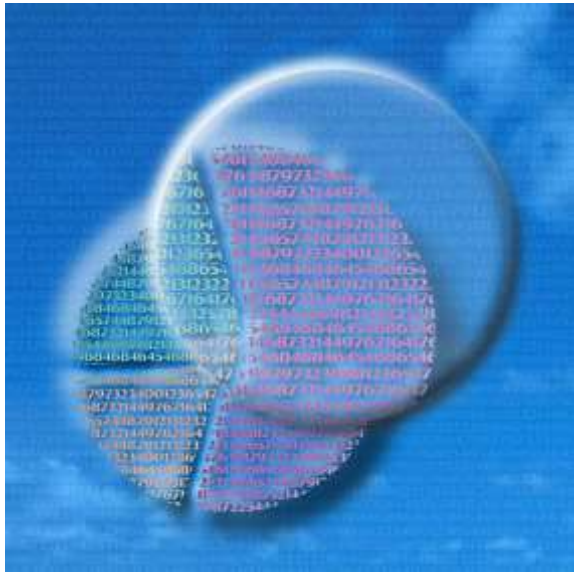


# Ethics of quantification

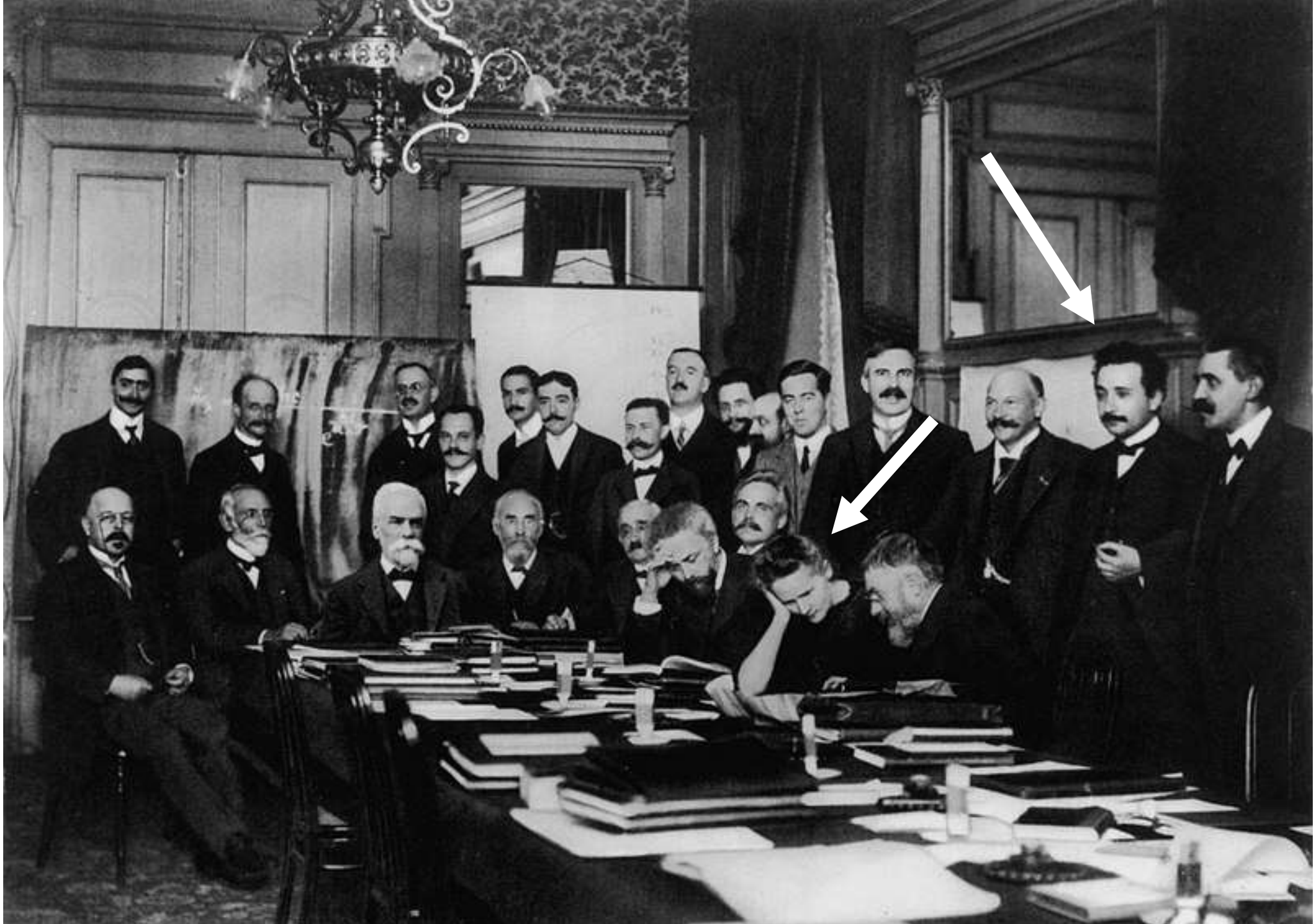
Andrea Saltelli
Centre for the Study of the Sciences and the Humanities (SVT), University of Bergen (UIB), and Open Evidence Research, Open University of Catalonia

