

Szilard's 10 Commandments

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THE TEN COMMANDMENTS OF LEO SZILARD

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It has been told that there were originally more than ten commandments that God gave to Moses. As Moses came down from mount Sinai carrying the heavy stones upon which the words were written, some have said he stumbled and fell and the stones were smashed. Several of the tablets were broken beyond repair, and only ten of the commandments survived. The fragments of the broken tablets have never been found, but the missing and garbled commandments may have been rediscovered by a small, overweight, Hungarian, Jewish, atomic scientist named Leo Szilard.

Szilard was one of the most accomplished, least known modern scientists. He had several careers, all different, innovative, and brilliant. He also managed to exasperate almost everyone he came in contact with. He was strange, his mental processes were oblique and non-standard. He said, to succeed you don't have to be much cleverer than others, just one day earlier. He was certainly one day earlier, in recognizing that nuclear fission could lead to a bomb, in alerting President Roosevelt to that fact, and in seeing more clearly the horror of the a-bomb when used against people.

He threw off ideas wherever he went. He was not always good at following up his ideas and turning them into reality, but when he was working on an invention or trying to convince someone of his idea, he was very tenacious. In the words of his friend Eugene Wigner, "the only man who ever baffled me for a lifetime was Leo Szilard." His career was not like that of an average scientist, one of writing and publishing papers. In fact, he only published about 30 papers in the scientific literature and a number of classified reports relating to the Manhattan Project. Instead he invented things and ideas. He was a firm believer in the patent system and hoped to make money with his inventions but probably did not. One of his first inventions was a method of refrigeration with no moving parts which he patented with Albert Einstein. He invented and patented the idea of a chain reaction in the mid thirties even before nuclear fission was discovered. After Uranium was found to give off neutrons during the fission process, Szilard and Fermi together patented the nuclear reactor and Szilard later proposed the term "breeder" to describe a reactor which produced more fuel than it burned. He also invented a lobbying group called the Council for a Livable World and thought up the idea for the Washington-Moscow hot line. When his political activities led General Groves to withdraw all government support from Szilard in nuclear physics, he switched his interests to molecular biology and helped establish the European Laboratory for Molecular Biology.

Szilard was one of the brilliant refugees driven from Europe by Hitler. In addition, he was from that small elite group including Teller, Wigner, and von Neumann who came from Hungary and were the products of the Budapest Gymnasia. These four were called by their fellow scientists the "Martians" because their ways seemed strange to the Americans and because of their otherworldly brilliance. All were theoretical physicists, friends of the world's leading scientist Albert Einstein, and steeped in European culture and interests. They spoke Hungarian, which perhaps sounds like Martian to some people.

In the Fall of 1940 Szilard was working furiously on many different fronts. He was writing complaining letters to government contacts trying to hurry the a-bomb project along; he was preparing to take a paid position for the first time in many years, and he was making a record of his inventions to insure credit before taking a job at Columbia University paid for by government funds. With all of these balls in the air, he still found time to put down on paper his semi-serious version of the Ten Commandments.

He wrote them in German with no thought, at the time, of publishing them. He may have started them earlier, perhaps having gotten the idea for his own version of the commandments from his friends Edward Teller and Carl Friedrich von Weizsacker who had done something similar in Copenhagen in 1934. During Szilard's lifetime, he was never happy with the attempts to translate the commandments into English, so they were never published while he was alive. After his death in 1964, Jacob Bronowski wrote them down in English as a remembrance for some of Szilard's friends, but they went no further than a small circle of physicists.

Bronowski's translation and the original German version of Szilard were published in the opening pages of the book of recollections by Spencer R. Weart and Gertrud Weiss Szilard "Leo Szilard: His Version of the Facts", (1978). I first saw these commandments about ten years before the Weart/Szilard book was published, framed and decorating the hallway of a famous physics laboratory. I was greatly impressed, and copied them down one by one while standing before them. After many moves, my handwritten copy has long been lost, but I am still impressed by the ideas.

