Henrietta R. Re-listen
Sat. Eve. Post
(Memorial Hosp.)

MEMOIRS - Leo Szilard

This is the first of four or five articles written for a national magazine. Start a new page.

I was living in Berlin where I was on the staff of the University at the time when Hitler got into office early in 1933. There was no immediate change but, rather, business went on as usual. While the Nazis were quietly reorganizing the government and getting ready for what was to come. I knew very well that this quiet will not last forever and my suitcases were packed - correction - and I packed my luggage, and I started to pack my belongings the day when Hitler became Chancellor. There were two suitcases packed in my room and I was ready to leave whenever things began to pop. In the meantime, I was marking time - correction - I did not give any classes during the term and I was merely marking time. It was during this period that I was touched by the first shadow cast by the Atomic Age. This first fleeting contact with the Atomic Age came about as the result of two accidental meetings. One of these was a meeting with a person and the other was the meeting with a book. The book was The World Set Free written by H. G. Wells in 1913 one year before the first World War. When this book first perdict the discovery of artificial radioactivity and puts it into the year of 1933, the year in which it actually happened. Wells describes how this discovery is followed by the release of atomic energy on an industrial scale, the development of atomic bombs and the World War which is fought with such bombs. London, Paris, Chicago and many other cities are destroyed in this War, which Wells puts into the year of 1956. In Wells' imagination, the first World War, the second World War and the third World War was telescoped in one. Wells saw

clearly, in 1913, how the world was headed for a war but he did not foresee that that war would come so soon.

New Paragraph.

At the time when I read this book, my interest in physics covered a broad field but I had no interest in nuclear physics. No one at the time saw any avenue through which atomic energy could be released on an industrial scale and neither did I. For me the book was a piece of fiction but a fiction which I found difficult to forget. The other encounter was with Otto Munzel. He was a Viennese of birth and when I met him a few years earlier, he was a wealthy timber merchant in London. His claim to fame, if he will be remembered at all, he will be remembered as the man who discovered H. G. Wells. At a time when H. G. Wells was virtually unknown, he caught Otto Munzel's fancy and Munzel set him to the task to publish his books in German. Whether he ever read The World Set Free, I do not know. When I met Munzel in the first few months of 1933, the world was under the cloud of the Nazi menace. Munzel and I talked about the possibility that the rise of the National Socialist Party in Germany might lead to another World War. There must have been many people at the time in Germany who were aware of this possibility and to this extent there was nothing unusual about our discussion, but at one point, Otto Munzel went off (dash) - at least so it seemed to me that he , quote, "I have been thinking about this matter for some time now," (end of quote) he told me, "and I came to the conclusion that if mankind is to save itself from a succession of wars which will be more and more destructive, it will have to embark on an enterprise which is capable of capturing man's imagination and permitting an outlet for man's

craving for heroic deeds. I know now," Munzel continued, "what this enterprise may be. The time is not far now when man may make an effort to leave the earth. It ought to be possible to build rockets powerful enough to overcome the gravitational field of the earth and to enable man to travel in space. There is nothing in history to show that man is capable of enduring a long period of idyllic life. To make a sacrifice, to risk his life, may well be an essential ingredient of human life. If there is no major - correction - unless mankind embarks on an effort on which those who want to make a sacrifice, those who want to risk their lives, can concentrate, mankind may well destroy itself in a succession of wars."

New Paragraph.

"This thought is new to me," I said to Munzel, "and I'm not certain whether I can accept your thesis but I'm going to give it some thought and this much I can say right now. If the time has come for man to leave the earth and, if it's true that this is what he must do in order to be able to live in peace, then all the physicists who agree with this thought ### ought to turn their attention to nuclear physics. To leave the earth will take energy. Perhaps it might be possible to escape the gravitational field of the earth by using conventional fuels but it will hardly be possible to escape from the solar system unless we find a source of energy which is superior. --but it will be hardly possible to leave the solar system - correction - but it will be hardly possible to escape the gravitation of the solar system by burning conventional fuels; for this one would need the energy locked up in the nucleus. Nuclear physics has not been my field in the past," I said to Otto Munzel, "but perhaps if you really - if you convince me that we must make efforts to leave the earth in

order to find salvation, I shall change my field now and move into nuclear physics."

New Paragraph.

This conversation took place only slightly more than 25 years prior to the first Russian rocket which circled the moon. This just goes to show that when human imagination takes a flight and thinks that he should penetrate the future as far as thought can reach - correction - this just goes to show that when your imagination takes a flight and then you think that you have peered into the future as far as thought can reach and that you've got a glimpse of what the future may bring many generations hence, you might best have predicted what will actually happen one generation ahead or at most, two. Otto Munzel anticipated the future by one generation; H. G. Wells anticipated it by two. This just goes to show, etc. The conversation with Otto Munzel made an impression on me but I couldn't say that it was more than a fleeting impression. The World Set Free by H. G. Wells - H. G. Wells' book made an impression on me also. When I read H. G. Wells' book, I read it as a piece of fiction to which I did not attach any deeper meaning. Still, somehow, the impression which this book made on me was deeper than I knew.

This is an insert, to be inserted above at the suitable location.

Perhaps because such an important part of my life evolved during the first World War, I had the tendency to limit my possessions to what could be held in two suitcases. I think I would have preferred to have roots, but I couldn't have roots I wanted to have wings and to be able to move at a moment's notice came to be important to me. Now that, for a second time, there was a major upheaval

in Europe (dash) - now that there was war again (dash) - I benefited from having wings and of not having roots. After the Reichstag was put on fire, I lingered for a few more days in Berlin. Having given up my apartment there, I lived in the ~~Secretary~~ Harnack House of Kaiser Wilhelm Institute in Berlin ~~Garden (?)~~ Dahlem, and was thus in close touch with the scientific community of this Institute. My colleagues found it difficult to bring themselves to believe that the Reichstag was set on fire on orders of the German Government. Germany has always been a very orderly country and setting fire to the Reichstag appeared to be a very disorderly thing. After a few days, having listened to all of my friends give their interpretation of the situation, I took a taxi - I locked my two suitcases, I picked up my two suitcases and drove to the railroad station where I took the night train to Vienna. I expected the train to be packed (semi-colon); it was empty. There were Nazi guards on the frontier but they didn't bother any of the few passengers who were on the train. In contrast to this, the same train which reached the Austrian frontier one day later, was jam-packed. The passengers were asked to leave the train on the Austrian frontier and their luggage was searched and their purses were searched. Many were turned back and were refused permission to leave. All this goes to show that in order to succeed in this life, you do not have to be clever. All you have to be is a tiny little bit cleverer than most other people are. You don't have to know what the future may bring. All you have to do is understand what the future may bring one day before most of the others do. As a result of a chance encounter in Vienna - by the time the wholesale dismissal of professors of the Germans got under way, I found myself in London.

Insert. Note the following. In detailed story of London, relate

incident with Otto . End of Insert.

Continuation.

In London where I got involved in the work of the Committees who tried to place those who - the scientists and scholars who left Germany and came to England. This activity suited my temperament for I always found it easier to solve the problems of others than to solve my own problems. Since I had to start a new life in any case, I was considering to change my field in physics and perhaps to begin some work in the field of nuclear physics, but I always had been tempted by the mysteries of biology and I was also thinking of the possibility of leaving physics and moving to biology. If you live in an orderly society in peace time, it is almost - the social pleasures are such that it is very difficult for a man to change his field, even within physics, and even more difficult to change his field from physics to biology. But these were not ordinary times. Among the many distinguished scientists with whom I came into contact in England through my work, was A. B. Hill, a Nobel Prize Winner in physiology, who was a physicist turned biologist. I told him that I was tempted to move into biology and was relieved to find that he was not shocked. Quote, "If you really make your mind - if you make up your mind that you really want to do this, I think I can find you a position somewhere as a demonstrator in physiology. If you know physics, you should have no difficulty in reading up what you need to know in physiology and demonstrate it the next day, reading up one day what you need to know in physiology in order to be able to demonstrate it the next day." End of quote. I had not really made up my mind that I wanted to make the change. In the first half of this century, clearly physics was the king of the sciences. In the first half of this century, one major mystery after another seemed

to be cleared up and in 1933 the major discoveries were still coming fast. First the neutron, for instance, was discovered just a little while earlier, in 1932. No one had really suspected the existence of this particle just a few years before. It resembled in mass the nucleus of the hydrogen atom but it carried no charge. The nuclei of all other atoms carry a positive charge and, thus, they repulse each other. Because the neutron carries no charge, it is not repulsed by the nuclei of the atoms and, therefore, it is able to penetrate into them. On a this seemed to me a particle that would be fascinating to study.

New Paragraph.

Fortunately I was not faced with making an immediate decision for the German scientists and scholars, who arrived in droves from Germany, took my full time and attention. Because I have a one-track mind more than because of a lack of time, I even stopped following physics by reading - correction - I even stopped reading the articles in physics which appeared in the periodicals. But because of my interest in world events, I kept on reading the London Times. In the fall of '33, the London Times reported a speech given by Lord Rutherford at a meeting of the British Association in which Rutherford said that whoever talked of the release of atomic energy on an industrial scale was talking moonshine. that something cannot be done I've always found rather irritating because how can anyone know what someone else might invent? I was wondering about this while strolling through the streets of London. Walking along Row, I had to stop for a street light and the very moment when the light turned green, it occurred to me that Rutherford might be wrong because there might exist an instable element that splits

off neutrons when it is bombarded by neutrons and such an element could sustain a nuclear chain reaction.

New Paragraph.

With this thought in mind, I began to look at the various elements which might-begin to look what element might be a promising candidate for sustaining such a nuclear chain reaction and the first element I hit on was beryllium. On the basis of the published masses of helium and beryllium, the beryllium nucleus ought (u) to have been instable and it could have disintegrated into two other particles and one neutron when hit by a neutron. I thought there might be other elements also which might by (u) instable in the same sense. This possibility intrigued me so much that I gave up the idea of shifting to biology and turned my thoughts to nuclear physics instead. I might have decided otherwise if I hadn't been alerted by H. G. Wells' book as to what the liberation of atomic energy on a large scale would mean. I also might have decided otherwise had it not been for the fact that just about that time Joliot discovered artificial radioactivity. If elements could be made radioactive by bombarding them with alpha particles as had thought, had shown, then why shouldn't elements be made radioactive when they are bombarded by neutrons? And if neutrons could turn ordinary elements into radioactive elements, then we had a tool, a very simple tool, which would enable us to discover the presence of neutron radiations. In science it is not enough to think of an important problem on which to work. It is also necessary to know the means which could be used to investigate this problem. I thought that I had an important problem on which to work and discoveries seemed to give me the means that I could use. As work with Committees who tried

to place displaced German scholars and scientists became less rewarding, I withdrew from this work and decided to mark time. I had a little money saved up, enough perhaps to live for a year in the style in which I was accustomed to live and, therefore, I was in no particular hurry to look for a job. I moved to the Strand Palace Hotel and started to dream about the possibilities which had been opened up by the recent discoveries in physics.

Dolphins

--brogate - to resort to partial abrogation of agreement in the case of minor violations rather than of being forced to choose between no abrogation and a total abrogation.

New Paragraph.

Pravda pointed out that the situation between America and Russia is by no means symmetrical and, income tax being in America what it was, an award of a million dollars would mean very little - correction - Pravda pointed it out that the situation between America and Russia is not entirely symmetrical. In America a million dollar award would mean very little, so Pravda asserted, income tax being what it is. This drew a prompt reply from the Department of the Treasury pledging that the award would not be subject to income tax. The Dolphins made no complete proposal at the rate at which the remaining legitimate equipment might be disposed of. Since the destruction of equipment which is listed and marked can be easily inspected, there was no major difficulty regarding the concealment involved in this issue. The major memorandum issued by the Dolphins dealt rather with the elucidation of the difference between controlled arms limitation and genuine disarmament. The difference lies, so the Dolphins pointed out, not in the amount of arms which are legitimately retained but, rather, on the purpose for which these arms are retained.

If these arms are retained merely as an insurance against the possibility of one of the other nations - against the possibility that some nation may secretly evade the agreement, then even a substantial amount of equipment retained is compatible with genuine disarmament. However, if the arms retained are retained for the purpose of making possible to prevent changes in the map by force or by the threat of force, then we are faced merely with controlled arms limitations, but not with genuine disarmament.

Start a new page. Call it "Last Chapter" and renumber the pages from here on.

In The year (dash,dash,dash)--- (Come in, come in, please.)

5

A 36

Letter, Ross Gunn to Szilard. July 10, 1939

(5) A38

Notes to p. 27

Letter, Szilard to Einstein. October 3, 1939

Letter, Sachs to Roosevelt, October 11, 1939

Letter, Sachs to Wigner, October 17, 1939

Letter, Sachs to Teller, October 17, 1939

Admiral Moore – correct title is Commander Moore

Notes to p. 17 A 22 (5)

✓ Letter, Szilard to Joliot, February 2, 1939

Telegrams from Lindemann, re beryllium block, Feb. 3, 1939 and one undated.

Letter, Szilard to Tuve re beryllium supply. March 24, 1939

✓ Letter, Wigner to Szilard re beryllium block. April 17, 1939

Many letters and telegrams among Szilard, Joliot, Weisskopf, Halban, Wigner, Dirac Blackett, and others, re withholding publication, March to April, 1939.

Also, two memoranda summarizing above events. Undated.