MNF990 / Theory of Science and Ethics, Bergen, February 11, 2021

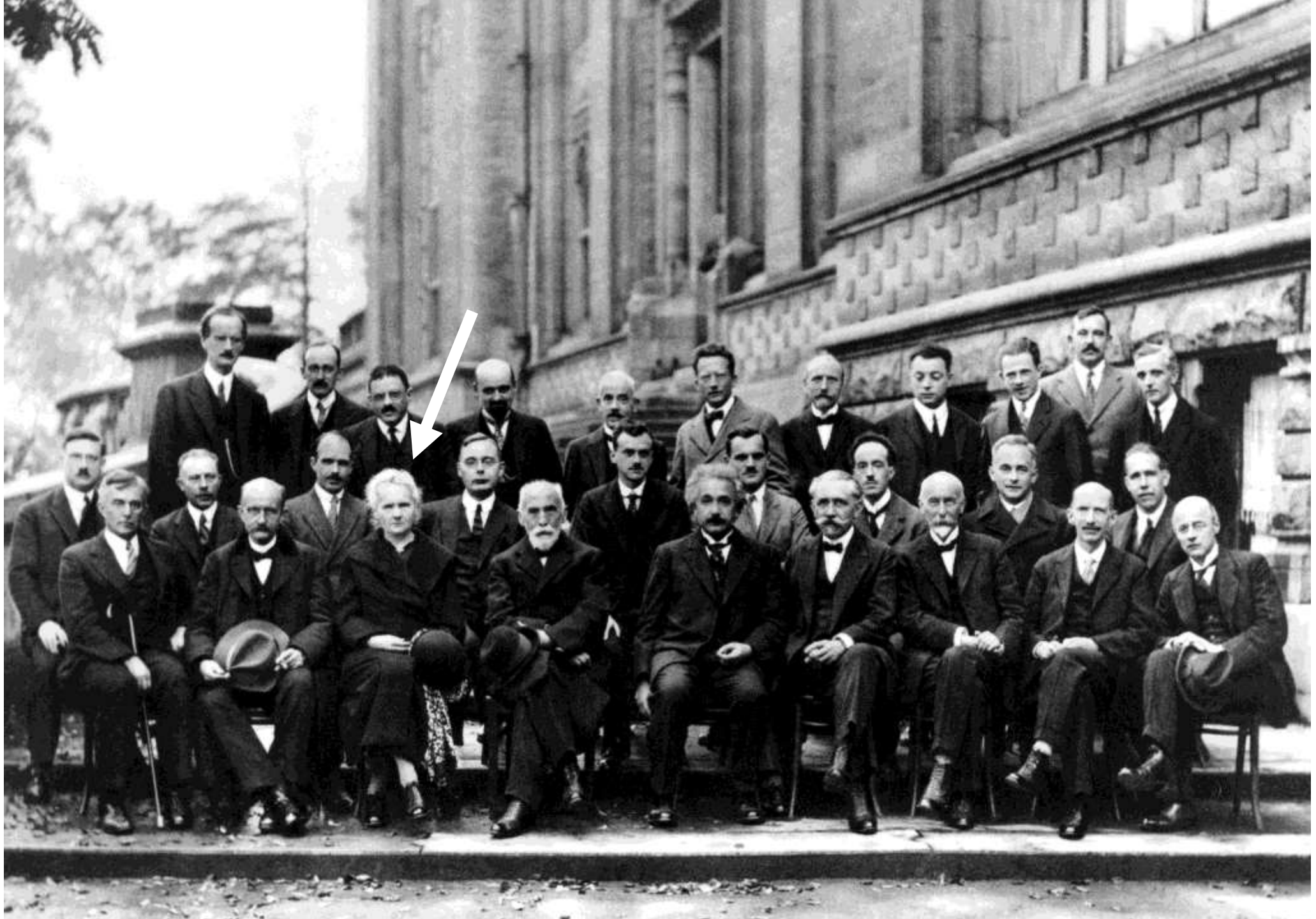
# Where to find this talk: www.andreasaltelli.eu

So many men,
so few women

1911



1927



# Lise Meitner

The first person to understand nuclear fission;

She did not win the Nobel prize 1944 for chemistry which went to her colleague Otto Hahn

Lise Meitner
1878- 1968

# Rosalind Elsie Franklin

Her X-ray images led to the discovery of the DNA double helix structure;

Nobel in Medicine 1962 to J. Watson, F. Crick and M. Wilkins;

She should have ideally been awarded a Nobel Prize in Chemistry (according to J. Watson)

Rosalind Elsie Franklin
1920-1958

# Eunice Foot (1819–1888)



CLIMATE HOME NEWS

# Meet the woman who first identified the greenhouse effect

Published on 02/09/2016, 5:58pm

Eunice Foote demonstrated the heat-trapping properties of carbon dioxide at a scientific conference in 1856, newly digitised records show

By Megan Darby

**Irish physicist John Tyndall is commonly credited with discovering the greenhouse effect, which underpins the science of climate change.**

ART. XXXI.—*Circumstances affecting the Heat of the*
by EUNICE FOOTE.

(Read before the American Association, August 23d, 1

MY investigations have had for their object to
different circumstances that affect the thermal actio
of light that proceed from the sun.

Several results have been obtained.

First. The action increases with the density o
is diminished as it becomes more rarified.

The experiments were made with an air-pump a
drical receivers of the same size, about four inc
ter and thirty in length. In each were placed two t
and the air was exhausted from one and condensed
After both had acquired the same temperature they
in the sun, side by side, and while the action of t
rose to 110° in the condensed tube, it attained on
other. I had no means at hand of measuring the d
densation or rarefaction.

The observations taken once in two or three min
follows:

| Exhausted Tube | | Condensed Tu | |
|---|---|---|---|
| In shade. | In sun. | In shade. | |
| 75 | 80 | 75 | |
| 76 | 82 | 78 | |
| 80 | 82 | 80 | |
| 83 | 86 | 82 | |
| 84 | 88 | 85 | |

This circumstance must affect the power of the
different places, and contribute to produce their fo
the summits of lofty mountains.

Secondly. The action of the sun's rays was found
in moist than in dry air.

