

# History of the invention of the transistor

Quentin Rafhay

Based on the book: Crystal Fire

# Everything starts with...

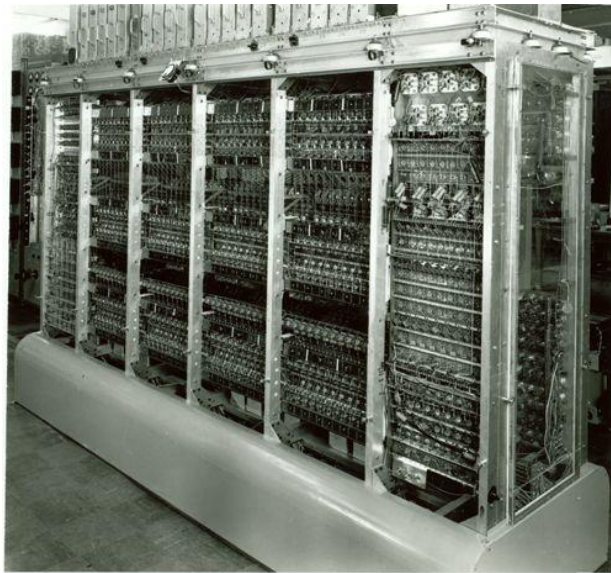


Mervin Kelly



Vaccum tube

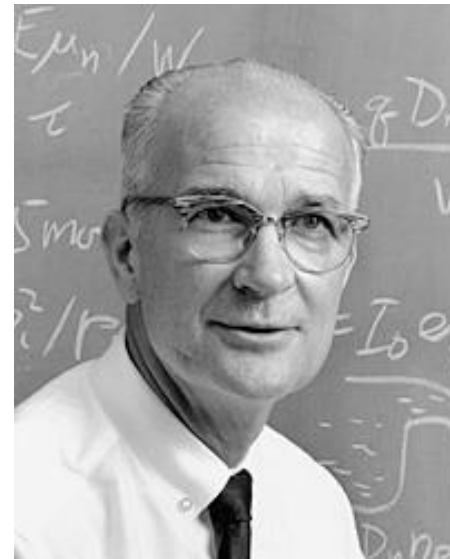
# Computer was like that...



# Kelly hires



Mervin Kelly



William Shockley

# Shockley hires (circa 1936)



Walter Brattain  
Experimentalist

# Sold state devices at that time



Cat whisker (moustache de chat)

Diode...



