



# NE290D: Special Topics in Nuclear History, Politics, and Futures

## The Life and Times of J. Robert Oppenheimer

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March 30, 2021 – W10L19



# Introduction

## Agenda

- ▶ Early years
- ▶ College years
- ▶ Berkeley “Go Bears”
- ▶ Los Alamos
- ▶ Princeton
- ▶ Trial

## W10L19 Learning Outcomes

- ▶ Appreciate the greatness of a great man.
- ▶ Recall the major historical milestones of the man who developed nuclear weapons and describe context of how his life shaped both policy and technology
- ▶ Organize the events on a timeline.
- ▶ Draw connections between the developments in 20<sup>th</sup> century physics and latter Manhattan project to modern day science.



# Miro Updates

miro NE2900

CUBES Demo

miro NE2900

Frames

10. History of the Cyclotron, Guest Tom H.

11. Neutron Era, Guest Carl Wile

12. Manhattan Project

13. The German Nuclear Program, Guest M.

14. Early Hospital Research, Guest A.

15. Physics Student Power, Guest Sophie M.

16. Cold War

Early 20th Century Physics

Manhattan Project

Early Hospital Research - Biomedicine

Physics Student Power - Sociology

History of the Cyclotron - Physics

Neutron Era - Chemistry

German Nuclear Program - History

Cold War - International Relations

Frames highlighting on changes

This screenshot shows a complex Miro board titled "CUBES Demo" for the "miro NE2900" project. The board features a large central workspace with various pinned items, including a detailed diagram of a cyclotron on the left and several text-based frames on the right. On the far left, there's a sidebar with a list of pinned frames, each containing a thumbnail image and a title. The top navigation bar includes standard Miro icons for boards, search, and sharing. The bottom of the screen shows the Miro interface with its characteristic blue header and footer.



“Knowledge cannot be pursued without morality.”

# 1904-1922: The Early Years

“He Received Every New Idea as Perfectly Beautiful”

- ▶ 1904 Apr 22nd Born in New York, New York.
- ▶ 1911 Sep Enrolled in the Ethical Cultural School in New York City.
- ▶ 1921 Graduated as valedictorian of his high school class.
- ▶ 1922 After being bedridden with dysentery, spent the summer in New Mexico to recuperate.



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<sup>1</sup><https://www.atomicheritage.org/history/timeline>

<sup>2</sup>Bird, Kai, and Martin J. Sherwin. American Prometheus: the triumph and tragedy of J. Robert Oppenheimer. Knopf, 2005.



# 1922-1925: As a Harvard Undergraduate

## "His Separate Prison"

- ▶ 1922 Enrolled at Harvard University.
- ▶ Majored in chemistry. Regretted it by end of freshmen year.
- ▶ Studied physics with a tutor

The dawn invests our substance  
with desire  
And the slow light betrays us,  
and our wistfulness:  
When the celestial saffron  
Is faded and grown colourless,  
And the sun  
Gone sterile, and the growing fire  
Stirs us to waken,  
We find ourselves again  
Each in his separate prison  
Ready, hopeless  
For negotiation  
With other men.

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<sup>1</sup> <https://www.atomicheritage.org/history/timeline>

<sup>2</sup> Bird, Kai, and Martin J. Sherwin. American Prometheus: the triumph and tragedy of J. Robert Oppenheimer. Knopf, 2005.

<sup>3</sup> Sherwin, Martin J. "The Private Oppenheimer." (1980): 698-700.

# 1925-1927: As a Graduate Student in Europe

"I Am Having a Pretty Bad Time"

- ▶ 1925 Began graduate work in physics at Cavendish Laboratory in Cambridge, England under J. J. Thomson.



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<sup>2</sup>Bird, Kai, and Martin J. Sherwin. *American Prometheus: the triumph and tragedy of J. Robert Oppenheimer*. Knopf, 2005.

# 1925-1927: As a Graduate Student in Europe

"I Find the Work Hard, Thank God, & Almost Pleasant"

- ▶ 1926 Moved from Cavendish Laboratory to the University of Göttingen to finish his graduate studies under Max Born.
- ▶ 1927 Received Ph.D. in Physics from the University of Göttingen **at 23 years old**.
- ▶ Maria Goeppert presented Born with a petition threatening a boycott of the class unless he made Oppenheimer chill.
- ▶ Thesis "On the quantum theory of continuous spectra"
- ▶ Developed the "Born-Oppenheimer Approximation"



<sup>1</sup> <https://www.atomicheritage.org/history/timeline>

<sup>2</sup> Bird, Kai, and Martin J. Sherwin. American Prometheus: the triumph and tragedy of J. Robert Oppenheimer. Knopf, 2005.

