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# **Oppenheimer: The Rest of the Story**

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Professor Emeritus, Stanford University

**MSTea & Cookies**  
**Los Alamos National Laboratory**  
**November 29, 2023**

# **Christopher Nolan's Oppenheimer**

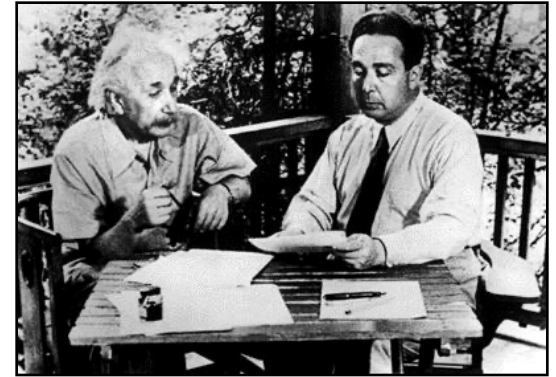
**The Rest of the Story (Paul Harvey back story, Chicago Radio 1976 to 2009)**

- **Oppenheimer – “beyond there is a different country.” The nuclear taboo?**
- **Oppenheimer on plutonium**
  - **Plutonium – one of the greatest stories hardly told.**
- **Edward Teller – revisited.**
- **The army uniform – UC management**
  - **Smartest people serving the nation**
  - **GOCO management**
  - **The DOE laboratory system**
- **The U.S. rises as scientific and technological giant**

# Manhattan Project

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- 1939 Einstein to Roosevelt letter
- 1941 United Kingdom MAUD report
  - Plutonium discovered
  - Pearl Harbor



Einstein & Szilard - 1939

- 1942 Fermi/Szilard Chicago CP-1 reactor  
Chicago Met Lab  
Army Corps of Engineers (Gen. Leslie Groves)  
UC Berkeley, U. Chicago, Columbia University
- 1943 Los Alamos, NM  
Oak Ridge, TN  
Hanford, WA
- 1945 Trinity Site, NM



# August 1945 changed the world forever

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**“A factor of millions”**



**Mankind realized its own mortality with the devastation at  
Hiroshima and Nagasaki – Richard Rhodes  
*The Making of the Atomic Bomb***



# Devastation in World War II

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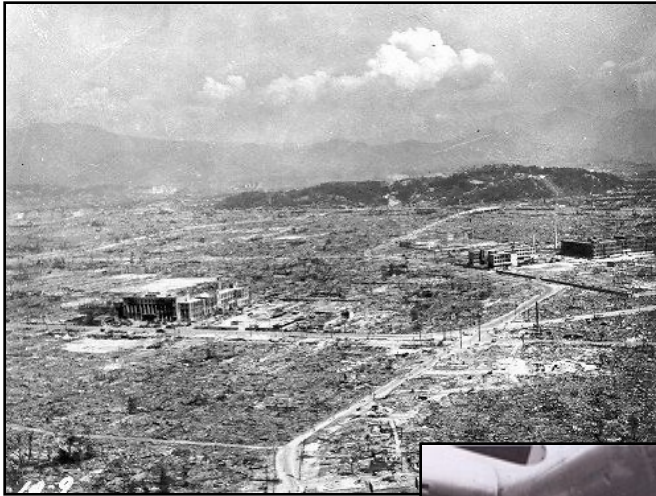


**Tokyo, March 1945**

**Hiroshima, August 1945**

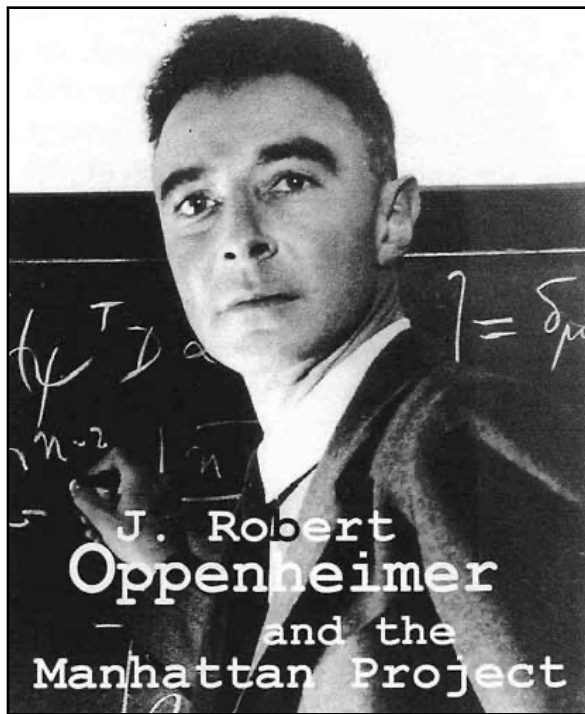
# Hiroshima – one bomb, not a campaign

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**Hiroshima, August 1945**  
**1 B-29**  
**4.7 sq. miles destroyed**  
**140,000 – 150,000 dead**





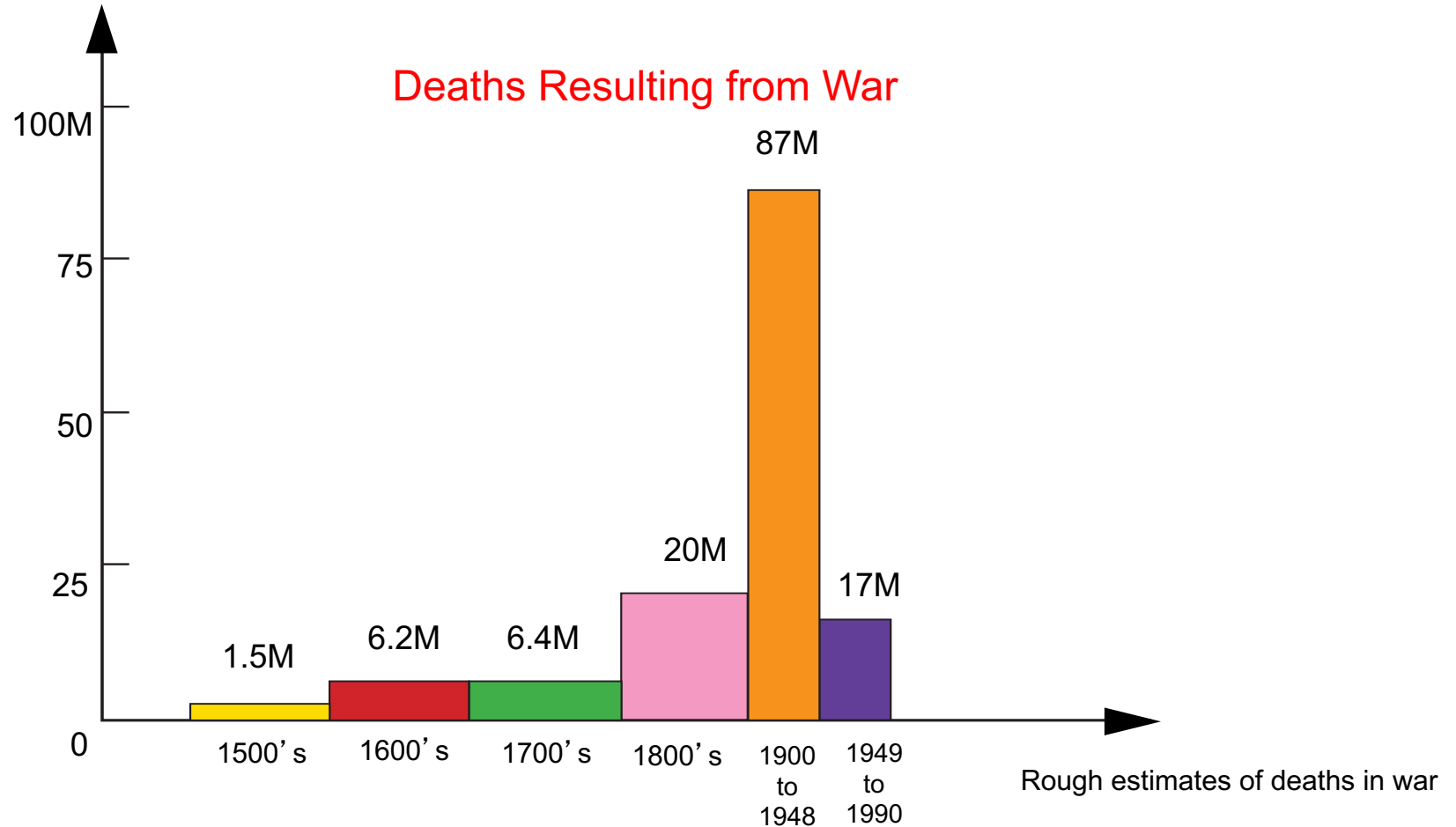
J. Robert Oppenheimer  
Director, Los Alamos Laboratory  
Scientific Leader, Manhattan Project

