

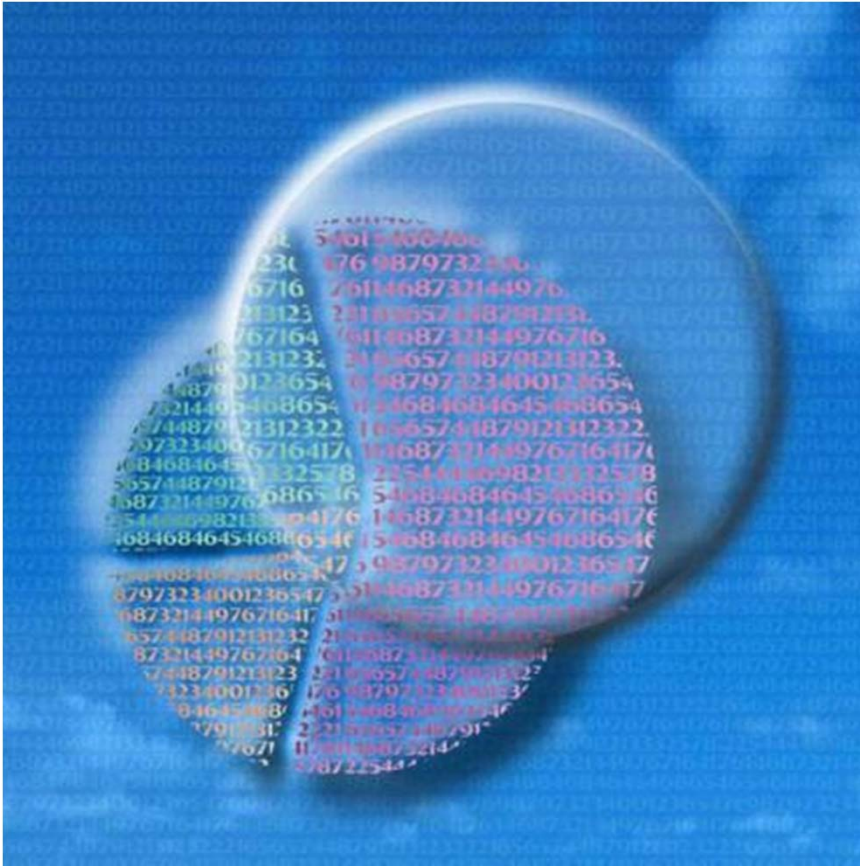
General introduction; context, crises, evidence for policy, use of mathematical models

5th Impact Assessment Course by JRC
and Sec Gen
January 20_ 21, Brussels

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Centre (JRC)

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Why is all this relevant ... are we living special times ?



The use of science for policy is at the core of a perfect storm generated by the insurgence of several concurrent crises: of trust, of science, of sustainability.

Crisis of trust



“the great ideas which once inspired Europe seem to have lost their attraction, only to be replaced by the bureaucratic technicalities of its institutions.”



“As the European Union has expanded, there has been growing mistrust on the part of citizens towards institutions considered to be aloof, engaged in laying down rules perceived as insensitive to individual peoples, if not downright harmful” (Strasbourg, November 25, 2014)

http://en.radiovaticana.va/news/2014/11/25/pope_francis_address_to_european_parliament/1112318

Issues become wicked



Times of controversy: ‘wicked’ issues: GMO’s, climate, Bees and pesticides, Shale gas fracking, Coolant for Mercedes-Benz, endocrine disruptors, badger culling, ...



Issues become wicked

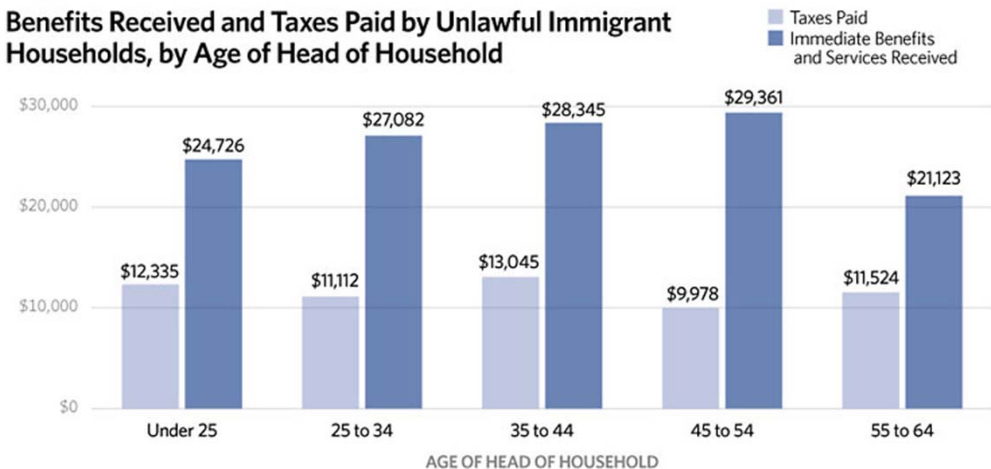


... from the fate of children raised by gay parents to the true long term cost of citizenship for illegal migrants in the US ... 'fought' with evidence



CHART 7

Benefits Received and Taxes Paid by Unlawful Immigrant Households, by Age of Head of Household



Note: Benefits include direct and means-tested benefits, public education, and population-based services. Lawful residents are included in these figures.

Source: Heritage Foundation calculations based on data from the U.S. Census Bureau, 2010 Current Population Survey, and U.S. Bureau of Labor Statistics, 2010 Consumer Expenditure Survey. Summaries of data sets are provided in the Appendix.

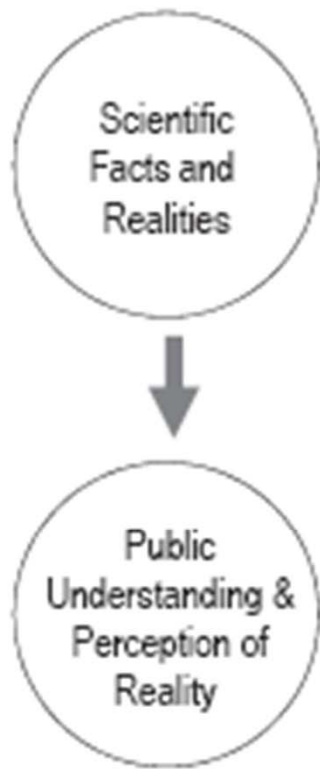
SR 133 heritage.org

More controversy - wicked issues

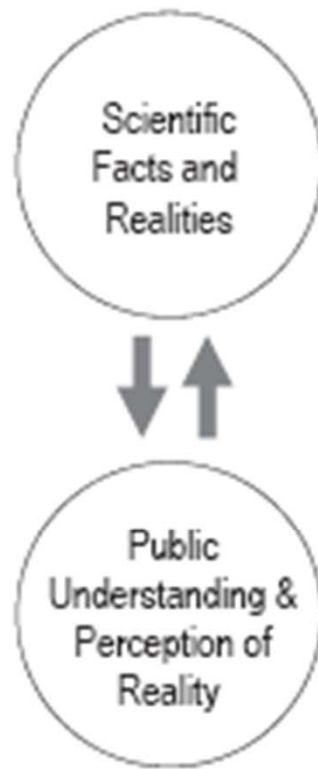
- More and more issues become ‘wicked’ , meaning by this deeply entangled in a web of hardly separable facts, interests and values...
- ‘Medialization’, agenda setting strategies (Scheufele, 2014)

Scheufele, D.A., 2014, Science communication as political communication, PNAS, 111(4), 13585–13592.

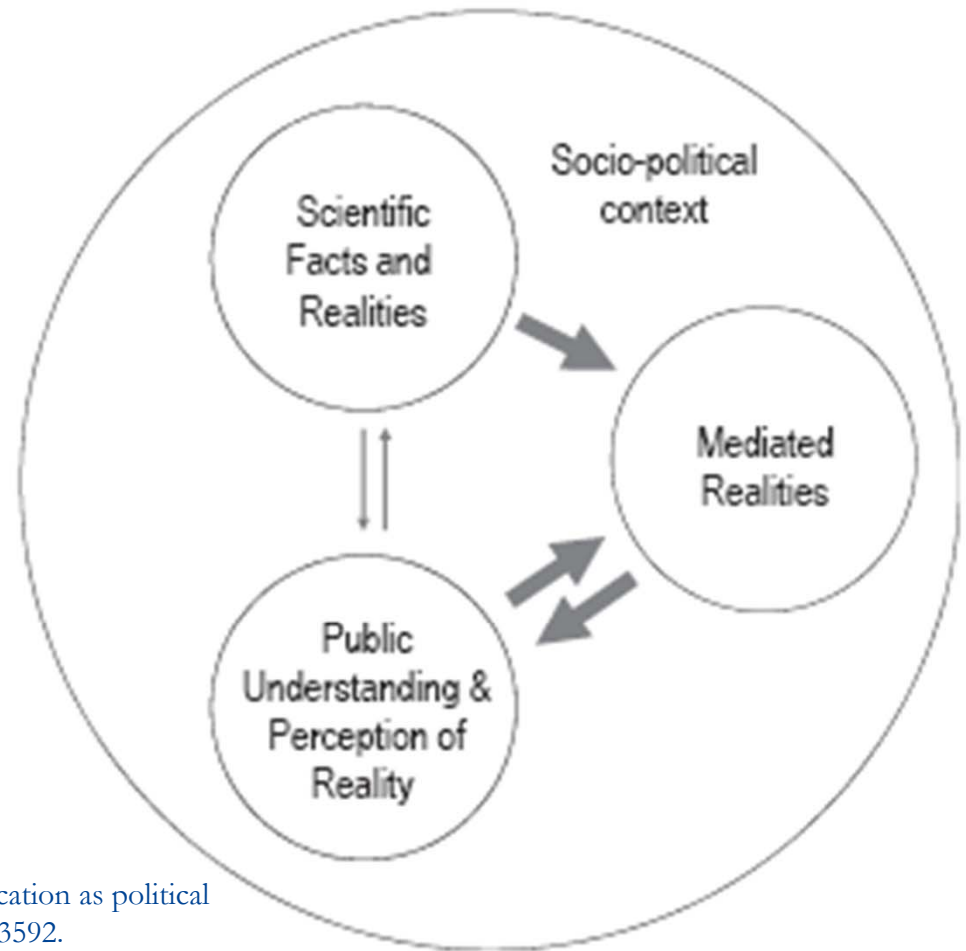
**MODEL 1:
Knowledge Deficit**



**MODEL 2:
Public Engagement
with Science**



**MODEL 3:
Science Communication
as Political Communication**



Scheufele, D.A., 2014, Science communication as political communication, PNAS, 111(4), 13585–13592.

