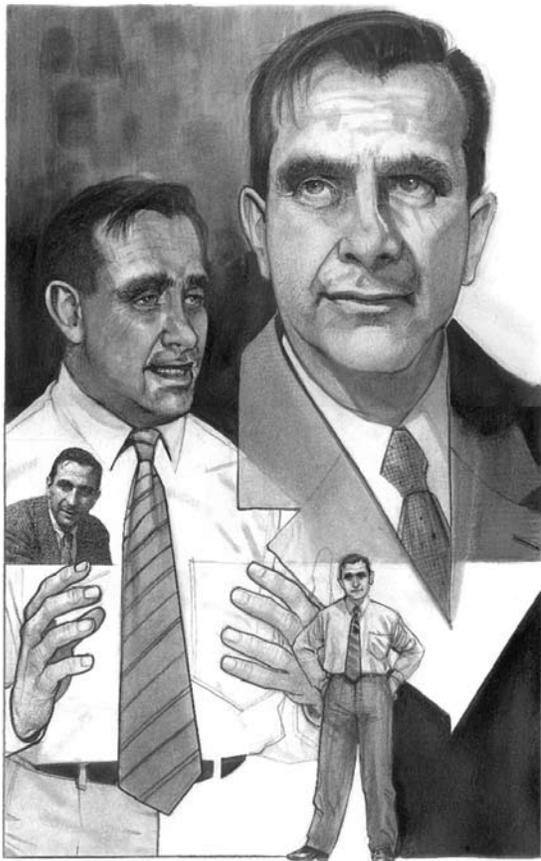


## prologue

PAGE 13

When I first saw it, I assumed that Peter Sellers' scientist character (he also plays two other roles, including the President of the United States) in the movie *Dr. Strangelove, or: How I Learned to Stop Worrying and Love the Bomb* was based on the German rocket scientist Werner von Braun. (The reflexive salute was the main reason for making that connection.) Teller it is, though. He has lived with the comparison ever since, and remains notoriously touchy about the subject of the Sellers role.

*Note: Except when referring to reference works difficult to obtain from a visit to a library—such as the Leo Szilard Papers found only at the University of California, San Diego, noted by their box/folder number as MSS 32: xx/yy—these notes won't usually cite specific sources.*



## birth

PAGES 17-18

For this morning's soak—a ritual he indulged in whenever he could—Szilard is reading *The World Set Free* by H.G. Wells, one of two books he credited for shaping his world view. (The other is *Tragedy of Man* by Imre Madách, which he refers to on page 25.)

PAGES 18-20

This is not the first place Szilard settled in London. His first residence was the Imperial, in the heart of London's Bohemian Bloomsbury neighborhood, whose facade was decorated in Edwardian Gothic style, and probably reminded him of Vienna. His second stop was a boarding house at 97 Cromwell Road, but he didn't stay there long before packing up his two suitcases (all he brought with him when he left Hungary, and setting a pattern for his travels from then on) and moving back into a hotel, this time The Strand Palace which, though it sounds quite fancy, wasn't. Szilard rented a room that had once been a maid's closet, and he took his customary multi-hour soak in the shared bath down the hall. His meeting with Beveridge actually occurred while he was staying at the Imperial.

PAGE 20

Panels 2-4: The London we see here is in the throes of the global depression, which ran through the beginning of the war.

PAGE 21

The son of a British civil servant in India, Sir William Beveridge was educated at Oxford. After serving as subwarden of Toynbee Hall, a London settlement house and then a director of Labour Exchanges, he became permanent secretary of the Ministry of Food in 1919. He directed the London School of Economics and Political Science from 1919 to 1937, when he was elected master of University College, Oxford. He served as a Liberal member of

Parliament from 1944-1945, and it was during this period he helped work out the blueprints of the new British welfare state.

PAGE 22

Panels 2-3: Szilard would later make light of his good luck, and his prescience, by saying "To succeed in this world you don't have to be much cleverer than others; you just have to be one day earlier."

Panel 5: Szilard actually said this to Max Planck. If anything, doing so required even more *chutzpah* than saying it to Einstein, since when Szilard began his studies Planck was considered the intellectual founder (though he was reluctant to be known as such) of quantum theory. Einstein would have been just coming into his own fame at this point.

PAGE 23

Szilard's monologue here comes mainly from letters he sent to Beveridge and other scholars at the time he was working to help set up the Academic Assistance Council (AAC).

Panel 4: Einstein actually expressed his thoughts on this more strongly, telling Szilard that "Your plan doesn't really set me on fire."

(Regarding Szilard's Jewish heritage, ever the pragmatist, he had applied in his neighborhood to change his religion from "Israelite" to "Calvinist.")

PAGE 24

Panel 4: Stanley Baldwin preceded the more notorious appeaser Neville Chamberlin as Prime Minister of Great Britain.

Panel 6: See the note for page 22, panels 2-3 for the actual quote.

PAGE 25

Panel 2: Szilard was premature in many things. I gave him this particular line of think-

ing about the aforementioned *Tragedy of Man*. It's apparently a tough slog for adults, and he read it when he was only 10. But from it he learned the notion quoted here.

PAGES 26-27

Sources for the quotes and thoughts here include *Genius, His Version of the Facts*, and the Szilard archives [MSS 32:42/25].

Szilard told the story of how quickly (and exactly where) his inspiration about the chain reaction occurred in a couple of different ways over the years. I've chosen the version where the vision occurs to him the same day he read about Rutherford's dismissal of atomic energy.

PAGE 26

Szilard missed Rutherford's talk because of a bad cold the day before we see him here. The paper in which the transcript appeared, *The Times*, didn't run headlines, so we take the liberty of using the *Evening Standard* instead.

PAGE 28

James Chadwick discovered the neutron about a year before Szilard's insight. The atomic model of a spherical nucleus surrounded by a solar system of electrons, used here for simplicity, is actually an anachronism: Physicists had begun to think of the atom as something far more complicated. However, this popular shorthand for describing what an atom looks like and how fission occurs persists, and works well enough for our purpose here. For a closer look at how fission works you may want to read about Lise Meitner in *Dignifying Science*.

As with the atomic model, the graphics shown for chain reactions is commonly used, but the specific reference for this depiction comes from a serialized feature called "The Story of the Atom" which appeared, courtesy of the NEA Service, Inc., in 17 installments from September 4 to September 21, 1945—just days after the bombing of Japan. (Thanks to Don Mangus for sending copies of this obscure comic strip.)

PAGES 28-36

From the last panel of page 28 through to page 36 we have excerpts from Wells' *The World Set Free*, as it might have filtered through Szilard's vivid imagination...an imagination so vivid that I've taken the poetic license of tinkering with Wells' work by having Szilard insert himself into the narrative.

PAGE 38

I have Szilard overstating his role in influencing Meitner, Hahn, and Strassman in panels 6 and 7 (they didn't waste their time testing all 70 known elements), the Curies in panel 8, and Niels Bohr in the last panel, but by the same token I greatly compress (and thus understate and diminish) Szilard's efforts along those same experimental lines.

PAGE 39

Panel 2: Fermi, as we see later in the story, was in many ways Szilard's polar opposite. In other words, he was a brilliant experimentalist, a thorough, careful and somewhat conservative scientist, and almost totally oblivious to (or at least uninterested in) the political implications of the work he did.

Panels 4-6: This statement comes from a recollection made much later by Szilard, reverse-engineering the reasoning behind his decision to approach Einstein.

PAGE 40

Panel 1: The first letter Einstein and Szilard wrote together was actually to the Belgian government, warning of the danger of allowing the Nazis to get hold of the uranium supplies in Belgian Congo (now the Democratic Republic of Congo).

Panels 2-4: Einstein pauses for three beats here to consider the problem on scientific, philosophical, and political grounds:

First, he wasn't entirely immune to worrying about being thought a fool. His famous mass-energy equation was, up until then, only

a theory for him—Szilard was making it a reality. Second, he was an avowed pacifist, so advocating something as terrible as weapons research was bound to cause him discomfort. But the third consideration, and the one that I think overcame the first two, was the risk of doing nothing.

Panel 7: Einstein did indeed go sailing right after this meeting, and Szilard did indeed use his economic contacts to hook up with Alexander Sachs. Though this provides our story with a convenient parallel to his meeting with Beveridge, I don't believe there's any actual connection.

PAGE 41

Panels 2-4: Yes, this is a real quote from Sach's interoffice communication (bizarrely) titled "Notes on Imminence World War in Perspective Accrued Errors and Cultural Crisis of the Inter-War Decades." And yes, there was no intended audience for the memo other than himself. You can't make some of this stuff up!

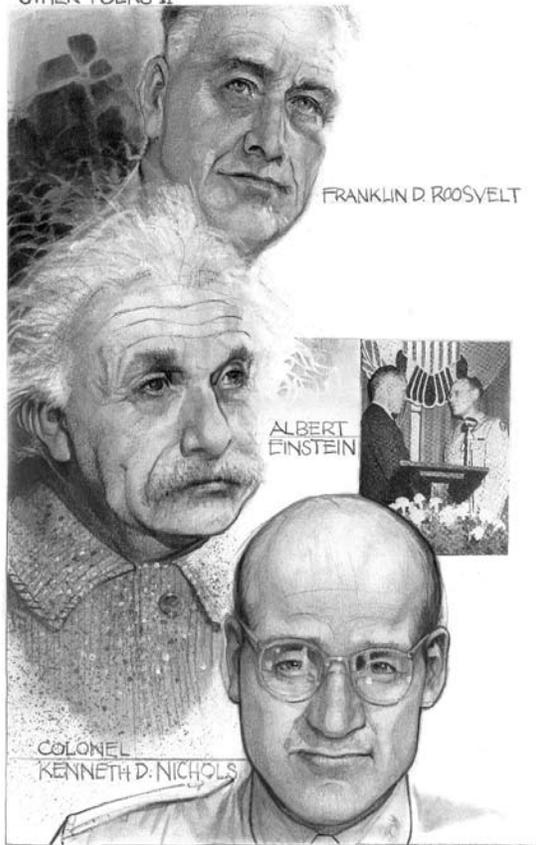
Panel 5: This quote comes from a letter Szilard wrote to Einstein months after they had sent their letter to Roosevelt—in other words it's out of context here, but nonetheless likely to reflect his thoughts about Sachs.