In one of the receivers the air was saturated wit
in the other it was dried by the use of chlorid of ca
Both were placed in the sun as before and the
follows:

| Dry Air. | | Damp Air. | |
|---|---|---|---|
| In shade. | In sun. | In shade. | |
| 75 | 75 | 75 | |
| 78 | 88 | 78 | |
| 82 | 102 | 82 | |
| 82 | 104 | 82 | |
| 82 | 105 | 82 | |
| 83 | 103 | 92 | |

# CIRCUMSTANCES

# Affecting the Heat of the Sun's Rays.

## BY MRS. EUNICE FOOTE.

Tweet

**Isabel Hilton**
@isabelhilton

Who could have imagined that the scientist who first demonstrate the potential for global warming with an elegant experiment could be so completely forgotten. Oh, it was a woman? Now I get it.

Overlooked No More: Eunice Foote, Climate Scientist Lost to History

Foote's ingenious experiment more than 150 years ago yielded a remarkable discovery that could have helped shape modern climate science had she not bee...

nytimes.com

https://www.nytimes.com/2020/04/21/obituaries/eunice-foote-overlooked.html

# Quantifications and the roots of the Cartesian dream

# Separate but related stories

Cartesian dream: possess and domination of nature

The ‘procedural utopia’: grounding social harmony and progress in calculations

Francis Bacon
(1561-1626)
Magnalia Naturae, in the New Atlantis (1627), '*Wonders of nature, in particular with respect to human use*'

We call Cartesian dream the idea of man as master and possessor of nature, of prediction and control, of Bacon's wonders of science and of Condorcet's mathematique sociale…

René Descartes
(1596-1650)
Discourse on Method
(1637)

Nicolas de Caritat, marquis de Condorcet
(1743- 1794)
'Sketch for a Historical Picture of the Progress of the Human Spirit'

Francis Bacon
(1561-1626)

## Magnalia Naturae, in the New Atlantis (1627),

*'Wonders of nature, in particular with respect to human use'*

The prolongation of life; The restitution of youth in some degree; The retardation of age; The curing of diseases counted incurable; The mitigation of pain; More easy and less loathsome purgings; The increasing of strength and activity; The increasing of ability to suffer torture or pain; The altering of complexions, and fatness and leanness; The altering of statures; The altering of features; The increasing and exalting of the intellectual parts; Versions of bodies into other bodies; Making of new species; Transplanting of one species into another; Instruments of destruction, as of war and poison; Exhilaration of the spirits, and putting them in good disposition; Force of the imagination, either upon another body, or upon the body itself; Acceleration of time in maturations; Acceleration of time in clarifications; Acceleration of putrefaction; Acceleration of decoction; Acceleration of germination; Making rich composts for the earth; Impressions of the air, and raising of tempests; Great alteration; as in induration, emollition, &c; Turning crude and watery substances into oily and unctuous substances; Drawing of new foods out of substances not now in use; Making new threads for apparel ; and new stuffs, such as paper, glass, &c; Natural divinations; Deceptions of the senses; Greater pleasures of the senses; Artificial minerals and cements.

# Magnalia Naturae, in the New Atlantis (1627),

## *'Wonders of nature, in particular with respect to human use'*

Francis Bacon (1561-1626)

The prolongation of life; The restitution of youth in some degree; The retardation of age; The curing of diseases counted incurable; The mitigation of pain;
[…]
Drawing of new foods out of substances not now in use; Making new threads for apparel; and new stuffs, such as paper, glass, etc.; Natural divinations; Deceptions of the senses; Greater pleasures of the senses; Artificial minerals and cements.

The study of letters leading to “doubts and errors”;

Comparing “disquisitions of the ancient moralists to very towering and magnificent palaces with no better foundation than sand and mud”;

Condemnation of humanities and exaltation of mathematics.

René Descartes (1596–1650)

Discourse on Method (1637)

“I perceived it to be possible to arrive at knowledge highly useful in life; and in room of the Speculative Philosophy […], to discover a Practical, by means of which, knowing the force and action of fire, water, air, the stars, the heavens, and all the other bodies that surround us, […]we might also apply them […], and thus render ourselves the lords and possessors of nature.”

http://www.bartleby.com/34/1/6.html

René Descartes (1596-1650)

Discourse on Method (1637)

In the formulation of Condorcet: “All the errors in politics and in morals are founded upon philosophical mistakes, which, themselves, are connected with physical errors” (Ninth Epoch)

Nicolas de Caritat, marquis de Condorcet
(1743- 1794)

‘Sketch for a Historical Picture of the Progress of the Human Spirit’

http://oll.libertyfund.org/titles/1669

Overpopulation? War due to scarcity of resources? Will not happen because technical progress and ethical progress will go hand in hand. Man will understand that his duty “will consist not in the question of giving existence to a greater number of beings, but happiness.” (Tenth Epoch)

Nicolas de Caritat, marquis de Condorcet
(1743- 1794)
‘Sketch for a Historical Picture of the Progress of the Human Spirit’

http://oll.libertyfund.org/titles/1669

# ‘Mathématique sociale’: We still use today terms such as ‘Condorcet method’, ‘Condorcet winner’, ‘Condorcet-ranking procedure’

Nicolas de Caritat,
marquis de Condorcet
(1743- 1794)