# They start working

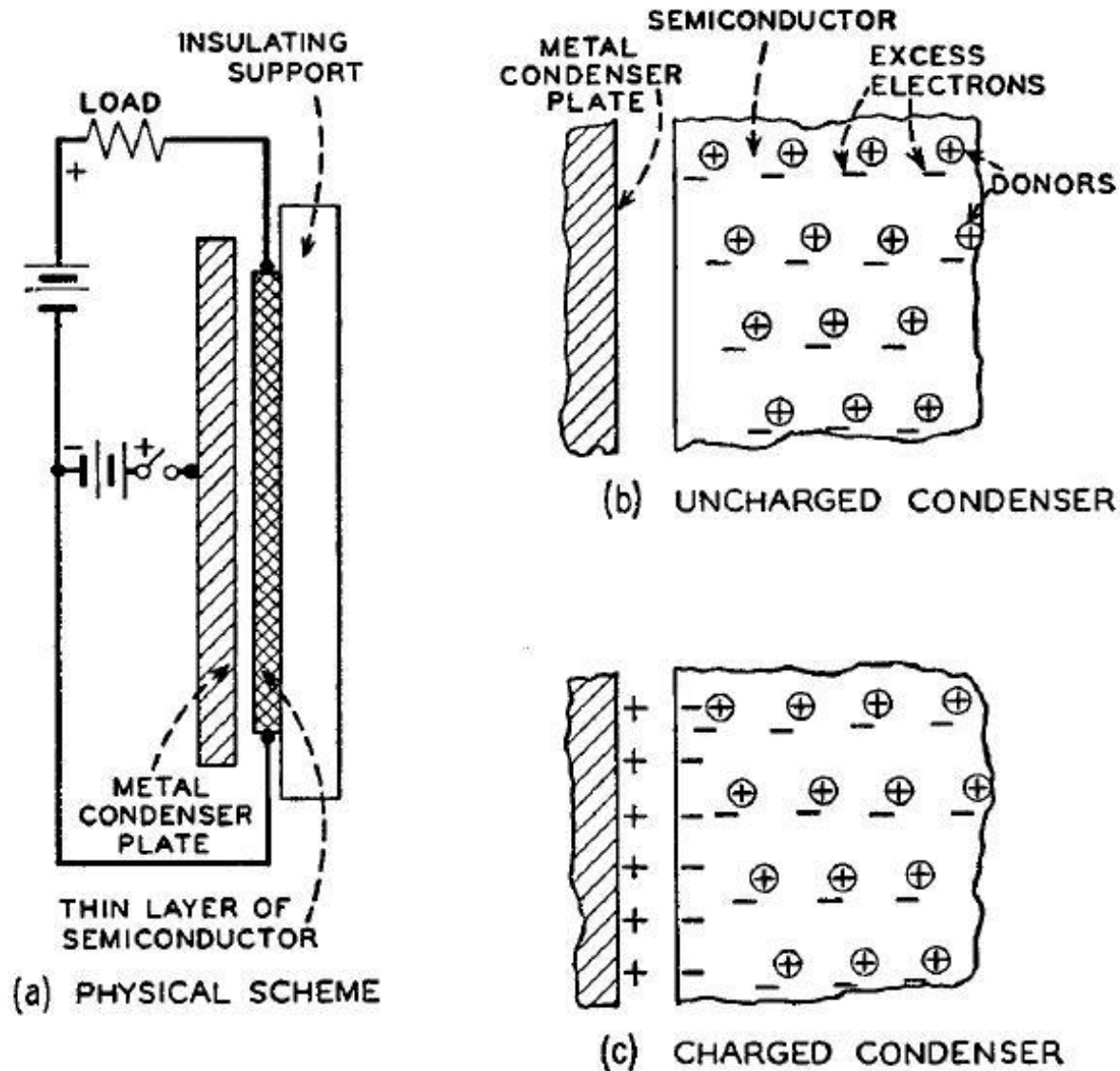