<sup>3</sup> Born, Max, and Robert Oppenheimer. "Zur quantentheorie der moleküle." Annalen der physik 389.20 (1927): 457-484.



# 1927: Homeward Bound

## "I am Oppenheimer"

- ▶ 1927 Joined the faculty at the University of California, Berkeley, and Caltech.

## Crossing

It was evening when we came to the river  
with a low moon over the desert  
that we had lost in the mountains, forgotten,  
what with the cold and the sweating  
and the ranges barring the sky.  
And when we found it again,  
In the dry hills down by the river,  
half withered, we had  
the hot winds against us.

There were two palms by the landing;  
The yuccas were flowering; there was  
a light on the far shore, and tamarisks.  
We waited a long time, in silence.  
Then we heard the oars creaking  
and afterwards, I remember,  
the boatman called to us.  
We did not look back at the mountains.

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<sup>1</sup> <https://www.atomicheritage.org/history/timeline>

<sup>2</sup> Bird, Kai, and Martin J. Sherwin. *American Prometheus: the triumph and tragedy of J. Robert Oppenheimer*. Knopf, 2005.

# 1927-1942: The Berkeley Years

## "The Nim Nim Boys"

- ▶ 1936 Meets Jean Tatlock
- ▶ 1937 Julius (father) dies of a heart attack
- ▶ 1937 Frank (brother) joins the Communist Party of America
- ▶ Oppie has become a fellow traveler
- ▶ 1939 Oppie marries Katherine ("Kitty") Puening



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<sup>2</sup> Bird, Kai, and Martin J. Sherwin. American Prometheus: the triumph and tragedy of J. Robert Oppenheimer. Knopf, 2005.



# 1927-1942: The Berkeley Years

“His physics was good”, said his student, “but his arithmetic awful”

- ▶ Made significant advances in thermonuclear astrophysics.
- ▶ Derived the Tolman–Oppenheimer–Volkoff limit for neutron star collapse.
- ▶ Predicted the existence of black holes.
- ▶ Nominated for the Nobel Prize for physics 3 times (1946, 1951, 1967) but never won.

SEPTEMBER 1, 1939

PHYSICAL REVIEW

VOLUME 56

## On Continued Gravitational Contraction

J. R. OPPENHEIMER AND H. SNYDER

*University of California, Berkeley, California*

We now wish to find the asymptotic behavior of  $e^\lambda$ ,  $e^r$ , and  $\tau$  for large values of  $t$ . When  $t$  is large we obtain the approximate relation from Eqs. (36) and (27):

$$t \sim -r_0 \ln \left[ \frac{1}{2} [(R/R_b)^2 - 3] \right] + R_b/r_0 (1 - 3r_0^{-1} \tau / 2R_b^2)^{1/2}. \quad (37)$$

From this relation we see that for a fixed value of  $R$  as  $t$  tends toward infinity,  $\tau$  tends to a finite limit, which increases with  $R$ . After this time  $r_0$  an observer comoving with the matter would not be able to send a light signal from the star; the cone within which a signal can escape has closed entirely. For a star which has an initial density of one gram per cubic centimeter and a mass of  $10^{48}$  grams this time  $r_0$  is about a day.

Substituting (27) and (37) into (28) and (29) we find

$$e^{-\lambda} \approx 1 - (R/R_b)^2 [e^{-t/r_0} + \frac{1}{2} [3 - (R/R_b)^2]]^{-1}, \quad (38)$$

$$e^r \approx e^{\lambda - 2t/r_0} [e^{-t/r_0} + \frac{1}{2} [3 - (R/R_b)^2]]. \quad (39)$$

For  $R$  less than  $R_b$ ,  $e^\lambda$  tends to a finite limit as  $t$  tends to infinity. For  $R$  equal to  $R_b$ ,  $e^\lambda$  tends to infinity like  $e^{t/r_0}$  as  $t$  approaches infinity. Where  $R$  is less than  $R_b$ ,  $e^r$  tends to zero like  $e^{-2t/r_0}$  and where  $R$  is equal to  $R_b$ ,  $e^r$  tends to zero like  $e^{-t/r_0}$ .