Panel 6: Enter Teller, sitting across from Sachs, in on the earliest days of the bomb almost by accident. Since Szilard didn't drive, Teller took him to Einstein's cottage on Long Island, serving as his second chauffeur in doing so.

Sachs was perhaps involved in an early draft of Szilard's letter, a draft that proved over-long and needlessly detailed. (What a surprise.) Einstein was probably not around for this, so this scene compresses that initial draft and Szilard's more direct collaboration with Einstein.

PAGE 42

Panel 1: These are again Sachs' own words (paraphrased, of course, since you can't fit the whole thing into an industry standard word balloon), written well after the fact and



without a hint of irony.

Panel 8: Again, the evidence suggests that Einstein didn't do much writing, at least of the first draft. He does in this version since I don't like the almost complete detachment from the process of setting the bomb in motion that having Szilard work on it alone would imply.

Einstein's quote about rational thought is genuine, but the quote about selling the idea rather than explaining it is paraphrased from Sachs. It's too plain-spoken for the Sachs persona created for this story, though, so I give the lines to Einstein instead.

PAGE 43

Panels 3, 5, and 7: These panels combine text from two letters from Szilard to Einstein (written in the opposite order shown) to emphasize

Szilard's continued misgivings regarding Sachs. These misgivings weren't so much in terms of his confidence in Sachs' ability to convince Roosevelt as much as his ability to actually get an audience with him.

Szilard did consider Lindbergh as an emissary, though he quickly abandoned that idea based on Lindbergh's increasingly rabid position regarding U.S. neutrality.

I further have Szilard writing three times since that's the number of times he composed letters intended for delivery to the President.

Panel 9: More labored prose from Sachs here and in the first panel of the next page. This bit is taken out of context from a much later meeting of the Uranium Committee. (I just can't cut this guy a break.)

PAGES 44-45

From panel 8 on we, for the most part, hear Sachs read The Letter. Not all of it, since it's longer than you—not to mention President Roosevelt—would have patience for. (And easy to find in many of the references, if you're so inclined.) But he read it aloud, all the way through. As presented here, parts of Sachs' speech to Roosevelt come from an October 11, 1939 letter Sachs wrote to the President. The remainder come from Szilard and Einstein's letter. I've rearranged and condensed it, but not so much (I hope) that you miss out on the density—not to mention the content—of his presentation.

PAGE 46

Panel 7: Standing in the doorway we have Roosevelt's secretary, General Edwin M. "Pa" Watson. And though Roosevelt reacted favorably—and immediately—to Einstein's letter, as indicated in both the interlude and by the gap of three years between the end of this section and the beginning of the next, it took a while for the government bureaucracy to spring into action on this.

## interlude

PAGE 49

Panel 2: The government initially only appropriated \$6,000 to research, and did so only starting in 1940, many months after the close of the previous section. More money became available later in the year—\$100,000 at about the time the German army entered Paris. Another letter from Einstein (again via Szilard) prompted a meeting with Szilard, Fermi, Teller, Wigner and government officials where Sachs argues effectively on behalf of the physicists for greater funding and against “bit-a-bit procedures.”

The U.S. only committed to full-scale pursuit of military applications of nuclear chain reactions on December 6, 1941...one day before the attack on Pearl Harbor.

Panel 3 on: As mentioned before, Fermi and Szilard couldn't have taken a more different approach to science and their lives. Fermi was the “scientist's scientist.” (When playing “Who do you want to be on your day off”—a party game of amateur psychoanalysis—Oppenheimer chose Fermi.)

PAGE 52

Panel 6: In case you want to look it up, “Divergent Chain Reactions in Systems Composed of Uranium and Carbon,” was eventually published as Report A-55 of the Uranium Committee, and declassified in November 1946 as MDDC-446 (1940). It begins: “As early as 1913 H.G. Wells forecast the discovery of induced radioactivity for the year 1933 and described the advent of nuclear transmutations on an industrial scale.” True to his word, Szilard cites Wells' book properly in his first footnote.

## school

PAGE 55

Panel 1: Oppenheimer joined the bomb project (not yet called the Manhattan Project at this point) in February of 1942. He took it over, largely by default, from Gregory Breit in May. At this point in our story he wasn't director and Bainbridge wasn't his assistant, though, so in that sense this scene is anachronistic.

The flowers aren't, though. They're here, and in the rest of the book as both an icon and as a reference to a story told by his brother Frank in *The Day After Trinity*:

Everything Robert did would sort of be special. If he went off in the woods to take a leak he'd come back with a flower. Not to disguise the fact that he'd made a leak, but just to make it an occasion, I guess.

Oppenheimer, though often called the father of the atom bomb, didn't match the picture people who grew up with the Cold War might have of him. He was of course a brilliant physicist. But he was also a poet, self-educated in the arts, fluent in many languages (both living and dead), and sensitive in the pre-1960s meaning of the word.

Panels 4-5: Agents Pash and Lansdale probably did not interview Oppenheimer at this time, but since they figure into later investigations we use them here as well.

PAGE 56

The misspellings and other excerpts from the reports are real. However, while having Oppenheimer act so supercilious is in character at this point in his political career, it's also unlikely that he did so in exactly this way.

PAGE 57

Panel 2: One of Oppenheimer's first tasks was to step up the caliber of scientist working on the bomb project. The Manhattan Project was slow to gain momentum, and early on—before the U.S. became engaged in the war—the very top physicists were not involved. (With a few

notable, and previously noted, exceptions.) For instance, early on I.I. Rabi's radar group at MIT had more and better scientists

Panel 5: Ironically, Oppenheimer began to reduce his involvement with political groups sharply at the time he took on a more active role in the bomb project. (My presumption, as indicated here, is that he did this both because of time constraints and the sense that war work took precedence over ideology.)

PAGE 59

Panel 1: Oppenheimer refers to Fermi's fondness for slang, which, as we saw in the previous interlude, he took pains to use often.

Panel 3: It seems likely that at this point, Oppenheimer would not have thought of himself as an administrator, hence his desire to gloss over personnel and budget and get right to the science.

Panels 4-5: Six was the first guess regarding the size of the initial group of scientists who would move out to Los Alamos. Even 600 was low—the Manhattan Project employed nearly 7,000 people by the end of the war.

PAGE 60

Panel 1: Lawrence is angry because he thought he should head the project. General Groves, who hasn't entered the scene yet in this version of the narrative, thought otherwise. Lawrence held a grudge against Groves (and probably Oppenheimer) for a long time after.

Panel 2: It turned out that Lawrence's favored method of electromagnetic separation did not prove feasible. In other words, what worked great for producing a few micrograms of weapons grade uranium worked poorly for producing kilograms. (For one thing, there wasn't enough copper in the U.S. to construct the necessary magnets.)

The gaseous diffusion method, on the other hand, proved more successful in exploiting the slight mass differences between the type (isotope) of uranium the bomb re-

quired and the far more common type that was merely in the way. The largest gaseous diffusion operation during the war took place in Oak Ridge, Tennessee—newspaper comics fans will recognize "Dogpatch," the workers' nickname for the place, as coming from Al Capp's *Li'l Abner*.

PAGE 62

Panel 1: The graphite blocks are 4x4 in. (10x10 cm) bricks with holes drilled in them to hold lumps of uranium oxide, and the physicists and their assistants stacked them in 4x10 ft. (1.2x3 m) piles in Columbia. Most wore dust masks and food service-like cloth caps. After a few hours of work the only white you could see on them were from their eyes and teeth.

Panel 3: The impurity was boron, the chemical equivalent of a neutron sponge. The first shipments of graphite that Fermi and Szilard used were laced with it, and its presence ruined their initial experiments.

Panel 4: The quotation about "remote possibility," though indeed from a conversation about the bomb with Fermi, is taken far (in both time and space) out of context. The real conversation occurred in 1939 between Fermi and I.I. Rabi, where Fermi considers the probability that "neutrons may be emitted in the fission of uranium and then of course a chain reaction can be made" unlikely.

PAGES 63-74

Szilard's talent, as indicated in the previous section, ran more along the lines of instigating fruitful lines of research and working behind the scenes to make that research possible. (He wasn't particularly good at doing the work needed to turn his ideas into reality.) These pages show an amalgamation of Szilard's efforts in pursuit of neutron fission, which included getting funding to rent some radium from The Radium Chemical Company of New York and Chicago—a subsidiary of a company in the soon-to-be-overrun-by-the-Nazis Belgium, securing boron-free graphite, and borrowing uranium

oxide, free of charge, from the Eldorado Radium Corporation.

Szilard on Fermi from MSS 32: 40/4, "Book": "I doubt that he ever understood that some people live in two worlds like I do. A world, and science is a part of this one, in which we have to predict what is going to happen, and another world in which we try to forget these predictions in order to be able to fight for what we would like to happen."

PAGE 63

Panel 7: For all the bluster shown here, Fermi did value Szilard's abilities along these lines, saying "He did a marvelous job which later on was taken over by a more powerful organization than was Szilard himself, although to match Szilard it takes a few able-bodied customers."

PAGE 64

Panel 1: Fermi was actually present at this luncheon as well, but I left him out for the sake of clarity and to contrast the type of work he typically did with that of Szilard.

PAGE 65

Panels 1-2: Though plans were drawn up to can and vacuum pack the first reactor, the specifications were exacting and especially troublesome because the only contractor skilled enough to meet them didn't speak English.

Panel 5: The reference to the Metallurgical Lab is probably anachronistic, since I don't believe this was the name of Fermi's group until it moved to the University of Chicago.

