History and Philosophy of Physics

A FORUM OF THE AMERICAN PHYSICAL SOCIETY · VOLUME XVI · NO. 2 · SPRING 2025

Perspectives on the Current Crisis in Science

By Kathryn M. Olesko, historian of science, Georgetown University (retired) and Chair-Elect, APS Forum for the History & Philosophy of Physics

With contributions from:

Toshihiro Higuchi, American diplomatic historian, environmental historian, and historian of science, Georgetown University;

Allison Macfarlane, Director, School of Public Policy and Global Affairs, University of British Columbia and former chair of the U.S. Nuclear Regulatory Commission, 2012-2014;

James Mattingly, philosopher of science, Georgetown University; and

Tiffany Nichols, historian of science and lawyer, Northeastern University

Readers of the *FHPP Newsletter* are familiar by now with the devastating consequences of the crisis in American science precipitated by President Donald J. Trump's executive orders (EOs) and the actions taken by his administration since Inauguration Day. Most follow the playbook outlined in Project 2025, a manifesto that is hostile to expertise, and in particular to the role of expertise in the federal regulatory process. [1] That hostility has grown and now targets America's research universities, threatening their existence with the cancellation of research funds already awarded, as has happened at several institutions, most notably Harvard University; with the replacement of university self-governance by federal oversight; and with extortion of various types, including the forced removal of university officials in lieu of the cessation of the institution's federal funding, as happened at the University of Virginia, where the president was compelled to resign when threatened with the loss of UVA's federal funding. [2] At this point, a mere six months into the current administration, the cascading effects of firing federal scientists, removing data from federal websites, reducing federal funding for science, and eliminating or downsizing federal scientific agencies and projects are already evident. Diminished enrollment of graduate students in scientific fields, recruitment of American scientists by foreign countries, and doubts regarding the stability of a career in science have already become realities. While lawsuits have reversed some, but not all, of the administration's destructive actions against science, several court cases are still unresolved. Some may reach the Supreme Court, but the prospect of results favorable to science are small when the court has voted in favor of the current administration more often than not, as it did in mid-July 2025 when it approved the president's dismantling of the Department of Education. Matters look grim and only appear to worsen day by day.

In the midst of this crisis, the scientific community has bravely risen to the occasion to defend science and protect the interests of its community and American intellectual life more broadly. The "Stand Up for Science" movement has rallied supporters, mostly from the younger generation, for protests against the administration's decimation of federal science and federally supported science. [3] Among scientific societies, the American Physical Society has been one of the most well organized and most outspoken champions for the cause of science, posting on its website a variety of ways in which its membership can effectively promote science. The APS has offered guidance on how to contact and speak to members of Congress (and even keeps a tally of states for which science advocates are needed); kept its members up-to-date on the proposed FY2026 budget; and supported the younger generation and international scholars, committing the society to being a home for the global physics community. For those affected financially by the crisis,

Continues on page 6

In This Issue

Quantum Century Project News

The world is marking the centennial of the initial development of quantum mechanics in 1925 with the UN-proclaimed 2025 International Year of Quantum Science and Technology (IYQ). The International Year officially kicked off in February at UNESCO headquarters in Paris, where the Opening Ceremony was attended by over a thousand guests who saw talks and panel discussions by leaders in quantum research, industry, and policy, including Nobel Laureates Anne L'Huillier and Bill Phillips. The Year is being celebrated with events at all levels around the world aimed at helping the public understand the importance of quantum science and technology over the past century and going forward. Over 1,000 worldwide events have been independently initiated in the first half of the year. Anyone who creates their own event can submit it to the IYQ website quantum2025.org for public listing and can use the IYQ logo and branding to help promote their event. In addition to independent events, a select group of events has received official IYQ sponsorship recognition and support. Among these is the 5th International Conference on the History of Quantum Physics, held this August in Salvador, Brazil. The process to realize a global celebration of 100 years of quantum mechanics was initiated by the FHPP in 2018. (It was Paul Cadden-Zimansky, Bard College, the author of this news note, who initiated this project in 2018!)

Note from the American Journal of Physics

The American Journal of Physics invites submissions for a special issue, *Motivating physics learning through research applications*, with a submission deadline of December 31, 2025. This issue will share how concepts from the undergraduate curriculum are applied in research, with the goal of providing instructors with examples to motivate students to learn these topics. Papers in this issue won't explain entire research problems, but, rather, will share examples from the research process that illustrate the use of specific topics in undergraduate physics. You might think about what concepts are most important for new students in your lab to understand, or what process you love to explain to new students because they recognize its connection to what they learned in class. For more information, see the call for papers.

History and Philosophy *of* Physics
NEWSLETTER

Forum on History and Philosophy of Physics | American Physical Society, One Physics Ellipse, College Park, MD 20740

The Forum on History and Philosophy of Physics of the American Physical Society publishes this Newsletter biannually at *http://www.aps.org/units/fhp/newsletters/index.cfm*. Each 3-year volume consists of six issues.

Editor
Donald Salisbury
Department of Physics
Austin College
Sherman, TX 75090
dsalisbury@austincollege.edu
(214) 405-6188

March 2025 FHPP Session Reports:

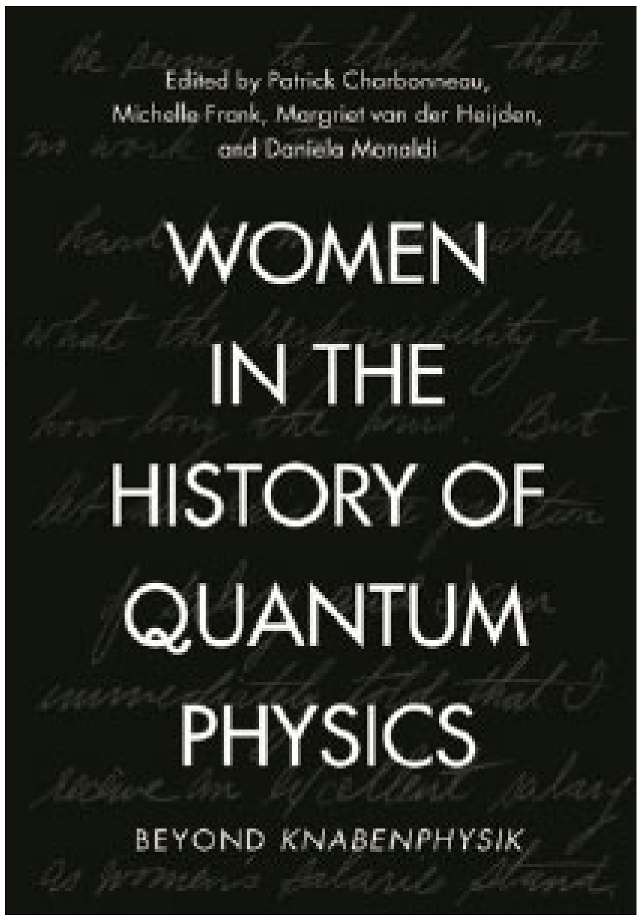
Report by Michelle Frank, City University of New York

Beyond Knabenphysik: FHPP Celebrates Women in the History of Quantum Physics at the 2025 APS Global Summit

Nearly four years ago, an international group of physicists, philosophers, writers, and historians convened on Zoom to discuss a troubling problem. We represented a dizzying array of universities, nations, and time-zones, but we shared a deep interest in the history of quantum physics, and a growing concern about patterns of omission from the dominant historical narrative. We asked one another, among the many accounts of Niels Bohr and Werner Heisenberg, discussions of the Pauli Exclusion Principle, and the so-called quantum dissidents, amidst writings about Bell's Theorem, and young contributors to a field known as Knabenphysik, where were the women?