This quantitative account of the behavior of  $e^\lambda$  and  $e^r$  can supplement the qualitative discussion given in I. For  $\lambda$  tends to a finite limit for  $r < r_0$  as  $t$  approaches infinity, and for  $r = r_0$  tends to infinity. Also for  $r \leq r_0$ ,  $v$  tends to minus infinity. We expect that this behavior will be realized by all collapsing stars which cannot end in a stable stationary state. Of course, actual stars would collapse more slowly than the example which we studied analytically because of the effect of the pressure of matter, of radiation, and of rotation.

<sup>1</sup> <https://www.atomicheritage.org/history/timeline>

<sup>2</sup> Bird, Kai, and Martin J. Sherwin. *American Prometheus: the triumph and tragedy of J. Robert Oppenheimer*. Knopf, 2005.

<sup>3</sup> Oppenheimer, J. Robert, and Robert Serber. "On the stability of stellar neutron cores." *Physical Review* 54.7 (1938): 540.

<sup>4</sup> Oppenheimer, J. Robert, and George M. Volkoff. "On massive neutron cores." *Physical Review* 55.4 (1939): 374.

<sup>5</sup> Oppenheimer, J. Robert, and Hartland Snyder. "On continued gravitational contraction." *Physical Review* 56.5 (1939): 455.

# 1927-1942: The Berkeley Years

## "The Coordinator of Rapid Rupture"

- ▶ 1942 Jan Organized a program on fast neutron theoretical physics at the University of California at Berkeley.
- ▶ 1942 Jun Joined the Chicago Met Lab to lead an effort on fast neutron physics, and prepared an outline for the entire neutron physics program.
- ▶ 1942 Jul to 1942 Sep Assembled theoretical study group in Berkeley to examine the principles of bomb design. Emerged as the natural leader.
- ▶ 1942 Sep 29th Proposed that a "fast-neutron lab" to study fast neutron physics and develop designs for an atomic bomb be created.



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<sup>2</sup> Bird, Kai, and Martin J. Sherwin. American Prometheus: the triumph and tragedy of J. Robert Oppenheimer. Knopf, 2005.

# 1927-1942: The Berkeley Years

## "The Coordinator of Rapid Rupture"

- ▶ 1942 Oct 15th General Leslie R. Groves asked Oppenheimer to head Project Y, planned to be the new central laboratory for weapon physics research and design.
- ▶ 1942 Oct 19th Vannevar Bush approves Oppenheimer's appointment in meeting with Oppenheimer and General Groves.
- ▶ 1942 Nov 16th Groves and Oppenheimer visit the Los Alamos, NM mesa in New Mexico and select it for "Site Y."



<sup>1</sup> <https://www.atomicheritage.org/history/timeline>

<sup>2</sup> Bird, Kai, and Martin J. Sherwin. American Prometheus: the triumph and tragedy of J. Robert Oppenheimer. Knopf, 2005.

# 1943: The Berkeley Years

## "The Chevalier Affair"

- ▶ Jan/Feb 1943 Chevalier had a brief conversation with Oppenheimer in the kitchen of his home.
- ▶ Chevalier informed Oppenheimer that Shell employee George Eltenton could transmit information of a technical nature to the Soviets.
- ▶ Oppenheimer rejected the overture, but failed to report it until August 1943, when he volunteered to Manhattan Project security officers that three men at Berkeley had been solicited for nuclear secrets
- ▶ December 1943 Groves orders Oppenheimer to identify Chevalier
- ▶ September 5, 1946 Oppenheimer interviewed by FBI and gave conflicting statements.



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<sup>2</sup> Bird, Kai, and Martin J. Sherwin. American Prometheus: the triumph and tragedy of J. Robert Oppenheimer. Knopf, 2005.

# 1943: Los Alamos

## "Bohr Was God, and Oppie Was His Prophet"

- ▶ 1943 to 1945 Director of the Los Alamos Laboratory.
- ▶ 1945 Jul 16th To his immense relief, witnessed the successful Trinity test.
- ▶ 1945 Oct 16th Resigns as director of Los Alamos Laboratory, accepting a post at CalTech.



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<sup>2</sup> Bird, Kai, and Martin J. Sherwin. American Prometheus: the triumph and tragedy of J. Robert Oppenheimer. Knopf, 2005.



