

# Some elements from history and philosophy of science for nanoethics

Andrea Saltelli

Course NANO 310, Bergen, August 31<sup>st</sup>, 2022



Where to find this talk: [www.andreasaltelli.eu](http://www.andreasaltelli.eu)

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... and these are 6 m worth watching from Slavoj  
Žižek [youtube.com/watch?v=TVwKjG...](https://www.youtube.com/watch?v=TVwKjG...)

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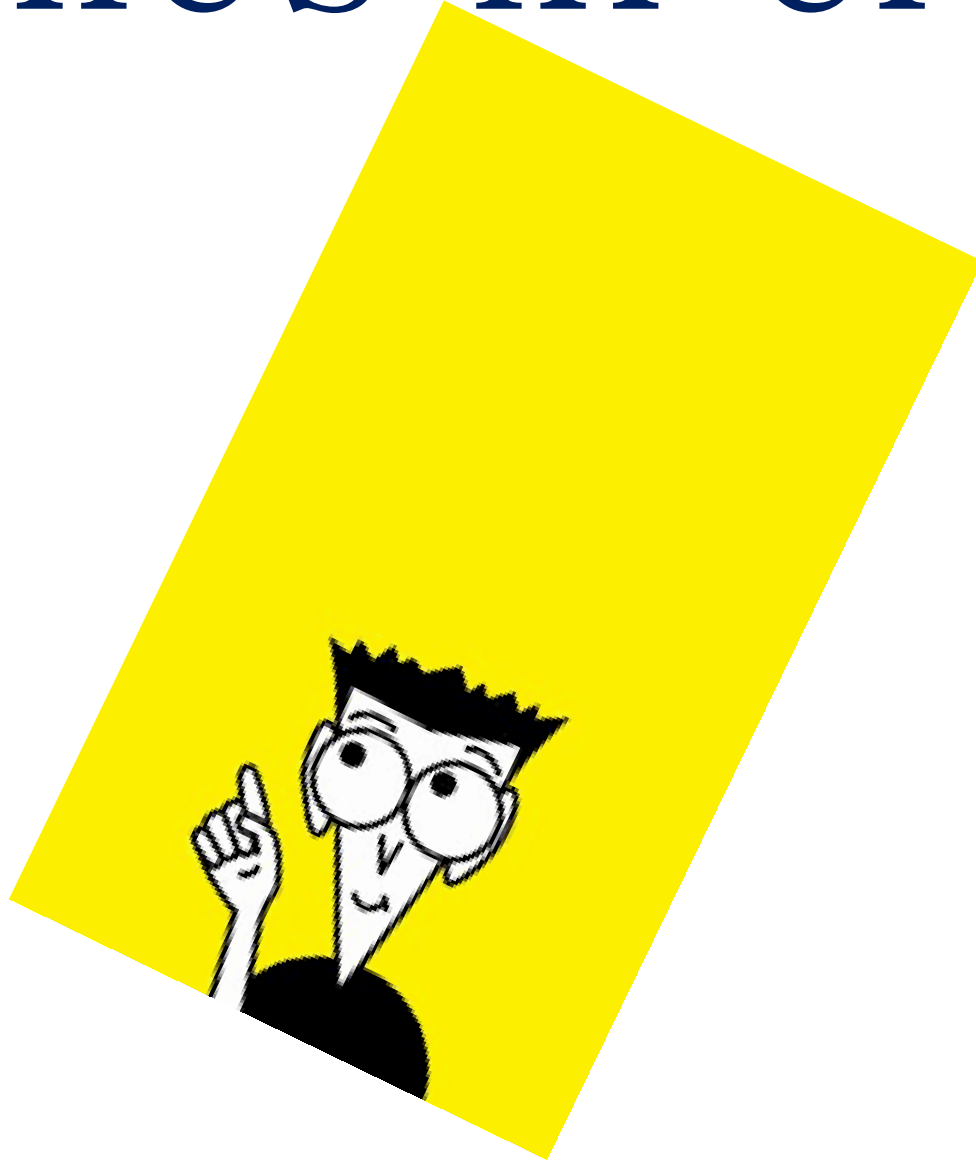
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# Ethics in crumbs



# Philosophical quests:

Ontology: what is

Epistemology: how to know

Ethics: what to do

Question:  
which  
comes  
first?



Golden rule



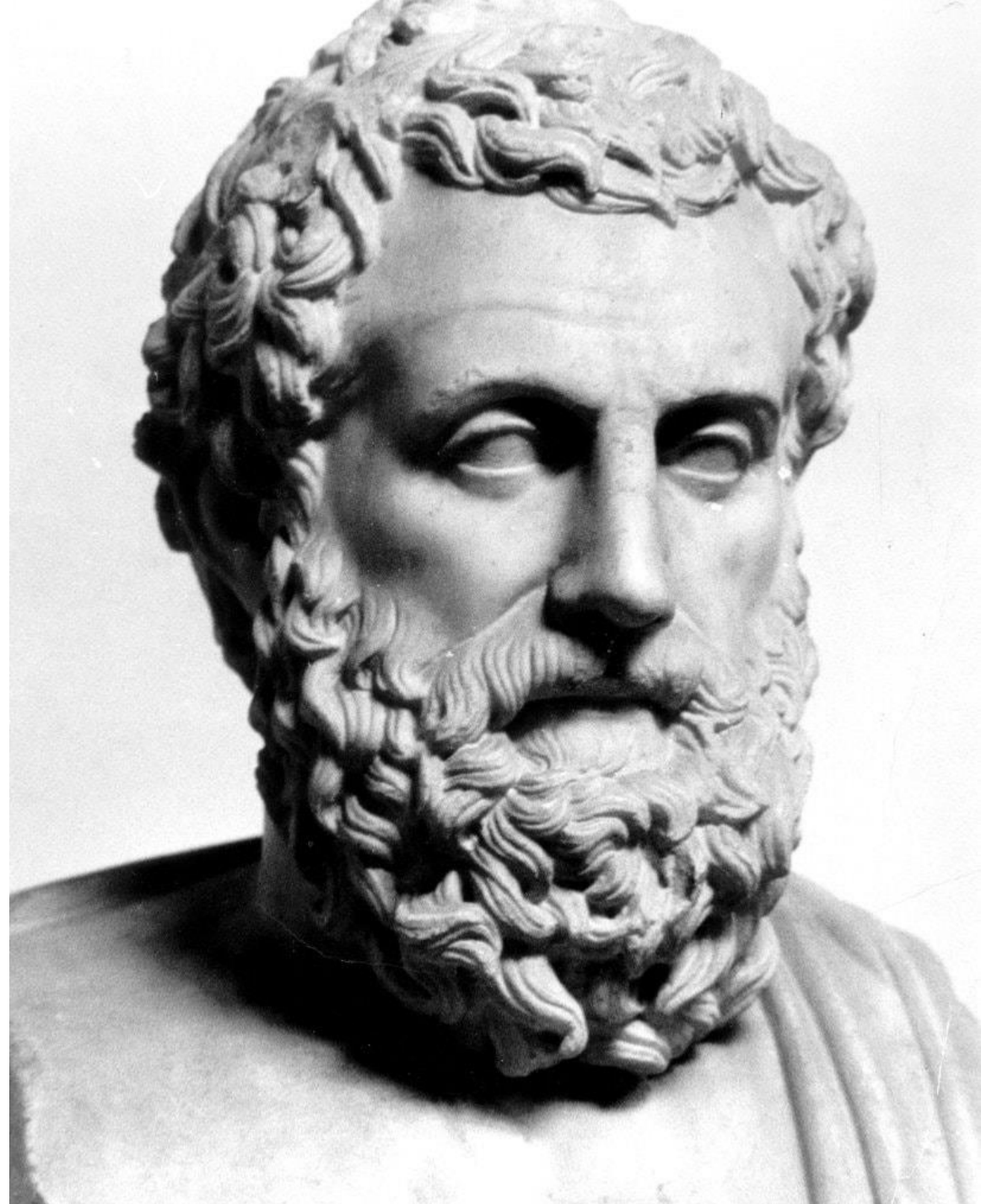
“treat others as you treat yourself” (Mahābhārata, ~IV–III century BCE)

“Avoid doing what you would blame others for doing” (Thales ~624 BC, ~546 BC)

“Treat your inferior as you would wish your superior to treat you” (Seneca, ~4 BC–65 AD)

“Thou shalt love thy neighbour as thyself”, (Paul the apostle, ~5–~64 AD)

# Aristotle's Nicomachean Ethics



For Aristotle (384, 322 BC) strict relation between ethics and politics

Ethics: How to live a good life (myself)

Politics: How to promote a good life (in the polis)

“...though it is worth while to attain the end merely for one man, it is finer and more godlike to attain it for a nation or for city-states. These, then, are the ends at which our inquiry aims, since it is political science, in one sense of that term”, Book 1, Chapter 2



Ethics for educated citizens [Athenians], no children, no barbaroi, no slaves or craftsmen, no idiots, no women, [but their happiness important]

Unlike in Plato, there is no universal good (no summum bonum)

As the function of man is intellectual activity, his 'good' must be plural and coincide with the exercise of virtues (aretes), among which justice is key

Question: which are the other three virtues?



Happiness descends from the living of a good life;  
eudaimonia corresponds to being good to the polis  
(ethics and politics together here)

*εὐδαιμονία*

The concept of eudaimonia has lost little of its appeal; see e.g. Jeffrey Sachs and the World Happiness Report...

**Figure 2.7: Ranking of Happiness 2016-2018 (Part 1)**

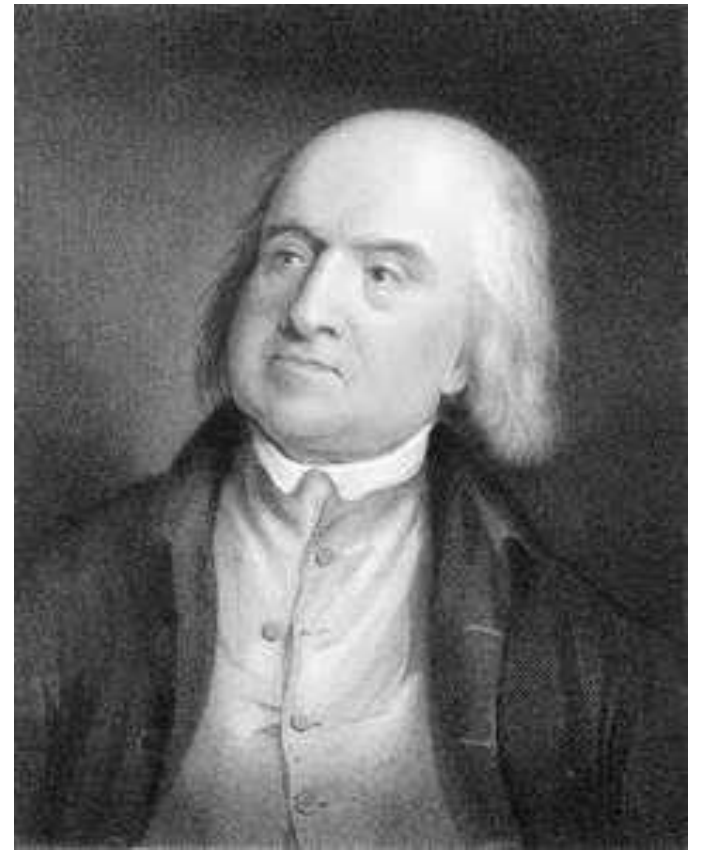


εὐδαιμονία

Fast forward some ~two millennia

Jeremy Bentham's fundamental  
axiom

"it is the **greatest** happiness of the  
**greatest** number that is the  
measure of right and wrong"



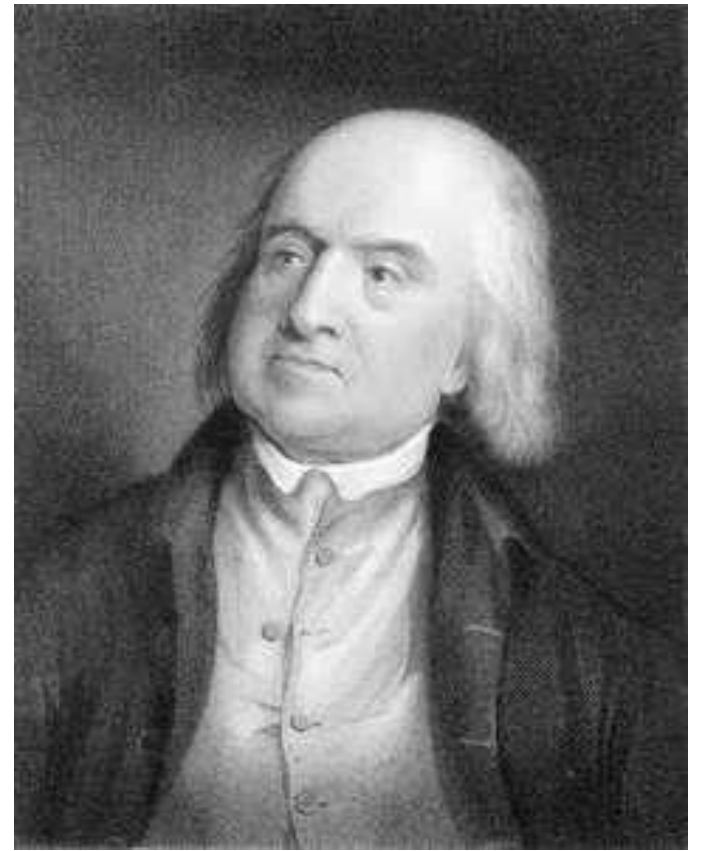
Jeremy Bentham  
(1748, 1832)

The long lasting influence of  
utilitarianism, e.g. today in economics;

Implies computing the greatest  
happiness for the greatest numbers

From Condorcet's *mathématique sociale*  
to today's cost benefit analyses

(decisionism, procedural utopia,...)



Jeremy Bentham  
(1748, 1832)





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Andrew Chen, 2002, The Ethics of Nanotechnology,  
Markkula Center for Applied Ethics, May 3, 2002,

<https://www.scu.edu/ethics/focus-areas/technology-ethics/resources/the-ethics-of-nanotechnology/>