PAGES 66-67

About those "footballers" Szilard refers to: By this point the University had volunteered the services of the football team to do the heavy lifting for the scientists. As indicated

previously, building the piles was tough work. Herbert Anderson had this to say:

We were reasonably strong, but I mean we were, after all, thinkers. So Dean Pegram...looked around and said that seems to be a job a little bit beyond your feeble strength, but there is a football squad at Columbia that contains a dozen or so of very husky boys who take jobs by the hour just to carry them through college. Why don't you hire them?

And it was a marvelous idea; it was really a pleasure for once to direct the work of these husky boys...handling packs of 50 or 100 pounds with the same ease as another person would have handled three or four pounds. Fermi tried to do his share of the work. [H]e donned a lab coat and pitched in to do his stint with the football men, but it was clear that he was out of his class. The rest of us found a lot to keep us busy with measurements and calibrations that suddenly seemed to require exceptional care and precision.

PAGE 67

Panels 7-8: Szilard did indeed say...and do...these things.

Panel 8: "I hear they're moving us soon" is fabrication, though Szilard was more likely to know this than Fermi.

PAGE 68

Panels 1-5: This briefing actually happened, though in reality Groves wasn't there with the Navy admiral. Just before Fermi entered the room, he heard his presence announced as "There's a wop outside." This no doubt added to his willingness to give an overly conservative assessment of the likelihood of producing a workable nuclear weapon.

PAGE 69

Panel 4: Note that the quoted phrase from Fermi may be something Rhodes (in *The Making of the Atomic Bomb*, p. 295) inferred from his research, but even though I couldn't verify it using other sources it's a good and

appropriate one, so I've used it.

PAGE 70

Panel 6: Eugene Wigner, also Hungarian, was the third strong proponent of secrecy about nuclear fission. On voting, see for example, MSS 32:40/4: "Book", p. X.

PAGE 71

Note that Compton (one of the few scientists who got along with Groves) probably didn't—and in fact probably wouldn't—consult or even tell Oppenheimer about this, since Oppenheimer was still working at the periphery of the project at this point.

PAGE 72

Panel 2: Here I give Szilard Fermi's speech pattern, for two reasons: First, I initially wrote this scene with Fermi doing the lecturing, but then realized that a) he probably wouldn't have taken the time to explain what he was doing to a non-scientist, and b) at this point in the story I needed Szilard to get in trouble with Groves, not Fermi. Second, and the after-the-fact rationalization for leaving it be, is because I liked the idea of suggesting that Fermi rubbed off on Szilard more than Szilard let on.

Panel 4: As I checked to make sure that the balloon was actually silk, I ran across the fact that it was custom-made by Goodyear, who later went on to bigger and better balloons...

PAGES 73-74

Groves and Szilard clashed from the very beginning. Though both advocated secrecy, Szilard only wanted to keep the results away from the Nazis. Groves' military background made his security concerns more restrictive. He favored compartmentalization of the various U.S. scientific groups, and considered Szilard the only villain of the Project. Szilard in turn thought Groves its biggest fool.

In MSS 32: 114/13 you can find a July 4, 1945 letter Groves wrote to Lord Cherwell of the British War Cabinet stating "Frankly, Dr. Szilard has not, in our opinion, evidenced wholehearted cooperation in the maintenance of security." Groves actually had no evidence of this, despite continued surveillance of Szilard. In reply, Cherwell wrote:

I am sorry to hear that Szilard has been indiscreet. ...As you know he worked in my laboratory at Oxford and always had rather a bee in his bonnet about the awful international implications of these matters...

When I spoke to Szilard in Washington in 1943, he was, so far as I can remember, mainly concerned with a topic which has inflamed so many scientists' minds, namely what sort of arrangements could be made to prevent an arms race with all the disastrous consequences to which this would lead. I do not recall that he offered any solution... My impression is that his security was good to the point of brusqueness. He did, I believe, complain that compartmentalism was carried to undue lengths in America.

PAGE 74

Panel 2: This quote from Groves, though real enough, is taken out of context...but I've softened it as well. After giving a lecture to Compton, Fermi, Szilard, and others on security that clearly went in one ear and out the other, Groves made this comment in regards to the security of the scientists themselves: "General, what would you think if someone threw a hand grenade through that window?" "It'd be a damn good thing. There's too much hot air in here."

Panel 3: Per MSS 32: 5/21, September 8, 1945 letter from Szilard to Bush, Szilard actually said this to Vannevar Bush, not Groves, but it fits perfectly here.

PAGE 76

On this and the next two pages we build the CP-1 (Chicago Pile One) reactor from the bottom up, adding seven layers of graphite and uranium in each panel.

Panel 1: Pile height = 12 layers. As mentioned before, the element boron is a neutron absorber. So while it's a "poison" for reactors, it's actually great to use in a detector, since that absorption property is just what you'd want. To count neutrons you need to capture them—it's not like you can watch 'em as they go by!

Panel 2: Pile height = 22 layers. Szilard was indeed working on CP-2 (Chicago Pile 2), a reactor designed to try and produce plutonium, something never done in quantity before.

PAGE 77

Panel 1: Pile height = 32 layers. Wigner teases Fermi about his definition of a remote possibility.

PAGE 78

Panel 1: Pile height = 52 layers. Woods' detectors and calculations show that the pile will reach critical mass sooner than anyone expected...

Panel 2: ...so they won't have to vacuum-pack it to achieve the first self-sustaining nuclear reaction. (Pile height = 57 layers.)

PAGE 80

Panel 2: Raccoon coats? Rifles? What's going on? A cold winter, an under-funded project, and a lab built beneath the stands of what used to serve as the University of Chicago's football stadium resulted in this unusual variation on the military dress code.

PAGE 81

Panel 2: Though I use Woods here, Szilard actually invited Heinrich Kluver (a friend from another academic department) out for his second dinner of the day. Woods makes a good stand-in, since in many respects she too was an outsider even though she was very much in the know and part of the team. (Note that Woods, like many of her colleagues,

thought Szilard was rich.)

Panel 5: Szilard's fears foreshadow those of the Trinity scientists who speculated on the atmosphere igniting upon explosion of the first atomic bomb.

PAGES 83-85

Most of what follows comes from Woods' description of the first criticality experiment given in her book *The Uranium People*.

PAGE 83

Panels 1-2: The cadmium nitrate (a neutron absorber) and zip rod are primitive versions of a method for "scramming" a reactor—the term used for shutting down the nuclear reaction abruptly in case of emergencies. We don't rely on people standing near the core with buckets any more, though.

PAGE 84

The instrumentation to record the experiment was "glowing and winking and radiating some gratefully received heat"—for all its potential to do so the reactor itself didn't generate much warmth.

PAGE 85

Panel 7: Fermi didn't really pull out the wires himself. A scientist named Volney Wilson took care of the control circuits, but since Fermi did let the alarms ring for a while—in an uncharacteristic break with his usual caution—I let him take control of stopping them as well.

PAGE 86

The beverage on hand was a bottle of chianti, which wouldn't have popped like champagne. But since it was a celebratory wine, and given their budget for this sort of thing was probably small, it's reasonable to give it some fizz.

# interlude

PAGE 88

Panel 1: I've manufactured the telegram Oppenheimer receives from a phone call between Compton and Conant. As noted, and in a classic good news/bad news sort of situation, Fermi reached critical mass with the pile sooner than he had expected. That's the good news. But it was bad news as well, since it probably led the U.S. team to believe that the Nazis had an easy time as well. Fortunately, achieving criticality was by no means trivial, and building a bomb proved even less so...

PAGE 93

Panel 3: Groves' dialogue comes from a different (and earlier) meeting with scientists than the one presented here, borrowed because it fits well with the tone and mood of this anecdote.

PAGE 94

Panel 5: This turn of phrase comes from my high school physics teacher, Mr. Valentine, who would often call some subtle principle or elusive phenomenon "intuitively obvious to even the most casual observer."

Panel 6: Phrases such as "atomic energy," "atomic fission," and "uranium" disappear from news reports in the U.S. in June, 1943.

PAGE 95

Panel 2: Renan also wrote "O Lord, if there is a Lord, save my soul, if I have a soul." (*Prière d'un Sceptique*), a phrase just as likely to have come to Oppenheimer's mind—though perhaps later in the project.

Panel 6: Oppenheimer probably coined the term "gadget."

PAGE 96

Groves' speech didn't occur in this exact context, but it's appropriate to place it at the first large gathering of scientists in Los Alamos.

Panels 4-6: Also in the audience during Groves' embarrassing speech were Hans Bethe, Nobel Prize winner in 1967, Harold Urey (1934) and James Franck (1925). Otto Frisch, who along with Lise Meitner was the first to correctly interpret Hahn and Strassman's fission experiments, may have been there too.

(Oppenheimer never won a Nobel.)



# work

PAGES 101-142

Much of what Robert Serber says here is quoted or paraphrased from Report LA-1, also known as "The Los Alamos Primer." I've moved things around to better serve the narrative, and omitted a great deal of material in the process, but what you get in this section is the state-of-the-art knowledge on how to build an atomic bomb. State of the art circa the 1940s, that is. (Did you really think you were going to learn how to make an atomic bomb from a comic book?)

And just as I haven't given the scientists accents (the melting pot theory of the United States was never tested more severely than at Los Alamos!), I've omitted Serber's lisp. Feel free to imagine it if you like.

PAGE 102

Panel 3: Fermi's quote comes from MSS 32: 40/4, "Book" p. 6.

Panel 5: Here, and throughout the rest of the story, I have "normalized" the units, using the English more often than the metric system, since feet and pounds were in more common use than meters and kilograms. The Primer itself mixes and matches the two systems, though, and that mixture occasionally creeps into our story as well.

PAGE 103

Panel 1: Soviet troops liberated Auschwitz on this date.

Panel 6: Contrast this with Oppenheimer's testimony in "Death."