**“The atomic bomb made the prospect of future war unendurable. It has led us up those last few steps to the mountain pass; and beyond **there is a different country**”**



# There was a different world

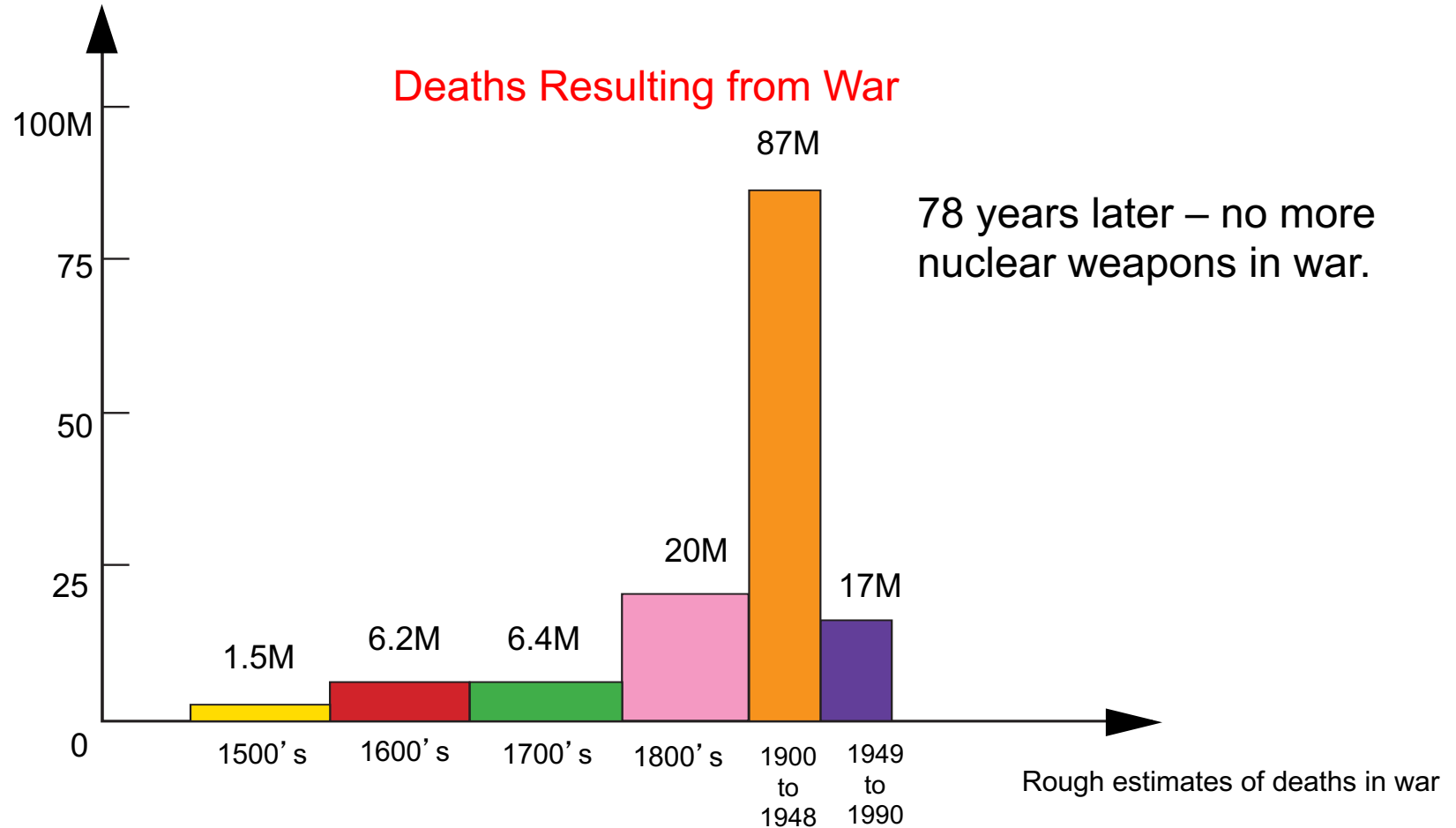
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**Atomic bombs caused a discontinuity in world affairs**

# There was a different world

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**Atomic bombs caused a discontinuity in world affairs**

# Oppenheimer on plutonium

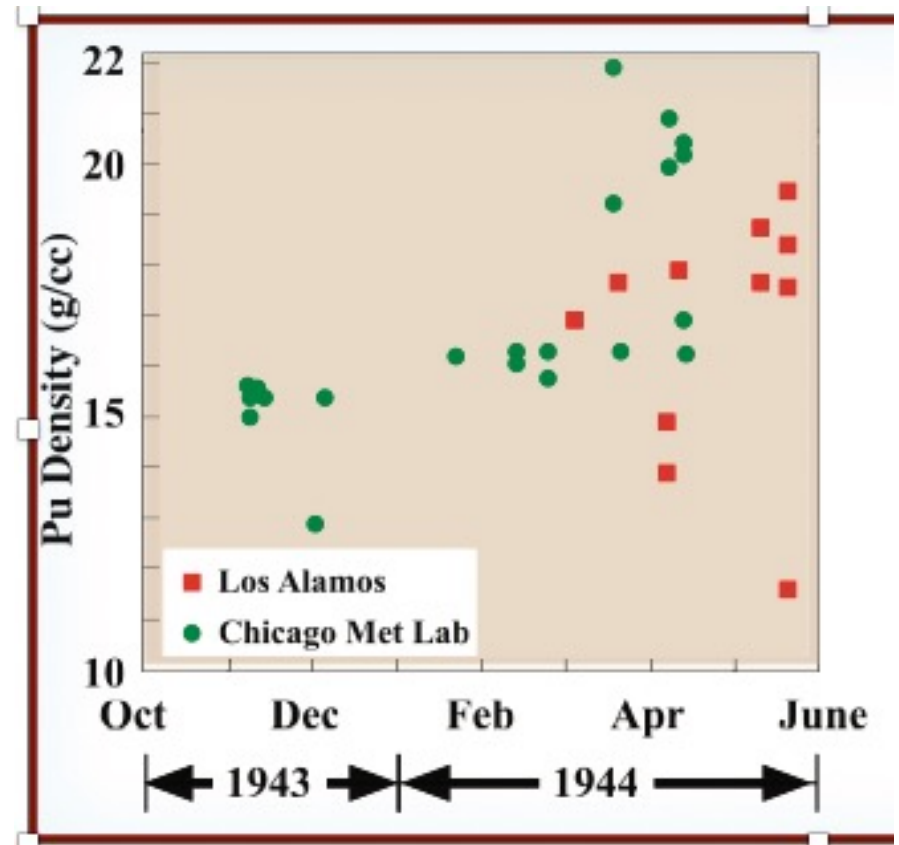
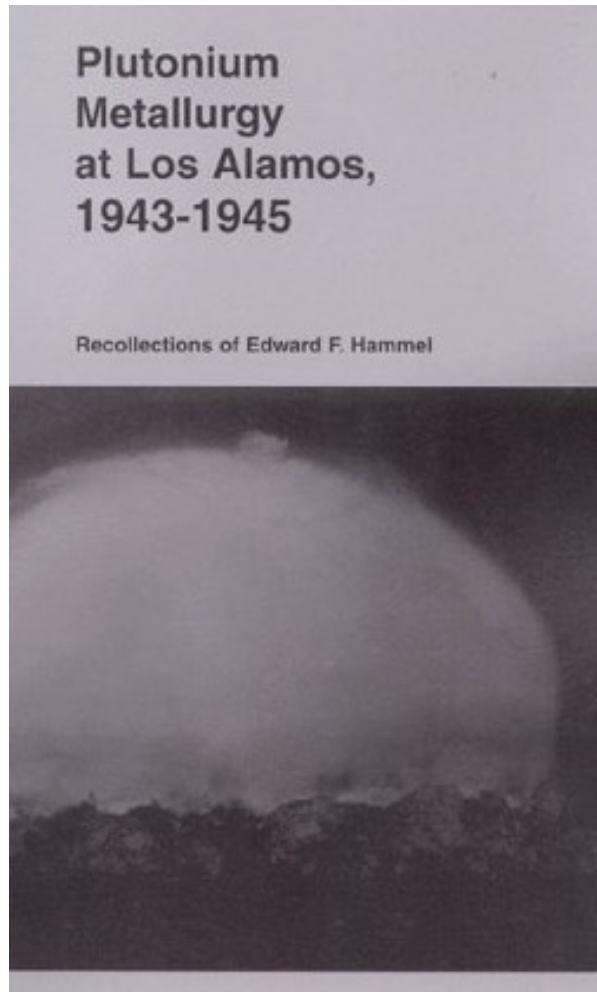
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**In his words:** Sept. 12, 1965 interview with Stephane Groueff