# Manufacturing

Precision Manufacturing

Material Reuse

Miniaturization

# Medicine

Pharmaceutical Creation

Disease Treatment

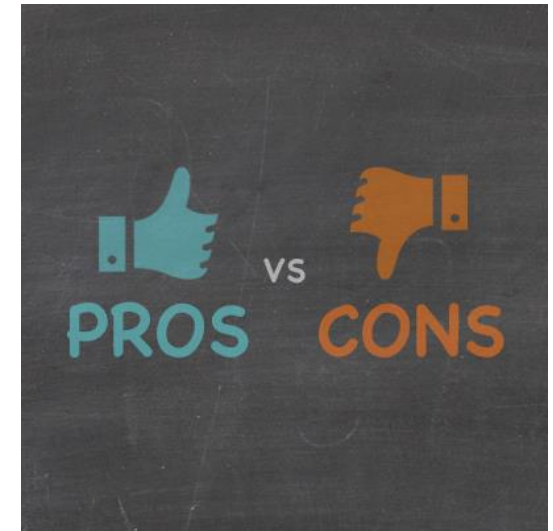
Nanomachine-assisted Surgery

# Environment

Toxin Cleanup

Recycling

Resource Consumption Reduction



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Weapons

Miniature Weapons and Explosives

Disassemblers for Military Use

Rampant Nanomachines

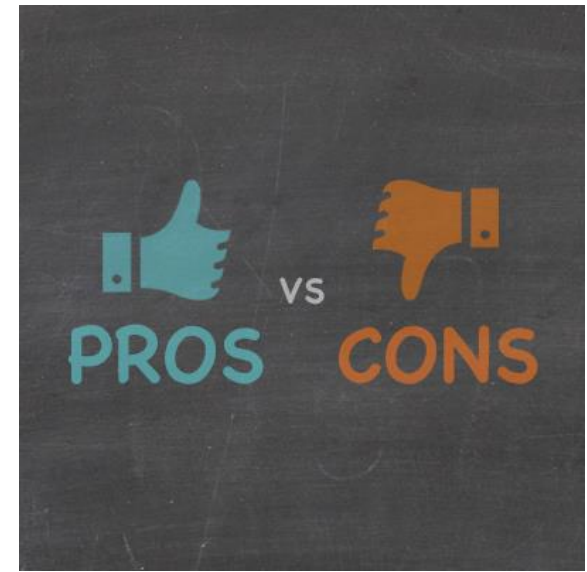
Self Replicating Nanomachines

The Gray Goo Scenario

Surveillance

Monitoring

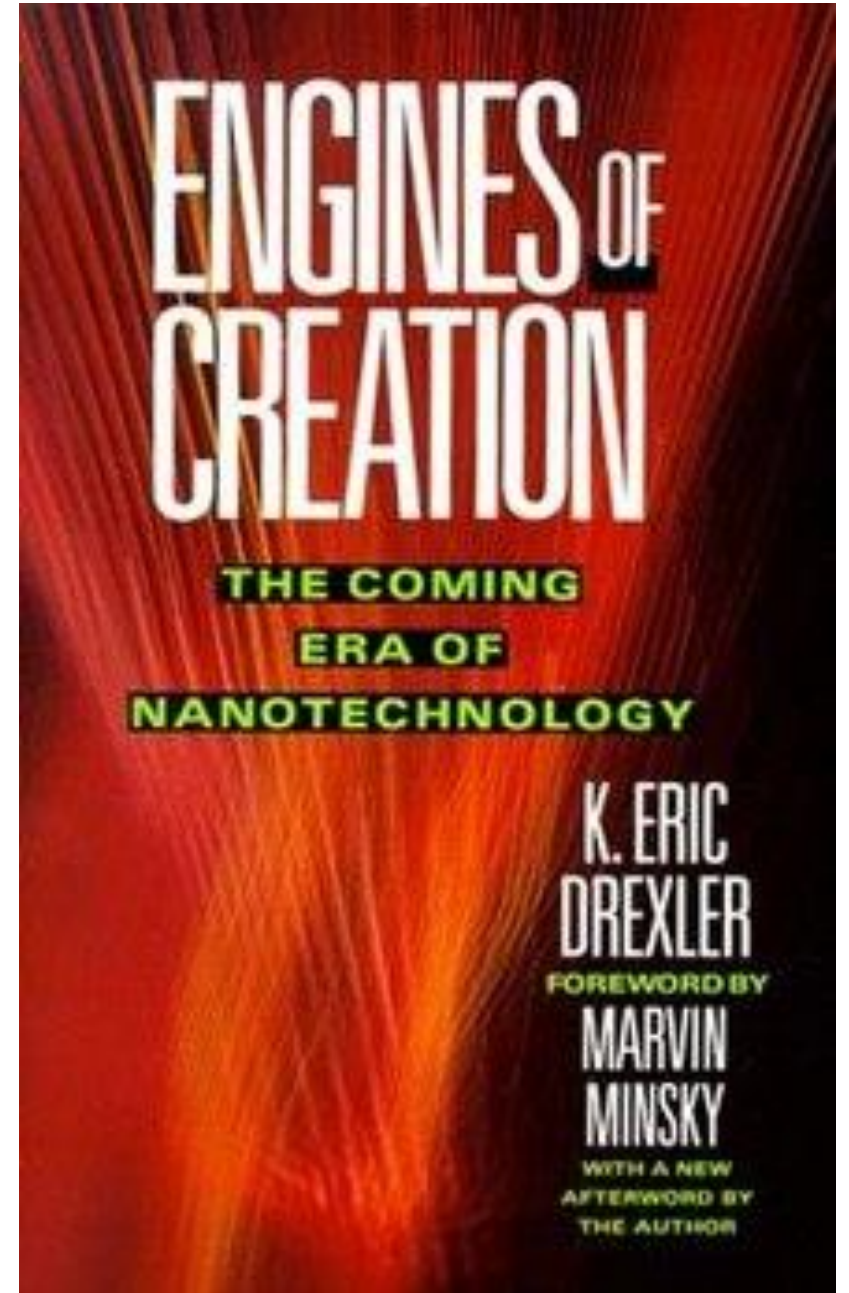
Tracking



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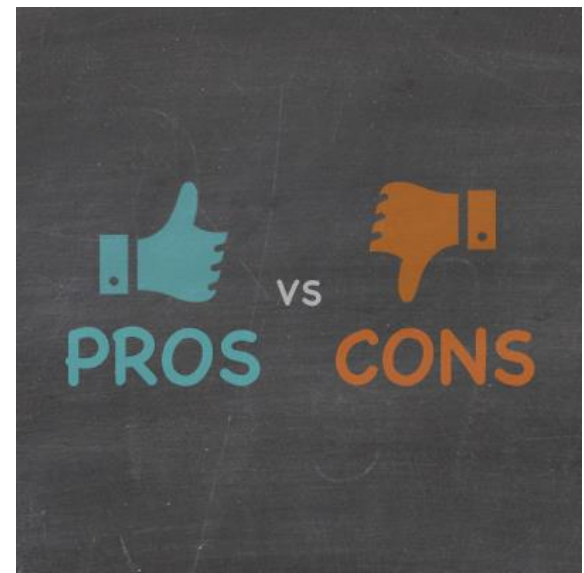
**Note:** Gray Goo Scenario =  
self-replicating robots  
consuming all biomass on  
Earth while building more of  
themselves

<https://foresight.org/>



# Possible guidelines

- Nanomachines should only be specialized, not general purpose
- Nanomachines should not be self replicating
- Nanomachines should not be made to use an abundant natural compound as fuel
- Nanomachines should be tagged so that they can be tracked





Against nano for  
weapons?

Campaign to stop autonomous lethal  
weapons,

<https://www.stopkillerrobots.org/>

Video:

<https://www.youtube.com/watch?v=TlO2gcs1YvM>

Article:

<https://ijermt.org/publication/36/IJERMT%20V-5-5-5.pdf>

Nano for trans-humanism?

Will GRIN technologies (-geno, -robo, -info, -nano) change the inner constitution of human body?

# Nano for trans-humanism?

Cuadernos de Bioética XXV 2014/3<sup>a</sup>

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## FROM DARWINIAN TO TECHNOLOGICAL EVOLUTION: FORGETTING THE HUMAN LOTTERY

DESDE LA EVOLUCIÓN DARWINIANA A LA TECNOLÓGICA:  
OLVIDAR LA LOTERÍA HUMANA

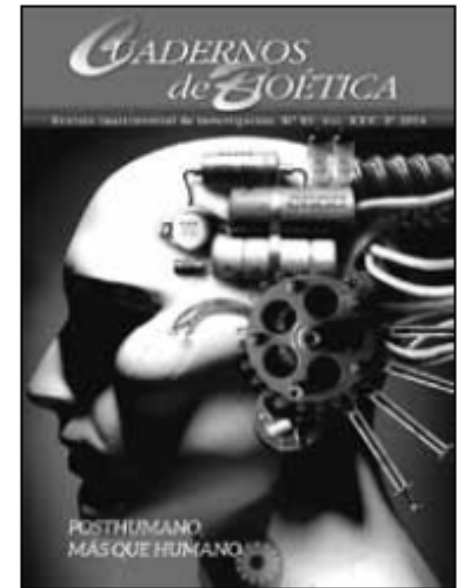
GIORGIO TINTINO

*University of Macerata*

*tinto13@alice.it*

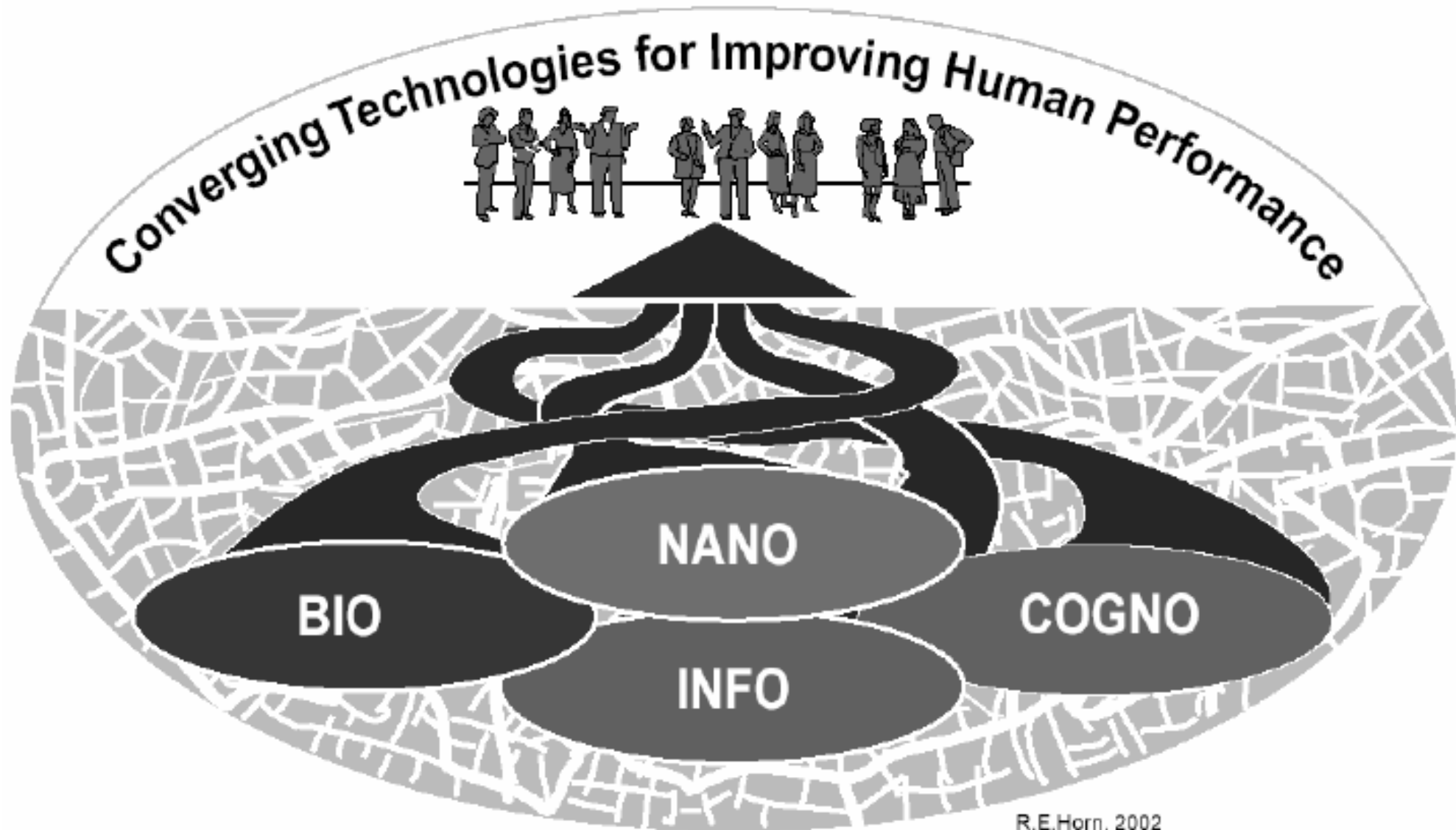
# Nano for trans-humanism?

“The human being finds his partner of evolution in technology, a partner who doesn't remain outside his biological constitution but penetrates the inmost of its processes”

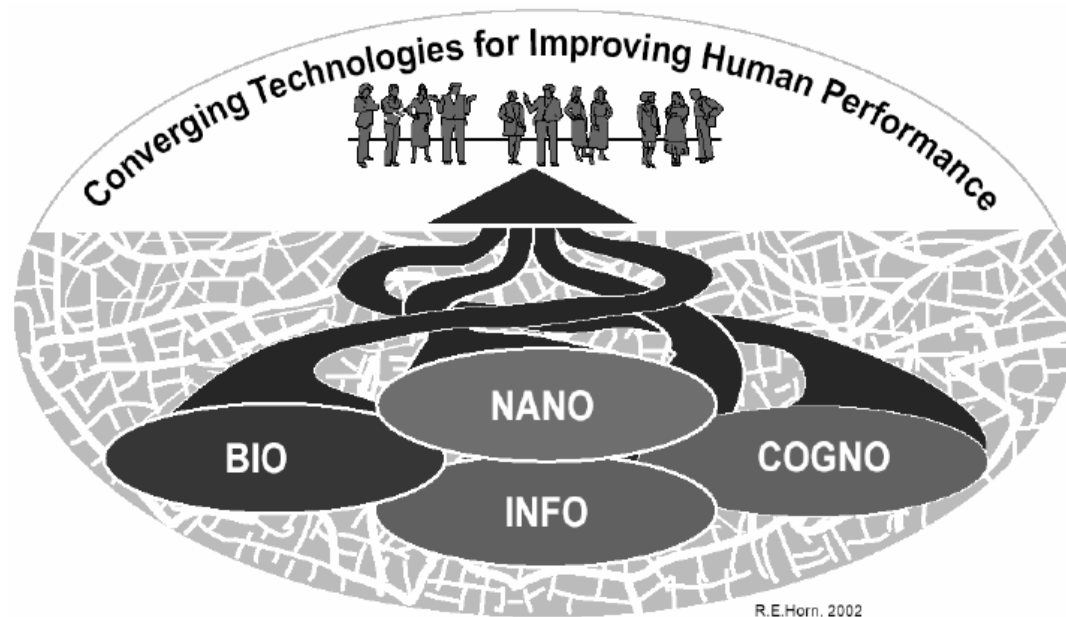




A criticized (in the EU) report coming from the US

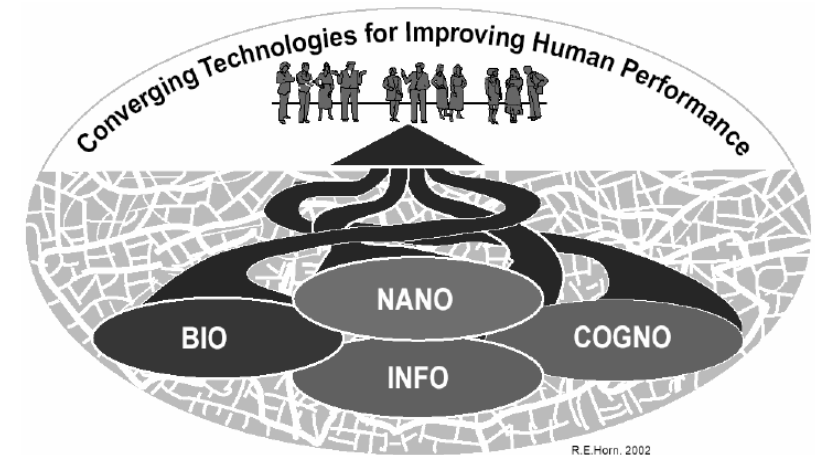


Funded by U.S. National Science Foundation and Department of Commerce; known as the **NBIC** report (Nanotechnology, Biotechnology, Information Technology, and Cognitive Science)



Roco, M.C., and Bainbridge, W.S. (eds) (2002) Converging technologies for improving human performance, NSF-DOC Report, Kluwer, 2003.

- Expanding human cognition and communication,
- Improving human health and physical capabilities,
- Enhancing group and societal outcomes,
- National security,
- Unifying science and education



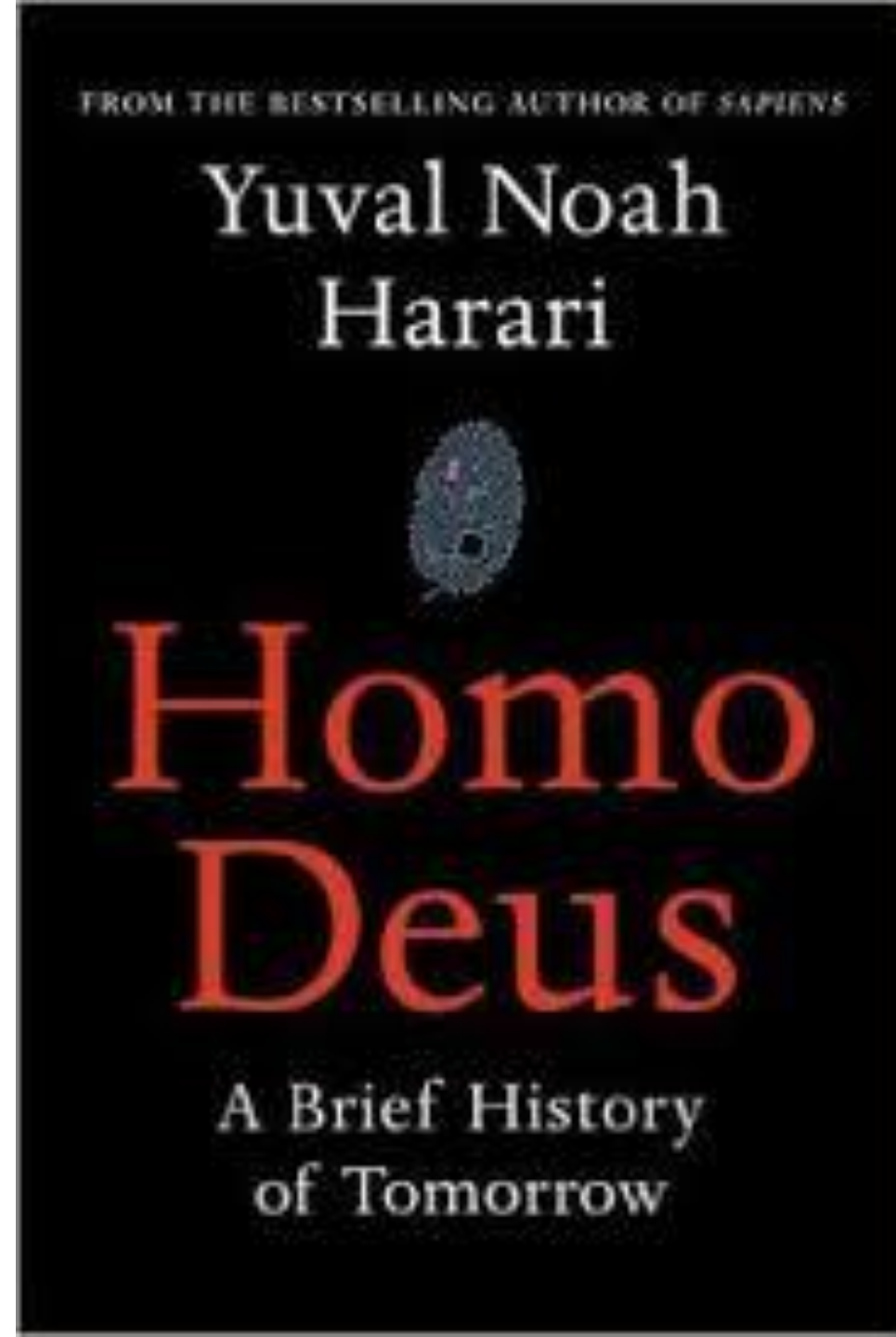
# Harari's reading

“Solving death?”

