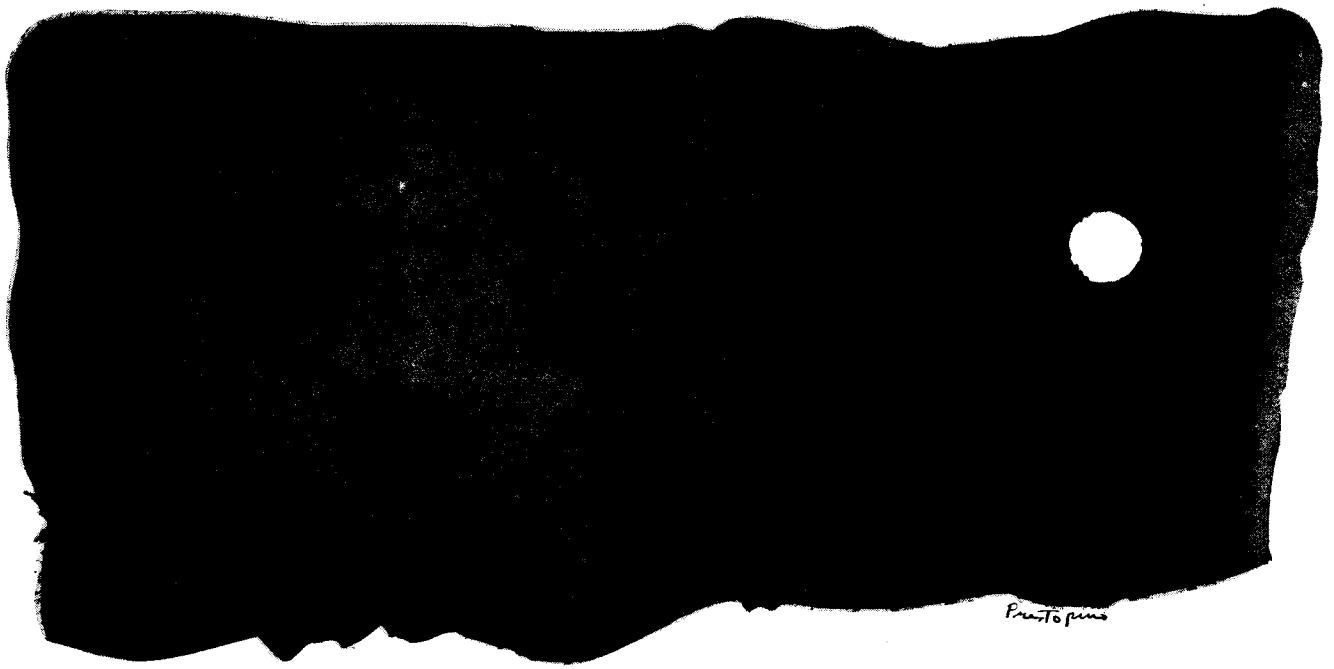
A SPECIAL REPORT



A Primer on Fallout

WALTER SCHNEIR

THE NATION'S PRESS gave surprisingly meager coverage to the second Congressional fallout hearings that were held in Washington from May 5 to May 8. The New York *Times*, for example, devoted only three inside-page stories to the testimony that was given before Representative Chet Holifield's Special Subcommittee on Radiation of the Joint Congressional Committee on Atomic Energy; a fourth story headlined STUDY MINIMIZES FALL-OUT DANGER (carried on page 1 and exceeding in length the other three combined) gave details of a reassuring report that was released during the hearings by the Atomic Energy Commission's General Advisory Committee.

The coverage in most other papers was even poorer than that in the *Times*. One noteworthy exception, the New York *Daily News*, carried a concise two-part roundup of the hearings several days after they ended instead of attempting to cover them as "spot news." But in general the press has all but ignored the most complete summary of the fallout situation currently available.

Pre-Hearing Chronology

The sparse press coverage was particularly unfortunate in that it came after several months of rising public concern and confusion, generated by these events:

February 27: Dr. Willard F. Libby of the Atomic Energy Commission told the Joint Committee on Atomic Energy: "The strontium-90 content of wheat is a matter of real concern to us. . . . occasionally samples are found which exceed the levels which are generally acceptable for a steady diet. Actually, of course, the general average food level is the important matter and we can say that this level is well below the maximum permissible level as given by the National Committee on Radiation Protection."

March: *Consumer Reports* magazine conducted its own tests of the strontium-90 in milk in forty-eight American and two Canadian cities. The AEC has been testing milk with some degree of thoroughness in only four American cities, the Public Health Service in ten. The magazine reported widely varying levels of strontium-90 in milk, ranging from 1.9 to 15.6 strontium units (S.U.). (A strontium unit is equal to one micromicrocurie of strontium-90 per gram of calcium.) The article recommended an expanded milk-sampling program and transfer of the biologic research activities of the AEC to the Public Health Service. It concluded: "We can surmise that we still are not heavily dosed, but we also can be sure that there have been unattributed individual tragedies caused to persons by fallout."

March 13: Dr. Libby (in a speech

delivered for him in Seattle) stated once again that radioactive debris takes five to ten years to fall out of the stratosphere. He thus maintained his position on the stratospheric residence time of fallout in the face of growing opposition from other scientists, some of whom had been insisting for several years that fallout was coming down much faster than Dr. Libby had predicted.

