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Progress Report to the Joint Committee on Atomic Energy

JUNE THROUGH NOVEMBER 1953

UNITED STATES ATOMIC ENERGY COMMISSION

WASHINGTON, D. C.

DECEMBER 24, 1953

~~TOP SECRET~~

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PROGRESS REPORT OF THE

United States Atomic Energy Commission

JUNE THROUGH NOVEMBER 1953

PREPARED FOR THE

JOINT COMMITTEE ON ATOMIC ENERGY

OF THE UNITED STATES CONGRESS

DECEMBER 24, 1953

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON 25, D. C.

Honorable W. Sterling Cole
Chairman, Joint Committee on
Atomic Energy
Congress of the United States

Dear Mr. Cole:

This seventeenth Progress Report of the United States Atomic Energy Commission for the period June through November 1953 is submitted in accordance with the Joint Committee's request of July 23, 1947. As has been the practice over the last six years, we have outlined in this report the Commission's major objectives and the measures being taken to achieve them.

The past six months have been a period of major change in Commission personnel. Two Commissioners, including the undersigned, were appointed and confirmed during the summer, and the new General Manager assumed his duties on November 1.

As in the past we are submitting the report as two separate documents in order to facilitate the safeguarding of information on the weapons program.

Sincerely yours,

Lewis L. Strauss
Chairman

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON 25, D. C.

December 16, 1953

Mr. Lewis L. Strauss
Chairman, United States
Atomic Energy Commission

My dear Mr. Strauss:

Submitted herewith is a report of progress in the activities of the U. S. Atomic Energy Commission during the period June through November 1953.

Respectfully submitted,

K. D. Nichols

K. D. Nichols
General Manager

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*Transmitted as separate document.

PART VI

Biology and Medicine

(UNCLASSIFIED)

The underlying objectives of the biology and medicine program are to protect man and his resources against the hazards of radioactive and toxic by-products of atomic energy and to exploit the beneficial aspects of atomic energy by controlling and applying radiation to the treatment of disease and to the improvement of the nation's sources of food. This issue of the Progress Report devotes special attention to weapon test activities and to selected recent accomplishments in research. It supplements the unclassified statement to be included in the forthcoming semiannual report to the Congress. (End of UNCLASSIFIED section.)

WEAPONS TEST ACTIVITIES

Investigation of Radiation Effects on Livestock ([redacted])

After the spring 1953 test series at Nevada, March 17–June 4, livestock owners reported that horses, cattle, and sheep which had grazed on ranges adjacent to the Proving Ground appeared to have been injured as a result of radioactive fall-out from the test shots. The claims were examined by specialists of the Commission, U. S. Public Health Service, and the Department of Agriculture in cooperation with representatives of several educational institutions. Laboratory experiments, post-mortem examinations, and studies of range conditions were made. Present findings are as follows:

a. Of 21 head of horses grazing about eight miles from the test site, five showed no evidence of radiation injury but 16 had skin lesions over the back comparable with typical beta burns. The Commission recognizes that the injuries were apparently caused by fall-out of radioactive particles, and arrangements are being made to compensate the livestock owners.

b. Out of a group of several hundred head of cattle that had been on winter range adjacent to the test site until June 1, eight head died and the owners believed radiation may have been a contributory cause. Inspection of the remaining herd and the condition of the range in June indicated that a large number of the cattle were in a state of malnutrition due to lack of range forage and drought. Hematological and pathological studies were made; no evidence of beta burns was found, and no significant amounts of radioactivity were present in the tissues or bones. The cattle owners have been notified that radiation injury could not have been a contributing cause of death.

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c. Herds of sheep wintered north of the Proving Ground experienced heavy losses (up to 30 per cent for lambs and 20 per cent for mature sheep) during April and May 1953 after the herds were removed to Cedar City, Utah, for summer grazing. Deaths during this period were estimated by the sheep owners to be as much as several thousand head. Radiological examinations were made, and while no evidence was found to account for the abnormal losses, present findings indicate the test activities did not contribute to the heavy losses. As a matter of scientific interest, however, the AEC is continuing its investigations to determine, if possible, the causes of the abnormal death rate. Also, Los Alamos Scientific Laboratory and Oak Ridge National Laboratory will give emphasis to existing research projects in the production and study of beta burns in sheep. (End of section for [redacted].)

Civil Effects Test Program–Operation UPSHOT-KNOTHOLE [redacted]

The civil effects test studies undertaken during the spring 1953 continental test series were designed to (1) develop data which could be used to improve the probability of survival and continuity of production in the event of an atomic attack; and (2) make further evaluations of the effects of neutrons and gamma rays on biological systems. The civil effects program was a cooperative research undertaking in which several government agencies such as the Federal Civil Defense Administration, Food and Drug Administration, Naval Medical Research Institute, and the Naval Radiological Defense Laboratory, actively participated. The studies comprised eight programs, 36 projects, and 114 project participations. Investigations in the areas of genetics and biological experiments will require a year or more for complete evaluation. Results obtained in certain projects are summarized below.