As we continued our discussions, a group name emerged in the fashion of the best experiments – that is, gradually, through trial and error, and iteration. Eventually, we landed on "WiHQP" or "Women in the History of Quantum Physics." Our members pronounce it as, "Wick-P." Others say the name should sound like "Wick-up," rhyming with "hiccup." Either way, during the summer of 2022, WiHQP members gathered in person at the University of Utrecht to share research findings. So many findings emerged that we began to ponder an edited volume. It turns out that in the history of quantum physics, women have been there all along, but their stories have been distinctly underreported. At times they worked in the shadows. At other times they faced pressure to leave the academies and institutions they'd fought fiercely to enter. More than once, they anticipated and reported the same, or similar, discoveries for which their male counterparts would be handsomely celebrated.

At the 2025 APS Global Summit, the Forum for the History and Philosophy of Physics sponsored "Beyond Knabenphysik: Women in the History of Quantum Physics," a panel presentation



celebrating our group's work. This June, Cambridge University Press has released our anthology, Women in the History of Quantum Physics: Beyond Knabenphysik, authored by WiHQP members. The book presents sixteen chapters about women both ordinary and extraordinary, all of whom made significant contributions to the development of quantum physics.

I had the privilege of chairing our panel at the APS Global Summit, featuring a subset of contributing authors and editors. As we wrote in our Introduction to the book, "Our working group seeks to ensure that women are discussed as part of the rich history of quantum physics, throughout the IYQ and beyond." The APS panel was an important step in this direction.

Daniela Monaldi, from York University, served as the panel's first speaker. Her talk, "The Gendered History of Quantum Physics," offered a powerful overview of what it means for science and for women when an entire field is (mis)construed as "masculine." Dr. Monaldi's observations invited the APS Global Summit audience members to reflect on the losses that can result, not only for individual scientists, but also for a field, as a whole, when a scientific discipline develops a sense of itself based upon an artificial binary. Because *Women in the History of Quantum Physics* aims to challenge the conventional, all-male narratives that reinforce a masculine image of the field, and because the book focuses on lesser-known figures, Dr. Monaldi explained that the emergent themes provide insight into the historically gendered descriptions of physics. In addition to contributing a chapter on Laura Chalk, Dr. Monaldi also served as the WiHQP Chair last year, steering the group through a set of Scylla-and-Charybdis-like decision points as our anthology took shape. Her clarity, diplomacy, and warmth are leadership strengths for which WiHQP is deeply fortunate.

Patrick Charbonneau, from Duke University, followed with "Elizabeth Monroe Boggs: From Quantum Chemistry to the Manhattan Project." He offered an engaging report on Elizabeth Monroe Boggs, a figure who came to be well known for her social justice advocacy

Continues on page 4

but who was forgotten for her equally impressive contributions to physics. Monroe Boggs had trained at Bryn Mawr, Cambridge, and Cornell, developing credentials as a mathematician, as mathematical chemist, and as a theoretical chemist. Then she joined the Manhattan Project, where she served at the Explosives Research Laboratory. Her work contributed to the birth of computational quantum chemistry and to the emergence of hard sphere crystallization. She also contributed to the development of new implosion technology during the second world war. All the same, her scientific career ended with World War II. Following the birth of her son, who suffered from a severe developmental disability, Monroe Boggs left physics, pivoting to a life of public advocacy where she focused on disability rights. For her advocacy, she is broadly recognized today. By contrast, as Dr. Charbonneau pointed out, her scientific training is less well known. He invited the audience to retrace Monroe Boggs' career trajectory from early quantum chemistry enthusiast to her later years when she became a key figure of the disability rights movement.

Next, Margriet van der Heijden, from Eindhoven University of Technology, discussed her jointly authored chapter, "Jo van Leeuwen, the other physicist behind the Bohr-Van Leeuwen theorem," co-written with Miriam Blaauboer, of Delft University of Technology. Dr. Van der Heijden is the current Chair of WiHQP, and she has provided our group with tireless leadership during the IYQ. She pointed out that the first four women to obtain a PhD in physics at Leiden University all studied under Nobel laureate Hendrik Lorentz. Hendrika Johanna (Jo) van Leeuwen (1887–1974) was one of these individuals. Her thesis discussed magnetism as an exclusively a quantum phenomenon; the same result was independently obtained by Niels Bohr in his thesis, and it is now commonly known as the Bohr–van Leeuwen theorem. Later, van Leeuwen worked at the Technische Hoogeschool in Delft, which became Delft University of Technology. After serving as an assistant for almost 30 years, she eventually became the first woman there to be appointed Reader. Dr. Van der Heijden contextualized Van Leeuwen's early contributions to the quantum theory of magnetism in relation to the broader backdrop of quantum developments, situating that work among the contributions of other women in physics in the Netherlands and Western Europe during the early twentieth century.

Marta Jordi, Director of the Institut Menorquí d'Estudis, spoke next, delivering a talk entitled, "Maria Lluïsa Canut: Between crystallography and feminist struggles." Dr. Jordi explained that Canut had been one of the most prominent crystallographers in Spain during the Francoist regime, and later she worked in the United States in partnership with her husband, José Luis Amorós Portolés (1920–2001) at Southern Illinois University. Canut published widely (more than 60 scientific papers and co-authorship for three books), exploring, and steadily mastering a novel field of research: the relationship between X-ray diffuse scattering through crystals and their thermal dynamics. For this work, and for her later research on innovative computer programming to calculate electron densities and symmetry factors in crystals, Canut received important accolades. Even so, Canut's contributions remained partially obscured by her husband's more public recognition. Moreover, the terms and conditions under which she worked did not keep pace with those of her male peers. Dr. Jordi discussed Canut's growing dissatisfaction with the unequal treatment she received at SIU, her eventual lawsuit against the university, and her involvement in the second feminist wave in the US, which ultimately interrupted the continuity of her crystallography career.

Charnell Chasten Long, from North Carolina A&T State University, closed the APS session with "Carolyn Parker's Freedom Dreams in Physics." Parker was the first African American woman to receive a postgraduate degree in physics, and her professional life has been the subject of many brief articles. As Dr. Long discussed, these accounts have typically centered on Parker's pursuit of a scientific education, her participation in classified wartime research, and her premature death, but Parker's full narrative has not received as much scholarly attention as it deserves. Dr. Long pointed out that Parker faced intersectional barriers as she pursued increasingly advanced degrees in physics, and she navigated a racially segregated climate that pervaded American academia during the middle of the twentieth century. By interrogating archival silences and fragmentary evidence, Dr. Long invited the audience to take a closer look at the ways in which Parker's career functions as a lens, making visible the challenges that African American women in physics have faced for decades. Dr. Long's account of Parker's trajectory illuminates how race and gender have shaped scientific recognition and participation in the U.S. in the 1950s, 1960s, and beyond.