‘

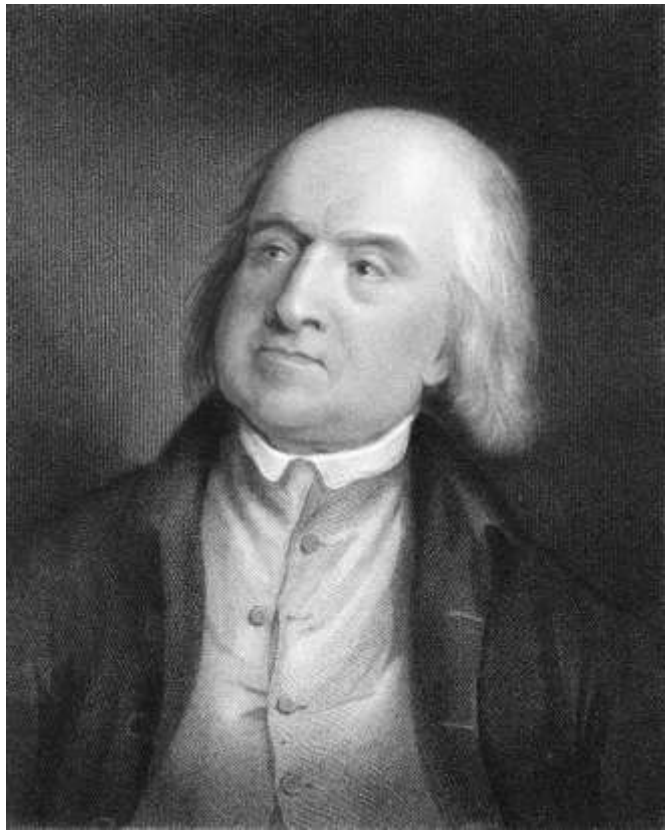
Feldman, J., 2005, Condorcet et la mathematique sociale: enthousiasmes et bemols, Mathematics and Social Sciences, 172(4), 7-41, http://www.ehess.fr/revue-msh/pdf/N172R955.pdf

Munda G. (2007) - Social multi-criteria evaluation, Springer-Verlag, Heidelberg, New York, Economics Series

# Condorcet's algorithms and Descartes' Geometry: the dream always had a quantification agenda

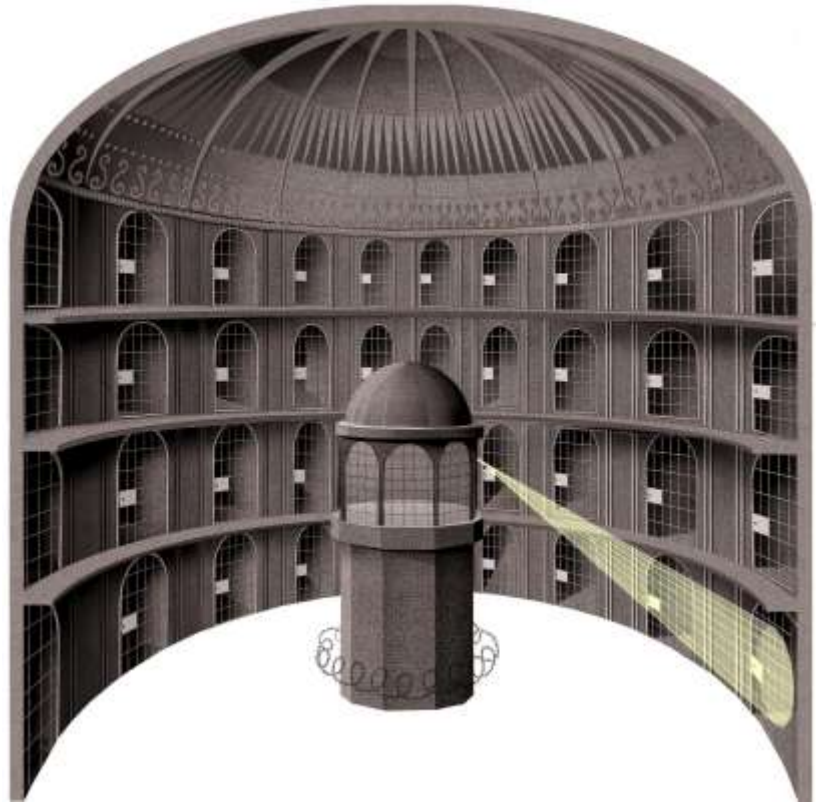
# Condorcet's Mathématique sociale had its continuation in Bentham's utilitarianism

Marquis de Condorcet (1743- 1794)



Jeremy Bentham (1748-1832)

Panopticon



Artwork: Adam Simpson, New York Times

Closer to our times the Cartesian dream was couched in the 'Endless Frontier' metaphor by Vannevar Bush, 1945:

Vannevar Bush
(1890–1974)

"One of our hopes is that after the war there will be full employment […] more jobs […] founded on […] basic scientific research. […the] Government […] opened the seas to clipper ships and furnished land for pioneers. Although these frontiers have more or less disappeared, the frontier of science remains."

Bush, V. (1945) Science: the endless frontier, United States Office of Scientific Research and Development, U.S. Govt. print office.

# The ethos of open science, the republic of science, CUDOS

Robert K. Merton

Michal Polanyi

M. Polanyi, J. Ziman, and S. Fuller, “The republic of science: its political and economic theory,” Minerva, vol. 38, pp. 1–32.

**Communalism** – the common ownership of scientific discoveries, according to which scientists give up intellectual property rights in exchange for recognition and esteem (Merton actually used the term Communism, but had this notion of communalism in mind, not Marxism);