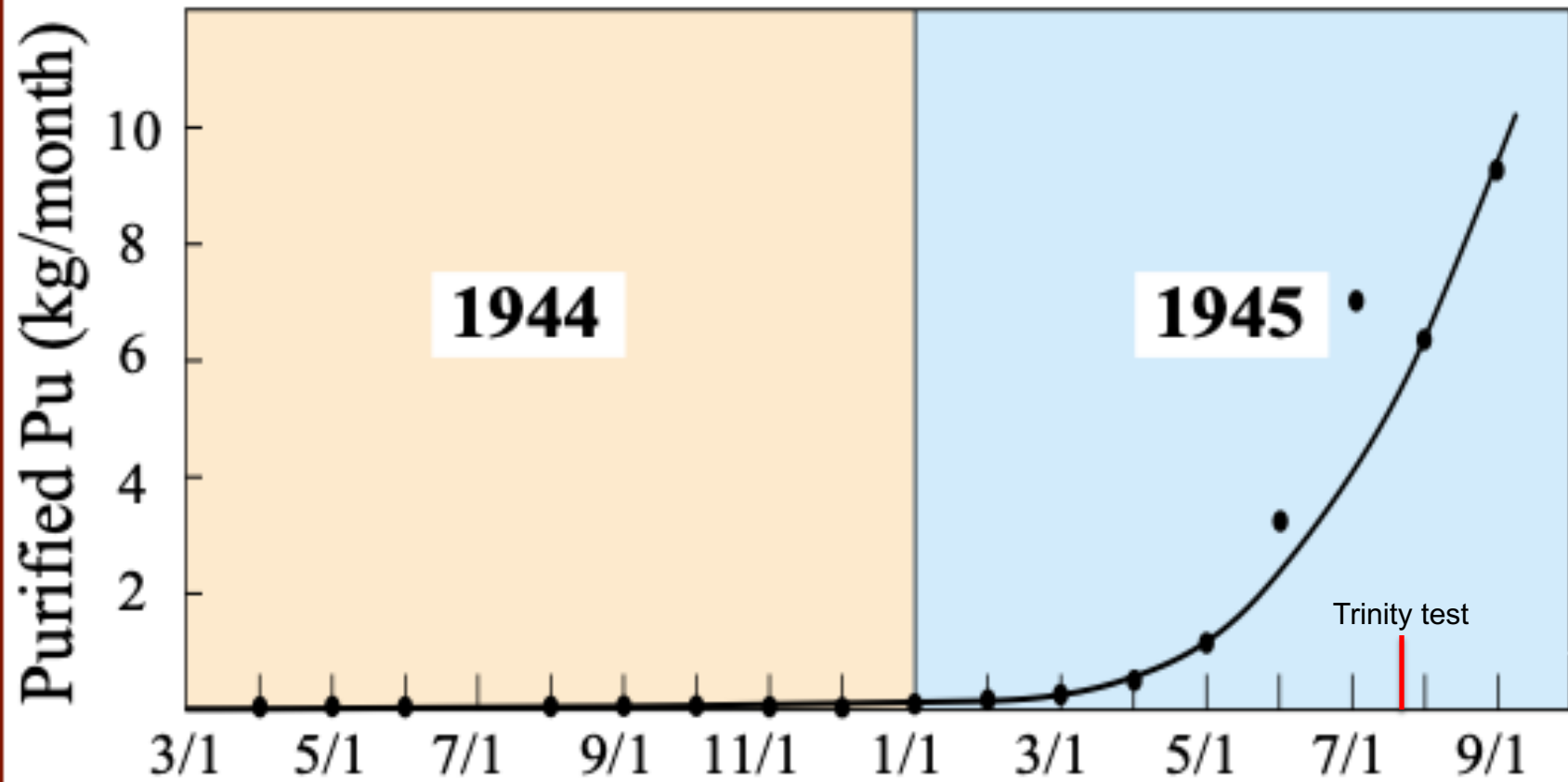
- Plutonium turned out not to be a cozy metal.
- For a year, Chicago and Los Alamos got different densities from plutonium. Since the densities closely connected to the critical size, this was not trivial.
- And plutonium was a terrible test from beginning to end and never stayed quiet: it gets hot, it is radioactive, you cannot touch it, you have to coat it, and the **coating always peels**.
- It is just a terrible substance, and it is one reason why— it has never been used for peaceful atomic power because you cannot buy anyone to pay any attention to it [laugh]. And we had to do it for other reasons.