March 21: Senator Clinton P. Anderson (D., New Mexico), chairman of the Joint Committee on Atomic Energy, forced release of two previously classified letters written by Dr. Libby and Major General Herbert B. Loper of the Defense Department. In his letter of February 19, 1959, to Senator Anderson, General Loper noted that the Defense Department had learned two new facts about fallout: that it is descending from the stratosphere in an average of three years (much faster than the five- to ten-year figure the AEC had been using), and that it is not being deposited uniformly throughout the world (as the AEC had also contended), but is coming down most heavily in a latitude band that includes large parts of the United States.

In his reply to General Loper on February 27, Dr. Libby conceded that the rate of fallout was faster than he had previously indicated. He promised to use a new figure for fallout time in his Seattle speech on March 13. But the figure used by Dr. Libby in that speech was the old one: five to ten years.

Senator Anderson criticized both the Defense Department and the AEC for trying to keep these letters secret. He noted further: "This new data [in General Loper's letter] appears to further contradict the official doctrine of AEC spokesmen as to residence time of fallout in the atmosphere and the theory that stratospheric fallout tends to drip out uniformly throughout the earth. The AEC letter of February 27, 1959 [written by Libby], ought to be checked for consistency with the speech of the same AEC spokesman on March 13, 1959, in Seattle.

"The Joint Committee will look into these matters when it holds its fallout hearings in May of this year under the chairmanship of Congressman Chet Holifield . . ."

March 23: Senators Anderson and Humphrey accused the AEC of withholding and "playing down" information on fallout.

March 24: John A. McCone, AEC chairman, denied that there had been any attempt on the part of the

AEC to suppress or modify fallout information. He announced that the AEC's General Advisory Committee, a scientific group appointed by the President, would hold a two-day meeting to review the entire subject.

March 25: President Eisenhower announced that the National Academy of Sciences would update its three-year-old study of radiation hazards. He commented: "To my knowledge, there has been no suppression of information . . ."

March 26: The Surgeon General's National Advisory Committee on Radiation, headed by Dr. Russell H. Morgan of Johns Hopkins, recommended immediate transfer of all research and control programs relating to health from the AEC to the PHS. Dr. Morgan said that it was administratively unwise to vest authority for determining the effects of radiation on human health in the AEC, whose primary mission is the development of new uses of atomic energy. He also questioned as misleading the use of the term "maximum permissible concentration" to signify a "safe" level of radiation, adding, "there is no such thing as a safe level of radiation."

April 1: Dr. John T. Gentry reported in the *American Journal of Public Health* that the incidence of malformed births is highest in those areas of New York State with the highest levels of natural background radiation from rocks and drinking water. Dr. Gentry's study was regarded by many scientists as an important pioneer effort aimed at more precise knowledge of the harmful genetic effects to human beings of small doses of radiation received over a long period.

April 10: Legislation to centralize all U.S. radiation and fallout protection programs under the PHS was introduced in Congress by Senator Lister Hill and Representative Kenneth A. Roberts.

April 20: The White House made public a letter sent on April 13 by President Eisenhower to Premier Khrushchev, appealing for a limited agreement to ban nuclear-weapons tests on the earth's surface and in the atmosphere to an altitude of fifty kilometers (approximately thirty-one miles). The President noted that "our negotiators could continue to explore with new hope the political and technical problems involved in extending the agreement . . . to cover all nuclear weapons testing. Meanwhile, fears of unrestricted resumption of nuclear weapons testing with attendant additions to levels of radioactivity would be allayed . . ."

April 20: The *Nation* magazine published details from an unpublished AEC-sponsored study by three scientists at Lamont Geological Laboratory, showing that the average level of strontium-90 in the bones of American children from birth to four years doubled during 1957 (from 0.67 S.U. to 1.38 S.U.) with highest concentrations found in bones of one- and two-year-olds.

April 22: The National Committee on Radiation Protection and Measurements released a summary of data from a then unpublished booklet containing the latest recommended Maximum Permissible Concentrations (MPC) of various radioactive substances for industrial workers in atomic plants. The industrial MPC for strontium-90 was raised from 1,000 S.U. to 2,000 S.U., causing many to jump to the erroneous conclusion that the MPC for the general population had also been doubled.

May 5: On the day the fallout hearings opened, AEC Chairman McCone told the National Press

Club that the findings of the AEC's General Advisory Committee would be released soon and would "give further reassurance to the people of the world about the very small hazard resulting from fallout."

Areas of Agreement

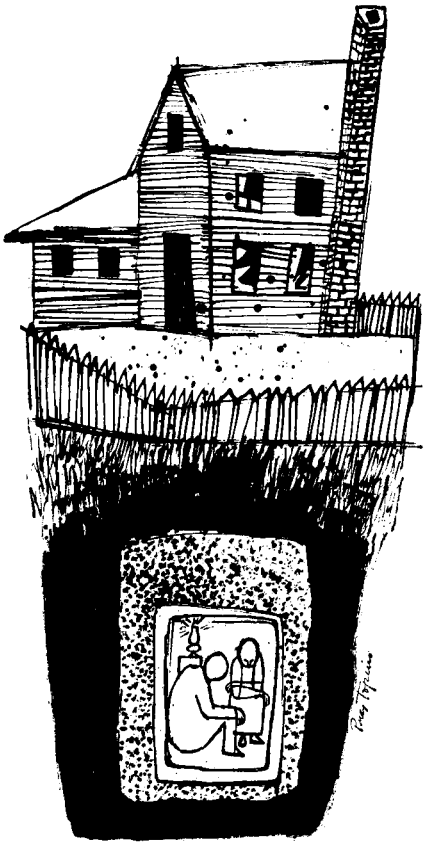
After so many statements and counterstatements, perhaps the most astonishing fact about the fallout hearings was the almost unbroken calm of the proceedings. Some observers ascribed this to the conciliatory attitude displayed by Holifield and most other members of the committee toward the AEC and its representatives. Contrary to expectations, scarcely a word of criticism was heard of any of the AEC's programs or policies.

