

Title: Toil, Trouble, and the Cold War Bubble: Physics and the Academy since World War II.

Date: Sep 10, 2008 02:00 PM

URL: <http://pirsa.org/08090000>

Abstract: <span>In the wake of recent swings in the values of technology stocks and the prices of real estate, many people have become (painfully) familiar with the boom-and-bust cycles of speculative bubbles. Although playing out on longer time-scales, student enrollments in the sciences have followed a remarkably similar pattern during the decades since World War II. The characteristic pattern can be seen in several countries, including the United States, Canada, and the United Kingdom. Enrollment patterns, and the specific policies that have been forged at various times to rapidly expand the number of trained scientists, sit at the intersection of science and society; they are where broad societal priorities and the infrastructure of higher education meet head on. Amid current discussions about globalization -- especially fears of potential challenges from booming scientific and technical training efforts in India and China -- the time is ripe to take stock of previous boom- and-bust cycles in our own recent past. How did they take hold, and what consequences have they had on the world of ideas? What intellectual trade-offs have been made, and with what impacts on the direction of scientific research?</span>

The background of the top section is a blue-tinted photograph of a large crowd of people, likely students in a lecture hall. A jagged, black-outlined line is overlaid on the right side of the image, extending from the top to the middle of the page. The line starts high, drops, rises to a peak, and then drops again.

*Toil, Trouble, and the  
Cold War Bubble:*

*Physics and the Academy since World War II*

The background of the bottom section is a blue-tinted photograph of a crowd of people, similar to the top section. A jagged, black-outlined line is overlaid on the right side of the image, extending from the middle of the page to the bottom. The line starts low, rises to a peak, and then drops.

**David Kaiser**





*Toil, Trouble, and the  
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*Physics and the Academy since World War II*

**David Kaiser**



Sept

24 Jos Uffink Fund QM  
30 Ilan CONDENSED MATTER

Oct

1 'surprise' treatment Time

8 Bistro Session

15 Chris Elmslie Neuroscience

22 Andy Albrecht Cosmology Time

27 Sari Diamond Arts Science

Nov

5 Vincent Rivasseau QFT

12 Xiang-Gang Wen Condensed Matter Frontiers

19 Bistro Session

26 Catherine Kellin Condensed Matter

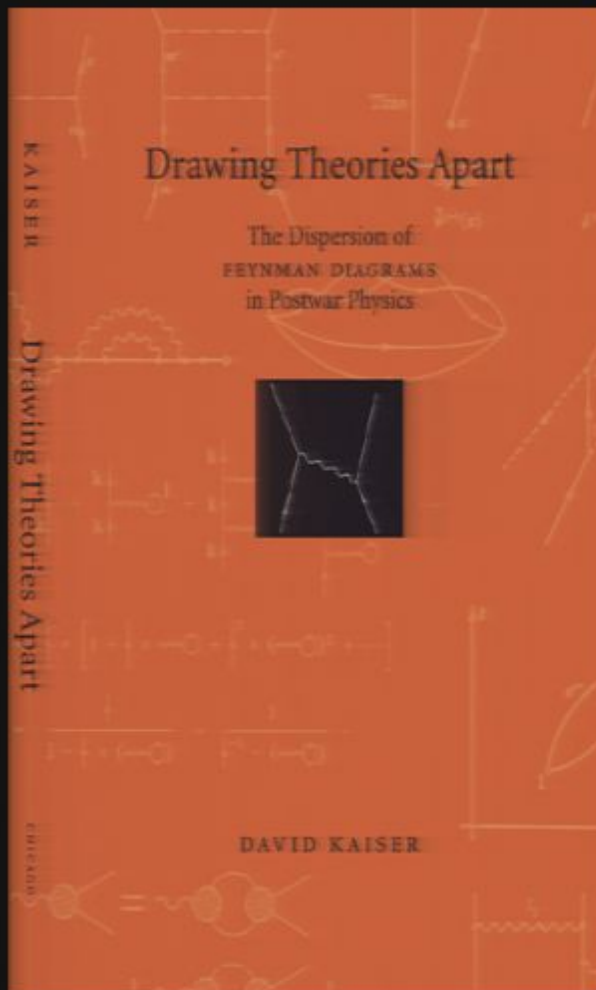
Dec

3 Abhay Ashtekar Quantum Gravity

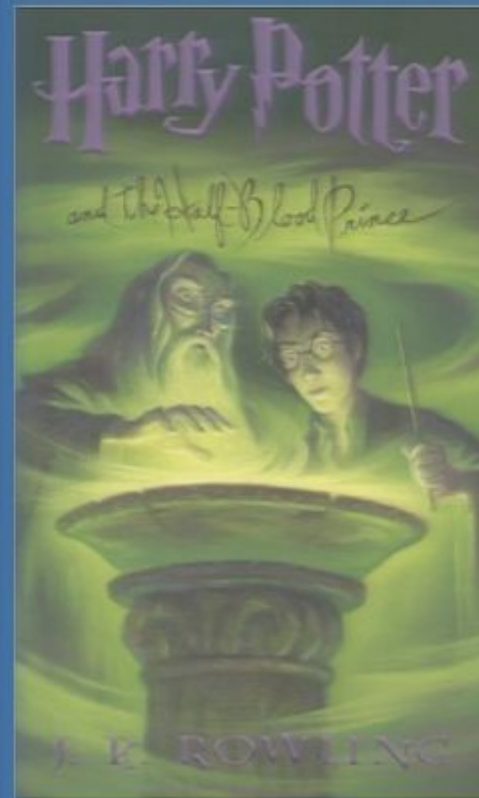
10 Keith Dixon High Energy Theory

# Pedagogical Histories

Stabilizing research tools and training new recruits often go hand-in-hand.

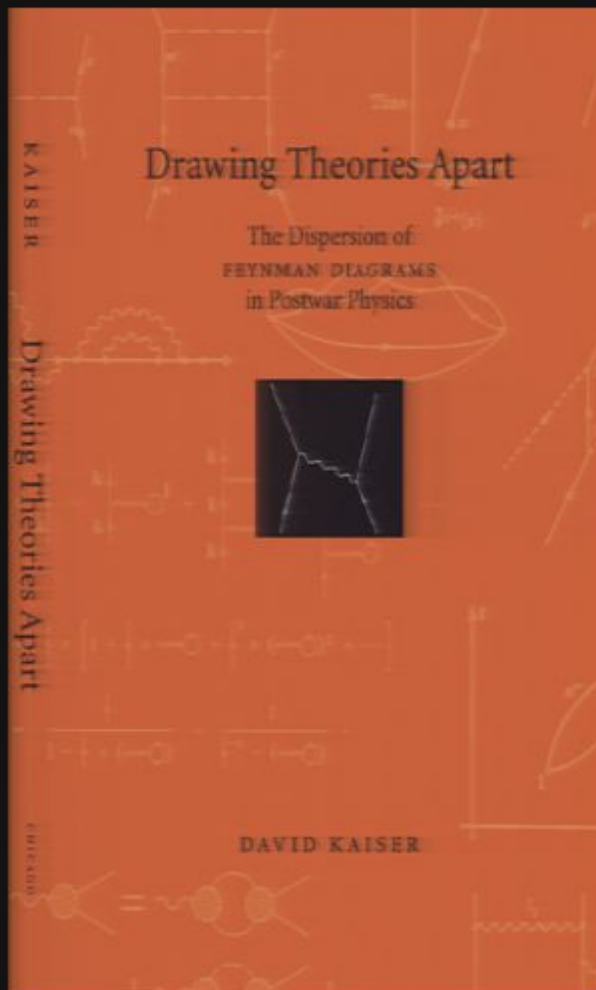


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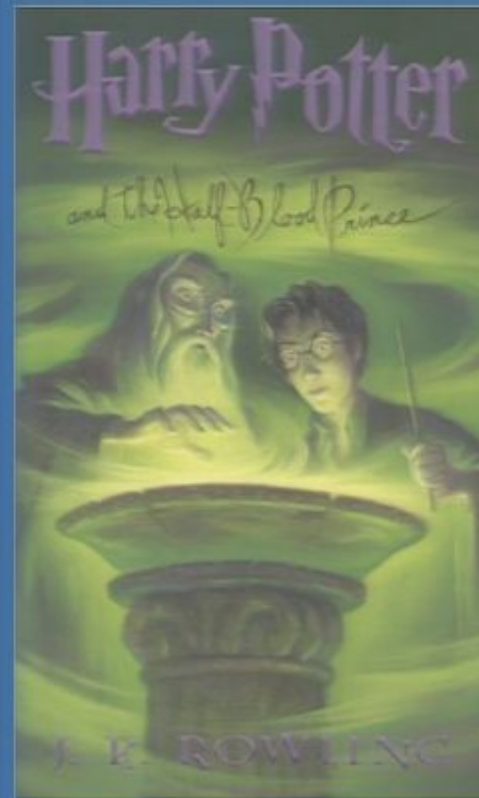


# Pedagogical Histories

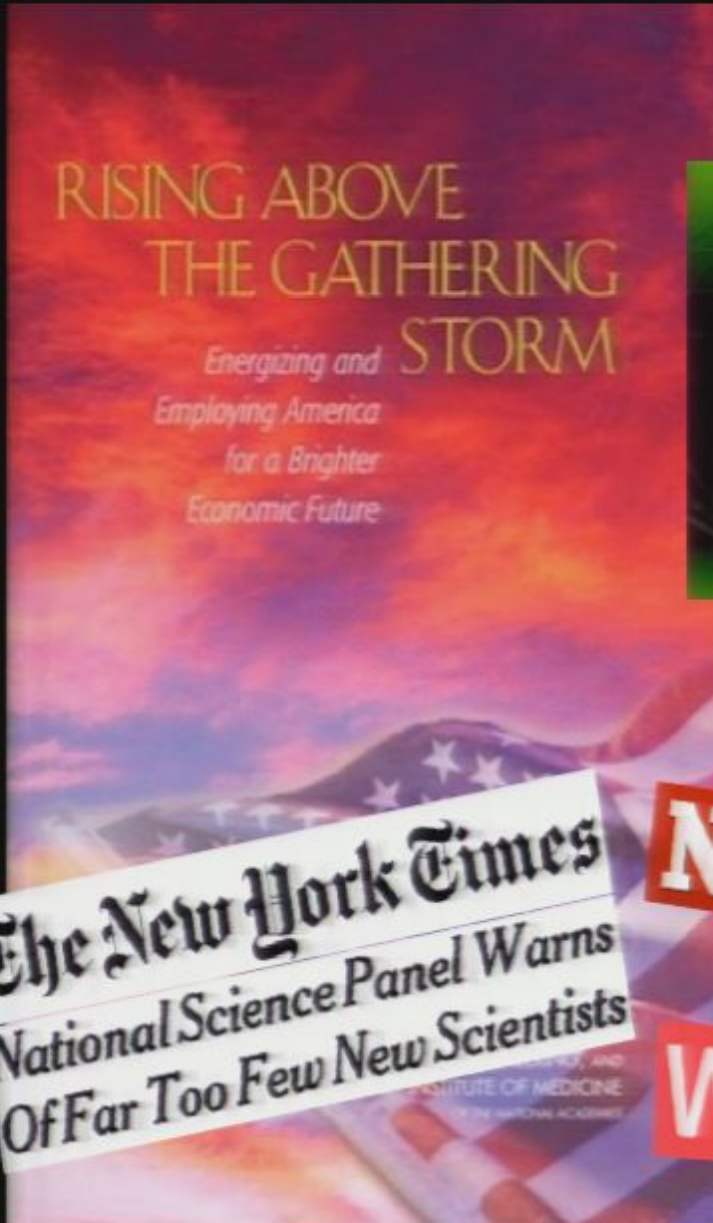
Stabilizing research tools and training new recruits often go hand-in-hand.