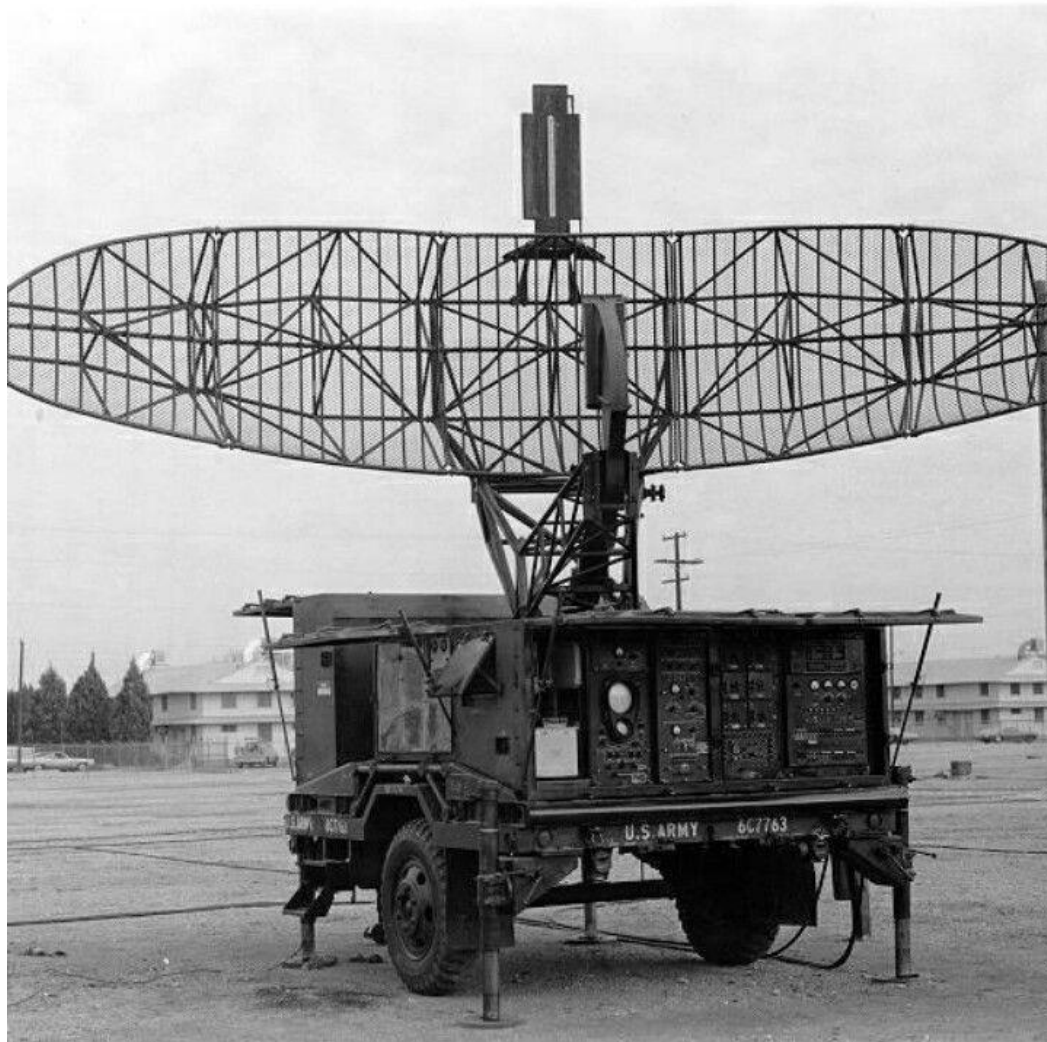


