The Discovery of Nuclear Fission: A Documentary History

By **H. G. Graetzer, D. L. Anderson**
120 pp. Van Nostrand Reinhold, New York, 1971. $2.95

The editors, both physics professors with scholarly reputations in the history of their science, have gathered together 30 key papers, reports and excerpts centering on the discovery of nuclear fission by Otto Hahn and Fritz Strassmann in late 1938, and its interpretation by Lise Meitner and Otto Frisch. This story begins with the work of Enrico Fermi, particularly his production of what were believed to be transuranium elements. Almost alone, Ida Noddack questioned whether element 93 was, indeed, being formed, urging that all other elements first be eliminated from consideration. Hahn, the most experienced radiochemist in the world, became intensely interested in the several activities caused by this neutron bombardment of uranium and, with Meitner and Strassmann, spent about three years trying to establish their decay sequences, half-lives, and chemical properties. Then, in 1937, Irène Joliot-Curie and Paul Savitch announced a 3.5-hour activity that chemically seemed to resemble lanthanum. When Hahn's group looked at this substance they found a number of constituents, including some that precipitated with barium, which was the standard carrier for radium. But with no observed alpha-decay, how could a neutron cause uranium (element 92) to transmute to radium (88)? Further tests convinced them that an even greater jump in the periodic table had occurred, for the activities in question remained with the barium when that element was separated from radium. The explanation, given in the dark days before World War II, was that the uranium nucleus had split, or fissioned, into roughly equal parts, a process considered by Rutherford decades earlier, but never observed and consequently forgotten.

At this time, however, the process could hardly be forgotten, as mass was converted into energy in amounts fantastic when compared with chemical reactions. Fission was confirmed and its mechanics speculated upon by such as Frisch, Edwin McMillan, Philip Abelson, and Niels Bohr in the first months of 1939. Next, energy distributions, cross sections, and other features of the process were studied, but none of more significance than the number of neutrons released in fission. The work of Frederic Joliot and his colleagues (and others elsewhere) showed that enough neutrons were emitted to

The first nuclear reactor. This is the only photograph taken during the construction of the reactor at Stagg Field, University of Chicago. Taken in November, 1942, it shows the 19th layer of graphite blocks almost covering the 18th, which contained uranium. A total of 57 layers were eventually added before the pile became operational. (Photo from the University of Chicago Archives, courtesy of the Niels Bohr Library.)

fission other uranium nuclei, in succession, providing that the neutrons were not captured by impurities or lost in other ways. This trail led in 1942 to Fermi's production of a controlled chain reaction.

By this time, of course, the world was at war and Fermi's reactor was the prototype of those used to produce plutonium for the Nagasaki bomb. The editors do not treat the Manhattan Project as such, but span it by including Albert Einstein's famous letter of 1939 to President Roosevelt and General Thomas Farrell's description of the Alamogordo test in 1945. They are somewhat more interested in the political and moral questions, for they reprint the Franck Report, recommending against use of the atomic bomb, Arthur Compton and Farrington Daniel's poll of the Chicago scientists on this question, and Secretary of War Henry Stimson's analysis of the decision to drop these new weapons on Japan.

With judicious use of introductory and connecting text, these numerous topics, represented by the original scientific papers or other appropriate documents, are fashioned into a continuous story of great interest and excitement. Where necessary, translations into English have been made. The volume, which is designed for college-level students, is both an excellent historical reference work and a valuable teaching tool, containing as it does a case study of scientific progress, with its false turnings, leading to a major discovery and its remarkable application. Its coverage in good part may be summarized by the verse Otto Hahn was fond of quoting:

To split the mighty atom
All mankind was intent.
Now any day the atom may
Return the compliment.

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Helium 4

***By* Z. M. Galasiewicz**
338 pp. Pergamon, New York, 1971. $9.50

The modern science of low-temperature physics dates from the liquefaction of helium in 1908. Since that time, the behavior of liquid helium has been widely studied owing both to its inherent fascination and to its nearly universal role as a cryogenic substance. This intensive effort has yielded successful phenomenological descriptions that fit the various experimental data. The theoretical picture remains incomplete, however, for it is still impossible to perform quantitative calculations from first principles. Consequently, the study of liquid helium continues to flourish.

It is therefore appropriate that Pergamon Press's Selected Readings in Physics series has issued a new volume *Helium 4,* edited by Zygmunt Galasiewicz. It contains an introductory essay of about 50 pages, followed by 19 basic papers (12 experimental and 7 theoretical) that have been wholly reset in a uniform format. As stated on the back cover, this series is planned for an undergraduate or beginning graduate student. In general, *Helium 4* keeps to this level, but it also contains some quite technical material on the derivation of the two-fluid model and the kinetic coefficients. Part of this last material summarizes Galasiewicz's earlier book *Superconductivity and Quantum Fluids* (Pergamon Press, 1970).

The introduction reports the present status of superfluid helium, with emphasis on the theoretical developments of Lev Landau, Nikolai Bogoliubov, and Richard Feynman. Regrettably, the text is marred by numerous misprints, including a confusion between h and $\hbar$. Thus the quoted expressions