Customers who bought this book also bought:



# The Gathering Storm?



New engineers  
trained, 2004:

China: 350k

U.S.: 140k

**Newsweek**

**WIRED**

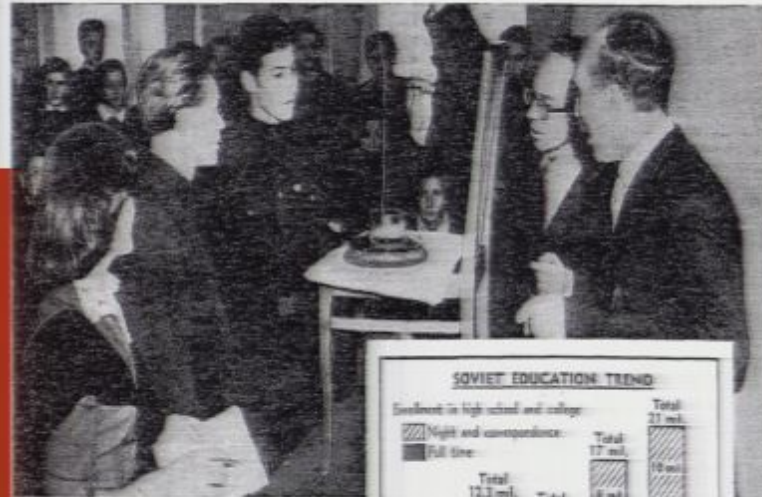
# Déjà Vu

Swapping just a few terms — “national security” for “economic competitiveness” and “Soviet Union” for “India and China” — produces an uncanny resemblance to an earlier frenzy...

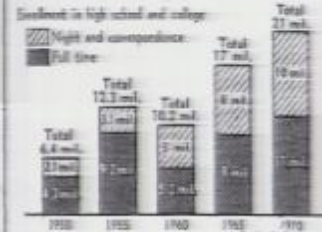
Russia Is Overtaking U.S.  
In Training of Technicians

Red Technical Graduates  
Are Double Those in U.S.

## SCIENCE AND TECHNOLOGY IN THE U. S. S. R.



SOVIET EDUCATION TREND

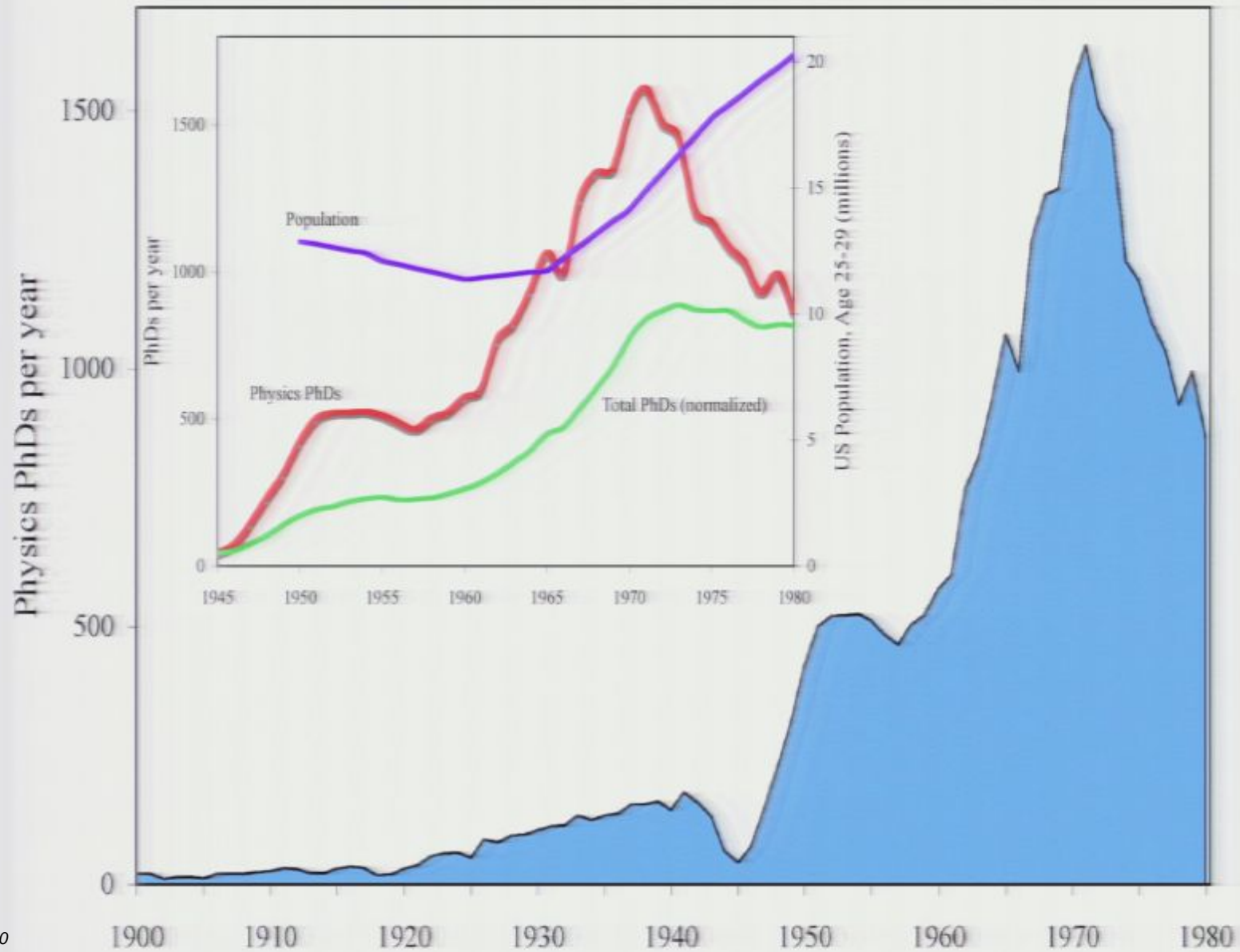


A new Soviet school program calls for part-time work in industry during the last three years of high school. The schools will stress a combination of theoretical science with applied technology. In top picture, Nobel

prize chemist Nikolai N. Semenov (at right) supervises a chemistry experiment in a Moscow high school. Lower picture shows ninth-grade students being prepared in a school workshop before they go to work in factories.



# The Cold War Bubble



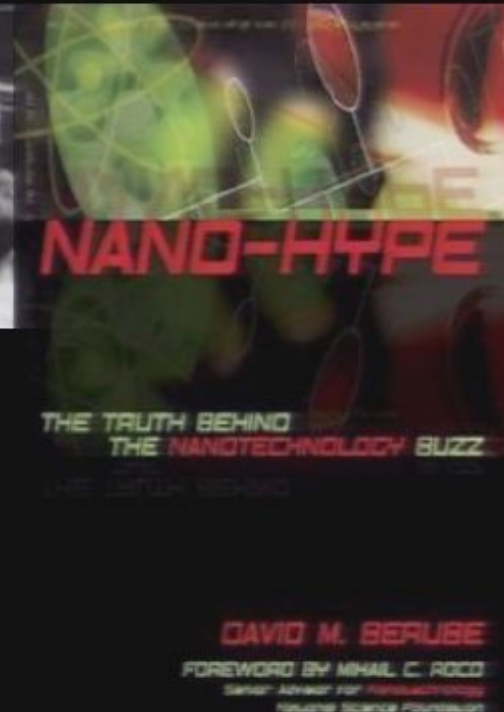
# I. A Speculative Bubble?



## II. Enrollments and Epistemology



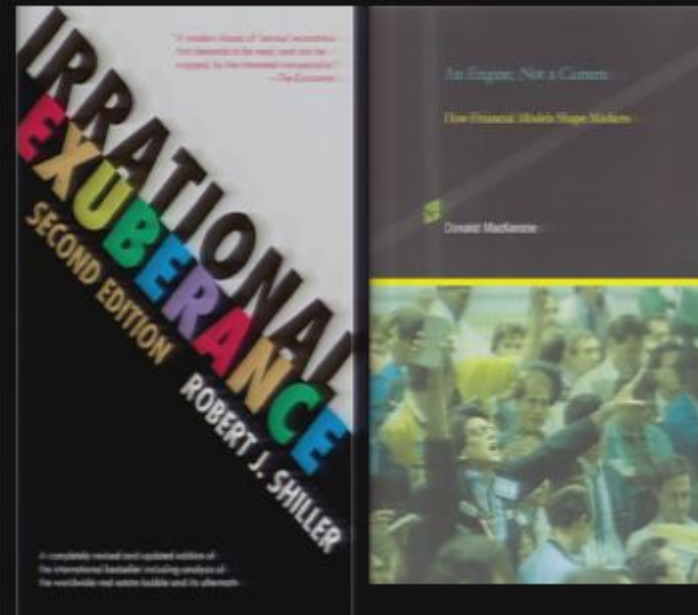
## III. All Over Again?



# Speculative Bubbles

- Tulip craze, 1630s
- South Sea Bubble, 1720
- Tech stocks, 1990s

“a situation in which temporarily high prices are sustained largely by investors’ enthusiasm rather than by consistent estimation of real value.” *Robert Shiller*



# Assessing the Soviet Threat

Nicholas DeWitt, *Soviet Professional Manpower: Its Education, Training, and Supply* (1955)

Alexander Korol, *Soviet Education for Science and Technology* (1957)

Nicholas DeWitt, *Education and Professional Employment in the USSR* (1961)

DeWitt: “an indefatigable digger”; Korol: “fastidious”



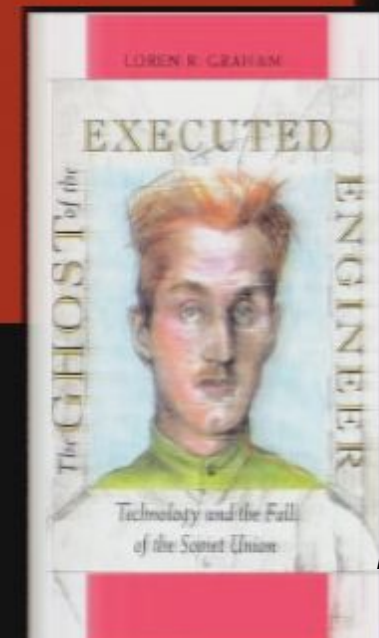
# *“Perplexities and Pitfalls”*

Both DeWitt and Korol warned against getting lost in the “numbers game”:

- large fraction of Soviet engineers worked in administration, not R&D
- extreme specialization
- standards jimmied to fit “production quotas” of 5-year plans
- extension and correspondence students inflating the ranks:  
1/3 in 1955, >1/2 in 1960.

*nonferrous metals metallurgy*

1. copper and alloys;
2. precious metals refining;
3. ....
- .....
- 11.



# Enrollment Patterns

Korol refused to tabulate enrollment data side by side, to avoid “unwarranted implications.” DeWitt did so only after emphasizing all the caveats. He found:

## Annual Degrees in Higher Education

	US	USSR
full-time students:	3	1
full + extension:	4	3
science and technology:	25%	75%

The Soviets were graduating 2-3 times more students per year in engineering and applied sciences than the US.

# Hype: "Two to Three Times..."



Red Technical Graduates  
Are Double Those in U.S.

