State of California
OFFICE OF ATOMIC ENERGY DEVELOPMENT
AND RADIATION PROTECTION
GOVERNOR'S OFFICE
SACRAMENTO 14

EDMUND G. BROWN
GOVERNOR

ALEXANDER GRENDON
COORDINATOR

March 21, 1961

Mr. George Holgate
Oxnard Democratic Club
3131 Balboa Street
Oxnard, California

Dear Mr. Holgate:

Please accept my apologies for the lateness of this reply, especially in the light of your wish to report to the next meeting of the Oxnard Democratic Club. There have been so many pressing activities, including the necessity of a trip to the East Coast and elsewhere, that I have had to defer this reply, in spite of my desire to assist you.

Before trying to answer your specific questions regarding the dumping of atomic wastes, let me give you a little background on the subject. The intensely active radioactive materials that are waste products from nuclear reactors are not being dumped at all in the sense in which you are interested. They are being held in underground storage tanks at several places in the United States, particularly, Oak Ridge, Tennessee; Hanford, Washington; and the National Reactor Testing Station in Idaho.

The wastes about which you are concerned are the small amounts of radioactive material that result from the use of radioisotopes in laboratories and industrial and medical applications, plus miscellaneous objects contaminated with radioactive materials in the course of experiments and developmental work. Compared to the amounts of radioactive material naturally present in the world -- some 450 billion curies are dissolved in the oceans alone -- the small amounts of a few hundred to a few thousand curies per year that are disposed of in this way could be thrown into the ocean carelessly and still probably do no harm.

In order to be additionally safe, however, we in the United States have adopted a more careful practice than other countries, some of which do dump their radioactive wastes in bulk into the sea. We require ours to be encased in heavy containers, either filled with or made of concrete, in order

to insure that they will go to the bottom of the depths at which we permit them to be dumped. We insist that these depths be at least 6,000 feet, and here in California we have even persuaded those concerned to go to slightly greater depths than that, not because 6,000 feet is unsafe, but because the additional factor of safety is easily obtained. The only purpose of the containers is intended to be that of carrying the material down to that great depth. There is a bonus, undoubtedly, in the fact that the containers will hold the material, or most of it, for a considerable time, and thus permit the radioactivity to decay even before it is released and diluted by the ocean waters.

Now, let me answer your specific questions:

1. The containers vary in kind. Most of them, it is thought, will hold the radioactive material for periods of the order of ten years, although as pointed out above, this is not a very important factor.

2. (a). The radioactive materials are of many kinds, each of which has a characteristic half-life. What this means is that for a material whose half-life is one year, the atoms disintegrate, giving up energy in various forms of radiation, and the disintegrations occur at such a rate that one-half of the atoms in any quantity of this material disintegrate in one year. This leaves only one-half the amount of the material at the end of one year; one-half of that, or one-fourth of the original amount at the end of two years, etc. At the end of ten half-lives, less than one-thousandth of the original amount is still present. In addition to this natural radioactive decay, as it is called, the materials may dissolve slowly in the ocean and thus be spread in very dilute form throughout a large body of water.

(b). When a radioactive atom disintegrates, giving out a gamma ray or a beta particle, the changes produced in its near vicinity are changes produced by ionization of atoms that these rays encounter. This ionization is a temporary thing and can produce lasting changes only if it results in some kind of chemical reaction. It is these chemical reactions in living things that may in some cases be harmful. From the human point of view, the irradiation of the sea water or creatures living in it, either microscopic or large, has no importance. The radioactive atoms that dissolve before disintegrating may be carried anywhere in the sea.

3. There is no danger whatever that currents or fish will carry the radiation itself anywhere, since the gamma and beta rays do not penetrate very far and cannot be carried on. The currents and living organisms may, indeed, carry radioactive atoms away from the dumping area, and the location of these atoms at the time they happen to disintegrate is of interest to man. However, man has so many radioactive atoms inside his body naturally, coming from the same sources as the 450 billion curies that I mentioned above which occur in the sea, that the effect of a few more radioactive atoms is immeasurably small. Only if a large number of such atoms, of kinds that happen to possess a number of undesirable characteristics, all congregate in one individual -- only then is there a significant likelihood that the individual may be harmed.