“Upgrading humans into gods?”

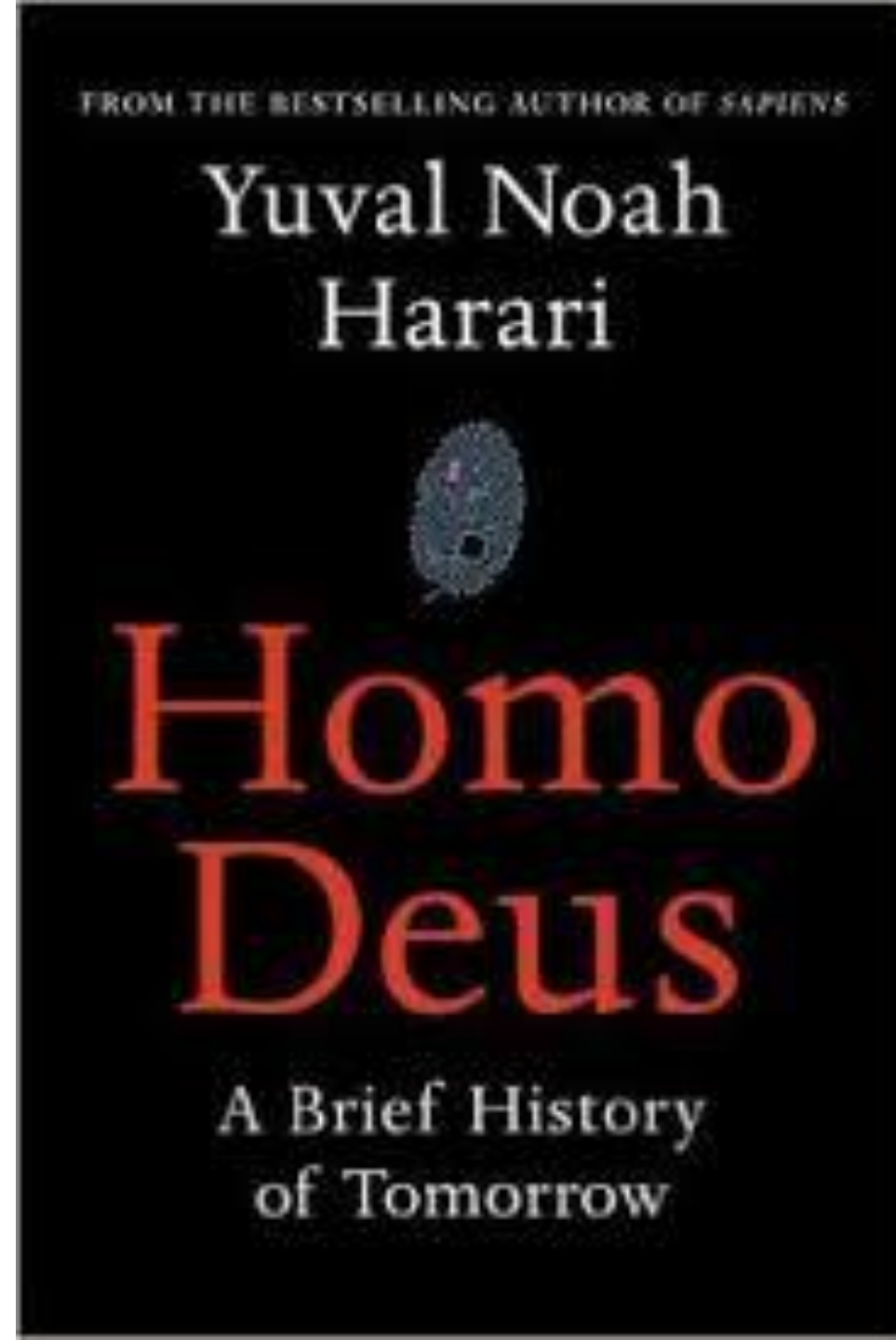
“Human bid for divinity certain”

“Nobody can hit the brakes”



# Harari's reading

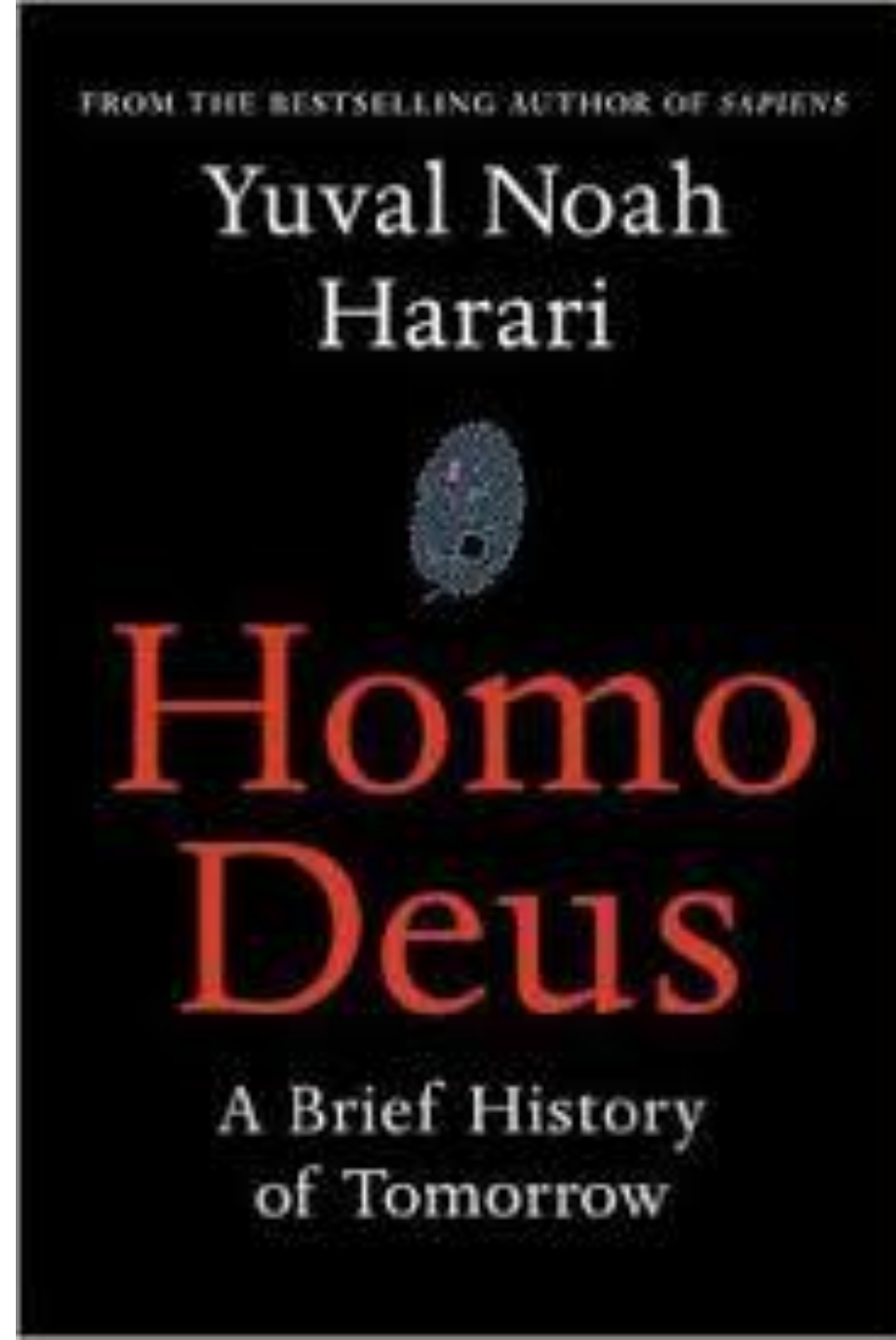
“...human bodies will incorporate a host of biometric devices, bionic organs and nano-robots, which will ... defend us from infections...online 24/7 ...”



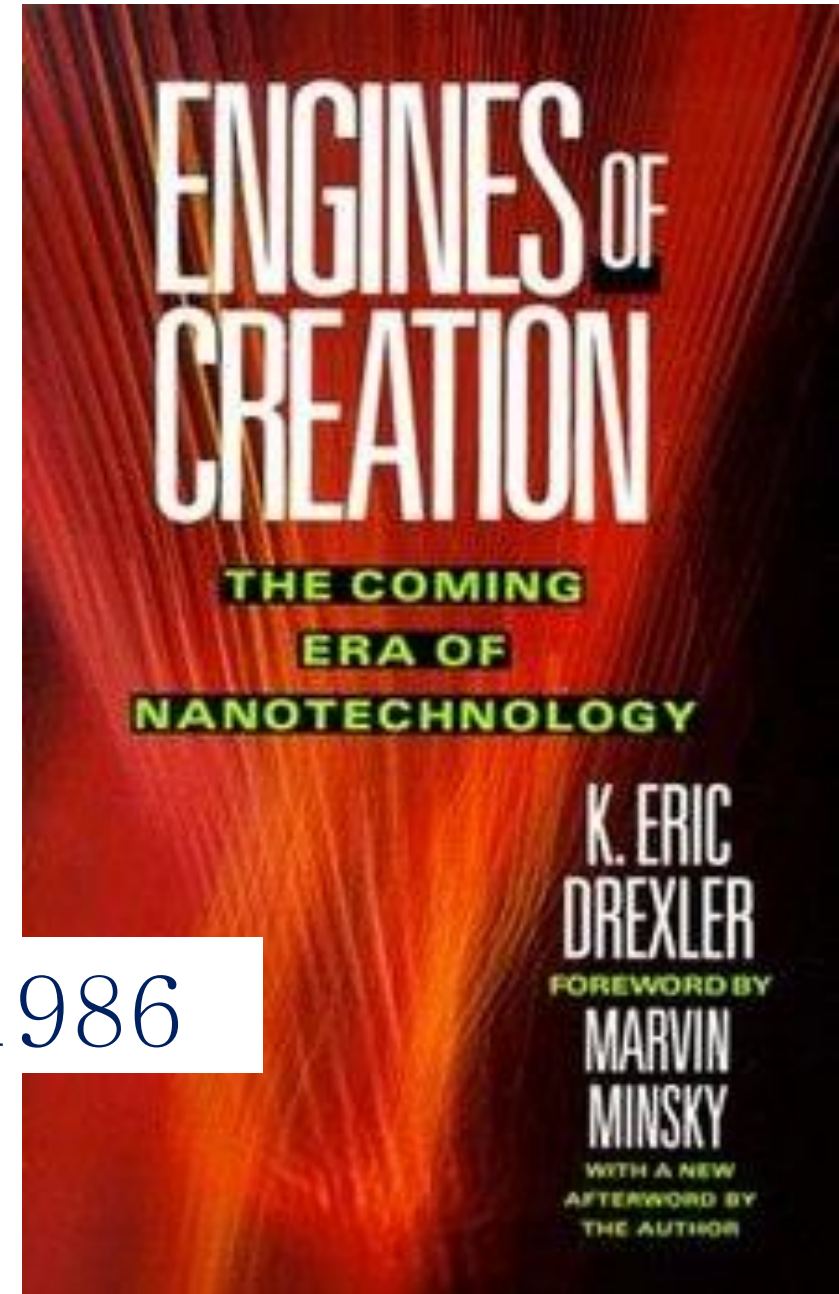
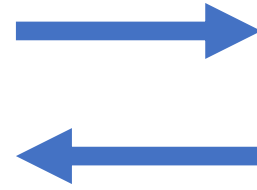


# Harari's reading

“... if I don't upgrade my antivirus regularly I might discover that the millions of nano-robots coursing through my veins are now controlled by a North Korean hacker.”



Richard P. Feynman, There's Plenty of Room at the Bottom, Speech at Caltech, December 29, 1959.



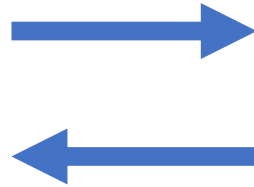
1986

[https://en.wikipedia.org/wiki/There%27s\\_Plenty\\_of\\_Room\\_at\\_the\\_Bottom](https://en.wikipedia.org/wiki/There%27s_Plenty_of_Room_at_the_Bottom)

See also <http://www.zyvex.com/nano>

# Richard Feynman versus Erik Drexler

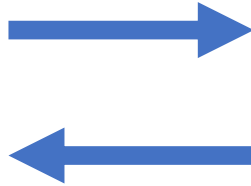
## 1959 versus 1986



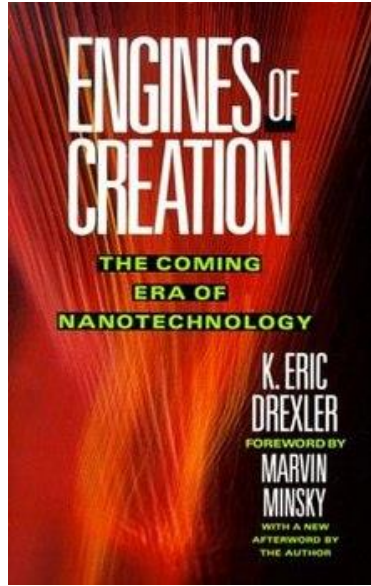
Both enthusiasts, and yet different worlds ...

[https://en.wikipedia.org/wiki/There%27s\\_Plenty\\_of\\_Room\\_at\\_the\\_Bottom](https://en.wikipedia.org/wiki/There%27s_Plenty_of_Room_at_the_Bottom)  
See also <http://www.zyvex.com/nano>

For both Feynman and Drexler nano  
holds promises of wonders

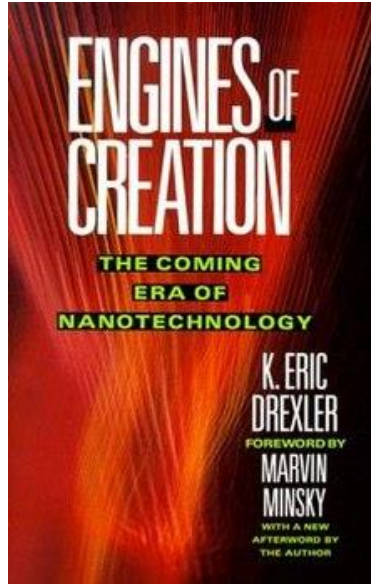


And yet Drexler sees dangers which  
Feynman doesn't. Was the innocence  
lost in just two decades?



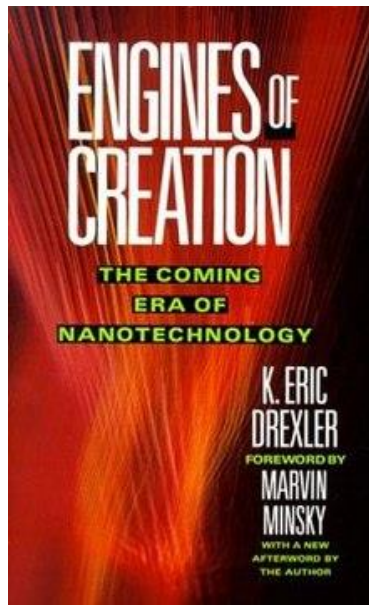
For Drexler (1986) nano will cure environmental degradation, postpone death, allow space travels, stop killer asteroids, solve the problem of nuclear waste, make 'Jurassic Park' possible, no more limits to growth, prosperity for all ...





