

Leo Szilard: The Conscience of a Scientist

by Tristram Coffin

PHOTOGRAPH BY ARNOLD NEWMAN

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DR. LEO SZILARD has become for many scientists and laymen a symbol of their social responsibility. At sixty-five, after brilliant careers in nuclear physics and several other sciences, he continues not only to apply the genius for research that first made him famous, but to express anxiety about the uses to which society puts his work. He is founder of the Council for a Livable World, a venture in wedding ethical science and political action.

The scientist, whether he likes it or not, is the superman and the prophet of the 20th Century. He has vastly changed the world by splitting the atom, striding about the universe, conquering plagues, and growing as many as twenty six bushels of wheat to the acre. He has invaded philosophy, military strategy, government and management. Scientists are now strewn about the Federal government as economists were during the New Deal. Ph.D.'s in science are so much in demand that a recent issue of the *New York Times* enticed them with nine pages of ads, naming salaries and conditions that would please a pasha.

The gifts of science are not an unmitigated blessing, as even its practitioners admit. Antibiotics and public-health programs have so prolonged life and increased the population that there may not be enough room or food for us all by the year 2000. Banging about the atmosphere has not improved the weather. There is the new problem of radioactivity. Some physicists are afflicted by the Hiroshima complex, a sense of guilt for the horrors of nuclear war. The nuclear weapon and its "proliferation" create spasms of fear each time a major statesman raises his voice. The scientist is bothered by the work he has done and the use society makes of his knowledge.

Leo Szilard is a symbol of modern science, its curiosity and its morality. He is a round, benign-looking theoretical physicist who between 1960 and 1963 held court in the lobby of a midtown Washington hotel and is now at the Salk Institute at La Jolla, California. Science historian Alice K. Smith suggests he is one of the five men of the past 100 years who have done most to change their times. (The others are Lincoln, Gandhi, Hitler and Churchill.) He is the co-inventor, with the late Enrico Fermi, of a chain-reaction system for releasing atomic energy, and has investigated the deepest mysteries in at least half a dozen varied fields. The citation on the Einstein medal awarded him in 1960 refers to his "outstanding achievement in natural sciences" and his scholarship "in the broadest areas of human knowledge." His imagination is so prolific he has been called the Jules Verne of science.

Now sixty-five, apparently cured of a serious cancer, Dr. Szilard sits in the lobby of the DuPont Plaza Hotel when he is back in Washington, talking in animated English or German that purrs with z's. His listeners are scientists who have come from all over the world to visit him, as well as politicians, diplomats, journalists and the kind of ardent young disciples whom Socrates gathered about him. He looks like a "good" character in a Grimm fairy tale, with rimless glasses and a great mane of white hair brushed back. His spirit is summed up in his confident statement, "If secrets exist, they can be explained."

Leo Szilard belongs to the rich strain of European learning that has produced most of the towering scientific intellects of the century. He is a Hungarian, studied in Berlin and was associated there with Einstein. He did research in nuclear physics at Oxford before coming to America. He has made major contributions to thermodynamics, nuclear physics, mathematics and molecular biology. He has examined birth control, aging, cancer, nuclear



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strategy and the American political system, and he stirred the dust wherever he passed. He is a professor of biophysics at the University of Chicago and a fellow of the Salk Institute. He has driven scientists into the arena of politics with the moral fervor of a Cotton Mather and the drama of a Fiorello La Guardia. He also has an eerie sense of prophecy.

To look at Doctor Szilard, and through him at the scientist, one must examine not only the scientist but the human being and the prophet-moralist.

Scientific discovery can be compared to a light gradually spreading through a dark cave and revealing its treasures. The most important gleam of light is not a demonstrable fact that newspapers can squeeze into a paragraph, but a theory. This is as creative as a great poem or painting, since it is drawn both from the imagination and from a disciplined mind. Few men may understand the theory, and even a half century later it may be incomprehensible to intelligent laymen. (How many lawyers and English professors can explain relativity?) For those who do understand the theory, it is a brilliant guiding beam in the mysterious cavern. They try to prove the concept and enlarge upon it, and in so doing discover facts that have been hiding all the while in the dark. Eventually a whole army of less creative scientists will with patience and thoroughness convert the knowledge of "pure" science into practical use.

I sat with Doctor Szilard in his tiny hotel office and asked him to explain to me just what a creative scientist was and what he did. He replied with an enthusiasm that was in itself revealing. At a conversation or a meeting, he habitually sits with a somnolent air, like a drowsy hound, sometimes giving the impression he is asleep. But if a remark or question excites him, he sits up smiling and speaks rapidly and vigorously.