Science's crisis



Issues with trust also
in the science ...





Issues with trust / quality in the scientific enterprise



- “Science still commands enormous—if sometimes bemused—respect. But its privileged status is founded on the capacity to be right most of the time and to correct its mistakes when it gets things wrong. [...] The false trails laid down by shoddy research are an unforgivable barrier to understanding”



Issues with trust / quality in the scientific enterprise

- Laboratory experiments cannot be trusted without independent verification (Sanderson 2013), rules are proposed to spot “suspected work [...] the majority of preclinical cancer papers in top tier journals” (Begley 2013).

Begley CG 2013 Reproducibility: Six red flags for suspect work Nature 497 433–434.

Ioannidis J P A 2005 Why Most Published Research Findings Are False PLoS Medicine 2(8) 696-701.

Sanderson K 2013 Bloggers put chemical reactions through the replication mill Nature 21 January 2013.



Issues with trust / quality in the scientific enterprise

In a landmark study of results in cancer science Begley and Ellis were able to reproduce only 11 per cent of the original findings (2012). A death sentence for patients on experimental trials (with pharma having passed the pre-clinical phase).

Begley, C. G., and Lee M. E., 2012, Drug Development: Raise Standards for Preclinical Cancer Research, *Nature*, 483, 531–533.

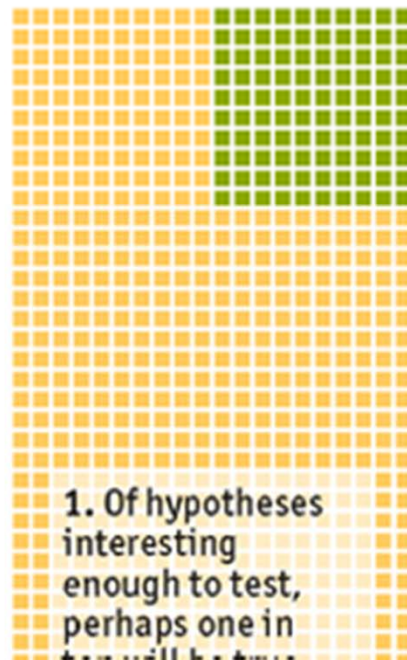
A statistical problem ?



Unlikely results

How a small proportion of false positives can prove very misleading

False True False negatives False positives



J. P. A. Ioannidis, Why Most Published Research Findings Are False, PLoS Medicine, August 2005, 2(8), 696-701.

Essay

Why Most Published Research Findings Are False

John P. A. Ioannidis

relationships proposed in each scientific field. In this framework, a research finding is less likely to be true when the studies conducted in a field are smaller; when effect sizes are smaller; when there is a greater number and lesser preselection of tested relationships; where there is greater flexibility in designs, definitions, outcomes, and analytical modes; when there is greater financial and other interest and prejudice; and when more teams are involved in a scientific field in chase of statistical significance.



Essay

Why Most Published Research Findings Are False

John P. A. Ioannidis

outcomes, and analytical modes; when there is greater financial and other interest and prejudice; and when more teams are involved in a scientific field in chase of statistical significance.



Science's crisis



Issues with trust / quality in the scientific enterprise

- A Meta-Research Innovation Centre launched at Stanford (METRICS) to combat 'bad science'.



- “85% of research funding ‘wasted’ ...”

The Economist, 2013, March 15, Combating bad science
Metaphysicians. Sloppy researchers beware. A new
institute has you in its sights.

Ioannidis, J. P. (2014). How to Make More Published
Research True. PLoS medicine, 11(10), e1001747.

Science's crisis



“Shoddy science” is not confined to natural sciences: social sciences are also affected; “I see a train wreck looming” warns Daniel Kahneman; Joseph Stiglitz condemns perverse incentives in the modelling of financial products at the hearth of the present crisis.



Daniel Kahneman



Joseph Stiglitz

Yong, E., Nobel laureate challenges psychologists to clean up their act, Nature, News, 03 October 2012.
Stiglitz, J. (2010) Freefall, Free Markets and the Sinking of the Global Economy, Penguin, London.

Science's crisis



Issues with trust / quality in the scientific enterprise

- Science/knowledge degenerates when it becomes a commodity for Lyotard (1979) and Mirowski (2011).

Lyotard, J.-F. 1979. *La Condition postmoderne. Rapport sur le savoir*, Paris : Minuit, Chapter 10.

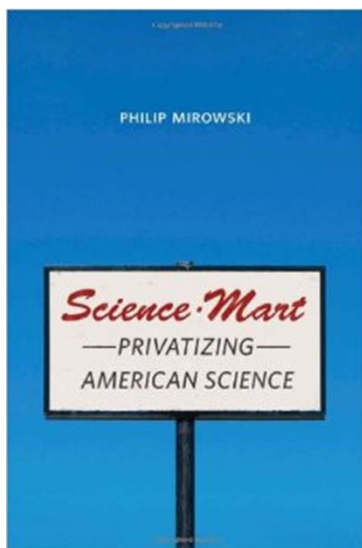
Mirowski, P. 2011. *Science-Mart: Privatizing American Science*, Harvard University Press.



Jean-François Lyotard



Philip Mirowski

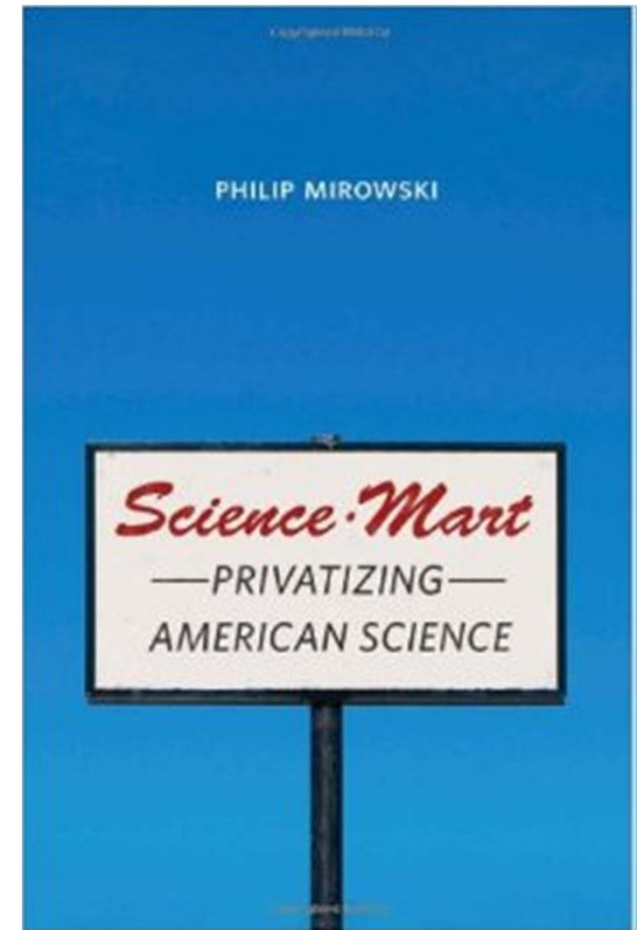


Issues with trust / quality in the scientific enterprise

- Mirowski's take on science's lost innocence:

After the eighties neoliberal ideologies succeeded in decreasing state intervention in the funding of science, which became increasingly privatized...

...Knowledge as a monetized commodity replaces knowledge as public good...



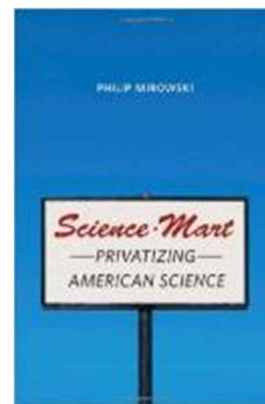
Issues with trust / quality in the scientific enterprise

- Mirowski's take on science's lost innocence:

...In house science labs of major corporation were closed and research outsourced to universities which ...

... became more and more looking as corporations...

... then research ended up outsourced again to contract-based private organizations.....→



An ethical problem?



Issues with trust / quality in the scientific enterprise

- The centrality of ethics for quality (1971).

“Two separate factors are necessary for the achievement of worthwhile scientific results: a community of scholars with shared knowledge of the standards of quality appropriate for their work and a shared commitment to enforce those standards by the informal sanctions the community possesses; and individuals whose personal integrity sets standards at least high as those required by their community.



Jerome R. Ravetz

Ravetz, J., 1971, Scientific Knowledge and its Social Problems, Oxford University Press, p.22.

An ethical problem?



Issues with trust / quality in the scientific enterprise

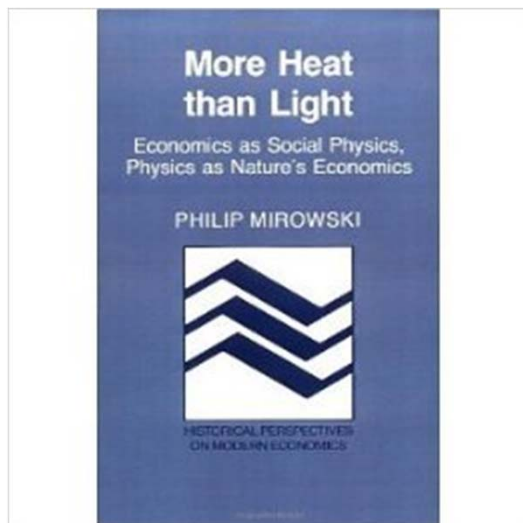
- The centrality of ethics for quality (1971).

“with the industrialization of science, certain changes have occurred which weaken the operation of the traditional mechanism of quality control and direction at the highest level. [...] The problem of quality control in science is thus at the centre of the social problems of the industrialized science of the present period. If it fails to resolve this problem [...] then the immediate consequences for morale and recruitment will be serious; and those for the survival of science itself, grave.”



