berkeley, Calif.
2,499,830	Air Proportional Counter	E. W. Molloy, Pasadena, Calif.
2,499,833	Method of Making Fluorinated Organic Compounds.	M. A. Perkins, Wilmington, Del.
2,499,836	Preparation of Higher Chlorides of Uranium	H. G. Reiber, Davis, Calif.
2,499,839	High Speed Mercury Diffusion Pump	G. R. Stoltenberg, Baltimore, Md.
2,500,492	Apparatus for Handling Materials	F. C. Henriques, Jr., Winchester, Mass.
2,500,756	Rectangular Pulse Amplifier	Q. A. Kerns, Berkeley, Calif.
2,501,461	Valve	H. E. Wirth, Worthington, Ohio.
2,502,074	Method and Apparatus for Pumping Corrosive Mediums.	H. S. Brown and H. H. Hubble, Oak Ridge, Tenn.
2,503,077	Perhalogenated Ethylcyclopentane	F. B. Stilmar, Woodstown, and W. S. Struve, Carneys Point, N. J., and R. N. Lulek, Silverside Heights, Del.
2,503,078	Cyclic Compounds and Method of Making	F. B. Stilmar, Woodstown, and W. S. Struve, Carneys Point, N. J., and R. N. Lulek, Silverside Heights, Del.
2,504,530	Vacuum Leak Detector Method	R. B. Jacobs, Rochester, N. Y.
2,504,585	Cyclotron Target	A. F. Reid, New York, N. Y.
2,505,877	Vapor Phase Fluorination Process	A. F. Benning, Woodstown, N. J.
2,505,919	Proportional Counter	J. A. Simpson, Jr., Chicago, Ill.
2,506,419	Method and Apparatus for Detecting Ionizing Particles.	E. R. Graves, Santa Fe, N. Mex.
2,506,428	Condensation Product and Process	E. T. McBee and J. S. Newcomer, Wes Lafayette, Ind.
2,506,431	Pressure Measuring Device	W. R. Perrett and T. Davis, Oak Ridge, Tenn.
2,506,433	Magnetic Flux Measuring Apparatus	E. H. Plesset, Los Angeles, Calif.
2,506,435	Radiation Measurement	B. B. Rossi, Winchester, Mass. and J. S. Allen, Champaign, Ill.
2,506,438	Electrolytic Process for Production of Fluorine	G. C. Whitaker, Brooklyn Heights, Ohio.
2,506,944	Neutron Meter	L. S. Stauffer, Rotterdam Junction, and T. M. Snyder, Schenectady, N. Y.
2,506,945	Treatment of Pitchblende Ores	H. C. Thomas and A. S. Tomcufcik, New Haven, Conn.
2,507,301	Apparatus for Controlling Magnetic Fields	H. W. Fulbright, Princeton, N. J.
2,507,321	Leak Testing Device	D. W. Sherwood, Seattle, Wash.
2,508,234	Distillation Apparatus	D. Duffey, La Fontaine, Ind.
2,508,989	Apparatus for Purifying Gases	M. M. Brandegee, Lewiston, N. Y.
2,509,009	Insulating Column Structure	J. L. McKibben, Los Alamos, N. Mex.
2,509,394	Vacuum Tube Flux Meters	R. Kinslow, Cookeville, Tenn.
2,509,669	Mechanical Couplings	L. B. Borst, Oak Ridge, Tenn.
2,509,700	Radioactivity Measuring Devices	J. A. Simpson, Chicago, Ill.
2,510,850	Methods of Producing Uranium Fluorides and a Compound Produced Thereby.	P. A. Agron, Kew Gardens, N. Y., and S. W Weller, Pittsburgh, Pa.
2,510,864	Catalysts for Fluorination	G. H. Cady, Leonia, N. J.
2,510,872	Methods for Regenerating Antimony Pentafluoride from Spent Antimony Halides Resulting from the Fluorination of Organic Chlorides.	F. B. Downing, Carney's Point, N. J.
2,510,930	Systems for Measuring Limited Current Changes.	K. G. MacLeish, Oak Ridge, Tenn.
2,511,667	Chemical Method for Concentrating Isotopes of Carbon.	M. Calvin and P. E. Yankwich, Berkeley, Calif.
2,512,538	Electric Discharge Device	W. R. Baker, Berkeley, Calif.
2,513,805	Detecting Device	W. R. Kanne, Chicago, Ill.
2,514,115	Method of Dissolving Difficult Soluble Metal Sulfates.	A. H. Angerman, Oak Ridge, Tenn.
2,514,116	Induction Reamer	W. R. Baker, Berkeley, Calif.
2,514,135	Radiation Detector	H. G. Neil, Knoxville, Tenn.
2,514,142	Hydraulically Driven Oscillatory Brush	J. D. Reid, Oak Ridge, Tenn.
2,514,909	Carrier for Radioactive Slugs	G. Strickland, Medford, N. Y.
2,515,112	Method for Disposing of Corrosive Gases	W. B. Burford, III, and H. C. Anderson, Baltimore, Md.
2,515,159	Quick Operating Valve	E. Zurcher, Knoxville, Tenn.
2,516,050	Adjustable Centrifugal Switch	Q. J. Evans, New York, N. Y. and A. Kushner, Oak Ridge, Tenn.
2,517,469	Method and Apparatus for Measuring Alpha Particle Radiation.	R. W. Dodson, Pasadena, Calif., and W. H. Beamer, Youngstown, Ohio.
2,517,676	Pulse-Forming Preamplifier	Q. A. Kerns, Berkeley, Calif.
2,517,863	Voltage Supply Circuit for Vacuum Tubes	D. K. Froman, Denver, Colo.
2,518,217	Apparatus for Testing Tensile Characteristics of a Material.	C. K. Beck and D. Kirkpatrick, Oak Ridg Tenn.
2,519,007	Radiation Counters	V. C. Wilson, Schenectady, N. Y.
2,519,319	Manufacture of Oxygen-containing Chlorinated Cyclic Compound.	E. T. McBee and J. S. Newcomer, West Lafayette, Ind.
2,519,323	Method of Measuring Corrosion and Erosion	W. B. Shank, D. H. Gurinsky and E. C. Creutz, Chicago, Ill.
2,519,792	The Electrolytic Production of Metallic Uranium.	R. Rosen, Elizabeth, N. J.
2,521,112	Method and Apparatus for Separating Fluids by Thermal Diffusion.	J. W. Beams, Charlottesville, Va.