Structure tests demonstrated that blast pressures of less than six pounds per square inch will demolish a new typical frame-residence and less than two pounds per square inch will render it uninhabitable with a 50 per cent loss of the structure. Inexpensive wood basement-shelters provided reasonable protection against debris load from collapsing frame-residences. Reinforced concrete and masonry home-type shelters with about three feet of earth cover structurally resisted the overpressures of a 16.3 KT explosion as close as 1250 feet. Group shelters that could accommodate 50 persons resisted the same effects structurally and gave protection against thermal and ionizing radiation. The shelters were constructed with reinforced concrete pipe or corrugated metal pipe of seven feet six inches inside diameter and had three feet of earth cover. The biological damage from blast-generated overpressures inside the shelters has not yet been determined.

Radiological defense training of about 20 state radiological officers, under full security clearances, continued through two detonations. These groups are now conducting instruction in unclassified training to civil defense personnel at state and community levels.

Biomedical and dosimetry experiments on the effects of ionizing radiation showed that, under the conditions of Shots 1 and 8, the neutron and gamma exposures inside the shelters were within permissible limits. Using fission detectors and other methods, significant measurements were obtained in the low and medium energy ranges of neutrons. This program also provided valuable data for comparing physical and biological dosimetry.

Civilian Vehicles. Of the 60 civilian vehicles exposed to a number of detonations, the hazard of fire was insignificant from a tower shot but important from an air burst. Sheet metal parts were vulnerable to pressures as low as one pound per square inch. Mechanically, the vehicles were highly resistant to blast effects. For personnel inside the vehicles, thermal hazards would be markedly reduced, although ionizing radiation effects would not be altered by the vehicle. Blast and displacement would probably remain as the greatest hazard. (End of [redacted] section.)

[redacted]

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Structures Test Planning ([redacted])

The Committee on Structures Test Planning and Screening* has examined the status of the test reports resulting from the civil effects test program mentioned above, has determined the status of test items proposed but not included in the last test series, and has evaluated civilian agency requirements for data to be secured in possible future tests. Estimating the probable effects of atomic aerial attack on water supply and piping, office buildings, hospitals, and residences is the primary future requirement. Important also are the incidence and spread of fire, possible contamination of plants through blast pressure on ventilating systems, and development of data on the adequacy of entrances to group shelters. However, there are at present no plans for another continental civil test series in the near future. (End of [redacted] section.)

Project GABRIEL ([redacted])

Project GABRIEL,† begun in 1949, is the study of the probable behavior, with particular reference to the effects on inhabitants of certain regions, of the fall-out of radioactive materials from the use of nuclear weapons in warfare. Depending upon the conditions under which such weapons are used, the major interest may lie in the short-range contamination from the use of a single weapon, or in the long-range problem of estimating probable hazards to the populations of major areas from the use of large numbers of weapons.

The Rand Corporation, selected in 1952 to make independent studies of these questions, has directed its efforts toward two phases: (1) securing a critical review of the subject by a conference of qualified persons in related specialties, held in July 1953 (a classified report on this review has been completed under the name "Project SUNSHINE"); and (2) predicting probable fall-out from high air bursts of varying yields under varying meteorological conditions (a report on this phase is expected early in 1954).

As a result of recommendations formulated at the conference in July, the Commission has begun exploratory sampling program of the occurrence of strontium 90 in humans, animals, milk, vegetation, and soils from selected areas in the United States and from several foreign countries. Samples are being obtained by the Bureau of Plant Industry, U. S. Department of Agriculture, and through hospital channels. Assays of sample materials are being made in laboratories of the University of Chicago, Columbia University, and the AEC New York Operations Office.

Although a reliable estimate of the present distribution of strontium 90 will represent a substantial contribution to Gabriel, additional information is needed to permit reliable estimates of changes in availability for human uptake as a function of time and of biological effects as a function of dose and of dose rate. Studies of radiotoxicity have continually constituted an important phase of the research program of the AEC, but at present, aspects of particular interest to Gabriel are being augmented and emphasized. (End of [redacted] section.)

RESEARCH ACCOMPLISHMENTS (UNCLASSIFIED)

Research studies in biology, medicine, and biophysics are directed toward advancing knowledge of the effects of radiation on living systems and the application of this knowledge

*For membership see Progress Report, December 1951 through May 1952, dated June 16, 1952, page 46.