FIG. 2-2—Modulation of Conductance by Surface Charges.

... but they have to stop

0:17:37-0:18:34





# After the war, Shockley hires



John Bardeen  
Theorician

# Bardeen first contribution

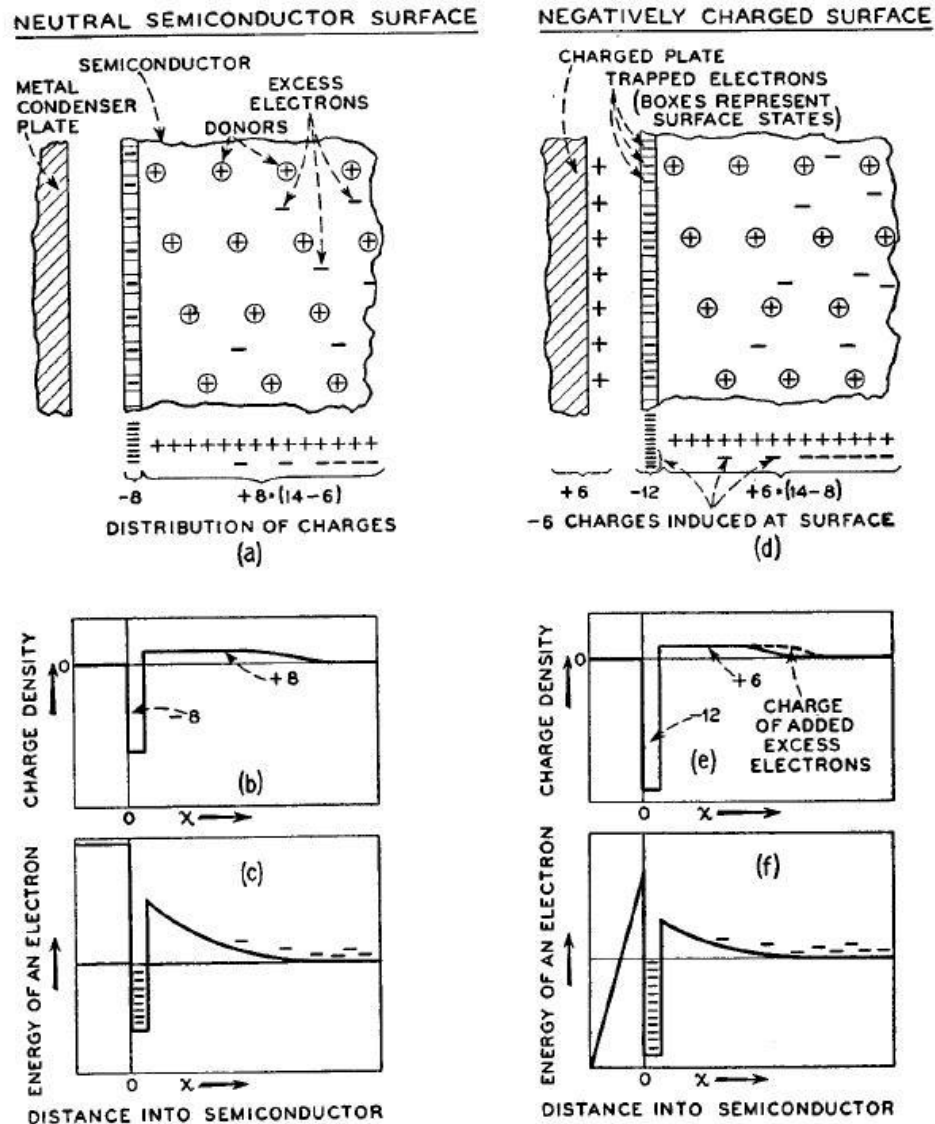
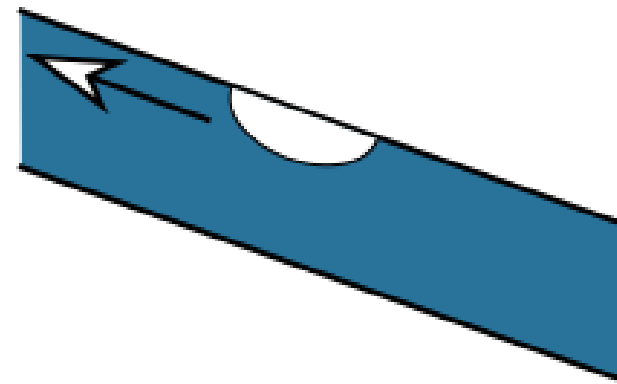
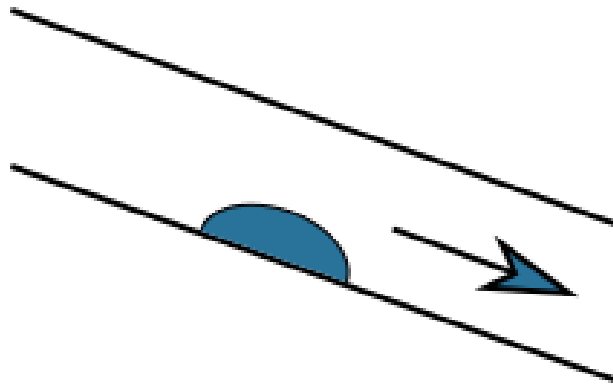
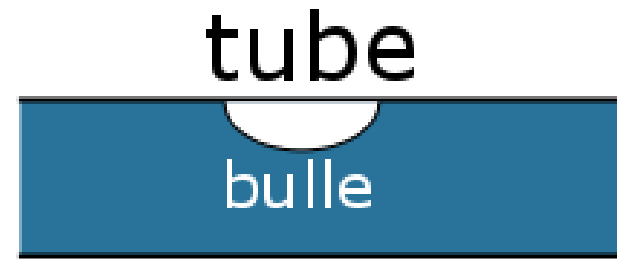
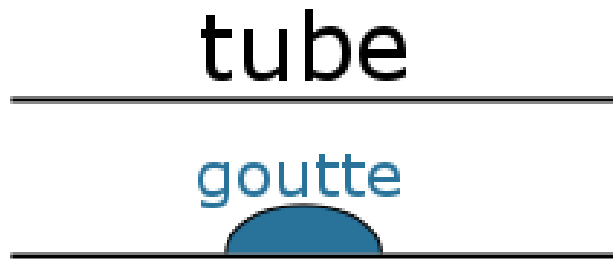