Another important reason for the absence of controversy at the hearings was the consensus among most of the scientific witnesses on the principal facts of fallout. They all agreed that **fallout is descending three or four times faster than had been predicted by Dr. Libby and the AEC,** and that it is coming down most heavily in a broad latitude band that includes the northern United States and large parts of Europe, the Orient, and probably the Soviet Union. Radioactive debris from Soviet tests held in the Arctic appears to be falling out fastest of all. We are now harvesting the fruits of last year's tremendous testing programs by the nuclear powers: the spring-summer rains in many parts of the world (including the United States) contain the heaviest burden of strontium-90 and other radioactive fallout products since atomic and hydrogen bomb tests began. Inasmuch as all radioactive atoms burn up or decay at a steady rate, fallout that comes out of the stratosphere rapidly is relatively "hot"; i.e., it still retains most of its energy.

Other areas of agreement were:

¶ Everywhere on earth today the soil contains measurable quantities of strontium-90 and cesium-137 from nuclear tests. As fallout from past tests continues to come down, **the average amount of strontium-90 and cesium-137 now on the ground will be doubled by 1962-1965.** Actually, the use of averages can be misleading. For example, the average amount of fallout per square mile predicted for the entire United States by 1962-1965 has already been reached and surpassed in many "hot spot" areas in the North Central States and Hawaii.

¶ As the amount of strontium-90 in the soil increases, the levels of this radioactive element will also rise steadily in all foods and in human and animal bone. A few years from now, the diet of most of the world's population will contain far more strontium-90 than it does today. By 1967 or earlier, the average amount of strontium-90 concentrated in the bones of infants and young children fed on this diet will have multiplied nearly sixfold over the bone levels detected in December, 1957. Furthermore, in the United States a good many children in the North Central area will have bone concentrations of strontium-90



three and four times the average. In the Orient, where the diet of millions is largely vegetarian, bone concentrations will be significantly higher than in the West and some youngsters will probably have from 50 to 100 S.U.

¶ From tests conducted to date, a small percentage of the world's total population will have bone concentrations of strontium-90 exceeding the so-called maximum permissible concentration. If tests are continued at the same pace as those of last year, the number of people having a strontium-90 concentration exceeding the MPC will rise steadily each year; in about twenty years everyone in the world would exceed the MPC and many people would exceed it by a great deal.

What Should A Man Believe?

The much-debated subject of how long fallout stays up in the stratosphere did not provoke any arguments among scientists at the hearings, because everyone, including Dr. Libby, was willing to agree that it is coming down much faster than had been expected. (No one asked Dr. Libby about the discrepancies between his letter to General Loper and his Seattle speech.) Senator Anderson, who was occupied with the Strauss hearings and so was not present for most of the fallout hearings, provided one of the few sharp exchanges when, on the second day, he bridled at the explanation by Merril Eisenbud of the AEC that faster fallout means ultimately *less* strontium-90 in the bones of human beings.

SENATOR ANDERSON: *Mr. Eisenbud, we had some testimony at one time about how good it was that it stayed up there, and it came down gradually. Now we get testimony about how good it is that it comes down fast and does not stay up very long. What should a man believe, in your opinion?*

MR. EISENBUD: *You mean with respect to this particular question?*

SENATOR ANDERSON: *Yes. One time it is good because it stays up for ten years. That is wonderful. The next time it is good because it comes down in two years, that is wonderful. Which would you believe if it were your place?*

MR. EISENBUD: *I have been asked to summarize what the panel submitted yesterday.*

SENATOR ANDERSON: *I asked you what you thought, Mr. Eisenbud.*

MR. EISENBUD: *I think it has been*

clear from the very beginning that the stratospheric residence-time is short in relation to the radiological half-life [twenty-eight years] of strontium-90. This means that for purposes of computation one can neglect the residence-time and simply assume that it is all going to come down. Everything that goes up has to come down.

SENATOR ANDERSON: *Now you are on a physics law that I can understand. What goes up must come down. Does that apply also to these claims about how it does no damage . . . ?*

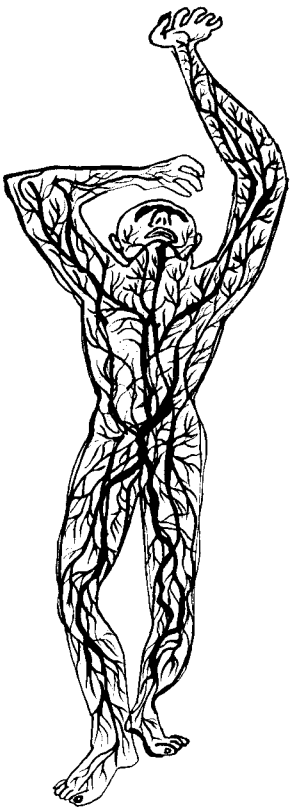
How Many Will Die?

No one knows the exact number of casualties that the increasing level of fallout will cause, but everyone agrees that **there will be casualties. Genetic casualties are the most certain.** Any radiation that strikes the germinal cells in the male testes and the female ovaries induces irreversible changes or mutations in the genes. These mutations are almost all harmful and increase the incidence of embryonic deaths, stillbirths, and various physical abnormalities and diseases. Dr. James Crow, a geneticist from the University of Wisconsin, summarized the hazard thus:

With present levels of fallout the amount of genetic damage from this source is such as to cause an extremely minute fraction of the total human death, disease, and misery. The effect is almost certain not to be detectable by any foreseeable measurement.

