



STANFORD UNIVERSITY MEDICAL CENTER

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STANFORD UNIVERSITY SCHOOL OF MEDICINE  
Department of Genetics

October 16, 1970

Chairman  
Select Committee on Nuclear Electricity  
Pennsylvania State Senate  
Harrisburg, Pennsylvania

Dear Sir,

Dr. John W. Gofman's testimony before you (dated August 20) has just come to my attention.

I believe it is my duty to amplify on the quotations attributed (correctly) to me by Dr. Gofman, as they are susceptible to misunderstanding. For that purpose I enclose the article referred to.

Indeed, I did estimate that the eventual cost of mutations calculated to be induced by the "permissible exposure level", which amounts to doubling the background, might reach \$10 billion per annum in the cost of health care and the loss of economic productivity. Since there is general agreement that the genetic effects of radiation outweigh all the others, this may give a convenient, if somewhat oversimplified yardstick for a cost-benefit analysis.

Before I expose my assumptions, however, may I stress that this is the eventual level of detriment, at equilibrium, which would require ten or more generations for its full impact. The costs are however estimated in terms of the 1970 economy.

That doubling the background would increase the rate of mutation by about 10 percent is generally agreed. There are only minor quarrels about the extent to which mutational damage might be decreased at very low dose rates, and balancing counter-arguments about the interaction of radiation with other pollutants.

The health cost of that increase in mutation is hard to estimate. I have assumed that the total burden of ill health costs us about \$200 B today, if we make a realistically comprehensive estimate. No one would say this is exaggerated by as much as two-fold. (Direct health care alone approaches \$80 B). I also argue, that genetic factors account for fully half that burden. The weakest part of my argument is that an increase in mutation rate would give a commensurate increase in genetic burdens, for other phenomena may play an important role, difficult to estimate.  $\$200B \times 10\% \times 1/2 = \$10B$ . With a relevant population of about 200 M people, this works out to a cost of \$50 per capita for doubling the background, or \$500 per capita per rad.

But the bill is not presented for payment immediately; it may be deferred for one, ten, or more generations. The main gist of my remarks was that compensatory research today (of a kind seriously slashed in

recent budget cuts) might mitigate most of that future burden. But some part of that \$500 per rad -- say \$100, until you make an independent calculation -- should be regarded as the present and unrecoverable cost to health in the visible future per rad per capita.

This line of argument does not support Gofman's proposal for a moratorium on nuclear plant construction. You may wish to consider whether nuclear energy should be taxed (to support the requisite health facilities and research) to the corresponding extent, which should work out to a few dollars per capita. I assume the economic benefits would far outweigh this estimate. At least these considerations should be included in an overall cost-benefit analysis. I do not know how to estimate the corresponding costs of pollution from fossil fuels; clearly these should not escape redress either.

I would of course urge you to resist any measures that would result in "using up" a substantial part of the guideline for "permissible exposure". This is not likely to occur within five years, whether you impose a moratorium or not. I have also urged the AEC to lower its allowances. They have so far resisted for reasons which I partly understand, but must still disagree with. In very large part, in my opinion, the AEC suffers from a serious public-relations problem, and from considerable public confusion about population dose and individual hazard. However, I agree with Gofman that, in due course, concerns about minimizing population exposure to radiation, with which he and the AEC and I are in full concurrence, should be embodied in explicit regulations so that long-range planning is based on the correct principles.

Dr. Gofman and I do agree on some policies, and disagree on others; none of my remarks here are addressed to his calculations based on doubling doses for carcinogenesis, which appear to me highly implausible on mechanistic grounds.

Yours sincerely,

Joshua Lederberg  
Professor of Genetics

CC: Dr. Gofman  
Dr. Totter (AEC)