



THE MUSHROOM CLOUD from the Castle Bravo thermonuclear test on 1 March 1954 at Bikini, an atoll in the Marshall Islands. Fallout from the explosion rained down on the Japanese fishing vessel *Lucky Dragon No. 5* and caused radiation sickness among its 23 crew members.

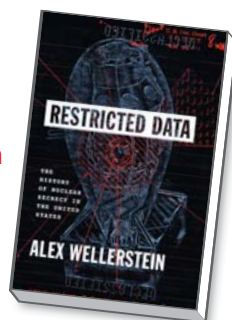
The conundrums of atomic secrecy

In 1979 the magazine *The Progressive* published an article featuring a series of illustrations purportedly showing the interior workings of a hydrogen bomb. Its author was Howard Morland, a journalist and activist with little physics training. Morland produced the illustrations by interviewing weapons scientists and reading encyclopedia articles, including one written by Edward Teller, the physicist who in 1951 first worked out the key design concept behind the H-bomb in collaboration with mathematician Stanislaw Ulam. Morland's drawings depicted the Teller-Ulam invention accurately enough that the US government took him, his editors, and the magazine's publisher to federal court to bar the article's publication.

The government eventually dropped the case, but by then multiple conundrums at the heart of US nuclear secrecy had come to light. Morland had no security clearance and no access to restricted

Restricted Data The History of Nuclear Secrecy in the United States

Alex Wellerstein
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data—the special classification given to nuclear secrets by the Atomic Energy Act of 1946. If he could uncover the secret of the H-bomb, had it really been a secret? Had the government inadvertently leaked the secret itself by trying to suppress Morland's drawings? Was nuclear secrecy compatible with American principles of free speech and democracy? Could the government control scientific knowledge? Should it want to?

As historian Alex Wellerstein explains in *Restricted Data: The History of Nuclear Secrecy in the United States*, nu-

clear secrecy is a tale of such irresolvable tensions. Wellerstein divides the story into three epochs. The first unfolded during World War II, when a scheme by scientists to self-censor their research on nuclear fission rapidly gave way to the Manhattan Project's formal secrecy. Information related to the bomb project was controlled by a strict policy of compartmentalization, enforced by the project's military overseer, Leslie Groves.

The second epoch began with the onset of the Cold War, when the government used the new legal category of restricted data to divide "dangerous" knowledge related to nuclear weapons from "safe" knowledge related to peaceful atomic research and the civilian nuclear power industry. In practice, the boundary between safe and dangerous knowledge proved unstable; the peaceful atom could all too easily be turned toward militaristic ends.

That bipolar secrecy system faced increasing challenges during the book's third epoch: the 1960s and beyond. During that period, commercial actors hoping to profit from research on isotope-separating centrifuges and laser-driven thermonuclear fusion bumped against some of the most closely guarded nuclear secrets. Meanwhile, secret seekers like Morland believed that prying restricted data from the state's hands would strike a blow against the nuclear complex on behalf of democracy and peace.

It may seem inevitable that the US nuclear secrecy regime gradually expanded into the sprawling behemoth we know today, but Wellerstein highlights several moments when history might have turned out differently. Alternative futures were especially thinkable in the immediate postwar years. The scientist-administrators who implemented secrecy as a wartime exigency saw the severest restrictions as temporary, and they considered a range of schemes for taming the atom. J. Robert Oppenheimer, for example, argued for pursuing a control strategy that was focused more on nuclear materials than on knowledge encoded in documents. In the end, the crucial category of restricted data might never have existed had Groves not chosen in early 1946 to leak information about a Soviet espionage ring in Canada just as a congressional committee was

working out new legislation for postwar atomic policy.

Readers of PHYSICS TODAY may be familiar with Wellerstein's engaging articles in this magazine and elsewhere (see PHYSICS TODAY, May 2012, page 47; April 2017, page 40; and December 2019, page 42); his blog, also titled *Restricted Data*; and his project NUKEMAP, which allows users to simulate the effects of nuclear detonations. Based on interviews and years of tireless spadework in government archives, the present book showcases his talents as a researcher and a skillful writer of narrative and analysis.

One of *Restricted Data's* many strengths is its reconstruction of the work of those inside the state who debated, designed, and performed the day-to-day bureaucratic practices of secrecy. The effect is one of demystification: Nuclear secrecy has been powerful, but it has also been messy, inconsistent, and often self-defeating. As Wellerstein wryly puts it, "the sensors are people too."

Yet the final chapters caution us from taking comfort in that observation. At the end of the Cold War, activists successfully lobbied for declassifications confirming the nuclear complex's vast harms to the environment and human health. The government disclosed that about 20% of US nuclear tests were never officially announced and that in the 1940s human radiation experiments were conducted without patients' informed consent. But secrecy reform has had limited ability to disrupt the nuclear system. The US government's post-Cold War openness was quickly reversed as new threats emerged and officials reasserted secrecy in the name of nuclear nonproliferation. "If anything," Wellerstein concludes, "it is the fact that so little has changed, despite the now many decades separating the end of the Cold War from the present, that is most striking."

Even if the censors wanted to alter the immense structures of the nuclear state, they would not be much better equipped to do so than the outsiders. In the realm of nuclear weapons, knowledge is not always power. One lesson of *Restricted Data* is that although a serious restructuring of the nuclear enterprise may begin with the exposure of its secrets, it cannot end there.

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THE DARK ENERGY SURVEY'S imaging camera was mounted on the Víctor M. Blanco 4-meter Telescope at the Cerro Tololo Inter-American Observatory in Chile, which is pictured here under the night sky with part of the Milky Way visible.

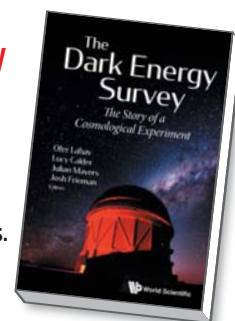
Unifying two fields

Although astronomy has been a part of physics for centuries, it maintained a separate culture until the relatively recent realization that some central problems in fundamental physics were best attacked using astronomical techniques. I can remember a time when I served on a Department of Energy panel and was advised never to use the word "telescope," because higher-level committees would frown on the unwanted incursion into astronomy. Equally telling is the warning I received as an undergraduate in the 1970s: Only "failed physicists" go into astronomy. That is no longer true. The two cultures are now conjoined by cosmology, and there is little distinction between astronomers and astrophysicists.

The Dark Energy Survey: The Story of a Cosmological Experiment documents a collaboration that epitomizes the recent melding of those two cultures. As the title suggests, it outlines how physicists and astronomers successfully attacked one of the most perplexing questions in physics: What explains the accelerated expansion of the universe? The book chronicles the collaboration's history from its genesis as a mere idea in 2003 through the six-year observational program it

The Dark Energy Survey
The Story of a Cosmological Experiment

Ofer Lahav et al., eds.
World Scientific, 2020.
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ran from 2013 to 2019. As one might expect, the book presents an informative overview of the project's many scientific discoveries. But it is equally valuable for its depiction of the nuts and bolts of fashioning an experiment spanning different scientific cultures and funding agencies.

The centerpiece of the Dark Energy Survey (DES) was an imaging camera built for the project and mounted at the prime focus of the Víctor M. Blanco 4-meter Telescope at the Cerro Tololo Inter-American Observatory in Chile. In each pointing, the camera observed 3 square degrees in five colors. The resulting observations were mosaicked together to form a final composite image that spanned 5000 square degrees. Researchers