Yet the number of persons exposed to fallout is as large as the world population, and, therefore, it is likely that tens or hundreds of thousands or more persons will be diseased, or deformed, or die prematurely, or be otherwise impaired if the present rates continue.

Dr. Crow's statement may be compared with one released to newspapers by the AEC and the Department of Defense on April 27, 1956: "Samples of airborne dust will be taken at approximately seventy various localities throughout the world, in addition to the U.S. stations. Previous studies of this kind have shown that the average gamma ray dosage delivered to world inhabitants by all tests to date is less than the dose they have received from natural background radiation during the same period of time. All of these dosages are believed by radiologists and radiobiologists to be harmless."



Cesium-137, Carbon-14

The principal agents of genetic damage in fallout are various radioactive atoms that emit powerful gamma rays, capable of penetrating the entire body. The longest-lived of these are carbon-14, which decays for nearly six thousand years before it has "burned up" one half its energy, and cesium-137 (half-life: twenty-seven years). In addition, we now know that a host of shorter-lived fallout products, whose effective energy is largely lost in a matter of days, or at most months, comes down in copious amounts in fresh fallout.

These shorter-lived radioactive atoms have been largely ignored in AEC calculations, but combined they may produce twenty or more times as much genetically harmful gamma radiation as do cesium-137 and carbon-14, according to a report from Argonne National Laboratory. If nuclear tests are not resumed, all of the shorter-lived fallout products from past tests will soon decay to relative harmlessness; but if tests start again and continue over a long period, the shorter-lived fallout products will be a very serious genetic hazard.

At present, though, the fallout product that will certainly cause the greatest number of casualties, with estimates ranging from many hundreds of thousands to millions, is long-lived carbon-14. Incredible as it may seem, these casualties will be spread over a period of eight thousand years or more. The fallout hearings revealed that since nuclear tests began, the amount of carbon-14 in all living matter has increased between ten and twenty per cent.

The only mitigating testimony on the genetic casualties caused by fallout was offered by Dr. W. L. Russell of Oak Ridge National Laboratory, who compared the effects on mice of long-continued low-level radiation with that from a single large dose of radiation.

Here are Dr. Russell's conclusions:

The genetic hazard from radiation delivered slowly over a relatively long period of time may be considerably less than had been expected. This statement presumably applies to: (a) background radiation, (b) fallout, and (c) many industrial uses of radiation.

It should not be forgotten that although lower mutation frequencies are obtained when the radiation is spread out, these frequencies are still appreciable.

What About Cancer?

As for somatic injury to the individual himself, as opposed to injury to his genetic material, scientists still face many uncertainties. They have plenty of evidence that **radiation in fairly large doses can cause cancer, including bone cancer and leukemia.** Among the irradiated survivors of Hiroshima, for example, the incidence of leukemia has increased several times. What is not known, however, is whether *very small* doses of radiation, applied to a *very large* group of people, in this instance the entire population of the world, will induce cancer in a certain small percentage

of them. In other words, is there a threshold below which radiation will not cause any bodily harm or is all radiation harmful to some susceptible people?

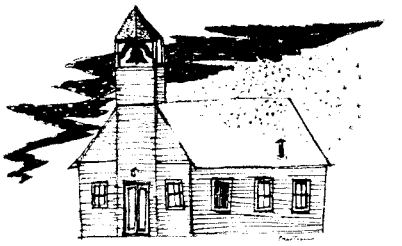
This question has been especially troublesome in attempts to assess the danger from strontium-90, the fallout product that concentrates in human bone. For example, Dr. Charles L. Dunham of the AEC predicted during the hearings that if there is no threshold for injury, strontium-90 from tests to date will produce 50 to 100 additional cases of bone cancer each year in the United States and about double that number of leukemia cases. Naturally, if there is a threshold, there could be fewer cases or none.

This AEC prediction of possible cancer casualties is inconsistent with the attitude toward strontium-90 displayed in the AEC press release of April 27, 1956, which stated: ". . . nowhere in the world are there concentrations of this isotope [strontium-90] remotely approaching hazardous amounts. The average concentration observed in human bone is less than 1/10,000 of the concentration which might be expected to show ill effect on human beings."

The American public has been confused these past few years by the plethora of differing estimates of casualties from strontium-90 and other fallout products. Sometimes these differing estimates result from different assumptions made by scientists in making their calculations. More often, the wide differences derive from variations in the way the same relative degree of hazard is expressed. For example, Dr. Dunham says that there could be 300 cases of leukemia and bone cancer in this country annually from fallout. Another scientist might use the same figures to say, with equal accuracy, that during the next thirty years there might be 9,000 cancer cases in the United States from strontium-90 or that the total number of cancer cases throughout the world in the next thirty years from strontium-90 may be 144,000.

The Unborn Victims

The effects of fallout on the young came in for special attention at the hearings. One scientist particularly



A FALLOUT LEXICON

HALF-LIFE: The amount of time that it takes for a particular group of atoms to disintegrate to half their original number. Some radioactive substances disintegrate in a matter of minutes, others decay for many years. At the end of its half-life, a radioactive substance is still not harmless; it has simply lost half its energy.

NATURAL BACKGROUND RADIATION: The small amount of radiation that man has always been exposed to from the soil, rocks, air, and water of his natural surroundings.