PATENT NO.	TITLE	PATENTEE
2,521,121	Dispersion Separation	M. Kilpatrick, Philadelphia, Pa.
2,521,133	Secondary Electron Multipliers	A. H. Snell, Oak Ridge, Tenn., and L. C. Miller, Oak Ridge, Tenn.
2,521,495	Carbonaceous Articles and Production Thereof.	H. A. Wilhelm, Ames, Iowa, and P. S. Gerard, Omaha, Nebr.
2,521,634	Accoustic Chamber for Analysis of Gaseous Mixture.	W. H. Janssen and W. Mikelson, Schenectady, N. Y.
2,521,656	Ionization Chamber	E. G. Segre, Santa Fe, N. Mex. and O. Chamberlain, Philadelphia, Pa.
2,521,891	Valve	J. W. Beams, Charlottesville, Va.
2,521,894	Low Inductance Resistor	R. J. S. Brown, St. Paul, Minn.
2,521,937	Method of Purifying Inert Gases	A. S. Newton, Ames, Iowa.
2,523,856	Resistance Capacitance Network	W. R. Baker, Berkeley, Calif.
2,523,892	Extraction Process for Cerium	J. C. Warf, Los Angeles, Calif.
2,524,379	Neutron Velocity Selector	E. Fermi, Santa Fe, N. Mex.
2,524,384	Production of Uranium Tri-iodide	J. A. Holmes, Stillwater, Okla.
2,524,388	Saturable Core Triggered Gap	Q. A. Kerns, Berkeley, Calif.
2,524,692	Scaling Circuit	W. H. Bradley, Chicago, Ill.
2,525,197	Thermal Flowmeters	J. W. Beams, L. B. Snoddy and L. G. Hoxton, Charlottesville, Va.
2,526,213	Processes for Production of Mesitylene	W. M. Ewalt, Niagara Falls, N. Y.
2,526,805	Method of Forming Uranium Carbon Alloys	J. H. Carter, Harrisonburg, Va. and A. H. Daane, Ames, Iowa.
2,526,825	Fluid Selecting Apparatus	A. O. C. Nier and G. H. Goertzel, Riverdale, and R. B. Thorness, Minneapolis, Minn.
2,527,320	Dehydration of Alkali-Metal Acid Fluorides	R. C. McHarness and A. F. Benning, Woodstown, N. J.
2,528,415	Pump	H. A. Boorse, Leonia, N. J. and G. F. Boeker, New York, N. Y.
2,528,436	Stuffing Box and Expansion Joint	M. E. Johnson, Prospect Park, Pa.
2,528,454	Coating Process	H. I. Schlesinger and G. W. Schaeffer, Chicago Ill.
2,529,666	Pulse Height Analyzer	M. L. Sands, Everett, Mass.
2,530,169	Electronic Regulator	E. O. Lawrence and V. B. Waithman, Berkeley, Calif. and F. H. Schmidt, Seattle, Wash.
2,530,176	Apparatus for Measuring Local Variations in Flux Density in a Magnetic Field.	W. M. Powell, Berkeley, Calif.
2,530,178	Fluxmeter	W. R. Rathkamp, Oak Ridge, Tenn.
2,531,065	Apparatus for Changing the Ion Source of a Cyclotron.	J. J. Livingood, J. V. Peters, and R. A. Streeter, Cedar Rapids, Iowa.
2,531,106	Pocket Radiation Alarms	R. J. S. Brown, Lawndale, Calif. and H. G. Weiss, Waltham, Mass.
2,531,143	Methods of Purifying Beryllium Oxide	J. G. Malm and C. A. Hutchison, Jr., Chicago, Ill.
2,531,144	Coincidence Proportional Counters	J. H. Manley, Urbana, Ill.
2,531,802	Filter and Valve Mechanism	R. Q. Boyer, Berkeley, Calif.
2,531,807	Magnetic Measuring Apparatus and Methods	J. DePangher, Berkeley, Calif.
2,531,811	Coulombmeters	J. E. Hammel, Oak Ridge, Tenn.
2,531,830	Voltage Pulse Generators	A. R. Simpson, Knoxville, Tenn.
2,531,833	Tachometers	H. A. Straus, Baltimore, Md.
2,531,953	Apparatus for Handling Radioactive Solutions	W. Q. Smith and G. W. Struthers, Oak Ridge, Tenn.
2,532,257	Corrosion Testing Apparatus	I. Kirshenbaum, New York, N. Y. and D. A. McCaulay, Chicago, Ill.
2,532,490	Processes for Recovery of C^{14} Activities	B. A. Fries, El Cerrito, Calif.
2,532,503	Electronic Counting Circuits	J. W. Kennedy, Santa Fe, N. Mex., W. R. Baker, Berkeley, Calif. and C. E. Wiegand, Santa Fe, N. Mex.
2,532,707	Methods of Preparation of Neptunium Trifluoride.	S. Fried, Chicago, Ill. and N. R. Davidson, Sierra Madre, Calif.
2,532,874	Detection Apparatus	H. L. Anderson, Hartford, Conn.
2,532,891	Flanged Joint Sealing Gaskets	W. W. Chupp, Berkeley, Calif.
2,532,956	Air Proportional Counters	J. A. Simpson, Jr., Chicago, Ill.
2,533,102	Containers for Radioactive Samples	J. F. Gifford, Richmond, Calif.
2,533,138	The Purification of Hydrogen	A. S. Newton, Ames, Iowa.
2,533,149	Precipitation Processes and Apparatus Therefor.	L. G. Stang, Jr., Chicago, Ill.
2,533,491	Valve Control Mechanism	J. B. McMahon, Wilmette, and T. A. Abbott, La Grange, Ill.
2,533,696	Diborane Purification Process	G. W. Schaeffer, St. Louis, Mo., and G. D. Barberas, Cleveland, Ohio.
2,533,701	Collimating Shield	R. D. Watt and W. N. Watson, El Cerrito, Calif.
2,534,676	Preparation of Compounds of Uranium and Non-metals.	A. S. Newton and O. Johnson, Ames, Iowa.
2,534,677	Production of Uranium Halides	A. S. Newton and O. Johnson, Ames, Iowa.
2,535,355	Voltage Regulator and Supply	D. K. Froman, Denver, Colo.
2,535,572	The Preparation of UF_6	R. M. Heiner, Revere, Mass.
2,535,886	Electronic Switches	W. R. Baker, Berkeley, and Q. A. Kerns, Oakland, Calif.
2,536,602	Automatic Flange System	J. J. Goett, Chicago, Ill.
2,536,610	Hydrogen Purification System	L. D. P. King, Santa Fe, N. Mex., C. P. Baker, Ithaca, N. Y., and R. E. Schreiber, McMinnville, Oreg.