Not sent to Harvard

A28 (5)

Letter, Szilard to Strauss. April 14, 1939

Letter, Strauss to Szilard. April 17, 1939

LEO SZILARD

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Patent Applications which ~~did~~ only partially issued into Patents (2)

To be reproduced in Appendix

U.K. 7840/34

U.S 10,500 (1935) – cancelled portion

PATENT APPLICATIONS WHICH PARTIALLY ISSUED INTO PATENTS

UNITED KINGDOM

7840/34 Filed March 12, 1934 TRANSMUTATION OF CHEMICAL ELEMENTS *

UNITED STATES

10,500 Filed March 11, 1935 TRANSMUTATION OF CHEMICAL ELEMENTS * **

* Reproduced in Appendix

~~** Cancelled portion reproduced in Appendix.~~

Kathleen Winsor
March 22, 1969

Leo Szilard's patent applications,
"TRANSMUTATION OF CHEMICAL ELEMENTS."

A COMPARISION OF BRITISH PROVISIONAL SPECIFICATION 7840/34, Mar. 12, 1934,
with: THE CANCELLED PORTION FROM U.S. APPLICATION 10,500, filed Mar. 11, 1935.

These two patent applications are extremely similar. The American 10,500 has evidently been typed by copying the British 7840. Even the typing errors have been faithfully copied, though on a different typewriter.

Page 1 Introductory paragraph: text identical.

Paragraph entitled "Generation of radio-active bodies."
7840 mentions "penetrating radiation" emitted when collisions are produced between diplogen and itself or other light elements.
10,500 covers the same ground in other words, calls the active agent in the penetrating radiation, neutrons.

Paragraph describing Fig. 1.
Texts identical.

Paragraph describing Fig. 2.
Texts identical, except that 7840 has the paragraph on page 2.

Pages 2-3
Cover much the same material, but arranged and worded differently; they describe the sudden heating up of the transmutation space.
7840 describes the general features of the invention, also suggests testing a mixture of many elements; 10500 does not.
Page 3-½ a? of 7840 is the same as page 3 of 10,500. It is necessary to describe the liberation of neutrons by X-rays, but doesn't seem to fit into this sequence. Also, it is on blue rather than black carbon paper.

Page 4 Texts identical, but 10,500 has some penciled corrections.

Page 5 Texts identical.

Page 6 Texts identical, but in 7840 penciled numbers have been added to refer to Figures.

Page 7 Texts identical. On 10,500 corrections have been initialed LS X by typewriter. One correction on 7840 (changing 403 to 407 in the middle of the page) has not been copied on 10,500.

Page 8 Texts the same, but some major corrections by L.S. on 10,500.

Pages 9-12 Texts identical; corrections (occuring in both) have been initial LS-X on 10.500.

Claims The claims in these two applications are worded differently, but seem to cover the same material.

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February 6, 1969
corr. to April 19, 1969

In reviewing the patent applications which were filed by Dr. Leo Szilard one is struck by the fact that they document an important part of the technical achievements of this great man. I hope that the following few remarks will help in understanding how such patent applications came to be filed, and provide at least some realization of the extent of their scientific importance.

To understand Leo Szilard's interest in patents one must know the man himself. Szilard had an inquisitive, probing mind and devoted his life to thinking and to spurring people into action. He was a man of many facets, somewhat abrasive in manner, unconventional, independent in spirit and action, and concerned with all that was happening in science and politics and its effect on mankind.

Szilard's independent spirit was well suited to his role as an inventor. His inquisitive, brilliant mind was honed by training in both engineering and physics. He was no sooner exposed to a problem than he was thinking of the solution. Szilard was once asked to state the qualities of a scientist. He replied that "the creative scientist has much in common with the artist and the poet. Logical thinking and an analytical ability are necessary attributes of a scientist but they are far from being sufficient for creative work. Those insights in science which have led to a breakthrough operate on the level of the subconscious. Science would run dry

if all scientists were crank turners and if none of them were dreamers." (1) Szilard in these words described his own capabilities and the reasons why he was truly a creative scientist and inventor.

Szilard was a man of great creativity, generally many years ahead of others. As ideas occurred, he would promptly write them down, then fold and seal the paper and post it to himself by mail. By this means he documented the dates when these ideas occurred to him. These ideas ran the gamut from simple solutions to practical everyday problems to complex theories which advanced the frontiers of science. Only a very small proportion of these ideas, those which appeared to have significant commercial potential, were later expanded and written in the form of patent applications. (2)

Szilard's earliest patent applications were filed between 1923 and 1931. (3) At that time he was working in Berlin and dividing his time between the University of Berlin and the Kaiser Wilhelm Institute. While at the University of Berlin he was closely associated with Einstein and certain of the applications filed during this period listed Einstein as a joint inventor.

During this period Szilard directed his energies to working on problems which he believed might have commercial application, such as

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(1) Excerpt from taped interview 1963.

(2) List of known disclosures presently in Szilard's files is appended.

(3) List of all of Szilard's known patent applications and issued patents is appended.

mercury vapor lamps, liquid metal pumping systems, refrigeration systems, the electron microscope, machines for accelerating charged particles, etc. He interested several German companies, including Siemens and the German General Electric Company (AEG), in certain of his ideas and apparently supplemented his income by acting as a consultant to these companies.

Several of Szilard's early German patents related to noiseless household refrigerators which operated without moving mechanical elements or linkages, and to liquid metal pumping systems for such refrigerators. (It may be interesting to note that Einstein collaborated with Szilard on certain of these developments.) As it turned out, such refrigerators were never commercially utilized due to the rapid advances made in mechanical refrigerators which eliminated their objectionable noise, the dangers from leakage of the poisonous refrigerant, and erratic operation. The liquid metal pumping systems developed by Szilard are of particular interest.(4) While for many years there did not appear to be any other practical use for such pumping systems, with the advent of atomic energy their need became evident (first to Szilard) and much effort has since been expended in their further development.

In 1928 Szilard began to direct his thoughts to atomic physics. Disintegration of the atom required higher energies than were available

(4) See, for example, German Patent No. 476,812.

up to that time. He therefore considered ways to accelerate particles to high speeds and this led to his development of the basic principles underlying the linear accelerator and the cyclotron. He documented these concepts in the form of patent applications which were filed in the German Patent Office. The application relating to the linear accelerator was filed on December 17, 1928 (Application No. S 89028 VI/40c) (5) and the application relating to the cyclotron was filed a few weeks later on January 5, 1929 (Application No. S 89288 VIIIa/21g). (6) His cyclotron application (which appears to predate the work of Lawrence) contains a description of the basic principles of the cyclotron including a discussion of the stability of the orbit brought about by having the magnetic field decrease in strength with increasing radius. Unfortunately, it appears that the existence of these applications (which were never issued into patents) was not known by other scientists working in this field and apparently did not influence the later development of the cyclotron and linear accelerator.

In 1933 Szilard moved to London and his interest remained focused in the area of atomic physics and its potentialities. In 1934 and 1935 he collaborated with T. A. Chalmers in experiments on induced radio-activity which were carried out in the Physics Department of the Medical College associated with St. Bartholomew's Hospital. In 1935 he obtained a fellowship at the Clarendon Laboratory at Oxford and continued with his work in the area of induced radioactivity.

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(5) (6) Reproduced in Appendix

During this period he considered the possible consequences of filing basic patents in the atomic field. From his prior experience in the area of patents he recognized that one could obtain a patent without actually testing or proving the validity or operability of the system being patented. He saw the possibility of filing patent applications in the area of atomic physics which might dominate future developments in this area. He futher felt that such patents might be exploited so as to provide a source of income disproportionate to the technical contribution involved. After careful consideration he arrived at a unique solution to his problem. He decided that patents in the area of atomic physics should be turned over to a nonprofit research corporation, and the income therefrom should be used for further research.

Szilard's thoughts on this subject are contained in letters to Drs. Fermi and Segre in 1936. (7)

Several applications which he filed in Great Britain during this period are worth special mention.

In the beginning of 1934 Szilard again considered ways of accelerating particles and on 21 February 1934 he filed a patent application in the British Patent Office (Application No. 5730) (8) entitled "Asynchronous and Synchronous Transformers for Particles." This application describes

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(7) Pertinent portions of this correspondence are reproduced in the Appendix.

(8) Reproduced in Appendix

the principle of operating an accelerator in which the frequency of the accelerating voltage increases with time. It explains the principle of phase stability bringing about the variation of frequency. Again it is unfortunate that this application did not issue into a patent or come to the attention of those working with cyclotrons since some ten years later these same principles were apparently independently rediscovered and utilized in completely revolutionizing the design of the cyclotron.

Another application entitled "Improvements in or Relating to the Transmutation of Chemical Elements" was originally filed on March 12, 1934 (Application No. 7840).(9) This application, which issued into Patent No. 440,023,(10) originally included three inventions: the generation of radioactive elements by means of neutrons, the concept of a nuclear chain reaction, and the chemical separation of radioactive elements from non-radioactive isotopes. This separation method was later experimentally demonstrated (in collaboration with T.A. Chalmers) in the case of iodine, by separating iodine from ethyliodide, and was reported in Nature, Vol. 134, September 22, 1934. This method has become generally known as the Szilard-Chalmers method or reaction.

Subsequently, because of his conviction that if a nuclear chain reaction could be made to work it might be used as an instrument of war to set up violent explosions, Szilard divided out that part of the application which related to the nuclear chain reaction and incorporated

(9) Reproduced in Appendix

(10) Reproduced in Appendix

it in modified form into a later filed application, No. 19157, which he assigned to the British Admiralty in order to prevent its publication.

It is worth noting that the following prophetic passage was included in Patent Application 7840 as filed in March 1934:

> "(a) Pure neutron chains, in which the links of the chain are formed by neutrons of the massnumber 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 its parts under liberation of energy. Elements like uranium and thorium are examples of 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." (11)

The aforementioned application, No. 19157, was originally filed on June 28, 1934. This application, which later issued as Patent No. 630,726,(12) was particularly directed to the idea of the nuclear chain reaction in which more than one neutron is emitted per neutron

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(11) A related United States patent application Serial No. 10,500 was filed on March 11, 1935. Once again, in order to prevent the publication of information that might have important military consequences, he deleted that portion which related to the nuclear chain reaction including the quoted passage. The expurgated application later issued as U.S. Patent No. 2,161,985.

(12) Reproduced in Appendix

absorbed. It was assigned to the British Navy in 1936 (for reasons set forth below). After World War II it was reassigned to Szilard, and the Patent Specification was finally published in September, 1949.

The genesis of this application covering the chain reaction is described by Szilard in material that he wrote for later use. It is quoted here because of the insight it gives into the creative mind of Leo Szilard.

(13) "In the fall of 1933, I found myself in London. I kept myself busy trying to find positions for German colleagues who lost their university positions, with the advent of the Nazi regime. One morning I read in the newspapers about the Annual Meeting of the British Association where Lord Rutherford was reported to have said that whoever talks about the liberation of atomic energy on an industrial scale is talking moonshine. Pronouncements of experts to the effect that something cannot be done have always irritated me. That day as I was walking down Southhampton Row and was stopped for a traffic light, I was pondering whether Lord Rutherford might not prove to be wrong. As the light changed to green and I crossed the street, it suddenly occurred to me that if we could find an element which is split by neutrons and which would

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(13) From taped interview, 1963

emit two neutrons when it absorbed one neutron, such an element, if assembled in sufficiently large mass, could sustain a nuclear chain reaction, liberate energy on an industrial scale and construct atomic bombs. The thought that this might be possible became an obsession with me. It led me to go into nuclear physics, a field in which I had not worked before, and the thought stayed with me even though my first hunches in this regard turned out to be wrong.

"I had one candidate for an element which might be unstable in the sense of emitting neutrons when it disintegrates, and that was beryllium. As it turned out later, beryllium cannot sustain a chain reaction and it is, in fact, stable. What was wrong was that the published mass of helium was wrong. This was later discovered by Bethe and it was a very important discovery for all of us because we did not know where to begin to do nuclear physics if there could be an element which should disintegrate, but doesn't.

"In the Spring of 1934 I applied for a patent which described the laws governing such a chain reaction. It was the first time, I think, that the concept of critical mass was developed and that a chain reaction was seriously discussed. Knowing what this would mean -- and I knew it because I had read H. G. Wells -- I did not want this patent to become public. The only way to keep it from the public was to assign it to the Government. So I assigned this patent to the British Admiralty."[14]

(14) Letter from Szilard to C.S. Wright dated Feb. 26, 1936. Reproduced in Appendix.

Szilard came to America in January 1938. He was still intrigued with the possibility of a chain reaction and continued to look for elements which might be useful for this purpose. In January 1939 he learned of the discovery of the fission of uranium. Because of his prior thinking with respect to a chain reaction, he immediately thought of the possibility that neutrons might be emitted in the fission process and that this process might sustain a chain reaction. All his energies were now directed toward this single goal.

Szilard's first action was to prepare a new patent application covering uranium as a neutron source for the production of radioactive elements and as a means of producing power by using a sufficient amount of uranium to provide a chain reaction. This patent application was filed in the United States Patent Office on March 20, 1939, Serial No. 263,017. (15) Szilard was able to file this application so quickly because it incorporated much of the work contained in his prior British patent application on a chain reaction. This United States application was subsequently abandoned in 1941. The available records are not entirely clear as to the circumstances for this abandonment. There are indications from correspondence with his patent attorneys that he intended to file an updated patent application which incorporated the substance of this patent application before it was abandoned. It is not clear why this updated application was not filed.