THRESHOLD: The smallest amount of radiation that will do damage to human beings. There is no threshold for genetic injury; even the smallest amount of radiation that strikes the gonads will cause some mutations. No one knows whether there is a threshold for bodily injury, i.e., whether there is a dose of radiation so small that it will not cause cancer in some susceptible people.

MAXIMUM PERMISSIBLE CONCENTRATION (MPC): An amount of radiation that is believed to be relatively, but not necessarily completely, safe—according to present knowledge. Radiation levels thought safe thirty years ago are now known to be extremely hazardous and MPCs have been revised drastically downward.

INDUSTRIAL MPC: The MPC set for the small group of adult workers in atomic energy plants: the industrial MPC for strontium-90 is currently set at 2,000 strontium units per gram of calcium.

GENERAL-POPULATION MPC: The MPC for the total population of the world, with its high percentage of children, pregnant women, and other groups especially sensitive to radiation injury. The general-population MPC for strontium-90 in bone is currently 66 strontium units per gram of calcium.

HOT SPOT: An area where the amount of fallout on the ground is particularly high, as compared with other areas. Also used to describe a part of the bone where some radioactive element, such as strontium-90, has concentrated.

KILOTON: A force equal in explosive power to 1,000 tons of TNT. The Hiroshima bomb was about 15-20 kilotons.

MEGATON: A force equal to a million tons of TNT. A two-megaton hydrogen bomb is equal in power to all the conventional bombs exploded during the Second World War.

CURIE: The unit of radioactivity. One gram of radium has the activity of one curie. (Less than one-millionth of this amount of radium can cause bone cancer or leukemia.)

MILLICURIE: One-thousandth of a curie. The amount of strontium-90 and cesium-137 desposited on the soil as fallout is often expressed as so many millicuries per square mile.

MICROCURIE: A millionth of a curie. Smaller still is a micromicrocurie, or a millionth of a millionth of a curie.

STRONTIUM UNIT (S.U.): One micromicrocurie of strontium-90 per gram of calcium. Used to represent the amount of strontium-90 in food and also in human and animal bone.

ROENTGEN: A unit of radiation dose. Each year we are ordinarily exposed to a natural background dose of radiation of about 0.1 roentgen.

STRONTIUM-90: One of the most important of dozens of radioactive elements present in fallout; did not exist before the nuclear age. Half-life is twenty-eight years. Closely similar chemically to calcium, with which it is taken up from the soil by plants. Concentrates in bone, where it may cause cancer or leukemia.

CESIUM-137: A fallout product that is a genetic hazard because it emits penetrating gamma rays. Half-life is twenty-seven years. The human gonads receive radiation from cesium-137 deposited on the ground and also from cesium-137 taken into the body, where it remains for many months.

CARBON-14: A very long-lived (half-life 5,568 years) fallout product produced by both fission and fusion. Concentrates in all tissue. A genetic hazard that will cause a small number of mutations each year for thousands of years.

IODINE-131: Half-life is eight days. This product concentrates in the thyroid, especially in children, where it may cause cancer.

interested in the subject was Dr. Jack Schubert of Argonne National Laboratory in Lemont, Illinois. Here is part of his testimony:

It is possible to make an estimate, and I want to emphasize it is an estimate, of the cancer-producing effects of fallout on children. This is based on the studies of Dr. Steward and Mr. Heyett . . . in England. In these studies, roughly two roentgens total body-dose in the fetus in the last three months of pregnancy resulted in a doubling of the amount of cancer that these children got before the age of ten . . . It is interesting that two roentgens should produce a doubling dose, for this reason: Before 1950 it was universally assumed that it took roughly 2,000 roentgens to produce cancer in humans. These data were based mainly on adults. Then in 1950 it was found that as little as 200 roentgens produced cancer in children who were irradiated in the neck region. Now, seven years later, we find that two roentgens have produced cancer in children, admittedly on the fetus, which is the most sensitive age.

Dr. Schubert estimated that at present the child receives during its nine-month gestation period a total dosage of twenty milliroentgens [thousandths of a roentgen] from all fallout products; and that **this could mean an increase of one per cent in the total number of children under ten who die of cancer each year.**

The need to consider the unborn and very young in assessing radiation hazards was also pointed up in testimony on a newly realized danger from fallout: thyroid cancer. Dr. E. B. Lewis of the California Institute of Technology revealed that over the past few years the thyroid glands of infants and young children in the United States have received average annual radiation doses from iodine-131 that are roughly one or two times the annual dose to the thyroid received from natural background radiation. Once again, the average here is misleading and the individual thyroid dose rates probably show wide deviations, with some children having received dosages many times greater than the average.

Dr. Lewis noted that the thyroid glands of infants and children are especially sensitive to radiation-induced cancer. Further, if an adult and an infant ingest the same amount of iodine-131, the thyroid of the infant will receive a radiation dose eighteen times greater than that of the adult, both because of the gland's much smaller size and because the child's thyroid may tend to take up more of the radioactive substance.

Dr. Arthur H. Wolff of the PHS commented on this point as follows:

I think we are generally agreed that strontium-90 as an environmental contaminant certainly deserves the primary attention, because the problem will persist for many years following the cessation of nuclear weapons testing. But I think data collected during the past few years does indicate that some of the shorter-lived isotopes, particularly iodine-131, are not necessarily insignificant. . .

It is particularly important to look in the young age group. . . . Much of the work that has been done in the past has been with adults. . .