In our Introduction to *Women in the History of Quantum Physics*, we wrote:

> Women's erasure – documentary or otherwise – is difficult to remedy. The tendency to shape scientific discoveries into heroic tales has perhaps compounded the problem... [I]t is worth asking what results from "heroic ideology" with its concomitant impulse to neglect collaboration and collective effort.
>
> ...But by shining a bright light on women in the history of quantum physics on the occasion of the IYQ, we hope that this volume contributes toward redressing the field's unbalanced history, and that it can be a sure step toward achieving a more inclusive world of physics, of science, and beyond, within our lifetime.

Those words are equally applicable to the presentations FHPP sponsored this spring at "Beyond Knabenphysik: Women in the History of Quantum Physics." By sharing women's histories more broadly, the panelists moved another step forward toward that hoped-for future.

[1] Portions of this article, including full references, are drawn from P. Charbonneau et al. (eds.), Women in the *History of Quantum Physics: Beyond Knabenphysik*, Cambridge University Press, Cambridge 2025. https://www.cambridge.org/de/universitypress/subjects/physics/history-philosophy-and-foundations-physics/women-history-quantum-physics-ibeyond-knabenphysiki?format=HB

History and Physics of the Manhattan Project and the Bombings of Hiroshima and Nagasaki

1:30 pm – 3:18 pm, Monday March 17
Session APR-C06
Anaheim Marriott, Platinum 9
Chair: Bruce J. Hunt (University of Texas

Secrecy and the Bomb

1:30 pm – 2:06 pm
Alex Wellerstein (Stevens Institute of Technology)

One of the defining characteristics of the Manhattan Project was its secrecy, from the initial self-censorship campaign by physicists in the United States after the discovery of nuclear fission, through the creation of the Atomic Energy Commission in the early postwar period. In this talk, I will discuss the various phases of secrecy that characterized the work during World War II, and the reactions that various scientists within the project, especially physicists, had to working under these information control regimes. It will furthermore explore the way in which a number of key project physicists — including Leo Szilard, Niels Bohr, J. Robert Oppenheimer, Henry DeWolf Smyth, and Edward Teller — conceptualized and engaged with what was termed the "problem of secrecy" in the postwar period, as the ad hoc wartime arrangements were transformed into a more permanent legal structure.

Modeling Fallout from Trinity to Nuclear War

2:06 pm – 2:42 pm
Sebastien Philippe (Princeton University)

The July 16, 1945 Trinity nuclear weapon test marked the first large-scale, uncontrolled release of radioactive materials into the atmosphere, contaminating land and exposing downwind populations to radiation. Over the following decades, more than five hundred atmospheric nuclear tests were conducted worldwide to advance nuclear weapons development, dispersing radioactive fallout at local, regional, and global scales, and increasing the risks of radiation-induced health effects for affected populations.

This presentation explores how modern scientific tools — combining advanced atmospheric transport models, reanalyzed historical weather data, and detailed nuclear weapon explosion source terms — enable a comprehensive reassessment of the radiological impacts of past nuclear testing. These analyses provide critical insights for shaping compensation and remediation policies while also identifying exposed populations in regions where historical fallout data is sparse or unavailable.

Furthermore, the presentation demonstrates the scalability of these tools for modeling fallout from modern nuclear conflict scenarios. By producing hour-by-hour fallout projections at kilometer-scale resolution anywhere on Earth, and integrating global population distribution, three-dimensional urban building data, and ecological and agricultural datasets, it is now possible to conduct detailed assessments of nuclear war's physical and societal consequences. These include impacts on public health, socioeconomic systems, agriculture, and the environment at local, regional, and global scales.

History and Ethics of Working on Nuclear Weapons

2:42 pm – 3:18 pm
Arjun Makhijani (Institute for Energy and Environmental Research)

Two currents ran through U.S. scientists' participation in the Manhattan Project. The motive for those who built the bomb was what led Einstein to write President Roosevelt: a Nazi atomic monopoly could mean nuclear blackmail at Hitler's hands. U.S. possession of the dreadful instrument could enable the United States and Britain to avoid that fate. The other current was represented by Vannevar Bush, who persuaded FDR to create the National Defense Research Council and put him in charge. He wanted civilian scientists to help develop new weapons not just to win the war. He believed that "the world is probably going to be ruled by those who know how, in the fullest sense, to apply science." He wanted to be the scientist who oversaw the process of putting the U.S. in that position. The use of atomic weapons was part of that current. By the end of 1944, it was clear that Germany did not have a viable bomb project. The deterrence job was done. But the project was accelerated; the target was Japan. In fact, Germany was explicitly de-targeted much before, on May 5, 1943, by the Military Policy Committee, headed by Bush. He made sure that the scientists who were busy making the bomb were excluded from that decision. Reflecting on it in 1981, Richard Feynman, who was at Los Alamos, opined that he "immorally" failed to reconsider his participation when the Nazis surrendered in May 1945. "I simply didn't think, okay?" he said in explanation. The process had created a U.S. atomic monopoly. Secretary of War Stimson told the newly installed President Truman on April 25, 1945, that the bomb could wreak total destruction. On the other hand, figuring out "the proper use of this weapon" would give the United States "the opportunity to bring the world into a pattern in which the peace of the world and our civilization can be saved." Atomic-tipped global control by the United States with a nuclear monopoly was not what Einstein had in mind. Toward the end of his life, he called writing the letter his "one great mistake." Eight decades later, we are still at the edge of the nuclear precipice. It is essential to reflect on Feynman's self-described thoughtlessness and Einstein's postwar regrets. What might it mean for scientists participating in the production of nuclear weapons today, when there are nine nuclear powers and we are still at the edge of the nuclear cliff?

Perspectives on the Current Crisis in Science

Continues from page 1

the APS has gone so far as to reduce its membership fees drastically. Its legal team has, in addition, filed amicus briefs supporting all affected federal employees at federal science agencies. The American Association of Science has taken similar measures, as has the American Historical Association, but sadly for members of FHPP, not the History of Science Society (at least to date). Of note: the splash or landing pages of the APS and the AHA are devoted to these advocacy measures for addressing the crisis, signs of its urgency. [4]

This contribution to the *FHPP Newsletter* is written in the spirit of these community advocacy measures and with the intent of providing historical, philosophical, and policy perspectives on some of the issues of interest to physicists and historians and philosophers of physics in the current crisis in science. It follows on the heels of a roundtable I organized with seven other historians for the journal History of Science at the request of its editor, Lissa Roberts. That roundtable, written and published at record speed, covered the first hundred days of the current administration. Now available through open access, it should be read as a companion piece to the perspectives provided here. That roundtable's topics include: an overview of the topology of the crisis; the consequences of changes to the U.S. nuclear energy and waste programs; the administration's attempt to redefine biological truth; the evisceration of the environmental sciences; the reactionary culture of Silicon Valley; the power politics at work in the struggle between science and the current administration; the significance of the long history of collective resistance to the federal government; and finally, because they are so appropriate to current circumstances, international comparisons of the current crisis with past totalitarian regimes. [5]