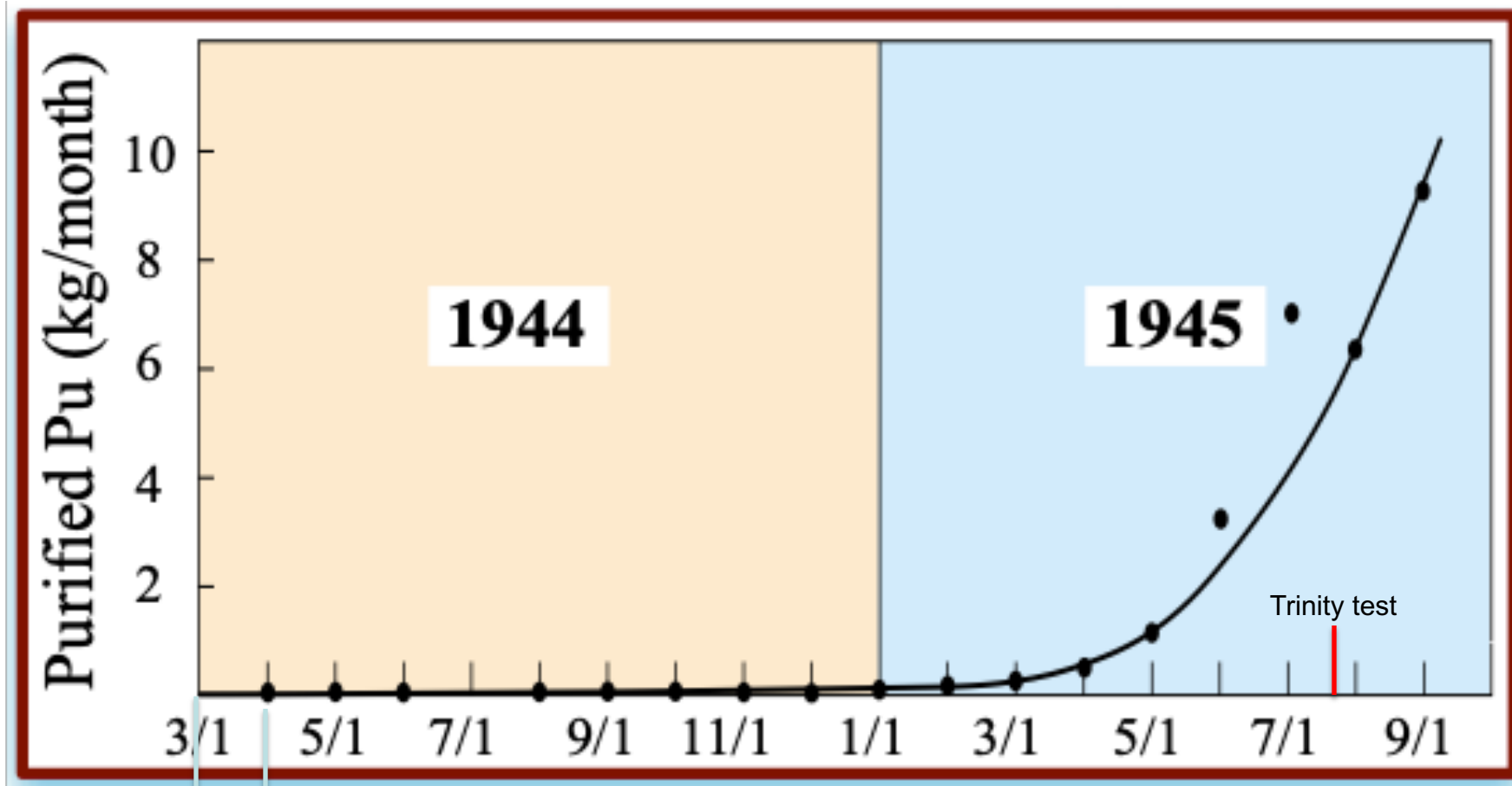
# Nolan should have been told the plutonium story

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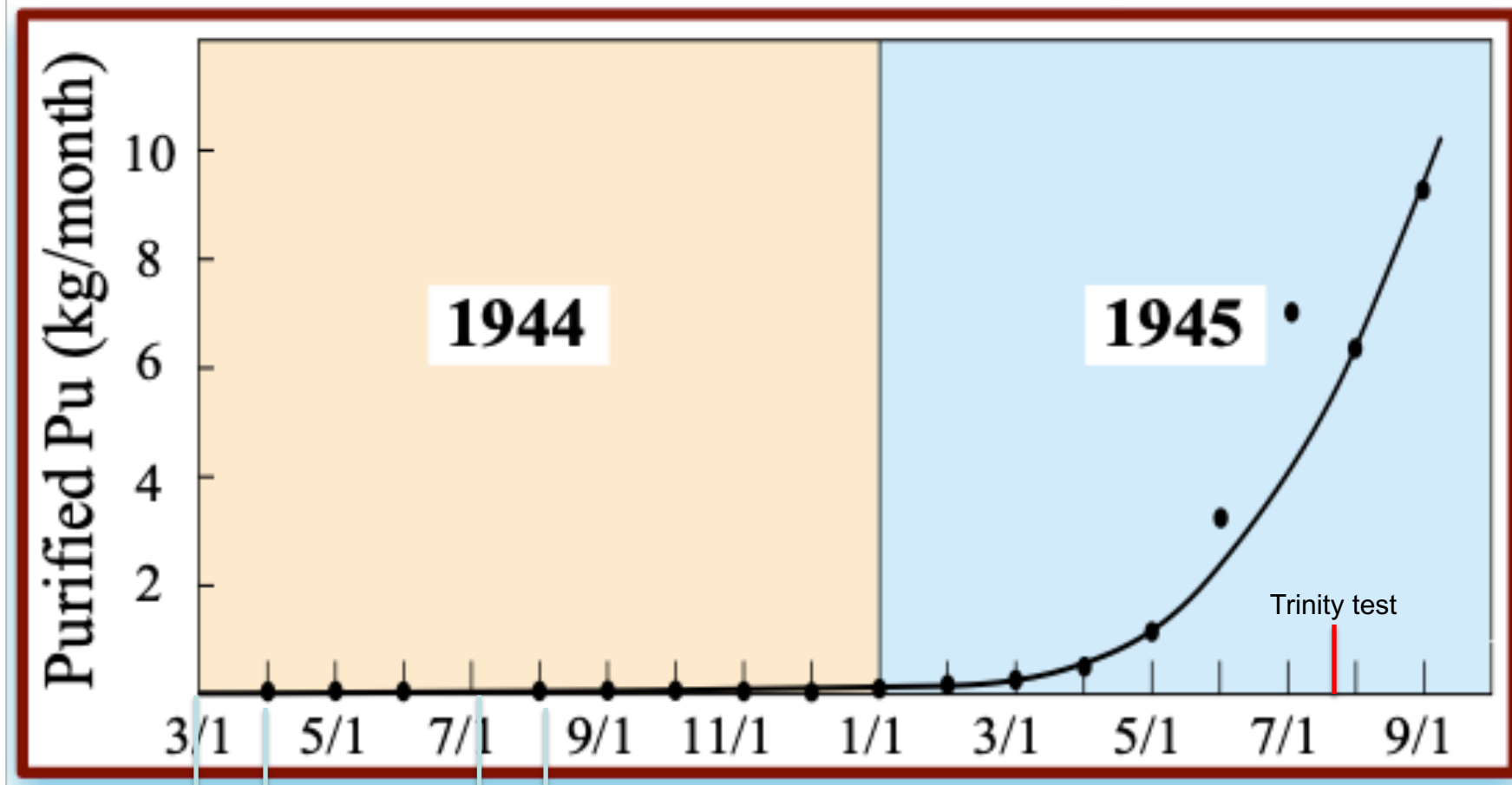