PATENT NO.	TITLE	PATENTEE
2,536,616	Preparation of Uranium Hydride	J. C. Warf, Ames, Iowa.
2,536,617	Direct Current Negative Feed-back Amplifier	B. L. Weller, Richland, Wash.
2,536,808	Fast Impulse Circuits	W. A. Higinbotham, Upton, N. Y.
2,536,991	Radiation Detector	E. O. Wollan and L. A. Pardue, Oak Ridge, Tenn.
2,537,775	Ion Vacuum Gauge	S. M. MacNeille, Oak Ridge, Tenn.
2,537,777	Chlorofluoroheptanes	E. T. McBee, West Lafayette, Ind.
2,538,632	Combination Beta and Gamma Chamber	E. R. Tompkins, Oak Ridge, Tenn.
2,539,273	Alternating Current Generator	W. L. Ringland, West Allis, Wis.
2,539,282	Rare Earth Separation by Adsorption and Desorption.	F. H. Spedding and A. F. Voigt, Ames, Iowa.
2,539,578	Bearing Test Apparatus	L. M. Headley, New York, N. Y.
2,540,248	Manufacture of Fluorine by Electrolysis	R. C. Downing, Wilmington, Del.
2,540,941	Latch Mechanism	C. B. Graham and V. D. Carver, Oak Ridge, Tenn.
2,540,944	Sampling Apparatus	S. L. Handforth, Wilmington, Del.
2,540,960	Electrolytic Cell	S. G. Osborne, Niagara Falls, N. Y.
2,541,190	Fluorination of Lubricating Oil	A. F. Benning, Woodstown, N. J.
2,541,198	Amplifier	I. R. Brenholdt, Chicago, Ill.
2,541,599	Radiography	P. Morrison, Chicago, Ill.
2,541,940	Electronic Circuit	B. B. Rossi, Cambridge, Mass. and H. H. Staub, Palo Alto, Calif.
2,542,905	Apparatus for Measuring Pressure	S. Cromer, Oak Ridge, Tenn., and E. T. Booth, Jr. and F. L. Alexander, New York, N. Y.
2,543,491	Pulse Integrating Circuits	D. K. Froman, Denver, Colo.
2,543,511	The Preparation of Diborane	H. I. Schlesinger, Chicago, Ill. and H. C. Brown, Detroit, Mich.
2,543,902	Radio Frequency Voltage Supply	R. C. Dye, Los Angeles, Calif.
2,544,277	The Preparation of Uranium Nitride	A. S. Newton and O. Johnson, Ames, Iowa.
2,544,285	Electrolytic Cells	K. E. Stuart and S. G. Osborne, Niagara Falls, N. Y.
2,544,472	The Preparation of Diborane	H. I. Schlesinger, Chicago, Ill., and H. C. Brown, Detroit, Mich.
2,545,595	Linear Accelerator	L. W. Alvarez, Berkeley, Calif.
2,545,606	Methods of Coating with Plutonium Acetylacetonate and Coated Product.	B. B. Cunningham, Chicago, Ill., C. Smith, Oakland, Calif., and J. S. Dixon, Santa Fe, N. Mex.
2,545,612	Sulfur-Containing Compounds of Neptunium and a process for Their Preparation.	S. Fried, Chicago, Ill., and N. R. Davidson, Sierra Madre, Calif.
2,545,623	Frequency Modulation Systems	K. R. MacKenzie, Pacific Palisades, Calif.
2,545,633	The Preparation of Lithium Borohydride	H. I. Schlesinger, Chicago, Ill., and H. C. Brown, Detroit, Mich.
2,545,920	Transuranic Metal Halides and a Process for the Production Thereof.	S. Fried, Chicago, Ill.
2,545,924	Fast Impulse Circuits	C. W. Johnstone, Los Alamos, N. Mex.
2,546,106	Apparatus for Regulating High Voltage	K. G. Morrison, Oakland, Calif.
2,546,700	Multiple Chisel Structure for Disintegrating and Removing Incrustations from Interior Walls of Receptacles.	C. H. Prescott, Jr., Berkeley, Calif.
2,546,933	Methods of Dissolving Thorium Values	F. L. Steahly and R. W. Stoughton, Oak Ridge, Tenn., and F. W. Schuler, Madison, Wis.
2,546,953	Zirconium-hafnium Separation Process	K. Street, Jr., Berkeley, Calif.
2,547,409	Guiding Means for Movement of Solid Materials.	C. H. Prescott, Jr., Berkeley, Calif.
2,547,874	Hydrogen Purification Method	E. D. Klema, Saline, Kans.
2,548,283	Ion Gauge	S. Bashkin, Madison, Wis.
2,548,449	Sensitivity Modulator	H. H. Staub, Palo Alto, Calif.
2,548,452	Corona Triode Voltage Regulator	G. M. Turner, Stony Brook, N. Y.
2,549,565	Method of Fluorinating Organic Compounds With Molten Silver Fluorides.	R. G. Benner, Carneys Point, N. J.
2,549,596	Beryllium Target and Method of Manufacture.	J. G. Hamilton, San Francisco, Calif., T. M. Putnam, Oakland, Calif., and J. H. Wiens, Redwood City, Calif.
2,549,609	Separation of Fluorinated Hydrocarbons by Distillation With Hydrogen Fluoride.	K. C. Johnson, Claymont, Del.
2,549,899	Process for the Preparation of Neptunium Tetrafluoride.	S. Fried and N. R. Davidson, Sierra Madre, Calif.
2,549,988	Manufacture of Organic Fluorine Compounds	M. A. Perkins, Wilmington, Del.
2,550,445	Electrolytic Cell With Welded Anode Assembly.	A. F. Benning, R. C. McHarness, Woodstown, N J., and G. W. Feldman, and M. K. Richards, Wilmington, Del.
2,550,460	Monitoring Circuit	G. M. Farly, and D. A. Mack, Berkeley, Calif.
2,550,488	Radiation Counter	C. R. Marsh, State College, Pa.
2,550,878	Pulsing Circuit	H. H. Staub, Palo Alto, Calif.
2,551,529	Pulse Amplitude Discriminator	F. J. Davis, Washington, D. C., and L. F. Curtiss, Garrett Park, Md.
2,551,531	Radiation Counters	M. S. Freedman, Chicago, Ill.
2,551,541	Improved Vacuum Pumping Method With Mechanical Oil Sealed Pumps.	F. A. Knox, Oak Ridge, Tenn.
2,551,542	Fluorophotometer	C. R. Marsh, State College, Pa., and C. B. Pickle, Baltimore, Md.
2,551,543	Production of Uranium Peroxide	P. Mohr, Urbana, Ill.