# 1943: Los Alamos

## Isidor Isaac Rabi

*"I do not wish to see the culmination of three centuries of physics a weapon of mass destruction"*

## Oppenheimer

*"I think if I believed with you that this project was 'the culmination of three centuries of physics, I should take a different stand. To me it is primarily the development in time of war of a military weapon of some consequence. I do not think that the Nazis allow us the option of [not] carrying out that development"*

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<sup>2</sup> Bird, Kai, and Martin J. Sherwin. *American Prometheus: the triumph and tragedy of J. Robert Oppenheimer*. Knopf, 2005.



## 1945: Los Alamos

“We knew the world would not be the same.  
A few people laughed, a few people cried.  
Most people were silent.”

# 1947: Nesting in Princeton

## "An Intellectual Hotel"

- ▶ 1947 Oppie named director of the Institute for Advanced Study in Princeton, New Jersey.
- ▶ Invited by Lewis Lichtenstein Strauss (businessman, philanthropist, and naval officer **AND major POS**)
- ▶ Under Oppenheimer's direction, physicists tackled the greatest outstanding problem of the pre-war years: infinite, divergent, and non-sensical expressions in the quantum electrodynamics of elementary particles. Julian Schwinger, Richard Feynman and Shin'ichiro Tomonaga tackled the problem of regularization, and developed techniques which became known as renormalization.

*"He didn't have Sitzfleisch, 'sitting flesh,' when you sit on a chair. As far as I know, he never wrote a long paper or did a long calculation, anything of that kind. He didn't have patience for that; his own work consisted of little aperçus, but quite brilliant ones. But he inspired other people to do things, and his influence was fantastic"*

– Gell-Mann

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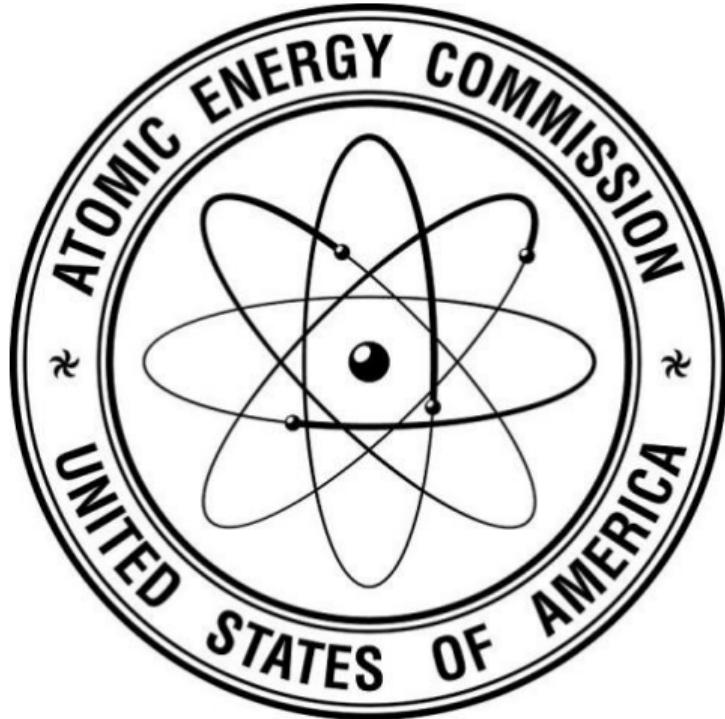
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<sup>2</sup> Bird, Kai, and Martin J. Sherwin. American Prometheus: the triumph and tragedy of J. Robert Oppenheimer. Knopf, 2005.

# 1947: The Atomic Energy Commission

“Our atomic monopoly is like a cake of ice melting in the sun”

- ▶ 1947 Atomic Energy Commission (AEC) formed as a civilian agency in control of nuclear research and weapons issues
- ▶ Oppenheimer was appointed as the Chairman of its General Advisory Committee (GAC).
- ▶ From this position he advised on a number of nuclear-related issues, including project funding, laboratory construction and even international policy.