**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;

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

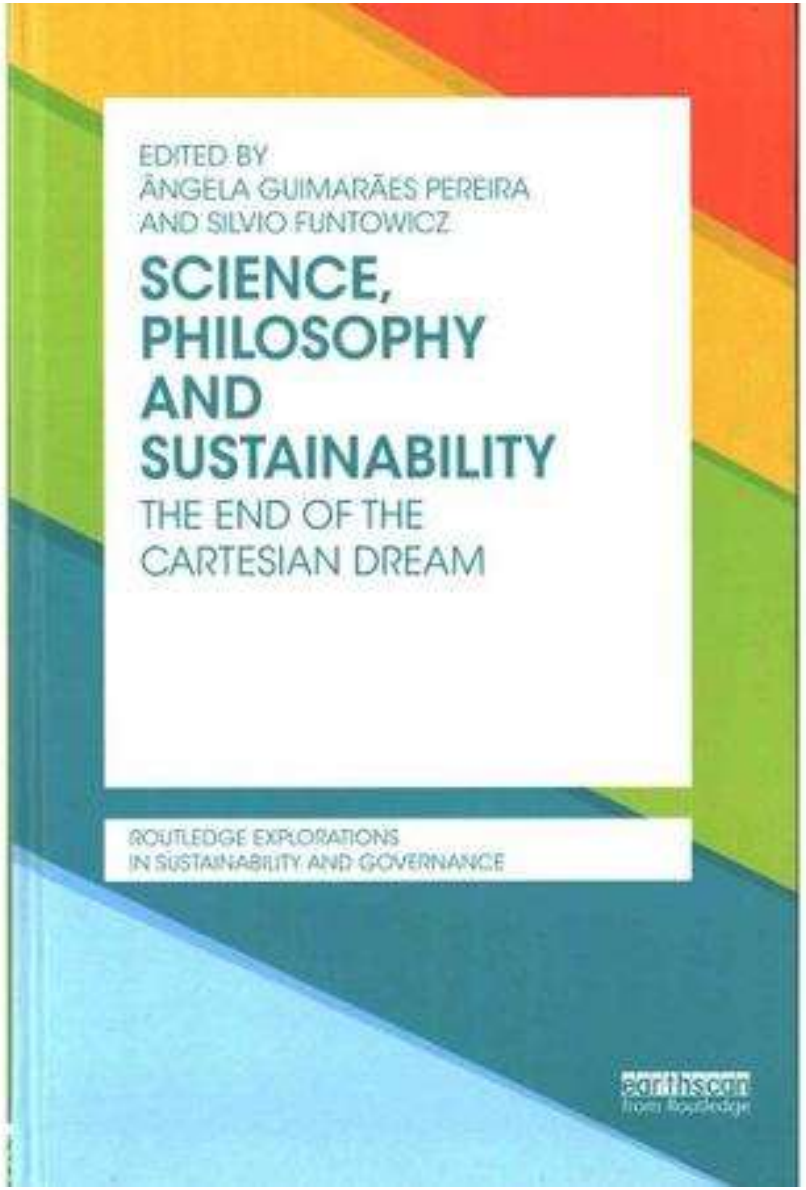
**Organized Skepticism** – all ideas must be tested and are subject to rigorous, structured community scrutiny.

# Minority views

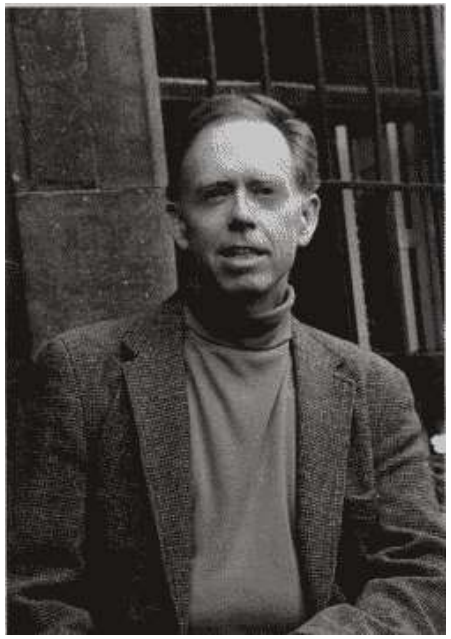
Ravetz, J, R, 2015, Descartes and the rediscovery of ignorance,

in

Guimarães Pereira, Â, and Funtowicz, S, Eds, 2015, The end of the Cartesian dream, Routledge.



