NATIONAL ACADEMY OF SCIENCES

LEO SZILARD

1898—1964

A Biographical Memoir by

EUGENE P. WIGNER

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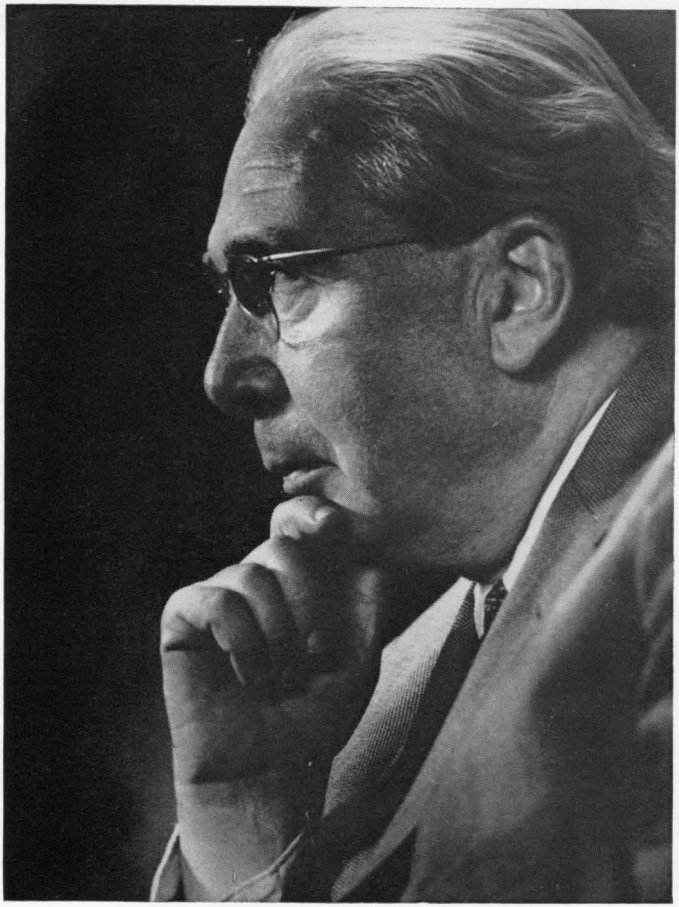

Leo Bilard

LEO SZILARD

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BY EUGENE P. WIGNER

DURING A LONG LIFE among scientists, I have met no one with more imagination and originality, with more independence of thought and opinion, than Leo Szilard. As a scientist, he contributed significantly to statistical mechanics, to nuclear physics, and to biology. As an engineer, he invented a method for pumping liquid metals, had a large share in the establishment of the nuclear chain reaction, and was one of the first to recognize the variety of purposes for which it can be used. As a citizen, he contributed as much as anyone—perhaps more than anyone else—to the undertaking by the United States of a large effort toward the exploitation of the fission process, leading to nuclear weapons. As a citizen, he founded at least two associations to influence the policies of the country which adopted him. He did thereby influence those policies and also the thinking of many of his colleagues. He wrote a charming little book, *The Voice of the Dolphins,* which was translated into six languages.

Szilard was born in 1898 in Budapest, Hungary. He seldom spoke about his parents but when he did his affection for his mother rarely failed to come through. After completing his high school studies in Budapest, he entered the Institute of Technology (Muegyetem) of the same city, but his studies were

interrupted by World War I. He served as an officer in the Austro-Hungarian army but never saw action. A few days before the collapse of the front, he returned to Budapest. After the war, he continued his studies at the Institute of Technology (Technische Hochschule) of Berlin. He was, first, a candidate for the Electrical Engineer's degree, but his interest gradually turned toward theoretical physics. This writer first met him at the Institute for Physical Chemistry of the Technische Hochschule—during a brief flirtation of Szilard with this subject.

As soon as it became clear to Szilard that physics was his real interest, he introduced himself, with characteristic directness, to Albert Einstein. I believe it was largely Szilard's doing that Einstein gave a seminar on statistical mechanics at which, in addition to Szilard himself, several of his friends, including D. Gabor and the present writer, participated. Einstein showed great virtuosity not only in recognizing the truly important unsolved questions but also in projecting a picture of the accomplishments and of the spirit of the theory. The seminar was a unique experience for most participants; it also inspired, I believe, Szilard's doctoral dissertation (1922).

Szilard's dissertation, and a companion paper which was published in 1929, contain several of the ideas which form the basis of present information theory. In spite of the obvious significance of these ideas, Szilard did not feel fully at home in theoretical physics. He felt that his skill in mathematical operations could not compete with that of his colleagues, and he spent most of his time experimenting with X-rays in collaboration with H. Mark, and pursuing some of his engineering ideas.