Jan. - 5 phases

Metal reduction  
successful

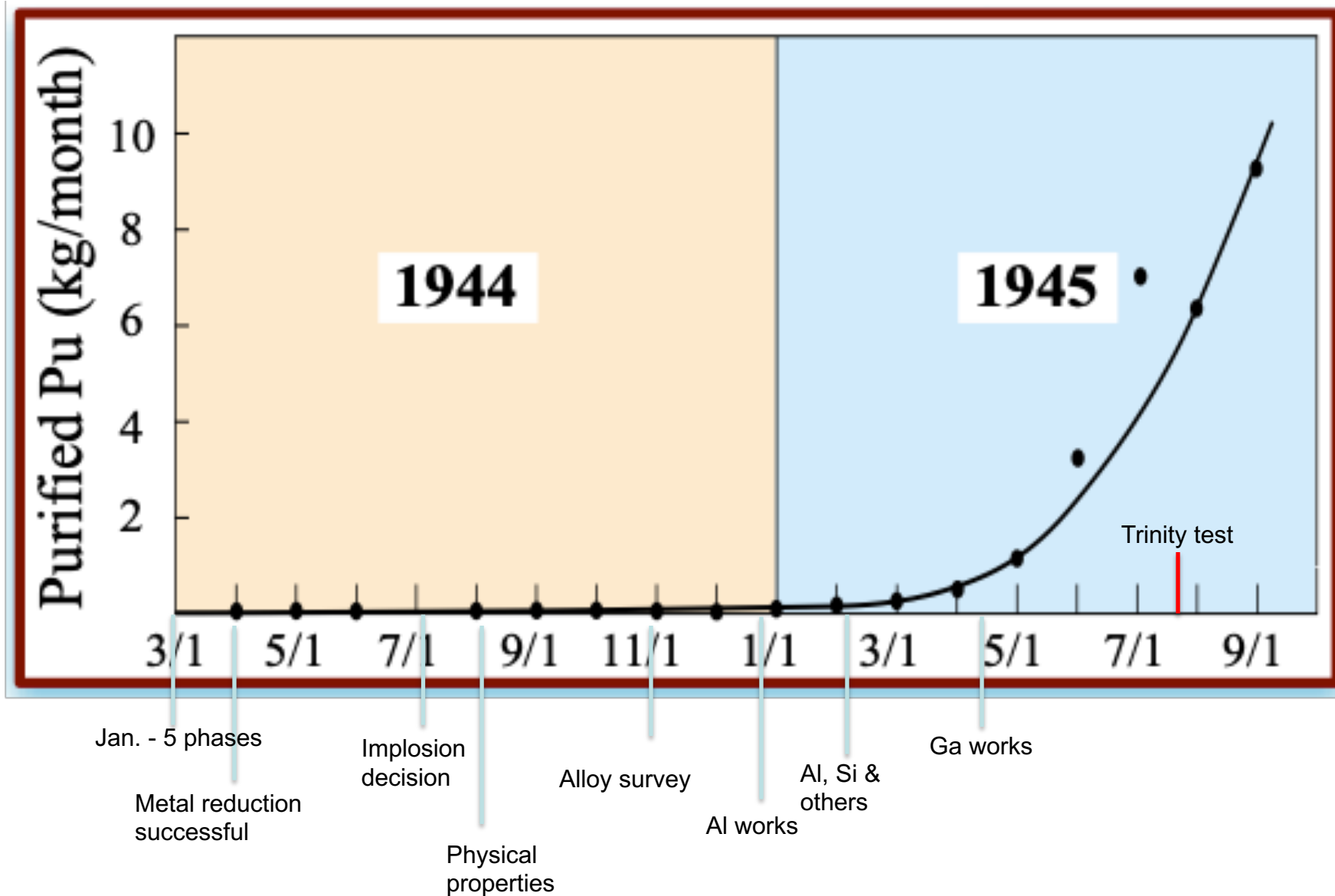


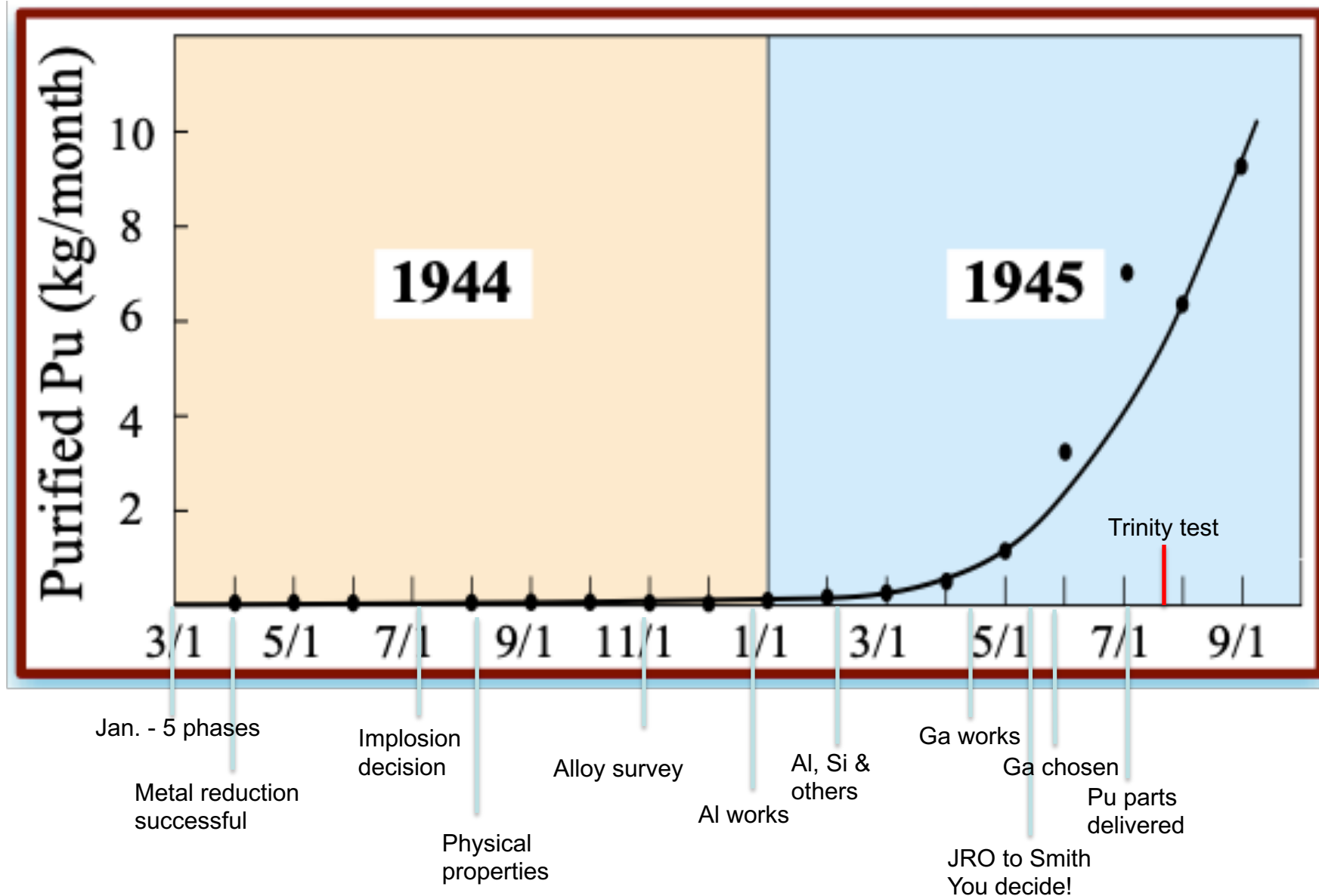
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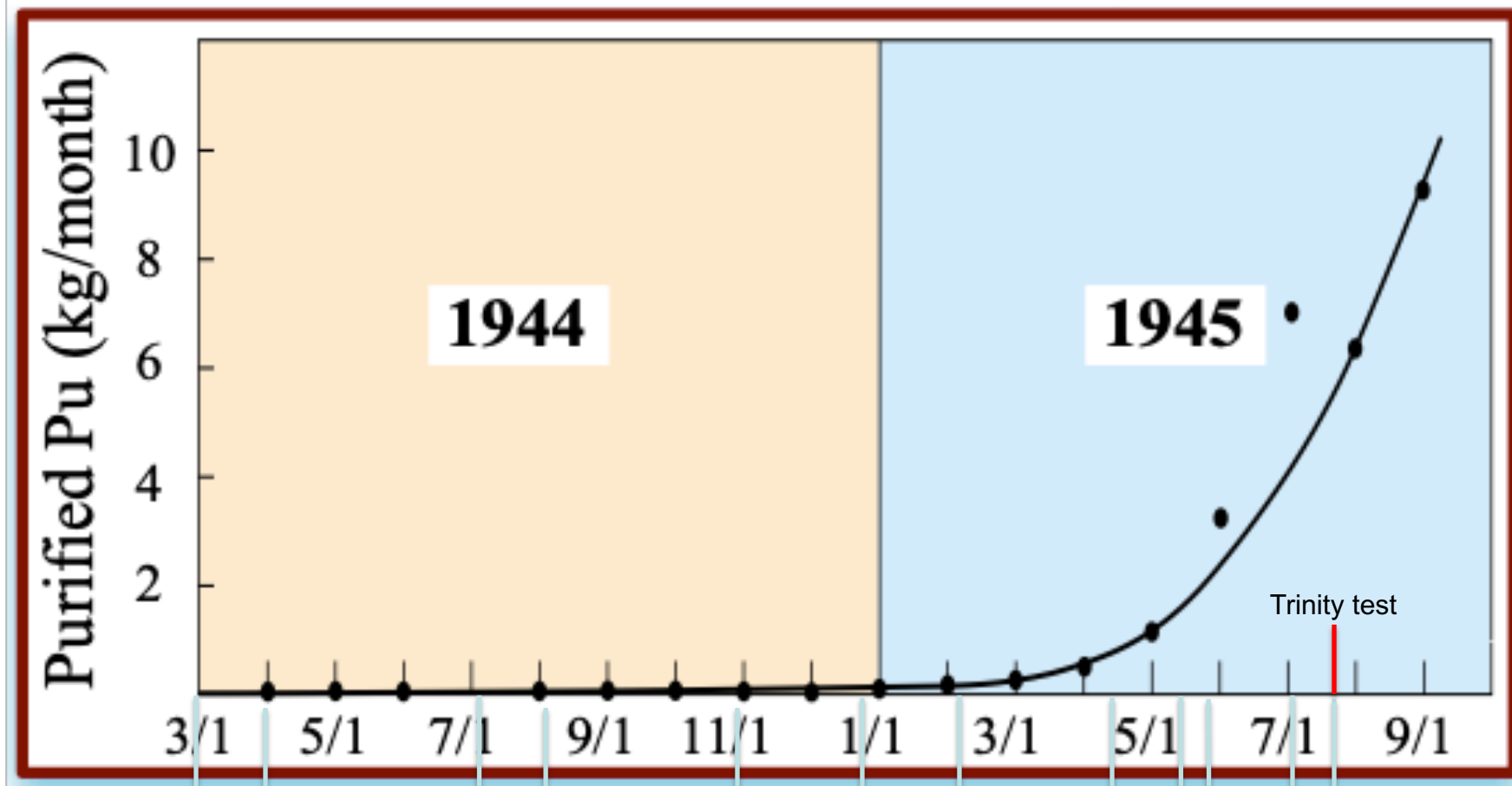
Implosion  
decision