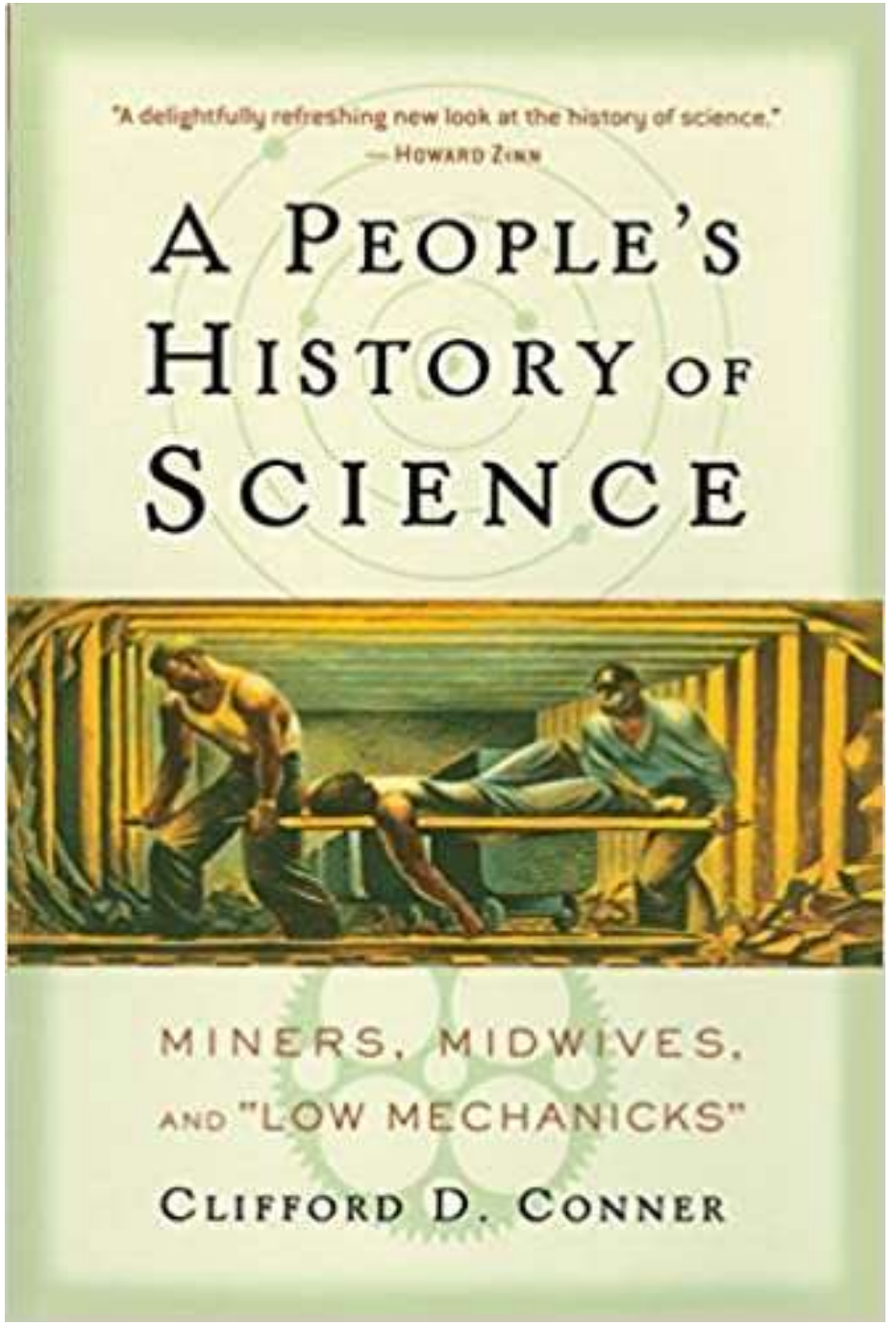
# A different vision

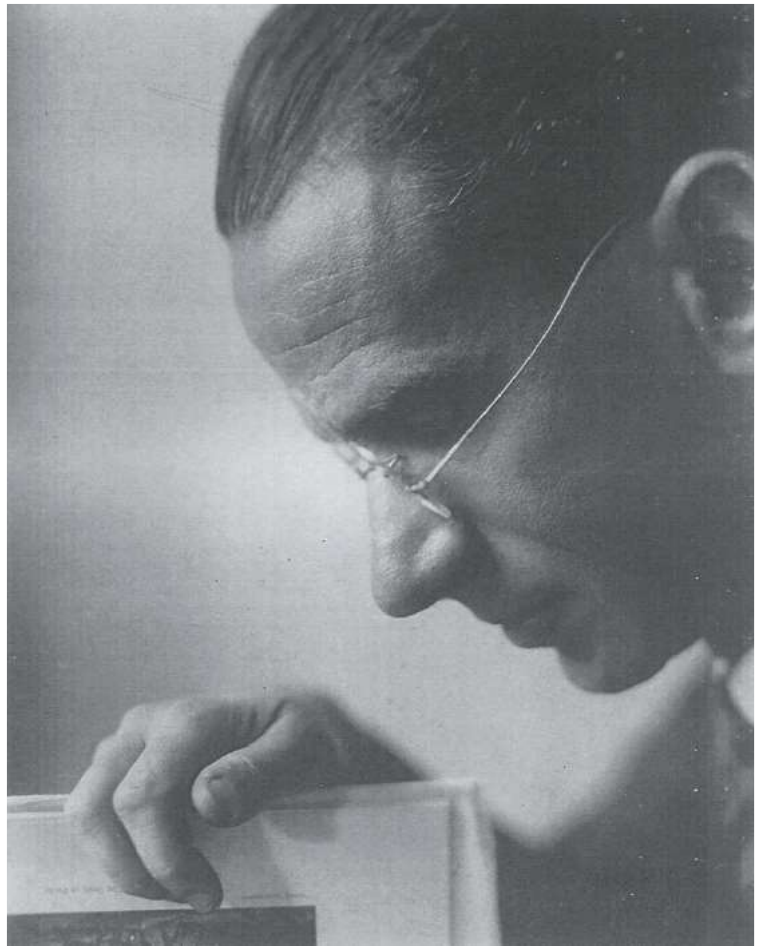


Clifford D. Conner

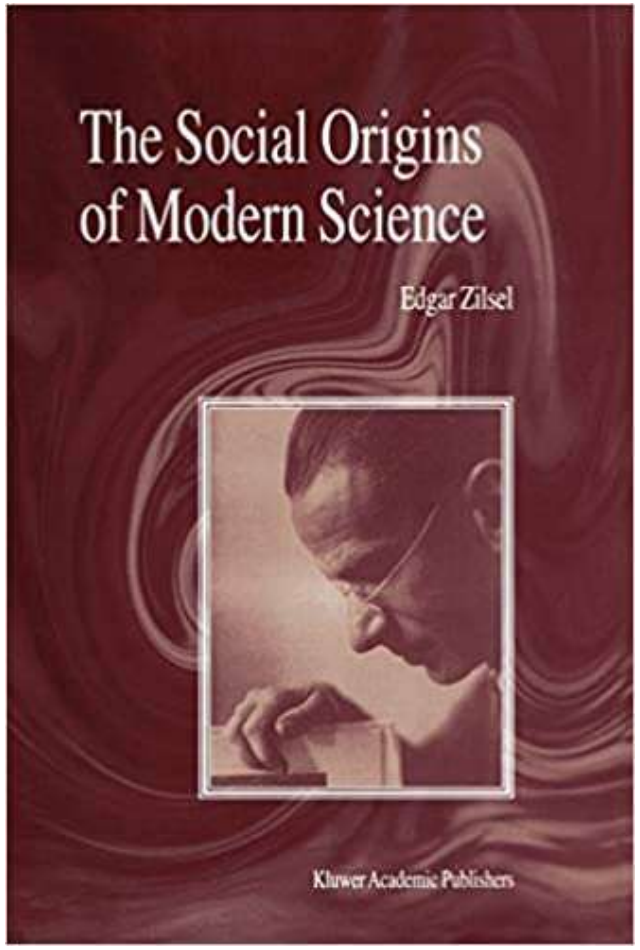
An antidote to a vision of the history of science as the fruit of the intuition of great (mostly) men