PAGE 104

Panel 6: The Hanford reservation in Washington was the other major source for weapons-grade material. It was a tough town. According to Leona Woods: "There was nothing to do except fight, with the result that occasionally

bodies were found in garbage cans the next morning."

PAGE 105

Panel 1: Emphasis on "interesting" here is mine. The prose style of the Primer is uniformly flat.

PAGE 106

Panel 1: In February regular shipments of plutonium began to arrive at Los Alamos. And on this particular date U.S. troops land on Iwo Jima.

Panels 2-4: We're following Richard Feynman as he makes his way back into the compound after sneaking out through a hole in the fence. See the chapters titled "Los Alamos from Below" and "Safecracker Meets Safecracker" in *Surely You're Joking, Mr. Feynman!* for a complete account of his shenanigans. (For more about Feynman in comics form, including the safecracker story, see *Two-Fisted Science*, the first of G.T. Labs' books about scientists.)

PAGE 107

Panels 6-7: The analogies of a baseball and a watermelon are suggested by Richard Rhodes in *The Making of the Atomic Bomb*.

PAGE 108

Panel 1: On this date, within 24 hours of Roosevelt's death, Harry Truman received his first briefing on what the Manhattan Project was all about. He had tried to learn about it on his own as chairman of the Senate Committee to Investigate the National Defense Program, but Secretary of War Henry Stimson had persuaded him to call off the investigation.

Panel 5: Teller's advocacy of a super (what we now call a thermonuclear/hydrogen) bomb, and desire to work on it before anybody even knew how or whether they could make even a wimpy

little fission bomb caused friction between him and his superiors well before the scene depicted here.

It's hard to understand why he or anyone would think this was a good idea. Many have written about him (and he's spoken for himself too, naturally) and through my reading I've come to believe that his actions come from a combination of his deep-seated fears of the Russian juggernaut and his awareness of how huge the territory Russia would likely control after the war, for which "mere" fission bombs wouldn't be enough. These fears had some basis in reality, but not enough to justify the destructive courses he has advocated—from the hydrogen bomb to the Strategic Defense Initiatives. (I view him more as a broken figure than an evil one. But just as you would never want to use a damaged part in a complex and dangerous machine, I wish Teller was never part of what Eisenhower called the military-industrial complex.)

Panel 6: Very early on, Niels Bohr and John Wheeler believed, correctly, that only a particularly rare variety of uranium could be used effectively in the creation of an atomic explosion. Bohr said this uranium isotope could not be separated from common uranium except by turning the country into a gigantic factory... Years later, when Bohr came to Los Alamos, Wheeler was prepared to say "You see..." but before he could open his mouth, Bohr said "You see, I told you it couldn't be done without turning the whole country into a factory. You have done just that."

PAGE 109

Panel 1: Klaus Fuchs, the notorious spy for the Russians, did indeed report to Bethe. Though he fooled everyone—from security personnel to his colleagues—for years, this came back to haunt Bethe.

Panel 3: VE (Victory in Europe) Day was May 8, 1945.

Panels 5-7: Actual quotes by Oppenheimer, taken in context.

PAGE 112

To keep the cast of characters from growing

too large I again make a substitution, replacing Otto Frisch with Fermi. Frisch actually performed this experiment, but Fermi also used the lab here so it's not too much of a stretch to keep the cast of characters smaller by switching them.

PAGE 114

Panel 5: Fermi's referring to the controlled experiments done at CP-1.

PAGE 115

Panel 3: In June a civilian advisory group to President Truman called the Interim Committee recommended that "the bomb should be used against Japan as soon as possible; that it be used on a war plant surrounded by workers' homes; and that it be used without warning." A separate Target Committee was at work at the same time.

PAGES 117-127

On these pages I paraphrase and quote from Szilard's draft of "The Story of a Petition" dated July 28, 1946, from MSS 32: 40/15, marked as "Not For Release." I place the actual events a little out of sequence here for dramatic effect, since Szilard didn't circulate the petition until right after the Trinity test.

The 'bang' and 'boom' sound effects on these pages are there to indicate both the constant explosives testing and also the celebrations (p. 126) throughout the U.S.

PAGE 117

Panel 8: Here Szilard refers to the March bombing of Tokyo, where the resultant firestorm killed an estimated 124,000 in a single night.

PAGE 120

Panel 3: This, known for obvious reasons as the gun method for assembly, was the mechanism used by the Hiroshima bomb, also known as "Little Boy."

PAGE 121

Panels 4-7: Fermi's actions are shown out of context here—he wouldn't have performed such an imprecise measurement of the blast effects under laboratory (well, "laboratory") conditions. He did, on the other hand, use just this method to estimate the explosive force of the Trinity test.

As he tells it, and other accounts confirm, he saw Trinity's light but didn't hear the explosion, since at that point he was busy estimating the bomb's yield by noting how far little bits of paper he dropped were kicked away from him by the wind. Unlike what we show here, he measured the scraps traveled with his shoes (which he knew were nine inches long). He then consulted a chart he'd prepared in advance and predicted 20 kilotons—as good a figure for the yield as the one obtained by the sophisticated instrumentation set up at the site.

PAGES 122-123

The work on the implosion method began well before the time you see here—George Kistiakowsky came to Los Alamos in January 1944 to begin work on the implosion method for detonating a plutonium bomb. The problem proved difficult, though, and the work continued at a frantic pace right up to Trinity.

PAGE 124

Oppenheimer, at over 6 feet (1.8 m) tall, weighed approximately 100 lb. (45 kg) by the time of the test, partly because he was recovering from chicken pox at the time, but mostly because of nerves.

By the time of the Trinity test the scientists had enough confidence that they didn't use Jumbo, but moved it about a half mile away from ground zero. It remains there to this day.

PAGE 126

Panel 6: The strike-through in this passage is in the original petition draft, and shows one of Szilard's rare concessions to political reality.

PAGE 127

Assembling a core, using either the gun or implosion method, is extremely difficult. Recall that you must put it together with almost perfect precision (or you get a fizzle), very fast (or you get a fizzle), and that you must have a neutron source there to initiate the chain reaction at just the right time (or you get a fizzle).

The basic research behind the implosion method shown here required massive computa-

tional power and prompted the development—almost from scratch—of modern computational fluid dynamics.

PAGE 128

The petition scene is presented one day before the test rather than when it actually occurred, which is one day after. I did this mainly because I wanted to close this section with the immediate reactions to the first atomic bomb, all of which are reported accurately based on eyewitness accounts—except for Szilard's, which is fiction.



About this meeting, Teller later said: "I made the great mistake of feeling relieved of my responsibility" and "The chance to show the world that science can stop a terrible war without killing a single person was lost." The quotes from Oppenheimer are real and were probably said without much irony.

PAGE 130

Panel 1: As noted earlier, Rabi worked on the development of radar at MIT's Radiation Laboratory.

Panel 3: Two versions of the origin of the name "Trinity" exist: One attributes the name to Oppenheimer, who based it on the fourteenth Holy Sonnet by John Donne, a 16th century English poet and sermon writer. The sonnet starts "Batter my heart, three-personed God." The other comes from Szasz in *The Day the Sun Rose Twice*, where he quotes Robert W. Henderson (head of the Engineering Group in the Explosives Division). According to Henderson, he and Major W. A. (Lex) Stevens were at the test site discussing the best way to haul Jumbo (see above) the thirty miles from the closest railway siding to the test site. "A devout Roman Catholic, Stevens observed that the railroad siding was called 'Pope's Siding.' He [then] remarked that the Pope had special access to the Trinity, and that the scientists would need all the help they could get to move the 214 ton Jumbo to its proper spot."

Regardless, in reality Oppenheimer and all the other invitees went out to the site well before the eve of the test...

Panels 7-8: ...though Leona Woods and Joan Hinton did sneak out via motorcycle in the early morning hours on the day of the test.

PAGE 133

Panels 1-3: I couldn't find all the contingency press releases written by NYT reporter William Laurence. All I know is "they were safely filed in New York. One dealt with no loss of life or property; the second discussed severe damage to property; the third detailed the obituaries of all the famous men in the immediate area, including himself..." and "Laurence enjoyed

concocting this version of the explosion—all the people supposedly died from a freak accident at Oppenheimer's ranch in the Pecos Mountains."

As he recalled years later, he "out Roger'd Buck Rogers" and "out Wells'd H.G. Wells."

PAGES 134-141

Albuquerque is roughly 100 miles away from the Trinity test's ground zero. Though Georgia Green (the blind woman we see here) is real, as was her experience, the actual setting for "What was that?" was in a car her brother was driving. They were on their way from her home in Socorro to the University of New Mexico where she was a music student. And though none of the rest were blind like Ms. Green, people in three states saw the first blast (not knowing what it was). Other reactions included:

A sheep herder who lay sleeping on a cot about 15 miles from ground zero was awakened by the flash and blown off his cot.

An old man at a crossroads store commented to two of the scientific observers who passed by on the way to a measurement site: "You boys must have been up to something this morning. The sun came up in the west and went down again."

Suddenly, there was an enormous flash of light... It blasted; it pounced; it bored its way right through you.

—I.I. Rabi

It was golden, purple, violet, gray and blue. Atomic fission...was almost full grown at birth.

—General T.F. Farrell

[The cloud] resembled a giant brain, the convolutions of which were constantly changing.

—Dr. Charles A. Thomas

Then as a climax, which was exceedingly impressive in spite of the fact that the blinding brightness had sub-

sided, the top of the slenderer column seemed to mushroom out into a thick parasol of a rather bright but spectral blue...

—D.R. Inglis, ballistics expert

I can still hear it.

—Otto Frisch

PAGE 135

Panel 1: This quote comes from a Mrs. H.E. Weisman, who saw the explosion while driving into New Mexico.

Panel 2: William Laurence's description.

Panels 4-5: Joan Hinton's description. (Hinton's words also appear on page 137, panel 3 and page 138, panel 1.)