PATENT NO.	TITLE	PATENTEE
2,551,544	Mass Spectrometer	A. C. Nier and M. G. Inghram, New York, N. Y.
2,553,217	Cyclic Organic Fluorine Compound and Method of Making.	F. B. Stilmar, Woodstown, N. J.
2,554,316	Production of Radioactive Halogens	A. F. Reid, New York, N. Y.
2,554,476	Radioactive Product and Method of Producing the Same.	L. B. Werner, Berkeley, Calif.
2,554,649	Separation of Radium from Barium	E. R. Tompkins, Berkeley, Calif.
2,554,792	Pressure Measuring Device	W. R. Perret, Vicksburg, Miss.
2,554,933	Photo-multiplier Circuit	L. F. Wouters, Oakland, Calif.
2,555,512	The Preparation of Diborane	H. I. Schlesinger, Chicago, Ill. and H. C. Brown, Detroit, Mich.
2,555,996	Valve	A. B. Pontius, New York, N. Y.
2,556,457	Pulse Width Modulation	R. J. Watts, Los Alamos, N. Mex.
2,556,768	Neutron Detector	J. L. McKibben, Madison, Wis.
2,556,921	Gold Beryllium Alloy and Method of Making Same.	H. Hirsch, Chicago, Ill. and M. Kowalchik, Rahway, N. J.
2,557,761	Flux Phase Indicator	W. M. Powell, Berkeley, Calif.
2,558,377	Preparation of Compacts of High Density Uranium Hydride.	M. L. Perlman, New Orleans, La. and S. I. Weissman, Chicago, Ill.
2,558,485	Cable Testing System and Method	J. D. Gow, San Francisco, Calif.
2,558,698	Electromagnetic Pump	E. J. Wade, Scotia, N. Y.
2,558,919	Method for Measuring Radiation of Neutrons	W. H. Zinn, Chicago, Ill.
2,559,259	Method of Making a Source of Beta Rays	J. R. Raper, Lake Geneva, Wis.
2,559,345	Casting Method and Composition	J. S. Church, Los Alamos, N. Mex. and H. R. Tyler, St. Louis, Mo.
2,559,564	Pneumatic and Air Sweep Closure	C. C. Sperling, Oak Ridge, Tenn.
2,560,166	Pulse Analyzer	W. E. Glenn, Jr., Birmingham, Ala.
2,560,167	Pulse Shaping Circuit	W. E. Glenn, Jr., Berkeley, Calif.
2,561,526	Production of Pure Ductile Vanadium from Vanadium Oxide.	R. K. McKechnie, Ballston Lake, N. Y. and A. U. Seybolt, Scotia, N. Y.
2,562,122	Preparation of Uranium Bromide	J. E. Powell, Ames, Iowa.
2,562,150	Electrical Contact for Electrolytic Cells	S. G. Osborne, Niagara Falls, N. Y.
2,562,153	Vacuum Distillation	T. I. Taylor, New York, N. Y.
2,562,159	Production of Xylene Hexafluoride	B. H. Wojcik and A. H. Mauce, Niagara Falls, N. Y.
2,562,637	Position Indicating Control Apparatus	C. W. Park, Oakland, Calif. and J. C. Kilpatrick, Berkeley Calif.
2,562,645	Electrical Scaling Circuit	B. Schloss and S. Robinson, New York, N. Y.
2,563,587	Method for Mitigating Radioactive Contamination.	J. DeMent, Portland, Oreg.
2,563,626	Ion Source	F. S. Stein, New York, N. Y., J. E. Binns, Upton, N. Y., C. R. A. Rice, Oak Ridge, Tenn and S. Bashkin, Madison, Wis.
2,563,718	Shielded Container	J. F. Gifford, Richland, Wash.
2,563,729	Method and Apparatus for Control of Boundary Between Electrolytic Fluids.	L. G. Longworth, New York, N. Y.
2,564,024	Method of Making Halocarbon Polymers	W. T. Miller, Ithaca, N. Y.
2,564,241	Extraction Process for Cerium	J. C. Warf, Los Angeles, Calif.
2,564,626	Measuring Device and Method of Measuring	A. M. McMahan, Houston, Tex. and A. H. Snell, Oak Ridge, Tenn.
2,566,052	Process for Photochemical Chlorination of Hydrocarbons.	A. Loverde and W. S. Beanblossom, Niagara Falls, N. Y.
2,566,066	Process for Photochemical Chlorination of Hydrocarbons.	A. Loverde and W. S. Beanblossom, Niagara Falls, N. Y.
2,566,665	Zirconium and Hafnium Separation Process	E. H. Huffman and L. J. Beaufait, Jr., N. Richmond, Calif.
2,566,684	Segmented Ionization Chamber	C. A. Tobias, Walnut Creek, Calif.
2,567,145	Method of Preparing Uranium Pentafluoride	C. J. Carignan, Cranston, R. I.
2,567,518	Preparation of Beryllium Nitride	A. S. Langsdorf, Jr., Chicago, Ill.
2,567,519	Pressure Monitoring Device	R. Livingston, Oak Ridge, Tenn.
2,567,661	Zirconium and Hafnium Recovery and Purification Process.	J. A. Ayres, Schenectady, N. Y.
2,567,668	Apparatus for the Measurement of Radioactivity.	J. Hecomovich, San Mateo, Calif.
2,567,759	Fluorination of High Molecular Compounds	A. F. Benning, Woodstown, N. J.
2,568,061	Rotary Shaft Driven Tapper	G. J. Evans, New York, N. Y.
2,568,642	Production of Dichlorododecafluoroheptane and Derivatives Thereof.	K. W. Krantz, Wilmington, Del.
2,568,660	Fluorination Process	R. Rosen, Elizabeth, N. J.
2,569,225	Method for Forming Uranium Monocarbide	J. H. Carter, Blacksburg, Va., and A. H. Daane, Ames, Iowa.
2,569,232	Filter	R. Delliban, Menlo Park, Calif.
2,569,644	Organic Fluorine Composition and Method of Making.	F. B. Stilmar, Woodstown, N. J.
2,569,646	Electrical Simulator	E. J. Wade, Schenectady, N. Y. and J. W Simpson, Wilkinsburg, Pa.
2,569,854	Drill Tool	A. P. Hatcher, Knoxville, Tenn.
2,570,119	Recovery of Carnotite from Its Ores	R. W. Handley, Denver, Colo. and C. W. Sawyer, Butte, Mont.
2,570,120	Process for Recovery of Pitchblende and Similar Uranium Minerals from Ores of Same by Special Flotation Practice.	R. W. Handley, Denver, Colo. and C. W. Sawyer, Butte, Mont.
2,570,435	Catalytic Vapor Phase Fluorination Apparatus.	F. B. Downing, Carney's Point, N. J. and J. B. Roberts, Wilmington, Del.

PATENT NO.	TITLE	PATENTEE
2,570,984	Ambient Pressure Responsive Clamping Means.	A. J. Reyenga, Oakland, Calif.
2,571,237	Adsorption Separation of Zirconium and Hafnium.	R. S. Hansen, Ames, Iowa.
2,571,302	Sampler for Highly Radioactive Substances	W. Q. Smith, Charleston, W. Va.
2,571,439	System for Determining Tube Characteristics	F. M. Glass, Oak Ridge, Tenn.
2,571,926	Preparation of Organic Materials	A. Murray, III, A. R. Ronzio, Los Alamos, N. Mex.
2,571,965	Process for Production of Radioactive Iron	J. A. Swartout, Oak Ridge, Tenn.
2,572,156	Process for Producing Uranium Hexachloride	F. A. Jenkins, Berkeley, Calif.
2,572,600	Mass Spectrometer	A. J. Dempster, Chicago, Ill.
2,573,069	Method and Apparatus for Measuring Strong Alpha Emitters.	E. G. Segre, Santa Fe, N. Mex.
2,573,639	Manufacture of Porous Articles from Trifluorochloroethylene Polymer.	M. A. Coler, New York, N. Y.
2,573,649	Gas Analyzer	A. O. C. Nier, Minneapolis, Minn.
2,574,268	The Manufacture of Uranium Tetrachloride	M. D. Kamen, Berkeley, Calif.
2,574,619	Process for the Preparation of Fluorocarbons	G. H. Cady, Leonia, N. J.
2,574,626	Uranium-Cobalt Alloys	A. H. Daane, Ames, Iowa and W. K. Noyce, Fayetteville, Ark.
2,574,627	Uranium-Cobalt Alloys	A. H. Daane, Ames, Iowa and W. K. Noyce, Fayetteville, Ark.
2,574,632	Radiation Detection and Measuring Apparatus and Methods.	D. W. Engelkemeir, Santa Fe, N. Mex. and N. Sugarman, Chicago, Ill.
2,574,649	Alkyl Ether of Chlorofluoroheptene	E. T. McBee and W. S. Barnhart, W. Lafayette, Ind.
2,574,655	Apparatus for Focusing High-Energy Particles	W. K. H. Panofsky and W. R. Baker, Alameda, Calif.
2,574,681	Materials and Method for Radiography	W. H. Zinn, Chicago, Ill.
2,574,841	Timing Apparatus	W. M. Powell, A. W. Hughes, Berkeley, Calif.
2,574,842	Method and Apparatus for Purifying and Packaging Uranium Hexachloride.	C. H. Prescott, Jr., Berkeley, Calif.
2,575,759	Counter Chronograph	W. A. Higinbotham, Ithaca, N. Y.
2,575,760	Preparation of Heavy Metal Borohydrides	H. R. Hoekstra, Park Forest, Ill. and J. J. Katz, Chicago, Ill.
2,576,600	A Device for Generating Neutrons	A. O. Hanson, Grand Fords, N. Dak.
2,576,601	Method of Accelerating Ions	E. E. Hays, Upton, N. Y.
2,576,616	Monitor for Fission Gases	R. Livingston and H. A. Levy, Oak Ridge, Tenn.
2,576,661	Pulse Shaping Circuit	L. F. Wouters, Oakland, Calif.
2,577,066	Pressure Measuring Device	W. A. Arnold, Oak Ridge, Tenn.
2,577,097	Method for Separation of Americium from Solutions Containing the Same.	L. B. Werner, Berkeley, Calif.
2,577,514	Method for Removal of Radioactive Contaminants.	J. DeMent, Portland, Oreg.
2,577,696	Electrical Positioning Proportional Floating Control.	T. A. Abbott, La Grange, and J. B. McMahon, Wilmette, Ill.
2,577,707	Pulse Transformer	Q. A. Kerns and W. R. Baker, Berkeley, Calif.
2,578,416	Method of Making Neptunium Chlorides	S. Fried, Chicago, Ill., and N. R. Davidson, Sierra Madre, Calif.
2,578,908	Electrostatic Generators	C. M. Turner, Richmond, Calif.
2,579,223	Regulated Power Supply	W. R. Baker, Berkeley, Calif.
2,579,225	Adjustable Support for Spectrometer Reflectors.	L. B. Borst, and R. J. Fox, Oak Ridge, Tenn.
2,579,231	Electromagnetically Operated Counter	H. D. Goldberg and M. I. Goldberg, New York, N. Y.
2,579,234	Vacuum Seal for Fluorine Generation System	D. O. Hubbard, Niagara Falls, N. Y.
2,579,235	Rectifier System	Q. A. Kerns, Berkeley, Calif.
2,579,243	Methods for the Production of Radioactive Isotopes.	A. F. Reid, New York, N. Y.
2,579,994	Neutron Density Indicator Devices	W. H. Zinn, Chicago, Ill.
2,580,349	Methods of Forming Uranium Carbide	R. W. Fisher, Ames, Iowa.
2,580,357	Apparatus for the Preparation of Metal Halides.	B. McDuffie, Princeton, N. J., A. D. Schelberg, New York, N. Y., and R. W. Thompson, Minneapolis, Minn.
2,580,358	Methods for Storing Perhaloacetyl Peroxide and Stabilized Perhaloacetyl Peroxide.	W. T. Miller, Ithaca, N. Y., A. L. Dittman, Jersey City, N. J., and S. K. Reed, Lewisburg, Pa.
2,580,360	X-Ray Shields	P. Morrison, Pittsburgh, Pa.
2,580,373	Process for Preparing Perhaloacetyl Peroxide	C. Zimmerman, Brooklyn, N. Y.
2,581,863	Process for Electrodepositing Uranium Dioxide.	M. Kahn, Berkeley, Calif.
2,582,163	Electrometers for Pocket Chambers	T. A. Rich, and J. E. Bigelow, Schenectady N. Y.
2,582,941	Processes of Producing Uranium Chlorides	C. D. Wilder, Oak Ridge, Tenn.
2,583,121	Mass Spectrometer Ion Sources	F. L. Reynolds, San Francisco, Calif.
2,583,469	Calibration Units for Cathode-Ray Tubes	M. E. Chun, Berkeley, Calif.
2,584,801	Pipe Extractor	S. L. Handforth, Wilmington, Del.
2,584,816	Electroplating Control System	M. L. Sands, Everett, Mass.
2,585,639	Compensated Electron Discharge Measuring Device.	W. C. Elmore, Springfield Township, Pa