There is no known way of saying with certainty that a certain amount of a particular radioactive material will harm a given individual, except for the extreme cases where we can say with certainty that a very large amount will kill anyone. Scientists have, however, investigated the subject so extensively that we have a fair idea of the chance of harm corresponding to various amounts of each radioactive substance. Arbitrary factors of safety of one hundred to one thousand or more have been applied to the smallest amounts that have been known to cause injury to some people, and these arbitrarily lowered values have been tabulated as "maximum permissible" amounts of radioactivity that a person should be allowed to acquire from man-made sources in the course of his ordinary activities. This concession to our desire to gain the advantages for mankind from the use of atomic energy and radioactivity should not be regarded either as a serious burden to mankind or as encouraging unnecessary exposure to radiation. The wisest course we know is to avoid unnecessary exposure, while recognizing that the small exposure involved at the levels I have mentioned really presents very little danger.

4. (a). Using the fission process to get atomic energy, as we do now in all of our nuclear reactors, radioactive waste is inevitable, but this waste is the high-level material that I mentioned earlier. Even if some day we can get our atomic energy from the fusion process rather than the fission process, and thus avoid producing the fission products that constitute most of this radioactive material, we will still deliberately want to produce quantities of radioactive material to serve the innumerable uses these materials presently serve in research, medicine, industry, and agriculture. It is these uses which principally produce the low-level radioactive waste we are talking about.

Since nothing we do changes the rate at which radioactive materials decay, only time can truly dispose of these materials

after they have served their purpose and become waste. All we can do to get rid of them is to disperse them so widely that they are in such dilute form that no one can get enough to expose him to a significant risk of harm. You will note that I keep using the term "significant." This is a term which is constantly challenged by those who feel that it hides a plot against the public health and welfare. In fact, it is only the cautious approach of the scientist when he wishes to make a completely accurate statement. We might equally say that there is no significant hazard in taking a bath, even though we recognize that some people slip and are injured or killed. What I have in mind is that the risks which I have termed insignificant are of the same order as -- or far less than -- innumerable risks involved in all of man's activities.

(b). There is no prospect that the low-level wastes will accumulate in amounts sufficient to cause serious problems, but the problems of disposing of high-level wastes still need to be solved. Much work is being done in research toward that end, and it seems likely that some one or more of the various approaches will succeed. Even if the fusion process of getting atomic energy does not reach a practical stage for many years, and if the use of nuclear reactors for power is increased to the maximum extent presently foreseen, the problem of keeping these radioactive wastes confined is not so great as to threaten man's survival.

5. The same principle that is applied to the high-level wastes, namely, confining them in known places rather than dispersing them and diluting them in the sea, has been used to a limited extent for low-level wastes. At the Atomic Energy Commission sites at Oak Ridge, Tennessee and in Idaho, areas have been set aside for the burial of such wastes in the ground, and many commercial users of radioactive materials and nuclear reactors have been sending their wastes to these locations for burial at the stipulated fee rather than paying a waste disposal firm to imbed the material in concrete and drop it into the ocean. The use of land burial as a means of disposal shows increasing promise. Only publicly-owned lands can be used in this way, since there must be assurance that the tract will not be employed for other purposes while radioactivity is present. Since some of the radioactive fission products have long half-lives -- some of the most important ones have half-lives of about thirty years -- it would be necessary to insure that these radioactive "cemeteries" are not used for other purposes for hundreds of years.

6. Radioactive materials become radioactive wastes only when they cannot be put to use. The low-level wastes above discussed

can no longer be put to use because of the very fact that they are in such scrambled forms: dilute solutions in waste water from laboratories, small amounts soaked into paper towels or rags, traces that cannot readily be removed from laboratory glassware, tools, shoes, coveralls, and the like. The large amount of wastes in more concentrated form -- the high-level wastes -- may turn out not to be waste at all, but indeed to be useful because of the heat that is generated. The radioisotopes that are in demand for a multitude of uses have been extracted from this mixture to the extent that present needs require, but more of the same may be found in these wastes, together with others for which there is no present demand. Small power sources for the electrical requirements of space missiles, isolated signal systems (lights and radio signals) and similar applications have already been developed, using radioisotopes as a source of heat. Work is being done aimed at using these mixed radioactive materials which constitute the waste fission products in a similar way.

I trust that, late as these answers are, they will nevertheless be helpful to you and your fellow club members.

Sincerely

Alexander Grendon
Coordinator