PAGE 136

Panels 4-5: Leslie Groves' description.

PAGE 137

Panel 2: Philip Morrison's description.

PAGE 139

Oppenheimer is quoting from and visualizing a passage from the *Bhagavad Gita* where Vishnu tries to persuade the Prince that he should do his duty and, to impress him, takes on his many-armed form.

PAGE 142

Fiction, as far as I know. I place Wells' book in the scene since he described a nuclear explosion proceeding more along the runaway lines of what some scientists initially feared (as mentioned on page 132) this way in *The World Set Free*:

CHAPTER THE FOURTH  
THE NEW PHASE

It is a remarkable thing that no complete

contemporary account of the explosion of the atomic bombs survives. There are, of course, innumerable allusions and partial records, and it is from these that subsequent ages must piece together the image of these devastations.

The phenomena, it must be remembered, changed greatly from day to day, and even from hour to hour, as the exploding bomb shifted its position, threw off fragments or came into contact with water or a fresh texture of soil. Barnet, who came within forty miles of Paris early in October, is concerned chiefly with his account of the social confusion of the country-side and the problems of his command, but he speaks of heaped cloud masses of steam. 'All along the sky to the south-west' and of a red glare beneath these at night. Parts of Paris were still burning, and numbers of people were camped in the fields even at this distance watching over treasured heaps of salvaged loot...'

Other descriptions agree with this; they all speak of the 'continuous reverberations,' or of the 'thudding and hammering,' or some such phrase; and they all testify to a huge pall of steam, from which rain would fall suddenly in torrents and amidst which lightning played. Drawing nearer to Paris an observer would have found the salvage camps increasing in number and blocking up the villages, and large numbers of people, often starving and ailing, camping under improvised tents because there was no place for them to go. The sky became more and more densely overcast until at last it blotted out the light of day and left nothing but a dull red glare 'extraordinarily depressing to the spirit.' In this dull glare, great numbers of people were still living, clinging to their houses and in many cases subsisting in a state of partial famine upon the produce in their gardens and the stores in the shops of the provision dealers.

...

If our spectator could have got permission to enter it, he would have entered also a zone of uproar, a zone of perpetual thunderings, lit by a strange purplish-red light, and quivering and swaying with the incessant explosion of the radio-active substance. Whole blocks of buildings were alight and burning fiercely, the trembling, ragged flames looking pale and ghastly and attenuated in comparison with the

full-bodied crimson glare beyond. The shells of other edifices already burnt rose, pierced by rows of window sockets against the red-lit mist.

Every step farther would have been as dangerous as a descent within the crater of an active volcano. These spinning, boiling bomb centres would shift or break unexpectedly into new regions, great fragments of earth or drain or masonry suddenly caught by a jet of disruptive force might come flying by the explorer's head, or the ground yawn a fiery grave beneath his feet. Few who ventured into these areas of destruction and survived attempted any repetition of their experiences. There are stories of puffs of luminous, radio-active vapour drifting sometimes scores of miles from the bomb centre and killing and scorching all they overtook. And the first conflagrations from the Paris centre spread westward half-way to the sea.

Moreover, the air in this infernal inner circle of red-lit ruins had a peculiar dryness and a blistering quality, so that it set up a soreness of the skin and lungs that was very difficult to heal...

Even a casual browse of your local library's or bookstore's shelves will present scores of books about atomic weapons. These notes and references offer a starting point for histories, but don't mention others, except as follows:

In prose, my favorite cautionary tale on science and war is *A Canticle for Leibowitz* by Walter M. Miller, Jr. In comics, the famous "Gen" series by Keiji Nakazawa (beginning with *Barefoot Gen*) offers a cartoon history of the Hiroshima bombing and its aftermath. It spends only two panels on the explosion itself, appropriately focusing on the people it affected. Many editions are available, as it goes in and out of print on an irregular basis. Also noteworthy is the 1953 Harvey Kurtzman/Wally Wood collaboration "Atom Bomb" from *Two-Fisted Tales* #33, available from Gemstone Publishing. Much shorter and much less complex than Nakazawa's story, this tale is still noteworthy not only for its graphic excellence, but also for its rather daring approach, appearing as it did during the height of U.S. fervor for these weapons.

Finally, though our story here doesn't touch at all upon the other major horror of the time, any book done in comics that deals with World War II must mention Art Spiegelman's *Maus*—if you read only one of the books recommended in this paragraph, please make it this one.

And as for Szilard himself, I found no documentation of his immediate reaction to the bombing of Hiroshima, or the setting in which he first heard about it. Perhaps because this was one of the first scenes I visualized, I didn't try all that hard.

# interlude

PAGES 145-148

The text of the speech excerpted here comes from MSS 32: 42/13, "Bloomington Speech."

PAGE 145

Panel 1: Here's the first we see of Dr. Trude Weiss, Szilard's friend since 1929. They kept in close touch from then until they married in 1951.

Their relationship was never conventional. They lived apart for many years after their wedding, but were almost constant companions for many years before. They also (probably at Szilard's insistence) didn't formally announce their marriage. Further, he sometimes forgot to introduce her as his wife. So having him hesitate here, while perhaps not likely in this instance/context, is certainly in character.

Panel 6: Szilard wasn't in Hollywood to hobnob with the stars, but rather to act as script doctor. (His reaction to the first shooting script was "It stinks.") So he remained on hand to rewrite some of the scenes to more accurately portray his meetings with Einstein.

PAGE 146

Panel 1: This is an overstatement. (Probably.) But Oppenheimer did appear to be pleased that the actor chosen to portray him was the most handsome and famous of all of those in the film.

PAGES 147-148

I have no idea about the real size of the crowds Szilard spoke to, or whether he made this speech indoors. But given the tenor of the times it's safe to assume that he was not telling people what they wanted to hear, and that people received his lectures with limited enthusiasm and in small numbers.

PAGE 150

Like many others involved with the bomb—though especially true for troublemakers like him—Szilard remained under almost constant surveillance for years. It wasn't done subtly, since it was intended to intimidate as well as to gather information. So Szilard did indeed know his shadows, and did indeed offer to share umbrellas and cabs with them.

# death

PAGES 153-191

The sidebar text in this section comes from *In the Matter of J. Robert Oppenheimer*, heavily edited from its original 992 pages. I've used the words verbatim when possible, but in cases where people were either so long-winded or used such tortured sentence construction that readers wouldn't believe anybody would ever actually talk that way, I've paraphrased their speech.

PAGE 155

Panel 1: Lloyd Garrison and Oppenheimer never became friends, or even friendly. Said Garrison: "He never went out of his way to thank us at all although we were doing all this without fee and at vast personal cost." Garrison also noted later that "...he may well have thought that I wasn't adequate for the occasion. Never a word of that was suggested to me, but he might well have felt that."

PAGES 160-161

This sequence with Harry Truman is inserted into a place where it doesn't belong in terms of strict chronology and testimony.

Though the quoted letter from Truman is real, the actual letter Garrison reads into testimony here was the one Oppenheimer sent to Lewis Strauss, head of the AEC:

Dear Lewis:

Yesterday, when you asked to see me, you told me for the first time that my clearance by the Atomic Energy Commission was about to be suspended. You put to me as a possibly desirable alternative that I request termination of my contract as a consultant to the Commission, and thereby avoid an explicit consideration of the charges...

I have thought most earnestly of the alternative suggested. Under the circumstances this course of action would mean that I accept and concur in the view that I am

not fit to serve this Government, that I have now swerved for some 12 years. This I cannot do....If I were thus unworthy I could hardly have served our country as I have tried, or have spoken, on more than one occasion, in the name of science and our country.

And of course Truman's reaction to Oppenheimer's hand-wringing doesn't appear in the testimony at all.

PAGE 162

Panel 5: In fact, Philip Morrison, Robert Serber, Luis Alvarez, and a number of other scientists were given field commissions as uniformed officers when it came time for them to assemble the bombs.

PAGE 164

Panel 3: Richard Feynman and his wife Arline enjoyed baiting the brass as much as Szilard did, and got into just as much trouble for doing so.

PAGE 166

Panel 2: Robb is quoting from the testimony of Marvin Kelly here.

PAGE 171

Sidebar text: Garrison's actual words were "I am sure there is no 'design,' Mr. Gray." But out of context from the paragraphs I removed this turn of phrase probably wouldn't make sense, so I've changed it to the more contemporary 'hidden agenda.'

PAGE 176

Panel 2: Groves, rather than Robb, actually made the statement in the second word balloon.

PAGE 177

Bethe's questioner was one of Oppenheimer's co-counsels named Marks, but for the sake of not introducing yet another character I use Garrison here instead.

PAGE 179

Panel 4: Note that Fermi is careful to call these non-scientific judgments "opinions."

PAGE 184

Panel 5: Robb and Teller had met the night before, where Teller had initially opined that Oppenheimer wasn't a security risk.

Sidebar text: This is the last use of the word "Dr." when referring to Oppenheimer. This is something of a cheat on my part, since they did use the honorific occasionally. But because this is the testimony that destroys Oppenheimer (politically) and Teller (socially, at least with many of his peers) I chose to emphasize how Robb and Teller drop the pretense of respect for Oppenheimer's status.

PAGE 185

Panel 2: This is how Teller recollected their conversation in the 1960s.

PAGE 186

Sidebar text: To editorialize, Teller's saying he was "just most dreadfully disappointed" in his otherwise stone cold testimony brings to mind the sniffingly excessive sincerity of some corrupt version of *Little Women*.

PAGE 188

Panel 5: Teller still bristles when Ulam's name gets mentioned in conjunction with the design



of the hydrogen ("super") bomb. In a recent article in the *New York Times* (April 24, 2001, Late Edition - Final, Section F, Page 1, "Who Built The H-Bomb? Debate Revives," by William J. Broad) he credits Dick Garwin for the first design. Along with himself, of course. Teller has long been silent about Garwin's role. He makes no mention of him in his books, perhaps because like many others Garwin is now an advocate of arms control, saying "If I could wave a wand [and make the hydrogen bomb go away] I would do that."