Russia Is Overtaking U.S.  
In Training of Technicians



...and then came Sputnik

# Amplification



***I. I. Rabi***, chair of PSAC: Urged Eisenhower to use Sputnik as a pretext for closing the “manpower gap.”

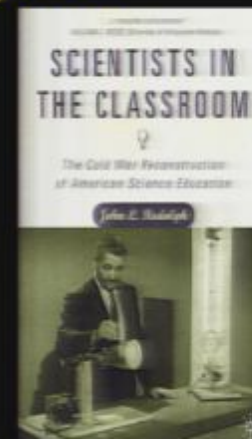


***Elmer Hutchisson***, director of AIP: “an almost unprecedented opportunity” to “influence public opinion greatly.”



***Hans Bethe***, past president of APS: repeated DeWitt’s ratio without knowing from whence it came or how it had been computed.

Eager press: count up number of hours spent on physics in US and USSR high schools.



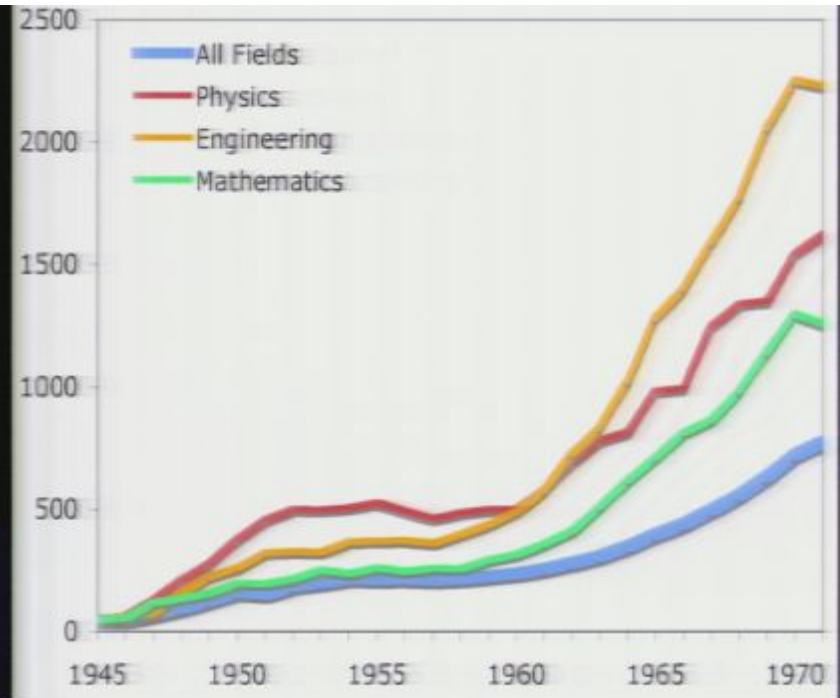


# Feedback Loop

**NDEA enacted, Sept 1958:**  
**\$1b (\$7b in 2008\$). First federal aid to education in a century.**

**First 4 years: 7k graduate fellowships; 500k undergrads.**

**Plus block grants and added incentives to states to increase enrollments. Sputnik scare had been used as a “Trojan Horse.”**



**NDEA's proponents "were willing to strain the evidence to establish a new policy."**



**All aid was restricted to "defense" fields: science, math, engineering, and area studies.**

# *Lies, Damn Lies, and Statistics*

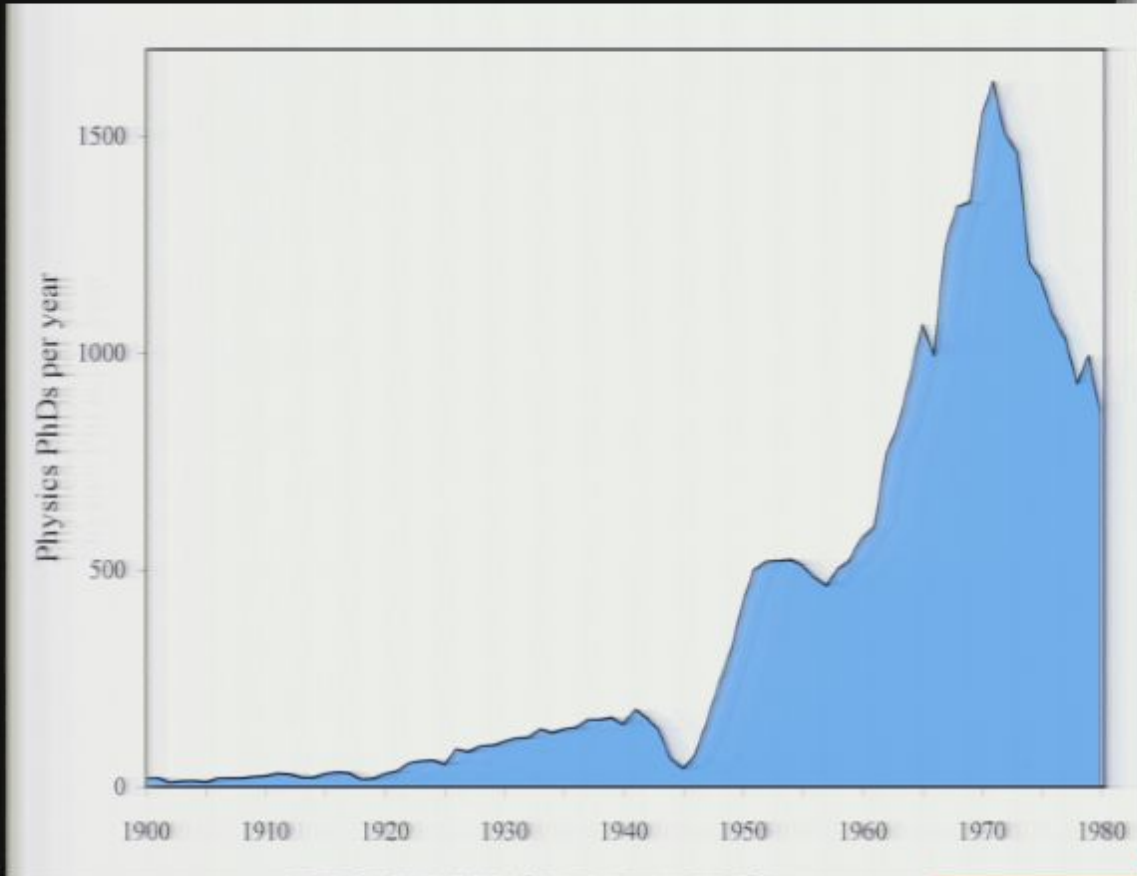
Even aside from DeWitt's and Korol's caveats — uneven quality, severe specialization, and inflation from extension and correspondence students — the numbers themselves deserved a closer look.

DeWitt: “engineering and applied sciences” = *engineering, agriculture, and health* → “2 to 3 times”



If drop agriculture and health and include science and math, the Soviet lead *fell by a factor of 10.*

# The Bubble Bursts



## AIP Job Placement Registries



	<i>Students registered</i>	<i>Jobs on offer</i>
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1963	449	514
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1968	989	253
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1971	1053	53
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# The Bubble Bursts



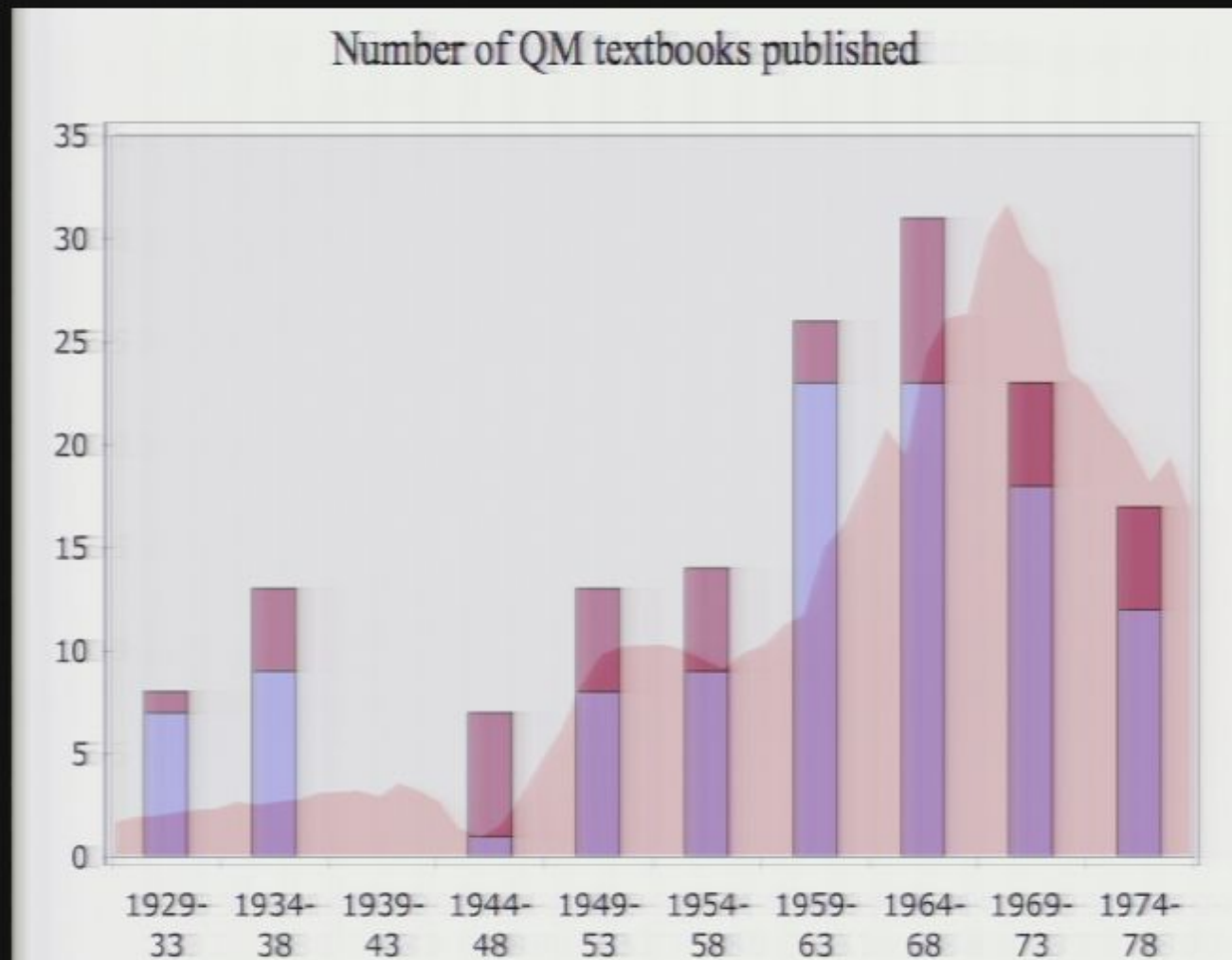
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# Enrollments and Epistemology

Was there any interplay between these enrollment swings and the world of ideas? Focus on the teaching of *quantum mechanics*.