As the readers of this newsletter are well aware, the current crisis in American science is wide-ranging and cuts to the heart of the scientific enterprise nearly everywhere. There are so many issues that deserve study, analysis, and commentary from the

Kathryn M. Olesko

perspective of science studies, especially history and philosophy of science. For this newsletter contribution, I have chosen four issues that I thought would be of interest to the newsletter readership. They are: (1) the closing of one of the two American sites of the Laser Interferometer Gravitational-Wave Observatory (LIGO); (2) the attempt to replace professional self-governance in science with a federally defined and adjudicated "Gold Standard Science;" (3) the politicization of the chair of the Nuclear Regulatory Commission (NRC); and (4) the proposal to eliminate the Linear No-Threshold model (LNT) for radiation exposure. All but one of these issues, LIGO, are tethered to a presidential executive order. I have also asked four scholars for their thoughts on the changes taking place in these four areas.

Laser Interferometer Gravitational-Wave Observatory (LIGO)

LIGO observations of gravitational waves are one of the phenomenal success stories of twenty-first-century science. Based at two geographically separated locations in the U.S.—Hanford, Washington and Livingston, Louisiana—LIGO was designed to detect gravitational waves as predicted by Albert Einstein's 1915 general theory of relativity. Observations at LIGO began in 2002, but it was not until 2015 that gravitational waves were finally observed as they approached Earth from the merger of two black holes 1.3 billion light years away. In 2017 American scientists Barry Barish, Kip Thorne, and Rainer Weiss won the Nobel Prize for the LIGO-based detection of gravitational waves.

By the time gravitational waves were observed in 2015, similar but less accurate international sites provided important data for the triangulations needed for locating the sources of the waves in the cosmic sky. A hallmark feature of the American sites is the precise quality of their measurements. According to Tiffany Nichols, an expert on LIGO's history, "in order to detect gravitational waves, LIGO must be able to discern length deformations 1,000 times smaller than the width of a proton. LIGO uses two widely spaced detectors [in Louisiana and Washington] to distinguish local noise at one or both detectors. A gravitational wave propagating through the Earth will appear in both instruments separated by the time that it takes to travel between the two sites, which is about 7 milliseconds. Two detectors are also needed to locate the source to the gravitation waves in the celestial sky." [6]

LIGO's results go beyond the confirmation of Einstein's predicted gravitational waves. Astronomical observations now can be done with either electromagnetic waves or gravitational waves. The advantage, Nichols explains, is that "when there are at least two detectors, LIGO physicists can alert astronomers at optical, infrared, x-ray, etc. observatories of the localization so that they can point their instruments to the location of the gravitational wave detection and perform observations across the spectrum." [7] With this kind of coordination, LIGO's results have also shed light on how heavy metals are made, how black holes merge, how neutron stars merge, and how galaxies evolve.

Now, a mere decade after LIGO's confirmation of gravitational waves, the experiment is threatened with amputation. Since its inception in 2002, LIGO has been NSF's most expensive project. The FY 2026 Budget cuts LIGO funding from 48 million to 29 million, a 40% reduction for the year in which LIGO was scheduled to be upgraded. Moreover, the budget did not specify which location would be axed. Louisiana is a Republican state; Washington, a

Democratic one that has already legally challenged cuts to NSF. Although the budget is in flux at the moment while it is under Senate review, prospects of restoring the entire NSF budget look grim.[8]

I asked Nichols about the decision to close one of the sites. She called it "alarming," especially because it is "decades after the bulk of the funding has been invested in constructing LIGO and upgrading LIGO to Advanced LIGO." The scientific consequences of closing one of the two LIGO sites are profound. Noise in the form of disturbances, even slight seismic activity, would reduce the precision and increase the errors of measurements taken at the remaining site. Pairing would have to take place with more distant, newer, less sensitive, and less accurate LIGO sites, such as VIRGO in Italy, with the consequence that not only would the final result be less precise, but also the determination of the signal location in the cosmic sky would be less accurate. With two LIGO sites, the U.S. is the unquestionable leader in the study of gravitational waves. With only one site, the U.S. would relinquish that position and probably would have to withdraw from the European Space Agency's Laser Interferometer Space Antenna, designed to observe gravitational waves in space before they reach Earth. [9]

Nichols adds that with the closure of one of the LIGO facilities, the field of multi-messenger astronomy—where multiple signals from the same source, but obtained in different ways (say through electromagnetic and gravitational waves, to cite one example), are coordinated to interpret an astronomical event—would "stall and potentially stop." "With instruments such as the Vera Rubin telescope," which began operation on 23 June 2025, "the world collectively has the most advanced fleet of astronomical and astrophysical instruments that have increased our knowledge of the universe many times over. Eliminating a LIGO facility effectively blots out not only our potential knowledge, but also the ability to obtain that knowledge of the universe." [10]

Nichols also warns that there are "downstream ramifications of decommissioning a site and the costs associated with that." Legal issues concerning the land on which LIGO's very large arms sit are numerous and comparable, according to Nichols, to the problems arising from "the removal of five telescopes and restoration of land on Mauna Kea in Hawaii." States that host LIGO have invested heavily in it. "The state of Louisiana purchased the land and the state of Washington has invested in Washington State University, Tri-Cities near Hanford." She explains that "these facilities were massive civil, environmental, and construction engineering feats. The bulk of the investment was made in building the facilities. Eliminating one would appear to be more wasteful than maintaining the operating costs of a facility that has already been built." [11]

The loss of a LIGO site would diminish the extended scientific community associated with LIGO where skilled scientists run the trials, postdocs and graduate students learn from more experienced scientists who know how to operate sensitive equipment, and K-12 STEM education occurs, enhancing students' exposure to the sciences in rural areas where there is a need for more science-based experiences. The educational impact of LIGO extends beyond these groups, though, to the public understanding and appreciation of science, according to Nichols. In the Tri-Cities area of Washington, "the LIGO Exploration Center allows LIGO Hanford to welcome local communities, especially K-12 students, to their facility and exposes them to the science of LIGO." Nichols added that she has family near the Louisiana facility. "I never heard them discuss science until they started talking about the LIGO facility. Everyone in the surrounding area knows about it. It has sparked their curiosity. It is a resource that inspires knowledge that was not possible prior to LIGO." Both LIGO facilities, she points out, "are in less populated areas that now have access to scientific sites that parallel areas surrounding universities." This public outreach would disappear should one of the sites be closed. [12]

Critics conclude that whoever recommended closing one of the sites didn't know the science and simply concluded that Hanford and Livingston were redundant facilities, and so one of them could be eliminated. As an astute commentator on Reddit put it: "They're going to 'wind-down' one of the two sites? That's like removing one of your eyeglass lenses and saying that you saved money." [13] Astrophysicist Maya Fishbach likens the proposed closing to "trying to fly a plane with only one wing." [14] Nichols concludes that "it seems that there is a lack of foresight and basic budgetary knowledge in the realm of science and technology policy" in the decision to close one of the sites. "If the basics of budget and policy are absent," she asks, "how can taxpayers have confidence in officials' ability to grasp the science?" [15]