Jerome R. Ravetz

Is economics at the hearth of a sustainability crisis



→ 1991

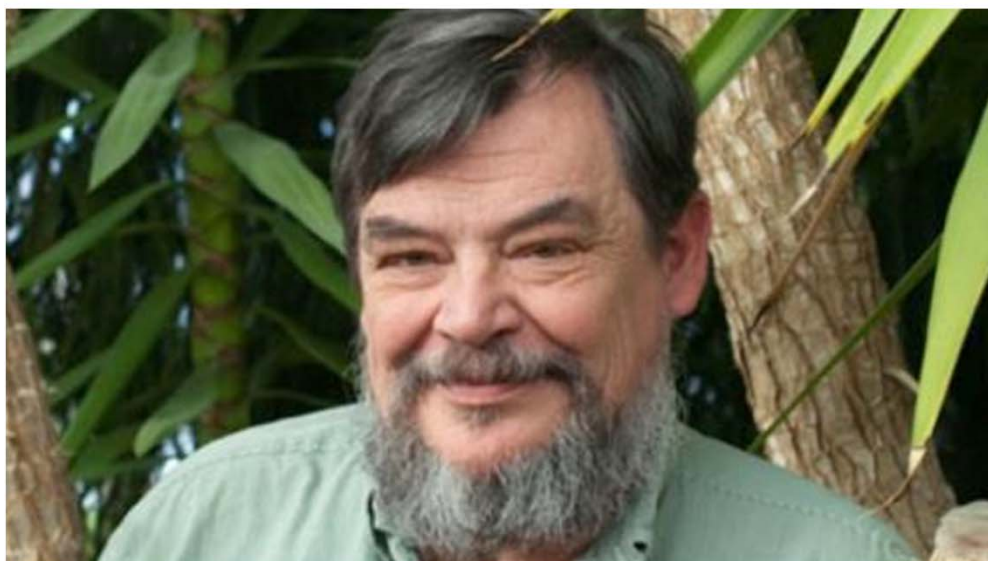


→ 2013



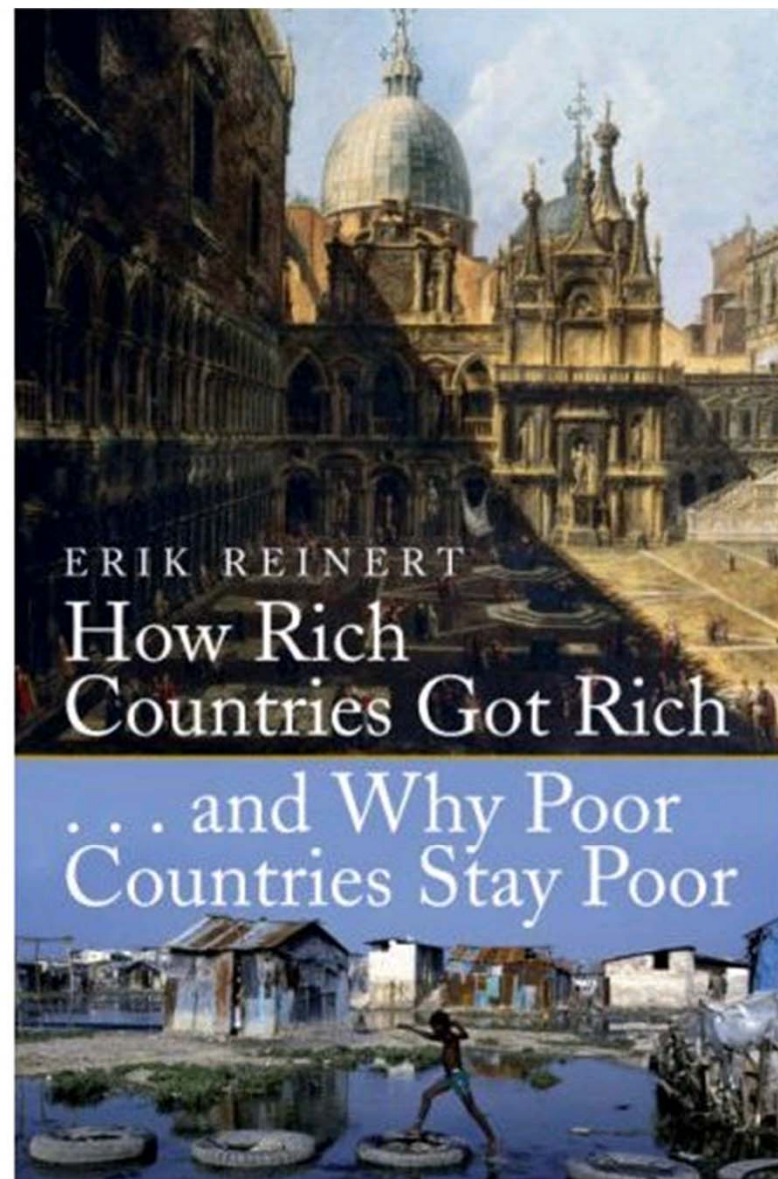
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Research
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Is economics at the hearth of a sustainability crisis



Erik Reinert

How Rich Countries Got Rich . . . and
Why Poor Countries Stay Poor
Public Affairs (October 7, 2008)



Is economics at the hearth of a sustainability crisis



Jerry Ravetz, **Economics as an elite folk science: the suppression of uncertainties,**

Journal of Post-Keynesian Economics, Winter 1994-95, 17(2).



Marion Fourcade, Etienne Ollion, and
Yann Algan, **The Superiority of**

Economists, *discussion paper 14/3, Max Planck
Sciences Po Center on Coping with Instability in Market
Societies*, 2014.



Is economics at the hearth of a sustainability crisis



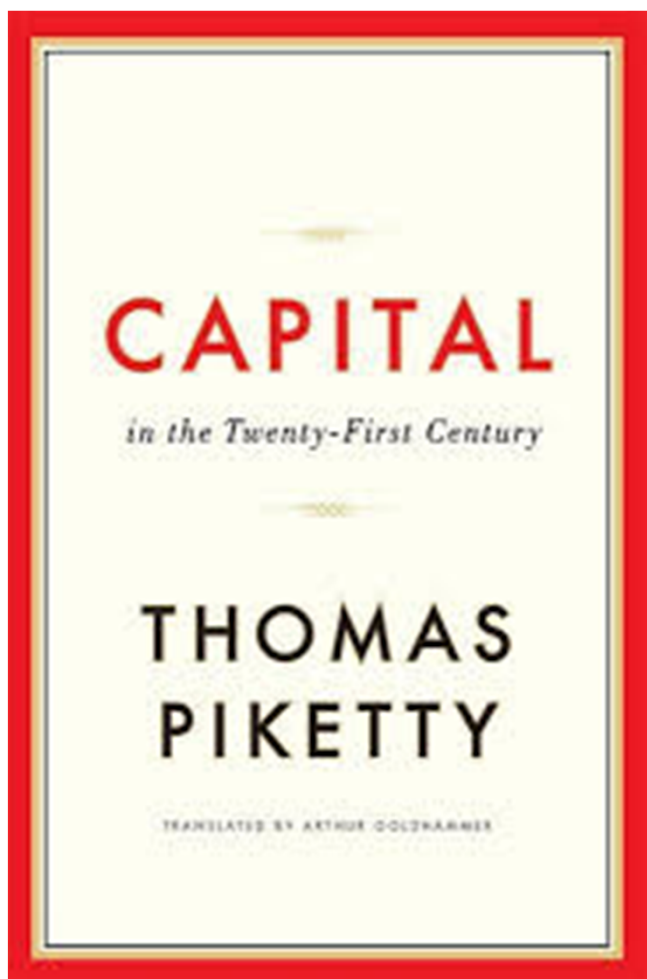
In relation to the predicaments of evidence based policy and the possible diseases of economics:



Ravetz, J., 1971, Op.Cit., p. 366 [Chapter on IMMATURE AND INEFFECTIVE FIELDS OF INQUIRY]

[...] The situation becomes worse when an immature or ineffective field is enlisted in the work of resolution of some practical problem. In such an uncontrolled and perhaps uncontrollable context, where facts are few and political passions many, the relevant immature field functions to a great extent as a 'folk-science'. This is a body of accepted knowledge whose function is not to provide the basis for further advance, but to offer comfort and reassurance to some body of believers.

Thomas Piketty and economics own internal debate



➔ 2014

On Piketty

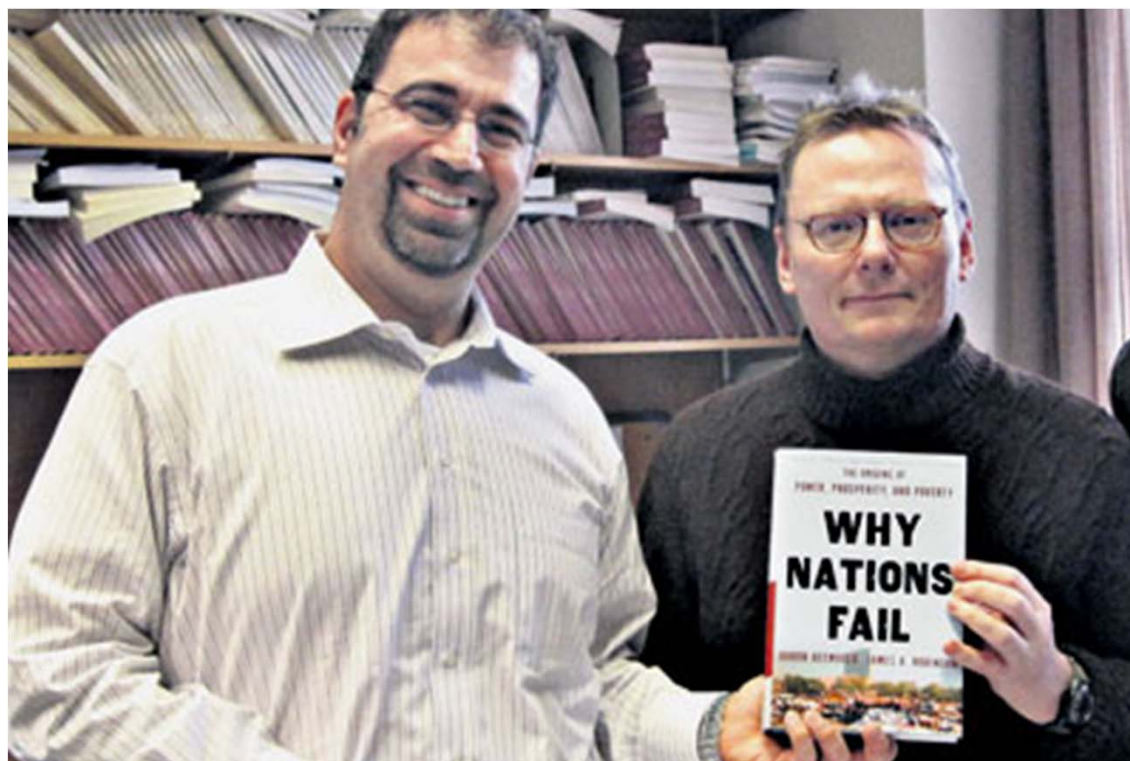


Piketty and the Crisis of Neoclassical Economics | John Bellamy Foster | Monthly Review

 monthlyreview.org/2014/11/01/piketty-and-the-crisis-of-neoclassical-economics/

Piketty's failure to relate inequality to power is not, it should be stressed, a particular failure on his part, but rather a general fault of neoclassical economics, tied to its position of ideological hegemony.