Bronowski's translation omits number five as being an untranslatable pun. The translation listed here is very similar to that of Bronowski with some minor variations, but the literal translation of number five will be given.

TEN COMMANDMENTS

by Leo Szilard

1. Recognize the relationships between things and the laws which govern men's actions, so that you know what you are doing.

2. Direct your deeds to a worthy goal, but do not ask if they will achieve the goal; let them be models and examples rather than means to an end.

3. Speak to all others as you do to yourself, without regard to the effect you make, so that you do not expel them from your world and in your isolation lose sight of the meaning of life and the perfection of the creation.

4. Do not destroy what you cannot create.

5. Touch no dish unless you are hungry. (A pun that could read -

Do not turn to the court of law unless you are hungry).

6. Do not desire what you cannot have.

7. Do not lie without need.

8. Honor children. Listen to their words with reverence and speak to them with endless love.

9. Do your work for six years; but in the seventh, go into solitude or among strangers, so that the memory of your friends does not prevent you from being what you have become.

10. Lead your life with a gentle hand and be ready to depart whenever you are called.

The fragments of the stone tablets that Szilard picked up are clearly different in both substance and tone from those which Moses brought down. Beyond the fact that they were written in German rather than Hebrew, they also seem to be softer, not nearly so blunt and unequivocal as the Old Testament prophets are wont to be. Even the "do not's" are modified to indicate that real life here on earth is not only black and white.

The ten commandments which God gave to Moses thundered out of the harsh desert of Egypt. Thou shalt (You will) or Thou shalt not do certain things. All of Szilard's commandments

seem to recognize more clearly the complexity of our world and adjust the commandments to take account of human situations. They seem to be teachings rather than laws. Perhaps Szilard had himself in mind when he allowed a little wriggle room in the commandments.

Of the original Ten Commandments, the first three establish the God who speaks to Moses as the one, the only, the true God, and there shall be no other higher Gods. This implies that these commandments, being the word of God, shall be the highest law. Szilard has no need to set his commandments above all others and asks only that they be accepted for what they are.

Besides the clear difference in tone, there is a considerable difference in content. The first 5 commandments of Szilard are completely new ideas not touched upon in the commandments in Exodus 20. Number 6 is a generalization but clearly connected to Moses' 10th commandment, "Thou shalt not covet thy neighbors house, --". Szilard's number 7 is a softening of the biblical injunction "Thou shalt not bear false witness". He recognizes that there may be occasions when a lie is necessary. In Szilard's 8th commandment he recognizes that the world will soon belong to the children and would have us honor them rather than "thy father and mother" which is the biblical law.

The law of the God of Moses requires 6 days of labor and that you do no work on the 7th day. Szilard's idea in his 9th commandment is quite different and is aimed at a different problem. He says do your work for 6 years and in the 7th do something different so you "can be what you have become". This is clearly not a matter of resting but of recreating yourself.

The final commandment put forward by Szilard also contains a new idea which would never be expressed by the ancient Jewish prophets. It says "Lead your life with a gentle hand". Don't take yourself too seriously. Other people have a right to their lives and their ideas even though you may think they are wrong. Be ready to give up life without regret or anger.

These words grew out of Szilard's experience. In his rough draft outline for a book that was never published he states "Very often it is difficult to know where one's set of values comes from, but I have no difficulty in tracing mine to the children's tales which my mother used to tell me. My addiction to the truth is traceable to these tales and so is my predilection for 'Saving the World'". He goes on to describe his school days "The set of values of the society in which I lived in Budapest was conducive for a young man to dedicate himself to the pursuit of science, and the poor quality of the teaching of science at the universities in Hungary furnished stimulation to independence of thought and originality." If the Hungarian universities were poor, not so the High Schools or Gymnasias. All of the "Martians" from Budapest gained their initial scientific interest and training from the wonderful teachers in those schools.