"Gold Standard Science"

The current administration is determined to change the standards and practice of science for many reasons. Two leading reasons are: (1) the perception that self-governance in science hasn't worked, and therefore standards of practice need to be reformed in order to stem various sins of scientific practice, including fabricating data and publishing results that cannot be reproduced; (2) the perception among conservatives that the regulatory state needs to be reigned in, and the principal way to do that is to muffle science and the voices of scientists in the federal government. EO 14177 on the President's Council of Advisors on Science and Technology (23 January 2025), charged members of the council with rectifying what the president viewed as the wayward course of science and technology: "At the heart of scientific progress lies the pursuit of truth. But this foundational principle, which has driven every major breakthrough in our history, is increasingly under threat. Today, across science, medicine, and technology, ideological dogmas have surfaced to elevate group identity above individual achievement, enforce conformity at the expense of innovative ideas, and inject politics into the heart of the scientific method. These agendas have not only distorted truth but have eroded public trust, undermined the integrity of research, stifled innovation, and weakened America's competitive edge." [16]

The administration's corrective to "distorted truth" emerged exactly four months later, on 23 May 2025, in the form of EO 14303 on Restoring Gold Standard Science. [17]

The administration attributed the need for scientific standards to events over the past five years (covering the Biden administration and the second half of the Covid pandemic years) that lead to a decline in public trust in science due to a reproducibility crisis, the falsification of data including plagiarism, public health measures taken during Covid that the administration felt were not sufficiently supported by data, extreme predictions regarding climate change, and so on. These were indicative, the administration argued, of the politicization of science under Biden, which it believed had been exacerbated by the diversity, equity, and inclusion measures imposed upon "all aspects of science." The administration's corrective was Gold Standard Science, defined as "science conducted in a manner that is:

(i) reproducible;
(ii) transparent;
(iii) communicative of error and uncertainty;
(iv) collaborative and interdisciplinary;
(v) skeptical of its findings and assumptions;
(vi) structured for falsifiability of hypotheses;
(vii) subject to unbiased peer review;
(viii) accepting of negative results as positive outcomes; and
(ix) without conflicts of interest." [18]

Some of these standards are familiar and rather uncontroversial. Overall, as a statement from the Center for Open Science argued, EO 14303 "fails to recognize that achieving all of these in any single study is rarely, if ever, achieved." [19] One has to consider, though, that this directive came not from within the scientific community, but from the executive branch of the government which has instructed federal agencies, under the guidance of the Office of Management and Budget Director (OMB) Russell T. Vought—an individual who has openly expressed his contempt for scientific expertise [20]—to implement and surveil the deployment of these standards. In one full swoop, the executive branch seeks to coopt scientific self-governance as it has been traditionally practiced in the scientific community.

Almost all of those who supported the administration's attempt to rectify misdeeds in the scientific community came from the political right. [21] The vast majority of commentators, however, were critical of EO 14303 precisely because it politicized science, was an attempt to ignore data that did not support the administration's political agenda, and was a major threat to the autonomy of science. In a short period of time the Stand Up for Science movement gathered over 10,000 signatures against EO 14303. [22] Gretchen Goldman, president of the Union of Concerned Scientists, called the EO "dangerous" precisely because it placed research integrity in the hands of political appointees rather than non-partisan civil servants versed in science. [23] Science activists Carl Bergstrom, Michael Mann, and others, in an opinion written for The Guardian, condemned EO 14303 as a "bad-faith adoption of open science language" that could have "catastrophic" consequences for science. [24]

What critics seem not to have caught are the implications of including in the "gold standard" the criterion of "falsifiability," a term that the philosopher of science Karl Popper developed and that has been disputed for decades. I turned to James Mattingly, a philosopher of science, for an explanation of what falsifiability meant in this context. He wrote: "The falsificationist standard is itself a mélange of slogans masquerading as guidance with some ideas related to falsification and some not. What the standard, as articulated, betrays is a lack of understanding of the nature of falsification itself. In the first place, the emphasis on falsification in the foundations of science is oriented toward rejecting metaphysics rather than increasing knowledge. Indeed, Popper's entire corpus is predicated on the explicit rejection of scientific knowledge because he rejects inductive reasoning, the foundation of all empirical knowledge. "Refutable predictions" are a pipe dream for any inductive science, and no "advanced statistical methods" as recommended by the standard can realize them. Falsification is a problematic standard on its own (for some of the reasons above), but to try to blend it with statistics as this standard does is sadly ignorant." [25]

Mattingly added, though, that one has to be cautious about EO 14303: "The reporting of null results, as good an idea as that is, has exactly nothing to do with whether or not the hypotheses are themselves falsifiable. That criterion belongs rather in the section addressing "accepting negative results as positive outcomes." This is just another example of the lack of understanding shaping this standard. There are other good ideas here as well, but those are already at the heart of empirical science (controlled experiments, randomized trials, advanced statistical tests) are already at the most basic level of scientific practice that it is hard to see the point of mentioning them." Yet he did highlight one saving grace in the EO. "One piece of good advice, emphasizing a practice that enhances confidence in experimental outcomes, is the suggestion that study protocols be pre-registered. Many members of the scientific community have been attempting to promote this standard for some decades, and standardizing the practice would be a good thing." [26]

About the directive by the executive branch's Office of Science and Technology Policy explaining how the "gold standard" had to be implemented in federal agencies, Mattingly wrote: "Reading the clarification of EO14303 as a whole, though, is a disappointment. For there is very little here that is strictly actionable. I suppose that is to be expected given that agency heads have yet to respond with their actual proposals for how to implement the EO. Still the sloganeering in the document does nothing to make one doubt the conclusions other [critics] have drawn, that the new protocols are simply cover for the hijacking of scientific expertise by administrators via political appointees." [27]

So why did the administration include Popper's notion of falsifiability in the EO on "Gold Standard Science?" In my view, the answer lies in how scientific knowledge is adjudicated, especially in courts and especially in the context of challenges to federal regulations. It turns out that conservatives love Karl Popper's philosophy of science because it facilitates legal challenges to the regulatory state. [28]

Two Nuclear Matters

The current administration has expressed its intent to expand and transform the nuclear energy industry in the U.S., in particular to support the development and application of quantum computing and artificial intelligence, which require extraordinarily large amounts of energy, and for military and national security purposes. Geopolitics plays into the nuclear initiative as well, as the U.S. tries to position itself favorably against China and Russia in nuclear energy. To these ends, four EOs (14299, 14300, 14301, 14302) dealing with the nuclear reactors and the Nuclear Regulatory Commission (NRC), were issued on 23 May 2025. [29] The target in each of these EOs is NRC, which was established in 1975 for the licensing, construction, and oversight of all nuclear and radiological facilities as well as for civilian radiological safety.

