GENERAL DISCUSSION

By Paul C. Aebersold[1]

As a bio-physicist, I have no place appearing before people in industrial engineering. That is the way I felt when I was invited in 1948 to give the Edgar Marburg Lecture before this Society.[2] I did not know much about the Society, but I soon found, of course, that it had considerable pre-war interest in nondestructive testing by means of radiation with both X-rays and radioactive materials. The Society is to be congratulated for taking a very early interest in the use of the post-war reactor products in this field.

In my 1948 lecture I could present only basic principles of the way isotopes might be used in industry. There were very few actual applications in industry at that time, and not over a hundred industrial firms using isotopes in 1948. Those groups were using them mainly in research and development programs, and these programs have paid off well.

I predicted that there were great potential values in the use of isotopes—that they could have great economic value—and this has been borne out. In the past five years there has been a tremendous growth in the industrial uses of radioisotopes. The number of users has increased by perhaps a factor of 15. There are over 2000 industrial groups using radioisotopes, and, as has been pointed out, there are over 3000 beta gages alone in use in industry. There are many other types of gages. The applications are quite diverse.

To estimate the savings from the use of thickness gages, assume there are 3000 gages and each gage saves only $40,000 a year. This is not a very great amount because some gages save much more than that, not only in manpower and materials but in reduced shutdown time and better operation, better product, and so on. If you take only $40,000 per gage and multiply it by 3000 gages you have $120,000,000, which is a substantial saving to industry. Another extensive use in the field of nondestructive testing, of course, is radiography, where a few thousand radiographic sources are in use by about 500 institutions. Estimates have been made of the over-all savings from radioisotopes used in industry and these run to several hundreds of millions of dollars per year.

One could go on about the increase in usefulness, the savings, and so on. It has been encouraging to see this growth, yet it has not been anything to what it could be. The potential still is very great. The number of industrial users that could derive economic and other benefits from the use of radioisotopes is very great indeed, so that the potential savings could run into billions of dollars per year.

Therefore, while commending the groups that have pioneered in this field and being encouraged by their developments, one might also ask why there has not been an even greater use of these

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[2] Paul C. Aebersold, "Isotopes and Their Application in the Field of Industrial Materials," *Proceedings*, Am. Soc. Testing Mats., Vol. 48, p. 527 (1948).

materials. At first there might have been a shortage of isotopes, but I doubt if that is going to occur again. Reactors are being built all over the country. We will produce this year a total of several hundred thousand curies of cobalt-60 alone, and we have a proposed program to produce millions of curies for use in the field of applied radiation.

In addition, we are building a fission product pilot plant. It will produce over 200,000 curies per year of cesium-137, a major gamma ray emitting fission product. It can also produce as many curies of strontium-90 and other fission products. This plant is being built to show what can be obtained from radioactive waste products. If one considers that there will be many power reactors throughout the country, the total quantity of fission products will be enormous. There is thus no longer a shortage in basic by-products, radioactive isotopes, and fission products.

Also, there is no shortage of instrumentation. Radiation instrumentation has developed greatly since ten years ago. It is not only more reliable but there are more sensitive types of instruments, including scintillation counters, both with solid detectors and liquid scintillators. The variety of detection schemes can be great indeed.

In addition, isotope know-how has increased greatly. The number of technical papers presented, not only in this Society but in many other societies, on uses of radioisotopes, has resulted in a large volume of information.

What then is the deterrent at present? A major item is the lack of trained personnel. You need training beyond what you now get in college, usually in engineering, or even in science curricula, to handle radioisotopes safely. There is always some degree of radiation hazard involved, but it does not take a large amount of training to learn how to handle this properly. You need not be a nuclear engineer to take advantage of most uses of the radioisotopes. For some uses one or two weeks of training is sufficient. However, for an extensive program of research and application with isotopes, a company may wish to have a supervisor trained for several months in the broad principles of the use of radioisotopes.

Another deterrent, I think, is management. Management in general has to be sold on at least two things. One is to overcome inertia to go into something new. They have to understand the economic advantages as well as other advantages. Also, they usually worry about the disadvantage of having radioactive materials in their plant. This problem may be overcome by public relations programs to show that these materials do not represent a serious hazard, that they are used in many plants throughout the country, and in Atomic Energy Commission installations the safety record has been excellent indeed.

Then, of course, there is a third item, the matter of setting up standards for industry or standards of testing. A major role of ASTM Committee E-10 has been advising the Society and other committees on tests that could become standard. Committee E-10 has been active, or "radioactive," in this field, but other committees have not been so highly activated. This inducing of radioactivity in the other committees has not taken place to any great extent. Tests demonstrated here could be taken over by other committees and standardized and specifications could be set up. Many tests could become accepted as routine.

At any time we would be glad to answer questions concerning policies of the Atomic Energy Commission. It would take too long here to go into all the different phases. I can say this, however, that in our program for making available not only radioactive by-products but also uranium, fissionable materials, and all the other hazardous materials of atomic energy, the system of controls consists of licensing, regulations, and inspection. Hazardous materials or devices or facilities must be covered by a license. The conditions of a license vary a great deal, from a facility with very little hazard to a large power reactor.

In addition to licensing, there are also regulations. There are regulations, for example, on health and safety— that is, how much exposure people can safely take of certain forms of radiation, and certain control procedures in maintaining security of the radiation sources. I do not mean military security, but just physical security so that the radioactive sources do not get lost. Lastly, there are controls by an inspection system for those kinds of materials and kinds of facilities that represent a substantial public hazard. Licensees will be visited from time to time to see if they are operating safely; the visitor acts not only in the role of inspector but perhaps more in the role of an educator, to see that the facilities are being used in the public interest in the matter of health and safety.