“... a world with machines that don’t clank, chemical plants that don’t stink, and production systems that don’t use people as cogs.”

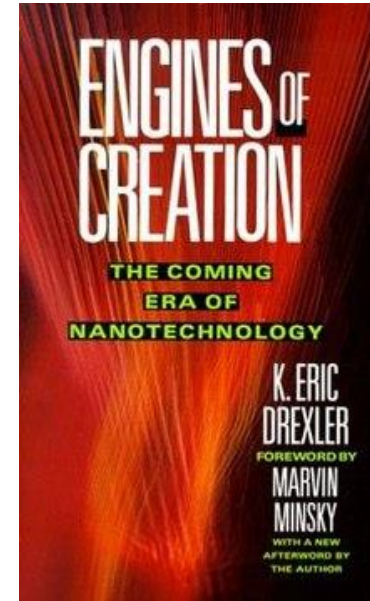




Unlike Feynman, Drexler predicts nanomachines which can reproduce themselves

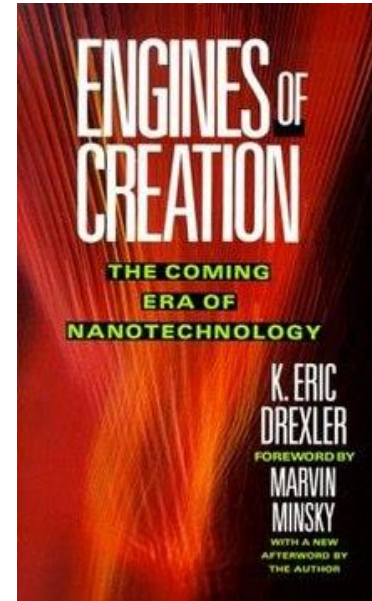
“As we look forward to see where the technology race leads, we should ask three questions: what is *possible*, what is *achievable*, and what is *desirable*”

“Will we develop monster technologies before cage technologies or after?  
Some monsters, once loosed, cannot be caged”



# Dangers ahead (in chapter 11 'Engines of Destruction')

- Grey Goo scenario  
(a single accident fatal)
- Nano will favour  
dictatorships against  
democracies [see AI]
- Military applications almost  
impossible to ban/control



But – with time more –  
Feynman became reflexive  
about big technology





Feynman's battles in the Rogers commission for the Challenger disaster in 1986, see <https://www.youtube.com/watch?v=4kpDg7MjHps>





Feynman: “not an accident”,  
<https://www.youtube.com/watch?v=4kpDg7MjHps>

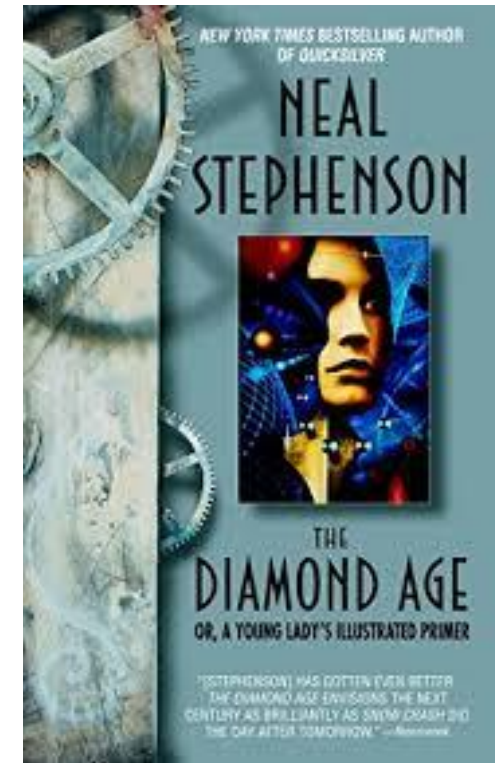
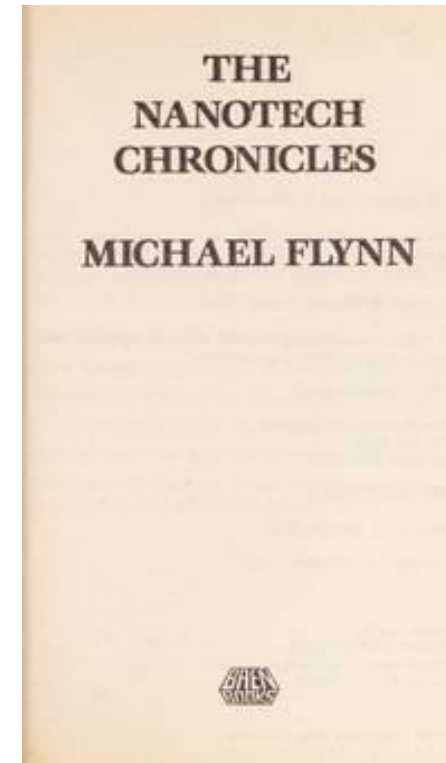


Fiction's corner

# *Teaching Societal and Ethical Implications of Nanotechnology to Engineering Students Through Science Fiction*

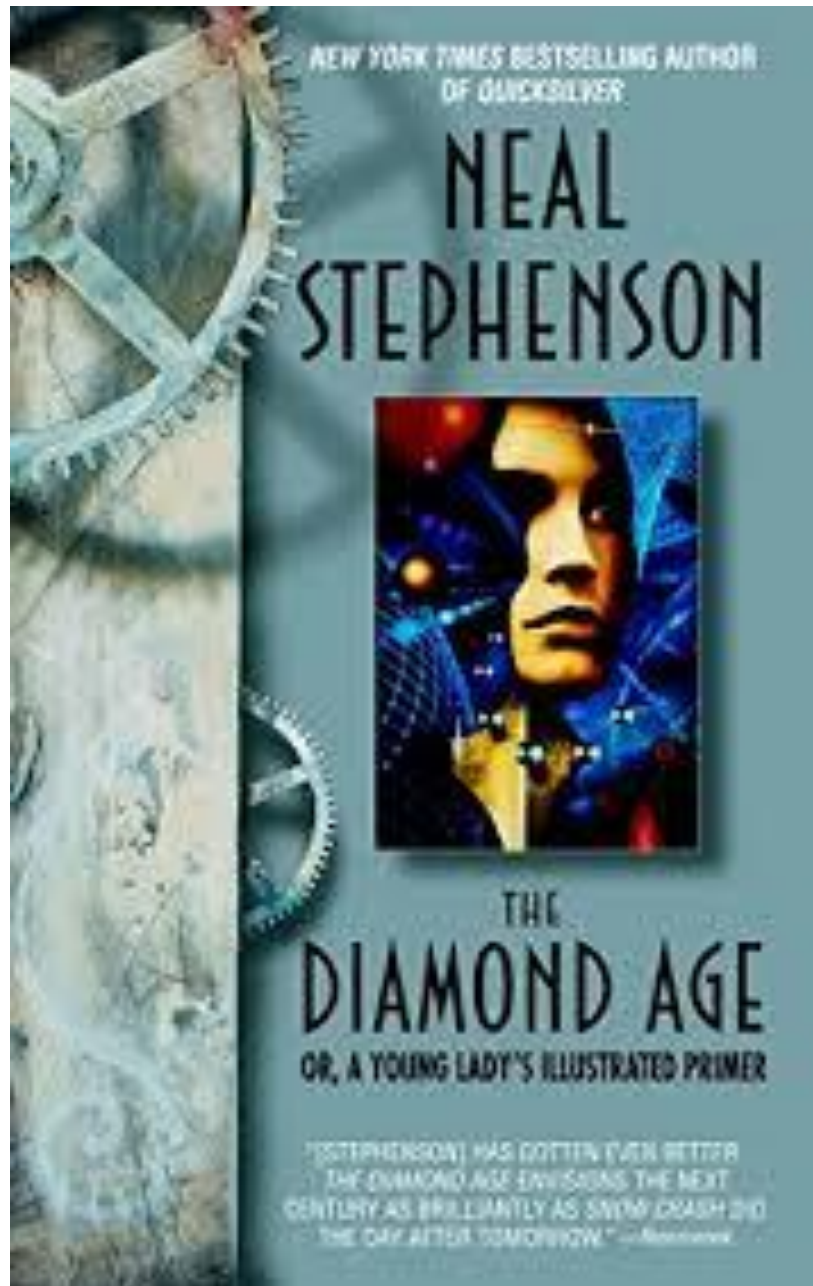
Rosalyn W. Berne  
University of Virginia

Joachim Schummer  
Technical University of Darmstadt



“Traditional deontology cannot easily be applied to futuristic technologies if life then may in no way resemble what we now know life to be.”

Berne RW, Schummer J. Teaching Societal and Ethical Implications of Nanotechnology to Engineering Students Through Science Fiction. Bulletin of Science, Technology & Society. 2005;25(6):459–468.  
doi:10.1177/0270467605283048



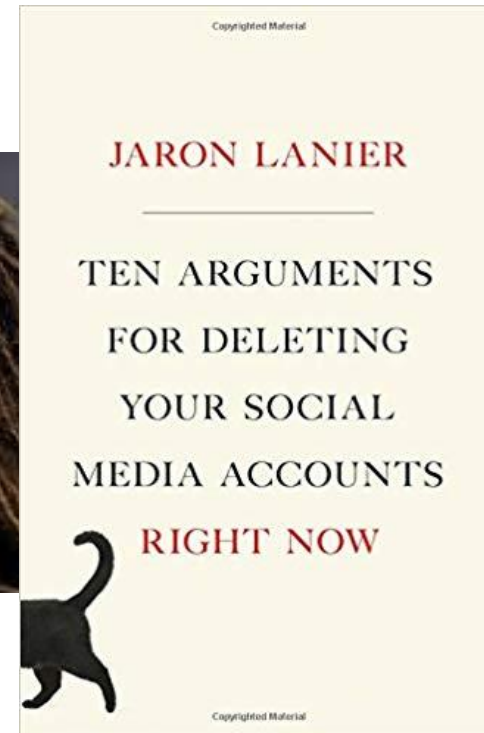
Neal Stephenson, The Diamond Age or a young lady illustrated primer

...coming of age story of a marginal girl in a world of ubiquitous nanotechnology (on the tap, as well as airborne) with class, power and technology conflicts; Feynman and Drexler mentioned



Note: New social media making us ... worse persons in a popular book of Jaron Lanier

Black Mirror (Hated in the Nation)  
Nano plus twitter in a sinister plot to educate the public against intolerance, the hard way



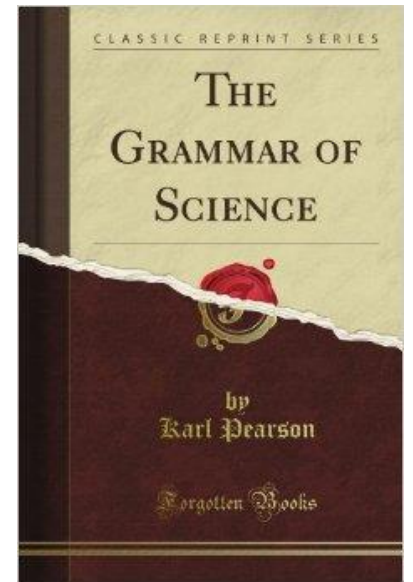
How are we taught our  
science



Karl Pearson (a social Darwinist) suggests not wasting resources on social programs as:

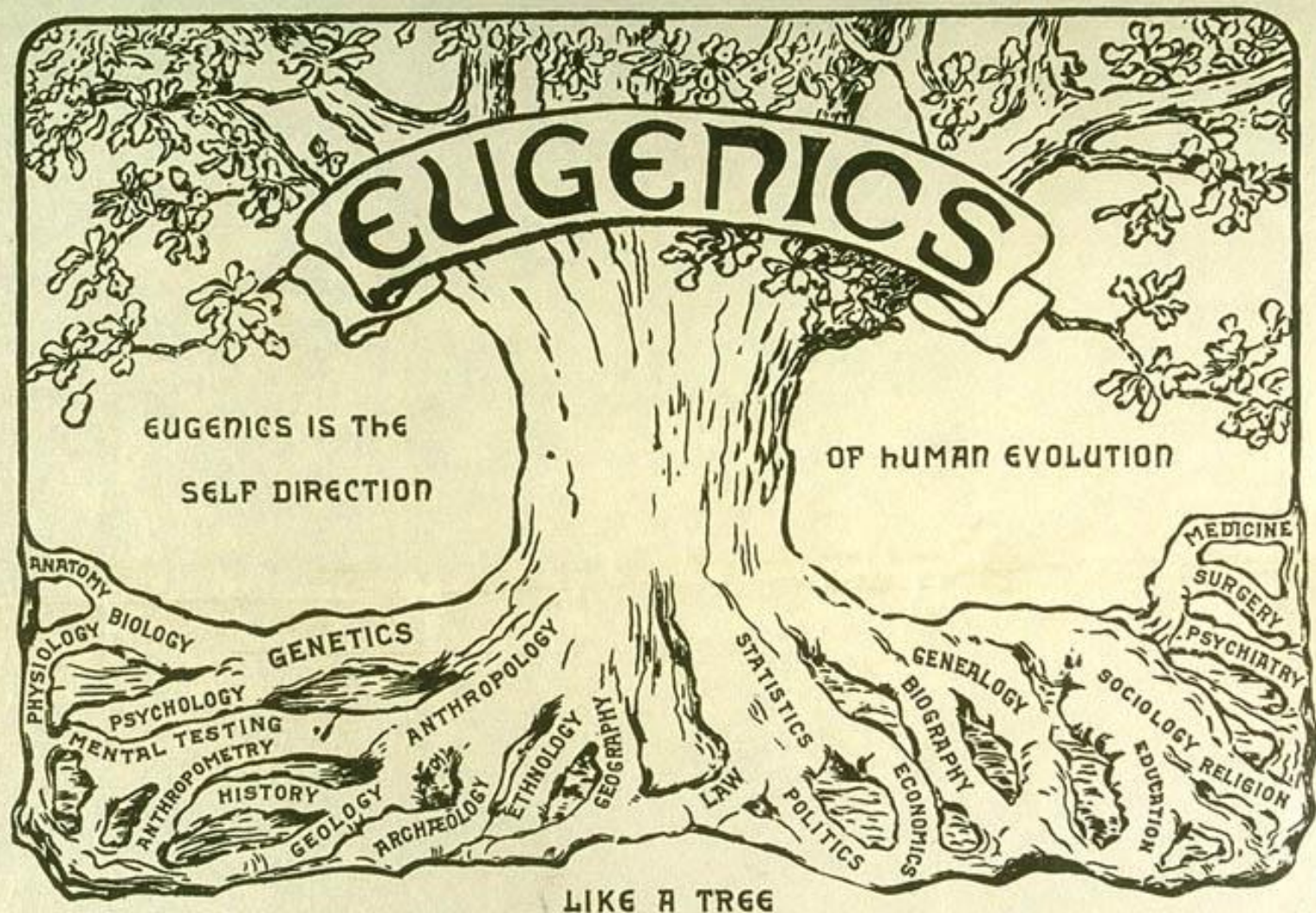
“No degenerate and feeble stock will ever be converted into healthy and sound stock by the accumulated effects of education, good laws, and sanitary surroundings”

Karl Pearson



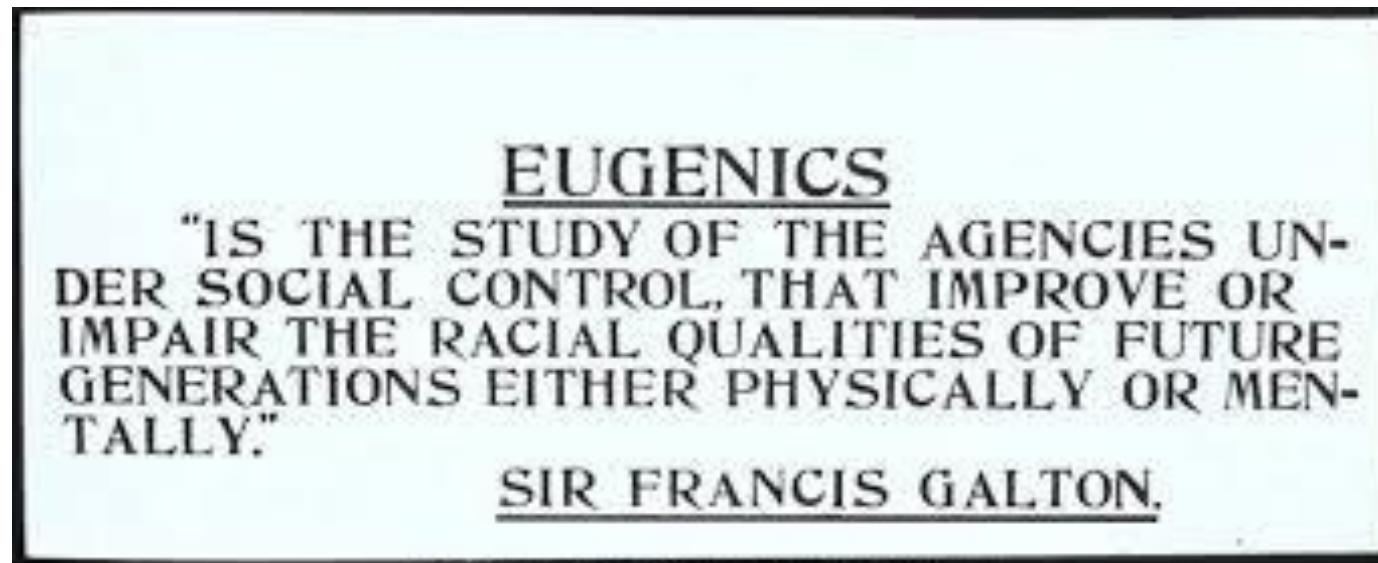
Pearson, K., 1892, The Grammar of Science, Walter Scott Publisher, London, p.32.