As a result of Hitler's assumption of power, Szilard left Berlin in 1933 and moved to England. It was here that he first engaged in semipolitical activities. With the same directness which characterized so many of Szilard's actions, he approached Sir William Beveridge and induced him to found the Academic Assist-

ance Council. The purpose of this organization was to help scientists who had to leave Germany because of non-Aryan (usually Jewish) descent to settle in other countries and to help them financially to overcome the initial difficulties. The funds were provided partly by donations, partly by a self-imposed tax paid by refugees from Germany who already had found positions elsewhere. The story of the Academic Assistance Council was described more completely in Edward Shils's memoir of Szilard, published in the December 1964 issue of *Encounter* (page 35).

Szilard's move to England also marks the beginning of his active interest in nuclear physics. He discovered, in London, the *modus operandi* which suited his talents best: he teamed up with a younger colleague, in this case T. A. Chalmers. The ideas conceived jointly were executed by this younger man, leaving more time for Szilard's imagination to roam over as yet uncharted territories. Some, at that time, very important measurements with slow neutrons date from this period, as does also the technique whereby nuclei ejected from a compound after absorbing a neutron are chemically separated. This technique—the Szilard-Chalmers process—is now widely used.

Unquestionably, the most important event in Szilard's life took place in England. This was the growth, in his mind, of the conviction that a nuclear chain reaction was possible and that a nuclear bomb could be developed on the basis thereof. The original basis of Szilard's conviction proved to be erroneous, but he held on to his idea tenaciously and it indeed came to fruition when nuclear fission, discovered in 1939, provided the missing key. Szilard was probably the first to suggest that neutron emission might accompany the fission reaction, that the number of neutrons emitted in the process might exceed 1, and that, as a result, it should be possible to establish an energy-producing chain reaction.

Szilard, in his own words, fell in love with England almost at first sight. Nevertheless when, as a result of the Munich agreement, the future of England appeared to be dubious to him, he moved permanently to the United States (1938; he was naturalized in 1943). At first, Szilard worked at Columbia University. As soon as he heard about nuclear fission, he started to determine those characteristics of this process which might render it possible to establish a chain reaction. These experiments were carried out in collaboration with W. H. Zinn, and simultaneously with similar experiments by Anderson and Fermi. The success of these experiments ensured Szilard a prominent place in the laboratory which was established in 1942, under A. H. Compton's leadership in Chicago, for the purpose of establishing such a chain reaction and making plans for a chain-reacting unit of high output. Indeed, "the General," as Szilard was called in the project by friend and foe alike, exerted an important influence not only by his many technical ideas—few of which were actually used—but principally by his foreseeing future problems and suggesting measures to overcome them. Nevertheless, he found the work at the "Metallurgical Laboratory" (the code name for Dr. Compton's project) frustrating.

As soon as the success of Dr. Compton's project appeared assured, Szilard's interest shifted to the more distant implications of the nuclear chain reaction and of the explosive which this produced. The concept of the breeder, a reactor which produces more fuel than it consumes, was born in these days. The new explosive, several million times more powerful than the old ones, posed also difficult political questions. These occupied him until about 1949 when, at the age of fifty-one, he turned to biology.

In his work in biology, Szilard finally realized his full potentialities. He had security and the freedom of a professor at the University of Chicago, as well as a talented and congenial collaborator, Aaron Novick. The simplicity of the experimental

equipment, together with the relative lack of sophistication of the subject, suited his temperament fully. Each of the seven papers published during the period 1948-1955 contains some new and relevant information. Most important is, perhaps, the development of the "chemostat," which is a device for maintaining a multiplying population of bacteria under conditions not changing in time. Thus, in spite of the multiplication of the bacteria, their number per unit volume remains constant. This device permitted him and Novick, for instance, to study the number of mutations produced in unit time under different rates of multiplication. They found that the rate at which mutations occur is independent of the rate of multiplication (number of cell divisions in unit time). An outcome of this period's work is Szilard's theory of aging which, though much questioned, doubtless has had a widely stimulating influence.

The last few years of Szilard's were again devoted to political activities. Altogether, the *homo scientiarum* can hardly be separated from the *homo politicus* in his case. He was strongly under the influence of Plato and his advocacy of rule by an elite. It was a favorite saying of Szilard's that one stupid person may be right as often as a bright one but two stupid people will be wrong much more often than two bright ones; they should not have as much to say about national policies as the latter. However, his good will toward all, including the stupid ones, was always wholehearted and no one can accuse him of malice. The Ten Commandments published in the German edition of *The Voice of the Dolphins* are inspiring reading.

Szilard was elected to the National Academy in 1961. He received the Einstein award—a prize originated by Lewis Strauss —in 1958 and the Atoms for Peace award in 1959. He died in 1964.

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KEY TO ABBREVIATIONS

Bull. Atomic Scientists = Bulletin of Atomic Scientists
Cold Spring Harbor Symp. Quant. Biol. = Cold Spring Harbor Symposia on Quantitative Biology
Phys. Rev. = Physical Review
Proc. Nat. Acad. Sci. = Proceedings of the National Academy of Sciences
Zeits. Physik = Zeitschrift für Physik

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