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(15) Reproduced in Appendix

Szilard played a central role in the historical development of atomic energy in the United States. He persuaded scientific colleagues to withhold the publication of their papers on nuclear fission in order to keep information from the German scientists, and was the "ghost writer" of the Einstein letter to Roosevelt which initiated the atomic bomb project. Between early 1939 and November 1940 Szilard was not directly affiliated with any University or other organization. When he was not attending scientific meetings or visiting scientific friends such as Fermi, Wigner, Teller, etc., he could be found working at the Kings Crown Hotel in New York. During this period he was granted guest privileges in the Physics Department of Columbia University where he carried out certain fission experiments in collaboration with Walter Zinn who had built equipment which was suitable for this purpose. In February 1940 Szilard wrote an important paper covering a chain reaction using a uranium-carbon system. This paper was originally intended for publication in the Physical Review, but was withheld from publication at his request. In November 1940 Szilard went on the payroll of Columbia University which had just received a contract from the Government to explore the possibility of setting up a chain reaction. From this point until the end of the war Szilard was associated with the Government-sponsored atomic bomb program, later referred to as the Manhattan project.

In February 1942 Szilard left Columbia University to join a small group which was then being assembled at the University of Chicago to direct the effort toward the construction of a controlled chain reaction. The Chicago branch of the Manhattan Project was known as the Metallurgical Laboratory. Immediately following the actual demonstration of a controlled chain reaction in Chicago on December 2, 1942, Szilard was informed that the Project desired to file patent applications on inventions relating to the chain reaction. After lengthy discussion and negotiation concerning the terms and conditions of his continuation on the project, Szilard finally assigned to the Government the patent rights to his inventions on the chain reaction made prior to his employment by the Government on November 1, 1940. He received the sum of $15,417.60, an amount equal to the expenses which he incurred in connection with the development of these inventions, in connection with arrangements relating to their transfer to the Government, and to compensate him for the time during which he worked on these inventions without a salary or other financial consideration.

Szilard remained at the Metallurgical Laboratory until the end of World War II. His many contributions to the Project are attested to by the numerous patent applications which were filed by the Government in his name. Of these applications the most notable is the basic application covering a graphite-moderated nuclear reactor, which listed Fermi and Szilard as co-inventors, and issued as Patent No. 2,708,656 on May 17, 1955.[16]

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(16) Reproduced in Appendix

although he was seldom in residence, he remained on the University staff until his retirement in 1963. Szilard then accepted a position as a resident fellow at the Salk Institute for Biological Studies in La Jolla, California. He moved to California and in the last few months of his life plunged into work with renewed energy.

Despite the frustrations from his past efforts Szilard's optimism in the value of patents remained unabated. He filed at least two patent applications in the United States Patent Office in the post-war period. Application Serial No. 264,263 was filed on December 29, 1951, for a "Process for Producing Microbial Metabolites," and Application Serial No. 320,816 was filed (jointly with A. Novick) on November 15, 1952, for "Caffeine-Containing Products and Method of Their Preparation." Both of these applications were later abandoned.

I should like to conclude with my own feeling of regret for the fact that Leo Szilard was never adequately compensated for his many contributions to the world. This is the purpose for which the patent system was designed. However, as seen in the case of Szilard, the system is clearly inadequate in the case of a visionary who is many years ahead of his time.

J. Tabin

Please return to JWS

VI.

Final

February 6, 1969

Julius Tabin

(E Tabin) corr. 3-12-69 corr. 4-12-69

4-19-69

In reviewing the patent applications which were filed by Dr. Leo Szilard one is struck by the fact that they document an important part of the technical achievements of this great man. I hope that the following few remarks will help in understanding how such patent applications came to be filed, and provide at least some realization of the extent of their scientific importance.

To understand Leo Szilard's interest in patents one must know the man himself. Szilard had an inquisitive, probing mind and devoted his life to thinking and to spurring people into action. He was a man of many facets, somewhat abrasive in manner, unconventional, independent in spirit and action, and concerned with all that was happening in science and politics and its effect on mankind.

Szilard's independent spirit was well suited to his role as an inventor. His inquisitive, brilliant mind was honed by training in both engineering and physics. He was no sooner exposed to a problem than he was thinking of the solution. Szilard was once asked to state the qualities of a scientist. He replied that "the creative scientist has much in common with the artist and the poet. Logical thinking and an analytical ability are necessary attributes of a scientist but they are far from being sufficient for creative work. Those insights in science which have led to a breakthrough operate on the level of the subconscious. Science would run dry

if all scientists were crank turners and if none of them were dreamers." (1) Szilard in these words described his own capabilities and the reasons why he was truly a creative scientist and inventor.

Szilard was a man of great creativity, generally many years ahead of others. As ideas occurred, he would promptly write them down, then fold and seal the paper and post it to himself by mail. By this means he documented the dates when these ideas occurred to him. These ideas ran the gamut from simple solutions to practical everyday problems to complex theories which advanced the frontiers of science. Only a very small proportion of these ideas, those which appeared to have significant commercial potential, were later expanded and written in the form of patent applications. (2)

Szilard's earliest patent applications were filed between 1923 and 1931. (3) At that time he was working in Berlin and dividing his time between the University of Berlin and the Kaiser Wilhelm Institute. While at the University of Berlin he was closely associated with Einstein and certain of the applications filed during this period listed Einstein as a joint inventor.

During this period Szilard directed his energies to working on problems which he believed might have commercial application, such as

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(1) Excerpt from taped interview 1963.

(2) See List of known disclosures presently in Szilard's files ~~is appended~~. page 000

(3) See List of all of Szilard's known patent applications and issued patents is appended. page 000

mercury vapor lamps, liquid metal pumping systems, refrigeration systems, the electron microscope, machines for accelerating charged particles, etc. He interested several German companies, including Siemens and the German General Electric Company (AEG), in certain of his ideas and apparently supplemented his income by acting as a consultant to these companies.

Several of Szilard's early German patents related to noiseless household refrigerators which operated without moving mechanical elements or linkages, and to liquid metal pumping systems for such refrigerators. (It may be interesting to note that Einstein collaborated with Szilard on certain of these developments.) As it turned out, such refrigerators were never commercially utilized due to the rapid advances made in mechanical refrigerators which eliminated their objectionable noise, the dangers from leakage of the poisonous refrigerant, and erratic operation. The liquid metal pumping systems developed by Szilard are of particular interest.(4) While for many years there did not appear to be any other practical use for such pumping systems, with the advent of atomic energy their need became evident (first to Szilard) and much effort has since been expended in their further development.

In 1928 Szilard began to direct his thoughts to atomic physics. Disintegration of the atom required higher energies than were available

(4) See, for example, German Patent No. 476,812. and German Patent No. 554 959 which is reproduced for its historical interest.

up to that time. He therefore considered ways to accelerate particles to high speeds and this led to his development of the basic principles underlying the linear accelerator and the cyclotron. He documented these concepts in the form of patent applications which were filed in the German Patent Office. The application relating to the linear accelerator was filed on December 17, 1928 (Application No. S 89028 VI/40c) (5) and the application relating to the cyclotron was filed a few weeks later on January 5, 1929 (Application No. S 89288 VIIIa/21g). (6) His cyclotron application (which appears to predate the work of Lawrence) contains a description of the basic principles of the cyclotron including a discussion of the stability of the orbit brought about by having the magnetic field decrease in strength with increasing radius. Unfortunately, it appears that the existence of these applications (which were never issued into patents) was not known by other scientists working in this field and apparently did not influence the later development of the cyclotron and linear accelerator.

In 1933 Szilard moved to London and his interest remained focused in the area of atomic physics and its potentialities. In 1934 and 1935 he collaborated with T. A. Chalmers in experiments on induced radio-activity which were carried out in the Physics Department of the Medical College associated with St. Bartholomew's Hospital. In 1935 he obtained a fellowship at the Clarendon Laboratory at Oxford and continued with his work in the area of induced radioactivity.

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(5) (6) Reproduced ~~in Appendix~~ on page 000

During this period he considered the possible consequences of filing basic patents in the atomic field. From his prior experience in the area of patents he recognized that one could obtain a patent without actually testing or proving the validity or operability of the system being patented. He saw the possibility of filing patent applications in the area of atomic physics which might dominate future developments in this area. He further felt that such patents might be exploited so as to provide a source of income disproportionate to the technical contribution involved. After careful consideration he arrived at a unique solution to his problem. He decided that patents in the area of atomic physics should be turned over to a nonprofit research corporation, and the income therefrom should be used for further research.

Szilard's thoughts on this subject are contained in letters to Drs. Fermi and Segre in 1936. (7)

Several applications which he filed in Great Britain during this period are worth special mention.

In the beginning of 1934 Szilard again considered ways of accelerating particles and on 21 February 1934 he filed a patent application in the British Patent Office (Application No. 5730) (8) entitled "Asynchronous and Synchronous Transformers for Particles." This application describes

(7) Pertinent portions of this correspondence are reproduced in the Appendix.

(8) Reproduced in Appendix

the principle of operating an accelerator in which the frequency of the accelerating voltage increases with time. It explains the principle of phase stability bringing about the variation of frequency. Again it is unfortunate that this application did not issue into a patent or come to the attention of those working with cyclotrons since some ten years later these same principles were apparently independently rediscovered and utilized in completely revolutionizing the design of the cyclotron.

Another application entitled "Improvements in or Relating to the Transmutation of Chemical Elements" was originally filed on March 12, 1934 (Application No. 7840).(9) This application, which issued into Patent No. 440,023,(10) originally included three inventions; the generation of radioactive elements by means of neutrons, the concept of a nuclear chain reaction, and the chemical separation of radioactive elements from non-radioactive isotopes. This separation method was later experimentally demonstrated (in collaboration with T. A. Chalmers) in the case of iodine, by separating iodine from ethyliodine, and was reported in Nature, Vol. 134, September 22, 1934. This method has become generally known as the Szilard-Chalmers method or reaction.

Subsequently, because of his conviction that if a nuclear chain reaction could be made to work it ~~can~~ might be used to set up violent explosions (as an instrument of war) ~~for reasons of national security,~~ Szilard divided out that part of the application which related to the nuclear chain reaction

(9) Reproduced in Appendix

(10) Reproduced in Appendix

and incorporated it in modified form into a later filed application No. 19157 which he assigned to the British Admiralty in order to prevent ~~by~~ its publication.

It is worth noting that the following prophetic passage was included in Patent Application 7840 as filed in March 1934:

> "(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 its parts under liberation of energy. Elements like uranium and thorium are examples of 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." (11)

The aforementioned application No. 19157/34 (British) was originally filed on June 28, 1934 ~~(Application No. 19157)~~. This application, which later issued as Patent No. 630,726, (12) was particularly directed to the idea of the nuclear chain reaction in which more than

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(11) A related United States patent application Serial No. 10,500 was filed on March 11, 1935. Once again, in order to prevent the publication of information that might have important military consequences, he deleted that portion which related to the nuclear chain reaction including the quoted passage. The expurgated application later issued ~~under~~ as U.S. Patent No. 2,161,985.

(12) Reproduced in Appendix

one neutron is emitted per neutron absorbed. ~~This application~~ It was ~~originally~~ assigned to the British Navy in 1936 (for reasons set forth below). After World War II, it was ~~later~~ reassigned to Szilard and the Patent Specification was finally published in September, 1949.

The genesis of this application covering the chain reaction is described by Szilard in material that he wrote for later use. It is quoted here because of the insight it gives into the creative mind of Leo Szilard.

(13) "In the Fall of 1933, I found myself in London. I kept myself busy trying to find positions for German colleagues who lost their university positions, with the advent of the Nazi regime. One morning I read in the newspapers about the Annual Meeting of the British Association where Lord Rutherford was reported to have said that whoever talks about the liberation of atomic energy on an industrial scale is talking moonshine. Pronouncements of experts to the effect that something cannot be done have always irritated me. That day as I was walking down Southhampton Row and was stopped for a traffic light, I was pondering whether Lord Rutherford might not prove to be wrong. As the light changed to green and I crossed the street, it suddenly occurred to me that if we could find an element which is split by neutrons and which would

(13) ~~Verbatim~~ taped interview, 1963 From

emit two neutrons when it absorbed one neutron, such an element, if assembled in sufficiently large mass, could sustain a nuclear chain reaction, liberate energy on an industrial scale and construct atomic bombs. The thought that this might be possible became an obsession with me. It led me to go into nuclear physics, a field in which I had not worked before, and the thought stayed with me even though my first hunches in this regard turned out to be wrong.

"I had one candidate for an element which might be unstable in the sense of emitting neutrons when it disintegrates, and that was beryllium. As it turned out later, beryllium cannot sustain a chain reaction and it is, in fact, stable. What was wrong was that the published mass of helium was wrong. This was later discovered by Bethe and it was a very important discovery for all of us because we did not know where to begin to do nuclear physics if there could be an element which should disintegrate, but doesn't.

"In the Spring of 1934 I applied for a patent which described the laws governing such a chain reaction. It was the first time, I think, that the concept of critical mass was developed and that a chain reaction was seriously discussed. Knowing what this would mean -- and I knew it because I had read H. G. Wells -- I did not want this patent to become public. The only way to keep it from the public was to assign it to the Government. So I assigned this patent to the British Admiralty.[14]"

(14) Letter from Szilard to C. S. Wright dated Feb 26, 1936 Reproduced in Appendix.