PATENT NO.	TITLE	PATENTEE
2,585,644	Process for Producing Fluorocarbons	R. D. Fowler, W. B. Burford, III and H. C. Anderson, Baltimore, Md.
2,585,649	Reaction Comparison Apparatus	A. O. Hanson, Grand Forks, N. Dak.
2,585,679	High Voltage Regulator	J. Priedigkeit, Oakland, Calif.
2,585,702	Spectrometer	R. W. Thompson, Minneapolis, Minn. and W. T. Leland, New York, N. Y.
2,585,901	Method of Isotope Analysis	G. H. Dieke, Baltimore, Md.
2,586,027	Casting Apparatus	C. F. Gray, Baton Rouge, La.
2,586,550	Halogen-Substituted Acetyl Peroxide Catalyst for Halo-Olefin Polymerization.	W. T. Miller, Ithaca, A. L. Dittman, Schenectady, N. Y. and S. K. Reed, Lewisburg, Pa.
2,586,984	Apparatus for Governing Fluid Flow	A. O. C. Nier, Riverdale, R. B. Thorness and C. M. Stevens, New York, N. Y.
2,587,426	Pulse Forming Network	W. R. Aiken, Berkeley, Calif.
2,587,919	Electrical Apparatus for Simulating the Time Dependent Response for Characteristic of Neutronic Reactors.	H. A. Straus, Baltimore, Md., P. R. Bell, Jr. and F. H. Murray, Oak Ridge, Tenn.
2,588,041	Separation of Metal Values in Fluoride Compositions.	M. A. Perkins, and M. Couper, Wilmington, Del.
2,588,153	Method of Making Metal Hydride	A. S. Newton, Berkeley, Calif.
2,588,466	Eletrical Generator	A. H. Barnes, Downers Grove, Ill.
2,588,564	Thermoelectrically Balanced Meter Network	G. S. Pawlicki, Urbana, Ill.
2,588,734	Pretreatment of Beryllium Prior to Coating	M. Kolodney, New York, N. Y.
2,588,789	Neutron Detector	W. H. Zinn, Chicago, Ill.
2,589,391	Boron Chloride Production from an Alloy of Boron with Tantalum.	C. A. Hutchison, Jr. and J. S. Smith, New York, N. Y.
2,590,057	Half-Life Determining Method	C. E. Wiegand, Oakland, Calif.
2,590,426	Processes for Photochemical Chlorination of Hydrocarbons.	A. Loverde, Niagara Falls, N. Y.
2,590,826	Oscillator Controlled Relay Circuits	R. T. Schenck, Lower Mound Bethel Township, Pa.
2,590,925	Proportional Counter	C. J. Borkowski and E. Fairstein, Oak Ridge, Tenn.
2,591,247	Coincidence Amplifiers	H. D. Farnsworth, Berkeley, Calif.
2,591,998	Leak Detectors	W. R. Baker, Berkeley, Calif.
2,592,416	Indicating Devices for Radioactivity Intensity.	E. J. Groth, Jr., St. Louis, Mo.
2,593,948	Distributed Coincidence Circuit	C. E. Wiegand, Oakland, and O. Chamberlain, Berkeley, Calif.
2,594,618	Thermal Flowmeter	E. T. Booth, Jr. New York, N. Y.
2,594,668	Flowmeter	M. Clifford, Schenectady, N. Y.
2,594,703	Photomultiplier Tube Circuit	L. F. Wouters, Oakland, Calif.
2,594,970	Viewing Device for Radioactive Materials	G. S. Monk, Chicago, Ill.
2,594,989	Magnetic Contouring System	W. M. Powell, Berkeley, Calif.
2,595,131	Universal Manipulator for Grasping Tools	C. M. Gordon, San Pablo, Calif.
2,595,550	Radiation Counter	J. A. Simpson, Jr., Chicago, Ill.
2,595,552	Photomultiplier Coincidence Circuit	R. E. Thomas, Berkeley, Calif.
2,595,611	Ionization Gauge	K. M. Simpson, Santa Barbara, W. R. Baker, and Q. A. Kerns, Berkeley, Calif.
2,595,622	Fission Indicator	C. E. Wiegand, Oakland, Calif.
2,595,924	Quaternary Bismuth Alloy	O. N. Carlson and H. A. Wilhelm, Ames, Iowa
2,595,925	Quaternary Bismuth Alloy	O. N. Carlson and H. A. Wilhelm, Ames, Iowa
2,596,047	Uranium-Aroyl Aldehyde Complexes and Method of Making Same.	H. I. Schlesinger, Chicago, Ill., and H. C. Brown, Detroit, Mich.
2,596,080	Ionization Chamber	J. R. Raper and R. E. Zirkle, Chicago, Ill.
2,596,081	Fluorinated Compounds and Process of Producing Same.	P. E. Weimer, West Lafayette, Ind.
2,596,529	Vibration Measuring Device	H. F. Clarke, Pullman, Wash.
2,596,530	Vibration Measuring Device	H. F. Clarke, Pullman, Wash.
2,596,531	Vibration Measuring Device	H. F. Clarke, Pullman, Wash.
2,596,956	Electronic Relay Circuit	L. G. Nierman, Chicago, Ill.
2,597,535	Radioactive Assay Apparatus	E. G. Segre, Berkeley, Calif.
2,597,596	Insulator Bushing Seal	J. D. Reid, Oak Ridge, Tenn.
2,598,215	Ionization Chamber	C. J. Borkowski and R. H. Firminhac, Oak Ridge, Tenn.
2,598,283	Copolymers of Perfluoropropene & Tetrafluoroethylene and Method of Making Same.	W. T. Miller, Ithaca, N. Y.
2,598,411	Rearrangement of Saturated Halocarbons	W. T. Miller, Ithaca, N. Y. and E. W. Fager, Chicago, Ill.
2,599,156	Thermal Neutron Detector Element	H. W. Bousman, Scotia, N. Y.
2,599,166	Method of Identifying Radioactive Compounds.	A. J. Dempster, Chicago, Ill.
2,599,182	Pulse Type Transformer	Q. A. Kerns, Oakland, Calif.
2,599,188	Magnetic Peeler for Proton Synchrotron	M. S. Livingston, Belmont, Mass.
2,599,203	Preparation of Aluminum Borohydride	H. I. Schlesinger, Chicago, Ill., and C. B. Brown, Detroit, Mich.
2,599,326	Decomposition of Complex Metal Phosphate Salts.	D. M. Gruen and J. J. Katz, Chicago, Ill.
2,599,922	Monitoring of Gas for Radioactivity	W. R. Kanne, Richland, Wash.
2,599,946	Oxidation Inhibitors of U_3O_8	I. Sheft, Park Forest, Ill. and S. M. Fried, Chicago, Ill.
2,600,057	High-voltage Multiple Core Transformer	Q. A. Kerns, Berkeley, Calif.
2,600,151	Ion Producing Mechanism	J. G. Backus, Los Angeles, Calif.
2,600,172	Direct Current to Alternating Current Signal Converter.	E. E. St. John, Oak Ridge, Tenn.