‘Knowing what’ was often only possible after ‘knowing how’ had been discovered





Edgar Zilsel
(1891-1944)




## The Zilsel thesis:

- Superion artisans,
- Secular humanists,
- University scholars

"Science originates in urban cultures, money economy, market economy…"

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”

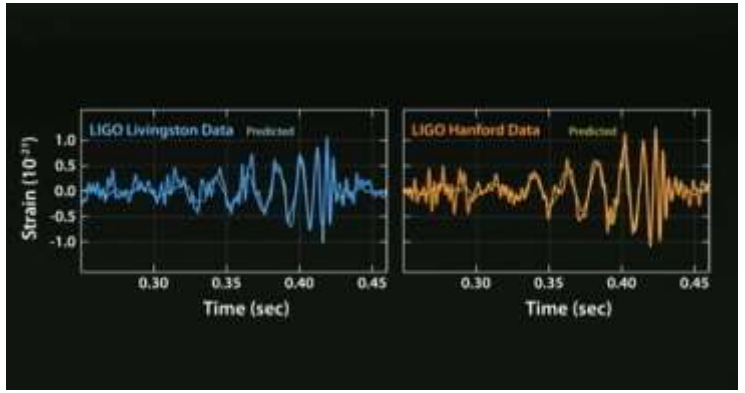
Thomas Kuhn, The structure of scientific revolution, 192, Chapters I and XIII

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.”

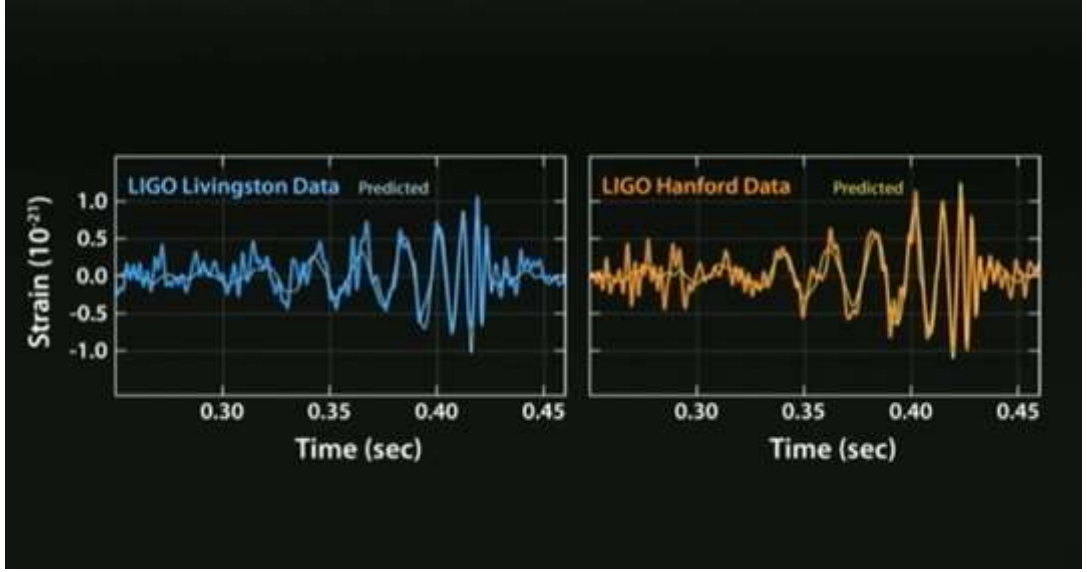
Thomas Kuhn, The structure of scientific revolution, 192, Chapter XIII

# The success of the Cartesian dream

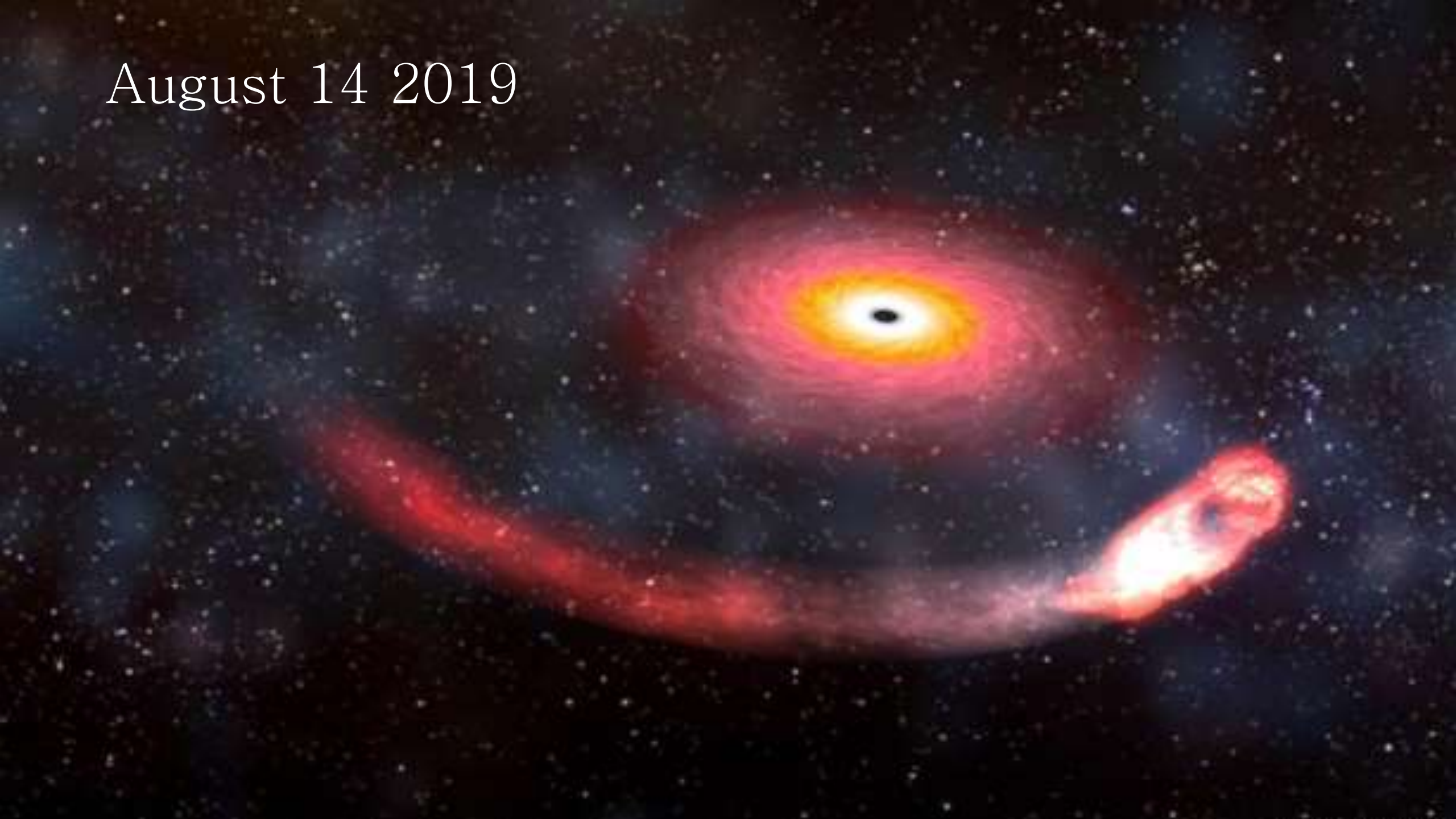
# The keeping of the promise: Gravitational waves, from J. Weber's cylinder to LIGO