"The creative scientist," he said, "has much in common with the artist and the poet. Logical thinking and an analytical ability are necessary attributes to a scientist, but"—he paused, looking out the window at the roofs surrounding DuPont Circle—"but they are far from sufficient for creative work. Those insights in science which have led to a breakthrough were not logically derived from pre-existing knowledge; the creative processes on which the progress of science is based operate on the level of the subconscious.

"Of course," he concluded briskly, "once a breakthrough is achieved, technicians can go for a long time producing publishable results just by turning the crank. But in the long run, science would run dry if all the scientists were crank turners and none of them were dreamers."

The United States has produced more crank turners than dreamers. We have a special category in our folk humor, the "mad scientist" whose creation is harmful or has no utility. The derisive term "egghead" describes one who indulges in pure thought. The idea of a man sitting in a hotel room for days simply thinking, as Doctor Szilard did while creating a theory of chain reaction, seems to us like succumbing to sloth. One legend has it that he spent much of this time in the bathtub: imagine the faces of senators if they heard that a scientist on whom the taxpayers lavish a generous salary was taking a month away from his desk to think in a bathtub.

Also, we are great for specializing. If a man is a nuclear physicist, he began specializing as an undergraduate; he dug himself deep into the rut in his years pursuing a Ph.D., and even deeper working for the Atomic Energy Commission or a private agency. He is supposed to stay put and not wander into other fields. Doctor Szilard was trained early as a physicist, but this has not kept him from roaming. He picked up the techniques of microbiology at the Cold Spring Harbor Biological Laboratory in Denver in 1946, at the age of forty-eight; in time he became so expert that the National Institutes of Health offered him an appointment in this area in 1958.

I had several talks with Doctor Szilard about his life, his work and his philosophy—in a hotel lobby, walking the winter streets, in a small café, squeezed among his papers in a tiny office. Often what was complex and baffling to me as a layman was perfectly clear to him, and my trying to reduce scientific concepts to simple words must have seemed to him like putting a sacred ritual into pig Latin. At one point he looked at me, shook his head in a characteristically impatient gesture and said, "You'll never understand."

I asked Doctor Szilard how he happened to take up physics instead of, say, chemistry. He said, "By the time I was thirteen I was very much interested in physics. If there had been some way of earning a living in physics in Hungary, I would have studied it when I reached college. However, a physicist could only become a high-school teacher, and this did not attract me. So I did the next best thing. I studied engineering. [His father was an engineer.] In 1919 I went to Berlin to continue these studies, but after a year at the Institute of Technology I quit and moved to the University of Berlin to study physics. This was the hey-day of physics in Berlin. Max Planck, Max von Laue, Walter Nernst and, later on, Ervin Schraedinger taught at the university, and Albert Einstein was there, attached to the staff of the Prussian Academy of Sciences."

The young Szilard's first important theoretical work was done when he was twenty-four years old and a postgraduate student at the University of Berlin. Von Laue suggested for his doctoral dissertation a problem in the realm of the general theory of relativity. As he recalls the episode, "At Christmas I decided to take a vacation from my work on the dissertation. I thought I would just loaf for a few weeks and think about whatever came to my mind. I started to follow up some curious ideas which came to me, and within three weeks I had written a paper on a completely unrelated subject. It showed that one may derive the relationship between probability and entropy from the Second Law of Thermodynamics—an intricate idea which became a major step toward giant computers. I didn't quite dare take the paper to von Laue, but I spoke to Einstein about it. At first he was quite incredulous, and thought what I claimed could not be done. It didn't take him more than a few minutes, however, to get the point. Encouraged by Einstein, I telephoned von Laue and asked whether I might bring him a paper to examine as a thesis in lieu of the assignment he'd given me. That evening I took the paper to his house in one of the Berlin suburbs. Next morning the telephone rang. It was Professor von Laue calling to tell me my thesis was accepted."

This established Szilard immediately as a young fellow of great creative talent. It was a feat for a graduate student to turn out a highly original piece of work in three weeks, one that surprised and pleased the great Einstein and so impressed von Laue that he read it until late at night and immediately approved it.

Three years later Szilard produced a paper of even greater scope. It touched physics, mathematics and engineering, and established for the first time the relationship between entropy and information. Some twenty years later the idea was rediscovered by Claude Shannon as one of the basic tenets of "information theory." Szilard's theory thus became the starting point for devising modern communications and thinking machines.