The Nevada Tests

A panel of scientists presented their estimate that the genetically significant radiation dose received from fallout by inhabitants of the north temperate zone in the coming thirty-year period would be about fifty milliroentgens. The hearings also disclosed that **many thousands of residents of the area around the Nevada Test Site in Arizona, Utah, and Nevada have already received many times this thirty-year dosage from the Nevada tests alone.**

A document entitled "Fallout from Nuclear Tests at the Nevada Test Site" was released at the hearings, listing the estimated external gamma exposures of the populations in hundreds of communities near the Test Site. No estimate is given, however, of the internal gamma-ray dosages that may have been received by these same individuals from cesium-137 and other gamma-ray emitters ingested with food.

Nevertheless, and although we don't know how accurate these *average* estimated dosages may be, the document makes fascinating reading alongside Paul Jacobs's article "Clouds from Nevada," in *The Reporter* of May 16, 1957. Here are a few of the cumulative gamma-ray dosages estimated in the document and stated not in milliroentgens but in roentgens:

Fallini Ranch, Nevada: 1.98; Nyala, Nevada: 2.06; Hurricane, Utah: 4.35; St. George, Utah: 3.70; Washington, Utah: 3.30; Santa Clara, Utah: 4.27; Butler Ranch, Nevada: 15.0; Lincoln Mine, Nevada, 5.95; Beaver Dam, Arizona: 2.30; Las Vegas, Nevada: 0.21. This last figure, 0.21, may seem low compared with the others listed—but it is more than four times the genetically significant fallout dosage that the panel of scientists predicted the average American will receive in thirty years.

In recent years, some scientists have complained that no bone samples from people who lived in the neighborhood of the Nevada Test Site have ever been analyzed for strontium-90 content. Dr. Dunham revealed at the hearings that the AEC is now supporting a PHS study of strontium-90 bone concentrations in the inhabitants of this area. Dr. Conrad F. Straub of the PHS noted cautiously:

We have received within the last month ten samples which have been analyzed, and preliminary data indicate that we have strontium-90 levels ranging from six-tenths to twelve micromicrocuries of strontium-90

per gram of calcium, which appears to be higher than those reported in the past by other individuals.

A Soothing Report

On the third day of the hearings the AEC released the report that Chairman McCone had promised in his National Press Club speech would "give further reassurance to the people of the world." This report from the AEC's General Advisory Committee provoked Senator Anderson to comment:

I am just hoping that it could be possible for the General Advisory Committee to be told very politely that this was a fine résumé of conditions as of two years ago, and that it might be still the same as now, but that we are interested in what might be going on ten years from now, and it is not against the law for them to take a look at that.

One point widely quoted in the press from the GAC report is that ". . . the amount of total body external radiation resulting from fallout to date, together with future fallout in any part of the world from previous weapon tests, is . . . less than five per cent as much as the average exposure to cosmic rays and other background radiation . . ."

But most of the people who live in the vicinity of the Nevada Test Site have received far more total whole-body external radiation than five per cent of the natural background dose. Some, including all the inhabitants of St. George, Utah, have received more than one hundred per cent of this dose.

Furthermore, very few studies have been made to determine with any scientific accuracy what the external radiation dose rate from fallout actually is. One of the few is being conducted at Argonne National Laboratory, and a report presented at the hearings showed that between May, 1957, and September, 1958, the average external gamma-ray dose rate in this area *was almost twenty per cent* of that received from natural background radiation. This spring, a sudden radiation increase was recorded by the laboratory, bringing the external fallout dose rate for April and May to a full *seventy-five per cent* of that received from natural sources. Most of this great increase is from short-lived fallout products, which will cease to be an important source of radiation in about a year—if no further tests are held.

What Is Your MPC?

Several weeks before the fallout hearings, the National Committee on Radiation Protection released summaries of the latest Maximum Permissible Concentrations recommended by them for industrial workers in atomic plants. The N.C.R.P., an unofficial body, suggested an increase in the industrial MPC for strontium-90 from 1,000 S.U. to 2,000. It was not generally known at the time that some months earlier the International Commission on Radiological Protection had recommended that the *general-population* MPC be calculated as one-thirtieth of the industrial MPC, rather than one-tenth as had been the practice heretofore.

Calculating the general-population MPC for strontium-90 according to this new formula would lower the figure from the present 100 S.U. to 66 S.U. According to testimony at the hearings, the N.C.R.P. will soon issue a statement on this question, probably concurring with the lower MPC.

The entire concept of a maximum permissible concentration, and who should set it, came up for some questioning at the hearing. Dr. Dunham made one attempt to define the MPC:

Standards of radiation protection have been commonly described by such terms as maximum permissible dose and maximum permissible concentration. These terms are often misunderstood. A recommended maximum permissible dose is neither an absolutely safe dose nor is it a dangerous dose. It is a dose which in the judgment of the person or group of persons making the recommendation represents the greatest hazard that in their opinion should be permitted under conditions to which the recommendation is applicable. Under different conditions either a lower or a higher permissible dose may be more appropriate.

After the hearings, Dr. Walter Selove of the University of Pennsylvania commented:

I believe that one of the very most important results that should come from these fallout hearings is the realization, on the part of both Congress and the public, that no group of scientists can set a "permissible" level for fallout. . . . I do not think that Congress can ask scientists to tell it what is an acceptable level of fallout. The responsibility lies with the members of Congress themselves.

In other words, there is a human cost for *all* increases in radiation, and the importance of this cost must be based upon a moral and political decision, not a technical one.