# "The General Epistemological Lesson..."



Kant



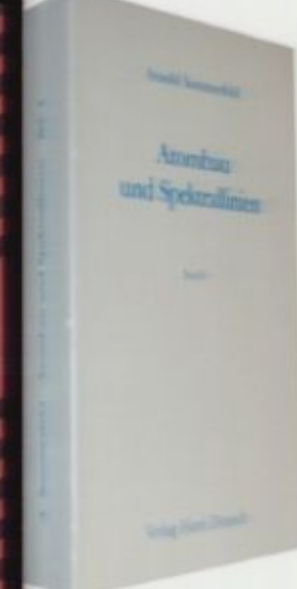
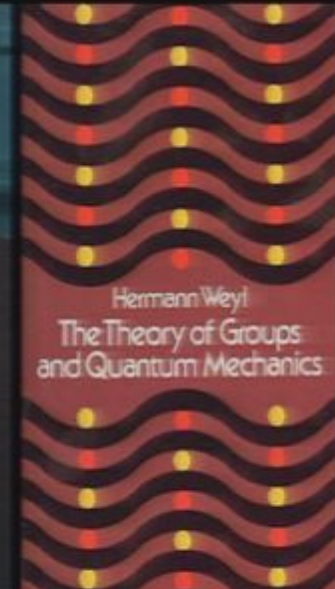
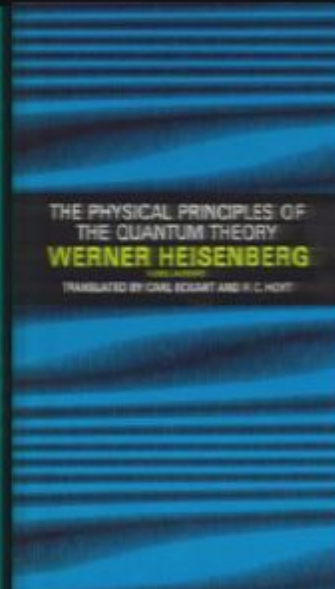
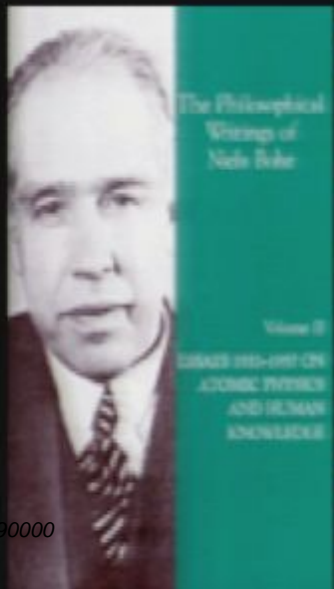
Mach



Jung

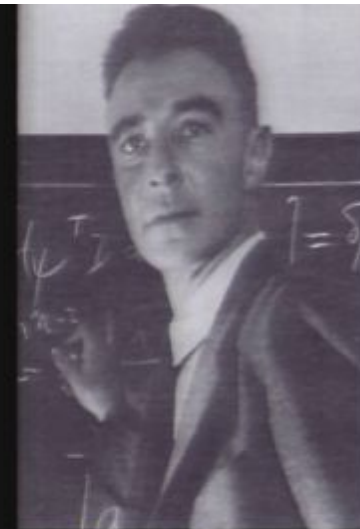


and friends



# Quantum Americans

US physicists also grappled with philosophical issues of QM before the war, in print and in their classrooms. They did not embrace the same responses as the Europeans, but they encouraged a similar activity.



Oppenheimer



Bridgman



Condon



Morse



Kemle



Urey

## Caltech oral exams, 1930s:

- measurement problem and the role of the observer
- uncertainty principle and the nature of physical explanation

Lecture notes, exams, textbooks, book reviews...

# *Philosophy Disappears*

Sudden shift by mid-1950s: interpretive material disappears from US lectures, exams, problem sets, and textbooks.



“Enough with this musty atavistic to-do about position and momentum...”

*Feshbach, 1962*

Book reviews:  
“avoids philosophical discussion”;  
“omits distracting, philosophically tainted questions” ...

General exams elsewhere:  
interpretive essay questions (1930s-40s) replaced by coterie of standard calculations (1950s).

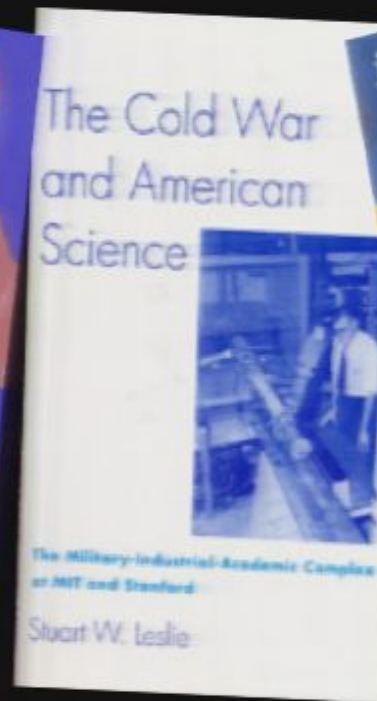
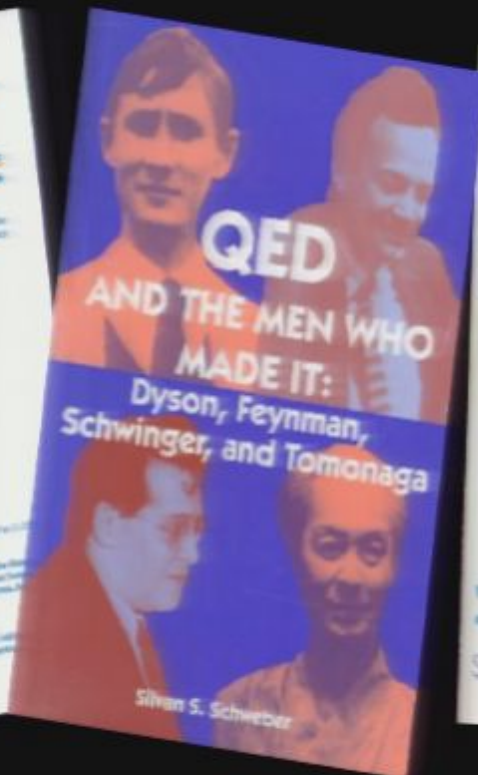
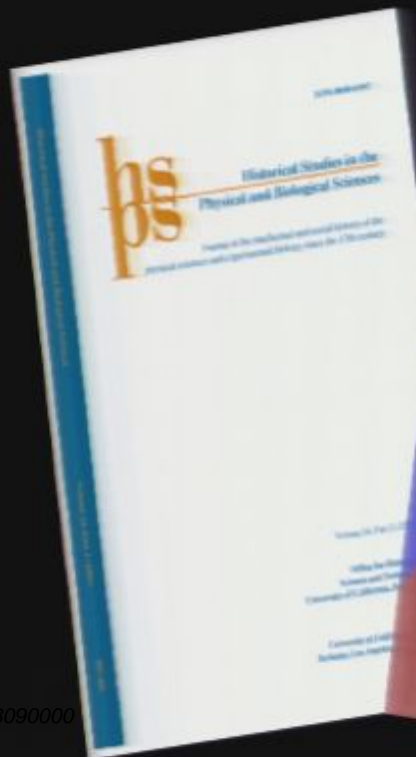
*Caltech oral exams, 1950s:*

- “the effort invested in analysis of paradoxes and queer logical points was of no use in the exam.”
- best advice: “memorize” and “rehearse” stock problems (“the usual spiel”).



# Accounting for the Shift

- *Were the puzzles and paradoxes resolved?*
- *Did war work turn US physicists into pragmatists?*
- *Changing patronage or employment demands?*



# Class Size and Teaching Style

“philosophical” classrooms

enrollment:  $12.7 \pm 5.7$

interpretive material:  $12.8 \pm 1.4\%$



“pragmatic” classrooms

enrollment:  $39.3 \pm 13.4$

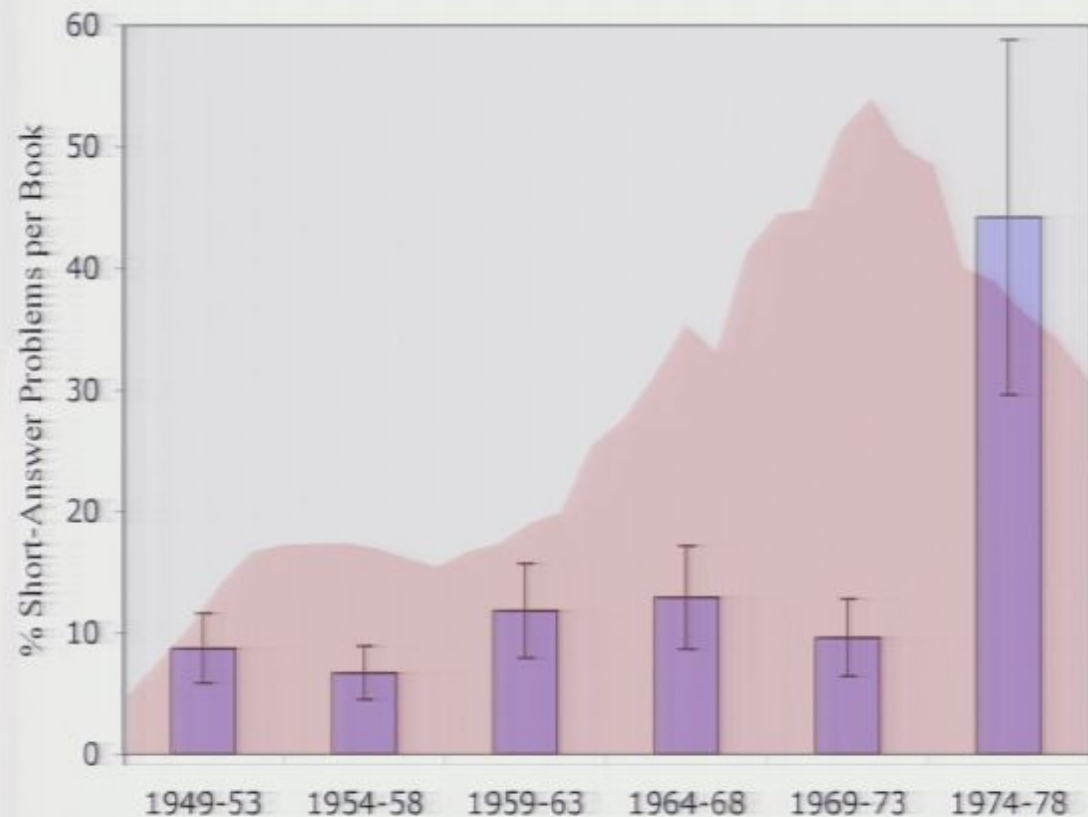
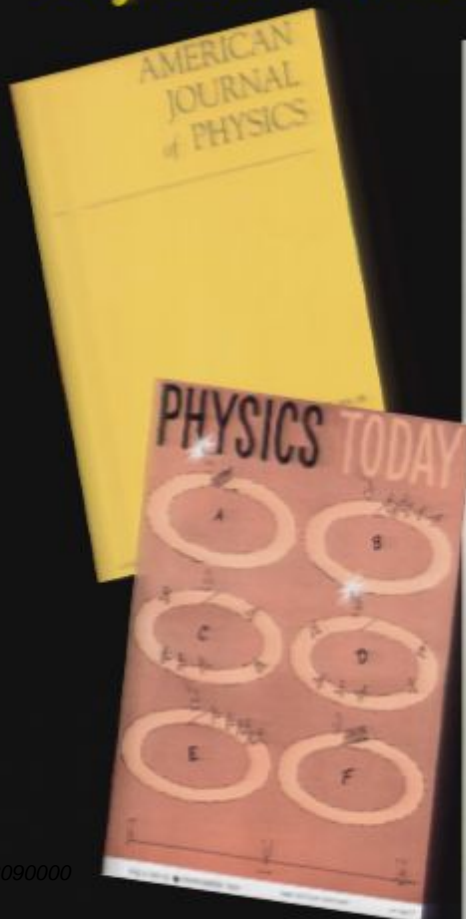
interpretive material:  $2.6 \pm 1.5\%$

*Gerjuoy, 1956:* “With these subjects [causality, complementarity, uncertainty], lecturing is of little avail. The baffled student hardly knows what to write down, and what notes he does take are almost certain to horrify the instructor.”