PAGES 192-197

The text in the right-hand sidebars is distilled from the Boards' findings based on General Nichols' recommendations, and in the left-hand sidebars you see a condensation of Lloyd Garrison's response.

Right sidebar: I initially included almost all of the Board's letter in the story itself, but because (a) it wasn't essential to the board's arguments and (b) it did bad things to the layout of the pages, I deleted the chunks below:

We are acutely aware that in a very real sense this case puts the security system of the United States on trial, both as to procedures and as to substance. This notion has been strongly urged upon us by those who recommended clearance for Dr. J. Robert Oppenheimer, and no doubt a similar view is taken by those who feel he should not be cleared.

If we understand the two points of view, they may be stated as follows: There are those who apprehend that our program for security at this point in history consists of an uneasy mixture of fear, prejudice, and arbitrary judgments. They feel that reason and fairness and justice have abdicated and their places have been taken by hysteria and repression. They, thus, believe that security procedures are necessarily without probity and that national sanity and balance can be served only by a finding in favor of the individual concerned. On the other hand, there is a strong belief that in recent times our government has been less than unyielding toward the problem of communism, and that loose and pliable attitudes regarding loyalty and security have prevailed to the danger of our society and its institutions. Thus, they feel that this proceeding presents the unrelinquishable opportunity for a demonstration against communism, almost regardless of the facts developed about the conduct and sympathies of Dr. Oppenheimer.

We find ourselves in agreement with much that underlies both points of view. We believe that the people of our country can be reassured by this proceeding that it is possible to conduct an investigation in calmness, in fairness, in disregard of public clamor and private pressures, and with dignity. We believe that it has been demonstrated that the Government can search its own soul and the soul of an individual whose relationship to his Government is in question with full protection of the rights and interests of both. We believe that loyalty and security can

be examined within the frameworks of the traditional and inviolable principles of American justice...

Gratitude from a young California Congressman named Richard M. Nixon...

Panel 2: I switched the words "science" and "government" from the original to add emphasis and provide a smoother transition to the scene on the next page.

Panel 2: Here are highlights from the complete text of Ward Evans' minority report, referred to by Smyth. Since there is little within it that isn't in Garrison's letter, I only used a few pieces of it in the story pages:

I have reached the conclusion that Dr. J. Robert Oppenheimer's clearance should be reinstated and am submitting a minority report in accordance with AEC procedure.

...

I am in perfect agreement with the majority report of its "findings" with respect to the allegations in Mr. Nichols' letter and I am in agreement with the statement of the Board concerning the significance of its "findings" to the end of page 32. I also agree with the last paragraph of this section in which the Board makes a final comment on Mr. Nichols' letter. I do not, however, think it necessary to go into any philosophical discussion to prove points not found in Mr. Nichols' letter.

The derogatory information in this letter consisting of 24 items has all been substantiated except for one item. This refers to a Communist meeting held in Dr. Oppenheimer's home, which he is supposed to have attended.

On the basis of this finding, the Board would have to say that Dr. Oppenheimer should not be cleared.

But this is not all.

Most of this derogatory information was in the hands of the Commission when Dr. Oppenheimer was cleared in 1947. They apparently were aware of his associations and his left-wing policies; yet they cleared him. They took a chance on him because of his special talents and he continued to do a good job. Now when the job is done, we are asked to investigate him for practically the same derogatory information. He did his job in a thorough and painstaking manner. There is not the slightest vestige of information before this Board that would indicate that Dr. Oppenheimer is not a loyal citizen of his country. He hates Russia. He had communistic friends, it is true. He still has some. However, the evidence indicates that he has fewer of them than he had in 1947. He is not as naive as he was then. He has more judgment; no one on the Board doubts his loyalty—even the witnesses adverse to him admit that—and he is certainly less of a security risk than he was in 1947, when he was cleared. To deny him clearance now for what he was cleared for in 1947, when we must know he is less of a security risk now than he was then, seems to be hardly the procedure to be adopted in a free country.

...

His judgment was bad in some cases, and most excellent in others but, in my estimation, it is better now than it was in 1947 and to damn him now and ruin his career and his service, I cannot do it.

His statements in cross examination show him to be still naive, but extremely honest and such statements work to his benefit in my estimation. All people are somewhat of a security risk. I don't think we have to go out of our way to point out how this man might be a security risk.

Dr. Oppenheimer in one place in his testimony said that he had told "a tissue of

lies." What he had said was not a tissue of lies; there was one lie...

He did not hinder the development of the H-bomb and there is absolutely nothing in the testimony to show that he did.

First he was in favor of it in 1944. There is no indication that this opinion changed until 1945. After 1945 he did not favor it for some years perhaps on moral, political or technical grounds. Only time will prove whether he was wrong on the moral and political grounds. After the Presidential directive of January 31, 1950, he worked on this project. If his opposition to the H-bomb caused any people not to work on it, it was because of his intellectual prominence and influence over scientific people and not because of any subversive tendencies.

I personally think that our failure to clear Dr. Oppenheimer will be a black mark on the escutcheon of our country. His witnesses are a considerable segment of the scientific backbone of our Nation and they endorse him. I am worried about the effect an improper decision may have on the scientific development in our country. Nuclear physics is new in our country. Most of our authorities in this field came from overseas. They are with us now. Dr. Oppenheimer got most of his education abroad. We have taken hold of this new development in a very great way. There is no predicting where and how far it may go and what its future potentialities may be. I would very much regret any action to retard or hinder this new scientific development.

This is my opinion as a citizen of a free country.

I suggest that Dr. Oppenheimer's clearance be restored.

[signed]  
WARD V. EVANS

# epilogue

PAGE 205

Panels 3-6: True to form, Szilard devised his own treatment for his bladder cancer, which, along with his unorthodox ways, did not endear him to the staff doctors.

All of the books on Szilard make note of this, but I'm particularly grateful to Dr. Anders B ar any of the Nobel Museum in Stockholm for sending me "Leo Szilard Plays Chess with Death," by George Klein. This article provided many insights—not only into this particular scene, but into Szilard's character in general.

The dose Szilard chose is tremendously high, but it worked to kill Szilard's cancer. It also destroyed his bladder.

PAGE 206

Panel 3: Szilard had to visit Khrushchev rather than the other way around. At their meeting, Szilard brought a Schick Injector razor and extra blades as a gift. "If you like the razor, I will send you fresh blades from time to time. But this I can do, of course, only as long as there is no war." Khrushchev replied "If there is a war I will stop shaving."

PAGE 207

Panels 2-5: "I am just going to write...this version of the facts." comes from MSS 32: 40/4: "Book."

# references

## BOOKS AND MANUSCRIPTS

“Leo Szilard Papers” at the University of California, San Diego. MSS 32: various boxes/folders as per the notes.

The primary source for some of the most telling story elements in this book.

The very first thing I saw when I opened the very first folder I wanted was a signed letter from Niels Bohr, which gave me a physical jolt not unlike an electric shock. I owe thanks to the archives staff at the Geisel Library.

(Yes, the Geisel we all know better as Dr. Seuss...the original cover art to *The Lorax* was in the display case right outside the Special Collections section.)

*Atomic Quest*, by Arthur Holly Compton (NY: Oxford University Press, 1956).

The source for some of the quotes and observations on the Trinity test, as well as background for the Oppenheimer hearings.

*Atoms in the Family*, by Laura Fermi (Chicago: University of Chicago Press, 1954).

Fermi’s life from his wife’s perspective, which for me added depth to the characterization of him, his colleagues, and the environment in which they worked.

*The Collected Papers of Enrico Fermi, Volume 2*, edited by Emilio Segré (Chicago: University of Chicago Press, 1965).

My source for Fermi’s perspective on both the early days of reactor research and Szilard.

*The Collected Works of Leo Szilard: Scientific Papers, Volume I*, edited by Bernard T. Feld and Gertrude Weiss Szilard (Cambridge, MA: The MIT Press, 1972).

Here you can read many of Szilard’s papers in facsimile form, including his patent documents and the technical papers referred to in the story.

*Critical Assembly: A Technical History of Los Alamos during the Oppenheimer Years, 1943-1945*, by Lillian Hoddeson, Paul W. Henriksen, Roger

A. Meade, and Catherine Westfall (Cambridge: Cambridge University Press, 1993).

This goes well beyond the “Los Alamos Primer” to provide both the physical context and a technical description of the weapons work done during the war.

*Dawn Over Zero: The Story of the Atomic Bomb*, by William L. Laurence (NY: Alfred A. Knopf, 1946).

One of the first books written about the Manhattan Project, by the reporter given exclusive rights to cover the story.

*The Day the Sun Rose Twice*, by Ferenc Morton Szasz (Albuquerque: University of New Mexico Press, 1985).

A detailed account of the happenings on the day of the first nuclear explosion. One of the many books that provided a source for impressions this event made on observers.

*Genius in the Shadows: A Biography of Leo Szilard*, by William Lanouette with Bela Szilard (Chicago: The University of Chicago Press, 1992).

The best biography I read on Leo Szilard.

*Hitler’s Uranium Club: The Secret Recordings at Farm Hall*, by Jeremy Bernstein (Woodbury, NY: American Institute of Physics, 1996).

Though not directly referenced in the story you just read, this book will give you background on Germany’s wartime efforts in the field of nuclear fission. The naiveté (for lack of a better word) of the German scientists is one of the most notable things that come through in the transcripts of the tapes made while Heisenberg and his colleagues were interred in Britain.

*In the Matter of J. Robert Oppenheimer: Transcript of Hearing before Personnel Security Board, Washington D.C. April 12, 1954 through May 6, 1954* (Washington: Government Printing Office, 1954).

Almost 1000 pages of small print, at least in the edition I worked from. Excruciating and fascinating in more ways than one.