†See letter to the Joint Committee dated November 12, 1953.

[redacted]

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to the prevention or reversal of toxic actions on living organisms. Data derived from these studies are examined to establish maximum permissible levels of exposure for man and laboratory animals and to provide a basis for the prediction of biological damage in cells and tissues after a given exposure. Such studies are important not only for recognition and evaluation of radiation damage but also for the development of therapeutic and diagnostic applications in the treatment of diseased cells and tissues. Only a few examples of these investigations can be reported here.

Effects of X Rays on Frog Retina

The University of California Radiation Laboratory, Berkeley, has completed a study of the effect of X rays on animal retina, particularly the retinal response of bull frogs to small doses of X rays to determine adaptation and recovery. It was found that an electrical response could be measured on the retina after an exposure of as little as 0.6 roentgens, that during exposure to X rays the sensitivity to light was reduced, and that the retina recovered less rapidly after X ray stimulus than after light stimulus. The recovery of the retina to penetrating radiations indicates that the effect is to a large extent reversible.

Biological Effects of Radiation

Los Alamos Scientific Laboratory has been experimenting to determine the biological effects in mice of whole body X radiation. Pretreatment of mice with p-aminopropiophenone (an agent producing a pronounced deficiency in oxygen) or glutathione exerted a marked protective effect against whole body X radiation. But a negligible degree of protection was found when mice so pretreated were exposed to radiation from the thermal column of a reactor (thermal neutrons plus gamma contaminant). Thus, it appears that agents which are protective against one type of ionizing radiation may not be of value against all types.

Radiation Effects on Mortality

The effects of whole body irradiation of male rats on mortality among their offspring is being studied by an AEC-University of Tennessee research group. Male rats were exposed to 300 roentgens of gamma rays from a cobalt 60 source, or to X rays from a 250 kilovolt machine. The irradiated males were mated to virgin females. The pregnant females were sacrificed, and it was found that the fetal death rate showed an increase in comparison with nonirradiated control rats. The fetal mortality rate for the various groups was: control group, 6.46 per cent; gamma-ray exposure, 19.37 per cent; and X rays (250 kv), 19.92 per cent.

After 60 days the same male animals were used in repeating the breeding test. The values obtained after sacrifice of the second group of pregnant females were 7.39 per cent for gamma exposure and 8.19 per cent for X rays. The decrease in fetal mortality rate between the first test and the second test of the irradiated males indicates that there is a period of recovery, and that the initial high mortality rate may be due to dominant lethal mutations induced during exposure in the more mature testis cells.

Prevention of Tumors Following Irradiation

For several years research has been proceeding on the role of the spleen as a protective organ in preventing radiation injury. Recent work at Argonne National Laboratory has indicated that a considerable degree of protection is provided against subsequent development of lymphoid tumors when the spleens of mice are shielded during irradiation.

With the dose used (225 roentgens repeated weekly for 4 weeks), the tumor incidence was 70 per cent in the unprotected group, but only about 3 per cent in the group with spleen shielding. The course of changes in the circulating lymphocytes in the unprotected mice indicated that the prolonged depression of the activity of bone marrow and lymphatic tissue was a probable factor in bringing about the lymphoid tumors.

Clinical Studies of Radioactive Materials

Investigations at Argonne National Laboratory and at Argonne Cancer Research Hospital have shown that total body radiation results in a large outpouring of amino acids in the urine. Continuing study of this radiation effect in humans and experimental animals will be directed toward explanation of the mechanism and its relation to protein synthesis and catabolism.