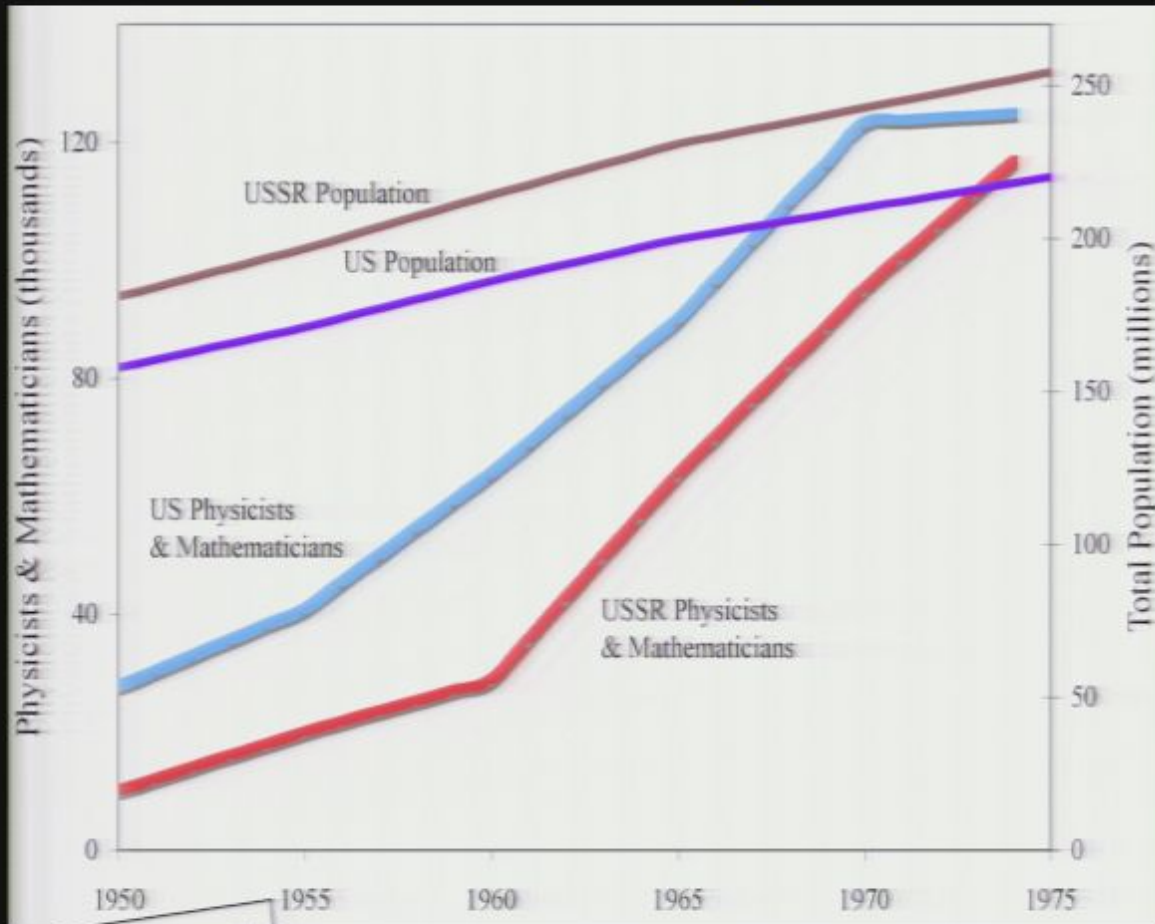
*Hill, 1958:* role of class discussions.

# Essays and Algebra

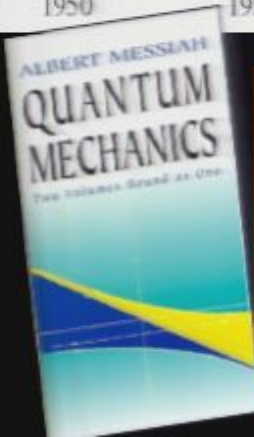
US physicists published 33 graduate-level QM textbooks during 1949-78, containing 6,261 problems. The proportion of interpretive (short-answer) problems stayed low until enrollments crashed.



# International Comparisons

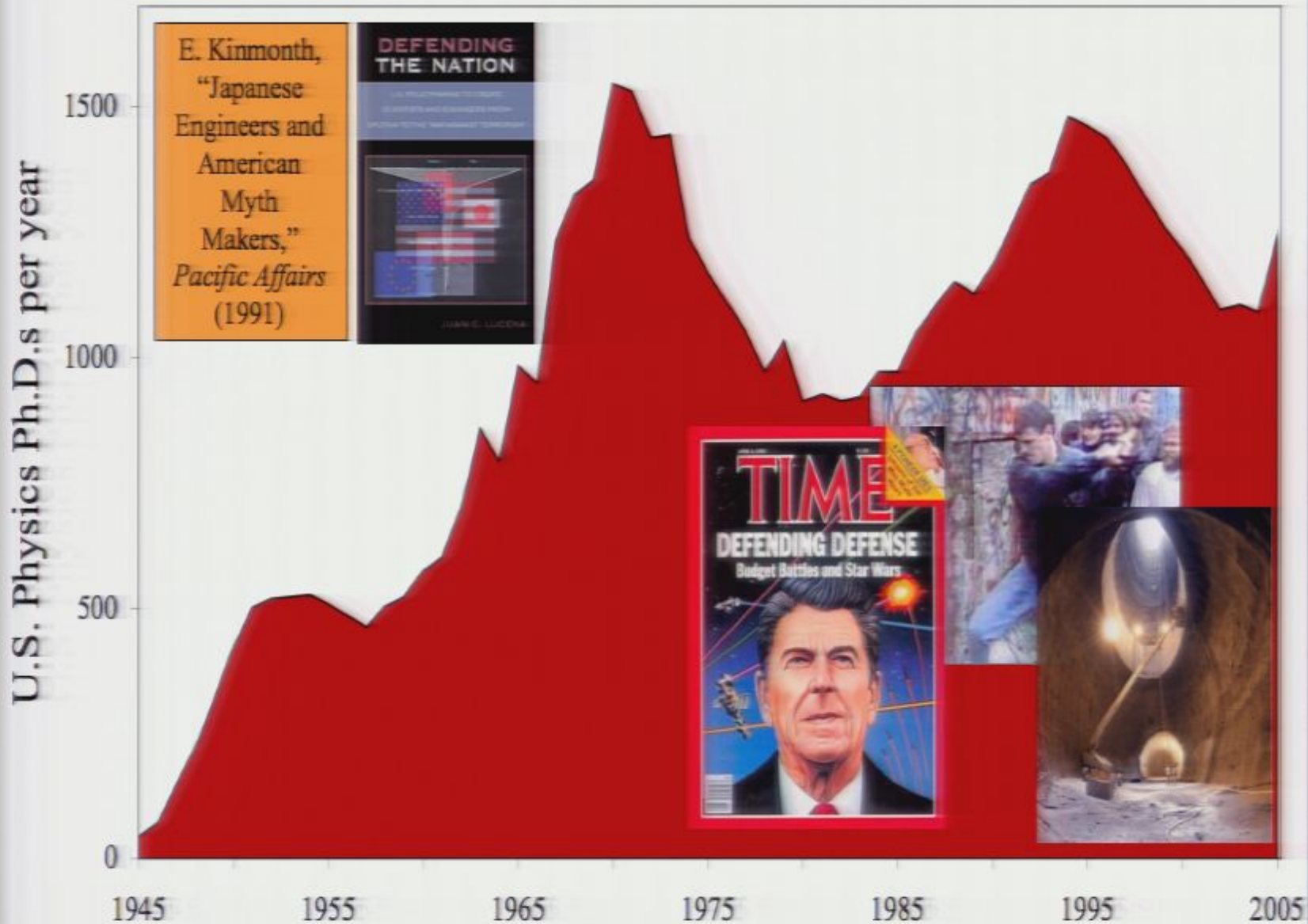


Canada, UK, USSR: Similar enrollment patterns; similar QM textbooks.



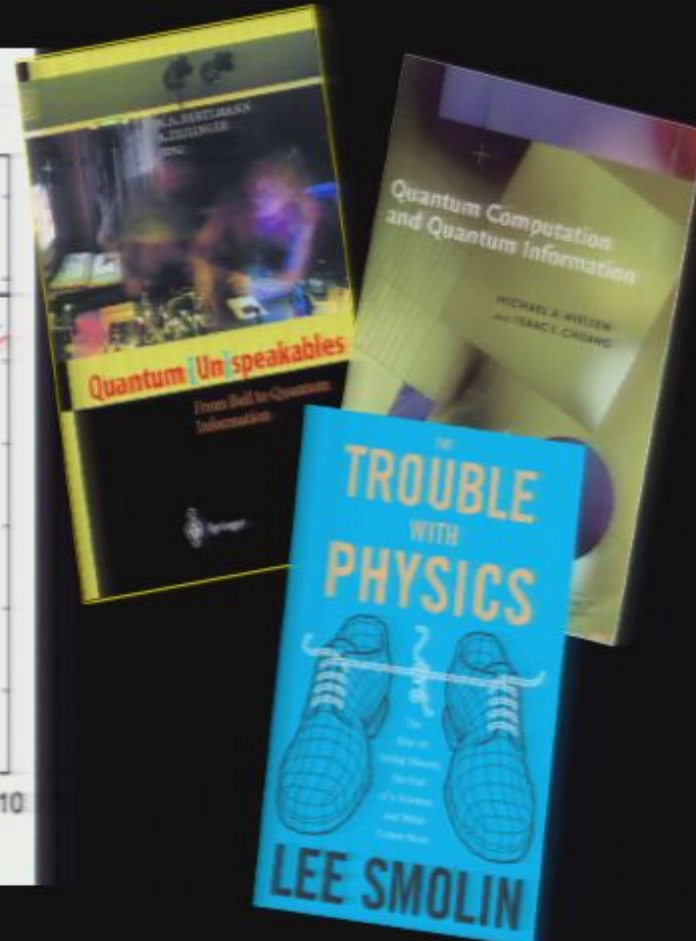
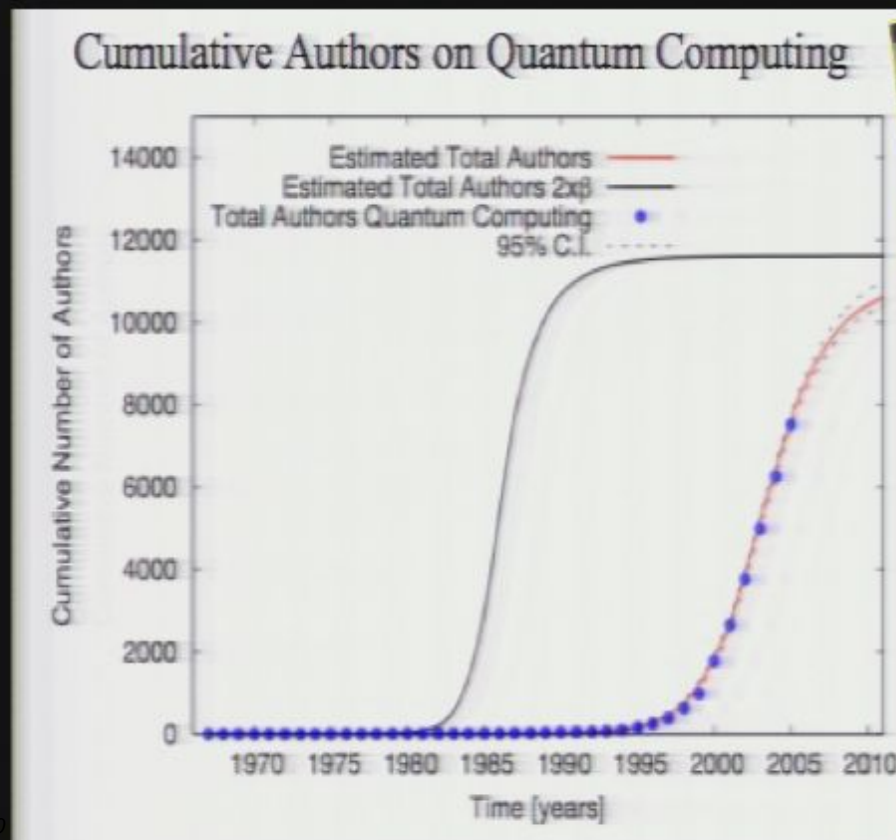
**W. Europe:** Little enrollment pressure; QM textbooks still included long sections on philosophy. They averaged *three times* the proportion of short-answer problems as US books.

