EXHIBIT

The following are excerpts from a memorandum written by E. P. Wigner, dated April 16, 1941, a copy of which was transmitted to me by E. P. Wigner in 1941.

"IDEAS BEFORE THE DISCOVERY OF NUCLEAR FISSION

I first heard the possibility of nuclear power seriously discussed in the spring of 1934 when I saw Szilard during a visit to London. The efficiency of collisions between neutrons and nuclei was realized by Szilard simultaneously with and independently from Fermi. He visualized the possibility of chain reactions involving neutrons even at this time. His interest was centered around the reaction

$$Be^9 + n - Be^8 + 2n, \qquad (1)$$

which he considered to be a potential neutron source. His belief of the usefulness of Be in this connection was based on the erroneous (too high) value of the Be^9 mass which was accepted at that time. He made some experiments, however, which raised suspicions in his mind as to the correctness of this mass. When the energy release from (1) was later found to be much smaller than it was believed in 1934, Szilard's hopes temporarily faded.

Szilard showed me copies of some of the patent applications which he made in 1934 and 1935. (I may remark that he presented his patents to the British Admiralty, according to a copy of a letter from this authority to Szilard.) These patent applications contain rather detailed plans and calculations and many of these calculations were very useful when the plans later reached a more acute stage. One of his applications contains the following passage:

"(a) Pure neutron chains, in which the links of the chain are formed by neutrons of the mass number 1 alone. Such chains are only possible in the presence of a metastable element. A metastable element is an element the mass of which (packing fraction) is sufficiently high to allow its disintegration into parts under liberation of energy. Elements like uranium and thorium are such metastable elements; these two elements, reveal their metastable nature by emitting alpha particles. Other elements may be metastable without revealing their nature in this way."

These were certainly almost prophetic words in 1934 or 1935. However, Be^9 was considered to be metastable at that time and was the element which was probably in Szilard's mind in the first place.

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NUCLEAR FISSION

The news of Hahn-Meitner and Strassman's discovery of nuclear fission reached us the very beginning of 1939 and was brought over by Niels Bohr. At that time I was laid up in the hospital with jaundice for about six weeks and Szilard was in town most of the time. He came down to the Infirmary every day and we discussed the uranium fission regularly.

Since I was interested in chemical reactions some time before, it was not difficult for us to realize the mechanism of the process and we developed in our daily conversations all the essential points of the theory which was published later by Bohr himself, in collaboration with Wheeler. In fact, I continue to believe that there were several points which we saw better than they are represented in Bohr and Wheeler's paper. These concern mainly the comparison of

the stabilities of ordinary and neutron-excited uranium nuclei. This topic served later as the subject of several discussions between Fermi and myself who objected to certain passages in the Bohr-Wheeler paper.

While I could claim half authorship in these considerations, carried out by Szilard and myself, I wish to emphasize two points.

First, that neither Szilard nor myself realized the fact that the slow neutron fission is due to the 235 isotope alone. This so extremely important realization is due to Bohr alone.

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Second, that the prediction that neutrons would be emitted during the fission process is entirely due to Szilard. I remember quite well when he mentioned it first. This prediction was extremely important because it naturally revived Szilard's pre-fission plans. Bohr and Wheeler were extremely sceptical towards this idea. Even when the neutron emission was found experimentally, they attributed it to a process which succeeds rather than precedes the various B-activities. Wheeler interpreted the neutron emission in this way in his lecture at the Princeton meeting of the American Physical Society and, indeed, a delayed neutron emission has been found by Tuve. This delayed neutron emission is, however, very much weaker and much less important than the instantaneous emission.

There was a Conference on Theoretical Physics in Washington some time in the early spring which I could not attend because of my jaundice. I heard, however, that Fermi gave a report at this

meeting on the theory of fission and its practical consequences. Although I did not hear his lecture, I have no doubt that he also developed the essential points of the Bohr-Wheeler theory of fission independently and foresaw many of its consequences just as Szilard did, although his attitude was much more cautious than Szilard's.