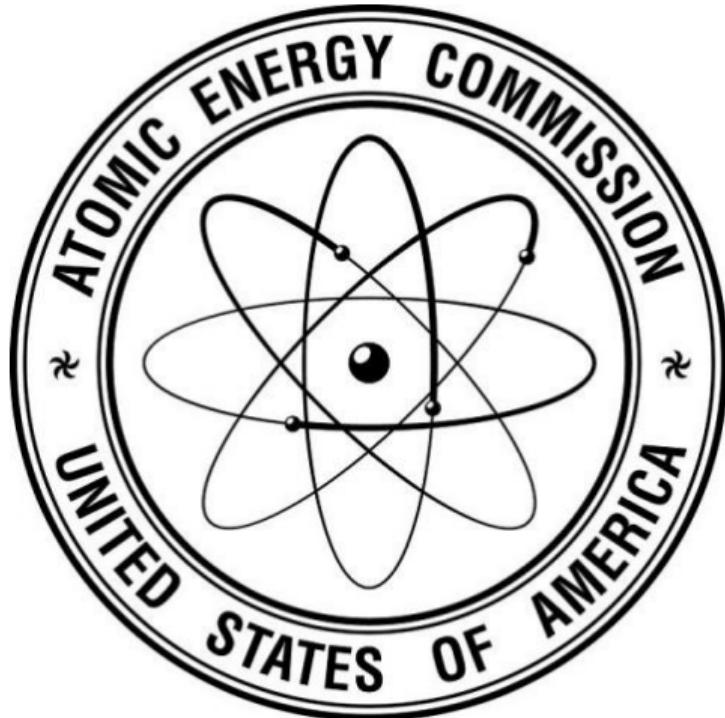
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# 1951 Troubles Brewing

“Our atomic monopoly is like a cake of ice melting in the sun”<sup>1</sup>

- ▶ August 29, 1949 Soviet Union conducted its first successful nuclear test
- ▶ Oppenheimer opposed the efforts to build the Thermonuclear Hydrogen Bomb, spearheaded by Teller
- ▶ 1950 Oppenheimer publishes “Memorandum: The International Control of Atomic Energy” which challenged fundamental assumptions underlying the Truman Administration’s view of both the bomb and the Soviet Union.
- ▶ 1950 Oppenheimer had every reason to think that the FBI, HUAC and the Justice Department were all closing in



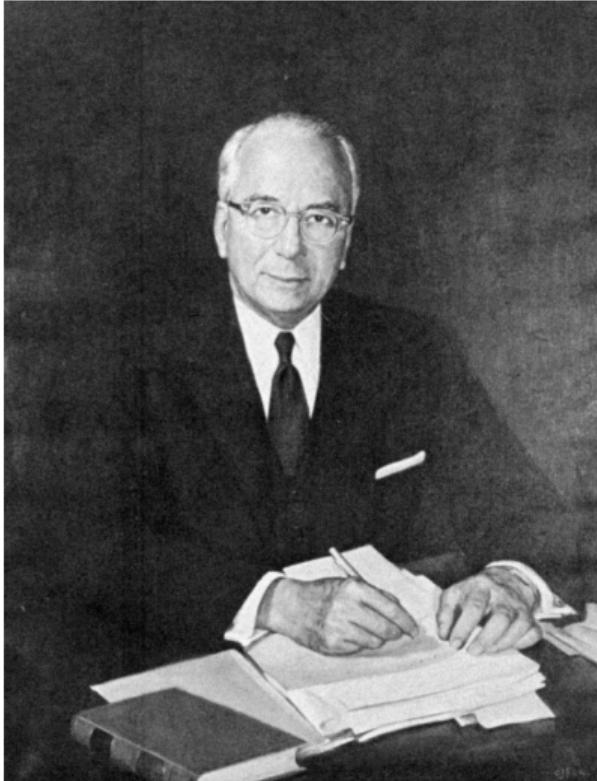
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<sup>2</sup> Bird, Kai, and Martin J. Sherwin. American Prometheus: the triumph and tragedy of J. Robert Oppenheimer. Knopf, 2005.

# 1951 Troubles Brewing

## “Dark Words About Oppie”

- ▶ After taking a stance against the super, Oppenheimer struggles against the new powers-that-be like Admiral Hyman G. Rickover and Lewis Strauss.
- ▶ Strauss continues undercutting Oppenheimer and encourages the FBI to gather more incriminating evidence



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<sup>2</sup>Bird, Kai, and Martin J. Sherwin. *American Prometheus: the triumph and tragedy of J. Robert Oppenheimer*. Knopf, 2005.