# A Second Bubble



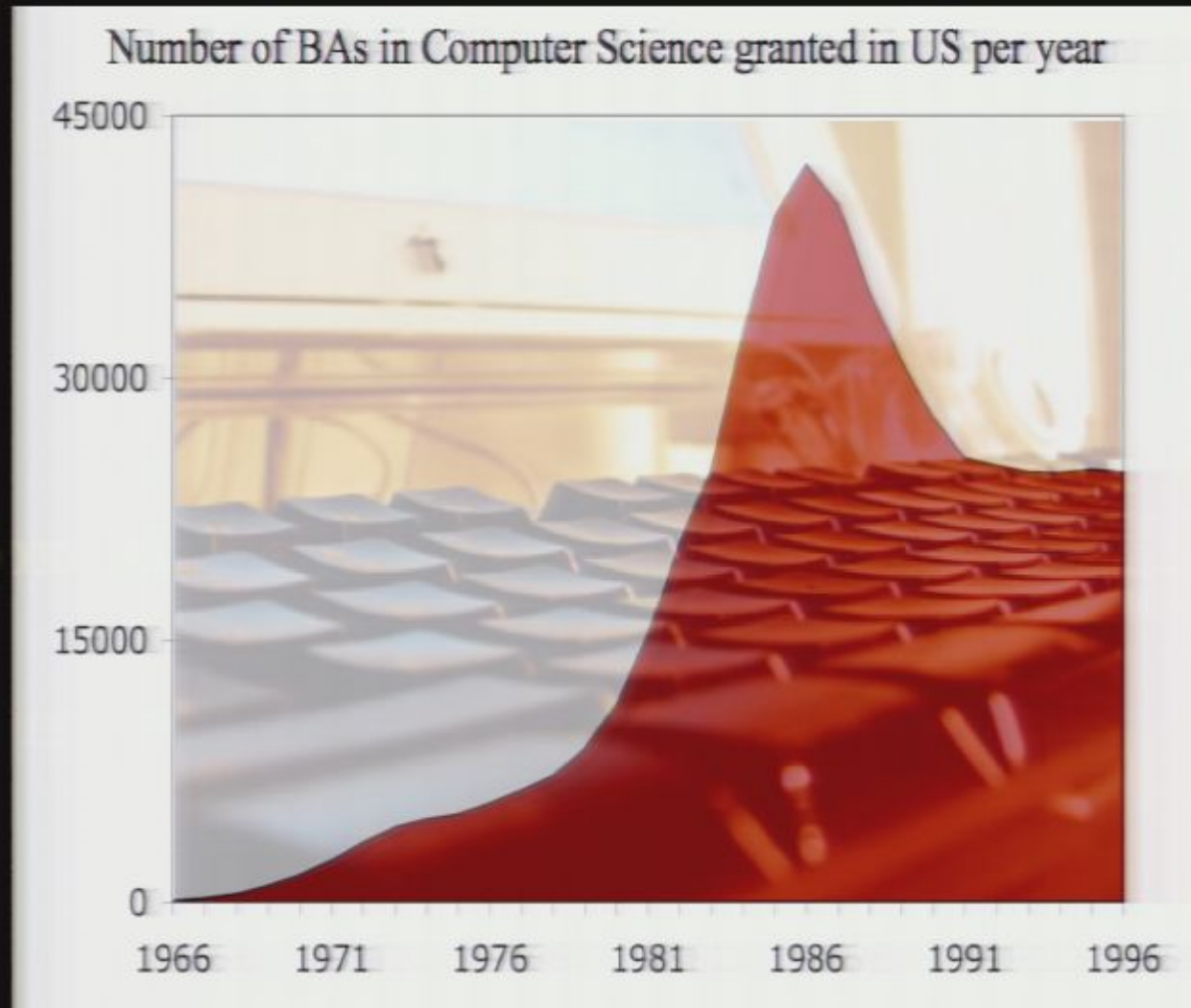
# Trade-Offs

It's not that one style was good and the other bad; by no means was the process one of "dumbing down." The narrowing of scope to calculation rather than interpretation fostered certain research directions while closing off others.

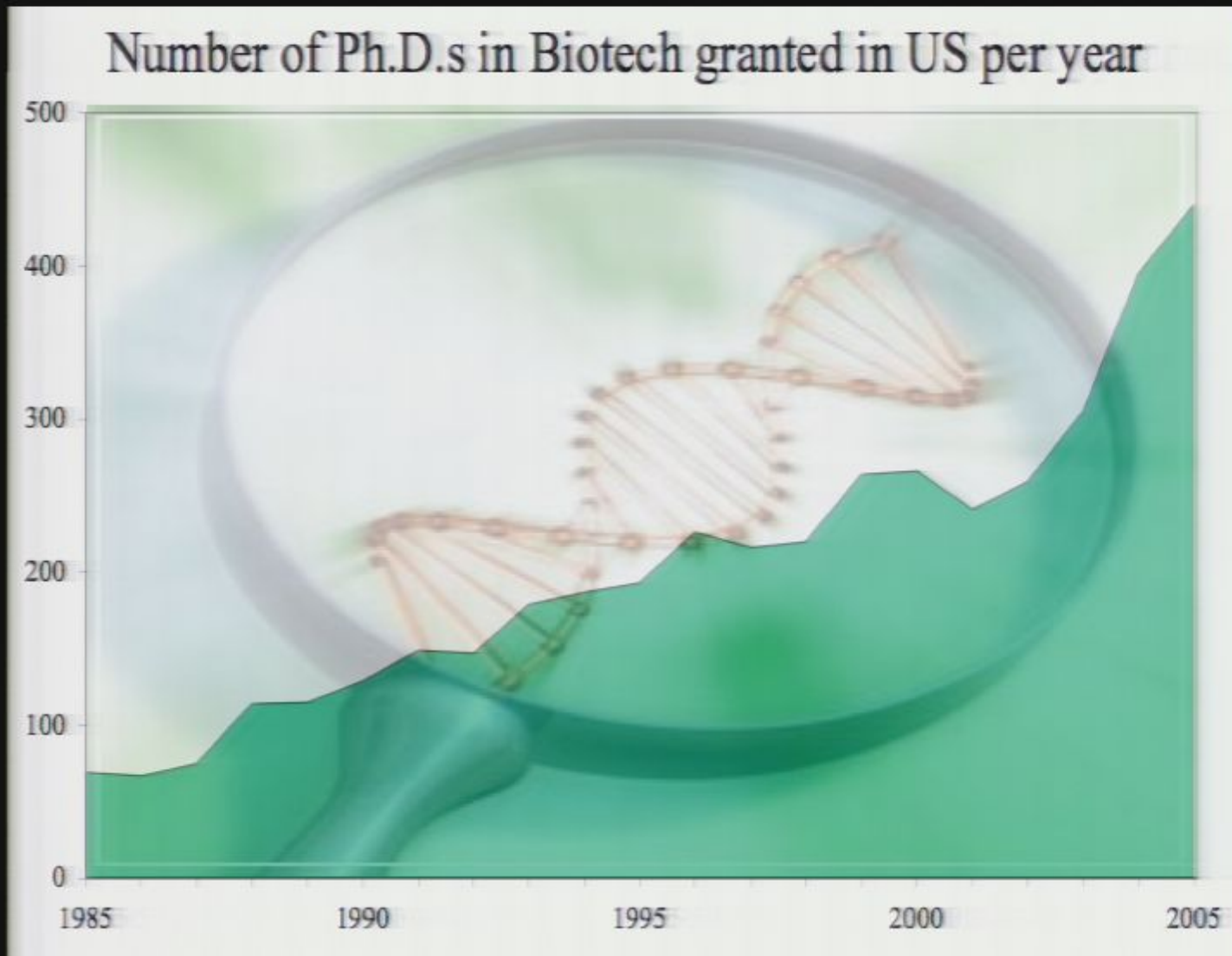


# Other Bubbles

Mid-1980s:  
introductory  
CS courses  
shifted from  
theories of  
computation to  
minutiae of  
programming.



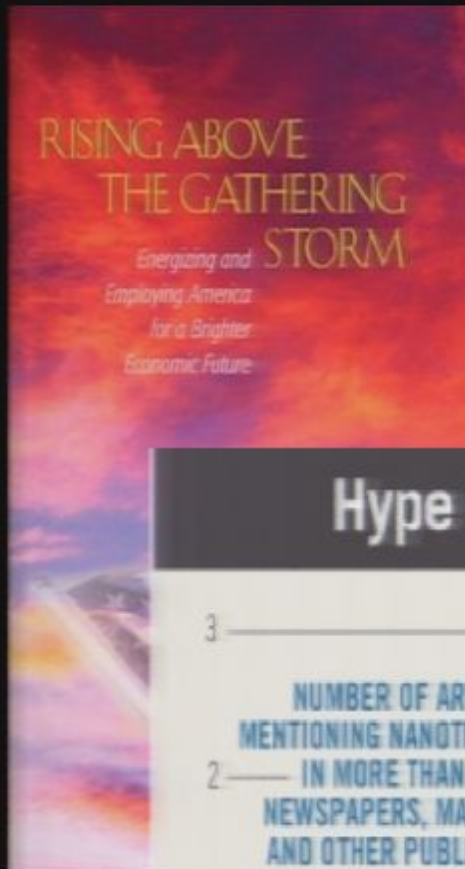
# Bubbles Today?



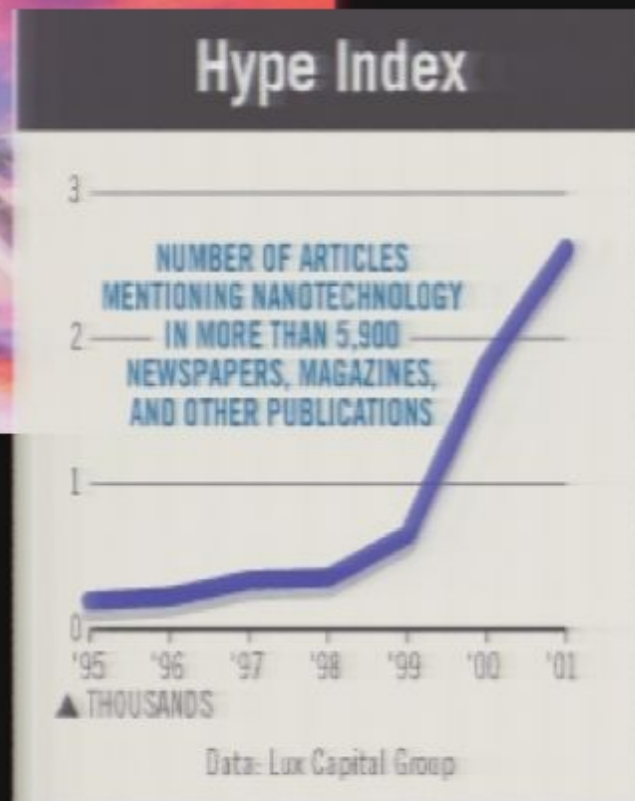
Annual rate has more than *quadrupled* in two decades...