Szilard came to America in January 1938. He was still intrigued with the possibility of a chain reaction and continued to look for elements which might be useful for this purpose. In January 1939 he learned of the discovery of the fission of uranium. Because of his prior thinking with respect to a chain reaction, he immediately thought of the possibility that neutrons might be emitted in the fission process and that this process might sustain a chain reaction. All his energies were now directed toward this single goal.

Szilard's first action was to prepare a new patent application covering uranium as a neutron source for the production of radioactive elements and as a means of producing power by using a sufficient amount of uranium to provide a chain reaction. This patent application was filed in the United States Patent Office on March 20, 1939, Serial No. 263,017. (14) (15) Szilard was able to file this application so quickly because it incorporated much of the work contained in his prior British patent application on a chain reaction. This United States application was subsequently abandoned in 1941. The available records are not entirely clear as to the circumstances for this abandonment. There are indications from correspondence with his patent attorneys that he intended to file an updated patent application which incorporated the substance of this patent application before it was abandoned. It is not clear why this updated application was not filed.

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(14) Reproduced in Appendix

(15)

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J. Tabin

PATENT APPLICATIONS WHICH PARTIALLY ISSUED INTO PATENTS

UNITED KINGDOM

7840/34	Filed March 12, 1934	TRANSMUTATION OF CHEMICAL ELEMENTS	*

UNITED STATES

10,500	Filed March 11, 1935	TRANSMUTATION OF CHEMICAL ELEMENTS	* **

* Reproduced in Appendix

** Cancelled portion reproduced in Appendix

Kathleen Winsor
March 22, 1969

Leo Szilard's patent applications,
"TRANSMUTATION OF CHEMICAL ELEMENTS."

A COMPARISION OF BRITISH PROVISIONAL SPECIFICATION 7840/34, Mar. 12, 1934,
with: THE CANCELLED PORTION FROM U.S. APPLICATION 10,500, filed Mar. 11, 1935.

These two patent applications are extremely similar. The American 10,500 has evidently been typed by copying the British 7840. Even the typing errors have been faithfully copied, though on a different typewriter.

Page 1 Introductory paragraph: text identical.

Paragraph entitled "Generation of radio-active bodies."
7840 mentions "penetrating radiation" emitted when collisions are produced between diplogen and itself or other light elements.
10,500 covers the same ground in other words, calls the active agent in the penetrating radiation, neutrons.

Paragraph describing Fig. 1.
Texts identical.

Paragraph describing Fig. 2.
Texts identical, except that 7840 has the paragraph on page. 2.

Pages 2-3
Cover much the same material, but arranged and worded differently; they describe the sudden heating up of the transmutation space.
7840 describes the general features of the invention, also suggests testing a mixture of many elements; 10500 does not.
Page 3-½ a? of 7840 is the same as page 3 of 10,500. It is necessary to describe the liberation of neutrons by X-rays, but doesn't seem to fit into this sequence. Also, it is on blue rather than black carbon paper.

Page 4 Texts identical, but 10,500 has some penciled corrections.

Page 5 Texts identical.

Page 6 Texts identical, but in 7840 penciled numbers have been added to refer to Figures.

Page 7 Texts identical. On 10,500 corrections have been initialed LS X by typewriter. One correction on 7840 (changing 403 to 407 in the middle of the page) has not been copied on 10,500.

Page 8 Texts the same, but some major corrections by L.S. on 10,500.

Pages 9-12 Texts identical; corrections (occuring in both) have been initial Ls-X on 10.500.

Claims The claims in these two applications are worded differently, but seem to cover the same material.

Leo SZILARD D

Published Patents

Nederland

(2 patents)

Uitgegeven 15 December 1928.

Dagteekening octrooi 16 October 1928.

OCTROOIRAAD

NEDERLAND

OCTROOI N°. 19092.

KLASSE 21 *g*. GROEP 21.

SIEMENS-SCHUCKERTWERKE GESELLSCHAFT MIT BESCHRÄNKTER HAFTUNG, te Berlijn-Siemensstadt en Dr. LEO SZILARD, te Berlijn-Dahlem.

Ontladingsbuis voor regelbare ontlading.

Aanvrage 31155 Ned., ingediend 2 September 1925, 2 u. 38 m. n.m.; openbaar gemaakt 15 Juni 1928; voorrang van 3 September 1924 af (Duitschland).

Uitgegeven 15 November 1933.

Dagteekening 17 October 1933.

C. D. 621.57

OCTROOIRAAD

NEDERLAND

OCTROOI N°. 31163.

KLASSE 17 *a*. 20.

Prof. Dr. ALBERT EINSTEIN, en Dr. LEO SZILARD, beiden te Berlijn.

Werkwijze voor het comprimeeren van den damp van het koudmakend middel in een koelmachine en koelmachine, geschikt voor de toepassing van deze werkwijze.

Aanvrage 44262 Ned., ingediend 27 December 1928, 14 u. 52 m.; openbaar gemaakt 15 Juni 1933, voorrang van 27 December 1927 af, voor de conclusies 1, 3 en 4, en van 3 December 1928 af, voor conclusie 2, (Duitschland).

D

LEO SZILARD

Published Patents

United Kingdom

(14 Patents)

To be reproduced in full

440,023

630,726

RESERVE COPY.

AMENDED SPECIFICATION.

Reprinted as amended under Section 8 of the Patents and Designs Acts, 1907 and 1919.

PATENT SPECIFICATION

Convention Date (Germany): Sept. 3, 1924. **239,518**

Application Date (in United Kingdom): Sept. 2, 1925. No. 21,972/25.

Complete Accepted: Aug. 26, 1926.

COMPLETE SPECIFICATION (AMENDED).

Improvements in or relating to Electron Discharge Tubes.

We, SIEMENS-SCHUCKERTWERKE GESELLSCHAFT MIT BESCHRÄNKTER HAFTUNG, of Berlin-Siemensstadt, Germany, a German company (part Assignees of Dr. LEO SZILARD, of 16, Faradayweg, Berlin-Dahlem, Germany, of Hungarian nationality), and Dr. LEO SZILARD, of 16, Faradayweg, Berlin-Dahlem, Germany, of Hungarian nationality, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

We, Siemens-Schuckertwerke Gesellschaft mit beschränkter Haftung, of Berlin-Siemensstadt, Germany, a German company (part Assignees of Dr. Leo Szilard, of 16, Faradayweg, Berlin-Dahlem, Germany, of Hungarian nationality), and Dr. Leo Szilard, of 16, Faradayweg, Berlin-Dahlem, Germany, of Hungarian nationality, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:-

RESERVE COPY

PATENT SPECIFICATION

Convention Date (Germany): Dec. 16, 1926. **282,428**

Application Date (in United Kingdom): Dec. 16, 1927. No. 34,096/27.

Complete Accepted: Nov. 15, 1928.

COMPLETE SPECIFICATION.

Improvements relating to Refrigerating Apparatus.

We, ALBERT EINSTEIN, of 5, Haberlandstrasse, Berlin, W. 30, Germany, a citizen of Switzerland, and LEO SZILARD, of 95, Prinzregentenstrasse, Berlin-Wilmersdorf, formerly of Faradayweg 16, Berlin-Dahlem, Germany, a Hungarian citizen, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to refrigerating apparatus having a refrigerant evaporated in the evaporator by the introduction of a pressure equalising auxiliary medium thereinto and separated from said medium by the absorption of the latter and condensation of the refrigerant as described in British Patent Specification No. 250,983.

NOTE.—*The application for a Patent has become void.*
This print shows the Specification as it became open to public inspection.

(3)

PATENT SPECIFICATION

Convention Date (Germany): Dec. 29, 1926. **282,808**

Application Date (In United Kingdom): Dec. 29, 1927. No. 35,201/27.

Complete not Accepted.

COMPLETE SPECIFICATION.

Refrigerating Machines in which the Pumping of Liquid is Effected by Intermittently Increasing the Vapour Pressure.

We, Dr. LEO SZILARD, of 95, Prinzregentenstrasse, Berlin-Wilmersdorf, Germany, and Professor Dr. ALBERT EINSTEIN, of Haberlandstrasse 5, Berlin, Germany, both German citizens, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

NOTE.—*The application for a Patent has become void.*
This print shows the Specification as it became open to public inspection under Section 91 (3) (a) of the Acts.

(4)

PATENT SPECIFICATION

Convention Date (Germany): Jan. 24, 1927. **284,222**

Application Date (in United Kingdom): Jan. 24, 1928. No. 2268/28.

Complete not Accepted.

COMPLETE SPECIFICATION.

Refrigerating Machine with Organic Solvent.

We, Professor Dr. ALBERT EINSTEIN, of 5, Haberlandstrasse, Berlin, Germany, and Dr. LEO SZILARD, of 95, Prinzregentenstrasse, Berlin - Wilmersdorf, Germany, both German citizens, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

PATENT SPECIFICATION

Convention Date (Germany): July 14, 1927. **293,865**

Application Date (in United Kingdom): July 10, 1928. No. 20,043/28.

Complete Accepted: May 30, 1929.

COMPLETE SPECIFICATION.

Improvements in Refrigerating Processes and Apparatus.

I, LEO SZILARD, formerly of Faradayweg 16, Berlin-Dahlem, but now of Prinz Regentenstrasse, 95, Berlin-Wilmersdorf, Germany, of Hungarian nationality, on my own behalf and as Assignee of ALBERT EINSTEIN, of 5, Haberlandstrasse, Berlin, Germany, of German nationality, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

NOTE.—*The application for a Patent has become void. This print shows the Specification as it became open to public inspection under Section 91 (3) (a) of the Acts.*

PATENT SPECIFICATION

Convention Date (Germany): Oct. 17, 1927. **298,950**

Application Date (in United Kingdom): Oct. 16, 1928. No. 29,915/28.

Complete not Accepted.

COMPLETE SPECIFICATION.

Improvements in or relating to Electric Condensers.

Dr. LEO SZILARD, of 95, Prinzregentenstrasse, Berlin-Wilmersdorf, Germany, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

(7)

PATENT SPECIFICATION

Convention Date (Germany): Oct. 31, 1927. **299,783**

Application Date (in United Kingdom): Oct. 29, 1928. No. 31,364/28.

Complete Accepted: Jan. 23, 1930.

COMPLETE SPECIFICATION.

Improvements in and relating to Refrigerating Machines.

I, Dr. LEO SZILARD, of 95, Prinz Regentenstrasse, Berlin-Wilmersdorf, Germany, of Hungarian Nationality, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

(8)

PATENT SPECIFICATION

Convention Date (Germany): Dec. 27, 1927. **303,065**

Application Date (in United Kingdom): Dec. 24, 1928. No. 38,091/28.

Complete Accepted: May 26, 1930.

COMPLETE SPECIFICATION.

Electrodynamic Movement of Fluid Metals particularly for Refrigerating Machines.

We, Prof. ALBERT EINSTEIN, of Swiss Nationality, of 5, Haberlanderstrasse, Berlin, Germany, and Dr. LEO SZILARD, of Hungarian Nationality, of 95, Prinzregentenstrasse, Berlin-Wilmersdorf, Germany, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

PATENT SPECIFICATION

Convention Date (Germany): Dec. 3, 1928.

344,881

Application Date (in United Kingdom): Dec. 3, 1929. No. 37,004/29.

Complete Accepted: March 3, 1931.

COMPLETE SPECIFICATION.

Pump, especially for Refrigerating Machines.

We, Prof. Dr. ALBERT EINSTEIN, of 5, Haberlandstrasse, Berlin, Germany, of Swiss Nationality, and Dr. LEO SZILARD, of 95, Prinz Regentenstrasse, Berlin-Wilmersdorf, Germany, of Hungarian Nationality, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

PATENT SPECIFICATION

Application Date: March 12, 1934. No. 7840/34.

440,023

" " July 4, 1934. No. 33540/35.

(No. 33540/35 being divided out of Application No. 19721/34.)

Application Date: Sept. 20, 1934. No. 27050/34.

One Complete Specification Left: April 9, 1935.

(Under Section 16 of the Patents and Designs Acts, 1907 to 1932.)

Specification Accepted: Dec. 12, 1935.

PROVISIONAL SPECIFICATION
No. 7840 A.D. 1934.

Improvements in or relating to the Transmutation of Chemical Elements

I, LEO SZILARD, a citizen of Germany and Hungary, c/o Claremont Haynes & Co., Vernon House, Bloomsbury, Square, London, W.C.1, do hereby declare the nature of this invention to be as follows:—

(11)

PATENT SPECIFICATION

630,726

Application Date: June 28, 1934. No. 19157/34.
" " July 4, 1934. No. 19721/34.

One Complete Specification left (under Section 16 of the Patents and Designs Acts, 1907 to 1946): April 9, 1935.

Specification Accepted: March 30, 1936 (but withheld from publication under Section 30 of the Patent and Designs Acts 1907 to 1932)

Date of Publication: Sept. 28, 1949.

Index at acceptance: —Class 39(iv), P(1:2:3x).

PROVISIONAL SPECIFICATION
No. 19157 A.D. 1934.

