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**FACTS ASSOCIATED WITH THE CONTINUANCE OF THE NUCLEAR WEAPONS TESTING PROGRAM**

It is difficult to give unclassified explanations of the need for the continuance of the nuclear weapons test program. Perhaps the best public statement which has been made on this subject is the detailed White House Press Release of October 24, 1956. This Press Release contains a statement by the President which includes ten points which he felt bore on this problem. In addition, the Press Release contains four memoranda, one lists the tests which have been conducted by the United States, another is a statement on fallout, the third is a statement on the long-range detection of the detonation of Soviet nuclear weapons, and the fourth is a list, together with explanations, of ninety steps that have been taken by this Government and others in an effort to reach an agreement with the Soviet Union on nuclear weapons production and testing and the Atoms for Peace Program.

Briefly, the President's ten points are:

1. Concrete progress is to be seen in the Atoms for Peace Program, the setting up of a Cabinet rank officer for disarmament, the discussions of the open skies offer, the acceptance of the Russian proposals for ground inspection, and the setting up of the International Atomic Energy Agency.
2. This Government's policy is "safe guards first and then disarmament" (there have been fourteen Soviet rejections of this idea in the last two years).
3. This Government feels that under the circumstances it must continue to develop and test nuclear weapons. The strength in this field is important due to the unavoidably large numerical superiority of Communist manpower.
4. The present rate of thermonuclear tests by this country and others does not imperil health. This conclusion is based on the findings of 150 scientists, of the first rank, of the independent National Academy of Sciences, who reported in June 1956 that fallout is a "small fraction of the exposure that individuals receive from natural sources and from medical x-rays during their lives".
5. The weapons tests have two benefits:
  - a) They make it possible to harness and discipline weapons, effectively reduce the fallout, and make it possible to concentrate their destructive power on military objectives.
  - b) Knowledge vital to Civil Defense and to the development of defensive weapons is gained.
6. Fallout is unavoidable from weapons of all sizes. (Recently the President has announced that new developments may make it possible to produce weapons with little or no fallout.)
7. The Soviet Union has insisted since 1946 on voluntary disarmament with no safe guards.
8. Tests in Russia of very large weapons can probably be detected, but not of weapons of all sizes.
9. Two years are needed to prepare and conduct a test. Consequently, this work cannot be stopped and started again quickly.

From these pertinent points the President concludes that we should continue to test and continue negotiations aimed at disarmament with safe guards.

Since the major objection to continued weapons tests is based on the argument that human biological damage will result from the consequent fallout it is important to give as much data as possible that bears on this problem, so that this possible damage can be compared to the necessarily brief statement given above of the diplomatic and military reasons for continuing these tests. In order to evaluate the radiation levels associated with the long-range fallout from nuclear detonations it seems to be pertinent to compare this radiation with other sources of low level radiation that are present in our natural environment. It is, of course, possible to compare the predicted injury caused by small radiation exposure with the injury caused by many other hazards of modern living. However, several of these other hazards of modern living are very different in their nature from radiation and such a comparison, even though made in terms of shortening of life expectancy or some other criterion, involve many value judgements which are hard to place on a quantitative basis. The relatively small biological damage which may be caused by natural radiation coming from our environment and the necessarily smaller damage which might be caused by radiation fallout are both unimportant compared to the well-known large scale dangers of modern living. Both these possible forms of radiation damage are essentially undetectable by any biological observations, even though enormous numbers of people or animals are involved. Other large scale hazards of modern living are so easily detected and produce such a large number of injuries that it seems unfair to compare the radiation problem to them and as a result all subsequent remarks will be confined to a numerical comparison of radiation due to fallout to other forms of radiation known to be essentially harmless.

Radiation dose rates will be expressed in terms of the unit milliroentgens per year. Briefly, the acceptable official dose rate established by the National Committee on Radiation Protection and the International Commission on Radiological Protection for individuals who work in the radiation industry is 5,000 mr/yr. The acceptable dose rate for bone effects in individuals who do not work in the radiation industry is 5,000 mr/yr; while the acceptable dose rate for genetic effects in non-workers is 500 mr/yr. The value of 5,000 mr/yr is established on the criterion that a person receiving this dose beginning at the age of 18 and extending through his working life will suffer no observable effects. The acceptable Strontium 90 exposure to the bones for the population as a whole is 3,000 mr/yr. If an extrapolation from large exposures to humans and from many animal experiments to the extremely low levels of radiation of which we are speaking is made then 1 mr/yr for one year corresponds to a reduction of seven minutes in life expectancy. It should be emphasized that the direct measurement of this quantity seems to be almost impossible and that it is only an extrapolation from data secured with dose rates of the size of 100,000 mr/yr. There is good evidence to indicate that the loss in life expectancy due to 1 mr/yr for 1 year should not be any larger than 7 minutes. In order to further evaluate the small size of the radiation doses involved in our environment a dose of about 50,000 mr is known to double the natural rate of genetic mutation.