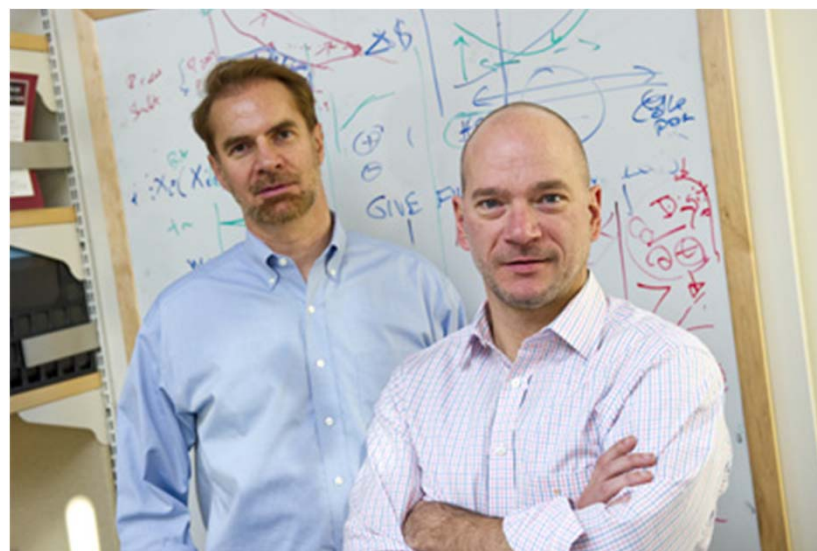
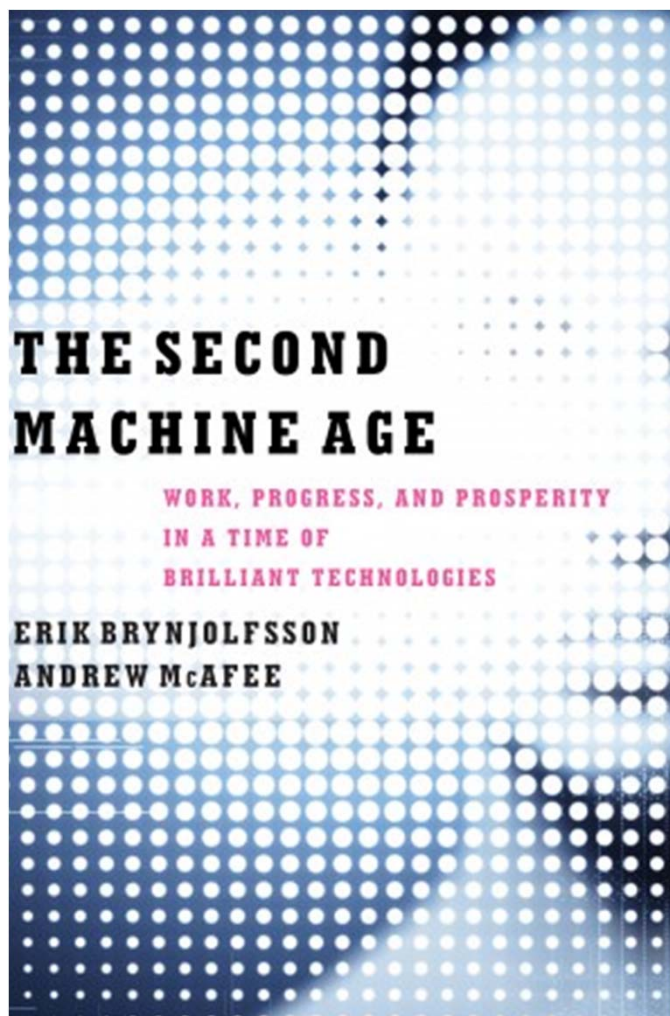
Daron Acemoglu and James Robinson



→ 2012

... quintessential vicious circle between inequality and rent seeking / corruption

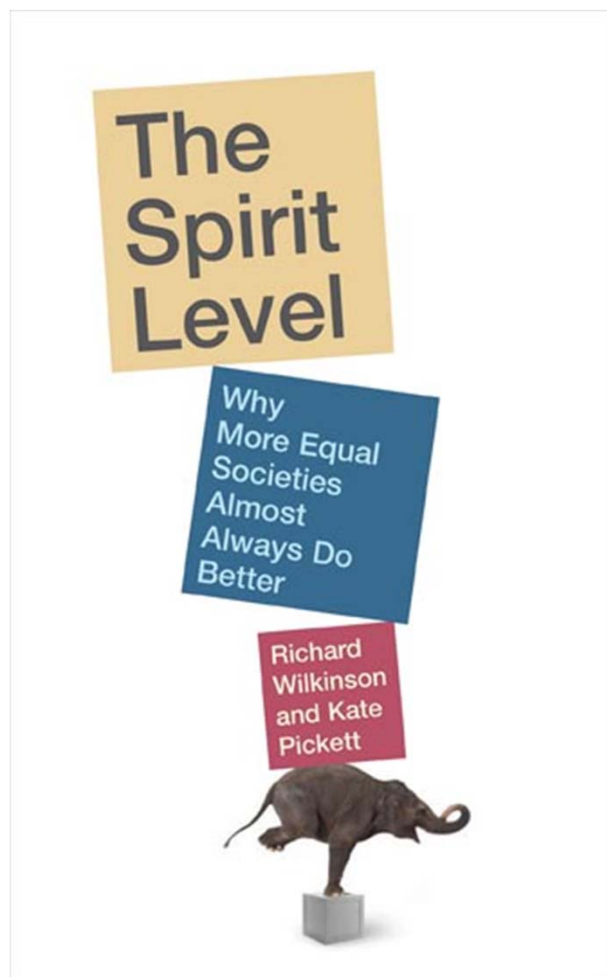
Erik Brynjolfsson and Andrew McAfee



- (i) Machines takes jobs, (ii) skill biased technological change, (iii) 'winner takes all' markets

➔ 2014

Kate Pickett, Richard Wilkinson



➔ 2012

Joseph Stiglitz (again!)