Improvements in or relating to the Transmutation of Chemical Elements

I, LEO SZILARD, a citizen of Germany and subject of Hungary, c/o Claremont Haynes & Co., of Vernon House, Bloomsbury Square, London, W.C.1, do hereby declare the nature of this invention to be as follows:—

This invention has for its object the production of radio active bodies the storage of energy through the production of such bodies and the liberation of nuclear energy for power production and other purposes through nuclear transmutation.

(12)

PATENT SPECIFICATION

817,571

Date of Application and filing Complete Specification: May 10, 1945. No. 11801/45.

Application made in United States of America on May 8, 1944.

Complete Specification Published: Aug. 6, 1959.

(Under Section 6(1) (a) of the Patents &c. (Emergency) Act, 1939 the proviso to Section 91 (4) of the Patents and Designs Acts, 1907 to 1942 became operative on April 4, 1957.)

Index at acceptance:—Class 39(4), C4B2, P2.

International Classification:—G21.

COMPLETE SPECIFICATION

Means for Testing Materials

We, UNITED KINGDOM ATOMIC ENERGY AUTHORITY, of London, a British Authority do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described in and by the following statement:—

The present invention relates generally to the subject of nuclear physics and more particularly to means for determining neutron absorption in graphite, or other neutron slowing material.

(13)

PATENT SPECIFICATION

817,751

Date of Application and filing Complete Specification: Feb. 1, 1945.
No. 2617/45.
Application made in United States of America on Dec. 19, 1944.
Complete Specification Published: Aug. 6, 1959.
(Under Section 6 (1) (a) of the Patents &c. (Emergency) Act, 1939 the proviso to Section 91 (4) of the Patents and Designs Acts, 1907 to 1946 became operative on April 4, 1957.

Index at acceptance:—Classes 1(3), A1(D28:G36D28); **39(4),** C1(A:B), C2(A2:B1:B2:C1:C2:F:H:J), C3(C:E:F), C4(A1:A2:B2), C5C, Q; **82(1),** I4A(2:3X:4C); **82(2),** E3; **and 83(2),** A187.

International Classification:—B23p. C01g. C22b. C23g. G21.

COMPLETE SPECIFICATION

Nuclear Chain Reactions

We, UNITED KINGDOM ATOMIC ENERGY AUTHORITY, of London, a British Authority, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

(14)

PATENT SPECIFICATION

DRAWINGS ATTACHED

825,521

Date of Application and filing Complete Specification May 22, 1946.
No. 15575/46.
Application made in United States of America on May 29, 1945.
Complete Specification Published Dec. 16, 1959.
(Under Section 12 of the Atomic Energy Act, 1946 the proviso to Section 91 (4) of the Patents and Designs Acts, 1907 to 1946 became operative on April 14, 1958).

Index at acceptance:—**Class 39(4),** C(1A:2A2:2B1:2B3A:2C1:2D:3A:3D:3E:3F:4A1:4B2:4B3), Q.

International Classification:—**G21.**

COMPLETE SPECIFICATION

Gas-Cooled Nuclear Reactor

We, UNITED KINGDOM ATOMIC ENERGY AUTHORITY, of London, a British Authority, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

LEO SZILARD

D

Published Patents
United States

(16)

To be reprod. in full: 2,708,656

Patented Jan. 1, 1929. 1,697,210

UNITED STATES PATENT OFFICE.

LEO SZILARD, OF BERLIN, GERMANY, ASSIGNOR TO SIEMENS-SCHUCKERTWERKE AKTIENGESELLSCHAFT, OF BERLIN-SIEMENSSTADT, GERMANY, A CORPORATION OF GERMANY.

DISCHARGE TUBE.

Application filed April 20, 1925, Serial No. 24,575, and in Germany September 3, 1924.

Patented June 4, 1929. 1,715,874

UNITED STATES PATENT OFFICE.

LEO SZILARD, OF BERLIN-DAHLEM, GERMANY, ASSIGNOR TO SIEMENS-SCHUCKERTWERKE GESELLSCHAFT MIT BESCHRÄNKTER HAFTUNG, OF SIEMENSSTADT, NEAR BERLIN, GERMANY, A CORPORATION OF GERMANY.

DISCHARGE TUBE.

Application filed October 28, 1925, Serial No. 65,394, and in Germany November 5, 1924.

Patented Nov. 11, 1930 1,781,541

UNITED STATES PATENT OFFICE

ALBERT EINSTEIN, OF BERLIN, AND LEO SZILARD, OF BERLIN-WILMERSDORF, GERMANY, ASSIGNORS TO ELECTROLUX SERVEL CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

REFRIGERATION

Application filed December 16, 1927, Serial No. 240,566, and in Germany December 16, 1926.

Our invention relates to the art of refrig[illegible]

Patented June 13, 1939

2,161,985

UNITED STATES PATENT OFFICE

2,161,985

PROCESS OF PRODUCING RADIO-ACTIVE ELEMENTS

Leo Szilard, New York, N. Y.

Application March 11, 1935, Serial No. 10,500
In Great Britain March 12, 1934

9 Claims. (Cl. 204—31)

[illegible] methods and appara[illegible] charge tube 11 referred to in Figure 1. The tube

United States Patent Office

2,708,656
Patented May 17, 1955

1

2,708,656

NEUTRONIC REACTOR

Enrico Fermi, Santa Fe, N. Mex., and Leo Szilard, Chicago, Ill., assignors to the United States of America as represented by the United States Atomic Energy Commission

Application December 19, 1944, Serial No. 568,904

8 Claims. (Cl. 204—193)

United States Patent Office

2,778,792
Patented Jan. 22, 1957

1

2,778,792

METHOD FOR UNLOADING REACTORS

Leo Szilard, Chicago, Ill., assignor to the United States of America as represented by the United States Atomic Energy Commission

Application April 19, 1946, Serial No. 663,452

1 Claim. (Cl. 204—154)

United States Patent Office

2,796,396
Patented June 18, 1957

1

2,796,396

METHOD OF INTERMITTENTLY OPERATING A NEUTRONIC REACTOR

Leo Szilard, Chicago, Ill., assignor to the United States of America as represented by the United States Atomic Energy Commission

Application April 16, 1946, Serial No. 662,512

[illegible] Claims. (Cl. 204—154)

United States Patent Office

2,798,847
Patented July 9, 1957

1

2,798,847

METHOD OF OPERATING A NEUTRONIC REACTOR

Enrico Fermi and Leo Szilard, Chicago, Ill., assignors to the United States of America as represented by the United States Atomic Energy Commission

Application December 1, 1952, Serial No. 323,452

1 Claim. (Cl. 204—154)

The present invention relates to the general subject of

United States Patent Office

2,807,581
Patented Sept. 24, 1957

1

2,807,581

NEUTRONIC REACTOR

Enrico Fermi, Santa Fe, N. Mex., and Leo Szilard, Chicago, Ill., assignors to the United States of America as represented by the United States Atomic Energy Commission

Application October 11, 1945, Serial No. 621,838

2 Claims. (Cl. 204—193.2)

The present invention relates to the general subject of nuclear fission and particularly to the establishment of self-sustaining

United States Patent Office

2,825,689
Patented Mar. 4, 1958

1

2,825,689

NEUTRONIC REACTOR AND FUEL ELEMENT THEREFOR

Leo Szilard, Chicago, Ill., and Gale J. Young, Hawthorne, N. Y., assignors to the United States of America as represented by the United States Atomic Energy Commission

Application April 25, 1946, Serial No. 664,732

2 Claims. (Cl. 204—193.2)

United States Patent Office

2,832,733
Patented Apr. 29, 1958

1

2,832,733

HEAVY WATER MODERATED NEUTRONIC REACTOR

Leo Szilard, Chicago, Ill., assignor to the United States of America as represented by the United States Atomic Energy Commission

Application April 23, 1946, Serial No. 664,145

1 Claim. (Cl. 204—193.2)

United States Patent Office

2,836,554
Patented May 27, 1958

1

2,836,554

AIR COOLED NEUTRONIC REACTOR

Enrico Fermi, Santa Fe, N. Mex., and Leo Szilard, Chicago, Ill., assignors to the United States of America as represented by the United States Atomic Energy Commission

Application May 29, 1945, Serial No. 596,465

3 Claims. (Cl. 204—193.2)

United States Patent Office

2,872,401
Patented Feb. 3, 1959

1

2,872,401

JACKETED FUEL ELEMENT

Eugene P. Wigner and Leo Szilard, Chicago, Ill., Edward C. Creutz, Pittsburgh, Pa., assignors to United States of America as represented by the Ur States Atomic Energy Commission

Application May 8, 1946, Serial No. 668,110

2 Claims. (Cl. 204—193.2)

This inv

United States Patent Office

2,886,503
Patented May 12, 1959

1

2,886,503

JACKETED FUEL ELEMENTS FOR GRAPHITE MODERATED REACTORS

Leo Szilard, Chicago, Ill., Eugene P. Wigner, Princeton, N.J., and Edward C. Creutz, Santa Fe, N. Mex., assignors to the United States of America as represented by the United States Atomic Energy Commission

Application February 20, 1946, Serial No. 649,080

4 Claims. (Cl. 204—193.2)

United States Patent Office

2,986,510
Patented May 30, 1961

1

2,986,510

MASSIVE LEAKAGE IRRADIATOR

Eugene P. Wigner, Princeton, N.J., Leo Szilard, Chicago, Ill., Robert F. Christy, Santa Fe, N. Mex., and Francis Lee Friedman, Chicago, Ill., assignors to the United States of America as represented by the United States Atomic Energy Commission

Filed May 14, 1946, Ser. No. 669,524

1 Claim. (Cl. 204—193.2)

This invention relates

United States Patent Office

3,103,475
Patented Sept. 10, 1963

1

3,103,475

REACTOR

Leo Szilard, Chicago, Ill., assignor to the United States of America as represented by the United States Atomic Energy Commission

Filed Sept. 20, 1946, Ser. No. 698,334

3 Claims. (Cl. 204—193.2)

LEO SZILARD

D

Published Patents

Deutsches Reich - Germany

(30 Patents)

To be published in full

Nr. 476, 812

(1)

DEUTSCHES REICH

AUSGEGEBEN
AM 26. JULI 1924

REICHSPATENTAMT

PATENTSCHRIFT

— № 399056 —

KLASSE 21g GRUPPE 16

(S 64002 VIII/21g²)

399056

Dr. Leo Szilard in Berlin-Dahlem und Dipl.-Ing. Imre Patai in Budapest.

Für Röntgenstrahlen empfindliche Zelle.

Patentiert im Deutschen Reiche vom 9. Oktober 1923 ab.

Reproduced

(2)

DEUTSCHES REICH

AUSGEGEBEN AM
3. JUNI 1929

REICHSPATENTAMT

PATENTSCHRIFT

№ 476812

KLASSE 31c GRUPPE 26

S 72993 VI/31c

Tag der Bekanntmachung über die Erteilung des Patents: 8. Mai 1929

Dr. Leo Szilard in Berlin-Dahlem

Verfahren zum Gießen von Metallen in Formen unter Anwendung elektrischer Ströme

Patentiert im Deutschen Reiche vom 20. Januar 1926 ab

(3)

DEUTSCHES REICH

AUSGEGEBEN AM
27. JULI 1929

REICHSPATENTAMT

PATENTSCHRIFT

№ 480 037

KLASSE 17 c GRUPPE 3

S 82114 I/17 c

Tag der Bekanntmachung über die Erteilung des Patents: 4. Juli 1929

Dr. Leo Szilard in Berlin-Wilmersdorf

Kältespeicher

Patentiert im Deutschen Reiche vom 9. Oktober 1927 ab

(4)

DEUTSCHES REICH

AUSGEGEBEN AM
28. MÄRZ 1930

REICHSPATENTAMT

PATENTSCHRIFT

№ 494 810

KLASSE 17 a GRUPPE 12

S 86025 I/17 a

Tag der Bekanntmachung über die Erteilung des Patents: 13. März 1930

Dr. Leo Szilard in Berlin-Wilmersdorf

Intermittierend wirkende Kältemaschine mit getrenntem Kocher und Absorber

Patentiert im Deutschen Reiche vom 13. Juni 1928 ab

(5)

DEUTSCHES REICH

AUSGEGEBEN AM
6. AUGUST 1930

REICHSPATENTAMT

PATENTSCHRIFT

№ 504545

KLASSE 21g GRUPPE 12

S 67727 VIIIa/21g

Tag der Bekanntmachung über die Erteilung des Patents: 24. Juli 1930

Dr. Leo Szilard in Berlin-Dahlem

Entladungsröhre mit Steuerung des Anodenstromes

Patentiert im Deutschen Reiche vom 13. November 1924 ab

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(6)

DEUTSCHES REICH

AUSGEGEBEN AM
27. SEPTEMBER 1930

REICHSPATENTAMT

PATENTSCHRIFT

№ 508486

KLASSE 17a GRUPPE 13/03

S 82485 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 11. September 1930

Dr. Leo Szilard in Berlin-Wilmersdorf

Kältemaschine

Patentiert im Deutschen Reiche vom 1. November 1927 ab

DEUTSCHES REICH

AUSGEGEBEN AM
23. DEZEMBER 1930

REICHSPATENTAMT

PATENTSCHRIFT

№ 515 054

KLASSE 21g GRUPPE 12

S 66997 VIIIa/21g

Tag der Bekanntmachung über die Erteilung des Patents: 11. Dezember 1930

Dr. Leo Szilard in Berlin-Dahlem

Entladungsröhre, bei welcher eine Gasentladung als Elektronenquelle dient

Patentiert im Deutschen Reiche vom 4. September 1924 ab

DEUTSCHES REICH

AUSGEGEBEN AM
1. DEZEMBER 1933

REICHSPATENTAMT

PATENTSCHRIFT

№ 531 581

KLASSE 17a GRUPPE 304

S 92040 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 30. Juli 1931

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531 581

Dr. Leo Szilard in Berlin-Wilmersdorf

Pumpe, insbesondere zur Verdichtung von Gasen und Dämpfen in Kältemaschinen

Patentiert im Deutschen Reiche vom 4. Juni 1929 ab

(9)