Since Szilard was somewhat reluctant to publish these commandments, particularly in English, the question arises as to how satisfied he was with their statement. Further, how well did he follow these precepts? Like all of us, our theoretical values are not always easily applicable to life's problems. A look at Szilard's life will show that his personality often battled these commandments, sometimes following them but at other times ignoring them as his ambition or his appetites triumphed.

The first of Szilard's commandments emphasizes how things work and connect together and the laws of human interaction. *Recognize the relationships between things and the laws which govern men's actions, so that you know what you are doing.* Strangely enough, this commandment, as it is written, is morally neutral. It is an exhortation to understand how things work and how people behave, presumably so you can have an influence. The influence, of course need not be only for the good. A successful politician

would follow this rule as would a dictator. Szilard's dilemma was to try to bring into balance the new physical understanding about the nucleus, the psychology and sociology of men about to lead their nations into a new world war, and his own moral convictions. A physical scientist like Szilard is generally interested in how nature works, but few are willing to spend much effort in understanding the social and behavioral laws associated with the interaction of people.

Szilard understood a lot about the conduct of men, but he had very little understanding of (or

interest in) women. He felt that they were too emotional and not ruled by the intellect as he was. His marriage was very unconventional and he rarely lived with his wife.

He admitted that he had two great passions in life, science and politics. He credited science with making it possible for him to earn his living. He thought politics saved his life.

In his recollections he tells of one experience in 1930 when his prescience and understanding of the laws of the conduct of men served him well. "I reached the conclusion that something would go wrong in Germany very early," he said. The major economists of Germany and France had a meeting in Paris to decide how much in reparations for World War I Germany would be forced to pay. One of the German representatives, Dr. Hjalmar Schacht who was president of the Reichsbank, made the very surprising statement that Germany could not pay any reparations unless it got its former colonies back. Szilard saw immediately that the German leaders were playing hardball, and if they thought they could get away with this first move, "things must be pretty bad." He took all of his money out of a German bank and transferred it to Switzerland. He later learned that he wasn't the only one who understood this move of Schacht's to be bad news, since many other people, mostly depositors living abroad, also moved their money out.

Eugene Wigner, one of Szilard's closest colleagues throughout his life, believed that his friend did not understand human nature at all. He believed Szilard to be extremely ambitious with a desire to be recognized and to attain high office. He wanted to be the boss or director of the lab, or senator, or president, perhaps philosopher king. He believed that society should be ruled by an elite who had the right answers. Wigner said of Szilard "- he saw no reason for stupid people to craft national policy. Bright people should; people quite a bit like Leo Szilard". According to Wigner, "Szilard did not understand human nature well enough to rule a vital group of scientists without listening to them. Though he was capable of listening, he never did it consistently." Szilard had initiated many of the ideas which went into the first reactor built by Fermi under Stagg Field at the University of Chicago. His foresight had made possible the tons of ultrapure carbon needed for the reactor, but when Fermi had asked him to help with the dirty job of machining the graphite, as he himself and his entire group was doing, Szilard refused, believing it more important to sit at his desk and design the next reactor.

The connections between scientific findings and their application industrially, militarily, and medically were always close to Szilard's thoughts. As early as 1934 he wrote a memorandum on the possible application of the liberation of atomic energy. He had read H.G. Wells book "The World Set Free" and was very impressed with the idea of energy from the nucleus of an atom. He wrote that if experiments presently underway are successful "the production of energy and its use for power production would be possible on such a large scale and probably with so little cost that a sort of industrial revolution could be expected." He had applied for several patents on methods for transmuting chemical elements into radioactive materials for use in the production of heat and power. He also envisioned the production of artificial "radium" for medical purposes.