# 1953 The Strauss Campaign Begins

## "The Beast in the Jungle"

- ▶ May 25, 1953 Strauss meets with the President Eisenhower and claimed "he could not do the job at the AEC if Oppenheimer was connected in any way with the program"
- ▶ Oppenheimer publishes a reproach in *Foreign Affairs* sparking a debate about public discourse on nuclear weapons and policy
- ▶ July 3, 1953 Strauss formally assumed the office of AEC chairman, taking charge and beginning the campaign against Oppenheimer

*"We may be likened to two scorpions in a bottle, each capable of killing the other, but only at the risk of his own life."*

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# 1953 The Strauss Campaign Begins

"I can't believe what is happening."

- ▶ Dec 2, 1953 Defense Secretary Wilson pushes President Eisenhower to act against Oppenheimer, after prompting from Strauss. Eisenhower gives in.
- ▶ Dec 21, 1953 presents Oppenheimer with a letter indicating that would be subject to a review and his security clearance would be revoked.
- ▶ Strauss' ultimatum: resign your clearance or fight. You have until 8PM to decide.
- ▶ Oppenheimer asks for a copy of the letter, Strauss says, "no. Only after you decide."
- ▶ That night, Oppenheimer retains legal council from Joe Vope, the former council to the AEC.
- ▶ Dec 22, 1953 Oppenheimer decides to fight, then collapses on the bathroom floor.

Dear Lewis,

*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. 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 served for some twelve years. This I cannot do. If I were thus unworthy I could hardly have served our country as I have tried, or been the Director of our Institute in Princeton, or have spoken, as on more than one occasion I have found myself speaking, in the name of our science and our country.*

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<sup>2</sup> Bird, Kai, and Martin J. Sherwin. American Prometheus: the triumph and tragedy of J. Robert Oppenheimer. Knopf, 2005.

# 1954 The Trial of J. Robert Oppenheimer

## "It Looks Pretty Bad, Doesn't It"

- ▶ April 12, 1954 Closed hearing begins and lasts for 4 weeks
- ▶ Prosecution (AEC) represented by Roger Robb and Arthur Rolander
- ▶ Oppenheimer represented by Lloyd K. Garrison
- ▶ Adjudicated led by Gordon Gray, (President, University of North Carolina), along with Thomas Alfred Morgan (industrialist), and Ward V. Evans (Chair of Chemistry Department at Northwestern University)
- ▶ A complete kangaroo court



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<sup>2</sup> Bird, Kai, and Martin J. Sherwin. American Prometheus: the triumph and tragedy of J. Robert Oppenheimer. Knopf, 2005.

# 1954 The Trial of J. Robert Oppenheimer

## I. I. Rabi

*"So it didn't seem to me the sort of thing that called for this kind of proceeding at all against a man who had accomplished what Dr. Oppenheimer has accomplished. There is a real positive record, the way I expressed it to a friend of mine. We have an A-bomb and a whole series of it . . . [deleted classified material] and what more do you want, mermaids? This is just a tremendous achievement. If the end of that road is this kind of hearing, which can't help but be humiliating, I thought it was a pretty bad show. I still think so."*



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<sup>2</sup> Bird, Kai, and Martin J. Sherwin. *American Prometheus: the triumph and tragedy of J. Robert Oppenheimer*. Knopf, 2005.

# 1954 The Trial of J. Robert Oppenheimer

## I. I. Rabi

*"You have to take the whole story. That is what novels are about. There is a dramatic moment and the history of the man, what made him act, what he did, and what sort of person he was. That is what you are really doing here. You are writing a man's life."*



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# 1954 The Trial of J. Robert Oppenheimer

## Johnny von Neumann

*"Sir. I don't know how to answer this question. Of course, I hope I wouldn't [lie]. But—you are telling me now to hypothesize that somebody else acted badly, and you ask me would I have acted the same way. Isn't this a question of when did you stop beating your wife?"*



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# 1954 The Trial of J. Robert Oppenheimer

## Vannevar Bush

*"I think history will show that was a turning point, that when we entered into the grim world that we are entering right now, that those who pushed that thing through to a conclusion without making that attempt have a great deal to answer for."*



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# 1954 The Trial of J. Robert Oppenheimer

## Earnest Lawrence

- ▶ Lawrence and Oppenheimer had fallen out. Oppie had opposed the super. He also slept with Ruth Tolman.
- ▶ Agreed to testify against Oppenheimer after request from Strauss.
- ▶ At the 11th hour, Lawrence fell ill with an attack of colitis. The next morning, he called Strauss to tell him he could not make it.
- ▶ Strauss decried Lawrence for making excuses and called him a coward.