Szilard's work led to the atom bomb, which made world war so monstrous a prospect. In 1928 and 1929 he filed a patent on the idea of the cyclotron, a device to bombard the nuclei of atoms with protons at very high speeds to study their characteristics. (The cyclotron was invented independently by Dr. Ernest O. Lawrence and built at the University of California in 1929.) In 1933, when Szilard was thinking of becoming a biologist, nuclear physics suddenly became more exciting: Frederic Joliot-Curie discovered artificial radioactivity; James Chadwick discovered the neutron, which can break through the electrical barriers

that surround the atomic nucleus. In the fall of that year, in London, Szilard had a fresh and rewarding idea.

"One morning," he told me with the air of a man fishing deep into memory, "I read in the newspapers about the annual meeting of the British Association. Lord Rutherford was reported to have said that whoever talks about the liberation of atomic energy on an industrial scale was talking moonshine. Pronouncements of experts to the effect that something cannot be done have always irritated me." He smiled briefly. "That day, as I was walking down Southampton Row and stopped for a traffic light, I was pondering where Lord Rutherford might be in error. 'What could make him turn out to be wrong?' I asked myself. As the light turned green, and I was crossing the street, it occurred to me that if one could find an element that absorbs neutrons and can be split in such a fashion that for each neutron it absorbs it emits two neutrons, it would be possible to set up a chain reaction."

At this point Doctor Szilard went to the Strand Palace Hotel, where he spent months in "retreat," simply thinking through the problem. He was trying to find an element to start a chain reaction. He suspected beryllium, a rare metallic element, of being sufficiently unstable. "It seemed conceivable," he said, "that if it were to absorb a neutron, it would fall to pieces and release two neutrons in the process. By 1934 I had developed the theory of such a chain reaction, which included the concept of the critical mass. I filed a provisional patent application in England for the principles involved.

In fact, he actually started experimenting with beryllium in the summer of 1934, at St. Bartholomew's Hospital in London. I borrowed a Geiger counter. I bought a quantity of beryllium with an appreciable portion of my savings, and I teamed up with Chalmers, a young Englishman on the hospital staff. Together we improvised a series of experiments. We found that beryllium emitted neutrons when it was exposed to the gamma rays of radium. These so-called photoneutrons of beryllium were destined to play a major role later on in solving the problem of a chain reaction."

A scientist on the trail of a discovery is awake to new knowledge. When Doctor Szilard heard of the fission of uranium by Hahn and Strassmann in January, 1939, he "saw at once," he told me, "that neutrons might be emitted in the process, and that uranium thus might sustain a chain reaction."

That year he came to the United States. No university, foundation or government bureau

would underwrite his experiments. He cabled to Oxford for his equipment, borrowed \$2,000 to rent a gram of radium, and won permission from Columbia University's physics department to use its laboratory. I asked him what he was trying to discover. Doctor Szilard explained, "In order to induce this kind of fission, uranium has to be bombarded with neutrons. The problem was to distinguish the neutrons emitted in the fission process from the neutrons used to induce the fission. I thought of using photoneutrons from beryllium, which are slow, and then looking for fast neutrons which might be emitted. This is what Dr. Walter Zinn and I did on March 3, 1939, at Columbia. The experiment showed that about two neutrons are emitted in the fission of uranium for each neutron absorbed."

This was, in the minds of many physicists, the crucial discovery in the controlled use of atomic energy.

After this exciting work, Szilard teamed up with the late Enrico Fermi, a brilliant physicist in voluntary exile from Fascist Italy, to develop a self-sustaining chain reaction. They came fairly close to it with a uranium-water system. In July, 1939, Szilard thought that a uranium-graphite system would work, and it finally did on December 2, 1942, at the University of Chicago.

Leo Szilard was not content to be known as a "grand old man" of nuclear physics and make pompous speeches at scientific conventions.

Besides being a splendidly creative theorist, he likes to shake the tree of knowledge savagely. More often than not there is nothing in this for him but the joy of waking men's minds. Also it satisfies, at least temporarily, his enormous lust for knowledge. Science benefits considerably, for its followers tend to fall gently into settled patterns unless a Szilard rudely rouses them.

After the war Doctor Szilard plunged into an entirely new area, biology—the fundamental processes of life, the origin of living matter, the character of the genes which pass traits on from generation to generation, the problems of degeneration and death. I asked him what made him think a physicist could crack them.

He replied, "The mysteries of biology are no less deep than the mysteries of physics were one or two generations ago, and the tools are available to solve them provided only that we believe they can be solved. It is this belief that the physicists, chemists and geneticists have brought into biology. Their success is due not so much to any special skills but rather to their attitude toward the phenomena of nature, which the older type of biologists have lacked. Recent successes in under-

standing the hereditary material of the cell have vindicated the faith that mysteries can be unraveled in biology no less than in physics."

