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FALLOUT. On February 15, 1955, the United States Atomic Energy Commission (USAEC) revealed for the first time that under suitable conditions the radioactive dust which falls on the earth's surface after the detonation of atomic weapons, called "fallout," can kill or injure all unprotected personnel present in areas covering thousands of square miles. This startling statement added a new dimension to the hazards of nuclear warfare. Until the official announcement of the USAEC, fallout was thought to make only an incidental contribution to the devastating effects of atomic explosions. Let us consider the origin and nature of fallout.

The explosion of a nuclear weapon produces heat so intense that all the fission products and components of the weapon assembly are volatilized. If the resulting luminescent "fireball" is in contact with the ground before it begins to rise, thousands of tons of soil are sucked up and become mixed with the radioactive fission products. When the fireball has cooled, many of the radioactive "ashes" of the nuclear fission reaction condense on the dust particles and upon traces of particulate matter present in the atmosphere. The radioactive dust carriers descend to earth at rates largely depending on the direction and speed of the wind and size of the particles. The larger particles fall out rapidly while still highly radioactive. The remainder of the radioactivity is carried on very small particles at great heights and is transported around and around the world. These particles gradually lose their radioactivity and fall out slowly over a period of years.

Only relatively small nuclear test explosions are conducted at the Nevada Test Site and these, only when weather conditions minimize the probability of fallout hazard. High air bursts at the Nevada Test Site have produced no significant fallout while heavy fallout from near-surface explosions has extended only a few miles from the point of explosion. The large scale thermonuclear explosions do not constitute a hazard to distant areas because it takes several days for the radioactive dust to reach such regions.

For a given nuclear weapon the rate and extent of fallout depends on the height at which the weapon is exploded. The amount of fallout is relatively insignificant when the weapon is exploded high enough so that the fireball does not touch the ground. Fallout is also relatively insignificant when the explosion takes place so far underground or under water that the resulting soil particles or water droplets remain near the site of the explosion.

The hazard of fallout depends on the radiation dosage which may be received. These dosages are measured in terms of roentgen units, called "r." In order to appreciate the significance of radiation exposures received from fallout it is necessary to review the relations between dosage and biological effects. When the entire body is exposed in a short time, say 24 hours, to a dose of 400r about half the individuals would be dead within a month, 200 to 400r would produce severe nausea and vomiting and some deaths, 50 to 200r would produce some nausea and temporary blood changes but in general recovery would be apparently complete. While sub-lethal doses of radiation may produce no short-term harmful effects there is good reason to believe that in proportion to the radiation dose, the potential long-range effects include a shortening of the life-span, genetic mutations, and an increase in tumor incidence.

In the ordinary atomic bomb about two pounds of radioactive materials are produced for each 20,000 tons of TNT equivalent explosive power. About 90 different radioactive elements are present in these two pounds. The radioactivity as a whole decreases in such a way that for every 7-fold increase in time, the radioactivity decreases 10-fold. Thus if a dosage of 1000r was being produced one day after the explosion, only 100r would be produced one week later.

The introduction of the thermonuclear weapons--the so-called H-bombs --increase enormously the amount of radioactivity produced. Thus a ten megaton bomb (10 million tons) may produce 1100 pounds of fission products. If the fallout from such a bomb were deposited uniformly over an area of 100,000 square miles, the contamination at one day would produce 67r and a week later only 6.7r. However, depending on local conditions, the size of the contaminated area and the power of the nuclear explosion, the radiation dosages may be far greater or less.

On March 1, 1954 a thermonuclear device was tested at Bikini atoll. The detonation took place on a coral island and the ensuing fallout contaminated an elongated cigar-shaped area extending 220 statute miles down-wind and varying in width up to 40 miles. Inside Bikini atoll at a point 10 miles down-wind from the explosion, it was estimated that the radiation dosage was about 5,000r for the first 36-hour period after the fallout. At one spot 100 miles from ground zero, the dosage for the same period was 2300r, 2000r at 110 miles, 1000r at 125 miles and farther south, 150r at 115 miles from Bikini. About 190 miles down-wind near the outer edge of the cigar-shaped area the radiation dosage was about 300r for the first 36 hours. About

7,000 square miles in all was heavily contaminated. The radioactive contamination was of course not uniform throughout the area because of local factors. The fallout material consisted of pulverized and incinerated coral (calcium oxide) coated with radioactive fission products.

An unfortunate series of circumstances caused a group of 23 Japanese fishermen on the trawler Lucky Dragon, at a distance of about 80 miles from the Bikini bomb explosion, to develop radiation sickness. One of the men died, though it is believed the immediate cause of death may have been jaundice incurred during necessary blood transfusions. Also exposed were 239 natives of islands near Bikini who received calculated radiation dosages of from 14 to 175r and a group of 28 American servicemen who received 78r.

Of the fission products present in fallout the isotope strontium-90, Sr^{90}, is one of the most important. It has an average life of 30 years which means it will remain around at least a generation. Further, because of its similarity to calcium, it will tend to collect in the bones when inhaled or swallowed.

Barring a full-scale atomic war, the average radiation exposure that individuals on the whole receive from carefully conducted weapons tests is less than the dosage received from natural sources such as cosmic radiation, the radioisotopes normally present in the body such as carbon-14 and potassium-40, and the radiation received from radioactivity produced by naturally occurring radioisotopes present in the earth and atmosphere. In addition, the radiation dosages received from various X-ray and fluoroscopies undergone in medical examinations far exceed the average dosage individuals receive in fallout from nuclear detonations.

The potential problems posed by the megaton H-bombs and fallout radiation are of great concern to the peoples of all nations. The problem becomes more acute in view of the fact that testing of thermonuclear weapons continues both by the USSR as announced by them on November 26 and by the U.S. and Great Britain. On December 3 the UN General Assembly adopted unanimously a U.S. resolution to establish a committee of scientists to collect, analyze and distribute information on the effects of radiation on man and his environment.