21 March 1980, Volume 207, Number 4437 **SCIENCE**

Radioactive Wastes from Biomedical Institutions

The low-level radioactive waste burial grounds in the United States have been closed or have operated at reduced capacity for many months, much to the inconvenience of biomedical institutions that are prevented by federal and state regulations from disposing of such wastes by other means. Most of the radioactivity in the wastes produced by these institutions is due to two nuclides, tritium and carbon-14, which are largely contained in plastic vials used in liquid scintillation counters.

Tritium and ^{14}C are both produced naturally by cosmic-ray interactions with the atmosphere. Tritium is produced at an annual rate of 1.9×10^6 curies (Ci), leading to a steady-state environmental inventory of 34×10^6 Ci. Carbon-14 is produced at an annual rate of about 38,000 Ci, which because of its long life results in a global accumulation of 315×10^6 Ci. Humans have always been exposed to the radiations from these nuclides, but they are both soft beta emitters and the annual dose we receive is only 0.001 mrem from ^3H and 0.7 mrem from ^{14}C. The combined dose from the huge accumulation of these nuclides is thus about 0.5 percent of the 130 mrem to which the average person is exposed from all natural sources. Tritium and ^{14}C were also dispersed into the environment when nuclear weapons were tested in the atmosphere; by 1972, an estimated 5.8×10^6 Ci of ^{14}C and 4.5×10^9 Ci of ^3H were added to the atmosphere in this way.

Compared to these quantities, the amounts of ^{14}C and ^3H present in the wastes from clinics and laboratories are miniscule. An estimated 2390 facilities in the United States used one or both of these nuclides in 1978 and shipped a total of 720 Ci of ^3H and 221 Ci of ^{14}C to waste burial grounds.

Wastes containing ^3H and ^{14}C in these quantities can in most cases be disposed of safely by the same procedures that are applicable to nonradioactive wastes. Subject only to limitations imposed by characteristics other than their radioactivity, they can be flushed into sewers, put into trash bins, or incinerated. If the incinerator is well designed and operated, the risk to the nearby public will be of no consequence. If the ^{14}C and ^3H used in 1978 by all biomedical institutions in the United States were to be discharged by the incinerator stack of a single institution, the dose to the public would meet existing standards within a few tens of meters from the point of release to the atmosphere.

Other important nuclides used in biology and medicine include technetium-99^m, sulfur-35, phosphorus-32, iodine-125, and iodine-131. The properties of these nuclides are also such that in most cases they too could be released harmlessly to the atmosphere by incineration.

The rules of the regulatory agencies permit application for a permit to incinerate, but the institutions have not taken advantage of this option because it would be difficult to obtain public acceptance of the practice. The institutions have instead opted to accept the burden of unnecessary record-keeping and inspection procedures, as well as the expense of shipping their wastes to distant burial grounds. These have now been denied to them for reasons related more to unrealistic fears than to justifiable concerns.

Radioactivity continues to present the public with unfamiliar concepts and terminology that present formidable barriers to its understanding of the subject. It is not unusual for discussions of waste disposal to involve units as small as picocuries (10^{-12} Ci) and as large as hundreds of megacuries. This is a range of 20 orders of magnitude, a spread of values totally without precedent insofar as the public and most scientists are concerned. Members of the public and their elected officials may not understand the enormous difference between picocuries and megacuries. The regulating agencies not only should take the initiative in eliminating absurd restrictions such as the above, but should be prepared to defend their decisions in the public arena.—MERRIL EISENBUD, *Institute of Environmental Medicine, New York University Medical Center, New York 10016*

Excerpted from an invited lecture delivered at the 5th Congress of the International Radiation Protection Association, Jerusalem, 10 March 1980.