Leo Szilard has stimulated a great deal of new thinking, and has produced a theory of aging in mammals which, twenty years from now, may be seen as a major landmark. In a huge simplification, he described his theory thus: "It assumes that, through a random process of 'aging hits,' a large part of a chromosome of a somatic cell, or perhaps the whole chromosome, becomes irreversibly inactivated. These 'aging hits' are not radiation-induced; they are spontaneous, and their true nature is not yet known. [Other scientists have suggested that the accumulation of radiation from all sources may be a factor.] When a sufficiently large number of the somatic cells of an individual become inactivated through such 'aging hits,' the individual dies."

Since his university days Doctor Szilard has been fascinated by the nervous system. After the war, among a host of other activities, he carried on dialogues with learned scholars on the nervous system, sleep, consciousness and memory. This proved so exciting that faculty members at the University of California at Los Angeles medical school wanted him to be a consultant in research on the nervous system. He declined. In May, 1958, the National Institutes of Health beckoned him as an adviser on research involving the nervous system and behavior. He accepted, but his work there was halted by his illness.

Birth control is another area he has invaded. His interest, a continuing one, is both scientific and humane. I asked him how he happened to get into this field, and he replied, "One of the most important problems of our times is to find a method of birth control for underdeveloped countries. In a country where arable land is short and the birthrate high, no amount of economic aid will raise the standard of living."

His method of attacking the problem was, as in other things, energetic, direct and unusual. He set up a panel of scientists and invited birth-control experts to explain their theories before it. He was, by all accounts, ruthless in his questioning. Dr. William Doering, Professor of Chemistry at Yale, who was on the panel, said, "Leo is almost frightening when he's on the trace of knowledge. He literally pulls men's minds apart. A great many leads were developed, and it had a very stimulating effect."

Doctor Szilard engaged in a dramatic personal battle with cancer. Characteristically, he will not discuss his own involvement. Also, this is an area in which scientists prefer a discreet silence; they do not wish to arouse hopes too early. The

story began in 1959, when he became seriously ill. At New York Hospital his trouble was diagnosed as an advanced cancer of the bladder. A radical operation was recommended as the only hope. From his hospital bed he began studying the store of knowledge on cancer, both by reading and by making long-distance calls to cancer experts.

Doctor Szilard has a capacity for finding the decisive fact and throwing out the less important details. In the end he ruled out the operation and chose radiation instead. A scientist familiar with the case told me, "Doctor Szilard provided himself with a detailed and sophisticated knowledge of his own case. There are not many individuals, even in medicine, who could be as thorough as he was. His wife, herself a doctor, was of great value. The signs three years later are good. It is a most unusual case."

Today Szilard is outwardly as lively, ruddy and energetic as a man twenty years younger. He travels about the land making speeches and attending scientific meetings, and sees a constant stream of visitors.

Leo Szilard, the human being, is complex. To a stranger he is a figure of awesome intellect and wit. He astounded a high-ranking British official whom he met at dinner by blandly outlining a highly secret strategic policy. Szilard had simply taken a few well-known facts and deduced the policy from them. And he delighted Khrushchev when they met in 1960 by presenting him with an injector razor and saying, "This is a small present. It is a very good razor, and I like it very much." Then he smiled and added, "If there is no war, I will send you the blades."

Once he was talking with a senator, who was giving him the line that democracy moves slowly because it must take into account the views of all the people. Szilard listened patiently and responded, "I am willing to go along with the democratic principle that one idiot is equal to one genius, but I will not accept the idea that two idiots are worth more than one genius."

Within the scientific community Doctor Szilard is known, both affectionately and with irritation, as "the terrible Hungarian." One well-known scientist told me, "I highly esteem Leo, and I would do anything for him except work with him." Doctor Szilard has acknowledged this repute with a certain pride. At a meeting he had thrown into confusion, he arose with all his small, round dignity and announced, "I think I can best contribute to the progress of this conference by leaving."

Part of this is his mighty ego. This, too, he admits. At a Los Angeles press conference he was asked if he was afraid that Communists would infiltrate a political-action group for scientists

which he was organizing, and manipulate it. Doctor Szilard smiled blandly and said, "No, I am not afraid. In order to manipulate me, the others would have to be much brighter, and I don't think there are many of that kind."

Nor will he suffer boredom. He would rather sacrifice good manners than endure it. A few years ago scientists at a biology conference in Denver devised the "Leo Szilard Index." If the great man walked out on a lecture after three minutes, the speaker's score was about par. Ten minutes constituted a very high rating.