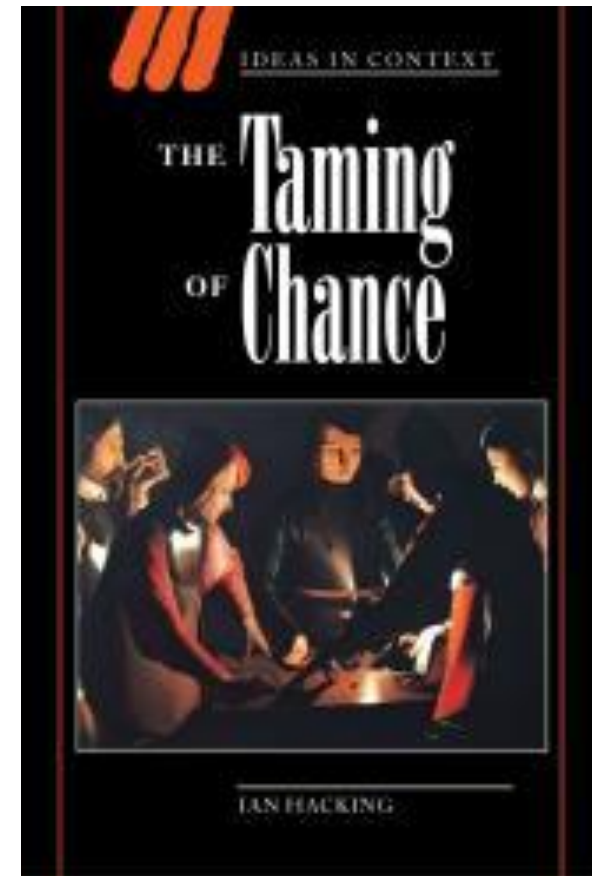


LIKE A TREE  
EUGENICS DRAWS ITS MATERIALS FROM MANY SOURCES AND ORGANIZES  
THEM INTO AN HARMONIOUS ENTITY.

Francis Galton and Karl Pearson (the one of chi-squared); laboratory of biometrics; distinguishing army officers from private soldiers from criminals convicted of murder from non-violent felons from Jews ...

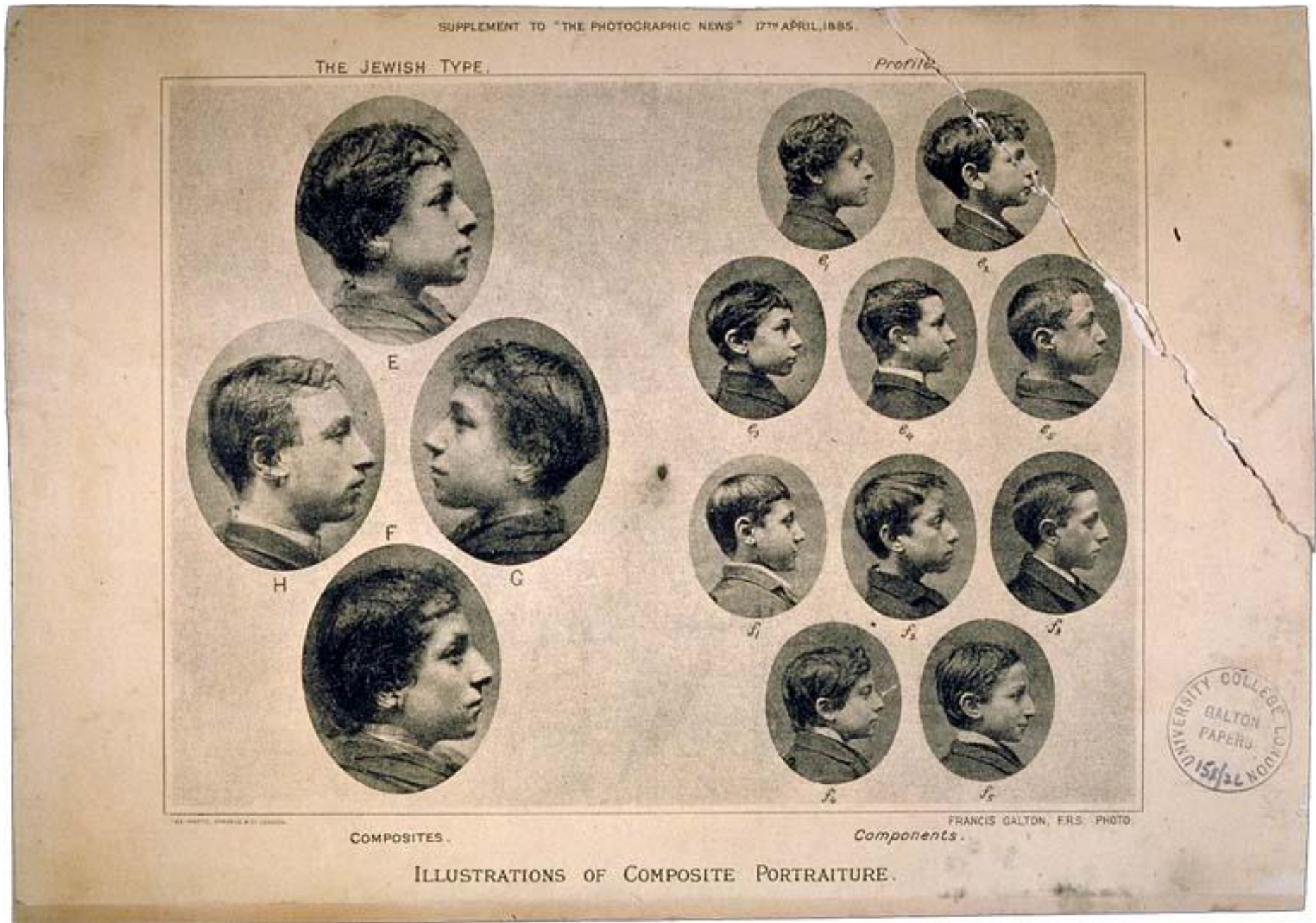


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# The Jewish type ...



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"Eugenics is the study of all of the agencies under social control which may improve or remedy the inherent qualities of future generations of man, either physically or mentally."

—Francis Galton



VOLUME II

AUGUST 1929

NUMBER 3

CONTENTS AND REED ORDINANCE APPLICABLE  
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The first R&D Statistics ever, by Francis Galton  
(1822–1911)

Measuring the numbers of sons and daughters of  
‘great men of science’ will tell us whether a  
society degenerates toward stupidity (Benoît  
Godin, 2010)

Godin, B., From Science to Innovation, INRS, Montreal, Canada,  
Communication presented to the Government–University–Industry Research  
Roundtable (GUIRR) US National Academy of Sciences, Washington, May 21,  
2010.



Kuhn said that the “educational initiation that prepares and licenses the student for professional practice... is both rigorous and rigid”

and “It is a narrow and rigid education [in physics/science], probably more so than any other except perhaps in orthodox theology”



Thomas Kuhn, *The structure of scientific revolution*, 192, Chapters I and XIII



and “the member of a mature scientific community is, like the typical character of Orwell’s 1984, the victim of a history rewritten by the powers that be.”



Thomas Kuhn, The structure of scientific revolution, 192, Chapter XIII

Thus disciplinary advancements are presented in textbooks as the “perception of the obvious” made by one-eyed men in the kingdom of the blinds (Ravetz, 1971).

Can statisticians ignore their role in Eugenics, can chemists ignore what is phlogiston, or geologists how Alfred Lothar Wegener 1915 theory of Continental Drift was met with skepticism ...

IN PRACTICE

Young statistician,  
you shall live in  
adventurous times



The so-called "crisis in science" presents challenges for statisticians starting out in their career. But there are strategies for survival, says **Andrea Salte**

SIGNIFICANCE

ROYAL  
STATISTICAL  
SOCIETY  
DATA | PEOPLE | DECISIONS

ASA  
AMERICAN STATISTICAL ASSOCIATION  
Promoting the Practice and Profession of Statistics

More here

<https://rss.onlinelibrary.wiley.com/doi/10.1111/j.1740-9713.2016.00983.x>

Science separated from ethics,  
from philosophy, from policy:  
possible? Desirable?

# Why ethics and science are separated?

Medicine has as a task to preserve life and avoid suffering, but does not say why; science aims to discover the secrets of nature but not tell why we should be doing so ...

Max Weber, 1864–1920  
“Science as a Vocation”  
‘Wissenschaft als Beruf’  
Speech at Munich University, 1918





# Why ethics and science are separated?

Who -- aside from certain big children who are indeed found in the natural sciences -- still believes that the findings of astronomy, biology, physics, or chemistry could teach us anything about the meaning of the world?

Max Weber, 1864–1920  
“Science as a Vocation”  
‘Wissenschaft als Beruf’  
Speech at Munich University, 1918



# Why ethics and science cannot be separated?



See a clean version here:

[http://www.andreasaltelli.eu/file/repository/Ideological\\_committment.pdf](http://www.andreasaltelli.eu/file/repository/Ideological_committment.pdf)

How science is conceived has important  
political implications

The **Vienna Circle** and the fight against the  
'metaphysical and theologizing' associated with  
fascism and national socialism (1929). Modern  
empiricism as a scientific world conception

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## **Ideological Commitments in the Philosophy of Science**

**With a Comment on Ravetz by Edgley**

Jerry Ravetz and Roy Edgley

RP 037 (Summer 1984)

# Verification or falsification?

Karl Popper

A radical departure from the principle of 'verification' that was at the heart of the Vienna Circle positivism (inductivism)

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# Verification or falsification?

Karl Popper

Truth cannot be verified: it can only be falsified



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# Socratic ethos

Is Socrates saying that he knows the truth?



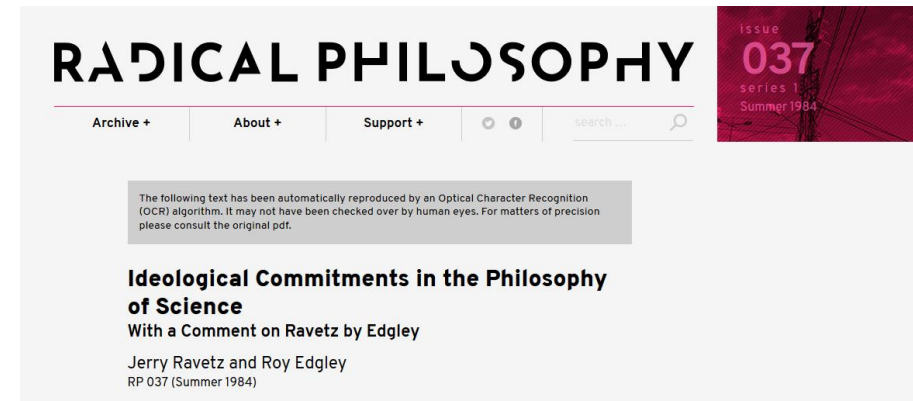
And what kind of man am I? One of those who would gladly be refuted if anything I say is not true, and would gladly refute another who says what is not true, but would be no less happy to be refuted myself than to refute, for I consider that a greater benefit ... I believe there is no worse evil for man than a false opinion about the subject of our present discussion

Courtesy of Kjetil Rommetveit

# Verification or falsification?

Karl Popper

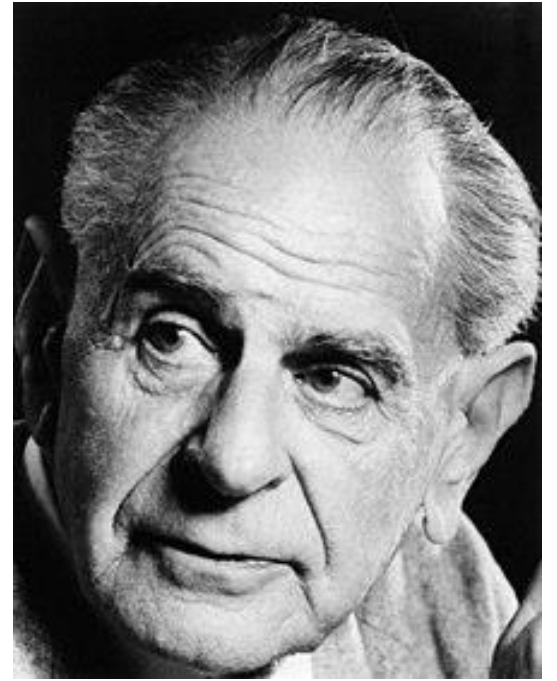
Demarcation science/non-science → Marxist historiography and psychoanalysis are not science



# Verification or falsification?

A champion of liberal democracy at times of cold war; open society as an alternative to totalitarianism

A critical member of the Mont Pelerin society, with Friedrich Hayek, Milton Friedman, Ludwig von Mises and others,



Karl R. Popper  
1902–1994

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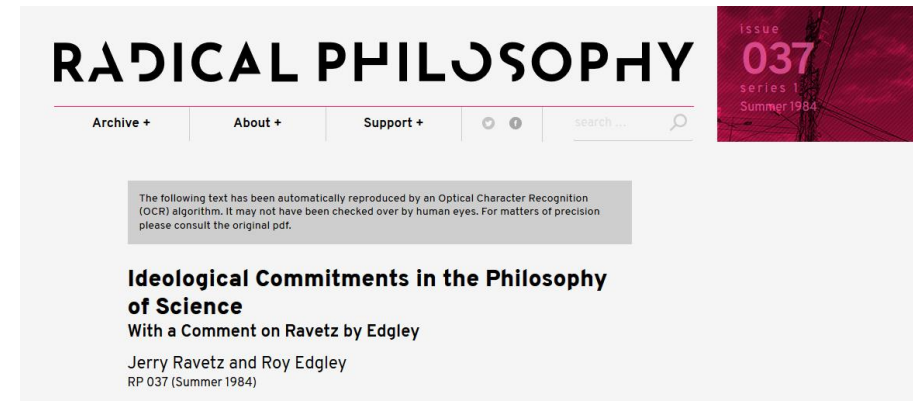
Jerry Ravetz and Roy Edgley  
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# Paradigm shifts

**Thomas Kuhn:** a disenchanted vision of science as alternating between ‘normal’ and ‘revolutionary’

Puzzle solving, dogmatic science, then a paradigm shift ... then the same over again

Lost a direction a progress



**Imre Lakatos:** defending science from its enemies.  
Remedying the weaknesses in Popper's program

“Proofs and Refutations” revealing the ambiguities of proof even in mathematics, on 'Euler Polyhedron Theorem'; If even mathematics can be ambiguous how can science be dogmatic?



Who remembers the theorem?