*J. Robert Oppenheimer: Shatterer of Worlds*, by Peter Goodchild (Boston: Houghton Mifflin, 1981).

A companion volume to the BBC television series of the same name, this book offers a thorough overview of Oppenheimer's life and features illustrations and photographs on almost every page.

*Lawrence and Oppenheimer*, by Nuel Pharr Davis (NY: Simon and Schuster, 1968).

Though the story you just read paints Teller as Oppenheimer's most vocal and damaging political opponent, as you saw from his behavior Oppenheimer had no trouble getting on someone's bad side. Ernest Lawrence and he clashed over policy (in no small part out of jealousy on Lawrence's part, in my opinion) from very early on, and this book provides a detailed account of the situation.

*The Legacy of Hiroshima*, by Edward Teller (NY: Macmillan, 1962).

The source for the quote by Niels Bohr about turning the whole country into a factory, it also provides insight into Teller's way of thinking at the time he recommended Oppenheimer for the Fermi Medal.

*Leo Szilard: His Version of the Facts*, Volume II of the Collected Works of Leo Szilard, edited by Spencer R. Weart and Gertrud Weiss Szilard (Cambridge, MA: The MIT Press, 1978).

Here you can find Szilard's Ten Commandments, personal recollections and letters, and the anecdote that inspired our epilogue.

*Leo Szilard: Science as a Mode of Being*, by David A. Grandy (Lanham, MD: University Press of America, Inc., 1996).

This book helped to round out the portrait of Szilard that I constructed from Lanouette's and Rhodes' work. Though short, it offers valuable insights into the cultural context in which Szilard lived and worked.

*The Making of the Atomic Bomb*, by Richard Rhodes (NY: Simon and Schuster, 1986).

Rhodes won the Pulitzer Prize, the National Book Award, and the National Book

Critics Circle Award for this work of history and literature. If you read no other book about the development of the first atomic bombs, please read this one.

*Men and Decisions*, by Lewis L. Strauss (NY: Doubleday & Company, 1962).

Strauss' cold-blooded account of the Oppenheimer hearings are a perfect match with the self-important title of his book.

*Now It Can Be Told*, by Leslie R. Groves (NY: Harper & Brothers, 1962).

The title says a great deal about the tone of the book, but Groves' point of view is an important one to hear regardless of how he presents it.

*Picturing the Bomb: Photographs from the Secret World of the Manhattan Project*, by Rachel Fermi and Esther Samra (NY: Harry N. Abrams, 1995).

Hundreds of superb pictures that provided reference for what you saw here, including the images that served as the basis for the inside front and back covers.

*Robert Oppenheimer: Letters and Recollections*, edited by Alice Kimball Smith and Charles Weiner (Cambridge, MA: Harvard University Press, 1980).

Letters to and from Oppenheimer, with the majority of the correspondence pre-dating the Los Alamos period.

*Science and the Common Understanding* and *The Open Mind*, by J. Robert Oppenheimer (NY: Simon and Schuster, 1954 and 1955, respectively).

Philosophical writings by Oppenheimer, touching on the role of science and politics. Copyright dates notwithstanding, all were written before Oppenheimer's political downfall.

*"Surely You're Joking, Mr. Feynman!"*, by Richard P. Feynman, as told to Ralph Leighton (NY: W.W. Norton & Company, 1985).

The "Dragon's Tail" experiment is described in this book, as are the incidents with the censors and an excellent example of Feynman's capacity for mischief regarding the strict security—a capacity we've only alluded to in the story. See "Los

Alamos From Below" for all this and more.

*Their Day in the Sun: Women of the Manhattan Project*, by Ruth H. Howes and Caroline L. Herzenberg (Philadelphia: Temple University Press, 1999).

Important to the story you just read for its outsider view of the Trinity test and the scene of Hinton and Woods hopping on a motorcycle to crash the party.

*Toward a Livable World: Leo Szilard and the Crusade for Nuclear Arms Control*, Volume III of the Collected Works of Leo Szilard, edited by Helen S. Hawkins, G. Allen Greb, and Gertrud Weiss Szilard (Cambridge, MA: The MIT Press, 1987).

More writing by Szilard, this time on political matters.

*The Uranium People*, by Leona Marshall Libby (NY: Crane, Russak & Company, 1979).

You know her in this story as Dr. Woods, but she married fellow scientist John Marshall soon after the CP-1 experiment. This book was an excellent source for details about the first atomic pile and the people who worked on it.

*The Voice of the Dolphins and Other Stories*, by Leo Szilard (Stanford, CA: Stanford University Press, 1961).

I'm not fond of Szilard as a prose writer, but the introduction makes this book worth picking up. And though I don't think his estate is likely to land a major motion picture based on any of the stories printed here, Szilard's intellectual range and great imagination are evident, and impressive.

*What Little I Remember*, by Otto Frisch (London: Cambridge University Press, 1979).

The source for Frisch's "I can still hear it." quote, along with the a more accurate account of the Dragon's Tail experiment than you read here.

*The World Set Free*, by H.G. Wells (1914, accessible from Project Gutenberg at <ftp://sailor.gutenberg.org/pub/gutenberg/etext97/twsfr10.txt>).

The inspiration for Szilard, and though

not Wells' best by far, it still contains many prescient details and some vivid writing.

#### ARTICLES

"Did Bohr Share Nuclear Secrets?," by Hans Bethe, Kurt Gottfried and Roald Z. Sagdeev and "What Did Heisenberg Tell Bohr About the Bomb?" by Jeremy Bernstein in *Scientific American*, vol. 272, no. 5, May 1995, 83-97.

The short answer: "No." Excellent articles that put Bohr's sometimes difficult to understand actions and philosophy in context.

"Dr. Oppenheimer Suspended by A.E.C. in Security Review; Scientist Defends Record," by James Reston, with letters from K.D. Nichols and J. Robert Oppenheimer in the *New York Times*, vol. 103, no. 35143, April 13, 1954, 1,16-19.

Breaking news, as the hearings began. It's all there in excruciating detail.

"The German Uranium Project," by Hans Bethe in *Physics Today*, vol. 53, no. 7, July 2000, 34-36.

A brief look at what Heisenberg and his fellow scientists did (and mostly didn't) know during the war.

"Infamy and Honor at the Atomic Café," by Gary Stix in *Scientific American*, vol. 281, no. 4, October 1999, 42-44.

The source of the "infamous" Teller quote, and a superb portrait of Teller in his later years.

"J. Robert Oppenheimer: Before the War," by John S. Rigden in *Scientific American*, vol. 273, no. 1, 76-81.

A quick overview of Oppenheimer's achievements in building an "American School" of physics that would rival the great European schools that dominated the world scene until World War II.

"Leo Szilard Plays Chess With Death," by George Klein in the *Eötvös Physical Society's Leo Szilard Centenary Volume* (ed. George Marx, Budapest: Eötvös Physical Society, 1998), 169-175.

As noted above, this is the source for the

details about Szilard's self-designed and administered radiation treatment.

"The Odd Couple of the Bomb," by William Lanouette in *Scientific American*, vol. 283, no. 5, November 2000, 104-109.

Like his book on Szilard, you'll find Lanouette provides an excellent portrait of Fermi and Szilard and their uneasy liaison in this article.

"Physicists in Wartime Japan," by Laurie M. Brown and Yochiro Nambu in *Scientific American*, vol. 279, no. 6, December 1998, 96-103.

Though it has nothing about bomb development, since there was none in Japan, this article points out some of the excellent science done during the war despite difficult conditions and almost complete isolation.

"A Reporter at Large: The Contemporaneous Memoranda of Dr. Sachs," by Geoffrey T. Hellman in *The New Yorker*, vol. 21, no. 32, December 1, 1945, 73-81.

The tortured syntax of Alexander Sachs comes through loud, clear, and quotable in this hot-from-today's-headlines article.

"Teller Deplores Secret Research," by J.N. Wilford in *The New York Times*, vol. 120, no. 41246, December 28, 1970, 1, 25 and "Political Science 1970," in *Newsweek*, vol. 77, no. 2, January 11, 1971, 78.

In both Teller describes presenting Oppenheimer with Szilard's petition. In the latter you can read about his refusal to accept the Public Health Research Institute's "Dr. Strangelove Award."

#### CD-ROMs

*Critical Mass: America's Race to Build the Atomic Bomb* produced and directed by Lisa C. Anderson (Seattle: Corbis, 1996).

An overview of the Manhattan Project and biographical sketches of Bohr, Fermi, Feynman, and Oppenheimer.

*The Day After Trinity: J. Robert Oppenheimer and the Atomic Bomb*, a film by Jon Else (1980, CD-ROM version by NY: Voyager, 1995).

Seek it out as a film, but the CD made a fine substitute because of its elegantly presented supplementary material.

#### WEBSITES

"Historical Nuclear Weapons Test Films," <http://www.nv.doe.gov/library/films/testfilms.aspx>

I don't have any direct experience to compare with, but I doubt these will give you much of a sense of what an actual explosion is like. Thank goodness we currently have no live alternative.

"LANL Research Library: Laboratory Publications: History: Los Alamos 50 Years Ago," <http://lib-www.lanl.gov/pubs/lanl50th/Homepage.htm>, updated 27 November 2000, ©2000, University of California.

The highlight of this site is the detail unavailable elsewhere, especially in such a condensed but readable form. [Note: Public access to this site has been taken away since the first publication of *Fallout*.]

"Los Alamos Primer" (also known as "Los Alamos Technical Report LA-1"), <http://lib-www.lanl.gov/la-pubs/00349710.pdf>.

Rough going unless you have a good technical background, but reading the Primer today does a great job of transporting you back to the early days of the Manhattan Project. [Note: Public access to this site has been taken away since the first publication of *Fallout*.]