Once in Chicago someone induced him to go to hear the Juilliard String Quartet. After a few minutes he decided he did not enjoy chamber music and calmly read his newspaper through the rest of the concert.

Doctor Szilard leads a frugal, even ascetic, life. To see him at dinner in a cheap restaurant, eating two bowls of vegetable soup and a serving of chicken, one would suppose he was a shabby old pensioner at his one filling meal of the day. Yet he is fascinated by money, which he calls "a useful tool." Doctor Szilard wrote six satirical essays—a sort of witty science fiction—which were published in a paperback volume in 1961 under the title *The Voice of the Dolphins*. In one of these pieces, *Grand Central Terminal*, he points out that one must have a coin in order to use the toilet in that great edifice. And during a discussion of a nuclear-test ban with Soviet scientists, he made a waggish suggestion.

"You should allow us unlimited on-site inspections," he said, "but charge several million dollars for each one. If you cheat, you will have to refund all payments plus a large fine. You won't have to limit the inspections. The Congress and the Bureau of the Budget will."

Scientists who have close contact with Doctor Szilard may be divided into those who revere him as "a great man" and others whose blood pressure begins rising when his name is mentioned. When one professor at Harvard heard that he was discussing disarmament with senators, he took off in alarm for Washington to tell the lawmakers not to heed him.

Szilard's wife and a few intimate friends see him as essentially a poet of science—highly creative, abnormally sensitive, intensely moral and idealistic and, as a consequence, troubled by the world about him.

As a small boy in Budapest he was ill much of the time, at home under the care and influence of his mother. In the highly sophisticated, gay and aristocratic Budapest of the late 19th Century, this tiny, very alive, selfless and moral Jewish mother must have been singular. When she was more than sixty she wrote her memoirs, and in them she told of an incident that shaped her life. She was a small girl when an older

sister, talented and beautiful, died. A few days later she overheard the servants say how sad it was the beautiful sister died and left the "naughty girl." In Hungarian the word for "naughty" also means "useless," and the child worried over this. Why was she useless? What did being useful truly mean? She devoted her life to this quest.

One of Leo Szilard's close friends related this story to me and remarked, "Leo's mother devoted her life to being useful to her family and community. In a sense he has gone beyond her and is trying to cure the sickness of the world—war."

Doctor Szilard's memories of her are vivid. He said to me, "She used to tell me children's tales, not the kind you find in a book but little tales she made up. They were designed to instruct in a higher principle. To tell the truth was important. She told me stories of my grandfather, a man of great integrity and honor, and through him I grew to admire those qualities."

I asked him what value ethics have for the scientist.

He replied, "A scientist must have certain qualities to be creative, and the moral qualities are very important. Intelligence is not enough. There must be a religious attitude. By that I mean an inner conviction that life has a meaning. Einstein said, and I agree, 'Religion without science is blind, science without religion is lame.'"

Like all creative people, Leo Szilard in his married life needs someone who believes in him, encourages his dreams, shares his burdens and his grief, is willing to squeeze her share of joy from his triumphs, and creates the kind of serene atmosphere in which he can work. Hers is the sacrificial role of the mother and wife, and Gertrud Weiss Szilard has been playing it for many years. She left her home in Vienna to follow him to England. She abandoned a medical career in England and again in Denver at his call.

They met in Berlin when he was thirty-two, a striking young Hungarian; she was twenty, a charming Viennese who had come to Germany to study physics and mathematics. She was dazzled by him at once. "He was absolutely fascinating," she told me one evening as we went through his "archives," of which she is the sole keeper.

Once they had met, he took charge of her life. "Why do you study physics?" he asked in a typically didactic, Szilardian manner. "You do not have the proper mind for it. You should switch to medicine."

Dutifully she returned to Vienna and a medical education. When this was completed, he persuaded her to come to England. She became homesick and returned to Vienna. He followed her to the Austrian capital, and after a long talk she went back with him. In the spring of 1934 he was think-

ing of creating a chain reaction and needed her to talk to. She told me, with the shining air of a woman recalling dear memories, "He took me for long walks along the river near Oxford. We roamed the countryside, and Leo told me of the atom bomb. It seemed, though, very far away and unreal. It was an idyllic time."

She came to America in 1937 because he felt this would be a safer place for her. Here she began her medical work anew. They were married in 1951. When he came to Washington, she came with him, to live in two cluttered hotel rooms. He likes the impermanence of it. It gives him a sense of freedom. She, as a woman, prefers a home and the sense of its being hers.