FIG. 2-3—Surface States Diagram, Showing Bardeen's Theory of the Role of Surface States in Immobilizing Induced Charge.

# Changing the approach

Injecting minority carriers



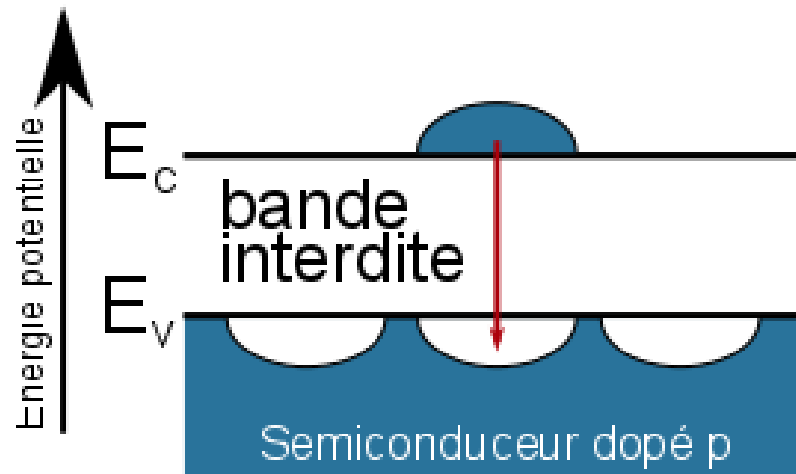
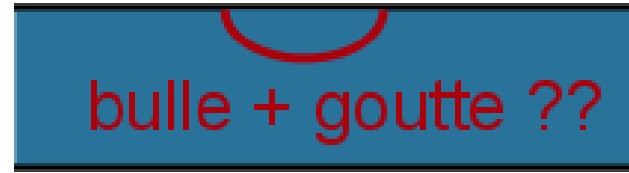
““Electron””

““Trou””