45

DEUTSCHES REICH

AUSGEGEBEN AM
21. SEPTEMBER 1931

REICHSPATENTAMT

PATENTSCHRIFT

№ 533 945

KLASSE 17a GRUPPE 3

S 91304 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 3. September 1931

Dr. L. Szilard in Berlin-Wilmersdorf

Pumpe

Patentiert im Deutschen Reiche vom 25. April 1929 ab

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100 (10)

DEUTSCHES REICH

AUSGEGEBEN AM
3. FEBRUAR 1932

REICHSPATENTAMT

PATENTSCHRIFT

№ 543 214

KLASSE 17a GRUPPE 3

S 92043 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 14. Januar 1932

543 214

Dr. Leo Szilard in Berlin-Wilmersdorf

Vorrichtung zur Bewegung von flüssigen Metallen

Patentiert im Deutschen Reiche vom 4. Juni 1929 ab

11

DEUTSCHES REICH

AUSGEGEBEN AM
1. NOVEMBER 1933

REICHSPATENTAMT

PATENTSCHRIFT

№ 548 136

KLASSE 17a GRUPPE 3 04

S 95968 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 24. März 1932

Dr. Leo Szilard in Berlin-Wilmersdorf

Kältemaschine

Patentiert im Deutschen Reiche vom 7. Januar 1931 ab

12

DEUTSCHES REICH

AUSGEGEBEN AM
27. JULI 1933

REICHSPATENTAMT

PATENTSCHRIFT

№ 554 959

KLASSE 17a GRUPPE 3 04

S 83372 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 30. Juni 1932

Dr. Leo Szilard in Berlin-Wilmersdorf und Dr. Albert Einstein in Berlin

Vorrichtung zur Bewegung von flüssigem Metall, insbesondere zur Verdichtung von Gasen und Dämpfen in Kältemaschinen

Patentiert im Deutschen Reiche vom 28. Dezember 1927 ab

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(13)

DEUTSCHES REICH

AUSGEGEBEN AM
9. DEZEMBER 1933

REICHSPATENTAMT

PATENTSCHRIFT

№ 555 141

KLASSE 17a GRUPPE 3 04

S 92042 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 30. Juni 1932

Dr. Leo Szilard in Berlin-Wilmersdorf

Vorrichtung zur Bewegung von flüssigen Metallen

Patentiert im Deutschen Reiche vom 4. Juni 1929 ab

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(14)

DEUTSCHES REICH

AUSGEGEBEN AM
28. JULI 1933

REICHSPATENTAMT

PATENTSCHRIFT

№ 555 413

KLASSE 17a GRUPPE 3 04

S 88745 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 7. Juli 1932

Dr. Albert Einstein in Berlin und Dr. Leo Szilard in Berlin-Wilmersdorf

Pumpe, vorzugsweise für Kältemaschinen

Patentiert im Deutschen Reiche vom 4. Dezember 1928 ab

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(15)

DEUTSCHES REICH

AUSGEGEBEN AM
2. SEPTEMBER 1933

REICHSPATENTAMT

PATENTSCHRIFT

№ 556 536

KLASSE 17a GRUPPE 3 04

S 92025 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 21. Juli 1932

Dr. Leo Szilard in Berlin-Wilmersdorf

Kältemaschine

Patentiert im Deutschen Reiche vom 4. Juni 1929 ab

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(16)

DEUTSCHES REICH

AUSGEGEBEN AM
16. SEPTEMBER 1933

REICHSPATENTAMT

PATENTSCHRIFT

№ 556 535

KLASSE 17a GRUPPE 3/04

E 40538 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 21. Juli 1932

Dr. Albert Einstein in Berlin und Dr. Leo Szilard in Berlin-Wilmersdorf

Pumpe, vorzugsweise für Kältemaschinen

Zusatz zum Patent 555 413

Patentiert im Deutschen Reiche vom 15. April 1930 ab

Das Hauptpatent hat angefangen am 4. Dezember 1928.

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(17)

DEUTSCHES REICH

AUSGEGEBEN AM
13. APRIL 1933

REICHSPATENTAMT

PATENTSCHRIFT

№ 561 904

KLASSE 17a GRUPPE 3/04

17a E 64. 30

Tag der Bekanntmachung über die Erteilung des Patents: 29. September 1932

Dr. Albert Einstein in Berlin und Dr. Leo Szilard in Berlin-Wilmersdorf

Kältemaschine

Patentiert im Deutschen Reiche vom 15. April 1930 ab

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(18)

DEUTSCHES REICH

AUSGEGEBEN AM
20. SEPTEMBER 1933

REICHSPATENTAMT

PATENTSCHRIFT

№ 562 040

KLASSE 21d² GRUPPE 18 01

S 85876 VIII b/21 d²

6. Oktober 1932.

Tag der Bekanntmachung über die Erteilung des Patents: 29. September 1932

Dr. Leo Szilard in Berlin-Wilmersdorf und Dr. Albert Einstein in Berlin

Elektromagnetische Vorrichtung zur Erzeugung einer oszillierenden Bewegung

Patentiert im Deutschen Reiche vom 1. Juni 1928 ab

DEUTSCHES REICH

AUSGEGEBEN AM
8. APRIL 1933

REICHSPATENTAMT

PATENTSCHRIFT

№ 562300

KLASSE 17a GRUPPE 1/01

E 40537 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 6. Oktober 1932

Dr. Albert Einstein in Berlin und Dr. Leo Szilard in Berlin-Wilmersdorf

Kältemaschine

Patentiert im Deutschen Reiche vom 15. April 1930 ab

DEUTSCHES REICH

AUSGEGEBEN AM
26. OKTOBER 1932

REICHSPATENTAMT

PATENTSCHRIFT

№ 562523

KLASSE 17a GRUPPE 14

S 99398 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 6. Oktober 1932

Dr. Leo Szilard in Berlin-Wilmersdorf

Absperrorgan

Patentiert im Deutschen Reiche vom 26. Juni 1931 ab

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(21)

DEUTSCHES REICH

AUSGEGEBEN AM
1. NOVEMBER 1933

REICHSPATENTAMT

PATENTSCHRIFT

№ 562898

KLASSE 17a GRUPPE 13 01

17a S 194. 30

Tag der Bekanntmachung über die Erteilung des Patents: 13. Oktober 1932

Dr. Leo Szilard in Berlin-Wilmersdorf

Wärmeübertrager

Patentiert im Deutschen Reiche vom 10. September 1930 ab

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(22)

DEUTSCHES REICH

AUSGEGEBEN AM
30. MAI 1933

REICHSPATENTAMT

PATENTSCHRIFT

№ 563403

KLASSE 17a GRUPPE 3 04

S 82663 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 29. Oktober 1932

Dr. Leo Szilard in Berlin-Dahlem und Dr. Albert Einstein in Berlin

Kältemaschine

Patentiert im Deutschen Reiche vom 13. November 1927 ab

(23)

DEUTSCHES REICH

AUSGEGEBEN AM
16. JULI 1934

REICHSPATENTAMT

PATENTSCHRIFT

№ 564680

KLASSE 17a GRUPPE 3/04

S 95969 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 3. November 1932

Dr. Leo Szilard in Berlin-Wilmersdorf

Kältemaschine

Patentiert im Deutschen Reiche vom 7. Januar 1931 ab

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(24)

DEUTSCHES REICH

AUSGEGEBEN AM
4. JULI 1933

REICHSPATENTAMT

PATENTSCHRIFT

№ 565614

KLASSE 17a GRUPPE 3 04

E 39852 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 17. November 1932

Dr. Albert Einstein in Berlin und Dr. Leo Szilard in Berlin-Wilmersdorf

Kompressor

Patentiert im Deutschen Reiche vom 11. September 1929 ab

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(25)

DEUTSCHES REICH

AUSGEGEBEN AM
15. SEPTEMBER 1933

REICHSPATENTAMT

PATENTSCHRIFT

№ 568 680

KLASSE 17a GRUPPE 304

S 95967 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 5. Januar 1933

Dr. Leo Szilard in Berlin-Wilmersdorf

Stator für Kältemaschinen

Patentiert im Deutschen Reiche vom 7. Januar 1931 ab

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(26)

DEUTSCHES REICH

AUSGEGEBEN AM
17. MÄRZ 1934

REICHSPATENTAMT

PATENTSCHRIFT

№ 570 959

KLASSE 17a GRUPPE 304

S 92041 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 2. Februar 1933

Dr. Leo Szilard in Berlin-Wilmersdorf

Vorrichtung zur Bewegung von flüssigem Metall

Patentiert im Deutschen Reiche vom 4. Juni 1929 ab

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(27)

DEUTSCHES REICH

AUSGEGEBEN AM
2. AUGUST 1933

REICHSPATENTAMT

PATENTSCHRIFT

№ 581 780

KLASSE 17a GRUPPE 3 04

S 95926 I/17a

Tag der Bekanntmachung über die Erteilung des Patents: 13. Juli 1933

Dr. Leo Szilard in Berlin-Wilmersdorf

Kompressor, im besonderen für Kältemaschinen

Patentiert im Deutschen Reiche vom 3. Januar 1931 ab

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(28)

DEUTSCHES REICH

AUSGEGEBEN AM
29. JUNI 1933

REICHSPATENTAMT

PATENTSCHRIFT

№ 579 679

KLASSE 21g GRUPPE 12 03

21g S 717. 30

Tag der Bekanntmachung über die Erteilung des Patents: 15. Juni 1933

Dr. Leo Szilard in Berlin-Wilmersdorf

Entladungsröhre, bei welcher eine Gasentladung als Elektronenquelle dient

Patentiert im Deutschen Reiche vom 4. September 1924 ab

DEUTSCHES REICH

AUSGEGEBEN AM
16. JULI 1934

REICHSPATENTAMT

PATENTSCHRIFT

№ 600 162

KLASSE 42g GRUPPE 11 01

S 98694 IX/42g

Tag der Bekanntmachung über die Erteilung des Patents: 28. Juni 1934

Dr. Leo Szillard in Berlin-Wilmersdorf

Verfahren zum elektrochemischen Aufzeichnen von Sprechströmen

Patentiert im Deutschen Reiche vom 17. Mai 1931 ab

Erteilt auf Grund des Ersten Überleitungsgesetzes vom 8. Juli 1949
(WiGBl. S. 175)

BUNDESREPUBLIK DEUTSCHLAND

AUSGEGEBEN AM
13. JUNI 1957

DEUTSCHES PATENTAMT

PATENTSCHRIFT

№ 965 522

KLASSE 21g GRUPPE 37 01

INTERNAT. KLASSE H 05j

S 18863 VIIIc/21g

Dr. Leo Szilard, New York, N. Y. (V. St. A.)

Mikroskop

Patentiert im Gebiet der Bundesrepublik Deutschland vom 4. Juli 1931 an
Patentanmeldung bekanntgemacht am 20. Dezember 1956
Patenterteilung bekanntgemacht am 29. Mai 1957
Die Schutzdauer des Patents ist nach Gesetz Nr. 8 der Alliierten Hohen Kommission verlängert

Translation of a letter from Leo Szilard to O.S.

(Tabin reference 5. and 6. German Patent applications)

Dear Herr Professor ,

Enclosed I am sending you "reprints" which will perhaps amuse you. These are two patent applications which contain the methods since developed by Lawrence. The first application was submitted before the publication of the corresponding paper by Wideroe and contains the method for the production of fast protons by means of rapidly changing electric fields. The second apllication was submitted shortly afterwards and contains the use of a stationary magnetic field for winding up a proton beam in an oscillating electric field. ~~Xxxxx~~ The two papers by Lawrence are of a later date, but Lawrence had, of course, no knowledge of these unpublished applications. Of course, the merit lies in the carrying out and not in the thinking out of the experiments, and I am sending you these "reprints" only to enable you to praise me, if necessary, with a better conscience.

With kindest regards,

Very sincerely yours,

(signed) Leo Szilard

P.S. If you wish to look at the applications at all, you will find that the first three to four pages of the second application are the most illuminating ones.

(Translation By G.W.Szilard, April 24, 1970, for Dr. Feld.)

bbs1 x

Draft

1155 East 57th Street
Chicago, Illinois
November 24, 1943

Captain R. A. Lavender
O.S.R.D.
1530 P Street, N. W.
Washington, D. C.

Dear Captain Lavender:

I understand that the sum of $25,000 has been authorized as monetary consideration for the rights in my inventions which you propose that I should assign to the Government.

I am writing to you in order to state that I prefer to limit the sum which I accept to expenses which I have incurred in connection with these inventions, in connection with arrangements relating to their transfer to the Government and to compensation for my time covering a certain period during which I worked on these inventions without a salary or other financial consideration. Of the expenses incurred I prefer to recover only that part of the expenses which represent as yet undischarged financial obligations toward third persons.