He also has a feeling of tenderness for the very young. This is expressed in an almost formal manner. A friend has a three-year-old daughter to whom he will talk gravely and respectfully, and the child will respond in kind. There seems to be a bond of innocence and trust between them that he, at least, needs and seldom finds elsewhere.

Leo Szilard, the scientist, has become an oracle of our time. The prophet and the scientist have much in common. They are incorruptible; they must tell the truth as they see it, no matter what the penalty. They remain outside the structure of power. Both are concerned with ethics. One can imagine Leo Szilard crying out in the words of the prophet, "Where there is no wisdom, the people perish."

He has a prophetic sense of danger which, he will tell you, is simply putting two and two and two together and getting six. In 1931, after the Nazis had won a great bloc of seats in parliament, Szilard knew a storm was gathering, and that Jewish intellectuals must choose between disaster and flight. He told me, "It became clear to me that political developments in Germany would lead to trouble. I came to America with an immigration visa in December, 1931, established myself as a resident and returned to Germany in 1932 to continue my studies. From then on I literally kept two suitcases packed, in my room at the Faculty Club at Berlin-Dahlem, where I lived."

In 1933, after the Reichstag fire, he picked up his bags and left for Vienna. The next train was boarded by Nazi soldiers; they barred all Jews from leaving Germany. Though safe himself, Doctor Szilard saw the need to save scientific talent from Hitler. A sort of underground railway was arranged to spirit Jewish scientists from Hitler's domain, and in England Szilard helped set up fellowships for these men. By the autumn of 1933, when he began his great work on the atom, he had so exhausted his time and resources in this rescue operation that he was himself hard pressed financially.

In 1936 he wrote to Gertrud Weiss,

"Come to England immediately. In two years you will not be able to exist in Vienna." He was right.

In 1939 he saw that war would sweep over all Europe, and that England itself would be a target. He told Miss Weiss she must go to America. She was enjoying England and thought he was being an alarmist. Szilard took her to an H. G. Wells movie showing scenes of a future war. In the middle of the film he took her by the hand and said, "Are you satisfied?" She nodded, they walked out of the theater, and she applied for a United States visa.

A few years earlier, when he was working during the summer at St. Bartholomew's Hospital Medical College in London, near St. Paul's Cathedral, Doctor Szilard had to be reminded of the hospital's regulations, which required radium needles to be locked in a safe from six in the evening until nine the following morning. Since Szilard's experiments often required long hours of observation, he sometimes found it difficult to abide by this rule.

Prof. F. L. Hopwood, head of the Physics Department, said to him, "You must understand my point of view if I suggest to you that you are to pay more attention to the customs of this hospital. It is the point of view of a man who is very much aware that these walls have been standing here for over five hundred years."

"I understand that very well," said Szilard, "but please keep in mind that these walls may not be standing here ten years from now."

The vicinity of St. Paul's Cathedral was one of the most heavily bombed areas of London, and the walls Professor Hopwood revered were demolished during the London blitz.

Another vision possessed Szilard in 1939. As he made the key experiment at Columbia, he recalls now, "All we did was to turn a switch and watch the screen of a television tube. If flashes of light appeared, it would mean that the freeing of atomic energy would take place in our lifetime. We turned on the switch, saw the flashes—we watched for about five minutes—and we switched off and went home. I knew then the world was headed for trouble."

He feared Hitler would get the bomb first. This drove him like a man bewitched, and undoubtedly some of his fellow scientists did think him a little mad. He tried to persuade nuclear physicists outside of Germany to censor their findings—that is, not publish them and so keep the knowledge from the Nazis. On February 2, 1939, he wrote to Joliot-Curie in Paris, "In certain circumstances this [a chain reaction] might then lead to the construction of bombs which would be extremely dangerous in general and particularly in the hands of certain governments." This was heresy to the tradition of science, which, since Galileo faced the Inquisition, had viewed any contact with politics as unclean. Joliot-Curie in-

dignantly refused to cooperate.

Szilard was denounced, but he persisted. He was convinced the United States must make the terrible weapon before Hitler did. He went to Einstein to beg him to go directly to President Roosevelt. As Szilard recalls the episode, in midsummer of 1939, "Einstein dictated a letter in German, and I used this as a basis for two other drafts, one short and one long. Einstein chose the latter. I also prepared a memorandum to enclose with Einstein's letter." The letter and memorandum were given to the President by Alexander Sachs, who has since remarked that Einstein was needed only because Szilard was almost unknown here. The famous letter said in part: "Some recent work by E. Fermi and L. Szilard, which has been communicated to me in manuscript, leads me to expect that the element uranium may be turned into a new and important source of energy." The mills started to grind, but very slowly.