Physical  
properties









Jan. - 5 phases

Metal reduction  
successful

Implosion  
decision

Physical  
properties

Alloy survey

Al works

Al, Si &  
others

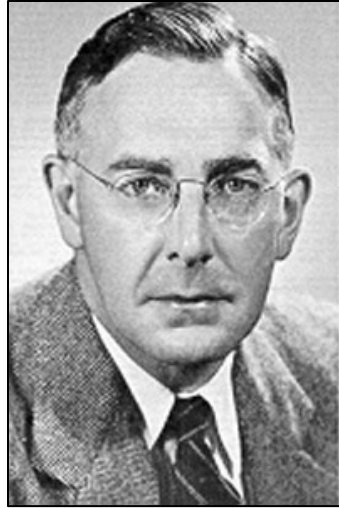
Ga works

Ga chosen

Pu parts  
delivered

JRO to Smith  
You decide!

Smith fixes  
blisters problem



Cyril Stanley Smith

C.S. Smith comes up with ingenious fix for the blisters that developed. “At approximately noon on 15 July 1945, at MacDonald’s Ranch near Alamogordo in New Mexico, my fingers were the last to touch those portentous bits of warm metal. The feeling remains with me to this day, thirty-six years later.”

# A bit more about plutonium

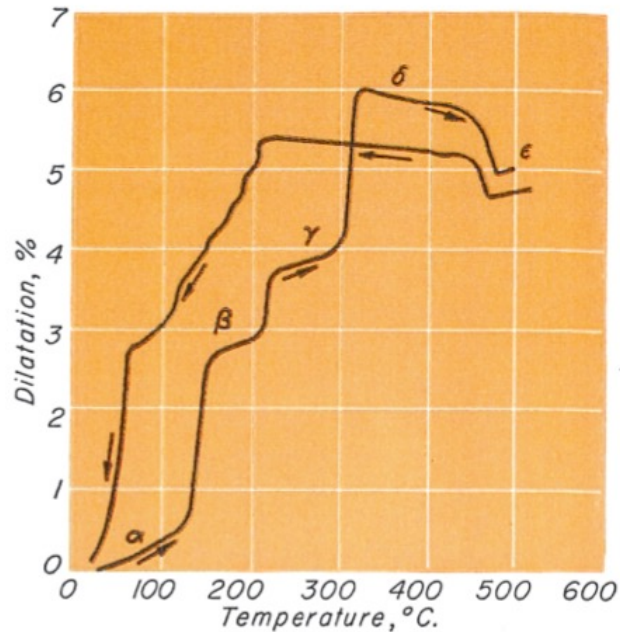
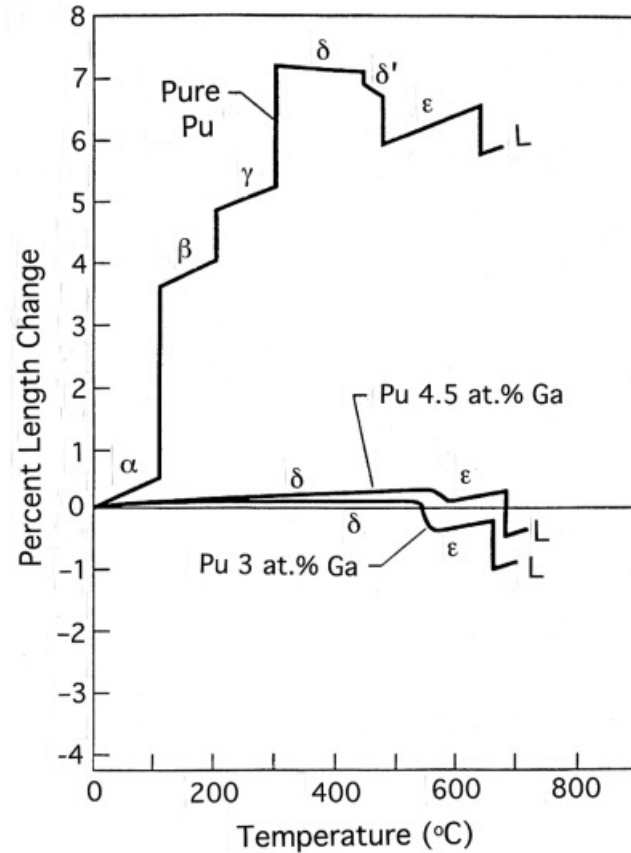