In the following you will find an itemized statement:

During 1939 and 1940 I spent for experiments carried out at Columbia University a sum exceeding $2,000. This was partially financed by a personal loan which I obtained for this purpose from Dr. Benjamin Liebowitz in the amount of $2,000. This represents an as yet undischarged obligation.. . . . . $2,000.00

An agreement concerning certain of my inventions was concluded with Mr. I. Adam in 1936 and this agreement was subject of a controversy. I understood that this controversy stood in the way of the proposed transaction with the Government and ~~in order to~~

~~Facilitate this transaction~~ I have settled this controversy and canceled the 1936 agreement. Out of this settlement arose an obligation to pay $8,000 to Mr. G. Jacobson, attorney for Mr. Adam. I was able to raise $2,000 out of this sum by entering into a commitment to assign to Dr. Benjamin Liebowitz the American patent No. 2,161,985 and the British patent No. 410,023 which had previously fallen under the agreement with Mr. Adam. There remains an uncovered obligation to pay $6,000.00

In connection with the negotiations for the cancelation of the 1936 agreement I received a bill dated October 11, 1943 from my attorney, Mr. F. Moses, amounting to $600 of which I have already paid $300 leaving an undischarged obligation of 300.00

In connection with the same negotiation for the cancellation of the 1936 agreement I have received an attorney bill from the firm Wachtell, Manheim and Grouf dated October 5, 1943 amounting to. 75.00

In connection with the negotiations with the government I received a bill from Mr. James P. Hume amounting to 375.00

I started experimental work at Columbia University in the field in which the government is now interested on ~~xxxxxxxxx~~ March 1, 1939 and after that date until November 1, 1940 I did not do any other work and worked exclusively along this line and received no financial consideration from any source. As a compensation for my time during those twenty months I arrive, on the basis of a monthly compensation of $333.33 at the sum of. 6666.60

Total . . 15,416.60 . . . . . .

I therefore propose that the monetary consideration for the proposed transaction be $15417.6 which includes the above items with the addition of one dollar ($1.00).

Very truly yours,

Leo Szilard

VI.

February 6, 1969

Julius Tabin

In reviewing the patent applications which were filed by Dr. Leo Szilard one is struck by the fact that they document an important part of the technical achievements of this great man. I hope that the following few remarks will help in understanding how such patent applications came to be filed, and provide at least some realization of the extent of their scientific importance.

To understand Leo Szilard's interest in patents one must know the man himself. Szilard had an inquisitive, probing mind and devoted his life to thinking and to spurring people into action. He was a man of many facets, somewhat abrasive in manner, unconventional, independent in spirit and action, and concerned with all that was happening in science and politics and its effect on mankind.

Szilard's independent spirit was well suited to his role as an inventor. His inquisitive, brilliant mind was honed by training in both engineering and physics. He was no sooner exposed to a problem than he was thinking of the solution. Szilard was once asked to state the qualities of a scientist. He replied that "the creative scientist has much in common with the artist and the poet. Logical thinking and an analytical ability are necessary attributes of a scientist but they are far from being sufficient for creative work. Those insights in science which have led to a breakthrough operate on the level of the subconscious. Science would run dry

if all scientists were crank turners and if none of them were dreamers." (1) Szilard in these words described his own capabilities and the reasons why he was truly a creative scientist and inventor.

Szilard was a man of great creativity, generally many years ahead of others. As ideas occurred, he would promptly write them down, then fold and seal the paper and post it to himself by mail. By this means he documented the dates when these ideas occurred to him. These ideas ran the gamut from simple solutions to practical everyday problems to complex theories which advanced the frontiers of science. Only a very small proportion of these ideas, those which appeared to have significant commercial potential, were later expanded and written in the form of patent applications. (2)

Szilard's earliest patent applications were filed between 1923 and 1931. (3) At that time he was working in Berlin and dividing his time between the University of Berlin and the Kaiser Wilhelm Institute. While at the University of Berlin he was closely associated with Einstein and certain of the applications filed during this period listed Einstein as a joint inventor.

During this period Szilard directed his energies to working on problems which he believed might have commercial application, such as

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(1) Excerpt from taped interview 1963.

(2) List of known disclosures presently in Szilard's files is appended.

(3) List of all of Szilard's known patent applications and issued patents is appended.

mercury vapor lamps, liquid metal pumping systems, refrigeration systems, the electron microscope, machines for accelerating charged particles, etc. He interested several German companies, including Siemens and the German General Electric Company (AEG), in certain of his ideas and apparently supplemented his income by acting as a consultant to these companies.

Several of Szilard's early German patents related to noiseless household refrigerators which operated without moving mechanical elements or linkages, and to liquid metal pumping systems for such refrigerators. (It may be interesting to note that Einstein collaborated with Szilard on certain of these developments.) As it turned out, such refrigerators were never commercially utilized due to the rapid advances made in mechanical refrigerators which eliminated their objectionable noise, the dangers from leakage of the poisonous refrigerant, and erratic operation. The liquid metal pumping systems developed by Szilard are of particular interest.(4) While for many years there did not appear to be any other practical use for such pumping systems, with the advent of atomic energy their need became evident (first to Szilard) and much effort has since been expended in their further development.

In 1928 Szilard began to direct his thoughts to atomic physics. Disintegration of the atom required higher energies than were available

(4) See, for example, German Patent No. 476,812.

up to that time. He therefore considered ways to accelerate particles to high speeds and this led to his development of the basic principles underlying the linear accelerator and the cyclotron. He documented these concepts in the form of patent applications which were filed in the German Patent Office. The application relating to the linear accelerator was filed on December 17, 1928 (Application No. S 89028 VI/40c) (5) and the application relating to the cyclotron was filed a few weeks later on January 5, 1929 (Application No. S 89288 VIIIa/21g). (6) His cyclotron application (which appears to predate the work of Lawrence) contains a description of the basic principles of the cyclotron including a discussion of the stability of the orbit brought about by having the magnetic field decrease in strength with increasing radius. Unfortunately, it appears that the existence of these applications (which were never issued into patents) was not known by other scientists working in this field and apparently did not influence the later development of the cyclotron and linear accelerator.

In 1933 Szilard moved to London and his interest remained focused in the area of atomic physics and its potentialities. In 1934 and 1935 he collaborated with T. A. Chalmers in experiments on induced radio-activity which were carried out in the Physics Department of the Medical College associated with St. Bartholomew's Hospital. In 1935 he obtained a fellowship at the Clarendon Laboratory at Oxford and continued with his work in the area of induced radioactivity.

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(5) (6) Reproduced in Appendix

During this period he considered the possible consequences of filing basic patents in the atomic field. From his prior experience in the area of patents he recognized that one could obtain a patent without actually testing or proving the validity or operability of the system being patented. He saw the possibility of filing patent applications in the area of atomic physics which might dominate future developments in this area. He futher felt that such patents might be exploited so as to provide a source of income disproportionate to the technical contribution involved. After careful consideration he arrived at a unique solution to his problem. He decided that patents in the area of atomic physics should be turned over to a nonprofit research corporation, and the income therefrom should be used for further research.

Szilard's thoughts on this subject are contained in letters to Drs. Fermi and Segre in 1936. (7)

Several applications which he filed in Great Britain during this period are worth special mention.

In the beginning of 1934 Szilard again considered ways of accelerating particles and on 21 February 1934 he filed a patent application in the British Patent Office (Application No. 5730) (8) entitled "Asynchronous and Synchronous Transformers for Particles." This application describes

(7) Pertinent portions of this correspondence are reproduced in the Appendix.

(8) Reproduced in Appendix

the principle of operating an accelerator in which the frequency of the accelerating voltage increases with time. It explains the principle of phase stability bringing about the variation of frequency. Again it is unfortunate that this application did not issue into a patent or come to the attention of those working with cyclotrons since some ten years later these same principles were apparently independently rediscovered and utilized in completely revolutionizing the design of the cyclotron.

Another application entitled "Improvements in or Relating to the Transmutation of Chemical Elements" was originally filed on March 12, 1934 (Application No. 7840).(9) This application, which issued into Patent No. 440,023,(10) originally included three inventions, the generation of radioactive elements by means of neutrons, the concept of a nuclear chain reaction, and the chemical separation of radioactive elements from non-radioactive isotopes. This separation method was later experimentally demonstrated (in collaboration with T. A. Chalmers) in the case of Iodine, by separating Iodine from Ethyliodine, and was reported in Nature, Vol. 134, September 22, 1934. This method has become generally known as the Szilard-Chalmers method or reaction.

Subsequently, ~~for reasons of national security,~~ because of his "conviction that if a nuclear chain reaction can be made to work it can be used to set up violent explosions" Szilard divided out that part of the application which related to the nuclear chain reaction

(9) Reproduced in Appendix

(10) Reproduced in Appendix

and incorporated it in modified form into a later filed application which he prevented from being published. ~~was placed under a secrecy order~~.

It is worth noting that the following prophetic passage was included in Patent Application 7840 as filed in March 1934:

> "(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 its parts under liberation of energy. Elements like uranium and thorium are examples of 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." (11)

The aforementioned application, which he then assigned to the British Admiralty ~~was placed under a secrecy order~~, was originally filed on June 28, 1934 (Application No. 19157). This application, which later issued as Patent No. 630,726, (12) was particularly directed to the idea of the nuclear chain reaction in which more than

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(11) A related United States patent application Serial No. 10,500 was filed on March 11, 1935. Once again, in order to prevent the publication of information that might have important military consequences, he deleted that portion which related to the nuclear chain reaction including the quoted passage. The expurgated application later issued ~~under~~ as U.S. Patent No. 2,161,985.

(12) Reproduced in Appendix

one neutron is emitted per neutron absorbed. This application was originally assigned to the British Navy in 1936 (for reasons set forth below). After World War II, It was ~~later~~ reassigned to Szilard and the Patent Specification was finally published in September, 1949.

The genesis of this application covering the chain reaction is described by Szilard in material that he wrote for later use. It is quoted here because of the insight it gives into the creative mind of Leo Szilard.

(13) "In the Fall of 1933, I found myself in London. I kept myself busy trying to find positions for German colleagues who lost their university positions, with the advent of the Nazi regime. One morning I read in the newspapers about the Annual Meeting of the British Association where Lord Rutherford was reported to have said that whoever talks about the liberation of atomic energy on an industrial scale is talking moonshine. Pronouncements of experts to the effect that something cannot be done have always irritated me. That day as I was walking down Southhampton Row and was stopped for a traffic light, I was pondering whether Lord Rutherford might not prove to be wrong. As the light changed to green and I crossed the street, it suddenly occurred to me that if we could find an element which is split by neutrons and which would

(13) ~~Identify~~ From taped interview, 1963

emit two neutrons when it absorbed one neutron, such an element, if assembled in sufficiently large mass, could sustain a nuclear chain reaction, liberate energy on an industrial scale and construct atomic bombs. The thought that this might be possible became an obsession with me. It led me to go into nuclear physics, a field in which I had not worked before, and the thought stayed with me even though my first hunches in this regard turned out to be wrong.

"I had one candidate for an element which might be unstable in the sense of emitting neutrons when it disintegrates, and that was beryllium. As it turned out later, beryllium cannot sustain a chain reaction and it is, in fact, stable. What was wrong was that the published mass of helium was wrong. This was later discovered by Bethe and it was a very important discovery for all of us because we did not know where to begin to do nuclear physics if there could be an element which should disintegrate, but doesn't.

"In the Spring of 1934 I applied for a patent which described the laws governing such a chain reaction. It was the first time, I think, that the concept of critical mass was developed and that a chain reaction was seriously discussed. Knowing what this would mean -- and I knew it because I had read H. G. Wells -- I did not want this patent to become public. The only way to keep it from the public was to assign it to the Government. So I assigned this patent to the British Admiralty."

Szilard came to America in January 1938. He was still intrigued with the possibility of a chain reaction and continued to look for elements which might be useful for this purpose. In January 1939 he learned of the discovery of the fission of uranium. Because of his prior thinking with respect to a chain reaction, he immediately thought of the possibility that neutrons might be emitted in the fission process and that this process might sustain a chain reaction. All his energies were now directed toward this single goal.

Szilard's first action was to prepare a new patent application covering uranium as a neutron source for the production of radioactive elements and as a means of producing power by using a sufficient amount of uranium to provide a chain reaction. This patent application was filed in the United States Patent Office on March 20, 1939, Serial No. 263,017. (14) Szilard was able to file this application so quickly because it incorporated much of the work contained in his prior British patent application on a chain reaction. This United States application was subsequently abandoned in 1941. The available records are not entirely clear as to the circumstances for this abandonment. There are indications from correspondence with his patent attorneys that he intended to file an updated patent application which incorporated the substance of this patent application before it was abandoned. It is not clear why this updated application was not filed.

(14) Reproduced in Appendix

Szilard played a central role in the historical development of atomic energy in the United States. He persuaded scientific colleagues to withhold the publication of their papers on nuclear fission in order to keep information from the German scientists, and was the "ghost writer" of the Einstein letter to Roosevelt which initiated the atomic bomb project. Between early 1939 and November 1940 Szilard was not directly affiliated with any University or other organization. When he was not attending scientific meetings or visiting scientific friends such as Fermi, Wigner, Teller, etc., he could be found working at the Kings Crown Hotel in New York. During this period he was granted guest privileges in the Physics Department of Columbia University where he carried out certain fission experiments in collaboration with Walter Zinn who had built equipment which was suitable for this purpose. In February 1940 Szilard wrote an important paper covering a chain reaction using a uranium-carbon system. This paper was originally intended for publication in the Physical Review, but was withheld from publication at his request. In November 1940 Szilard went on the payroll of Columbia University which had just received a contract from the Government to explore the possibility of setting up a chain reaction. From this point until the end of the war Szilard was associated with the Government-sponsored atomic bomb program, later referred to as the Manhattan project.