NEW YORK TIMES BESTSELLER

JOSEPH E. STIGLITZ

WINNER OF THE NOBEL PRIZE IN ECONOMICS

"A searing read." —Nicholas Kristof

THE ~~PRICE OF~~ INEQUALITY

HOW TODAY'S DIVIDED SOCIETY
ENDANGERS OUR FUTURE

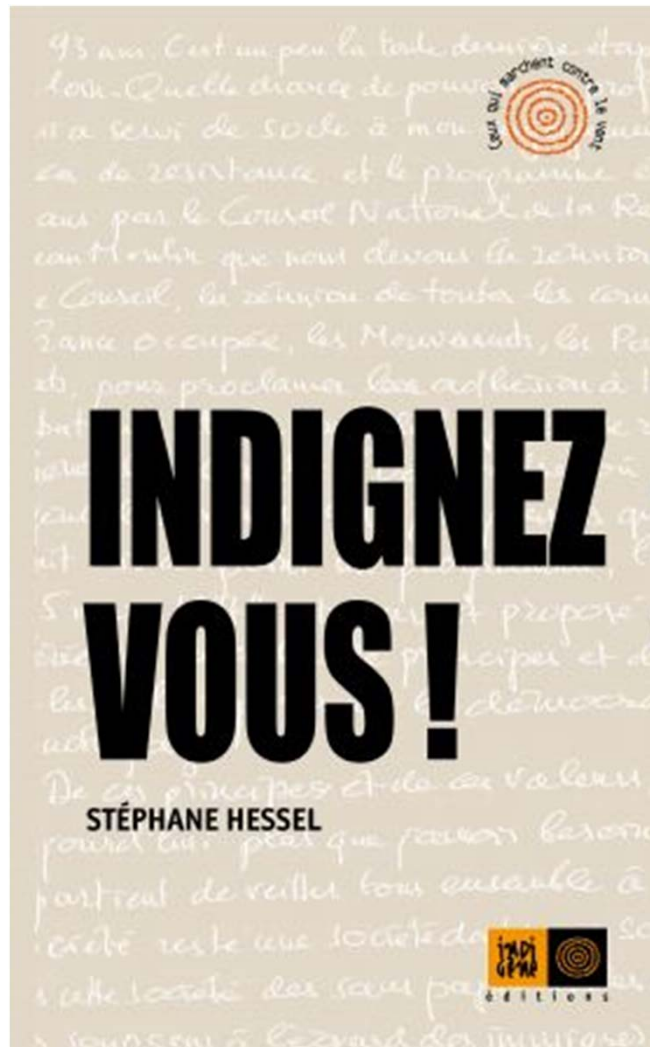
WITH A NEW PREFACE

➔ 2012



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Stéphane Hessel

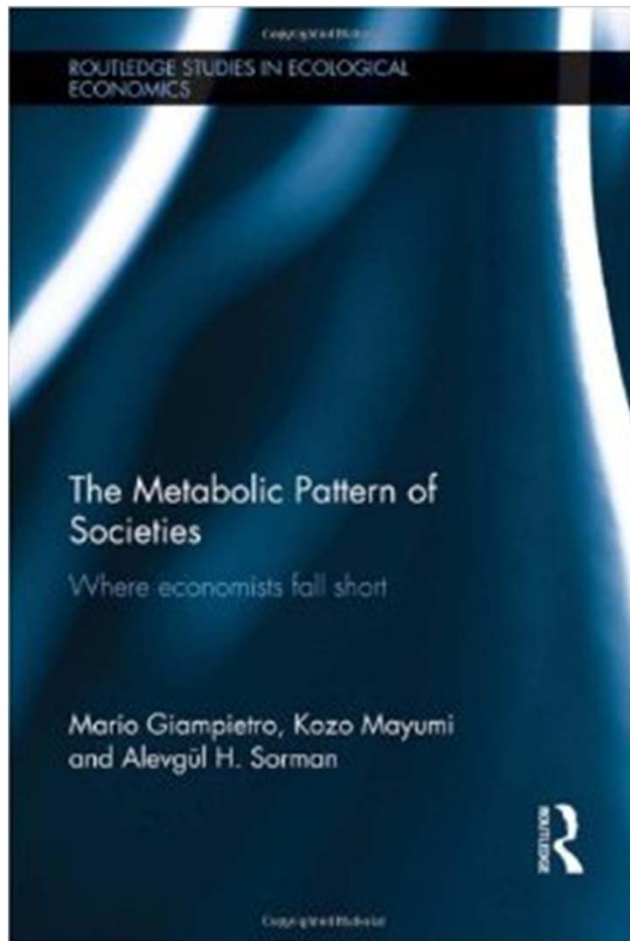


Robert David Steele



For Steele what the world needs right now is the restoration of trust collapsed by rampant corruption at all level of government and representation, and this can be achieved by a grass root movement for collective decision-making based on open source everything: *‘The open source ecology is made up of a wide range of opens – open farm technology, open source software, open hardware, open networks, open money, open small business technology, open patents ...’*

School of Nicholas Georgescu-Roegen



→ 2012



Biophysical constraints



Evidence based policy versus policy based evidence:

“the more knowledge is produced in hybrid arrangements, the more the protagonists will insist on the integrity, even veracity of their findings” ...

Grundmann, R., 2009, The role of expertise in governance processes, *Forest Policy and Economics* 11, 398–403, citing Latour, B., 1993. *We Have Never Been Modern*. Cambridge, Harvard UP.



Evidence based policy was always tricky ...

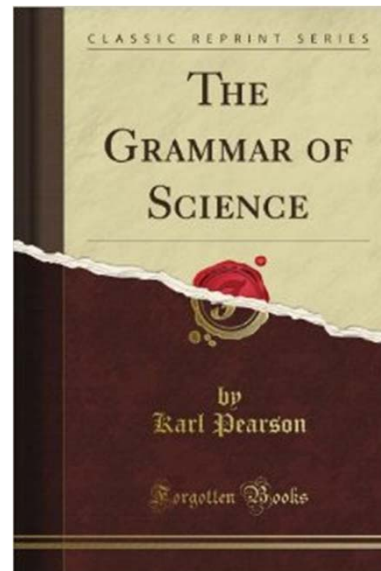


Karl Pearson (a social Darwinist) suggests not wasting resources on social programs as:

“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”



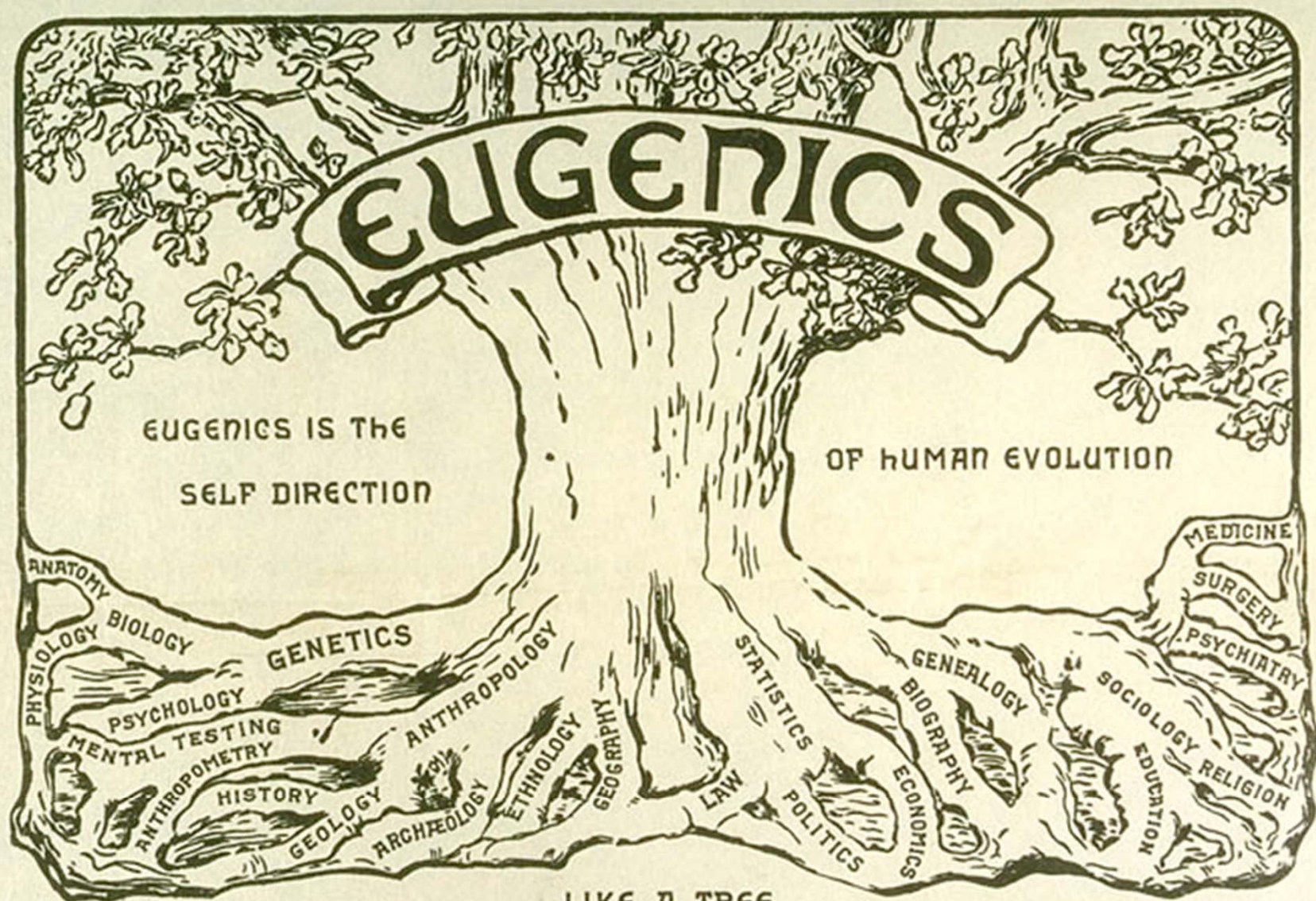
Karl Pearson



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

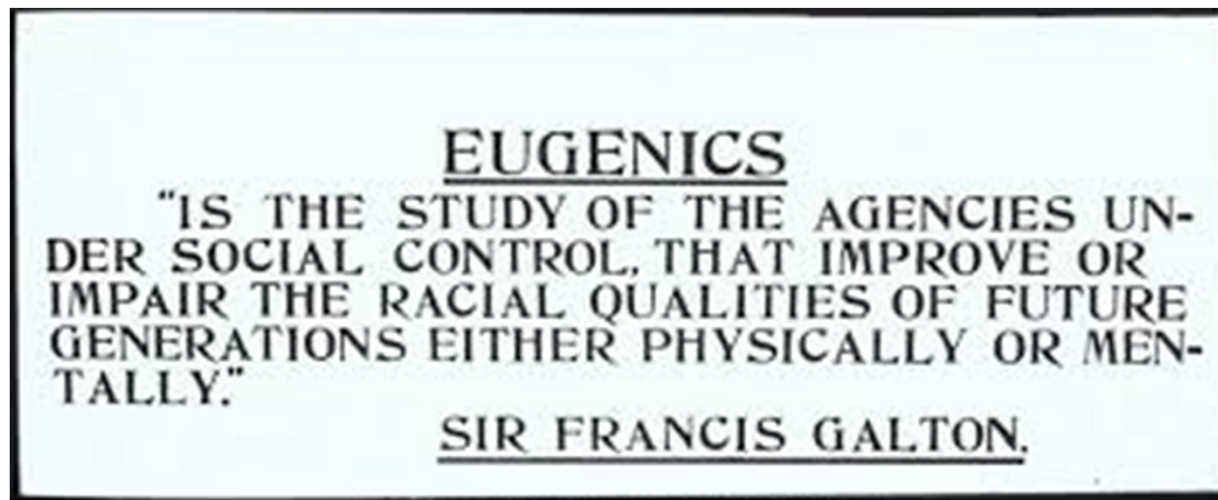
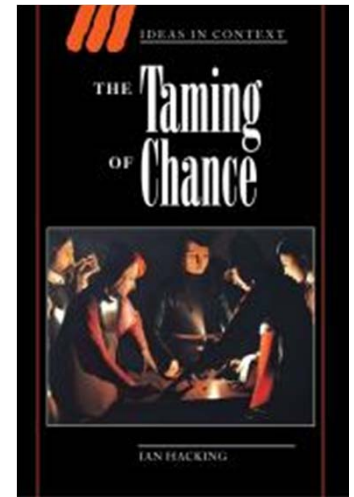
Jerry Ravetz uses this example to falsify the naïve belief that “scientific method' can be applied in a simple and straightforward fashion to [practical] problems”, Ravetz, J., *Op. Cit.*, p.346

Is it possible to disentangle evidence based policy from policy based evidence?



