THE REACTOR AND THE PRODUCTION OF ISOTOPES

by

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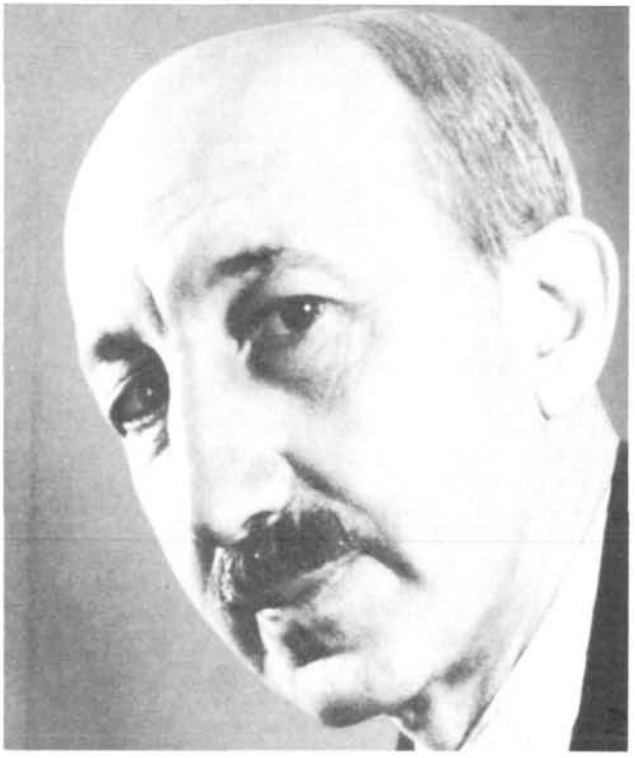
When Ernest Lawrence first operated his cyclotron the Geiger counters placed around his device forcibly reacted. The first operation of the cyclotron was such a tremendous task that Lawrence had clearly neither the energy nor the time left to bother about the reaction of the counters. The latter indicated the production of radioactive isotopes through the action of neutrons coming from the cyclotron.

The discovery of artificial radioactivity soon afterwards was due to the genius of Frederic and Irene Joliot-Curie. Shortly after their discovery Fermi and his colleagues - among them Emilio Segré to whom we owe, besides numerous other important discoveries, that of radioactive isotopes of elements not found in nature - embarked on a detailed study of artificial radioactivity. They discovered a great number of radioactive isotopes and made the observation of fundamental importance that rapid neutrons can be slowed down by collision with light nuclei.

When shortly after Joliot-Curie's discovery we were faced with the task at Niels Bohr's Institute to extend our studies of the application of tracers in life sciences to the use of artificially produced radioactive isotopes, we chose without hesitation P^{32} as a tracer to be applied first. This isotope can easily be separated from sulphur from which it is produced by neutron bombardment and made available as carrier-free P^{32}. In life sciences the availability of more or less carrier-free tracers is often of great importance. Furthermore, the possibility of the study of phosphorus metabolism, with the aid of a radioactive indicator, was a tempting one.

For years we made use in our studies of active phosphorus samples of small activity produced through the action of neutrons on large volumes of carbon disulphide. Later the generosity of Ernest Lawrence made it possible to attack problems which needed the availability of larger P^{32} activities. The few millicuries of P^{32} produced by the cyclotron were mailed to us in airmail letters by Martin Kamen. In those days the mailing of radioactive substances was not strictly regulated. I am inclined to believe that the radiation emitted by those samples did not harm any passenger of the airplane, not even a photographic film.

The construction of the cyclotron immensely advanced the availability of radioactive tracers, a few



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of which even today can be produced only with the aid of this device. But even this great advance was overshadowed by the fabulous production of isotopes by the reactors. Isotopes of almost any element and of almost unlimited activity became available. It now became possible to apply H^3 - discovered already in the 'thirties by Rutherford and Oliphant - and C^{14}, and these were used in thousands of investigations.

Twenty years have passed since the first construction of a reactor, since the day on which the planning of something which had sounded like a fairy tale became a reality. Our thoughts today are with the men who were responsible for the conversion of the fairy tale into reality, first of all with the late Enrico Fermi and the late Ernest Orlando Lawrence.