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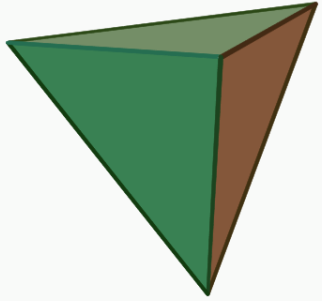
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Jerry Ravetz and Roy Edgley  
RP 037 (Summer 1984)

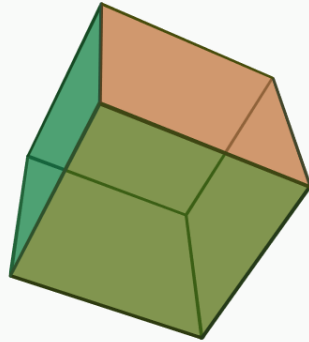


# Euler's Polyhedron Formula

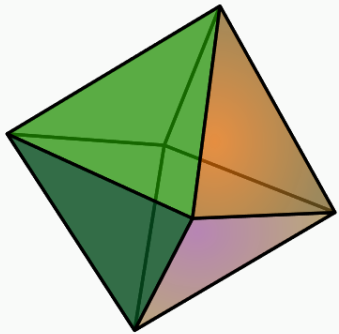
$$\text{Vertices} - \text{Edges} + \text{Faces} = 2$$



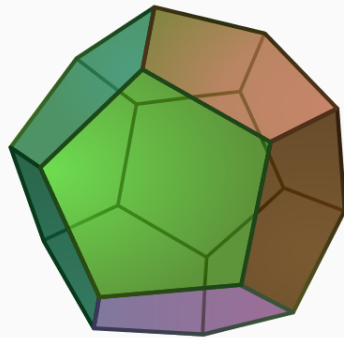
$$V = 4 \quad E = 6 \quad F = 4$$
$$4 - 6 + 4 = 2$$



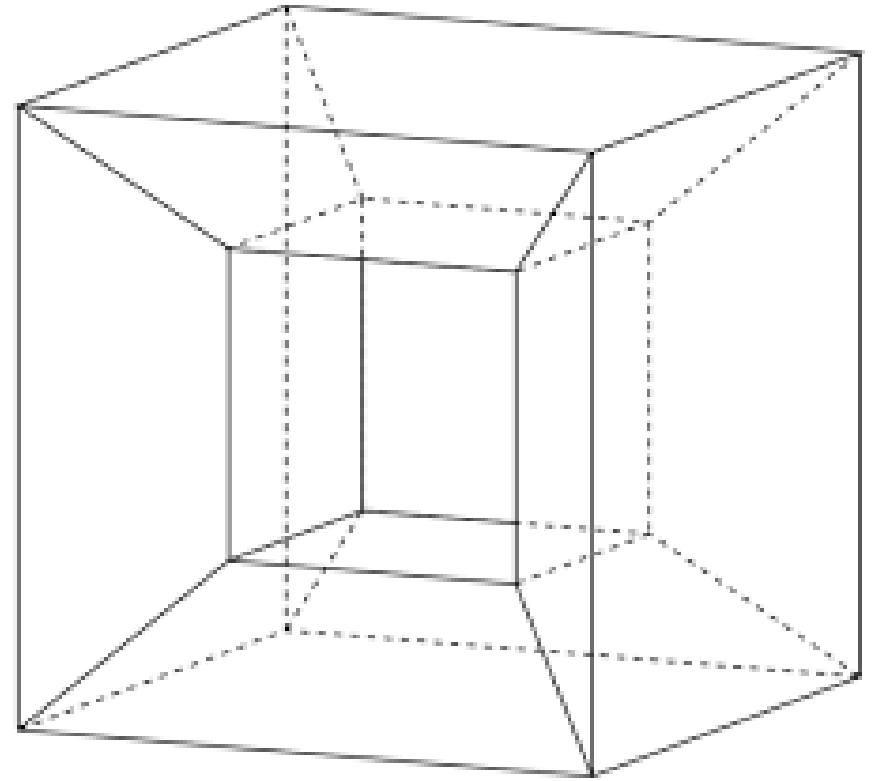
$$V = 8 \quad E = 12 \quad F = 6$$
$$8 - 12 + 6 = 2$$



$$V = 5 \quad E = 8 \quad F = 5$$
$$5 - 8 + 5 = 2$$



$$V = 20 \quad E = 30 \quad F = 12$$
$$20 - 30 + 12 = 2$$



A monster example?



**Imre Lakatos:** The idea of ‘decadal’ research programmes to save Popper’s falsificationism from Kuhn’s critique by combining the two visions, abandoning ‘naïve falsificationism’

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Issue  
**037**  
series 1  
Summer 1984

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### **Ideological Commitments in the Philosophy of Science**

With a Comment on Ravetz by Edgley


Jerry Ravetz and Roy Edgley  
RP 037 (Summer 1984)

# Paul Feyerabend



Perhaps the most erudite and most philosopher among the four; and the most destructive of any theory of scientific method

In “Against Method” he shows how the best among scientists (e.g. Galileo Galilei) violated any ‘rule’

A court jest, a fascist,  
a Zen master? Asks Ravetz



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Issue 037 series 1 Summer 1984

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**Ideological Commitments in the Philosophy of Science**  
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# Paul Feyerabend

Human imperfections of Galileo can 'blow the mind' of a student for whom the authority of science is as absolute

After such a shock the student may be ready to awaken to the truth that there is no truth to awaken to (Feyerabend as a Zen master?)

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### **Ideological Commitments in the Philosophy of Science**

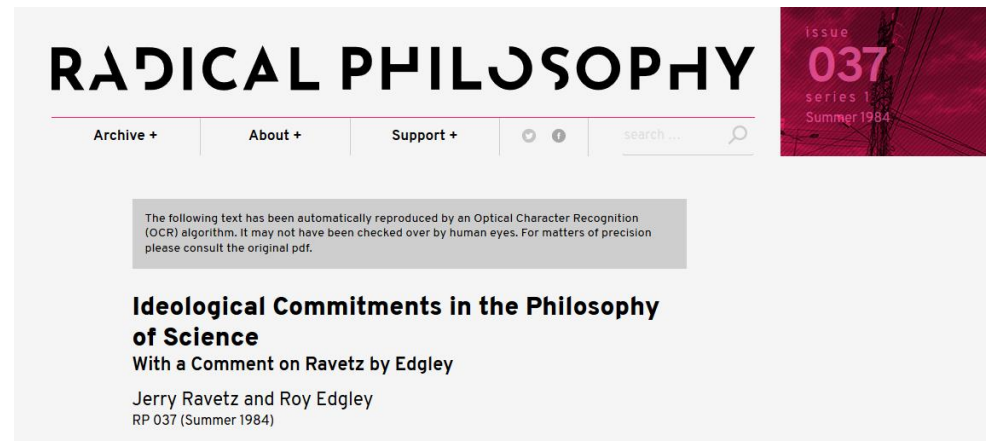
With a Comment on Ravetz by Edgley

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RP 037 (Summer 1984)

# Paul Feyerabend

For Ravetz, Feyerabend shows to the lay public science's sacred images being sprayed by a philosophical machine gun (Feyerabend as a fascist?)

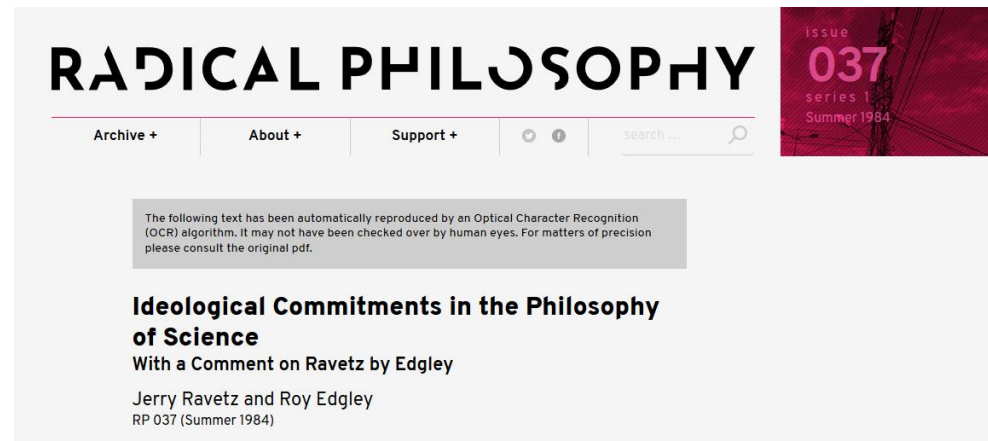
Killing science as we know it or showing the hypocrisy of this image?





# Ravetz's conclusions

The edifice built by Popper and Lakatos was vulnerable to the critique of Kuhn and Feyerabend, perhaps because of its ideological aspirations

Yet the Enlightenment battle against the church cultural and political hegemony is over, so is a simplistic image of science upholding the Good and the True



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Is this true?



The Enlightenment battle against the church cultural and political hegemony is over, so is a simplistic image of science upholding the Good and the True

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# **The Republic of Science: Its Political and Economic Theory**

## **Michael Polanyi**

Science as a market which feeds  
society's thirst for self improvement

Science as a community of practice  
capable of self-governance



Michal Polanyi

Minerva, I, 1 ( Autumn, 1962) , pp. 54– 73, [https://mitpress-request.mit.edu/sites/default/files/titles/content/9780262690201\\_sch\\_0001.pdf](https://mitpress-request.mit.edu/sites/default/files/titles/content/9780262690201_sch_0001.pdf)

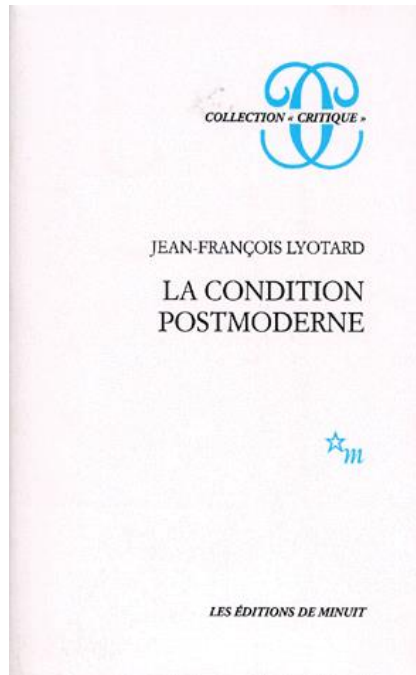
For Lyotard the grand  
narrative of the relation  
between knowledge/science  
and power has come to an end



Jean-François Lyotard

Lyotard, J.-F. 1979. La Condition postmoderne. Rapport sur le savoir, Paris : Minuit.

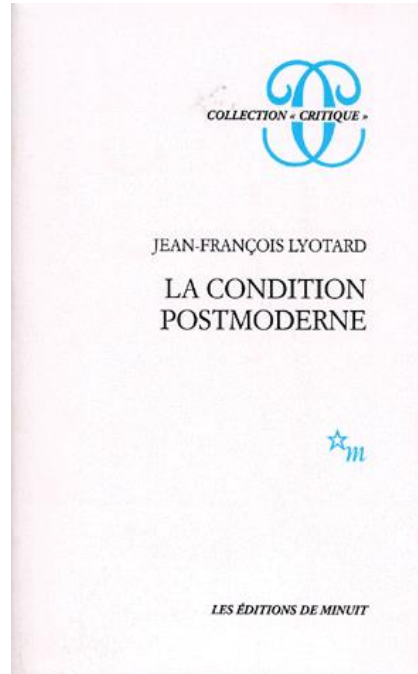
“The question of the legitimacy of science has been indissociably linked to that of the legitimation of the legislator since the time of Plato.”



Jean-François Lyotard

Lyotard, J.-F. 1979. La Condition postmoderne. Rapport sur le savoir, Paris : Minuit.

“...the right to decide what is true is not independent of the right to decide what is just,[...] there is a strict interlinkage between the kind of language called science and the kind called ethics and politics ...”



Jean-François Lyotard

Lyotard, J.-F. 1979. La Condition postmoderne. Rapport sur le savoir, Paris : Minuit.

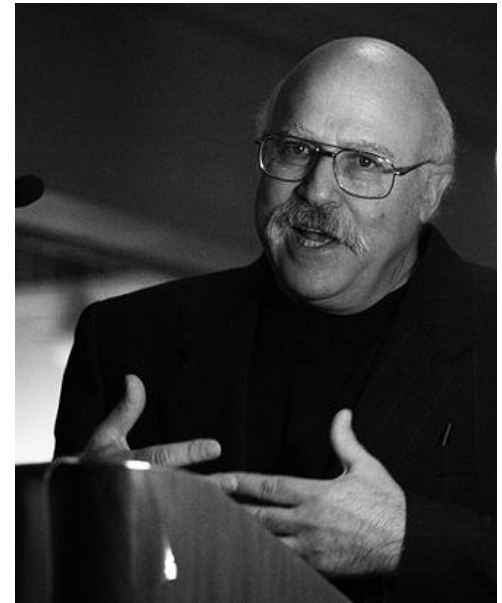


“Solutions to the problem of knowledge are solutions to the problem of social order...

Trust in Science and trust in the prevailing social order are linked.”



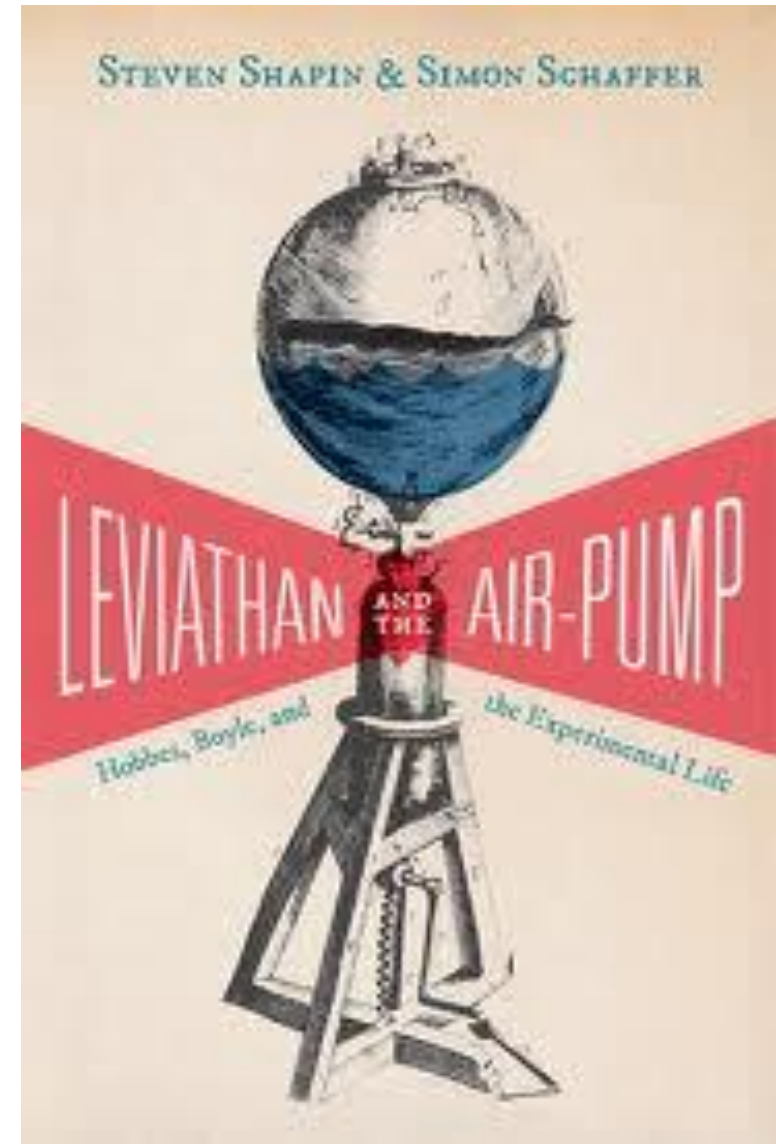
Simon Schaffer



Steven Shapin

Shapin, S., Schaffer, S., 1985, Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life, Princeton, 2011 Edition

Establishing ‘matter of facts’  
under controlled ‘laboratory’  
experiments before  
witnesses as a way to  
subtract the discourse about  
knowledge from religious  
squabbles ...

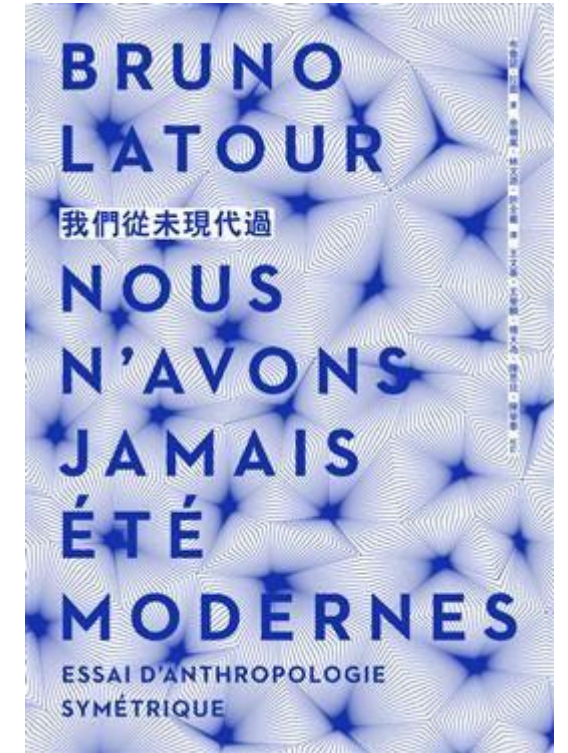


Shapin, S., Schaffer, S., 1985, Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life, Princeton, 2011 Edition

Shapin and Schaffer's book inspired Bruno Latour's 'Nous n'avons jamais été modernes', 1991, and was 'hot' during the 'science wars'.