High Altitude And Underground

Testimony at the fallout hearings by Dr. Libby and Dr. Selove should clarify, once and for all, the essential facts—and the common misconceptions—about high-altitude nuclear explosions. These facts are simple. A nuclear bomb exploded a few miles above the earth's surface deposits nearly one hundred per cent of its radioactive debris as worldwide fallout. **But at altitudes up to at least 600 miles, the worldwide fallout from a nuclear test would still range between fifty and one hundred per cent of the total debris.**

The great confusion as to whether or not high-altitude tests cause fallout may have originated with President Eisenhower's April 13 letter to Premier Khrushchev, proposing an immediate ban on all nuclear tests except those conducted underground or above fifty kilometers. The President's letter noted that if his proposal were accepted, fears of "additions to levels of radioactivity would be allayed . . ."

As recently as June 8, a New York *Times* story noted: "The limited ban would eliminate the major hazards of radioactive fallout. . ." That just isn't so.

Actually, no one in the AEC has ever said in so many words that high-altitude tests would not cause fallout. What the hearings did reveal is that when Dr. Libby speaks of the

relative harmlessness of testing nuclear weapons in space, he is not necessarily referring to altitudes of a few hundred miles.

Here is the relevant testimony on the subject:

DR. LIBBY: *A distance perhaps somewhere near halfway to the moon or even farther would be best. We have had no experience with this method so far, so most of it is theory. . . . The only things that even approach it were the Johnston Island shots and the Argus shots, but they are at way lower altitudes. . . . I would hesitate to give you the impression that it is just around the corner or anything like that. . . .*

DR. SELOVE: *Mr. Holifield, recently the United States proposed a cessation of tests below thirty miles altitude. I understand, as Dr. Libby has indicated, that a test carried out at 100,000 miles from the earth will emit radioactive particles, very few of which will be going in the direction of the earth, and therefore we will get a reduced fallout. But by the same token an explosion carried out even a few hundred miles above the surface of the earth . . . would deposit in the very outer regions of the earth's atmosphere half of the total amount of fallout. . . . I have observed in the official statements that have been made by the U. S. Government there has been no direct statement that fallout from shots above thirty miles will be sharply reduced, although I must say it seems to me the statements are phrased in such a way that one easily reads them to mean that. I wonder whether Dr. Libby might enlighten us somewhat . . .*

REPRESENTATIVE HOLIFIELD: *Dr. Libby's statement covers shots far out, half way to the moon. Of course, he does not treat with the areas closer to the earth. Let us assume, for the time being, we are talking in terms of five or six hundred miles from the earth. Is that satisfactory?*

DR. SELOVE: *Yes.*

DR. LIBBY: *I would think that Dr. Selove's statement is completely right . . .*

Interestingly, though much energy has been expended recently in arguing about the efficacy of detection systems for underground tests, some of Dr. Libby's testimony revealed that our knowledge of the possible hazards of such tests is remarkably limited:

It is necessary to emphasize that our experience is limited and we have to learn more about such matters as the characteristics of the rock necessary to completely seal in the radioactive fallout so that it cannot contaminate ground waters or escape to the surface . . . I would say that our underground experience has been limited to pretty small explosions.

Apparently at least one of the five underground explosions conducted to date *did* break through the surface, as evidenced by a reference in one of the hearing reports to "the beta activity of fallout from the underground shot, Jangle Series . . ."

The Unknown

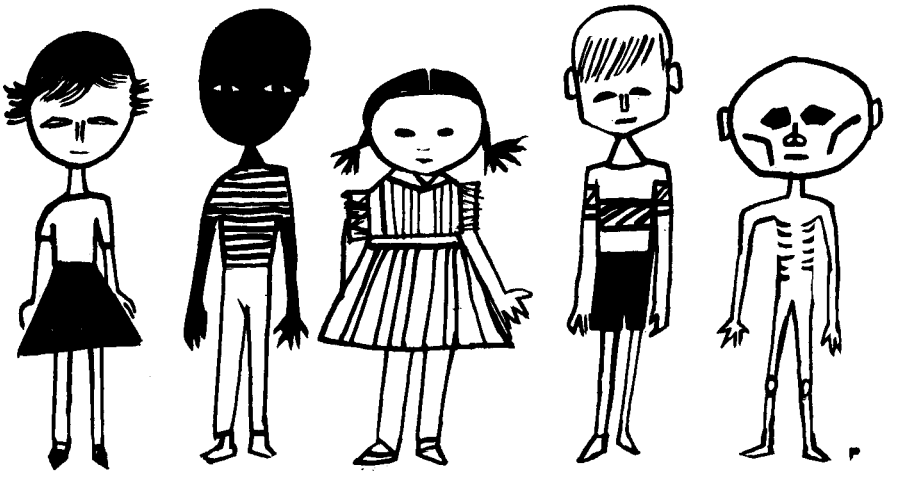
The second Congressional fallout hearings were not, of course, the last word on the effects of nuclear-bomb tests on man. For example, one extremely important question was completely unanswered by the hearings; to what extent does strontium-90 tend to concentrate in tiny areas of the bone, irradiating these "hot" areas with a dosage very many times that which might be expected if the strontium-90 were distributed uniformly in the skeleton?

Furthermore, during the past few years we have learned many new things about fallout, and radioactivity in general, that have caused us to revise some of our ideas sharply, so it would be strange if our present picture were not modified somewhat with time.