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PATENT NO.	TITLE	PATENTEE
2,600,370	Uranium Borohydride & Method of Making Same.	H. I. Schlesinger, Chicago, Ill. and H. C. Brown, Detroit, Mich.
2,600,891	Vacuum System Leak Detector	S. M. MacNeille, Oak Ridge, Tenn.
2,600,936	Method and Apparatus for Measuring Low-Pressures and Related Conditions.	W. G. Stone, Oak Ridge, Tenn.
2,601,583	Radiation Measuring Instrument	C. O. Ballou, Wilmington, Del.
2,601,637	Pocket Ionization Chamber	J. E. Rose and E. W. Hinspater, Chicago, Ill.
2,602,047	Method of Concentrating Isotopic Carbon	M. Calvin and J. W. Weigl, Berkeley, Calif.
2,602,632	High-Speed Bearing and Turbine	J. T. Serduke, El Cerrito, Calif. and R. O. Webster, Los Alamos, N. Mex.
2,602,725	Method of Producing Zirconium Tetrafluoride	H. A. Wilhelm and K. A. Walsh, Ames, Iowa
2,602,871	Nickel Welding	R. A. Noland and C. T. Szymko, Chicago, Ill.
2,602,898	Ion Intensity Control Mechanism for Mass Spectrometers.	M. G. Inghram, Chicago, Ill. and B. M. Rustad, New York, N. Y.
2,602,904	Radiation Device and Method of Construction	J. A. Simpson, Jr., Chicago, Ill.
2,604,514	Ionization Gauge Regulation	H. G. Neil, Oak Ridge, Tenn.
2,604,598	Ionization Chamber for Neutron Flux Measurements.	L. W. Mead, Chicago, Ill. and F. C. Armistead, Marblehead, Mass.
2,604,612	Control Circuit	O. B. Rudolph, Oak Ridge, Tenn.
2,605,219	Preparation of Radioactive Bromine	H. Jacobson, New York, N. Y.
2,605,332	Electronic Analyzer	J. H. Parsons, Los Alamos, N. Mex.
2,605,429	Portable Radiation Survey Instrument	H. V. Herndon and R. G. Hoff, Richland, Wash.
2,605,449	Pulse Generator	G. F. Schrader, Richmond, Calif.
2,605,633	Insulator Testing Apparatus	J. D. Gow, San Francisco, Calif.
2,606,291	Method and Apparatus for Material Separation.	R. R. Wilson, Cambridge, Mass.
2,606,296	Radiation Counter	J. A. Simpson, Jr., Chicago, Ill.
2,606,573	Adjustable Venturi Assembly	W. M. Brobeck, Berkeley, Calif. and J. G. Dorward, Jr., Albany, Calif.
2,607,809	Dry Cell Assembly	E. C. Pitzer, Schenectady, N. Y.
2,608,530	Electrodeposition of Metal Salts	M. Kahn, Berkeley, Calif.
2,608,593	Fluorination Process	R. D. Fowler and H. C. Anderson, Baltimore, Md.
2,608,661	Means for Measuring Radiation	W. H. Zinn, Chicago, Ill.
2,608,855	Method and Apparatus for Measuring Tightness of Vessels.	R. B. Jacobs, Rochester, N. Y.
2,609,500	Injector Mechanism	M. D. Martin, Berkeley, Calif.
2,610,300	Flow Control	W. W. Walton, Oak Ridge, Tenn. and R. C. Bowers, Berkeley, Calif.
2,612,470	Selective Electrodeposition of Silver	J. C. Griess, Jr., Oak Ridge, Tenn. and L. B. Rogers, Cambridge, Mass.
2,612,779	Compensated Thermocouple	S. F. Mulford, Van Nuys, Calif.
2,613,235	Mega Voltmeter	C. E. Grunsky, Garden City, N. Y.
2,613,236	Voltage Measuring Apparatus	H. Palevsky, Chicago, and R. K. Swank, Urbana, Ill.
2,613,305	Welding Device	R. W. Clack, Lafayette, Calif.
2,613,327	Dosimeter	A. O. Beckman, Altadena, H. H. Herd, S. Pasadena, and A. D. Robinson, Pasadena, Calif.
2,613,344	High-Voltage Regulator	W. H. Nelson, Cadillac, Mich.
2,613,531	Diffusion Measuring Meter	C. G. Bacon, Oak Ridge, Tenn.
2,614,113	Uranium Purification As Complexes of Esters of Trifluoroacetoacetic Acid.	H. I. Schlesinger, Chicago, Ill. and H. C. Brown, Detroit, Mich.
2,614,645	Apparatus for Chemical Reaction Detection	H. A. Wilhelm, Ames, Iowa.
2,615,063	Current Measuring Device	C. J. Brown, Los Alamos, N. Mex.
2,615,129	Synchrocyclotron	E. M. McMillan, Berkeley, Calif.
2,615,135	Mass Analyzing Apparatus	W. E. Glenn, Jr., Berkeley, Calif.
2,615,349	Atomic Air Burst Direction Finder	G. A. Allard, Schenectady, N. Y.
2,615,798	Extraction of Cerium with an Organic Solvent	E. C. Pitzer, Schenectady, N. Y.
2,615,967	Time-Delay Relay Testing Device	C. B. Gould, Cleveland, Ohio.
2,616,042	Stabilizer Arrangement for Cyclotrons and the Like.	R. R. Weeks, Upton, N. Y.
2,616,052	Fast Neutron Dosimeter	G. S. Hurst, Oak Ridge, Tenn.
2,616,053	Method and Apparatus for Measuring Beam Current.	M. G. Holloway, Ithaca, N. Y.
2,616,847	Disposal of Radioactive Cations	W. S. Ginell, Levittown, N. Y.
2,617,042	Coincidence Circuit	L. F. Wouters, Oakland, Calif.
2,617,946	Radiation Detector Circuit	B. L. Weller, Richland, Wash.
2,618,750	Apparatus for Supplying Charge Material to Mass Spectrometer.	V. L. Parsegian, Brooklyn, N. Y. and C. M. S. Stevens, Chicago, Ill.
2,619,107	Fluid Flow Control System	C. B. Graham, Oak Ridge, Tenn.
2,619,552	Automatic Drift Corrector	Q. A. Kerns, Berkeley, Calif.
2,619,609	Adjustable Electrode Support	J. D. Reid, Oak Ridge, Tenn.

