

rona,¹ which is normally concealed from the human eye by the blue sky.

The 2.5-hour solar eclipse gave plenty of time for us to engage and motivate students to learn more about astrophysics and radio astronomy. Many Northeastern students who watched our live stream² were curious about the difference between the optical and radio observations. The students were quite enthusiastic about the real-time radio tracking of the eclipse, so we plan to continue live streaming radio-telescope observations in the future.

References

1. V. V. Zheleznyakov, *Radio Emission of the Sun and Planets*, J. S. Hey, ed., H. S. H. Massey, trans., Pergamon Press (1970).
2. Northeastern University Center for Radio Astronomy, "Solar Eclipse 2024," <https://cfra.sites.northeastern.edu/solar-eclipse-2024>.

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Beyond the cinematic feat: Consequences *Oppenheimer* ignored

A big red button. A bright flash of light. A loud thundering sound. Laughter. Cheers. That is how Christopher Nolan's *Oppenheimer* depicts the 1945 Trinity nuclear test. The movie won seven Oscars, including Best Picture, as well as acclaim at other awards ceremonies. But as physicists and nu-

clear security researchers, we contend that the deleterious consequences and pervasive neglect that characterize the Manhattan Project—and the nuclear enterprise in general—merit as big of a spotlight as the film has received.

While the film glorifies the Trinity explosion as a scientific feat, it fails to fully convey its consequences. Although just one scene in the film, it is representative of how the movie misleads the public about the nuclear enterprise and romanticizes its scientific pursuits.

Despite the celebratory nature with which Trinity is portrayed in the movie, the test was in fact a tragedy. The project scientists were aware of the hazards posed by radiation,¹ yet the film barely recognizes the far-reaching dangers of fallout. The test led to contamination of air, food, and water sources in New Mexico. Tina Cordova, a cofounder of the Tularosa Basin Downwinders Consortium, has described how her family is one of the many New Mexican families who have experienced four or five generations of cancer.² Simulations by Sébastien Philippe of Princeton University and colleagues indicate that Trinity radiation made its way to 46 US states, Mexico, and Canada within 10 days of the explosion.³

Oppenheimer dangerously seems to celebrate scientists' role in contributing to one of the most dangerous scientific projects in human history. Other research by Philippe, for example, shows that a nuclear attack on central-US missile silos could potentially result in millions of deaths across North America.⁴ Models by Rutgers University climate scientists Lili Xia and Alan Robock and their collaborators have shown that immediate climate changes caused by a nuclear war between Russia and the US could result in more than 5 billion deaths from starvation alone within two years.⁵ Scientists, nevertheless, have continued working to maintain and enhance the US's collection of such weapons.

The movie, furthermore, underplays the agency of scientists by indicating a separation between the scientific and military components of the Manhattan Project. Perhaps the most prominent depiction of that separation is captured in the scene in which military officials arrive at Los Alamos to take away the bombs. When J. Robert Oppenheimer attempts to inform one official that the

blast would be less powerful if the weapon is detonated high in the air, the man responds, "With respect, Dr. Oppenheimer, we'll take it from here." The scene conveys a message that although the scientists invented and constructed the atomic bombs, they were not responsible for the manner in which they were used. It's a depiction that could lead the public to absolve the scientists who actively participated not only in the bomb's construction but also in its deployment.

We can't argue with the movie's artistic quality. When you have access to such an incredibly wide-reaching platform, however, you have an enormous responsibility to get things right. The public, after all, may take the information in the film at face value. When you're conveying a message about nuclear weapons, it's important not to underplay the risks or the agency of scientists, even if unintentionally. At the end of the day, future scientists may be watching. We don't want to risk the chance that the next generation of scientists will continue to support the development of even-deadlier weapons and will work under the rationale that their projects are for the sake of science without fully considering the risks.

By romanticizing the development of nuclear weapons, *Oppenheimer*, like its namesake, might have done a disservice to society—potentially recruiting to the scientific enterprise more people who believe that science can be separated from its military use.

References

1. US Department of Energy Office of History and Heritage Resources, "Safety and the Trinity Test," https://www.osti.gov/opennet/manhattan-project-history/Events/1945/trinity_safety.htm.
2. T. Cordova, "What 'Oppenheimer' doesn't tell you about the Trinity test," *New York Times*, 30 July 2023.
3. L. M. M. Blume, "Trinity nuclear test's fallout reached 46 states, Canada and Mexico, study finds," *New York Times*, 20 July 2023; S. Philippe et al., <https://arxiv.org/abs/2307.11040>.
4. S. Philippe, "Who would take the brunt of an attack on U.S. nuclear missile silos?," *Scientific American*, 1 December 2023.
5. L. Xia et al., *Nat. Food* 3, 586 (2022).

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