# Changing the approach

Injecting minority carriers

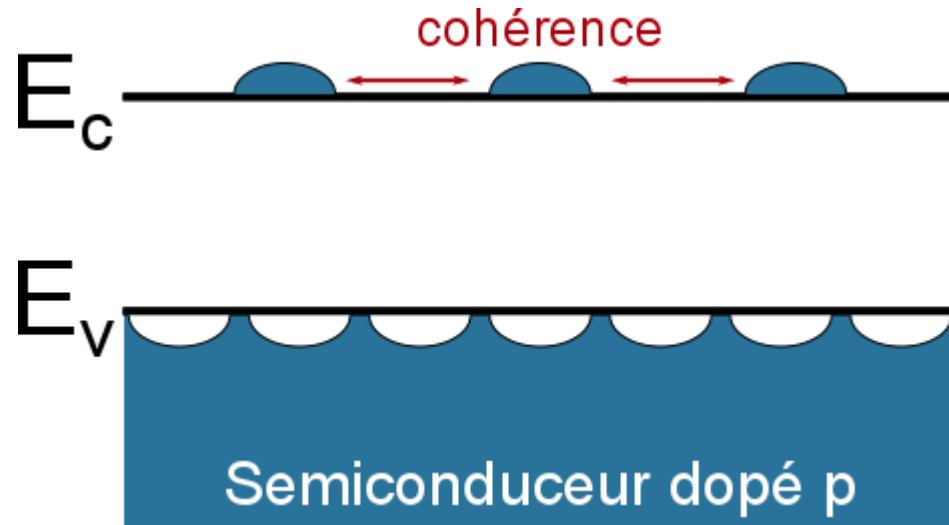
tube



Why electron do not recombine immediatly

# Changing the approach

Injecting minority carriers

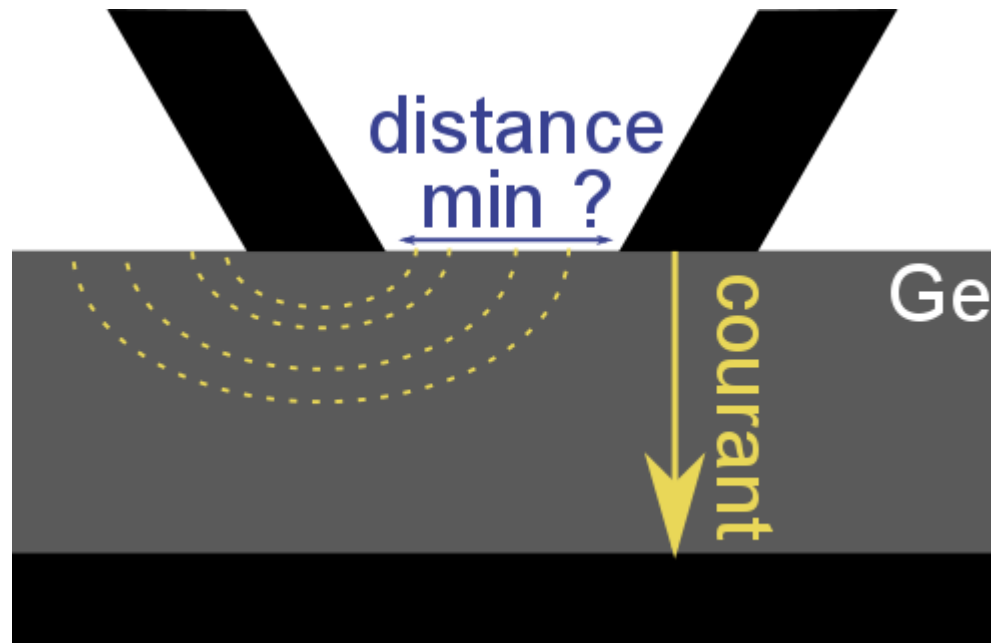


Electron wave function in quantum coherence