# Bubbles and the World of Ideas

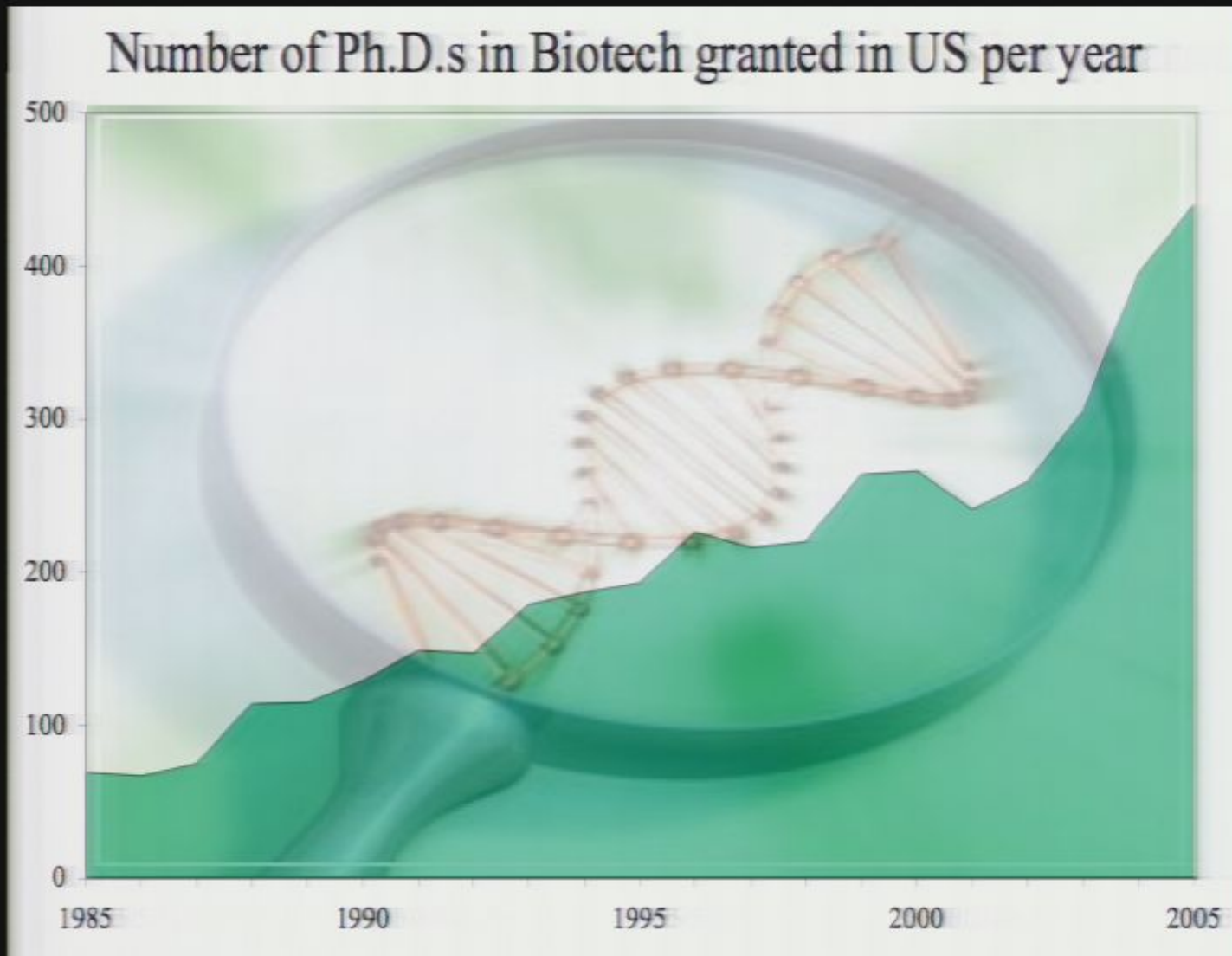


We must treat talk of “shortages” of scientific and technical labor with great care. The numbers can be made to tell all kinds of stories.



More is at stake than an unstable labor market. These boom-and-bust cycles can shape what counts as “real” science in a given time and place.

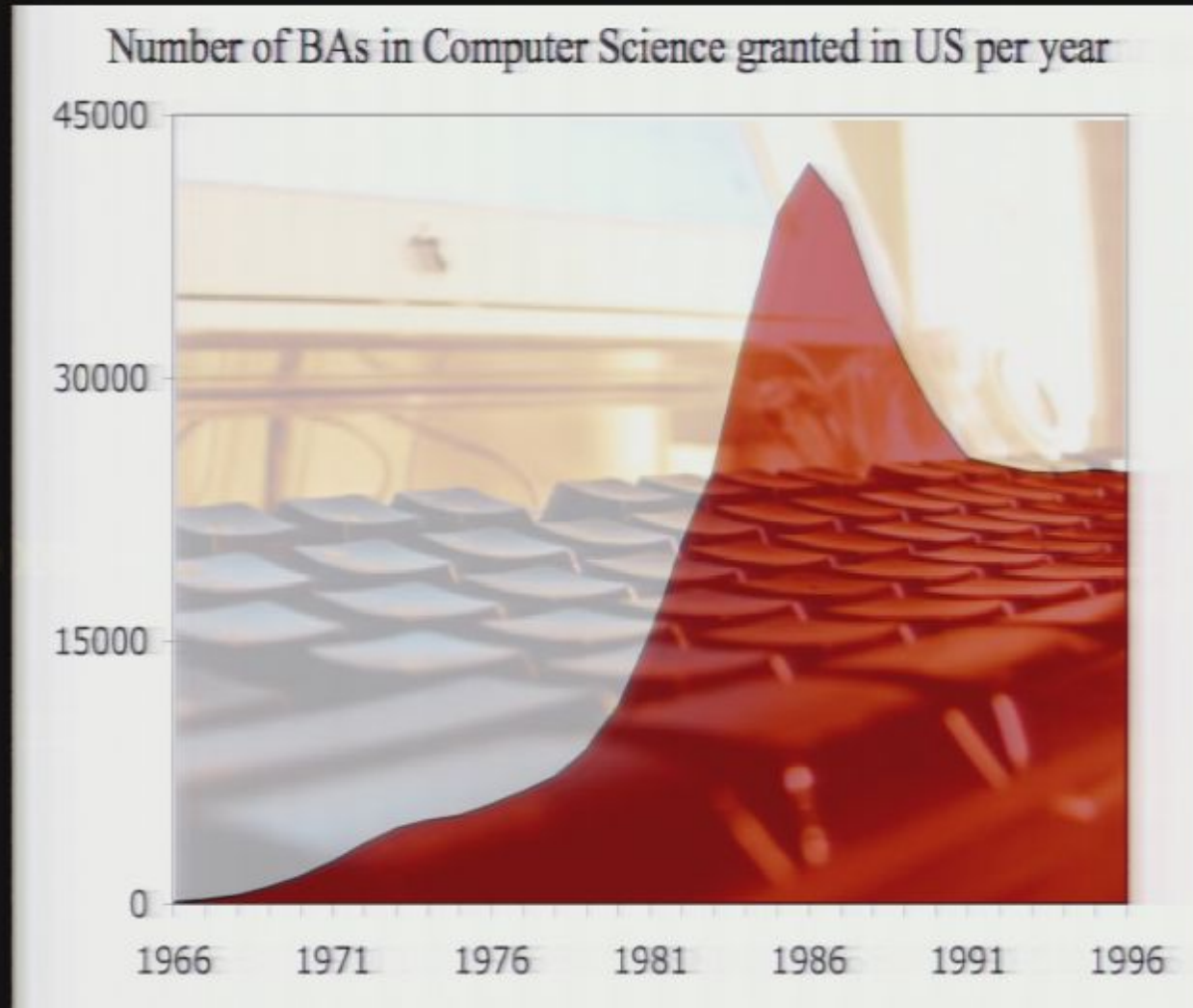
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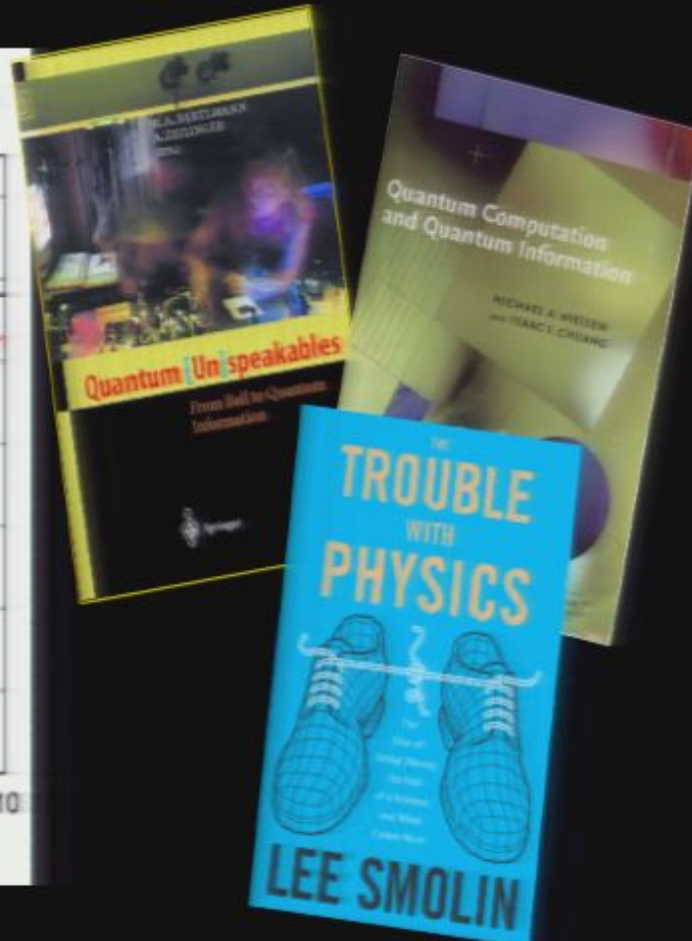
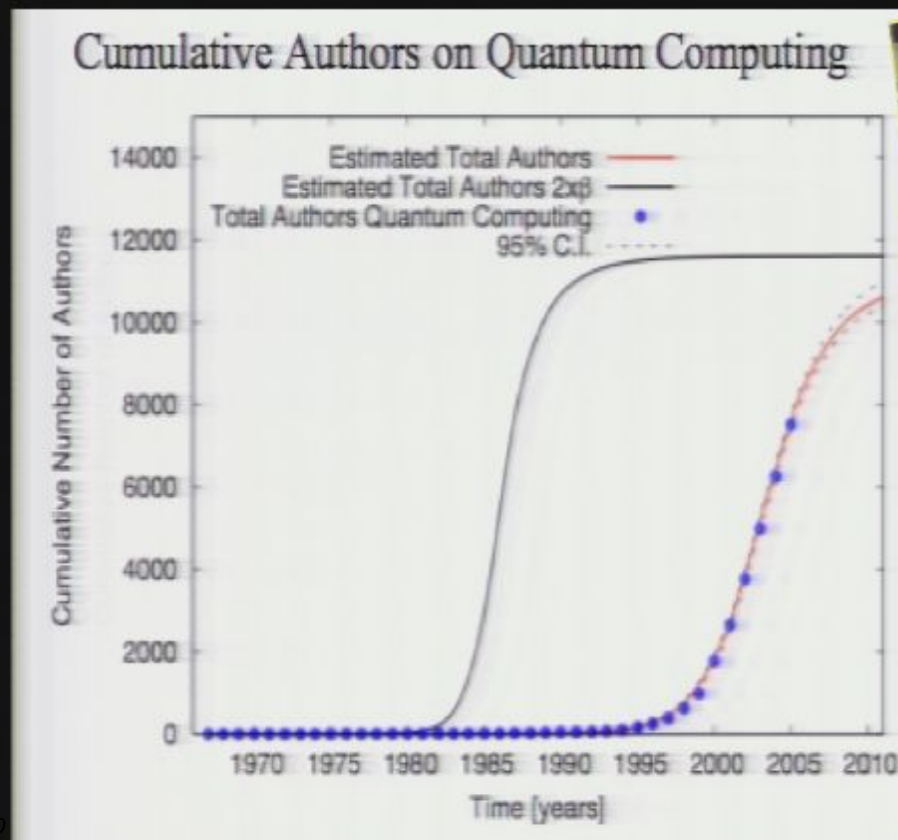
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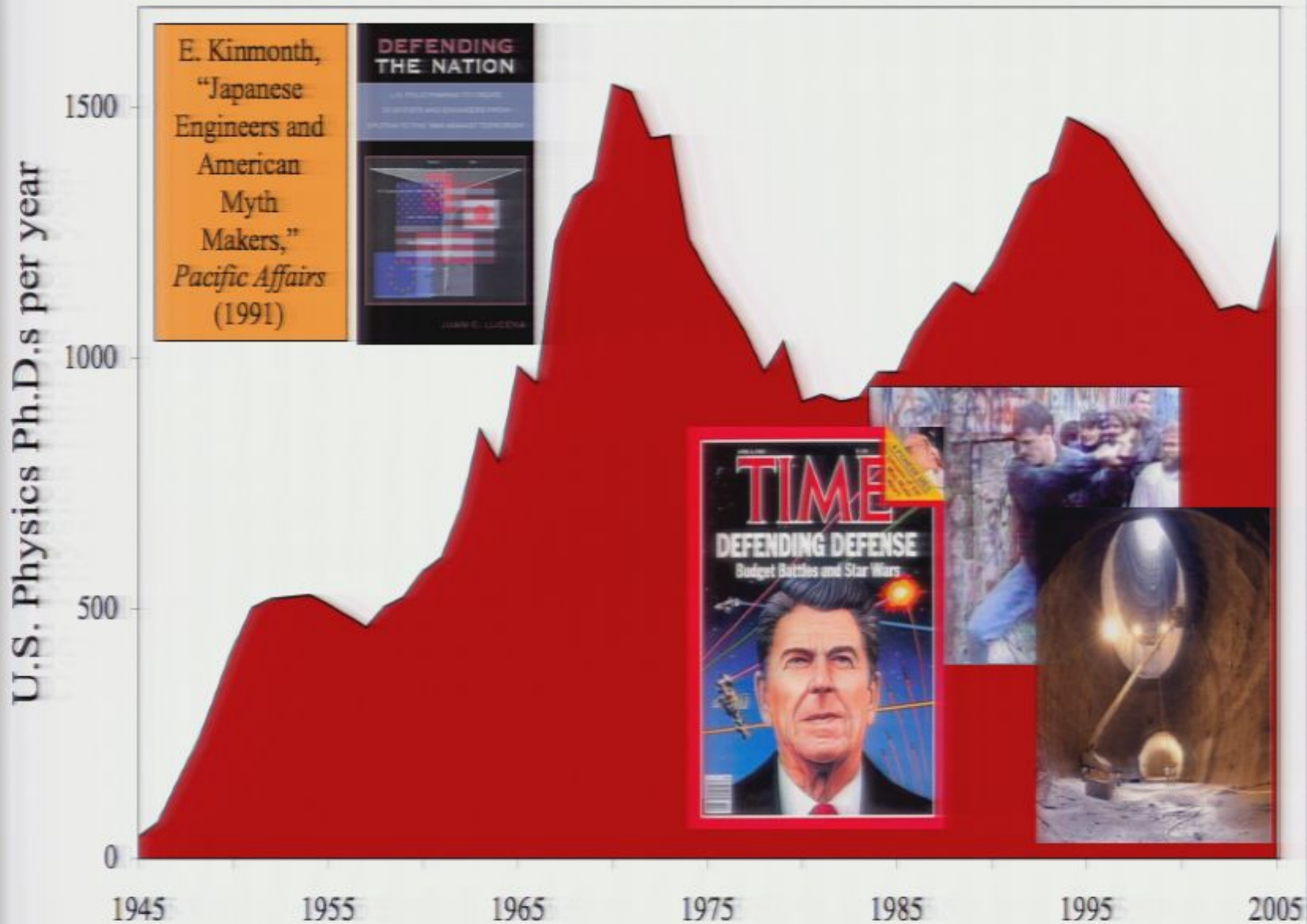