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

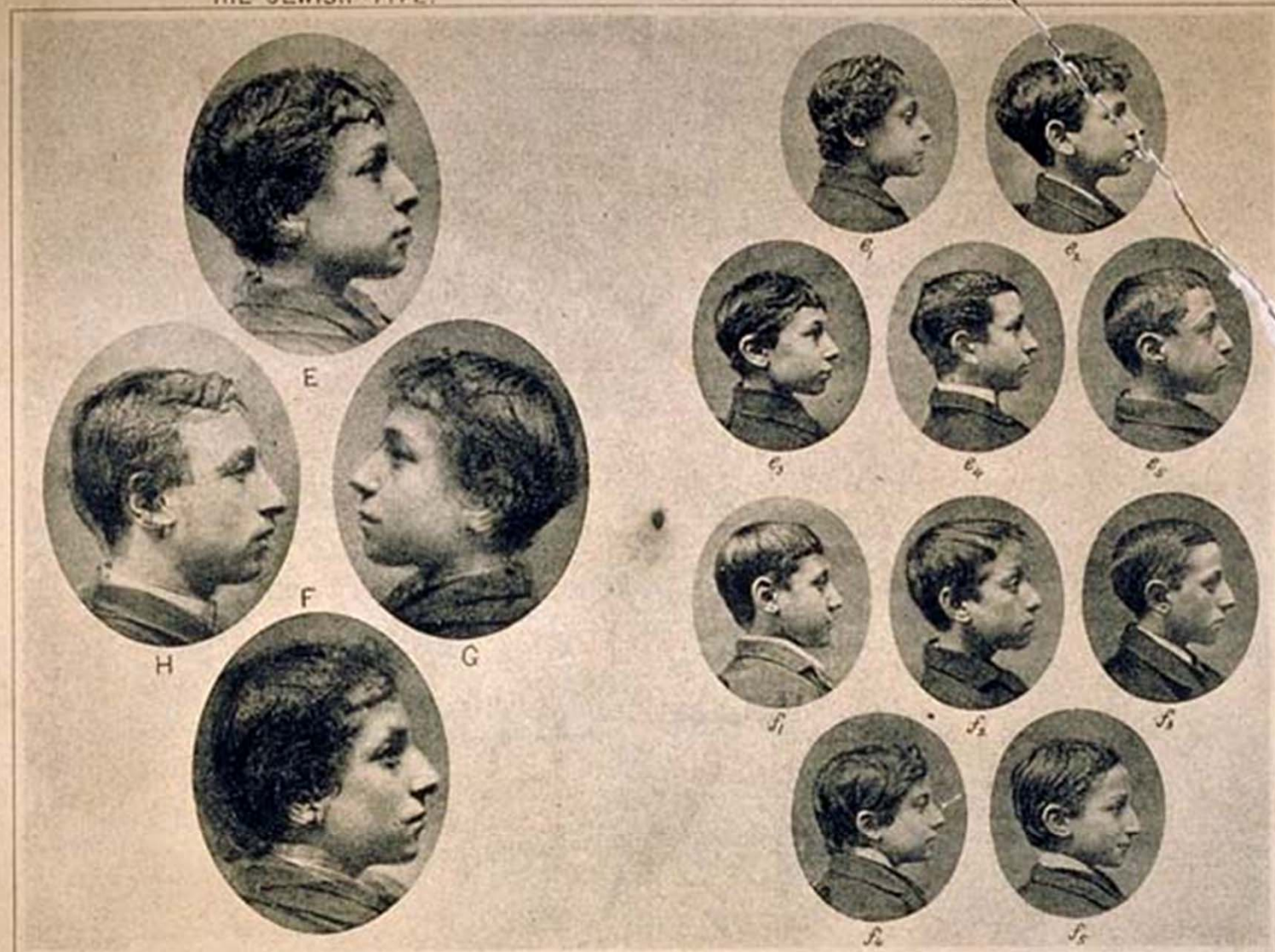
Francis Galton and Karl Pearson (the one of chi-squared, of the first university statistics department...) and their laboratory of biometrics ... distinguishing army officers from private soldiers from criminals convicted of murder from non-violent felons from Jews ...



Texas State University. Noncommercial educational use only.

THE JEWISH TYPE.

Profile.



COMPOSITES.

FRANCIS GALTON, F.R.S. PHOTO.
Components.

ILLUSTRATIONS OF COMPOSITE PORTRAITURE.

The story of the first R&D Statistics ever. Benoît Godin (2010) tells us what these researchers thought: Measuring the numbers of sons and daughters of scientists will tell us whether a society degenerates toward stupidity.





Separating the evidence from the policy: the ‘**demarcation model**’ of science’s input to policy.



- ‘Demarcation model’ of science’s input to policy.
- Protecting science from the political interference...
 - Preventing possible abuse of science...
 - ... and scientific information driven by agendas...
 - Prescribes a clear demarcation between the institutions (and individuals) who provide the science, and those where it is used.



Silvio Funtowicz

Funtowicz, S. 2006. What is Knowledge Assessment? In Guimarães Pereira, Â., Guedes Vaz, S. and Tognetti, S. (eds) Interfaces between Science and Society. Greenleaf Publishers, Sheffield.



On demarcation:

“the incoming commission must find better ways of separating evidence-gathering processes from the ‘political imperative’”, A. Glover, former Chief Science Adviser of President Barroso (Wildson, 2014).



Anne Glover

Wildson, J. 2014. Evidence-based Union? A new alliance for science advice in Europe. In The Guardian. Available at: <http://www.theguardian.com/science/political-science/2014/jun/23/evidence-based-union-a-new-alliance-for-science-advice-in-europe>.



The demarcation model is challenged in more recent epistemologies, mostly based on the impossibility to achieve separation between facts and values. Alternatives are offered by ‘Post Normal Science’ (Funtowicz and Ravetz, 1991, 1992, 1993) and by the ‘Co-production of knowledge’ (Jasanoff, 1996) models.

Funtowicz, S. O., & Ravetz, J. R., 1991. A new scientific methodology for global environmental issues. In R. Costanza (Ed.), *Ecological economics: The science and management of sustainability* (pp. 137–152). New York, NY: Columbia University Press.

Funtowicz, S. O., & Ravetz, J. R. 1992. Three types of risk assessment and the emergence of postnormal science. In S. Krimsky & D. Golding (Eds.), *Social theories of risk* (pp. 251–273). Westport, CT: Greenwood.

Funtowicz, S. O. & Ravetz, J. R. 1993. Science for the post-normal age. *Futures*, 25(7), 739–755.

Jasanoff, S. 1996, Beyond Epistemology: Relativism and Engagement in the Politics of Science. *Social Studies of Science*. 26(2) 393-418.

An alternative: the Model of Extended Participation from PNS:

- The ideal of rigorous scientific demonstration is replaced by that of open public dialogue...
- “Science” is but one among a plurality of ‘relevant knowledges’...
- Citizens become both critics and creators (public engagement, coproduction...)
- Facts become ‘extended facts’ ...



Another feature of PNS: quality as a new organizing principle which “enables us to manage the irreducible uncertainties and ethical complexities” (Funtowicz and Ravetz, 1994).

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.

When using ‘demarcation’

- ‘*science speaks truth to power*’ (Wildavsky, 1979)
- the problem are the citizens with their limited understanding of scientific subject (deficit model);
- Public understanding of science (PUS).

Wildavsky, A., 1979, *Speaking Truth to Power: The Art and Craft of Policy Analysis*, Boston Little, Brown and Company.

All this to say that in fact you cannot separate evidence based policy from policy based evidence.

Why is this story of evidence based policy so important?

Chapter 2, Le probleme: La legitimisation

‘C’est depuis Platon que la question de la **légitimation de la science** se trouve indissociablement connexe de celle de la **légitimation du législateur**. Dans cette perspective, le droit de décider de ce qui est vrai n’est pas indépendant du droit de décider de ce qui est juste [...] **savoir et pouvoir sont les deux faces d’une même question**: qui décide ce qu’est savoir, et qui sait ce qu’il convient de décider? La question du savoir à l’âge de l’informatique est plus que jamais la question du gouvernement.’