AEC NON-EXCLUSIVE PATENT LICENSEES

The following individuals and companies have received non-exclusive licenses to use AEC owned patents. The list includes those who acquired the licenses pursuant to the provisions of their contracts or in accordance with the Commission policy, announced in December 1949, to grant non-exclusive licenses on AEC owned patents.

LICENSEE	PATENT NO.
Aerojet Engineering Corp., Azusa, Calif.	2,543,511 2,544,472 2,545,633
Ainsworth, Merrill J., Northridge, Calif.	2,521,626 2,521,495 2,431,969
Allied Process Corp., New York, N. Y.	2,461,661 2,461,662 2,461,663 2,494,968
	2,543,511 2,544,472 2,545,633 2,555,512
Allis-Chalmers Manuf. Co., Milwaukee, Wis.	2,539,273
American Instrument Co., Silver Spring, Md.	2,555,996
Applied Physics Corp., Pasadena, Calif.	2,483,981
Astrolite Co., St. Louis, Mo.	2,513,805
Beckman, Arnold O., Inc., South Pasadena, Calif.	2,613,327
Bendix Aviation Corp., Detroit 2, Mich.	2,576,601
Beva Laboratory, Trenton 9, N. J.	2,462,935 2,483,981 2,487,510 2,486,976 2,493,137 2,500,756 2,506,431 2,506,435 2,512,538 2,529,666
Bryne Associates, Inc., New York 4, N. Y.	2,531,106
Burnham, John, Camarillo, Calif.	2,559,259
Calectron, Inc., St. Paul, Minn.	2,531,106
Canadian Radium & Uranium Corp., New York, N. Y.	2,458,632 2,465,938 2,472,365 2,474,773 2,479,271 2,479,600 2,481,506 2,481,964
Collins Radio, Cedar Rapids, Iowa	2,531,065 2,616,042
Cottingham, J. G., Center Moriches, N. Y.	2,536,808
Crane Co., Chicago, Ill.	2,465,018 2,431,732
E. I. duPont de Nemours & Co., Wilmington, Del.	2,540,248
General American Transportation Corp., New York 17, N. Y.	2,502,074
General Electric Co., Schenectady, N. Y.	2,521,634 2,476,249 2,506,944 2,599,156 2,558,698 2,582,163 2,594,668
Arthur Harris & Co., Chicago 7, Ill.	2,584,816
Harshaw Chemical Co., Cleveland, Ohio.	2,506,438
Hooker Electrochemical Co., Niagara Falls, N. Y.	2,506,438 2,422,590 2,510,864 2,510,872 2,537,777 2,540,248 2,541,190 2,544,285
Hooker Electrochemical Co., Niagara Falls, N. Y.—Continued	2,549,998 2,562,150 2,562,159 2,566,052 2,566,065 2,568,642 2,540,960 2,483,961
Industrial Nucleonics Corp., Columbus 12, Ohio.	
Kellex Corp., New York, N. Y.	2,618,750
M. W. Kellogg Co., New York, N. Y.	2,618,750 2,596,530 2,442,625 2,495,061 2,526,825 2,586,964 2,577,696 2,504,530 2,608,835 2,533,491 2,499,839 2,541,198
Klemp, William F., Co., Chicago, Ill.	2,494,641
Leavell, Moses, Waukegan, Ill.	2,596,500
Leon Sales Co., Inc., Buffalo 3, N. Y.	2,531,106
Lucidol Division Novadel-Agene Corp., Buffalo 5, N. Y.	2,580,358
Markite Co., New York, N. Y.	2,580,373 2,573,639
Massachusetts Institute of Technology, Cambridge, Mass.	2,422,590
Maywood Chemical Works, Maywood, N. J.	2,539,282
Melaire Distributing Co., New York 17, N. Y.	2,531,106 2,558,698 2,596,500
Metal Hydrides Inc., Beverly, Mass.	2,461,661 2,461,662 2,461,663 2,494,968
Microchemical Specialities Co., Berkeley 3, Calif.	2,417,392
Miller, William T., Ithaca, N. Y.	2,567,956 2,580,358 2,586,550 2,598,283 2,598,411
Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.	2,483,981 2,531,811 2,532,574 2,542,905 2,574,632 2,577,696 2,585,564 2,588,789 2,606,573
McIntyre Engineering Co., San Francisco, Calif.	2,528,415 2,528,436
McNamara, Patrick Joseph, Borman, N. D.	2,458,632 2,472,365 2,491,320 2,499,830 2,506,944 2,506,945 2,513,805 2,532,956
National Research Counsel, Cambridge 42, Mass.	2,551,541
National Research Laboratories, South Pasadena, Calif.	2,596,500 2,483,981
North American Signal Co., Hyattsville, Md.	2,513,805
Nuclear Instrument & Chemical Corp., Chicago 10, Ill.	2,605,429

LICENSEE	PATENT NO.
Nuclear Research Corp., Philadelphia 46, Pa.	2,523,892
	2,524,379
	2,524,692
	2,526,825
	2,528,436
	2,528,454
	2,535,355
	2,536,617
	2,536,808
	2,536,991
	2,538,632
	2,540,944
	2,541,198
	2,541,599
	2,541,940
	2,605,429
Nuclear Specialty Co., Center Moriches, N. Y.	2,536,808
Ohio State University Research Foundation, Columbus, Ohio.	2,501,461
Pennsylvania Salt Manuf. Co., Philadelphia 18, Pa.	2,540,248
	2,562,150
	2,594,970
Phillips, Henry W., Paducah, Ky	2,595,134
	2,595,550
	2,595,924
John B. Pierce Foundation, Raritan, N.J.	2,475,138
Radiation Counter Laboratory, Chicago 15, Ill.	2,494,267
	2,528,454
	2,606,296
Radium Chemical Co., Inc., New York 22, N. Y.	2,440,999
Scientific Service, Inc., Albany, Calif.	2,419,915
	2,423,173
	2,436,083
	2,436,084
	2,440,167
	2,442,599
	2,442,622
	2,443,365
	2,458,632
	2,476,249
	2,479,271
	2,479,600
	2,479,699
	2,485,469
	2,486,207
	2,489,028
	2,492,365
	2,500,492
	2,504,530
	2,506,419
	2,506,438
	2,507,301
	2,508,989
	2,509,669
	2,531,953
	2,532,891
	2,533,102
	2,533,149
	2,533,701
	2,535,886
	2,536,602
	2,537,775
	2,539,282
	2,539,578
	2,540,941
	2,540,944
	2,540,960
	2,541,599
	2,542,905
Shell Oil Co., Houston 1, Tex.	2,442,625
	2,452,156
	2,481,320
	2,483,981