➔ Increase lifetime of minority carriers

# Changing the approach

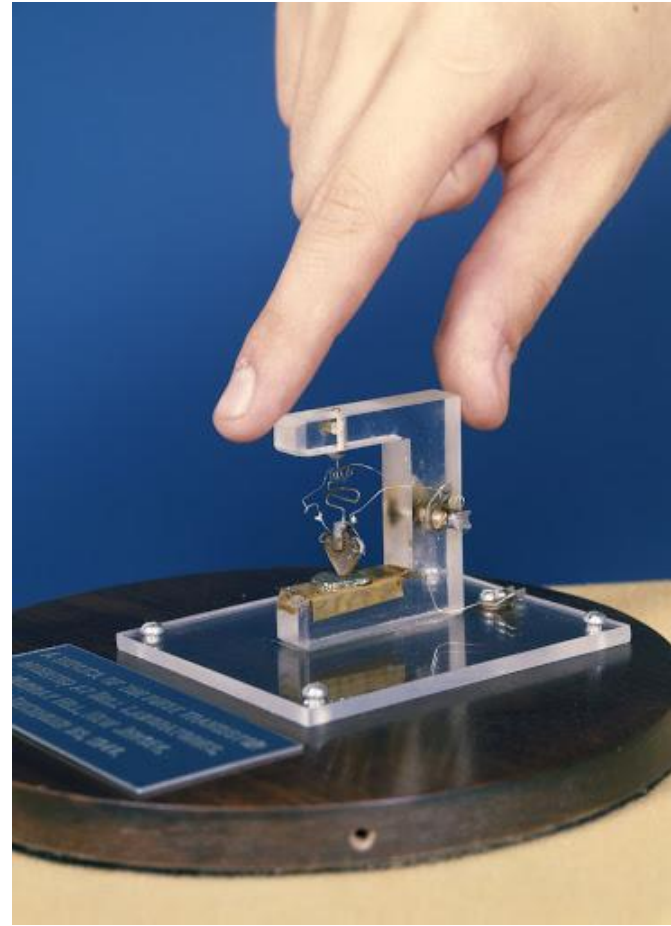
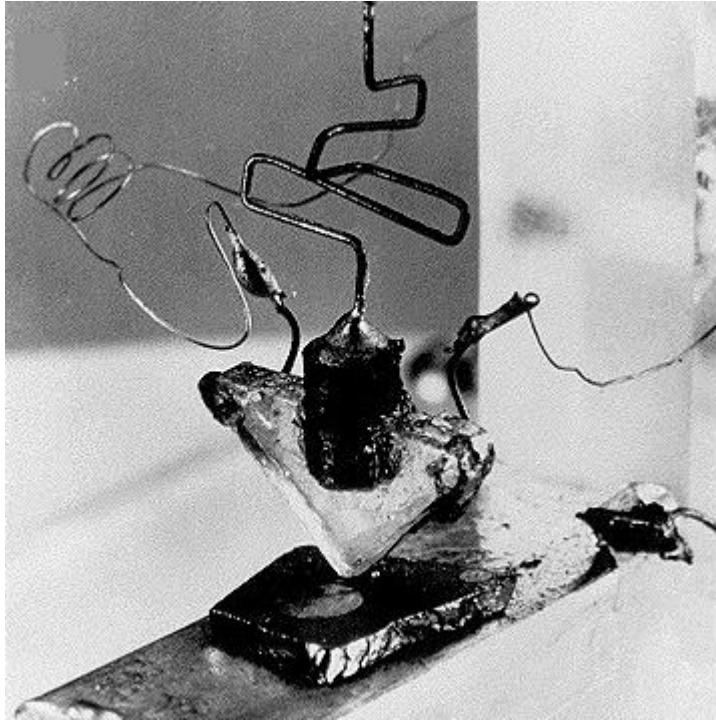
Injecting minority carriers



Theoretical calculation by Bardeen on the minimum length which could influence a current