In February 1942 Szilard left Columbia University to join a small group which was then being assembled at the University of Chicago to direct the effort toward the construction of a controlled chain reaction. The Chicago branch of the Manhattan Project was known as the Metallurgical Laboratory. Immediately following the actual demonstration of a controlled chain reaction in Chicago on December 2, 1942, Szilard was informed that the project desired to file patent applications on inventions relating to the chain reaction. After lengthy discussion and negotiation concerning the terms and conditions of his continuation on the project, Szilard finally assigned to the Government the patent rights to his inventions on the chain reaction made prior to his employment by the Government on November 1, 1940. He received the sum of $15,417.60, an amount equal to the expenses which he incurred in connection with these inventions, in connection with arrangements relating to their transfer to the Government, and to compensate him for the time during which he worked on these inventions without a salary or other financial consideration.

Szilard remained at the Metallurgical Laboratory until the end of World War II. His many contributions to the project are attested to by the numerous patent applications which were filed by the Government in his name. Of these applications the most notable is the basic application covering a graphite-moderated nuclear reactor, which listed Fermi and Szilard as co-inventors and issued as Patent No. 2,708,656 on May 17, 1955. (15)

After the war Szilard turned his attention to biophysical problems. He became a Professor of Biophysics at the University of Chicago, and,

(15) Reproduced in Appendix

although he was seldom in residence, he remained on the University staff until his retirement in 1963. Szilard then accepted a position as a resident fellow at the Salk Institute for Biological Studies in La Jolla, California. He moved to California and in the last few months of his life plunged into work with renewed energy.

Despite the frustrations from his past efforts Szilard's optimism in the value of patents remained unabated. He filed at least two patent applications in the United States Patent Office in the post-war period. Application Serial No. 264,263 was filed on December 29, 1951, for a "Process for Producing Microbial Metabolites," and Application Serial No. 320,816 was filed (jointly with A. Novick) on November 15, 1952, for "Caffeine-Containing Products and Method of Their Preparation." Both of these applications were later abandoned.

I should like to conclude with my own feeling of regret for the fact that Leo Szilard was never adequately compensated for his many contributions to the world. This is the purpose for which the patent system was designed. However, as seen in the case of Szilard, the system is clearly inadequate in the case of a visionary who is many years ahead of his time.

J. Tabin

R1

X 1-12-71

c/o Clarendon Laboratory,
Parks Road,
OXFORD.

14th April, 1936.

Sir,

You might remember that I mentioned to you some two years ago patents concerning practical applications of nuclear Physics, for which I have applied. Rightly or wrongly, I thought at that time that if physicists take out such patents in the capacity of self-appointed trustees, they may keep open the door for a disinterested attempt on the part of scientists to exert some measure of control over this field.

None of the practical applications are as yet sufficiently important or dangerous for scientists to concern themselves about them. May I however state that the patent for the production of radio-active elements by means of neutrons has now been accepted, and that this patent (which must not be considered in any way - except in form - as my personal property) is at any time at the disposal of those physicists who are pioneers of this field, in case they wish to concern themselves with the proper administration of such patents.

The matter is hardly of sufficient importance at present to justify my approaching you about it. Even at present, though, such patents might be used for raising funds for research purposes, and since it would be hardly right for me to act along this line as a self-appointed trustee, I was thinking of asking perhaps Chadwick, Cockcroft or Fermi if two of them would be willing jointly to decide any issue which might arise in connection with this matter, and to decide about the use of any funds which might arise from it.

If, for any reason, this course of action appears to you to be wrong, I should very much appreciate your letting me know any objections. If no satisfactory solution can be found, the trivial remedy of withdrawing these patents remains open at any time.

Yours very truly,

moral support

I'll be glad to selection

here provided I am satisfied

that the doc. will fairly accurately

portray my husbands achievements

+ philosophy of life.

Accordingly before proceeding

I would like to have

the opport. of reviewing

the outline of your script

Doc. in Stocks

Peter Kaye

Compensation

Preface

TREUHANDSTELLE
REICHSPATENTAMT Informationsamt für gewerbliche Schutzrechte

Auskunftsstelle Pat/GM.
Gesch.-Z.: W 1/ 728- W/Gt.-
(Angabe bei Antwort erbeten)
Ihr Zeichen: --

1 Berlin 61, den
Gitschiner Str. 97 - 103 · Fernsprecher: 61 03 61 App.
Fernschreiber: 01 83 604 dtpatamtdst bln
Postscheckkonto: Berlin West Nr. 70 für
Kasse der Treuhandstelle Reichspatentamt
Bankkonto: Landeszentralbank in Berlin, Girokonto Nr. 1/1542

30. Juli 1965

278

Madame
Dr. Gertrud Weiss Szilard, M.D.
Del Charro

- 2380 Torrey Pines Road -
La Jolla /California 92038

Betr.: Professor Dr. Leo Szilard
Vorg.: Ihre Schreiben vom 15.6. u. 24.7.1965
- Unser Schreiben vom 8.7.1965 -

Sehr geehrte Frau Doktor Weiss-Szilard!

Auf den Namen

Dr. Leo Szilard, Berlin-Dahlem
bzw. Berlin-Wilmersdorf, bzw. London,

wurden in dem Zeitraum von 1920 bis 8.5.1945 die folgenden deutschen Schutzrechte ermittelt:

1. P a t e n t e :

	Patent-Nr. Kl./Gr.:	v o m:	Bezeichnung:
1	562 300/17a, 1/01	15. 4. 30	Kältemaschine Berlin Inhaber: Dr. Albert Einstein/ und Dr. Leo Szilard, Berlin-Wilmersdorf
2	533 945/17a, 3/02	25. 4. 29	Pumpe
3	531 581/17a,3/04	4. 6. 29	Pumpe, insbesondere zur Verdichtung von Gasen und Dämpfen in Kältemaschinen
4	543 214/17a,3/04	4. 6. 29	Vorrichtung zur Bewegung von flüssigen Metallen

-Bl. 2 -

	Patente-Nr.Kl./Gr.:	vom:	Bezeichnung:
5	548 136 / 17a, 3/04	7. 1. 31	Kältemaschine
6	554 959/17a, 3/04	28.12. 27	Vorrichtung zur Bewegung von flüssigem Metall, insbesondere zur Verdichtung von Gasen und Dämpfen in Kältemaschinen Inhaber: Dr. Leo Szilard, Berlin-Wilmersdorf und Dr. Albert Einstein, Berlin
7	555 141 " "	4. 6. 29	Vorrichtung zur Bewegung von flüssigen Metallen
8	555 413 " "	4.12. 28	Pumpe, vorzugsweise für Kältemaschinen Inhaber: Dr. Albert Einstein, Berlin und Dr. Leo Szilard, Berlin-Wilmersdorf
9	556 535 " "	15. 4. 30	Pumpe, vorzugsweise für Kältemaschinen Inhaber: wie vor - Zusatz zum Patent 555 413 -
10	556 536 " "	4. 6. 29	Kältemaschine
11	561 904 " "	15. 4. 30	Kältemaschine Inhaber: Dr. Albert Einstein, Berlin und Dr. Leo Szilard, Berlin-Wilmersdorf
12	563 403 " "	13.11. 27	Kältemaschine Inhaber: wie vor
13	564 680 " "	7. 1. 31	Kältemaschine
14	565 614 " "	11. 9. 29	Kompressor Inhaber: Dr. Albert Einstein, Berlin und Dr. Leo Szilard, Berlin-Wilmersdorf
15	568 680 " "	7. 1. 31	Stator für Kältemaschinen
16	570 959 " "	4. 6. 29	Vorrichtung zur Bewegung von flüssigem Metall
17	581 780 " "	3. 1. 31	Kompressor, im besonderen für Kältemaschinen
18	494 810/17a, 12	13. 6.28	Intermittierend wirkende Kältemaschine mit getrenntem Kocher und Absorber

	Patent-Nr. Kl.:/Gr.:	v o m:	Bezeichnung:
19	508 486/17a, 13/03	1. 11. 27	Kältemaschine
20	562 898/17a, 13/03	10. 9. 30	Wärmeübertrager
21	562 523 ", 14	26. 6. 31	Absperrorgan
22	480 037/17c,3/11	9.10. 27	Kältespeicher
23	562 040 /21d[1], 22	1. 6. 28	Elektromagnetische Vorrichtung zur Erzeugung einer oszillierenden Bewegung Inhaber: Dr. Leo Szilard, Berlin-Wilmersdorf und Dr. Albert Einstein, Berlin
24	504 545/21g, 12/03	13.11. 24	Entladungsröhre mit Steuerung des Anodenstromes
25	515 054/21g, 12/03	4. 9. 24	Entladungsröhre, bei welcher eine Gasentladung als Elektronenquelle dient
26	579 679/21g, 12/03	4. 9. 24	Entladungsröhre bei welcher eine Gasentladung als Elektronenquelle dient
27	399 056/21g, 18/02	9.10. 23	Für Röntgenstrahlen empfindliche Zelle Inhaber: Dr. Leo Szilard, Berlin-Dahlem und Dipl.-Ing. Imre Patai, Budapest
28	476 812/31c, 26/01	20.1. 26	Verfahren zum Gießen von Metallen in Formen unter Anwendung elektrischer Ströme
29	600 162/42g, 11/01	17.5. 31	Verfahren zum elektrochemischen Aufzeichnen von Sprechströmen

2. bekanntgemachte Patentanmeldungen

S 89 172 der Klasse 21g, Gruppe 21 vom 24.12.1928
Bez.: " Verfahren zur Beschleunigung des Zerfalls schwach aktiver oder radioaktiver Substanzen"
- bekanntgemacht: 28.4.1932 -
-zurückgezogen: 3.11.1932-

S 99 399 der Klasse 42 k, Gruppe 30/01 vom 25.6.1931
Bez.: " Einrichtung zur Dichtigkeitsprüfung von luftdicht zu verschließenden Apparaten, insbesondere von Kältemaschinen mit dünnwandigen Behältern"
- bekanntgemacht: 16.3.1933 -
-zurückgezogen: 6.4.1933 -
Anmelder: Leo Szilard, London

-Bl. 4 -

S 105 894 der Klasse 17a, Gruppe 9/01 vom 19.8.1932
Bez.: " Intermittierend wirkende Absorptionskältemaschine "
- bekanntgemacht: 18.10.1934 -
- zurückgezogen: 14.2.1935 -

3. eingetragene Gebrauchsmuster:

nicht ermittelt.

- - - - - - - - - -

Unterlagen sind hier in größerem Umfange noch bis 8.5.1945 vorhanden.
Bekanntmachungen von Patentanmeldungen wurden jedoch nur bis 30.9.1943 veröffentlicht.

Diese Auskunft wird ohne Gewähr für Vollständigkeit erteilt.

Von den genannten Patentschriften können Druckexemplare zum Preise von je 1,30 DM bzw. - falls vergriffen - Ablichtungen zum Preise von 0,60 DM je Seite von unserer Lichtbildstelle bezogen werden.

Hochachtungsvoll
Im Auftrage

Anl.:
1 Gebührenrechnung

(Warnatsch)

PS. Die in Ihrem Schreiben vom 15.6.1965 erwähnten Patentanmeldungen S 89.028 bezw. S 89.288 konnten hier nicht ermittelt werden, desgleichen die Anmeldung vom 5.11.1924 (Kathodenröhre). Bei der Patentanmeldung vom 27.12.1927 (elektrodynamische Bewegung von flüssigen Metallen) dürfte es sich um das auf Seite 2 unserer Aufstellung erwähnte Patent 554.959, 17a, 3/04, handeln.
D.O.

Luftpost

DEUTSCHES PATENTAMT
Auskunftsstelle

8000 MÜNCHEN 2, den 24. Juni 1965
Zweibrückenstraße 12
Fernruf 22 94 51, Fernschreiber 05-23534
Fernrufdurchwahl über 22 94 5 Hausruf 3402
Postscheckkonto der Amtskasse: München 791 91
Girokonto der Amtskasse: Landeszentralbank München 6/154

PA-Nr.: 312 995 (W)
Ihr Zeichen: -.-
Eingabe vom: 15. Juni 1965

Frau
Dr. Gertrud Weiss Szilard M.D.
Dell Charro
2380 Torrey Pines Road
LA JOLLA CALIFORNIA 92038

Sehr geehrte Frau Weiss-Szilard!

In den Unterlagen des Deutschen Patentamts konnte für Herrn Dr. Leo Szilard nur eine Anmeldung ermittelt werden, auf die das Patent Nr. 965 522 erteilt wurde.

Die Unterlagen der bis zum 8. Mai 1945 beim ehemaligen Reichspatentamt eingereichten Anmeldungen befinden sich bei der Treuhandstelle Reichspatentamt, Berlin 61, Gitschiner Strasse 97-103. Ihre Anfrage vom 15. Juni 1965 wurde daher zur weiteren Erledigung dorthin weitergeleitet.

Hochachtungsvoll

(Großmann)

Pa