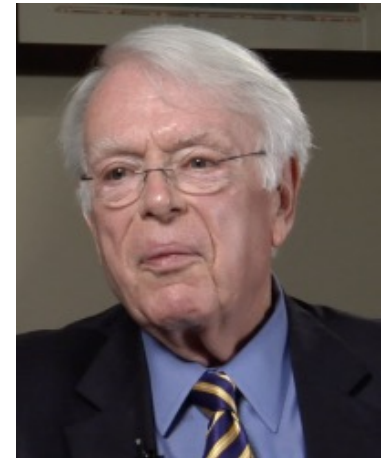
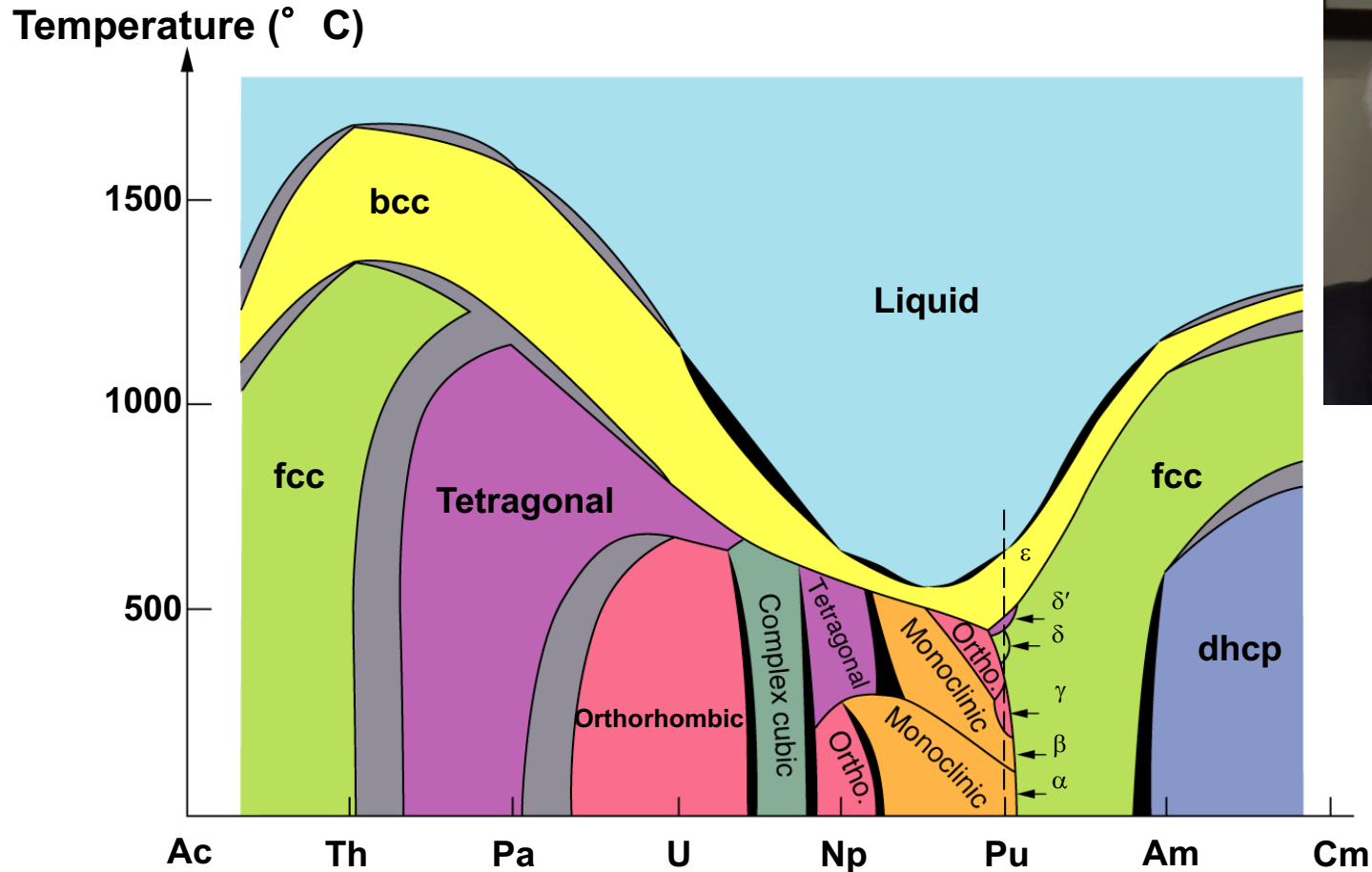
Fig. 5—Hysteresis in the Four Transformations in Plutonium, as Determined in a Dilatometer. Heating Rate,  $2.3^{\circ}\text{C. per min.}$ ; cooling  $2.6$

Summer 1944 dilatometry +  
Willie Zachariasen Powder XRD



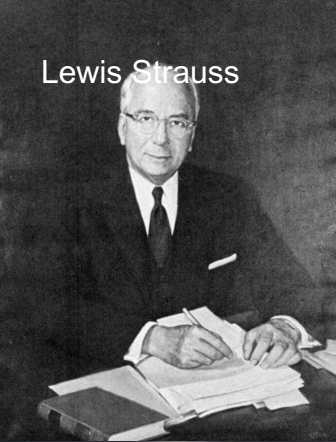
Modern version – Ga effect

# Another Smith (J.L.) helped us understand. The experimental connected actinide phase diagram.



[Smith and Kmetko, 1983]

