The bellwether for the use of isotopic radiation is generally considered to be the radiation process for the production of ethyl bromide. This product is conventionally produced by reacting ethylene and hydrogen bromide in the presence of a catalyst. This reaction is quite difficult to control, has side reactions, and results in product impurities. Gamma radiation was found by one manufacturer to sustain the reaction between ethylene and hydrogen bromide in the absence of any chemical catalyst. The process was much easier to control and yielded a much purer product. The company has converted its entire commercial production of this chemical—about one million pounds a year—to the radiation method. With appropriate instrumentation the process has been made self-regulating and runs 24 hours a day without attendance.

Another company recently purchased 250,000 curies of cobalt-60 to be used in a commercial process for the controlled degradation of polyethylene oxide. Polymerization of ethylene oxide yields a very high molecular-weight polymer. For some uses of polyethylene oxide, however, lower molecular-weight grades of the polymer are desirable. Radiation permits controlled degradation of the polymer to selected molecular-weight ranges.

Radiation synthesis of polyethylene is of special significance. This is the most widely used polymer in the world, with several billion pounds produced annually. Some years ago AEC-sponsored work at Brookhaven National Laboratory resulted in a demonstration of the feasibility of polymerizing ethylene with radiation from the radioisotope cobalt-60. This work showed that with radiation the exothermic polymerization reaction could be much more easily controlled than with chemical catalysis. Also, because no chemical catalyst was required, the product was much purer. Finally, the radiation process appeared to be economically competitive.

As a result of this AEC laboratory-scale research and development, two companies have invested their private funds in pilot plants for radiation production of polyethylene, and a third company is considering a similar investment. I believe that during the next round of expansion of polyethylene production capacity we may well see several full-scale plants using cobalt-60 or another suitable radioisotope for polyethylene manufacture.