A persons entire body is subjected to radiation from external sources which vary somewhat with his living conditions. This radiation is expressed in Table I in terms of mr/yr, time of life shortening per years exposure, and time of life shortening per 65 years of exposure.

TABLE I  
 AVERAGE ENVIRONMENTAL EXTERNAL WHOLE BODY RADIATION  
 (NCRP Max. Permissible Level = 500 mr/yr  
 for the population as a whole)

	<u>mr/yr</u>	<u>Hours Life Expectancy Lost Per Yrs Exposure</u>	<u>Days Life Expectancy Lost Per 65 Yrs Exposure</u>
Cosmic Rays Only at Sea Level	35	4	11
Over Sedimentary Rock Outdoors - at Sea Level	78	9	25
Over Granite Rock Outdoors - at Sea Level	145	17	47
Brick or Concrete House - at Sea Level	150-300	18-36	49-98
Luminous Dial Watch	40	5	13
Medical and Dental X-rays (Americans)	80	10	26
Fallout at Present*	0.3	0.03	0.1
Total Average Over Population	200-400	24-48	65-130
*Projected Fallout Exposure From Continued Testing for Many Years	0.6-16	0.07-2	0.2-5

It is seen that cosmic-rays give a relatively small dose rate which is about equal to that of luminous dial watches. Living in a brick or concrete house is a relatively large effect. Fallout gives the smallest of all the dose rates; being somewhat less than 1% of any possible living situation. The radiation due to fallout can be expressed in terms of cosmic radiation by noting that an increase in altitude of 200 feet from sea level increases the cosmic radiation dose rate by an amount just equal to the present fallout dose rate. The increase in dose rate due to cosmic rays from its sea level value to its value in Kensington is several times the fallout dose rate while the increase in cosmic ray dose rate from its sea level value to the value in Denver, Colorado is 60 times the fallout dose rate.

In addition to the above external sources of radiation a person is subjected to internal radiation which can either be localized or distributed throughout his body due to differences in the metabolism of the different elements. Four elements are significant. Potassium 40 and Carbon 14 are distributed uniformly throughout the body, while Radium 226 and Strontium 90 are concentrated in the bones. The Radium 226 content of human bones varies greatly with the locality in which the person lives. The Strontium 90 content of the bones, which is the principal constituent of fallout, is seen at the present time to be relatively small compared to that of Radium 226, and in the projected future (assuming that the present rate of testing continues indefinitely) to still be relatively small compared to that of other natural sources of radiation to the bone.

TABLE II

AVERAGE ENVIRONMENTAL INTERNAL WHOLE BODY AND BONE RADIATION DOSES  
(NCRP Max Permissible Level for bones = 3000 mr/yr)

Potassium forty	nr/yr 25
Carbon fourteen	1
Radium in bones - local and non-uniform (depends on water and food sources)	5-370
Present* Strontium ninety in adult bones	0.3
Present* Strontium ninety in childrens bones	1
Total bone dose due to Radium and other sources	130-500
 *Projected Strontium ninety bone dose rate if tests continue indefinitely at the present rate	 3-30

The even smaller doses due to natural causes in turn also produce no detectable biological effects. It thus seems reasonable that the still smaller radiation levels due to fallout, even though the weapons tests be continued indefinitely, will produce no detectable effects. It should be emphasized that even though we were, until 50 years ago, unaware of it, that all animals and all men and all other living forms have from even the remotest times been subjected to these low levels of radiation, and apparently there is adequate immunity built into these living forms to protect them from injury and to allow them to continue to exist indefinitely although continuously irradiated by a few hundred mr/yr.

Conclusions: Three successive levels of radiation dose rate have been mentioned, the largest of which, the one established as safe for workers in the radiation industry by the NCRP, produces no observable biological effect.