Thus Szilard clearly understood the connection of things, but he followed his logic to the extreme, even when it made him look like a coward in the eyes of his friends and colleagues. During the Cuban missile crisis, he believed that there was a high probability that the Russians would use the missiles against the U.S. He decided that it would be safer in Europe, so he packed a bag and flew to Switzerland. He turned up unannounced at the European Laboratory for Nuclear Research (CERN) where he stayed until the crisis was resolved. He was criticized for his fear and for leaving his secretary behind without a thought, but to him it was an entirely logical move and consistent with his belief that the nuclear confrontation between the United States and Russia was inherently unstable. He said, "If I were to stay in Washington (when the bombs fell) and were to perish ... I would consider myself, not a hero but a fool".

Szilard often forgot his second commandment, *Direct your deeds to a worthy goal, but do not ask if they will achieve the goal; let them be models and examples rather than means to an end.* It is clear that he directed his life towards worthy goals, the development of the atomic bomb to beat Hitler, the struggle to keep the bomb from being used on people, and the understanding of human biology. He was first and foremost a scientist, but his passionate beliefs led him into the political arena where his acts seemed less models and examples than means to an end.

After he heard from Wigner that Otto Hahn in Germany had discovered that Uranium fissions and breaks into two pieces when bombarded by neutrons, he thought immediately of his old idea about a chain reaction which would release energy from the nucleus. He knew that if neutrons were released in the fission event, there might be a chance that these neutrons would cause more fissions and a chain reaction could be initiated. Since he, as well as others, knew that Europe was just about to go to war, he considered it urgent to check out his chain reaction idea while at the same time keeping any nuclear experiments secret from Hitler. Other scientists, including Fermi, thought the probability of a chain reaction was small and felt that there was no urgency about the research and it should proceed systematically.

Szilard followed up his beliefs in every way possible. To keep as much of the nuclear research as possible from Nazi Germany, he started writing letters to his friends asking them not to publish the results of their research into fission. At the same time he was racing to do his own research, sending a telegram to England asking for a block of beryllium to slow down the neutrons in his experiment and borrowing \$2000 from a friend so that he could rent a gram of Radium to produce the neutrons. He did this even before finding a place to do the research. He had no institutional address, of course, but managed to talk his way into Columbia University where the chairman of the physics department, George Pegram, gave him permission to use their facilities for three months.

His experiment was ready in March of 1939 and was immediately successful in finding neutrons emitted during the fission process. He noted, "That night there was very little doubt in my mind that the world was headed for grief". After his success, he met with Fermi (who had also been successful in finding fission neutrons), Wigner, and Pegram to determine what their next step should be. Szilard pushed very hard for withholding the results from publication, but Joliot in France went ahead and published his research and the scientists in Columbia decided, against Szilard's advice, to follow normal procedure in science and publish. Szilard was warned by Columbia that if he continued his objections to publications, he would lose the use of the Columbia facilities.

Szilard wouldn't put it aside. He still felt that the research going on in France, England and America on nuclear fission should be kept secret from Hitler and that it should go forward at the greatest possible speed. Most people would keep their head down, do their research and worry only about their career. Not Szilard. He was determined to find the secret of nuclear fission, which he had dreamed of since the early 30's, while at the same time denying that secret to the Nazis whom he and his friends had fled Europe to escape. This is not exactly making acts models and examples rather than means to an end.

The question was what to do to push forward with his agenda. He had no permanent position, he was not well known in science because he had accomplished relatively little, and he feared the Germans were ahead in the race because of Otto Hahn's initial breakthrough. He had the friendship of the other "Martians" from Hungary and most significantly, he had the confidence of Albert Einstein with whom he had worked in Berlin and had patented several refrigeration ideas. Einstein had a worldwide reputation and would be taken seriously in anything that he proposed.

After he convinced Einstein of the need for a letter to president Roosevelt, Einstein dictated the letter based on a draft by Szilard, and it was sent through Dr. Alexander Sachs who had an entree to the White House. It was this letter that initiated the Manhattan Project and the U.S. work on the atomic bomb.