Lewis Strauss



June 1954

$$x^2(x+z)$$

**DR. OPPENHEIMER SUSPENDED  
BY A.E.C. IN SECURITY REVIEW;  
SCIENTIST DEFENDS RECORD**

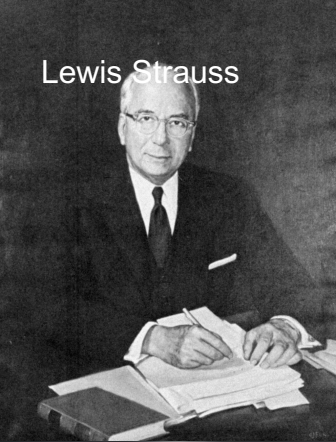


Edward Teller

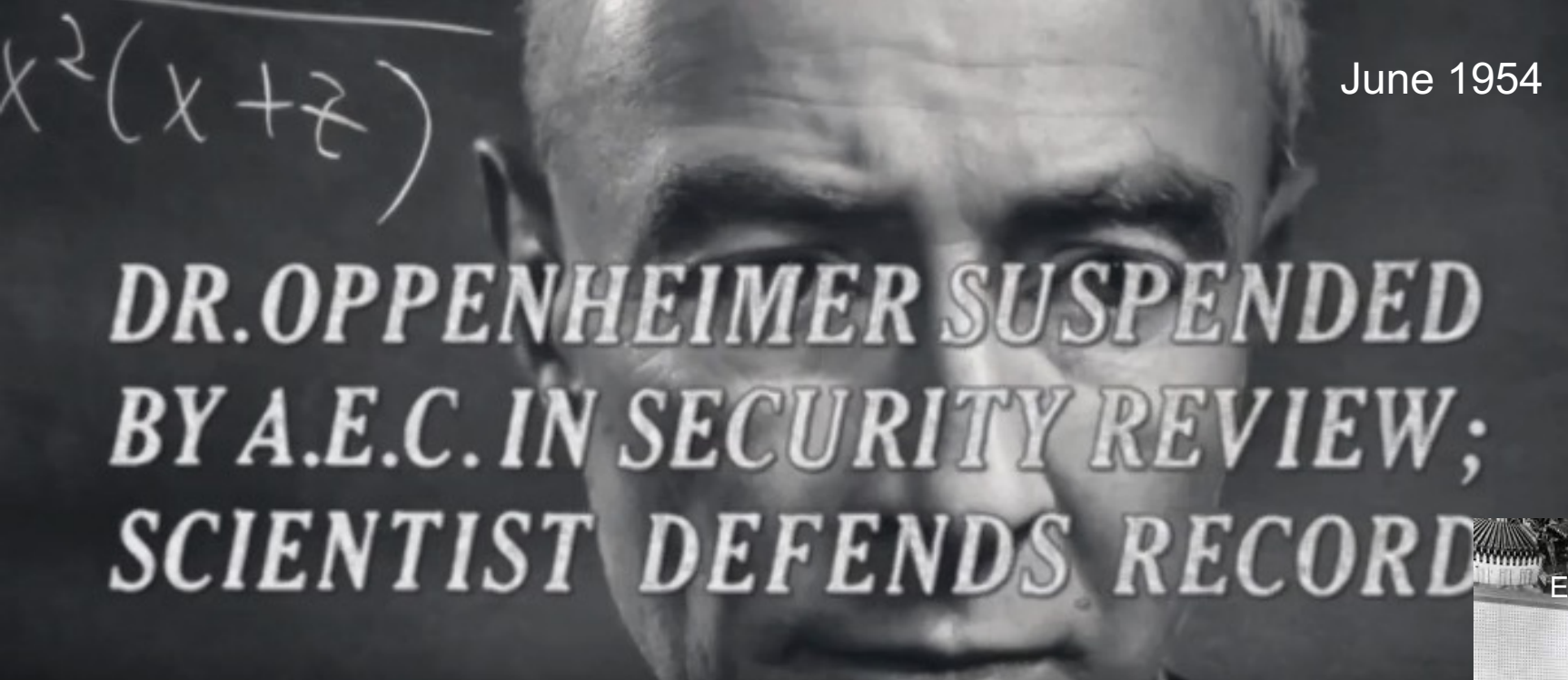




Lewis Strauss



## What was Edward Teller's role?



Edward Teller



# What did Teller say at the 1954 AEC Hearing

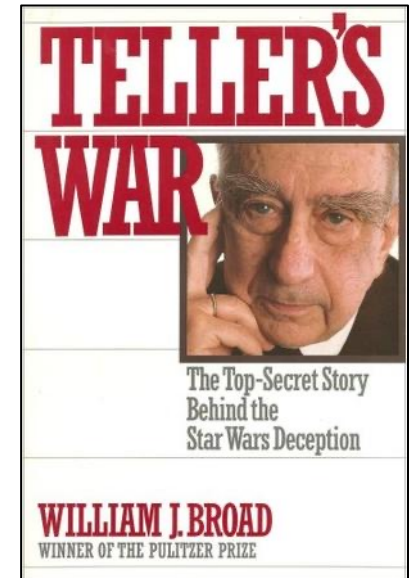
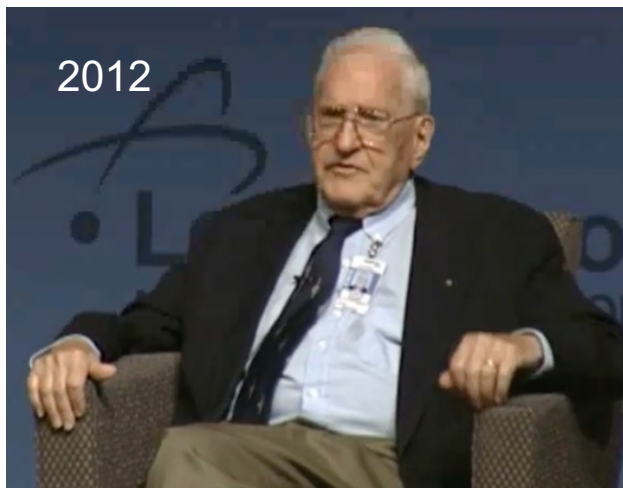
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- “I have always assumed, and now assume, that he is loyal to the United States.”
- Nonetheless, Teller said he considered Oppenheimer a security risk. He concluded, “I feel that I would like to see the vital interests of this country in hands which I understand better and therefore trust more.”
- “If it is a question of wisdom or judgement, as demonstrate by actions since 1945, then I would say one would be wiser not to grant clearance.”

# Edward Teller – re-examined

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- Harold Agnew (2012) – Teller got a bum wrap for 1954 Hearing.
  - He said I would rather not have JRO advise the government
  - Harold said – no wonder, JRO was against nuclear power and nuclear submarines
  - Harold invited Teller back to lab right after he became director
- Yet, lots of reasons to disagree with Teller
  - With E.O. Lawrence set up second lab (Livermore)
  - Ardent Cold War hawk
  - Proponent of Star Wars and X-ray laser



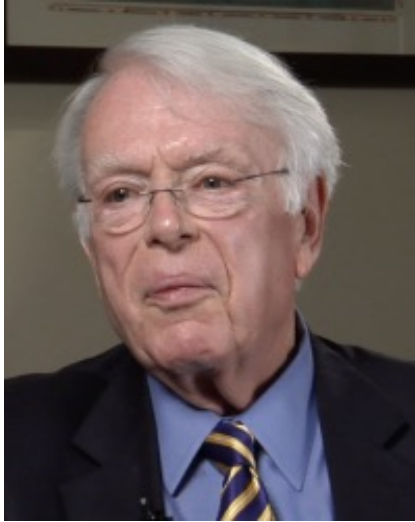
# Edward Teller and the H-bomb

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- J. Bernstein interview of Bethe : Teller first raised idea of an H-bomb on a train ride in 1942 from Chicago to San Francisco by Teller to Bethe.
- 1942 Oppenheimer summer meeting at Berkeley – much of it devoted to the super.
- Manhattan Project – Teller wanted only to work on the H-bomb
- Teller-Ulam radiation driven H-bomb concept in 1951
  - Was it Teller or Ulam?
- Agnew credits Enrico Fermi telling Teller “Have you considered radiation?”

# Edward Teller and Los Alamos

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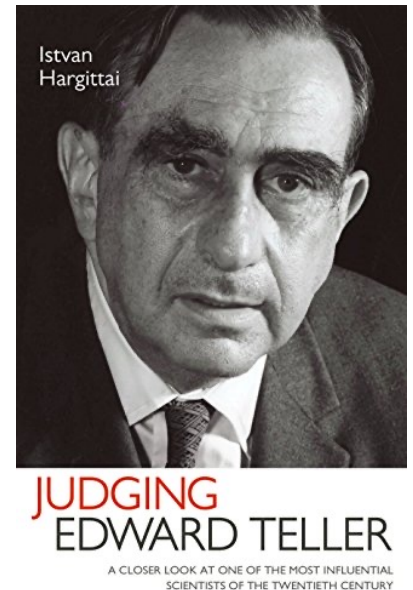
James L. Smith



Greg Canavan



Jim Smith with Edward Teller.  
They are not discussing H-bomb.





# Oppenheimer and the uniform

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**Did Oppenheimer ever wear one?**

# Oppenheimer and the uniform

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## **Did Oppenheimer ever wear one?**

No record of ever having worn one.

However, Gen. Groves told him they all had to wear one.

Oppenheimer went to Presidio to begin enlistment.

Apparently ordered uniform – one of a Lt. Colonel.

But Robert Bacher and I.I. Rabi refused.

# Oppenheimer and the uniform

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Robert F. Bacher



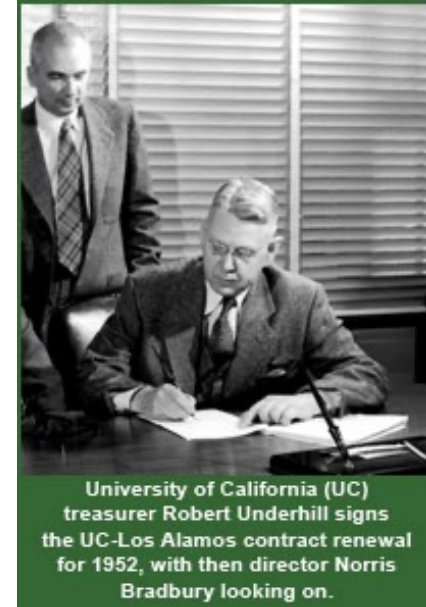
Isidor I. Rabi

Argued that science could not flourish within a rigid military structure.

# Enter the University of California

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- April 20, 1943 – Groves signs contract with UC to manage the Los Alamos Laboratory.
- UC agreed to furnish necessary personnel, supplies, materials, and equipment.
- University personnel rules and regulations, as well as general university operating procedures, would apply at the lab.
- The university, nonetheless, was virtually unrepresented at the site.

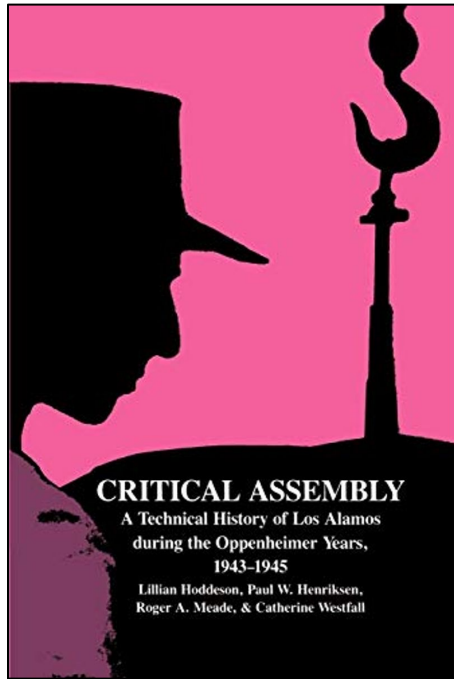


After the war, Oppenheimer noted that the "contractor during the war years was an extremely helpful and able contractor - **but was really distinguished primarily by his absence.**"

Born was the GOCO model – Government Owned, Contractor Operated  
UC managed the laboratory until 2005.

# Post WW II – U.S. rises as industrial and scientific powerhouse

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## Manhattan Project

- Critical assembly of scientific/engineering talent
- Big science – theory, computation & experiment
- Innovative management – government & universities
  - Freedom of inquiry
- Government funding of scientific research
- Effective incorporation of foreign scientific talent

Nobel prizes	1900-45	1945-1990	1990-2020
Physics	6/45	62/110	22
Chemistry	3	41/75	33

There is more to the “Rest of the Story,”  
but for another time.