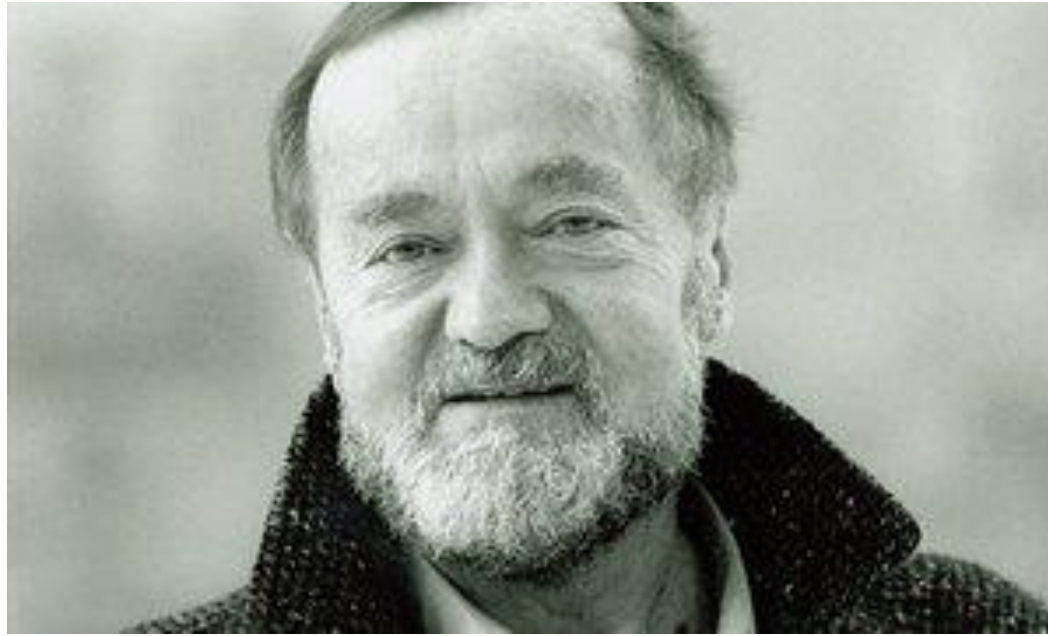


Bruno Latour

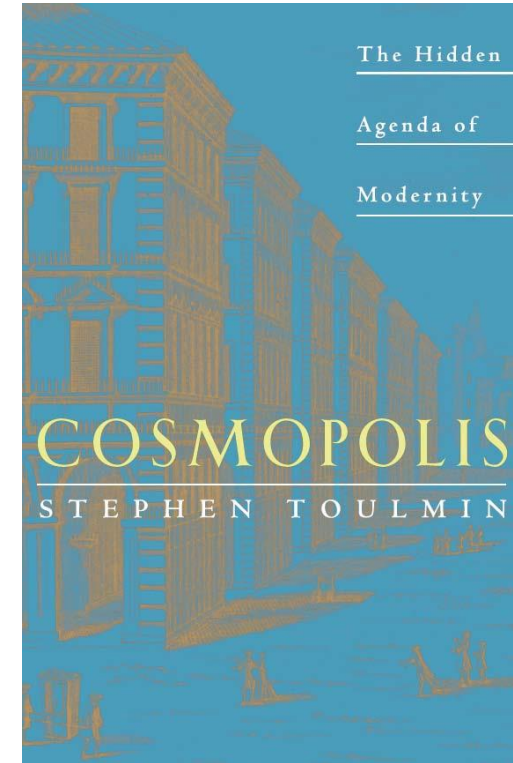


Latour, B., 1991, Nous n'avons jamais été modernes, Editions La découverte, 1993; We Have Never Been Modern. Cambridge, Harvard UP.

# Stephen Toulmin: Modernity as a counter-Renaissance; Descartes versus Montaigne; the delusion of a Newtonian view of society



Stephen Toulmin



Stephen Toulmin, 1990, *Cosmopolis: The Hidden Agenda of Modernity*, The University of Chicago Press.

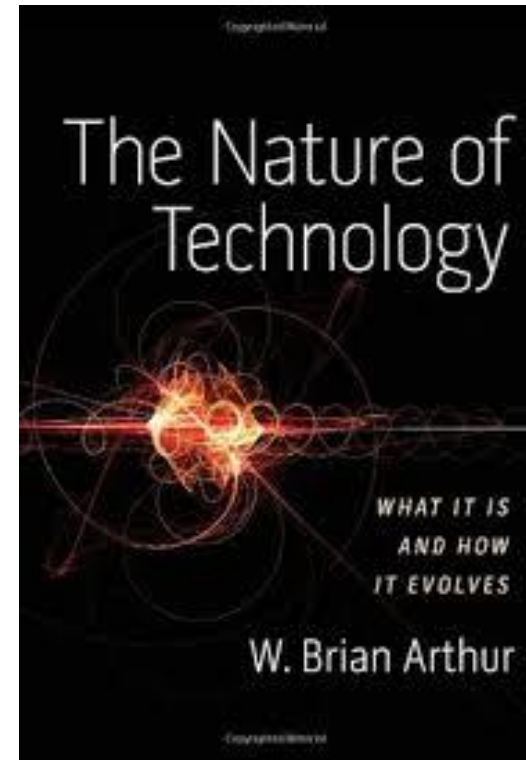


Mastering the  
technique / science /  
the machine

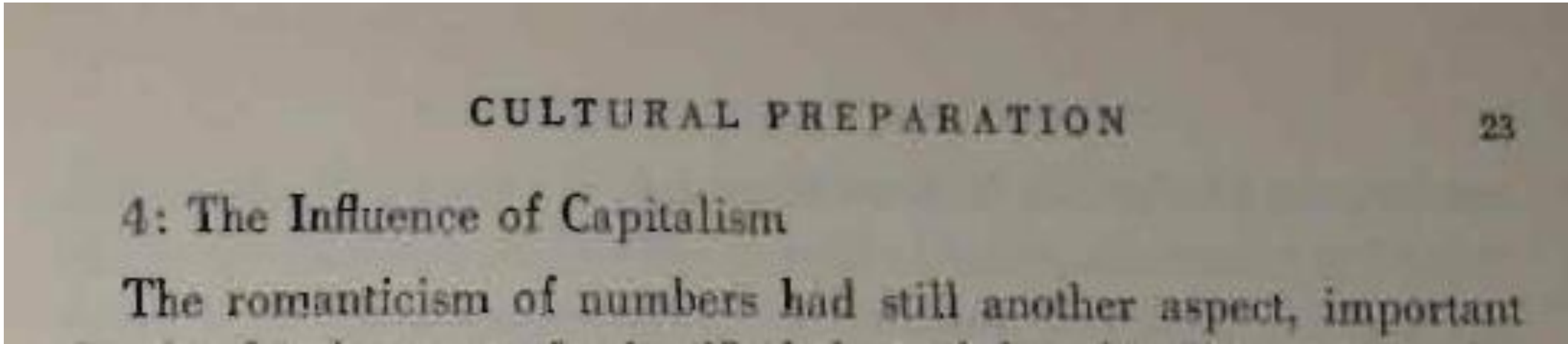


What do Lyotard, Toulmin, Dewey, Bakunin, and (Fritz) Schumacher have in common?

From post-modern thinkers to pragmatists to anarchists to the fathers of the ecological movement, a common concern about mastering science and technology and its uses, about the dangers of modernity



Lewis Mumford explained in 1934 how well the  
'machine' integrates with capitalism



Lewis Mumford, **1934**, Techniques and Civilization, ROUTLEDGE & KEGAN PAUL LTD, p.  
23-31 of the 1955 edition.

“The necessity to promote continual changes and improvements, which has been characteristic of capitalism, introduced an element of instability into technics and kept society from assimilating its mechanical improvements and integrating them in an appropriate social pattern”

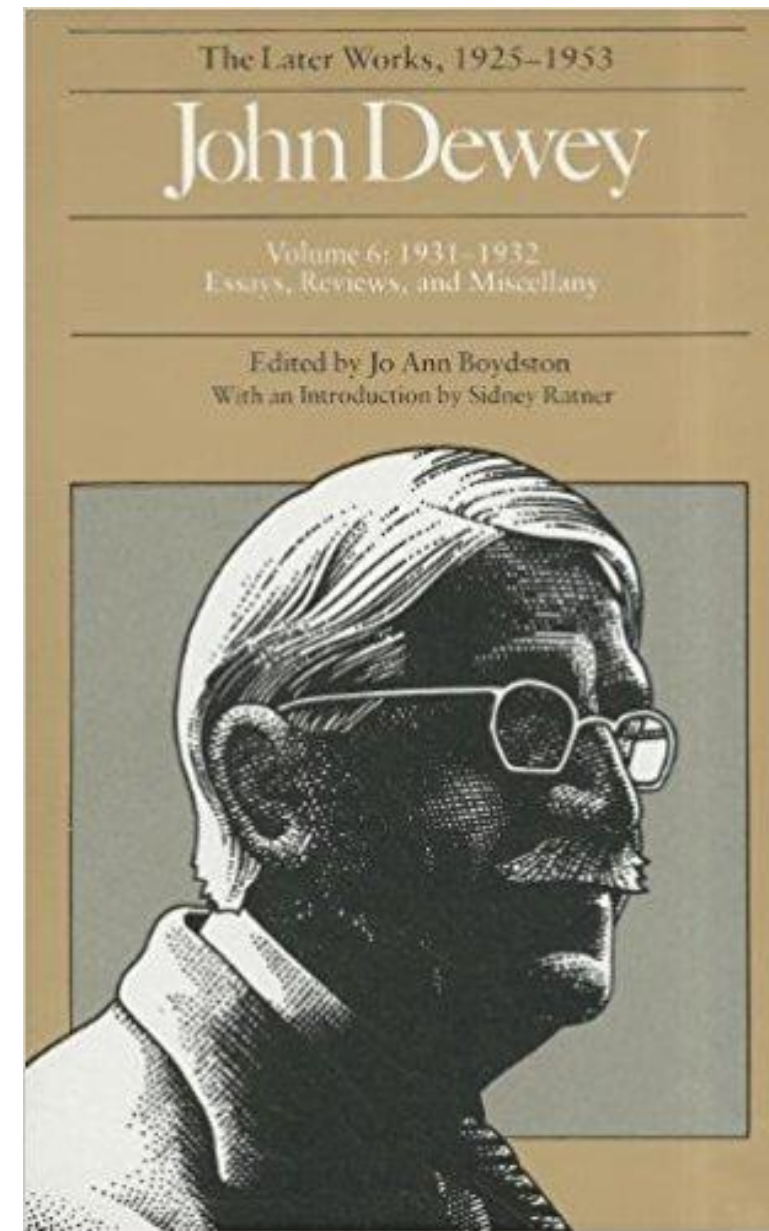


Lewis Mumford,  
1895–1990

Lewis Mumford, **1934**, *Techniques and Civilization*, ROUTLEDGE & KEGAN PAUL LTD, p. 23–31 of the 1955 edition.

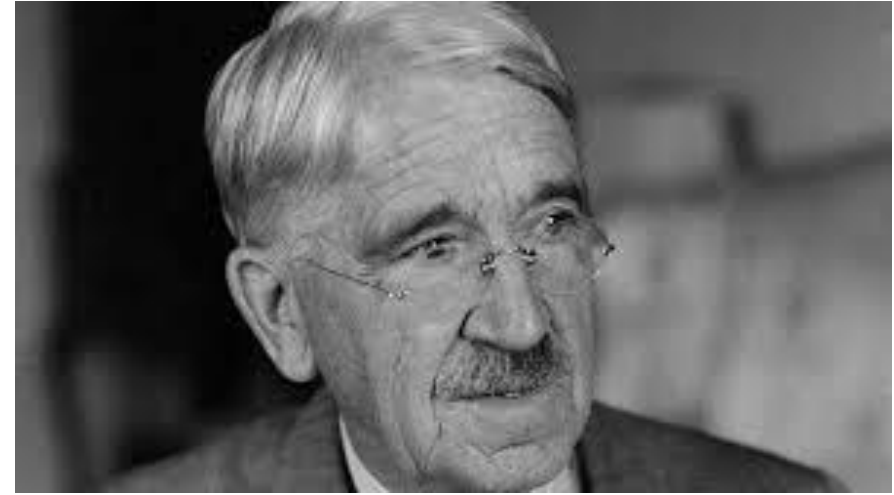
Here lies the heart of our present social problem. Science has hardly been used to modify men's fundamental acts and attitudes in social matters. It has been used to extend enormously the scope and power of interests and values which anteceded its rise. Here is the contradiction in our civilization. The potentiality of science as the most powerful instrument of control which has ever existed puts to mankind its one outstanding present challenge.

**From J. Dewey 'Science and Society' in John Dewey: The Later Works, 1925-1953: 1931-1932, Vol. 6-ExLibrary**



John Dewey 1859-1952

“Here lies the contradiction of our civilization. The potentiality of science as the most powerful instrument of control which has ever existed puts to mankind its one outstanding present challenge”



John Dewey

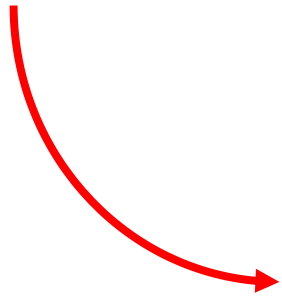
J. Dewey, Science and society, in ‘John Dewey: The Later work , 1931–1932 Vol. 6



“Science, which should have been the wind of truth to clear the air, has polluted the air, helped to brainwash, and provided weapons for war.”