These EOs nearly completely unravel past practices in NRC-based nuclear regulation and safety first, by assigning the Department of Defense (DOD) and the Department of Energy (DOE) regulatory and oversight responsibility for advanced nuclear reactors and nuclear fuel recycling and waste management on federal lands owned by these two agencies (EO 14299). The NRC would function only in an advisory capacity in these instances. Second, they initiate a series of reforms, an "overhaul of NRC culture," by shortening the timelines for reactor approval; diminishing the role of radiation safety in reactor design, construction and maintenance; overhauling the NRC's regulatory culture to accommodate the rapid approval of advanced reactors (microreactors, small modular reactors, etc.); and reducing the number of employees while working with the Department of Government Efficiency (DOGE) to speed up the licensing of reactors (EO 14300). Third, they reform nuclear reactor testing by moving that task from national laboratories (e.g., the Idaho National Laboratory), with their supposed "overregulated complacency," to other sites (EO 14301). Finally, they assign to DOE, DOD, the Department of Transportation, and OMB responsibility for crafting a policy for the management, use, and storage of spent nuclear fuel, a charge that seems to overlook the problems of Yucca Mountain and of stored spent fuel at Hanford and other nuclear sites (EO 14302). In what is planned to be major innovations in reactor development and operation, the NRC—considered the gold standard in reactor approval and oversight—is nearly completely sidelined.

Chair of the NRC

The NRC is run by a five-member NRC commission confirmed by the Senate from which the president appoints a chair. By design, the commission is an independent oversight board, but with the implementation of the EOs of 23 May 2025, which diluted the charges of the NRC, matters changed. Three weeks after these EOs were issued, on June 16, 2025, the president fired Commissioner Christopher Hanson (D), who had been chair until Inauguration Day. [30] The commission now has two Republicans (one of them is now Chair) and two Democrats. Around mid-July 2025 it was discovered that job applicants to the NRC were required to answer political questions on their application, explaining how they would promote the president's energy priorities. [31] Also as of mid-July 2025 a DOGE representative is embedded in the NRC and recently told the chair that he would have to automatically approve nuclear reactor proposals from DOE or DOD. [32] This is just the beginning.

I asked Allison Macfarlane, former chair of the NRC (2012-2014), for her views on the EOs that affected the NRC. She has long been a champion of the NRC's independence. She had recognized early on in the current administration, in mid-February 2025 when the president issued EO 14215 "Ensuring Accountability for All Agencies," that it was time to speak out on the NRC's independence because, as she put it, "this order gave the Office of Management and Budget power over the regulatory process of until-now independent agencies." She knew that what the president wanted was subordination. [33]

After the EOs of May 2025 came out, she concluded that "they will potentially have the combined effect of severely damaging the independence and therefore ability of the NRC to ensure safety at all nuclear facilities and of all nuclear materials that they oversee. The mission of the NRC is to ensure public health, security, and environmental safety. This mission is undermined by when the agency is no longer independent and therefore under the influence of industry and politics. Indeed, Congress created the NRC in 1975 to avoid the conflicts present in the Atomic Energy Commission, which both promoted and regulated nuclear energy. You can't do both well." [34]

The executive branch claimed throughout the four EOs of May 2025 that national security was a driving concern for reforming the NRC, and that the changes outlined in those EOs would enhance national security. Macfarlane argues otherwise. "U.S. national security is at stake without an independent nuclear regulator, as we learned during the Fukushima accident. Within a year of that accident, 30% of Japan's electricity supply from its nuclear power plants was shut down, seriously constraining the use of electricity. One hundred and six thousand people evacuated from their homes and towns near the Fukushima Dai'ichi nuclear power plant where three reactors had experienced core meltdowns and released large quantities of radiation into the nearby Pacific Ocean and the atmosphere. The damaged reactors remain and cleanup will take decades. The fishing and agricultural industries nearby were decimated. The Japanese Diet, in a report on the accident, noted that [the accident] resulted from collusion between the regulator, industry, and the government—exactly what a truly independent regulator would have avoided." [35]

Macfarlane concludes that the NRC's reputation will diminish as a result of these presidential EOs. "These executive orders will not only make nuclear power plants less safe, they will have the potential to impact new nuclear designs by US vendors who hope to access global markets. With the NRC no longer setting the "gold standard" in regulation as a result of Trump's political interference, other countries will not be assured by design approvals meted out by the NRC."

"In the end, these executive orders serve no one, especially the American people." [36]

Linear No-Threshold Model of Radiation Exposure

EO 14300 pits the NRC's concern for radiation safety against the "severe domestic and geopolitical costs of such risk aversion." To date the NRC has adhered to the Linear No-Threshold Model (LNT) of radiation exposure, which originated in studies of the survivors of Hiroshima and Nagasaki. LNT maintains that risks from radiation accumulate linearly with each increase in dosage, and that there is no safe level of exposure. [37] The administration argues, without proof, that "those models lack sound scientific basis and produce irrational results, such as requiring that nuclear plants protect against radiation below naturally occurring levels." On those sketchy grounds, the EO instructs the NRC to abandon the "flawed" LNT model and to adopt instead "science-based radiation limits," and in particular to consider the adoption of "determinate radiation limits" by consulting with DOD, DOE, and the Environmental Protection Agency. This interagency process would not only violate the NRC's statutory charge, but also would increase the number political appointees making decisions that had been in the hands of the experts on the NRC Commission.

The anti-regulatory flank argues that the LNT model is "too strict and costly." Conservative scientists point to an alternative to the LNT model: hormesis. Hormesis is the theory that not only are low doses of radiation acceptable; they may actually be beneficial to cell function. In particular they argue that a differentiation between low and high doses of radiation is necessary for catastrophic radiation exposure events like Fukushima and Chernobyl, a differentiation that they think is relevant to an undesirable and improbable case of a major radiological accident. In 2015 a group supporting hormesis, Scientists for Accurate Radiation Information, presented a petition to the NRC. Six years later the NRC rejected it on the grounds that while radiation tolerance levels are uncertain, hormesis did not have a preponderance of evidence supporting it. [38]

In the science studies community, there is a growing interest in LNT, so I asked Toshihiro Higuchi, author of Political Fallout: Nuclear Weapons Testing and the Making of a Global Environmental Crisis (Stanford, 2020), what he thought about the debate over LNT since he had done so much work on the earlier years of radiation measurements and how they were interpreted. His response was sanguine.