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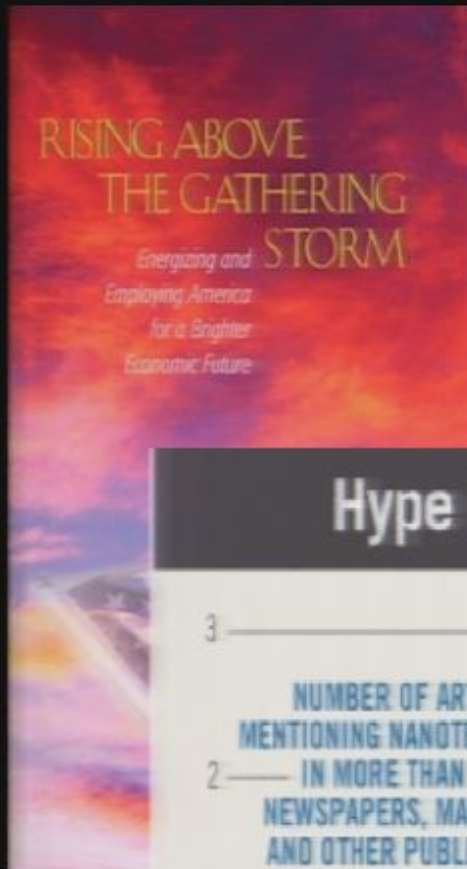
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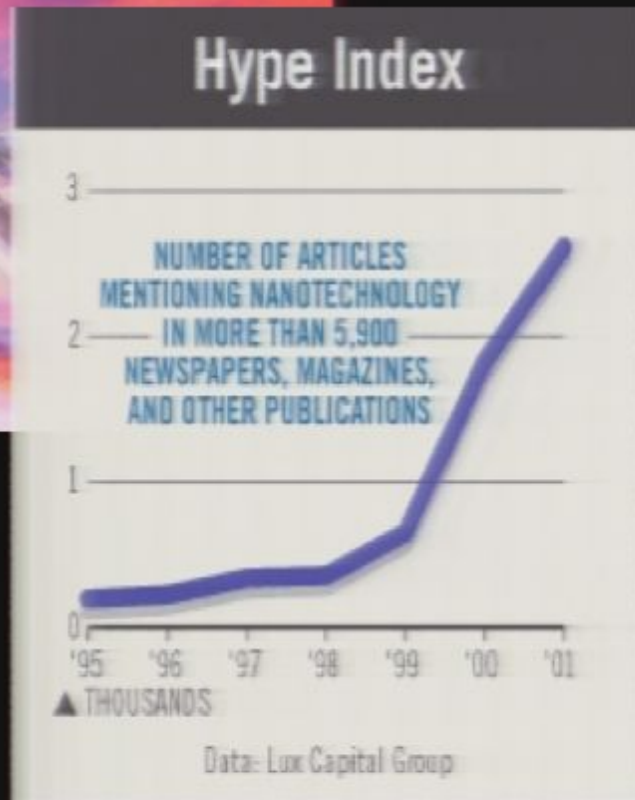
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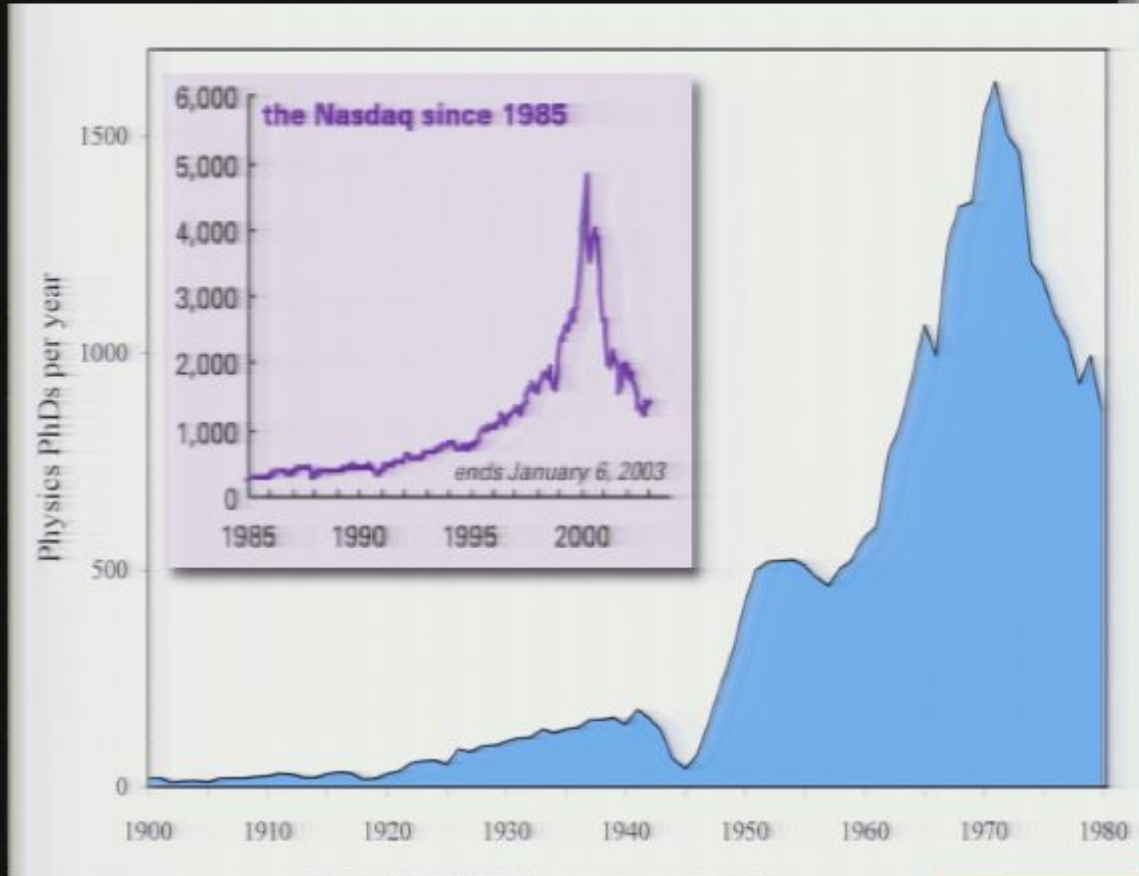


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