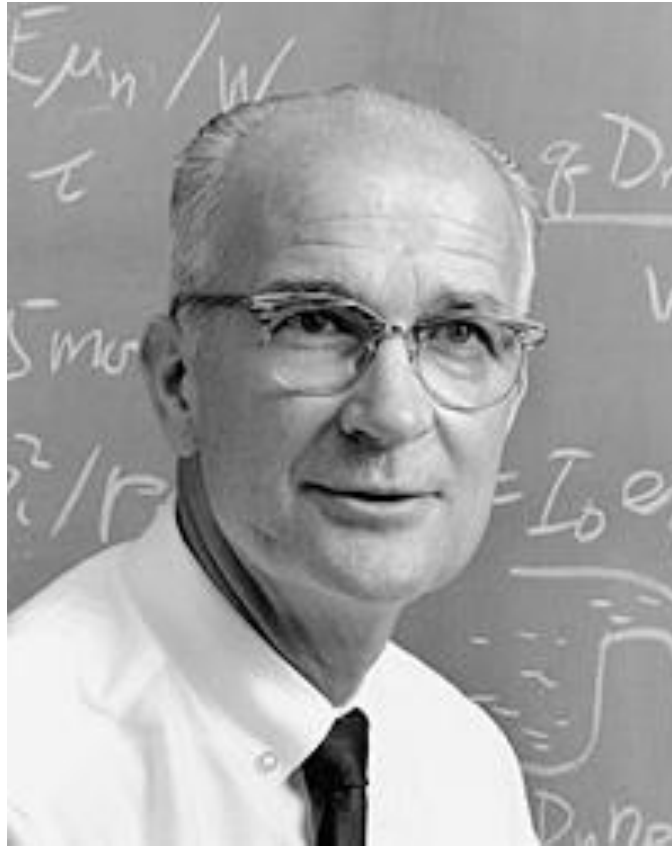


# On the 23rd of december, 1947



Invention the Point Contact transistor

# Shockley's answer

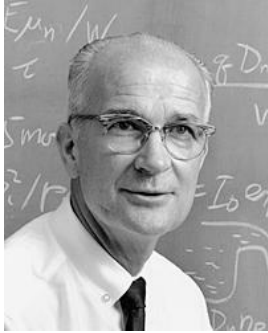


Invent bipolar transistor, paper and pen...

# The aftermath

- Industrial development of the Ge point contact
- Not reliable enough
- Industrial development of the Ge bipolar transistor
- Then Si
- In parallel, the team explodes...

# New directions



Make a company :  
Shockley Semiconductor

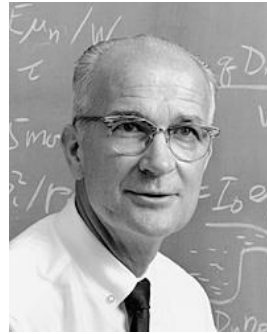


Go teach at the  
University of Illinois



Stays at Bell Labs, then  
retire

# Shockley semiconductor...



In 1956, Shockley settle his compagny in a valley, near Palo Alto (CA)...  
Hire them:



# Still in 1956 : Nobel Price for Shockley Bardeen and Brattain

0:46:01-0:47:37





# Still in 56...



## BCS theory of superconductivity

One of Bardeen PhD student invents the LED in visible light

# In 1957 : the end Shockley semiconductor...

« The traitorous eight »



Gordon Moore

Robert Noyce

# Invention of the integrated circuit (1959)



Jack Kilby



Robert Noyce

Based on the passivation process  
developped by **Mohamed M. Atalla** at  
the Bell Labs

# Invention du MOSFET (1959)

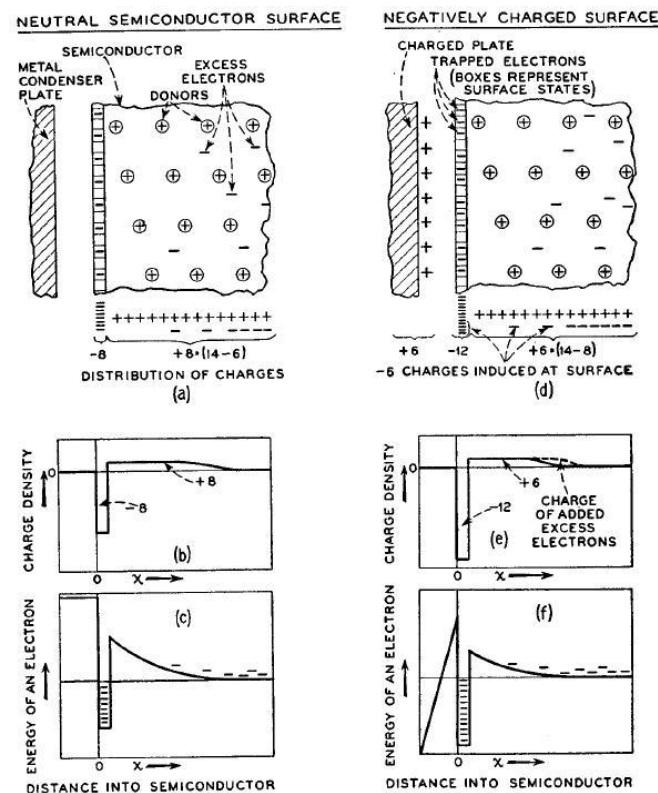


FIG. 2-3—Surface States Diagram, Showing Bardeen's Theory of the Role of Surface States in Immobilizing Induced Charge.

Passivation and oxidation  
= suppress interface states