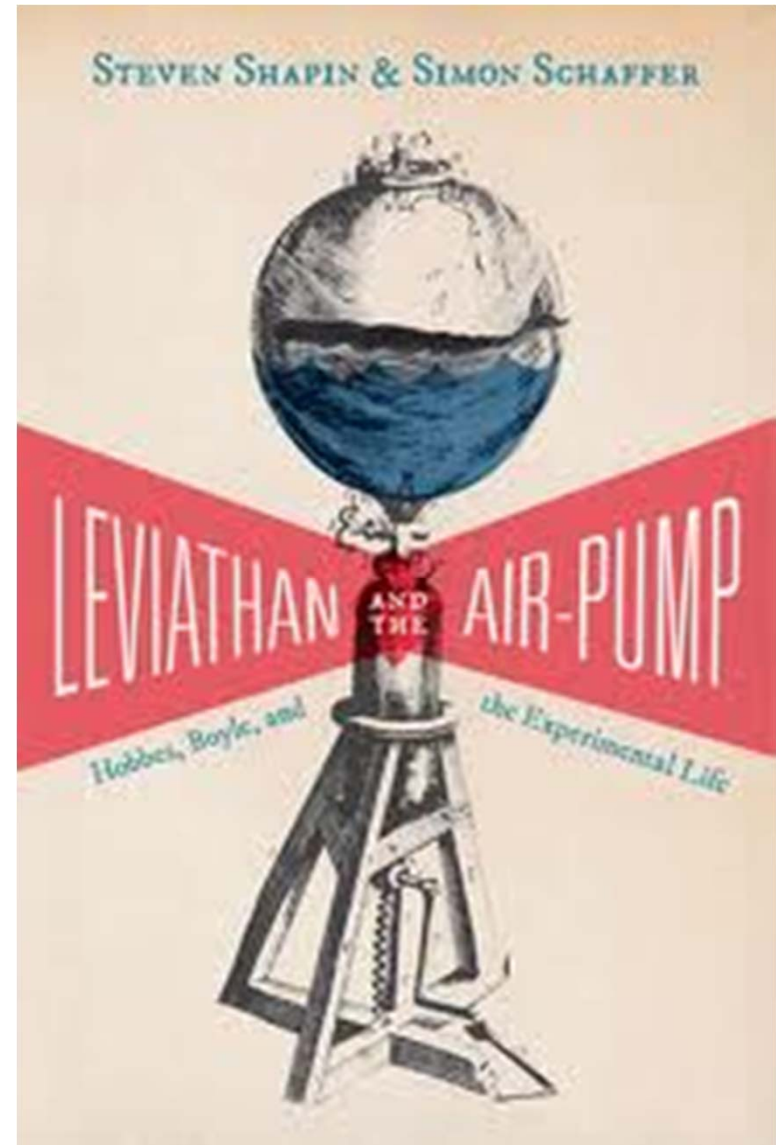


Jean-François Lyotard

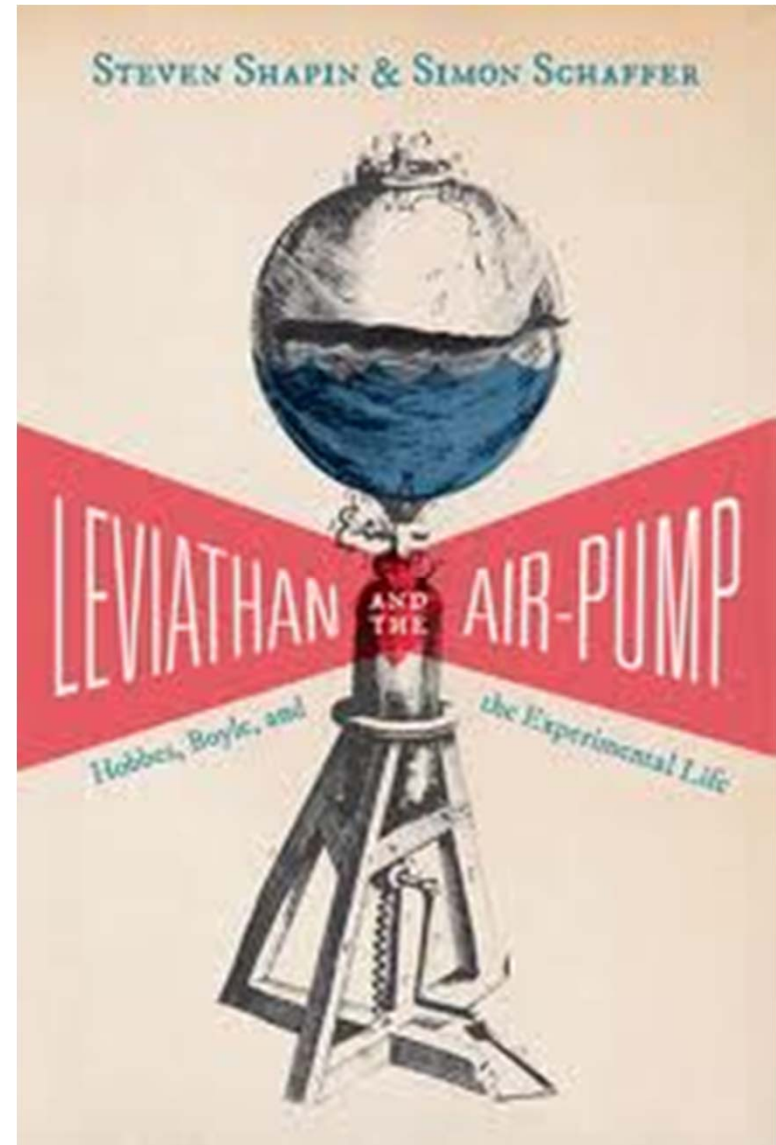
‘Solutions to the problem of knowledge are solutions to the problem of social order.

[...] Trust in Science and trust in the prevailing social order are linked’

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



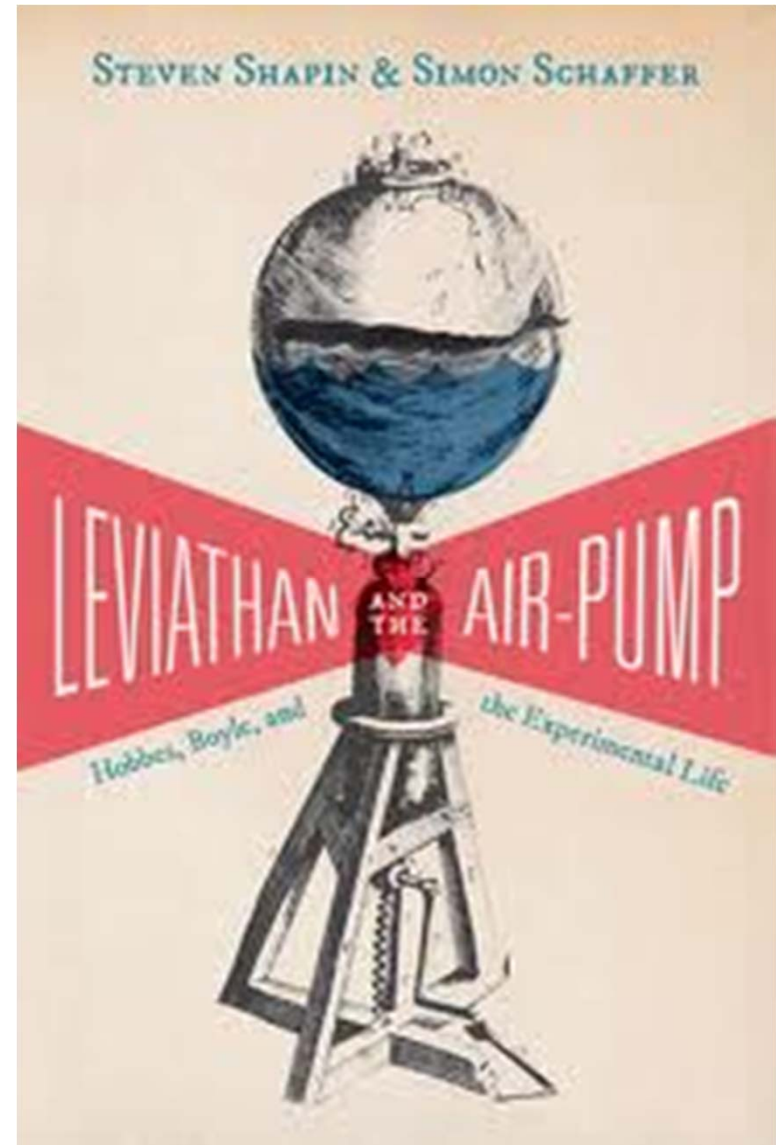
Shapin and Schaffer discusses how establishing 'matter of facts' under controlled 'laboratory' experiments before witnesses, was a way to subtract the discourse about knowledge from religious squabbles ...



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





Why is this story of evidence based policy so important?

“And so we have a large consultancy business of transport modellers, environmental experts, risk managers and impact assessment modellers, **the front line of an army that has turned evidence-based policy into policy-based evidence.** These procedures cloak often casual instinctive assessments in an appearance of objective justification”, Kay, 2014.

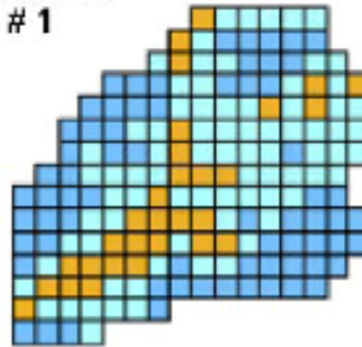
Kay, J., 2014, The wisest choices depend on instinct and careful analyses, *Financial Times*, September 2.

Model structure uncertainty...

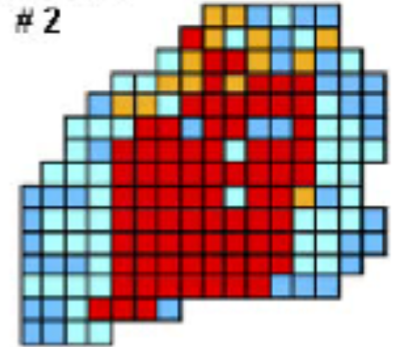
5 consultants, each using a different model were given the same question:
“which parts of this particular area are most vulnerable to pollution and need to be protected?”

(Refsgaard et al, 2006)

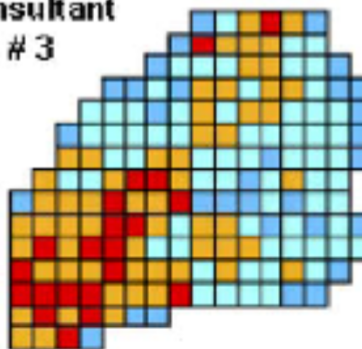
Consultant
1



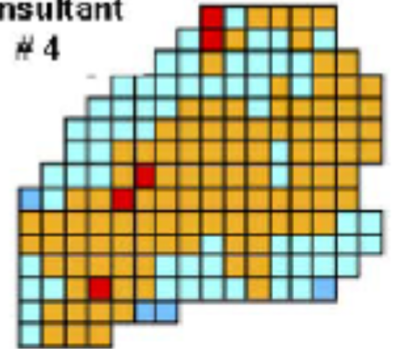
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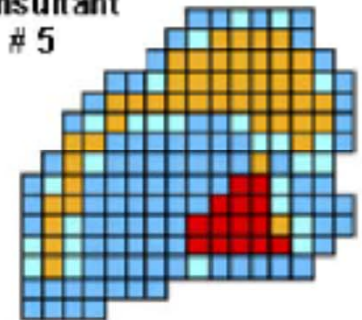
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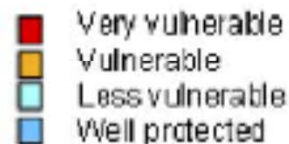
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Consultant
5



vulnerable areas



Courtesy of Dr. Jeroen P. van der Sluijs, Centre for the Studies of the Sciences and the Humanities (SVT), University of Bergen (NO)

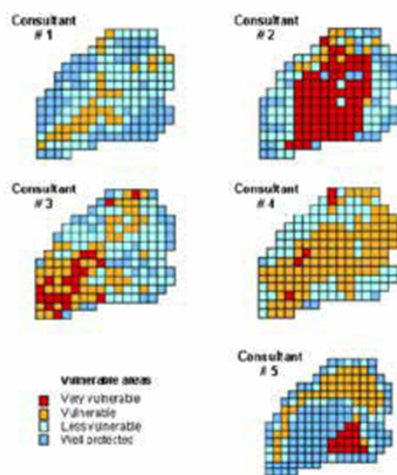


Fig. 1. Model predictions on aquifer vulnerability towards nitrate pollution for a 175 km² area west of Copenhagen [11].

