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Professor Joshua Lederberg
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Stanford, California 94305

Dear Professor Lederberg:

I very much appreciated your prompt reply of January 22 which certainly established an even keel to our discussion. As you expected, I had not seen your letter of January 1 addressed to me at the Academy. The staff there is collecting the replies to their inquiries to review with me on my next visit. Obviously, we should get together to discuss the many points in our areas of mutual interests.

With regard to the nuclear plant issue, I agree with you that interposing this as an example in my paper opens the door to a controversy not intended as a principal issue in that particular publication. However, it is an area in which I have an active and historical interest. When we do get together, I would be very pleased to discuss this in some detail. In the meantime however, it might be useful background for you to know that I am aware of all the discussion and uncertainty in the physiological aspects of radiation effects. I took these into account in the statement made in my paper. There are also several other complexities which tend to confuse this type of generalized discussion which might be helpful for you to be aware of even now.

First, nuclear plants come in several varieties. The radioactive effluents from these plants may differ under normal or accident conditions by orders of magnitude. For example, the boiling water reactor and the pressurized water reactor both involve a continuous radiation induced decomposition of the cooling water. The off-gasses can include leakage radioactivity from the fuel elements. In this regard, the boiling water reactor has traditionally been a much greater problem than the pressurized water reactor. On the other hand, the liquid metal fast breeder involves none of these phenomena and has normal effluent conditions that are very much less than either of the above. In all of these reactors, however, it is feasible by the addition of filtering equipment to bring the normal effluent radioactivity down to any level considered necessary.

The same kind of difference in behavior occurs under accident conditions. Water cooled reactors operate under very high pressures so that their energy release could hypothetically require pressure containing protective equipment. The liquid metal fast breeder operates at close to atmospheric pressure and has none of this type of stored energy. The conditions, therefore, for sudden release of radioactivity varies substantially among these reactor types. Also, the release of fission products which might be contained in such a release are not the same. Here again it is possible by the addition of further protective containment to reduce the release to the public to any value considered necessary.

What, then, is the real issue? If there were no economic factors, we could control both the operational effluents and the accidental releases to any minimal value. However, assume for example, that every factor of 10 improvement in public exposure requires a 10% increase in cost of power to the public. Then the policy issue is whether this is an optimum allocation of national resources for the objective of improving public health. For example, a one million kilowatt station could hypothetically supply the needs for approximately one million people at a cost per person of about $100 a year for electrical power. A 10% increase in this case would represent, therefore, about $10,000,000 per year. If that sum of money were applied to improving the public health of that group in alternate ways, would the improvement be substantially greater than if that money were applied to reducing the effluents from a nuclear station? At what level of nuclear safety does the marginal utility shift to other areas? I will leave that question for us to discuss more fully. I use these numbers only to illustrate what I consider the real "gut" issue in the nuclear controversy.

The question has been raised of why use nuclear power at all if we have available fossil fuels. Here again, aside from economics, the public health issue becomes very complex. In addition to the chemical pollutants normally associated with fossil fuel power plants, there is also a radioactive emission, particularly in the case of coal. Due to the presence of naturally occurring uranium and thorium in coal, the combustion effluents contain the radioactive daughter products of these elements. It is possible to remove most of these products by flyash precipitation, but with uncertain efficiency. Actual experiments indicate that the public radioactive exposure from modern coal burning plants are greater than that from a modern pressurized water reactor. Again, we are dealing with a trade-off of controlled removal and economics. It does appear that a complete comparison of the impact on the public health of the alternatives of nuclear or coal plants would indicate the nuclear plant to be the safer choice. The issue on this question is whether the availability of electric power significantly improves the public welfare to justify the risks associated with its generation and use.

Without wishing to belabor an additional point, I might mention that the often repeated contention that the Price-Anderson Act distorts the economics of nuclear power is not supported by the actual operation of the utility industry. As you know, no payment has been made under this Act. Also, the utilities carry up to $80,000,000 of regular insurance for nuclear plants, none of which has had to be used. The history of the Price-Anderson Act, in which I was personally involved, indicates that it was never intended as a measure of nuclear safety, but rather as a psychological goad to encourage the utilities to venture into a new technology. I know of no situation in which the availability of the Price-Anderson Act has altered in any way the economics of nuclear power.

I raise these points not to dissuade you from agressively pursuing elucidation of all the issues, but rather to indicate the complexity of the engineering, economic, and public welfare aspects. These are quite comparable in their complexity to the biological aspects with which you are so familiar. I am very interested in exploring these matters further with you and I hope we can arrange an opportunity to do so some time in the next several months.

Sincerely yours,

Chauncey Starr
Dean

CS:dg