Afterward Szilard felt that the a-bomb project should have been his to lead. After all, he thought of the idea of a chain reaction, he, through Einstein, had alerted the federal government to the need for the project and had gotten the first money, and finally his ideas, together with Fermi's, were the basis for the first nuclear reactor. Thus Szilard felt that it was unfair that he played only an insignificant role in the Manhattan Project, and he continued to try to insert himself and his ideas concerning nuclear energy and the bomb into government decision making throughout the war and afterwards.

Szilard's third commandment, *Speak to all others as you do to yourself, without regard to the*

effect you make, so that you do not expel them from your world and in your isolation lose sight of the meaning of life and the perfection of the creation, was one that he found easy to follow. He was so eager to convince everyone of his ideas that he spoke much more than he listened. When he first came to the United States and was staying in New York, he would pester his friend Isador Rabi, a professor in the Physics Department at Columbia University, to do experiments for him. Rabi would say, "Please go away --- You have too many ideas. Please go away." Szilard was unemployed at the time, but by his persistence, he finally forced his way into a temporary position at Columbia.

He never worried about expressing only "safe" ideas and he never forgot the moral dimensions of his work. Other men would see the practical obstacles too clearly, and while believing that something should be done, would end by doing nothing. Szilard, like Don Quixote would go ahead and tilt at the windmill.

Einstein said of Szilard that he tended to overestimate the role of rational thought in human interactions. He was an elitist and never hesitated to say it. He believed that scientists, because of their education and truthfulness were superior and more objective than other men. He argued that it is crazy to say that one moron is as good as one genius, because that would imply that two morons are better than one genius.

Szilard was appalled at the way Senator McCarthy treated scientists and was very disturbed at the way the Atomic Energy Commission used security clearances for what he considered political purposes. He satirized the Oppenheimer hearings in a fictional account of anti-Communist hysteria. Even though he disliked Oppenheimer personally, as several scientists did, believing that he was hypocritical in arguing that scientists should leave national policy to the government officials while pushing his own views strongly with those same officials, he believed that the threat to Oppenheimer was a threat to all scientists. He stated his convictions bluntly, "Classing Oppenheimer as a Security Risk and subjecting him to a formal hearing is regarded by scientists in this country as an indignity and an affront to all; it is regarded by our friends abroad as a sign of insanity - which it probably is." His caustic tongue and his penchant for satire led him to state "wouldn't arresting him and shooting him be the only prudent course of action" (if they really thought Oppenheimer would leak information to the Russians).

Szilard was a builder, not a destroyer. He clearly kept his fourth commandment, *Do not destroy what you cannot create*. He built organizations for research and for peace, but the idea of destroying cities and people was morally repugnant to him.

Although Szilard would have been willing to use the a-bomb against Hitler, he felt strongly that its use against civilians in Japan was wrong on moral grounds. In his petition to the President of the United States he argues that "a nation which sets the precedent of using (the atomic bomb) may have to bear the responsibility of opening the door to an era of devastation on an unimaginable scale". Because of the U.S. lead in atomic energy, he felt that it had the solemn responsibility to mobilize the world to prevent a nuclear arms race. He felt that this could only be done if our hands were morally clean.

In early 1945 Szilard was confident that the war with Germany was won and began to worry about a postwar arms race with the Soviet Union. He believed that the only way to head this off was for the United States to take the lead in renouncing the use of the bomb against civilians. Again he went to Einstein and asked for a letter to president Roosevelt requesting a meeting to try to head off the use of the bomb against Japanese cities. Before any meeting could be set up with the president however, Roosevelt died and Szilard's first attempt to stop the bomb died with him.

Szilard next tried to set up a meeting with the new president by using political connections through the Pendergast machine in Kansas City. After Truman's appointment secretary learned the purpose of the meeting, he shunted Szilard off to James Byrnes in South Carolina. Byrnes was completely unsympathetic to the scientist's arguments, and Szilard knew that his second try at stopping the use of the bomb had failed.