"Truman and the Bomb, a Documentary History, Chapter 10: War Department Press Release C. August 6, 1945," edited by Robert H. Ferrell, [http://www.trumanlibrary.org/whistlestop/study\\_collections/bomb/ferrell\\_book/ferrell\\_book\\_intro.htm](http://www.trumanlibrary.org/whistlestop/study_collections/bomb/ferrell_book/ferrell_book_intro.htm).

The first public announcement of the atomic bomb.

"G.T. Labs: *Fallout*," <http://www.gt-labs.com/fallout.html>.

Visit the G.T. Labs site for live links, downloadable notes and references, color versions of some of the images from the book, and other extras.

## the artists

JANINE JOHNSTON (“Birth” and visions of Trinity in “Work”) lives in Victoria, British Columbia. When not doing artwork of various sorts, she’s usually found gardening, cycling, taking photos, gathering more reference books, and enjoying life. She would like to give special thanks to Michael Kaluta for his amazing search skills and Jo-Lee Bertrand for printing out all those images, which made getting this project done on time that much easier. You’ll find her online portfolio at [www.janinejohnston.com](http://www.janinejohnston.com).

JEFFREY JONES (cover) was born and raised in Atlanta, Georgia, and his passion for drawing seemed born with him. An interest in art and science got him through childhood, and he entered college majoring in physics. He soon switched to art, but dissatisfied with the curriculum he moved to New York City where he learned to paint during visits to the Metropolitan Museum of Art. Books of his work have been translated into eight languages and he has won many international awards. Now female, Jeffrey lives with her wife Maryellen in the Catskill Mountains of Woodstock, New York. Find out more at [www.ulster.net/~jonesart/](http://www.ulster.net/~jonesart/).

CHRIS KEMPLE (Szilard’s visions of *The World Set Free* in “Birth”) currently resides in Durham, NC with his wife Krista, 2 dogs, and his soon-to-be-born daughter. In addition to freelancing, Chris is an artist in the video game industry as well as creator, artist and writer of his own comic, the 1950’s adventure character “Red Vengeance”, recently in development as a cartoon at FoxKids.

STEVE LIEBER (“Death”), Eisner award winning artist of *Whiteout* and *Whiteout: Melt*, makes his home in Portland, Oregon. He has toiled for all of the major comics publishers and many of the minor ones as well. For more about Steve, visit [www.stevelieber.com](http://www.stevelieber.com).

VINCE LOCKE (“School”) is the creator of *Deadworld* and has illustrated *Sandman*, *Saint Germaine*, and the original graphic novel *A Brief*

*History of Violence*. He lives in Michigan. Nate Pride assisted him on the lettering.

BERNIE MIREAULT (prologue, interludes, and epilogue) is the mastermind behind *MacKenzie Queen*, *Dr. Robot*, *The Jam*, *Isaac vs. Eli* (which you can find on the web at [www3.sympatico.ca/bem69](http://www3.sympatico.ca/bem69)) and more innovative art and coloring jobs than you can imagine. He gets old-fashioned mail at his home in Montreal, Quebec and on the net at [bem69@sympatico.ca](mailto:bem69@sympatico.ca).

EDDY NEWELL (the model sheets you see interspersed throughout these notes) has won critical acclaim for his moody work on *Black Lightning*, *Batman*, *Daredevil*, and for numerous illustration projects, from fashion on out. He lives in Ohio, on the shores of Lake Erie.

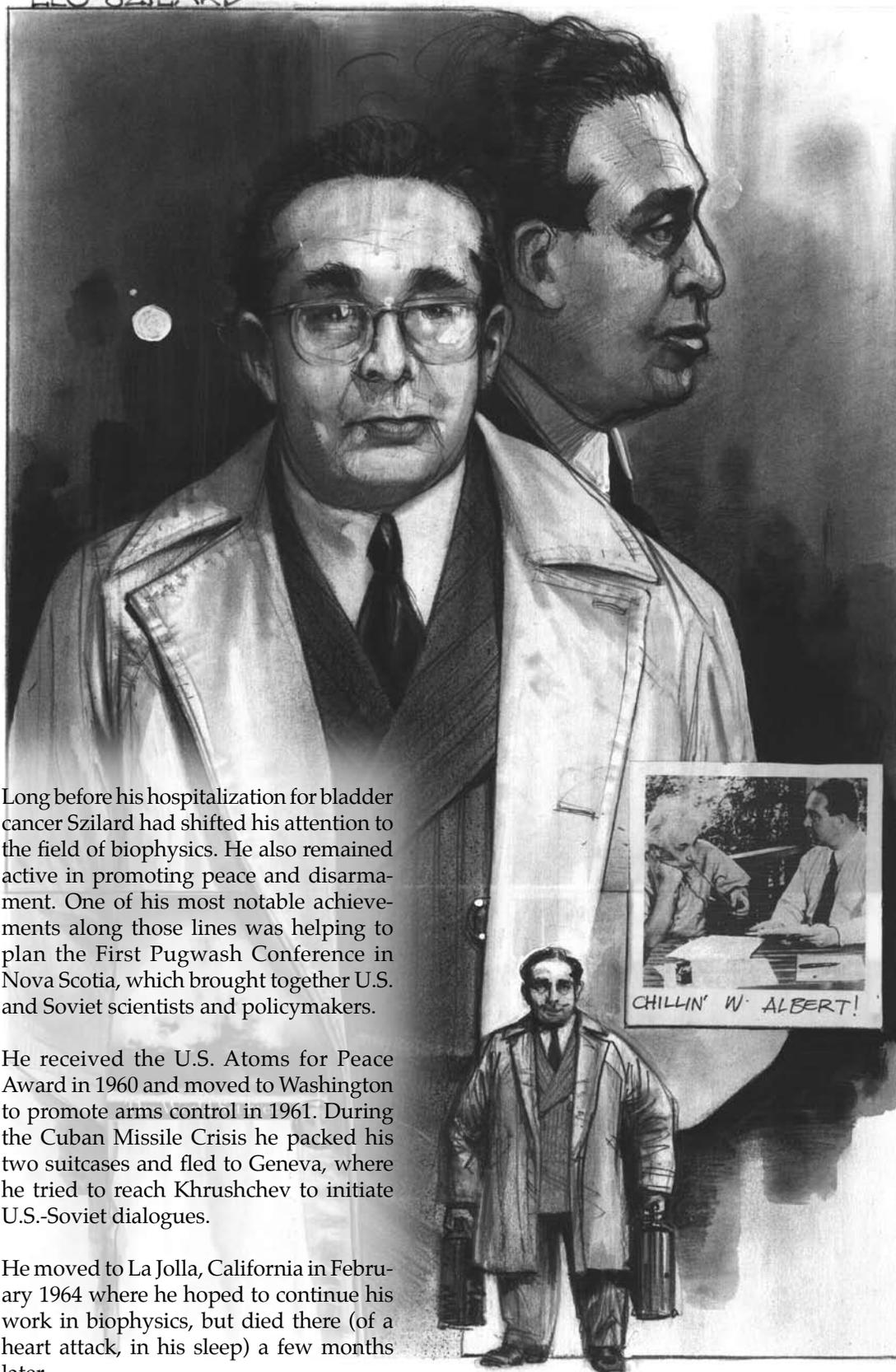
TOM ORZECZOWSKI (letterer, “Birth”) has worked for a variety of comic book publishers on titles ranging from *X-Men* to *Captain Carrot and His Amazing Zoo Crew*. Over the years he has received every major professional and fan award, but is proudest to have been a contributor to *Neal Adams’ Skateman*, known in the industry as the World’s Worst Comic Book.

JEFF PARKER (“Work”) earns his daily bread in Los Angeles doing storyboard and animation work. Keep an eye out for his own series, *The Interman*, coming soon. He lives in Portland. Find out more at [parkerspace.com](http://parkerspace.com).

ROBIN THOMPSON (layouts for “Birth”) currently writes and draws his own independent titles *Captain Space Man* and *Knuckles Malone: Private Gut Buster*. A graduate of the Ontario College of Art in Toronto, he currently lives in Victoria, British Columbia.

JIM OTTAVIANI’S first career was as a nuclear engineer. He currently works as a librarian and has written many other graphic novels about scientists. You can contact him via either [www.gt-labs.com](http://www.gt-labs.com) or G.T. Labs, P.O. Box 8145, Ann Arbor, MI 48107.

## LEO SZILARD



Long before his hospitalization for bladder cancer Szilard had shifted his attention to the field of biophysics. He also remained active in promoting peace and disarmament. One of his most notable achievements along those lines was helping to plan the First Pugwash Conference in Nova Scotia, which brought together U.S. and Soviet scientists and policymakers.

He received the U.S. Atoms for Peace Award in 1960 and moved to Washington to promote arms control in 1961. During the Cuban Missile Crisis he packed his two suitcases and fled to Geneva, where he tried to reach Khrushchev to initiate U.S.-Soviet dialogues.

He moved to La Jolla, California in February 1964 where he hoped to continue his work in biophysics, but died there (of a heart attack, in his sleep) a few months later.

## J. ROBERT OPPENHEIMER

Long after our story ends, Edward Teller nominated Oppenheimer for the Enrico Fermi Medal, awarded by the Atomic Energy Commission each year for distinguished service to the country's nuclear programs. President Kennedy had given the medal to both Teller and Bethe, but doing so personally to Oppenheimer might have stirred up controversy. On November 21, 1963—the day before he was shot in Dallas—he decided to risk the political backlash and present it himself.

Lyndon Johnson made the presentation on December 2, 1963 (twenty-one years to the day after the CP-1 went critical). Upon receiving the medal Oppenheimer said "I think it is just possible, Mr. President, that it has taken some charity and some courage for you to make this award today."

Oppenheimer resigned from the Institute of Advanced Studies in early 1966 when he underwent surgery and radiation therapy for a malignant tumor in his throat. He died of throat cancer on February 18, 1967. De Wolf Smyth and Bethe both delivered addresses at the funeral, and Rabi, Serber, Groves, and Lansdale all attended.