LICENSEE	PATENT NO.
Shell Oil Co. Houston 1, Tex.—Con.	2,487,510
	2,514,116
	2,526,825
	2,528,415
	2,531,802
	2,531,811
	2,531,833
	2,558,485
	2,558,698
Alva T. Smith Co., Milwaukee 3, Wis.	2,531,106
Strat-O-Seal Manuf. Co., Chicago 47, Ill.	2,597,596
	2,600,891
Sunrise Products Co., Hawthorne, N. J.	2,442,599
	2,486,207
	2,509,669
	2,531,106
	2,550,488
	2,558,485
	2,574,841
	2,579,231
	2,579,841
	2,584,801
	2,586,027
	2,591,998
	2,595,552
	2,596,500
	2,596,956
Southern Minerals, Inc., Morgantown, N.C.	2,523,892
	2,539,282
Superior Air Products Co., Newark, N.J.	2,521,937
	2,525,197
	2,528,415
Taylor Instrument Co., Rochester, N.Y.	2,441,042
	2,441,044
	2,446,385
Taylor, John D., Lydia, S. C.	2,531,106
Tele-Vision Clock Corp. of America, Pittsburgh, Pa.	2,536,991
Tennessee Eastman Corp., Kingsport, Tenn.	2,466,118
	2,486,976
	2,489,028
	2,492,365
	2,506,431
	2,510,930
	2,514,135
	2,514,142
	2,515,159
	2,530,178
	2,531,811
	2,537,775
	2,540,941
	2,551,541
	2,554,792
	2,577,066
	2,592,416
	2,597,596
	2,600,891
	2,604,514
	2,604,612
	2,613,531
Tracerlab Inc., Boston, Mass.	2,465,886
	2,483,991
	2,601,583
Union Mines Development Corp., New York, N. Y.	2,570,119
United States Cosmetic Co., Chicago 47, Ill.	2,570,120
Vacuum Research Co., San Leandro, Calif.	2,564,024
	2,532,891
W. M. Welch Manuf. Co., Chicago 10, Ill.	2,551,544
N. Wood Counter Laboratory, Chicago 37, Ill.	2,442,314
Youngstown Welding & Engineering Co., Youngstown, Ohio.	2,602,871

APPENDIX 10

Statement by AEC on Release of Restrictions on Portions of the Wahluke Slope Lands in the State of Washington.

After many weeks of careful study and deliberation, and after obtaining the best advice available to us, we have determined to withdraw our objections to the possible irrigation of two portions of the Wahluke Slope area comprising a total of approximately 87,000 acres, including about 23,000 acres in the southeast end of the Secondary Zone, which could be served by the Potholes East Canal. We have so notified the Bureau of Reclamation.

We feel justified in making this determination on the basis of the knowledge and experience gained during 8 years of safe and successful operation of the Hanford Works, during which the safety systems of the plant have been steadily improved. We expect that these safety features will be further improved by the time actual settlement on the newly-released lands begins.

We wish to emphasize as strongly as we can, however, that our release of these lands does not mean that all risk or hazard in the operation of the Hanford Works has been eliminated, or that it will be eliminated by the additional safety measures now being taken.

The facts are as follows:

1. There is no risk of hazard in the so-called Secondary Zone of the Wahluke Slope resulting from normal operation of the Hanford plant.
2. There is a risk of hazard in the entire Wahluke Slope area and for many miles beyond in the event of a major accident or disaster at the Hanford plant. As the distance from the plant increases, the danger becomes less. In the newly-released lands, however, the risk in the event of a major disaster continues to be very great.
3. The real danger in the operation of the Hanford plant exists in the remote possibility that one or more of the nuclear chain reacting piles in which plutonium is produced may go out of control. If any of these reactors goes completely out of control, and this is highly unlikely, dangerous amounts of radioactivity may be released to the atmosphere. The reactors cannot explode, like an atomic bomb, but, under the worst possible conditions, they could produce so much heat that the fuel elements would melt, thus releasing a very dense and highly radioactive cloud—more dangerous than the cloud produced by an atomic bomb explosion.
4. Depending upon weather conditions and wind direction, it is probable that such a cloud would pass at low altitude over part of the Wahluke Slope. If it did so, it would emit very dangerous radiations that could cause severe injury or death. These radiations—mostly gamma rays—would be similar to those released by an atomic bomb detonation. Like X-rays, they cannot be seen, heard, or felt. They can, however, be detected by the use of instruments.
5. In the event of such a disaster, it is very likely that extremely small, highly-radioactive particles of matter—too minute to see—would be deposited by this cloud as it passed over an area. These particles—mainly plutonium and fission products—if inhaled or swallowed by humans or animals, could produce severe injury and possibly death. Any rainfall coming from the cloud would contain concentrations of these particles. In the absence

of rainfall, the fallout of particles from the cloud would probably be heaviest in the immediate vicinity of the pile, becoming increasingly less dangerous as the distance from the pile increased.

The chance a major accident or disaster occurring in one or both of the Hanford piles is small. These are safety devices, both automatic and manual, that are designed to shut the pile reaction down if it starts to go out of control. Additional safety devices are now being incorporated. But there always remains the small chance that all of these safety devices might fail simultaneously, or simultaneously be put out of commission by a natural disaster, such as an earthquake, or by human action as enemy attack or sabotage.

In the light of these sobering facts, we have very carefully considered our moral and legal responsibilities in regard to the Wahluke Slope. These we have concluded to be as follows:

1. To operate the Hanford plant as safely as possible.
2. To forewarn the public of the hazard involved in settling on the Wahluke Slope.
3. If adequately forewarned, to permit the public to take the calculated risk of settling in those parts of the Slope where there would be an opportunity to escape without injury in the event of a major Hanford disaster.
4. To prevent the public from settling in those parts of the Slope where there would not appear to be an adequate opportunity to escape without injury in the event of disaster.
5. To establish a method for warning Wahluke Slope residents in the event of disaster, and to encourage and assist in the development of an adequate evacuation plan.
6. To undertake a public educational campaign to explain the nature of the hazard at Hanford, for the benefit of those who will settle in the newly-released lands, where the potential danger is greatest, and also for the benefit of others in the region who might also be in danger in the event of a disaster.

In accordance with this evaluation of our responsibilities, we have determined that the public must continue to be prevented from residing or working farms in those parts of the Wahluke Slope not included in the lands released by our action today. This area must remain in a restricted category for the reason that persons living or working there might not have an adequate opportunity, from the standpoint of time, to escape without injury in case of a Hanford disaster.

Also, in accordance with our evaluation of our responsibilities, we have asked our Manager of Operations at Hanford, Mr. David F. Shaw, to undertake as soon as possible a public educational campaign to acquaint those who will settle in the released lands with the real nature of the risk involved. We have asked Mr. Shaw to extend this campaign to include all areas in which a substantial risk to health or property might exist in the event of a catastrophe at the Hanford reactors.

We also consider it to be our duty to discourage any concentration of population, in towns or cities, anywhere within a 25-mile radius of the Hanford production area. To permit such concentrations would inevitably make evacuation a harder task, and would also increase the magnitude of any calamity that might result from a failure in the warning of evacuation plans.

We are continuing our studies on the development of improved safety features, and if, as a result of this work, the risk inherent in the Hanford operation is further reduced or eliminated, we shall in the future consider a further reduction in the Secondary Zone area from which farm residents must be excluded. We have concluded, however, for reasons of both safety and security, that the lands currently included in the so-called Control Zone should be incorporated permanently within the Hanford reservation boundaries. We have asked Mr. Shaw to carry this out.

The considerations which apply at Hanford are not the same as those affecting the area surrounding other reactor installations, since the Hanford reactors are unique in design, construction, and operations. Potential hazards in case of catastrophe at other reactor locations are not so great.

We are most grateful to the members of the Industrial Committee on Reactor Locating Problems, upon whose advice we have relied to a large extent in reaching our decisions; and to the members of the Reactor Safeguard Committee with whom the Industrial Committee consulted in their studies.

(The members of the Industrial Committee on Reactor Location Problems are listed in Appendix 2.)