General Groves was extremely angry when he heard that Szilard had gone outside of channels to try to interfere with plans to use the bomb against Japan. By July Szilard was certain that

it was too late to stop the use of the bomb. Nevertheless, he thought it necessary for scientists to go on the record stating the immorality of targeting Japanese cities. He prepared and circulated several copies of a petition to the president asking that the bomb not be used unless Japan had been given every opportunity to surrender and had refused, and after the president had given full consideration to his moral obligations to the country and to the world. The petition was signed by only 72 scientists, all from the Chicago Metallurgical Lab. General Groves held the petition until it was too late to have any impact on events, so Szilard's final attempt failed as had the others.

Szilard's fifth commandment, *Touch no dish unless you are hungry* was an interesting idea to him, but he was clearly unable to follow it. He learned to love food from his father who took a great interest in feeding the family well. When Leo was a boy, the Spitz family (Leo's father later changed the family name to Szilard) often served meals of six or more courses. Soup followed by fatted goose liver appetizers and main courses of several vegetables with roasted piglet, a fish with tarter sauce, rich Hungarian deserts and cheeses with special pumpernickel bread and all ending with cups of cafe au lait or strong Turkish coffee.



Szilard had a strong appetite which he was often unable (or just unwilling) to control. Although he could be completely rational and say to himself, Don't eat unless you are hungry, when confronted with candy or goose liver or rich chocolate deserts, he would conveniently forget this 5th commandment.

Leona Marshall Libby tells that when she first met Szilard in Chicago, he was shaped like Santa Claus. "But no wonder he was more or less spherical. I saw him eat as many as seven sherberts for dessert many evenings at the Quandrangle Club, --" she said.

Although Szilard in his younger days was moderately slender, a photograph of him taken with Jacques Monod three years before his death shows a roundness which cannot be hidden.

One of Szilard's patent disclosures dated in 1953 was for an adding machine built in the form of a mechanical pencil that could be carried in the pocket. He proposed that it could be used, for instance, for adding up during the day the caloric value of the various meals eaten. There is no indication that this device was ever built, and if built that it was ever used.

The death of Leo Szilard on May 30, 1964 was attributed to a heart attack during his sleep. His wife Trude requested an autopsy to see if his earlier cancer had reoccurred. There was no sign of cancer, but when the doctors looked at his heart, they found plenty of evidence that a lifetime of heavy eating and little exercise had led to coronary arteriosclerosis and the coronary thrombosis from which he died.

There is little evidence that the sixth commandment, *Do not desire what you cannot have* was

any problem for Szilard. His world was a world of ideas, not one of things. He had almost no personal property. He had a couple of suits, shoes which he wore until they came apart, and suitcases which he left with friends in various parts of the world containing his notes, papers, and letters. He never owned a home but stayed in hotels or with friends wherever he went. He was sometimes short of money when he hadn't been employed for some time, but he was never desperate, and he usually had money to fly between Europe, England and America whenever it suited his purpose.

Plato when speaking of his guardians, the leaders of his ideal republic, said, "none of them must possess any private property beyond the barest necessities. Next, no one is to have any dwelling or store-house that is not open for all to enter at will". Szilard seemed to unconsciously follow these precepts in order to leave his mind free for what he considered to be important.

Szilard in his seventh commandment, *Do not lie without need*, clearly did not want to accept a flat prohibition against telling a lie. He was sure that he could tell when a lie was necessary and would refrain from lying except in those cases. Again, he saw himself as a philosopher king who knew better than anyone when a lie was needed and proper. As a scientist, he revered the truth and would not deviate from it under any ordinary circumstances.

Plato gives the right to tell lies to the guardians of the republic. In the Republic he says, "If anyone, then, is to practice deception, either on the country's enemies or on its citizens, it must be the Rulers of the commonwealth, acting for its benefit; no one else may meddle with this privilege". It is hard to fault Szilard for being naive about human nature after reading Plato.