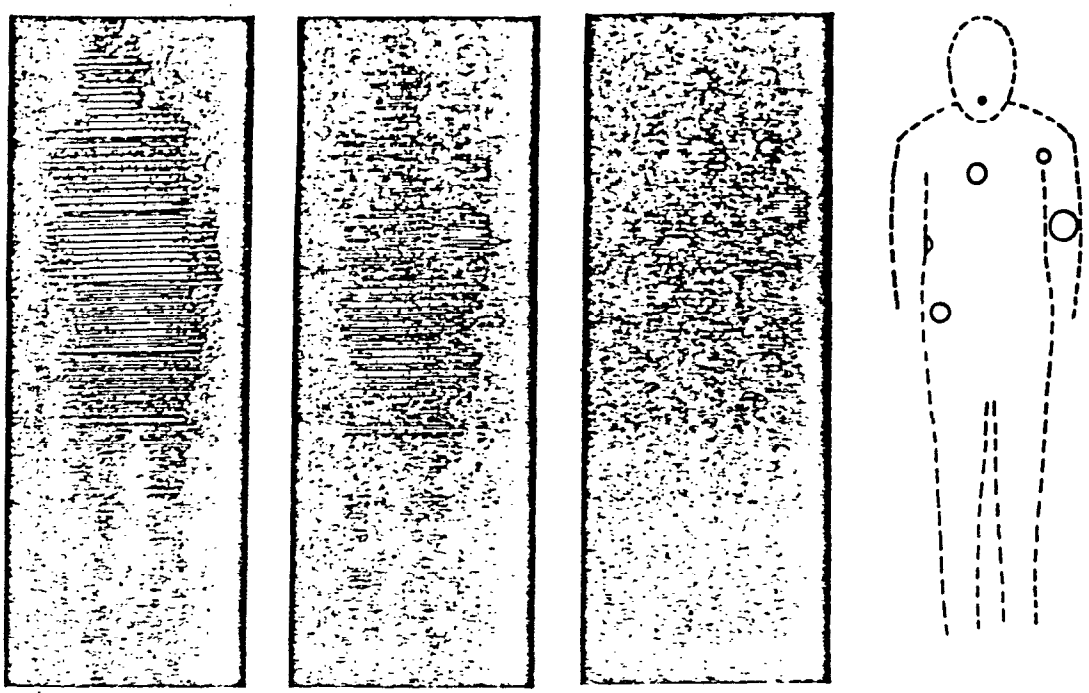
In cooperation with Stateville Penitentiary, near Argonne National Laboratory, a study is being made of the rate at which radium is deposited in the body from natural drinking water and food which contain small amounts of radium. Drinking water at Stateville and in many towns around Chicago, comes from deep wells and contains more of this rare element than occurs where the city water supply comes from Lake Michigan or shallow wells. The amount is only a small fraction of that considered unsafe for lifetime consumption, but is enough to make significant measurements possible. Radium gives off radon as one of its daughter products. Hence, when the breath of volunteer prisoners at Stateville is sampled and measured for radon, one can determine the amount of radium present in the skeletons of the volunteers. The individuals are also being measured for gamma radiation by scintillation counting devices.

New-type Scanners for Detection of Diseased Tissues

New types of scintillation counter scanners have been developed at the University of California Radiation Laboratory (Berkeley) for locating and following the path of gamma-emitting tracers administered to patients and laboratory animals. One type used for diagnostic work in humans is a pinhole gamma-ray camera which detects and locates accurately microcurie amounts of gamma emitters. The practicality of using such small amounts in tracer studies is helpful in that the hazards to healthy tissues are reduced. The pinhole camera scanner consists of a scintillation detector, image amplifier similar to that used in television, and a fluorescent viewing screen or photographic film. The equipment is also adaptable to any field where accurate location of one or many beta-gamma emitters is desired, for example, making a gamma-ray photograph of radioactivity resulting from an accident in a laboratory, or in an area where radioactive fall-out may have occurred.

A second type of scanner recently developed can be used in both tracer research and clinical diagnosis. It includes ten adjacent directional scintillation counters which move simultaneously in parallel lines, and thus the scanning procedure is completed in one-tenth of the time previously necessary. The scanner has proved useful in locating residual thyroid tissue (with iodine 131 as a tracer), and to show the size and shape of the liver and spleen (using gold 198). With this instrument slight abnormalities barely visible on an X-ray plate can be identified with relative certainty as metastatic thyroid lesions. In Figure VI-A, an example is shown of a gamma-ray image of a thyroid carcinoma patient with six metastases. Radioiodine was used as a tracer. By the scanning procedure, an image of the patient is formed as a pattern of dots, each of which represents a degree of radioactivity. Thyroid cancer growths can thus be detected, and where it is advisable surgery may be performed. (End of UNCLASSIFIED section.)

CANCER DETECTION WITH NEW-TYPE SCANNER...



1 HOUR *Radioiodine in blood stream gives off radiations from all parts of the body.*

48 HOURS *Radioiodine begins to concentrate in tissues of patient.*

96 HOURS *Radioiodine is concentrated almost completely in thyroid cancer growths in diverse parts of the body.*

FINAL: Schematic drawing showing exact location of six thyroid metastases.

Fig. VI-A — Concentrations of radioiodine in thyroid cancer growths in patient at intervals after administration of tracer.

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PARTIAL DOCUMENT RECORD SHEET

Parts of this document were judged irrelevant to the CIC collection effort and were not copied:

Pages Part I (pgs. 7-20), Part II (pgs. 21-34), part III (pgs 35-36)

~~Enclosures~~ Part IV (pgs 37-46), Part V (pgs. 47-52)

~~Attachments~~ Appendix A (pgs. 59-83)

Other _____

DOE ARCHIVES

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L. Tench
signature

10/2/85
date

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