Paul Goodman



Now resurgent concern for  
military/authoritarian apps

# Techies' fury at being drafted for Trump army

Working for the Pentagon is prompting staff revolts in Silicon Valley

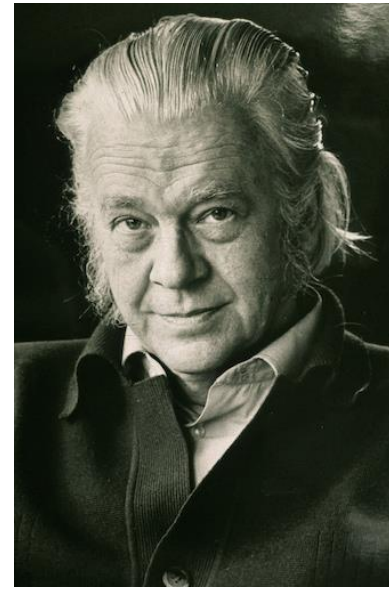
Danny Fortson, San Francisco

November 4 2018, 12:01am, The Sunday Times

“From Amazon to Google, rank-and-file employees are revolting against their employers for taking the powerful tools they helped to build and selling them for unexpected purposes, from apprehending illegal immigrants to supercharging America’s war machine”



Doubts about the scientific quantification of the impact of new technologies (e.g. risk or cost-benefit analyses)



Fritz Schumacher

Langdon Winner

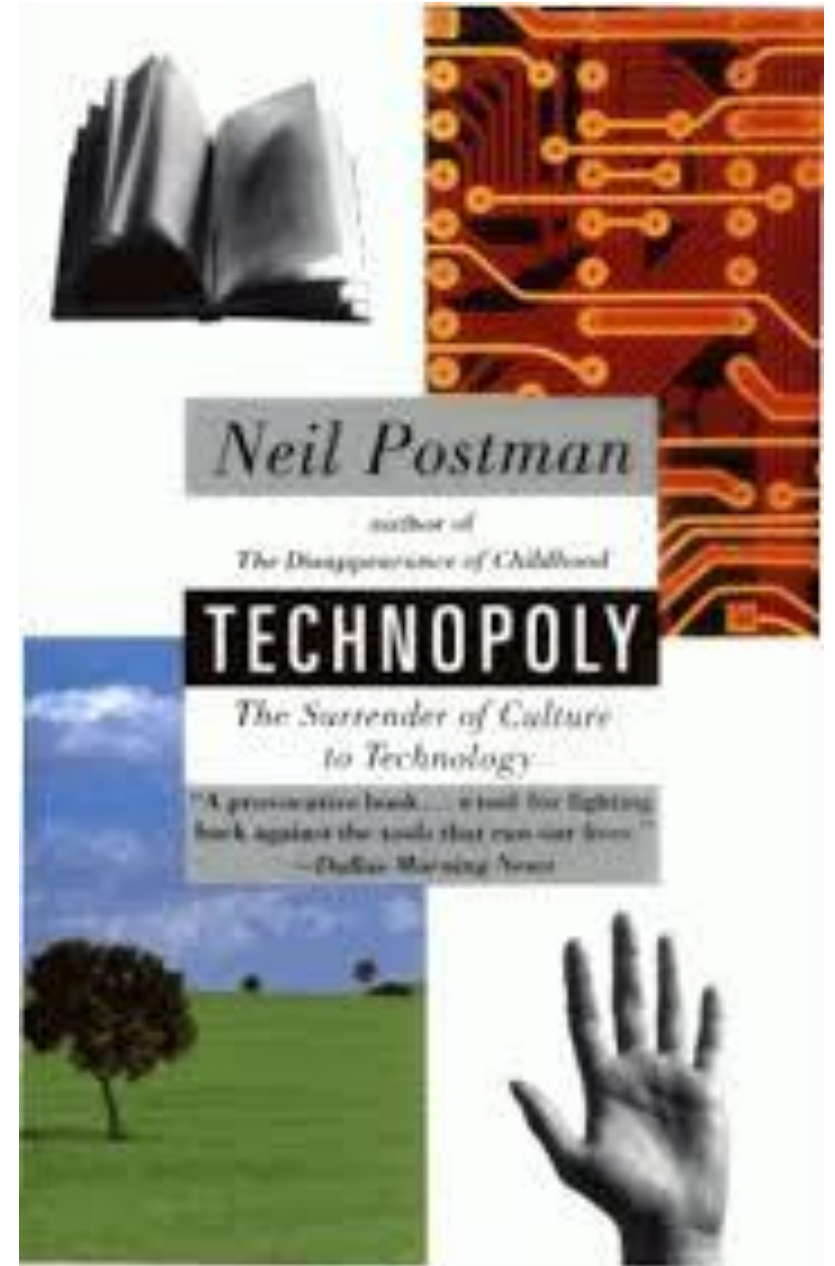


E. F. Schumacher, 1973, *Small Is Beautiful. Economics as if People Mattered*, Penguin Perennial.

Winner, L., 1986. *The Whale and the Reactor: a Search for Limits in an Age of High Technology*. The University of Chicago Press, 1989 edition.

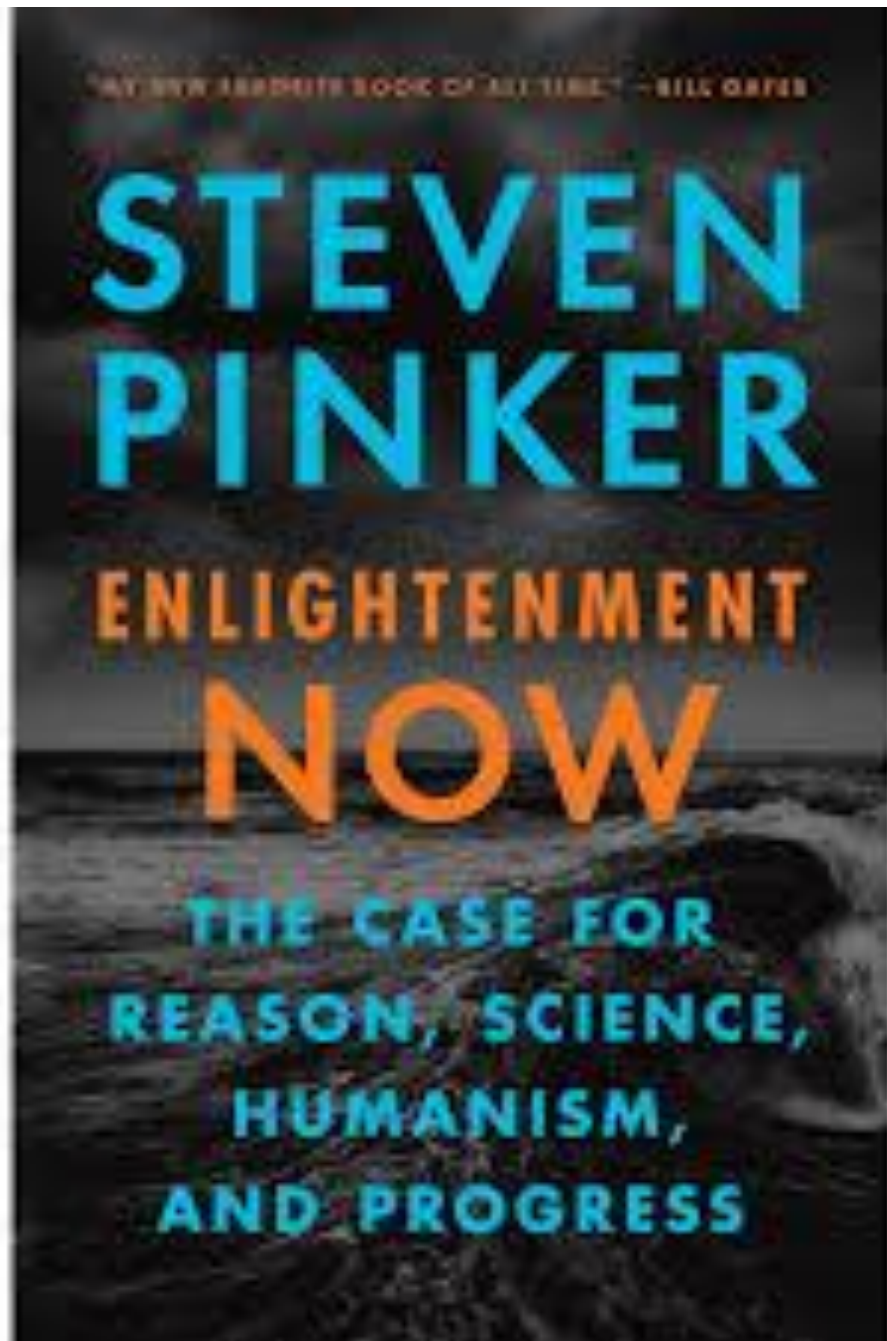
Funtowicz, S.O. and Ravetz, J.R. (1994). The worth of a songbird: Ecological economics as a post-normal science. *Ecological Economics* 10(3), 197-207.

“... it is inescapable that every culture must negotiate with technology, whether it does so intelligently or not”  
(N. Postman, Technopoly)



The discussion on the  
legacy of Enlightenment  
goes on



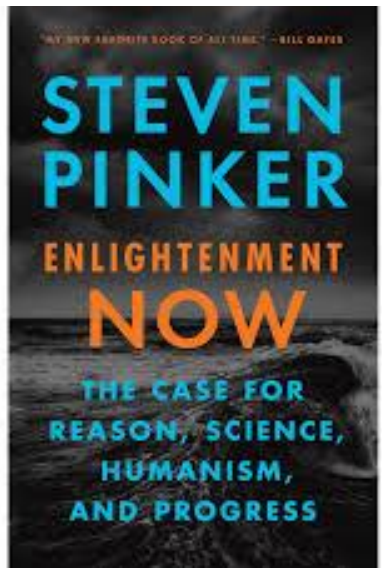


Steven Pinker



Jeremy Lent





“A future perfect. Steven Pinker’s case for optimism; “Enlightenment Now” explains why the doom-mongers are wrong”, The Economist

“Steven Pinker Wants You to Know Humanity Is Doing Fine. Just Don’t Ask About Individual Humans” (Jennifer Szalai, The New York Times)

“a monumental apologia for a currently fashionable version of Enlightenment thinking” ((John Gray, New Stateman)

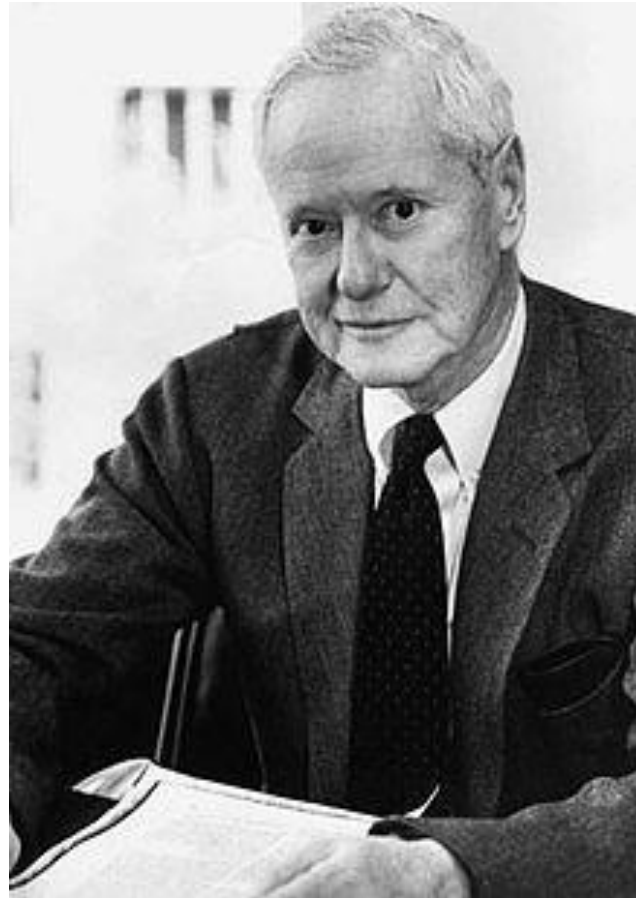


The history of western history's two powerful metaphors: “man as master and possessor of nature” and “nature as a machine”

From the dualism of Greek and Christian philosophies to our days

Contrasted with alternative metaphors, such as nature as a system of systems

The ethos of science



Robert K. Merton, sociologist of science,  
considered the father of Science and Technology  
Studies, 1910–2003



# CUDOS

Communalism – the common ownership of scientific discoveries, according to which scientists give up intellectual property rights in exchange for recognition and esteem ...

Universalism – according to which claims to truth are evaluated in terms of universal or impersonal criteria, and not on the basis of race, class, gender, religion, or nationality;

# CUDOS

Disinterestedness – according to which scientists are rewarded for acting in ways that outwardly appear to be selfless;

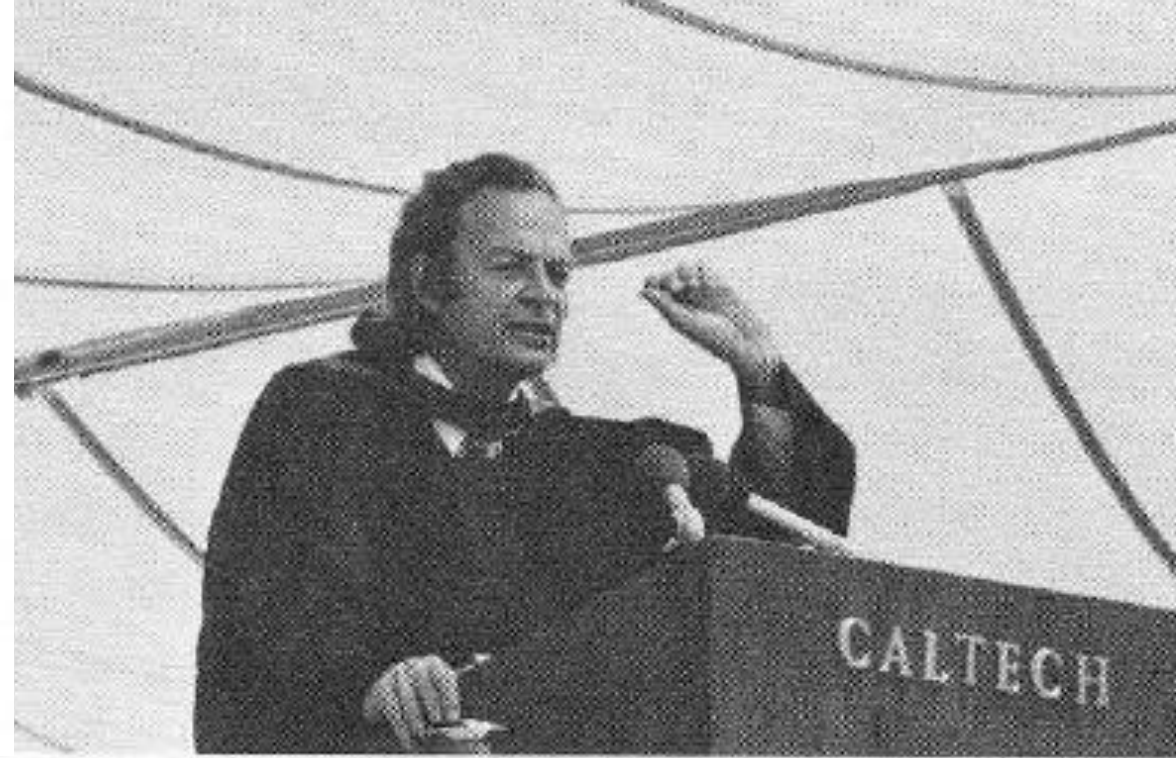
Organized Scepticism – all ideas must be tested and are subject to rigorous, structured community scrutiny

# A lesson from Richard Feynman

# Cargo Cult Science

by RICHARD P. FEYNMAN

**Some remarks on science, pseudoscience, and learning how to not fool yourself. Caltech's 1974 commencement address.**



<http://calteches.library.caltech.edu/3043/1/CargoCult.pdf>





“In the South Seas there is a cargo cult of people. During the war they saw airplanes land with lots of good materials, and they want the same thing to happen now.

So they've arranged to imitate things like runways, to put fires along the sides of the runways, to make a wooden hut for a man to sit in, with two wooden pieces on his head like headphones and bars of bamboo sticking out like antennas—he's the controller—and they wait for the airplanes to land”

“They're doing everything right. The form is perfect. It looks exactly the way it looked before. But it doesn't work. No airplanes land. So I call these things cargo cult science, because they follow all the apparent precepts and forms of scientific investigation, but they're missing something essential, because the planes don't land”



“[...] there is one feature I notice that is generally missing in cargo cult science. That is the idea that we all hope you have learned in studying science in school [...] .



It's a kind of scientific integrity, a principle of scientific thought that corresponds to a kind of utter honesty--a kind of leaning over backwards.





“Details that could throw doubt on your interpretation must be given, if you know them. [...] give all of the information to help others to judge the value of your contribution.”



# The End



@andreasaltelli

The same R.K. Merton realized later in life that norms have corresponding counter norms

Mitroff, I. I. 1974, Norms and Counter-Norms in a Select Group of the Apollo Moon Scientists: A Case Study of the Ambivalence of Scientists, American Sociological Review, 39, 579–595.

# NORMS AND COUNTER-NORMS IN A SELECT GROUP OF THE APOLLO MOON SCIENTISTS: A CASE STUDY OF THE AMBIVALENCE OF SCIENTISTS\*

IAN I. MITROFF

American Sociological Review 1974, Vol. 39 (August): 579-595

*This paper describes a three and a half year study conducted over the course of the Apollo lunar missions with forty-two of the most prestigious scientists who studied the lunar rocks. The paper supports the Merton-E. Barber concept of sociological ambivalence, that social institutions reflect potentially conflicting sets of norms. The paper offers a set of counter-norms for science, arguing that if the norm of universalism is rooted in the impersonal character of science, an opposing counter-norm is rooted in the personal character of science. The paper also argues that not only is sociological ambivalence a characteristic of science, but it seems necessary for the existence and ultimate rationality of science.*

Three-and-a-half-year study conducted over the course of the Apollo lunar missions with forty-two of the most prestigious scientists who studied the lunar rocks

The paper supports the Merton-E. Barber concept of sociological ambivalence, that social institutions reflect potentially conflicting sets of norms

[We must] consider, first, how potentially contradictory norms develop in every social institution; next, how in the institution of science conflicting norms generate marked ambivalence in the lives of scientists; and finally, how this ambivalence affects the actual, as distinct from the supposed, relations between men of science (Merton, 1963a:80).



- Solitariness (secrecy, miserism) is often used to keep findings secret in order to be able to claim patent rights...

Instead of Communalism

- Particularism [...] a real issue, particularly when you consider the ratio of researchers in rich countries compared with those in poor countries

Instead of Universalism

- Interestedness arises because scientists have genuine interests at stake in the reception of their research...  
Instead of Disinterestedness

- Dogmatism because careers are built upon a particular premise (theory) being true...

Instead of Organized  
Skepticism