Szilard clearly believed that there are times when it is morally acceptable to lie for a greater purpose. It seems clear that he would have been ready to lie to stop the use of the A-bomb on Japan if he thought that it would make a difference. Still there are very few documented cases where Szilard was found to have been untruthful for any reason. He was not really deceitful nor did he play complex underhanded games. He didn't think it necessary. Although he continually ignored the chain of command, he believed that as a civilian and a scientist that was his right, and his opinion was as good or superior to that of the military and General Groves in particular.

Szilard was awkward with most people, but with children he could be playful and carefree. Thus his eighth commandment, *Honor children. Listen to their words with reverence and speak to them with endless love*. He enjoyed the company of children, but throughout his life, spent very little time with them. He wrote a short fable for children called "Kathy and the Bear" based on his friendship with the daughter of a friend of Trude's during a visit to Colorado one Summer.

One reason Szilard found it easy to love children was that he interacted with them only on his own terms. He never had any children of his own to be responsible for, so they didn't interfere with his unusual lifestyle. In addition, he wasn't threatened by children's ideas. They didn't argue with him as many adults did.



Szilard and Friend 1948

In the opening lines of his Recollections he states that "Many children are born with an inquisitive mind, -- I became a scientist because in some ways I remained a child." It wasn't only the inquisitive mind that remained with Szilard, but also certain naive beliefs in the purity of science and the dedication of scientists to truth and the betterment of mankind.

Szilard's ninth commandment, *Do your work for six years; but in the seventh, go into solitude or among strangers, so that the memory of your friends does not prevent you from being what you have become*, fit him perfectly. He did not need this commandment to encourage him to move and go among strangers. He had no permanent address but always lived out of a few suitcases in hotels. When he got bored or unhappy with the surroundings, he would move. Although Wigner claimed not to understand Szilard, he had a great deal of experience with his comings and goings. He described it this way "He came to stay with you because he missed you and hated cooking for himself; then he left because the bed was too hard and he was tired of you."

It was rare for Szilard to stay in any one spot for more than six years. In 1919 he left Hungary and went to Berlin to study and escape the anti-Semitism which was allowed and encouraged by the Horthy regime. He received his doctorate with highest honors in 1922 and then served as an assistant for three more years before he began his career on his own as an instructor in physics.

For the next six years he collaborated with Einstein, taught quantum mechanics with John von Neumann, taught seminars with Lisa Meitner, and filed patents on a cyclotron, an electron microscope, and the Einstein-Szilard pump for refrigerators. At the end of this six year period in 1933 he fled to England to escape the Nazis and Hitler's anti-Semitism.

It was in London, waiting for a street light to change, that the idea for a neutron chain reaction came to him. He continued to invent things in England including one of his most important pieces of scientific work, the Szilard-Chalmers reaction. He obtained a refugee fellowship to Oxford and continued his research there until 1939 when he moved to New York, anticipating that world war II was about to begin.

He didn't stay in New York for the allotted six years but moved to Chicago in 1942 to help Fermi build the first reactor. In Chicago he became close friends with Chancellor Hutchins and called upon him many times for help with his projects. In 1947 he again changed directions and decided to leave physics and take up biology, establishing his own laboratory at the University of Chicago.

In 1951 he took a big step and married his long-time friend Gertrude Weiss. He never settled into any sort of domestic routine though and spent his time in the laboratory studying phage and the mutation of bacteria. It was said of him that he lived in a hotel in New York, worked in Chicago, and was married to a wife in Denver.

After spending time in Washington, where he hoped, as he put it, "to find a market for his wisdom", he moved again. He was unsuccessful in Washington as the Kennedy administration felt that they had all the wisdom they needed. His last move was to the Salk Institute in La Jolla, California. Here he found, for the first time in his life, a permanent lifetime appointment and security. He became content for a few months. Then he died.