"While EO 14300," he wrote, "may alter how the Nuclear Regulatory Commission (NRC) weighs factors in licensing and regulating nuclear power generation, it's unlikely to fundamentally change the principles, guidelines, and practices of radiation protection. The EO largely overlooks key administrative aspects of radiation protection that consistently favor the LNT model as a science-informed, yet primarily administrative, framework." He went on to explain that: "First, the radiation protection community has developed a comprehensive model for diverse forms of radiation exposure, extending far beyond nuclear power generation. Both in the U.S. and internationally, radiation protection organizations primarily focus on medical use. Here, the LNT model, combined with case-by-case risk/benefit analyses based on physician discretion, has successfully guided diagnostic and therapeutic radiation administration, protecting both patients and professionals from overexposure over time." [39]

He pointed to the problems in a threshold approach: "A threshold model would pose an impossible challenge: universally defining a line between "safe" and "dangerous" doses, irrespective of exposure mode. This would have far-reaching implications for exposure record-keeping, protective device design, and insurance rate setting. Paradoxically, and often to the dismay of critics, the LNT model can accommodate uneven and changing dose rates as long as the overall dose remains below established guidelines. This flexibility has radically simplified radiation exposure management and recording to the benefit of atomic energy use (e.g., using a daily film badge instead of real-time dosimeters that record constant fluctuations). Historically, the demand for simple radiation protection management, alongside its alleged (and still disputed) scientific basis, favored the LNT. It's highly improbable that the entire radiation protection community would embrace a threshold model, as it would undermine the foundation of radiation protection across industrial sectors."

"It's possible," he continued, "that the EO could make nuclear power generation an "exception," similar to how the radiation protection community handles activities like cancer therapy and outer space exploration. However, this would hardly change the LNT as the fundamental model for general radiation protection, regardless of its scientific merits."

He added some important considerations: "We also need to consider how radiation protection guidelines are established, disseminated, and observed globally. The U.S. federal government cannot unilaterally dictate this process. Even if it were to adopt a different scientific basis or value judgment (e.g., a higher threshold to support aggressive nuclear power expansion), it's likely to remain isolated from broader radiation protection practices both domestically and internationally. Organizations like the National Council on Radiation Protection and Measurements (NCRP) in the U.S. and, more importantly, the International Commission on Radiological Protection (ICRP) are likely to uphold the LNT model. While they might allow national agencies like the NRC to exercise administrative discretion in weighing risks and benefits differently, "American exceptionalism" in radiation protection would likely undermine the competitiveness of the U.S. nuclear industry. Operating and exporting reactors abroad would become challenging if different standards apply solely within the U.S." [40]

Final Remarks

In the administration's eyes, science gets in the way of the regulatory process and in the administration's view of the world, particularly the environment. It's not that the administration does not like science, it's just that they want a "science" of a different kind.

There are several conflicts here. One is between a science that holds up standards of safety and the protects citizens, and one that pursues economic opportunity and tolerates higher degrees of risk. Another conflict is that between of belief that the government should be devoted to the well-being of its citizens, and one that views its role as promoting industry and industrial development, no matter the cost.

In broader terms, the emergent view of science in the current administration is not of science as a national treasure, but, due to science's role in the regulatory state, as an obstacle to economic development. Many of the presidential EOs discussed here seek to dismantle the regulatory state. In the process, science and scientists, expertise and experts, have suffered.

There is more to the administration's disregard of and even hostility toward science and expertise that suggests we are in the midst of a radical transformation of the postwar social contract that has bound science and the state since Vannevar Bush's Endless

Frontier, published eighty years ago this month in July 1945. [41] Only further historical research will uncover what that transformation means and where it is headed.

Stand Up for Real Science!

The 80th Anniversary of Trinity
July 16, 2025

Notes

[1] Project 2025 Presidential Transition Project. *Mandate for Leadership: The Conservative Promise* (The Heritage Foundation, 2023), https://static.heritage.org/project2025/2025_MandateForLeadership_FULL.pdf (14 July 2025).

[2] Dhruv T. Patel, "Harvard Officials Say Federal Actions Could Cost the University $1 Billion Annually," *The Harvard Crimson*, 14 July 2025, https://www.thecrimson.com/article/2025/7/15/federal-policy-1-billion/ (14 July 2025); Jessica Blake and Katherine Knott, "Why UVA President's Resignation Could be a Watershed Moment," *Inside Higher Ed*, 30 June 2025, https://www.insidehighered.com/news/governance/executive-leadership/2025/06/30/uva-reels-after-president-resigns-under-pressure (14 July 2025).

[3] https://www.standupforscience.net/

[4] https://www.aps.org/, https://www.aaas.org/resources/speaking-us-scientific-enterprise-resources-support-latest-news, https://www.historians.org/ Contrast to https://hssonline.org/

[5] Kathryn M. Olesko, Anthony Eames, Cyrus C. M. Mody, Ilana Löwy, Thomas Zeller, Mark Walker, Mitchell G. Ash, and Donna Haraway, "The Crisis in American Science," *History of Science* 63(2) (2025): 125-165, https://journals.sagepub.com/doi/10.1177/00732753251343655 (open access published 29 May 2025).

[6] Tiffany Nichols to Kathryn M. Olesko, Email, 24 June 2025.

[7] Nichols to Olesko.

[8] Anette Cary, "Trump Science Cuts May Close Washington Observatory that Confirmed Theory of Relativity," *The Chronicle*, 1 June 2025, https://www.chronline.com/stories/trump-science-cuts-may-close-washington-observatory-that-confirmed-theory-of-relativity,381921 (14 July 2025).

[9] Nichols to Olesko; Hannah Richter, ""Shattering" NSF Budget Proposal Threatens Gravitational Wave Science," 17 June 2025, https://skyandtelescope.org/astronomy-news/shattering-nsf-budget-proposal-threatens-gravitational-wave-science/ (14 July 2025); Adrian Cho, "Trump's Proposed Cut to Giant Physics Experiment Could Snuff Out New Form of Astronomy," *ScienceInsider*, 10 June 2025, https://www.science.org/content/article/trump-s-proposed-cut-giant-physics-experiment-could-snuff-out-new-form-astronomy (14 July 2025).

[10] Nichols to Olesko; Evan Ackerman, "How the Rubin Observatory will Reinvent Astronomy," *IEEE Spectrum*, 23 June 2025, https://spectrum.ieee.org/vera-rubin-observatory-first-images (14 July 2025).

[11] Nichols to Olesko.

[12] Nichols to Olesko; Richter, ""Shattering" NSF Budget Proposal Threatens Gravitational Wave Science;" Cho, "Trump's Proposed Cut to Giant Physics Experiment Could Snuff Out New Form of Astronomy."

[13] Comment by zbubbs99, https://www.reddit.com/r/space/comments/1l020b0/scienceorg_new_nsf_proposal_would_shut_down_ligo/ (14 July 2025).

[14] As quoted in Richter, ""Shattering" NSF Budget Proposal Threatens Gravitational Wave Science."

[15] Nichols to Olesko.

[16] "President's Council of Advisors on Science and Technology [Executive Order 14177]," 31 January 2025, https://www.federalregister.gov/documents/2025/01/31/2025-02121/presidents-council-of-advisors-on-science-and-technology (18 April 2025).

[17] "Restoring Gold Standard Science [Executive Order 14303]," 23 May 2025, https://www.federalregister.gov/documents/2025/01/31/2025-02121/presidents-council-of-advisors-on-science-and-technology (2 June 2025).

[18] "Restoring Gold Standard Science."

[19] "COS Statement on "Restoring Gold Standard Science" Executive Order," 29 May 2025, https://www.cos.io/about/news/cos-statement-on-restoring-gold-standard-science-executive-order (5 June 2025).

[20] Olesko, et al., "The Crisis in American Science," p. 127.