The military were indifferent. An Army ordnance colonel pompously told Szilard, "It usually takes two wars to develop a new weapon. Besides, it is morale, not arms, that brings victory."

Finally, on December 2, 1942, nine years after Leo Szilard thought of the idea while crossing a street in London, the first self-sustained chain reaction was achieved in an old squash court under the West Stands of Stagg Field at the University of Chicago. The patent issued for the process names Szilard and Fermi as joint inventors.

In 1945, with Germany collapsing in ruins, Doctor Szilard was vastly relieved to think the weapon would not have to be used. He had no wish to be a Frankenstein, the creator of a monster. Then, to his horror, he learned that American military leaders were determined to drop the bomb on Japan. In March, 1945, he wrote a memorandum, which he hoped to deliver to President Roosevelt, against this plan. He argued that the United States, too, would be vulnerable to atomic attack and should quickly bring the weapon under international control. If the United States used the bomb and tried to be its sole possessor, other nations would move heaven and hell to make their own.

President Roosevelt died. Doctor Szilard tried to see President Truman and was shunted off to James F. Byrnes, the former South Carolina senator. Byrnes, as special assistant to the President, occupied a position equivalent to the king's vizier. This was a curious confrontation, as if two men were shouting through a brick wall at each other. Szilard presented his case and was told by Byrnes, "Aren't you worrying too much about this?" Byrnes thought the bomb should be used to frighten the Russians and make them more "manageable."

Some weeks later a committee advising the Secretary of War recommended that the bomb be dropped on Japan without prior warning, and on a

target not exclusively military. Three scientists were on the committee, and they in turn had consulted a scientific panel of seven. This was a severe shock to Szilard. It was not a case of a madman using the bomb; scientists and generals were eager to test the new gadget, and politicians wanted to be sure they got their money's worth.

At this point Leo Szilard became a Jeremiah crying out protest against the bomb. He instigated what amounted to a revolt among the scientists at the huge Manhattan District Project operated by the Army. In another society he would probably have been shot for his efforts. He appealed to the agitated consciences of the atomic scientists. The immediate result was the Franck Report—dated June 11, 1945, and written by Nobel Prize winner James Franck and Szilard, and signed by themselves and five other noted scientists—in the form of a memorandum to the Secretary of War:

"We found ourselves by the force of events, during the past five years, in the position of a small group of citizens cognizant of a grave danger for the safety of this country as well as for the future of all mankind, of which the rest of mankind is unaware. . . . In the past, scientists could disclaim direct responsibility for the use to which mankind has put their disinterested discoveries. We feel compelled to take a more active stand now because [our] success . . . is fraught with infinitely greater dangers than were all the inventions of the past. . . . Science has often been able to provide new methods of protection against new weapons of aggression; but it cannot promise such efficient protection against the destructive use of nuclear power. . . . If the United States were to be the first to release this new means of indiscriminate destruction upon mankind, she would sacrifice public support throughout the world, precipitate the race of armaments and prejudice the possibility of reaching international agreements on the future of such weapons."

The signers predicted that Russia would make its own bomb within a few years.

The report was rejected. Szilard made a last forlorn attempt after the test at Alamogordo. The petition was circulated among the members of the Manhattan Project. It urged that the bomb not be used against Japan without a prior demonstration and an opportunity to surrender; it also urged the government to seek a means of international control of the weapon. General Leslie R. Groves, the military administrator of the Project, stopped the circulation of the petition by declaring it contained "secret" information and locked it up. It did not reach the President.

Then came Hiroshima. The guilt and despair of the atomic scientists were reflected in a letter one wrote his mother: "I am not a bit proud of the job we have done . . . the only reason

was to beat the rest of the world to a draw . . . perhaps this is so devastating that man will be forced to be peaceful. The alternative to peace now is unthinkable. But unfortunately there will be some who don't think . . . anyway it is over now, and God give us strength for the future."

In our conversations I tried to draw out Doctor Szilard on the responsibility of the scientist. He was slumped in his chair by the window, and he looked out briefly and inquiringly into the spring afternoon. Then, speaking fast and with an accent that became heavy at times, he said, "A scientist cannot maintain control over his discoveries, and he cannot prevent their being used for destructive purposes. Nobody is guided by moral considerations alone, and nobody is guided by expediency alone. The people whose actions are mainly guided by moral considerations represent a small minority, a few percent perhaps. Among scientists this minority is larger than among the general population, and among the truly creative scientists this minority might even be the majority."