On February 10, 1957, William A. Laurence, the famous New York *Times* science editor, wrote an article on strontium-90 in human beings, using the very best information then available or known. A comparison of some of the facts of his article today, less than two and a half years later, with information presently available on fallout shows that three of the main points are now known to be misleading and in error: Laurence noted that the average strontium-90 content in the bones of man in the fall of 1955 was about one ten-thousandth of the MPC; however, this average does not reflect the relatively high concentration found in children and these very early bone samples were compared with an industrial MPC (of 1,000 S.U.) intended only for a small group of adult workers in atomic plants. He also reported that stratospheric fallout was being deposited on the ground uniformly, at a rate which we now know is far too slow. Finally, Laurence quoted three Columbia University scientists working on an AEC grant to the effect that "test explosions totaling the enormous figure of 35,000 megatons . . . would be required to bring the average world population up to the maximum permissible concentration of strontium-90 in the bone structure."

We now know, with a world total of less than 100 megatons of fission energy released to date, that the explosion of 35,000 megatons of nuclear weapons would amount to a public-health disaster of unparalleled dimensions for the world's population.

But that was almost two and a half years ago. What shall we have learned two and a half years from now?



The One That Broke The Camel's Back

JOSEPH KRAFT

WASHINGTON

CHANCE counted heavily in the Senate's rejection of Lewis Strauss as Secretary of Commerce. But underlying the case was a general issue, only dimly perceived: that of Congress's inability to obtain the most ordinary kind of information about the workings of the Federal government. This issue has increasingly come to poison relations between the Executive and Legislative branches; in the Strauss case, it gave rise to a new phenomenon in the Senate—a kind of neo-Populism.

Of the chancy factors, personality was all-important. "Arrogant" was the description of Mr. Strauss favored by his opponents. Hugh Scott of Pennsylvania, a leading backer, cited a sympathetic article which asserted merely that Mr. Strauss had "plenty of confidence in Lewis L. Strauss." Arrogant or self-confident, he evinced in the hearings a manner ill calculated to charm senators.

Respect laid on with a trowel is the demeanor usually enjoined upon seekers of senatorial blessing. In winning confirmation as ambassador to Israel over opposition from Senator Fulbright, Ogden Reid, for example, served up slow stuff that only an expert slugger could move past the infield. Asked once whether he had a statement to make, Mr. Reid said: "No sir; I am here trying to co-operate to the fullest possible extent. I am sure you have some questions, and I do not want to presume to take any of your valuable time."

Mr. Strauss, by contrast, fogged in fast ones which the feeblest batter, if he connected, could hit for the distance. Repeatedly he corrected the senators on facts: when they fumbled, he prompted. In a biographical statement, read after a shorter version had been inserted by the committee chairman, Mr. Strauss found thirty-eight occasions for use of the first person singular. Without so much as a nod at David Lilienthal, Dean Acheson, Harry Truman, or even Edward Teller, he advanced the claim that "I began the movement to initiate development of . . . the thermonuclear bomb."

Connected with personality were the tactics used on behalf of Mr. Strauss. Senator Scott on the Senate floor likened the Strauss case to the Dreyfus affair. The New York *Times* and *Herald Tribune,* both Strauss supporters, immediately asserted that there was not the slightest trace of anti-Semitism in the Strauss opposition. Why, then, hint that there was? Simply to impress Majority Leader Lyndon Johnson, so the figuring went on Capitol Hill, into believing that a stand against Mr. Strauss would harm his chances of winning the Jewish vote as a Presidential candidate. Rumors also circulated that a Democratic senator from New England had been won over by pledges to curtail competition from Japanese textiles; that senators from the coal states of West Virginia and Kentucky had been taken in tow by hints that imports of residual fuel oil would be kept down; and that some hanky-panky on sugar prices had appealed to Coca-Cola, which, it was said, passed the word to Georgia's senators.

In the end, two senators protested publicly against such pressures, and it is doubtful, on balance, whether Mr. Strauss gained much from these maneuverings. But apart from all personal factors, what best armed the opposition was the general problem of Congressional access to information about the government.

What Goes On?

Technological and international realities have been working for nearly half a century to make the government huge and complex. With the best will in the world, senators could not know, and officials could not tell them, *all* that goes on inside the bureaucracy. But only very slowly has there broken in upon members of Congress the sense that they have, at best, an exceedingly faint idea of what goes on. They are in the position of the man who itches all over and doesn't know where to scratch.

As target for the information itch, Lewis Strauss was the ideal candidate. He had made his money as a banker on Wall Street, doing deals beyond the fathoming of ordinary men and not a few senators. He had made his name in government in a field—atomic energy—doubly remote from public understanding: security considerations restricted knowledge of his work at the AEC; and technical complexities and the rapid pace of development pushed comprehension of the atom past the intellectual grasp of all but a handful on the Hill.

The specter of similar secret powers at the Commerce Department was raised at the very first committee hearing on the Strauss nomination. Chairman Warren Magnuson of Washington read into the record a list of fourteen different agencies, boards, commissions, and so forth that would be under Strauss's thumb, summoning images of shadowy bureaucratic empires.

Senator Clinton Anderson of New Mexico, chairman of the Joint Congressional Committee on Atomic Energy, posed the information issue squarely in testimony on Mr. Strauss's "various deliberate efforts to avoid keeping the Joint Committee fully and currently informed." It was a good thing that someone spoke plainly, for without another word of explanation, virtually every topic in the committee hearings seemed, mysteriously, to gyrate around the information question without ever defining it.

It was brought out that Mr. Strauss, though he divulged his personal financial holdings, was not keen to make known those of his family. (Neither is anyone else, and the practice is rarely, if ever, followed.) It was claimed that Mr. Strauss used control of security clearances to beat down personal foes. An aimless trek (240 pages in the record) through the trackless waste