Szilard lived his life the way he wanted to, and his final commandment, *Lead your life with a*

gentle hand and be ready to depart whenever you are called, seemed to fit him well. With all of the controversies and the political battles, he never carried any personal animosity towards anyone except perhaps General Groves. When one path towards his goal was blocked, he tried another. He did not gnash his teeth and strike at his enemies but soldiered on in new directions. Although he argued with everyone, in his strange way, he was friendly with all of his colleagues. He tried to steer Teller into supporting Oppenheimer during his security hearings even though he liked Teller personally much better than he liked Oppenheimer. Szilard's friends were often angry with him, but they recognized him as a force of nature which would not be changed.

In the late 1950s Szilard was diagnosed as having bladder cancer. Then, as perhaps now, this was a very difficult cancer to treat and the prognosis for cure was very poor. Two options for treatment were offered, surgery or radiation. Neither had a very good record of success, and there was no consensus among the doctors about which method was best.

Szilard decided to take his own case in hand and make his own decisions. It was his life on the line, and he believed he could understand the situation as well as anyone could. He asked his friend, who incidently was his wife and a physician, to find out from the medical literature which method had the best record for cures. The results were about fifty-fifty and did not offer much hope for either method.

After carefully weighing what he knew, he decided in favor of the radiation treatment but one of his own devising. He decided against surgery for several reasons; first he would lose all control of the operation once under the anesthesia, secondly he didn't understand surgery but he did understand radiation, and finally he believed that if the surgery were unsuccessful he would not be able to continue working until he died, but if the radiation didn't work he could still function until the inevitable happened.

Radiation treats cancer by killing the cancer cells in the irradiated region. Of course, it also kills the healthy cells through which it penetrates. Szilard knew that beta particles had only a short range compared to gamma and x-rays but a much higher ionization and thus killing potential within that range. Thus with help from his friends at Brookhaven National Laboratory he had short lived beta emitting compounds prepared that were chosen with chemical properties which would cause them to be concentrated in the bladder. With this method he could limit the radiation primarily to the cells he wanted to kill and also control the dose to the cells by the short lifetime of the beta emitters.

The treatment was a total success and the autopsy performed after his death showed that there was no cancer remaining in his body.

Leo Szilard was a unique combination of opposites. He had the imagination and sometimes the naivete of a child but also the boldness and bluntness of a man. He loved science but his politics often took precedence. He was at once a thinker and an activist. Like many of us, he wanted it all. His character was shaped in his youth by the European intellectual tradition and in his adulthood by the global conflict and the worldshaking discoveries in nuclear physics. His ten commandments were a thoughtful expression of his middle age, and he followed them when he could.

Amazingly, for all of Szilard's ideas, arguments, and inventions, he never won the Nobel Prize or held any administrative post of distinction. While he received many honors including an honorary doctorate by Brandeis University, the Atoms for Peace Award together with Eugene Wigner in 1960 and election to the National Academy of Sciences in 1961, he felt that these were insufficient recognition for his contributions. Although the \$37,500 that came with the Atoms for Peace award was greatly appreciated by Szilard, he felt all of his life that his contributions were not properly recognized and that he deserved more honors and more money.

In one sense, his life can be written as tragedy. He had little influence on the direction of the Manhattan Project which he was influentially in starting, and his efforts to stop the bomb being used against Japan in the waning days of the war were unsuccessful. He was an outsider in Washington, and his efforts to push through arms control and reduce tension with the Soviet Union were largely ineffective. Even his private life was far from the American dream, no house, no car, no wife and kids, no permanent job, and most of his life embroiled in controversy.

Perhaps he tried to do too much. If after the war he had left the politics to others and spent his time on science, as his friend Eugene Wigner did, he too might have won the Nobel Prize. Like Oppenheimer, Szilard tried to be both a scientist and a politician. Whatever can be said of Szilard's politics, the time it took certainly reduced his effectiveness as a scientist. Yet he left behind a legacy of institutions and a corpus of writings and ideas which have changed the world.

FOR FURTHER READING

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