When I asked Doctor Szilard if he thought scientists should study history, and politicians science, so that they might communicate better, he replied, "If a scientist wants to understand current events, he would do well to study history. As to politicians, I would not suggest they study science. I would be quite content to have them study history." He also blames the "expediency" of the political mind for wars and other great breakdowns of civilization.

I asked if it was the tragedy of the scientist that his advances in knowledge are used for destruction. He replied, "This is not the tragedy of the scientist; it is the tragedy of mankind."

After the war Leo Szilard studied restlessly in the field of biology. Then, when he was in the hospital pondering the world, the spirit of the prophet returned to him. He would go out among the young; they alone had the capacity for moral outrage. He went initially to Harvard, speaking at the Law School Forum on November 14, 1961. Here was the prophet, his hair white but the fury of his judgment unspent, arousing the young with fearful visions: "I myself believe . . . that our chances of getting through the next ten years without war are slim." Then a glimmer of hope, as if he were saying, follow me, my children, to the promised land of reason.

Typically, Doctor Szilard did not offer a detailed plan, but rather a series of theorems for the conduct of foreign policy and military strategy so as to avoid the cataclysm. Stop petty quarreling and name-calling. Discuss in earnest a set of rules for keeping the peace and for disarmament. Renounce the first strike. Use tactical nuclear weapons only to halt aggression, and not on enemy soil. Keep nuclear weapons within the American command.

If you believe me, he said, join me. He proposed a political-action com-

mittee of reasonable men. The members would turn over two percent of their earnings to back candidates for Congressional offices. By all accounts, he was a kind of cerebral Billy Graham. He caught the young people's sense of alienation from the confused world of their fathers, their vague but ardent hopes to escape doomsday. They stood around him after the meeting, reluctant to let him go.

Doctor Szilard went on to seven other American colleges, organized his Council to Abolish War with several thousand subscribers, and collected a respectable sum for the 1962 Congressional elections. The next year he quietly changed the name to Council for a Livable World, having discovered that Washington thought any outfit trying to abolish war must be made up of subversives or fools.

The prophet suffers more than other men. Most of us go about our lives attending to our errands, enjoying our little pleasures and avoiding as much as we can the view of the abyss. But the prophet lives hourly with his fears; they

possess him. One night in October, 1962, Leo Szilard's friends saw how deeply he suffers.

The Cuban crisis was at its height. President Kennedy was speaking on television. Russian ships were plowing through the Caribbean, United States naval vessels waiting to meet them. A dozen or more of Doctor Szilard's young disciples came to his hotel room in search of reassurance. The great man would have the answers.

What they saw instead was a man in the depths of despair. He was the inventor of a monster which, he feared, was about to destroy the world. His genius had been wasted on an ogre.

"What can be done?" a young disciple asked.

"Nothing," he answered. "It is hopeless." In what was for him an emotional and often rambling speech, he said he had failed, and the only hope was that the young people would pick up the broken pieces. He was too old.

The next day he packed his bags and flew to Geneva, Switzerland. When he returned a few weeks later, the world

had not been smashed; peace, or what passes for it, still covered the land.

Since then Leo Szilard has painfully returned to his scientific detachment and his research, inquiring into the mysteries of the molecule at the Salk Institute. He no longer believes the end of the world is upon us. He gives it six years, and in optimistic moods even longer. The last time I talked to him, he said, "As long as nations abide by some code of behavior, like the United Nations charter, they can avoid a resort to force. To follow a course of pure expediency is courting disaster." Plainly he felt that expediency was still being courted in Washington and elsewhere. The Council for a Livable World, no longer under his close personal direction, operates as a study group and foreign-policy lobby, with headquarters in Washington and a membership of several thousand scientists.

Doctor Szilard sat in a comfortable chair by the window, thinking. His pretty Irish secretary was waiting to take down his words. A cup of coffee steamed on the window ledge. The day bed was

covered with bulging paper files of the projects he is pursuing. Some are mysterious and involve talks at the White House and with foreign scientists. On his desk were notes to himself on exciting scientific work. I sat stiffly on the edge of the bed and wondered if, without him and his kind, man would ever have left the caves.

A few days later another scientist gave me a poetic answer to the question of Leo Szilard's place in the scheme of things. He went to his bookshelf, pulled out a volume of Edwin Arlington Robinson's poetry and read these lines from *Ben Jonson Entertains a Man from Stratford*:

Today the clouds are with him, but anon
He'll out of them enough to shake
the tree
Of life itself and bring down fruit
unheard of.
And, throwing in the bruised and
whole together,
Prepare a wine to make us drunk
with wonder.

THE END