How to act upon such uncertainty?

- **Bayesian** approach: 5 priors. Average and update likelihood of each grid-cell being red with data (but oooops, there is no data and we need decisions now)
- IPCC approach: Lock the 5 consultants up in a room and don't release them before they have **consensus**
- **Nihilist** approach: Dump the science and decide on an other basis
- **Precautionary** robustness approach: protect all grid-cells
- **Academic bureaucrat** approach: Weigh by citation index (or H-index) of consultant.
- Select the consultant that you **trust** most
- Real life approach: Select the consultant that best fits your **policy agenda**
- Post normal: explore the relevance of our ignorance: **working deliberately within imperfections**



3 framings of uncertainty

'deficit view'

- Uncertainty is provisional
- Reduce uncertainty, make ever more complex models
- *Tools:* quantification, Monte Carlo, Bayesian belief networks

– *Speaking truth to power*

'evidence evaluation view'

- Comparative evaluations of research results
- *Tools:* Scientific consensus building; multi disciplinary expert panels
- focus on robust findings

– *Speaking [consensus] to power*

'complex systems view / post-normal view'

- Uncertainty is intrinsic to complex systems
- Openly deal with deeper dimensions of uncertainty
- *Tools:* Knowledge Quality Assessment

– *Working deliberately within imperfections*





Dueling Visions For a Hungry World

Sparks began to fly when scientists and activists against genetically modified crops came together to assess agricultural knowledge and the role of biotech in development

When economist Carl Pray heard about plans for the first international assessment of agricultural research, a gold standard sprang to mind: the Intergovernmental Panel on Climate Change (IPCC). But things didn't turn out the way he expected.

IPCC has been pivotal in proving that climate change is real and linking it to human activities. As an agricultural economist at Rutgers University who has worked in many poor countries, Pray is convinced that agricultural research—and genetic modification in

mentally, socially and economically sustainable development through the generation, access to, and use of agricultural knowledge, science and technology?" Critics say this broad mandate made conflict inevitable and started the assessment's analytical rigor.

On several key issues, consensus proved elusive. Industry scientists and some academics—mainly agricultural economists and plant biologists—believe the assessment was “hijacked” by participants who oppose genetically modified (GM) crops and other common

the outcome. They note that the voice and experience of small-scale farmers, particularly women, have finally been brought to the fore by the assessment. “It really deals with issues of power, influence, and benefits,” says Marcia Khil-Eitman of the Pesticide Action Network North America in San Francisco, California. Toby Kiers, who studies sustainable agriculture at Vrije University in Amsterdam, the Netherlands, agrees. “For technology to be most effective, farmers must be at the center, influencing how it is developed, delivered, and

loaded from www.sciencemag.org on March 14, 2008

The IFPRI had raised about \$460,000 for the modeling, which would have provided insights to help policymakers [...]

[...] But Greenpeace [...] objected that the models were not “transparent”.

Source: Dueling visions for an hungry world, Erik Stokstad, 14 MARCH 2008, 319 SCIENCE

THE ASSESSMENT, IS A DILEMMA: HOW CAN we reduce hunger and poverty, improve rural livelihoods, and facilitate equitable, environ-

* www.assessment.org

community-based knowledge.

- Create space for diverse voices and include social scientists in policy.

UNUSUAL, SUCH THE WORLD BANK'S CHIEF SCIENTIST, suggested that the bank review the entire range of agricultural technologies and policies. Convinced that agricultural research should be considered in the context of the myriad factors

CREDIT: HANALOV

We just can't predict, says N. N. Taleb, and we are victims of the ludic fallacy, of delusion of uncertainty, and so on. Modelling is just another attempt to 'Platonify' reality...

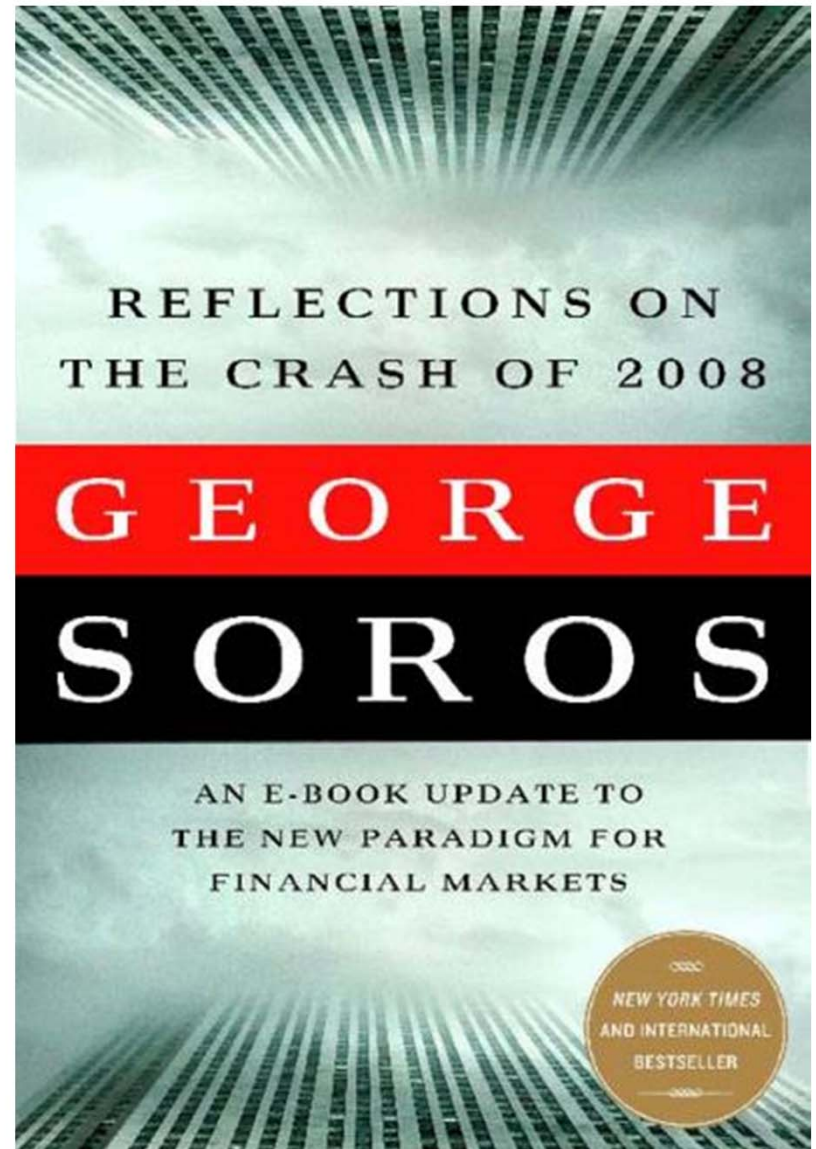


Written before the
financial crisis

Nassim Nicholas
Taleb, *The Black
Swan*, Penguin,
London 2007



Postulate of 'radical fallibility':
"Whenever we acquire some
useful knowledge, we tend to
extend it to areas where it is
no longer applicable"
(Taleb's -Platonification')



Models by their nature are like blinders. In leaving out certain things, they focus our attention on other things. They provide a frame through which we see the world.

Joseph E. Stiglitz, 2011, RETHINKING MACROECONOMICS: WHAT FAILED, AND HOW TO REPAIR IT, Journal of the European Economic Association August 2011 9(4):591–645



Caeteris are
never paribus!



The rethorical question Keynes asks is (Keynes, 1940):

"It will be remembered that the seventy translators of the Septuagint were shut up in seventy separate rooms with the Hebrew text and brought out with them, when they emerged, seventy identical translations. Would the same miracle be vouchsafed if seventy multiple correlators were shut up with the same statistical material?"

Keynes, J. M. , 1940, On a Method of Statistical Business-Cycle Research. A Comment, The Economic Journal, Vol. 50, No. 197 (Mar., 1940), 154-156.

Mirowski on DSGE



Philip Mirowski

“...To be fair, **DSGE and similar macroeconomic models** were first conceived as theorists’ tools. But why, then, are they being relied on as the platform upon which so much practical policy advice is **formulated**? And what has caused them to become, and to stay, so firmly entrenched?”



The quote reported is from Miller, B., 2010, Opening Address, The Hearing Charter of the House Committee on Science and Technology and sworn testimony of economists Sidney Winter, Scott Page, Robert Solow, David Colander and V.V. Chari. See book on this slide..



THE NEW YORKER

“Carmen Reinhart and Kenneth Rogoff [...] famous (now infamous) research that conservative politicians around the world had seized upon to justify pennypinching Policies ...”

John Cassidy, April 2013 issue

The Reinhart and Rogoff affair



“... rising levels of government debt are associated with much weaker rates of economic growth, indeed negative ones ...”

It was instead a coding error uncovered by three researchers at the university of Michigan.



“In Britain and Europe, great damage has been done as a result.”

THE NEW YORKER

Excel horror stories and warnings



“The fact that software is commercial is no guarantee that it does what it's supposed to do” (Philip B. Stark)

<http://www.stat.berkeley.edu/~stark/Preprints/auditingPosition09.htm#excel>

Philip B. Stark





Perils of placing faith in a thin theory



By Wolfgang Münchau April 21, 2013

Reinhart and Rogoff told policy makers what they wanted to hear

John Kenneth Galbraith [about] Milton Friedman: “Milton’s misfortune was that his policies had been tried.” [...]

As for Profs Reinhart and Rogoff, I suspect that they, too, will be mostly remembered for the fact that their policies have been tried.

More on all this:



*Of styles and methods
Future institutional identities
at times of change in
scientific advice to policy*

*Ângela Guimarães Pereira
and Andrea Saltelli*

European Commission, Joint Research Centre
Econometrics and Applied Statistics Unit

http://www.andreasaltelli.eu/file/repository/straw_man_final_TR_REGISTER_Small.pdf





END

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