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<sup>2</sup> Bird, Kai, and Martin J. Sherwin. *American Prometheus: the triumph and tragedy of J. Robert Oppenheimer*. Knopf, 2005.

# 1954 The Trial of J. Robert Oppenheimer

## Edward Teller

*"In a great number of cases I have seen Dr. Oppenheimer act—I understood that Dr. Oppenheimer acted in a way which for me was exceedingly hard to understand. I thoroughly disagreed with him in numerous issues, and his actions, frankly, appeared to me confused and complicated. To this extent, I feel that I would like to see the vital interests of this country in hands which I understand better and therefore trust more.*



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# 1954 The Trial of J. Robert Oppenheimer

“There is more than Dr. Oppenheimer on trial in this room.  
The Government of the United States is here on trial also.”  
– Garrison



# 1954 The Trial of J. Robert Oppenheimer

Grey, Morgan

*"We find that Dr. Oppenheimer's continuing conduct and association have reflected a serious disregard for the requirements of the security system. We have found a susceptibility to influence which could have serious implications for the security interests of the country."*

Evans

*"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."*

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<sup>2</sup> Bird, Kai, and Martin J. Sherwin. *American Prometheus: the triumph and tragedy of J. Robert Oppenheimer*. Knopf, 2005.

# The Aftermath

Werner von Braun

*"In England, Oppenheimer would have been knighted."*



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<sup>1</sup> <https://www.atomicheritage.org/history/timeline>

<sup>2</sup> Bird, Kai, and Martin J. Sherwin. American Prometheus: the triumph and tragedy of J. Robert Oppenheimer. Knopf, 2005.

<sup>3</sup> Bethe, Hans A. The Road from Los Alamos: Collected Essays of Hans A. Bethe. Springer Science Business Media, 1991.



# Discussion

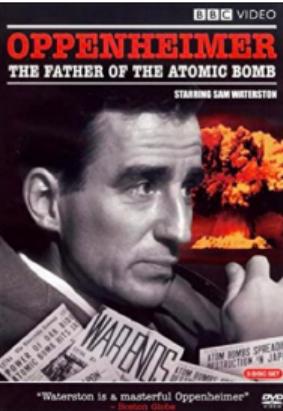
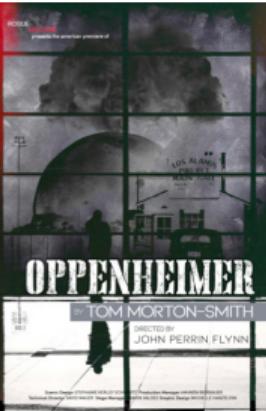
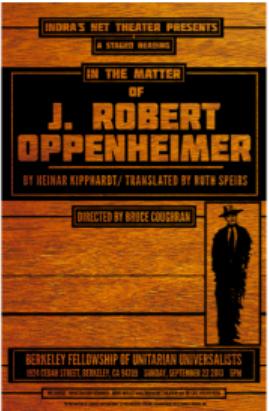
## Questions

- ▶ What is the proper place in society for a scientist like Oppenheimer?
- ▶ To what extent should a person's past influence their agency in the government?  
In science? In positions to craft policy?
- ▶ What can be done to ensure that a man like Lewis Strauss is never allowed to infect the halls of power?

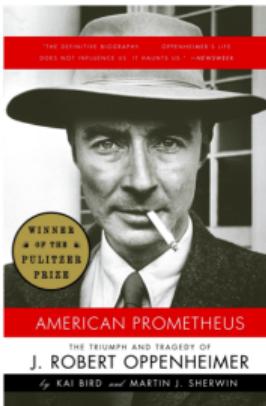
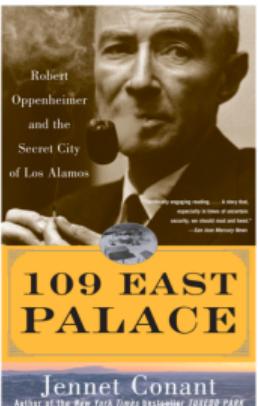


# Remembering Oppenheimer

## Plays



## Nonfiction Books



## Opera