[21] See for instance comments by Victoria LaCivita, spokesperson for OSTP, in Jeff Tollefson and Dan Garisto, "Trump's Call for "Gold-Standard Science" has Prompted an Outcry: Here's Why," *Nature*, 28 May 2025, https://www.nature.com/articles/d41586-025-01668-x (5 June 2025) and remarks by the conservative groups Iowa Climate Science Education (https://iowaclimate.org/2025/05/27/a-new-era-for-american-science-the-gold-standard-is-back/ (27 May 2025) and the National Association of Scholars (https://www.nas.org/blogs/statement/nas-endorses-restoring-gold-standard-science-executive-order (27 May 2025).

[22] https://actionnetwork.org/petitions/open-letter-in-support-of-science (27 May 2025).

[23] As quoted in Tollefson and Garisto, "Trump's Call."

[24] Colette Delawalla, Victor Ambros, Carl Bergstrom, Carol Greider, Michael Mann, and Brian Nosek, "Trump's New "Gold Standard" Rule Will Destroy American Science as We Know It," *The Guardian*, 29 May 2025, https://www.theguardian.com/commentisfree/2025/may/29/trump-american-science (27 June 2025).

[25] James Mattingly to Kathryn M. Olesko, Email, 1 July 2025.

[26] Mattingly to Olesko.

[27] Mattingly to Olesko. On the directive explaining how the "gold standard" should be implemented by federal agencies, see: Michael J. Kratsios, Director OSTP, "Memorandum for the Heads of Executive Departments and Agencies," 23 June 2025, https://www.whitehouse.gov/presidential-actions/2025/02/memorandum-for-the-heads-of-executive-departments-and-agencies/ (23 June 2025).

[28] See for instance Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 539 (1993), https://supreme.justia.com/cases/federal/us/509/579/ (5 June 2025) and https://fedsoc.org/commentary/publications/colloquium-junk-science-the-courts-and-the-regulatory-state-part-ii, 1 May 1998 (5 June 2025). I will be devoting a future Substack post to this issue of falsification, Popper, and the regulatory state (kathrynolesko.substack.com).

[29] "Deploying Advanced Nuclear Reactor Technologies for National Security," [Executive Order 14299]," 23 May 2025, https://www.federalregister.gov/documents/2025/05/29/2025-09796/deploying-advanced-nuclear-reactor-technologies-for-national-security (1 June 2025);

"Ordering the Reform of the Nuclear Regulatory Commission [Executive Order 14300]," 23 May 2025, https://www.federalregister.gov/documents/2025/05/29/2025-09798/ordering-the-reform-of-the-nuclear-regulatory-commission (1 June 2025): "Reforming Nuclear Reactor Testing at the Department of Energy [Executive Order 14301]," 23 May 2025, https://www.federalregister.gov/documents/2025/05/29/2025-09799/reforming-nuclear-reactor-testing-at-the-department-of-energy (1 June 2025); "Reinvigorating the Nuclear Industrial Base [Executive Order 14302]," 23 May 2025, https://www.federalregister.gov/documents/2025/05/29/2025-09801/reinvigorating-the-nuclear-industrial-base (1 June 2025).

On the problems that are likely to arise with the president's nuclear EOs, see: Toby Dalton and Ariel E. Levite, Trump's Executive Orders Could Endanger America's Nuclear Renaissance," *The Hill*, 28 May 2025, https://thehill.com/opinion/energy-environment/5320458-trump-orders-nuclear-power/ (5 June 2025). Reform of the NRC's regulatory practices had actually begun late in the Biden administration. Nuclear Regulatory Commission, "About the ADVANCE ACT," https://www.nrc.gov/about-nrc/governing-laws/advance-act.html (5 June 2025).

[30] Evan Halper, "Trump Fires Nuclear Regulator as White House Seeks to Soften Oversight," Washington Post, 16 June 2025, https://www.washingtonpost.com/business/2025/06/16/nuclear-power-regulation-commission-fired/ (30 June 2025).

[31] Timothy Gardner, "U.S. Nuclear Regulator Asks Job Seekers Political Questions," Reuters, 15 July 2025, https://www.reuters.com/legal/government/us-nuclear-regulator-asks-job-seekers-political-questions-2025-07-14/ (16 July 2025).

[32] Francisco "A.J." Camacho and Peter Behr, "DOGE told Regular to "Rubber-Stamp" Nuclear," *Politico*, 14 July 2025, https://www.politico.com/news/2025/07/14/doge-to-regulator-rubber-stamp-nuclear-00450658 (16 July 2025).

[33] "Ensuring Accountability for All Agencies [Executive Order 14215]," 18 February 2025,

https://www.federalregister.gov/documents/2025/02/24/2025-03063/ensuring-accountability-for-all-agencies (1 April 2025); Allison Macfarlane, "Trump Has Just Assaulted the Independence of the Nuclear Regulator. What Could Go Wrong?" *Bulletin of the Atomic Scientists*, 21 February 2025, https://thebulletin.org/2025/02/trump-just-assaulted-the-independence-of-the-nuclear-regulator-what-could-go-wrong/ (1 March 2025); Stephen Burns, Allison Macfarlane, and Richard Meserve, "Why the US Must Protect the Independence of its Nuclear Regulator," *Bulletin of the Atomic Scientists*, 7 July 2025, https://thebulletin.org/2025/07/why-the-us-must-protect-the-independence-of-its-nuclear-regulator/ (7 July 2025).

[34] Allison Macfarlane to Kathryn M. Olesko, Email, 27 June 2025.

[35] Macfarlane to Olesko.

[36] Macfarlane to Olesko.

[37] Nuclear Regulatory Commission, "Linear No-Threshold Model and Standards for Protection Against Radiation [Denial of petition]," 17 August 2021,

https://www.federalregister.gov/documents/2021/08/17/2021-17475/linear-no-threshold-model-and-standards-for-protection-against-radiation (12 June 2025); National Academies of Science, "Beir VII: Health Risks from Exposure to Low Levels of Ionizing Radiation" [Summary], 2006,

https://nap.nationalacademies.org/resource/11340/beir_vii_final.pdf (12 June 2025).

[38] Tom Brown, "To Boost Nuclear Power, Trump Orders Rewrite of Controversial Radiation Safety Rules," *ScienceInsider*, 29 May 2025, https://www.science.org/content/article/boost-nuclear-power-trump-orders-controversial-rewrite-radiation-safety-rules (10 June 2025); Scientists for Accurate Radiation Information, "Charter," 12 February 2016, https://radiationeffects.org/charter-mission/ (5 June 2025); Steven C. Bondy, "The Hormesis Concept: Strengths and Shortcomings," 2023, https://www.mdpi.com/2218-273X/13/10/1512 (5 June 2025).

[39] Toshihiro Higuchi to Kathryn M. Olesko, Email, 25 June 2025.

[40] Higuchi to Olesko.

[41] NSF reissued Bush's landmark document for the book's 70th anniversary, and again for the 75th anniversary of NSF this year. See https://nsf-gov-resources.nsf.gov/2023-04/EndlessFrontier75th_w.pdf