A Madman Dreams of Tuning Machines: The Story of Joseph Weber, the Tragic Hero of Science Who Followed Einstein's Vision and Pioneered the Sound of Space-Time, By Maria Popova, https://www.brainpickings.org/2016/04/25/black-hole-blues-janna-levin-joseph-weber/



https://www.brainpickings.org/2016/04/25/black-hole-blues-janna-levin-joseph-weber/


August 14 2019

NEWS · 02 SEPTEMBER 2020

# ‘It’s mindboggling!’: astronomers detect most powerful black-hole collision yet

Gravitational-wave detections suggest merging black holes fell into ‘forbidden’ range of masses.

Davide Castelvecchi

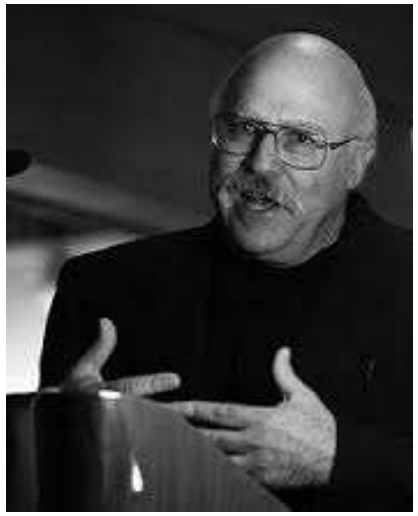
“the two objects were estimated to weigh around 85 and 66 solar masses”

“In their latest discovery, the LIGO and Virgo detectors sensed only the last four ripples produced by the spiralling black holes, with a frequency that rose from 30 to 80 Hertz within one-tenth of a second”

If you are a natural scientists you were nourished and trained in the Cartesian dream, (S. Toulmin: ‘The hidden agenda of modernity’)

Stephen Toulmin

The dream was spectacularly successful, in all fields of endeavor, leading to what Steven Shapin calls ‘invisible science’



Steven Shapin

Steven Shapin, 2016, Invisible Science, The Hedgehog Review: Vol. 18 No. 3 (Fall 2016).

# Many voices of alarm as to misuse of quantification

# Numbers, visible and invisible…

# Blurring lines:

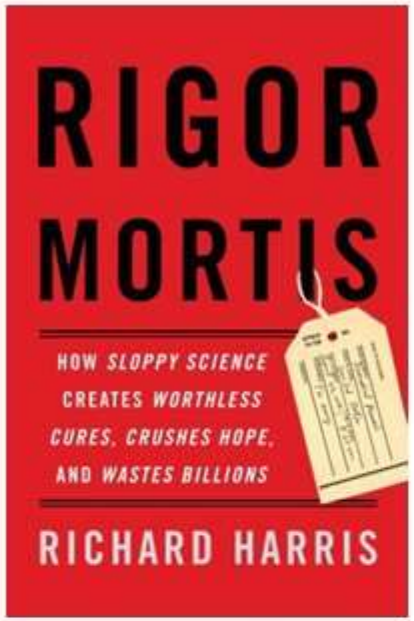
"what qualities are specific to rankings, or indicators, or models, or algorithms?"

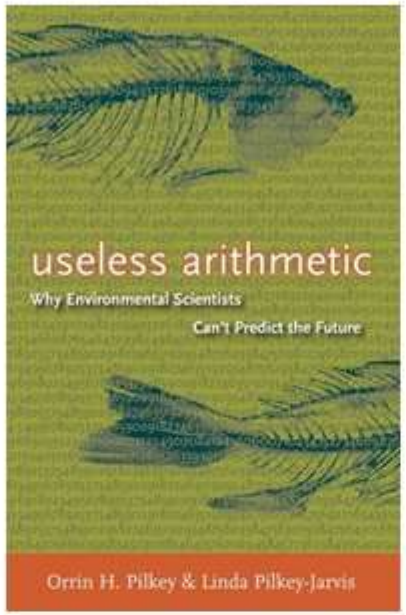
Elizabeth Popp Berman

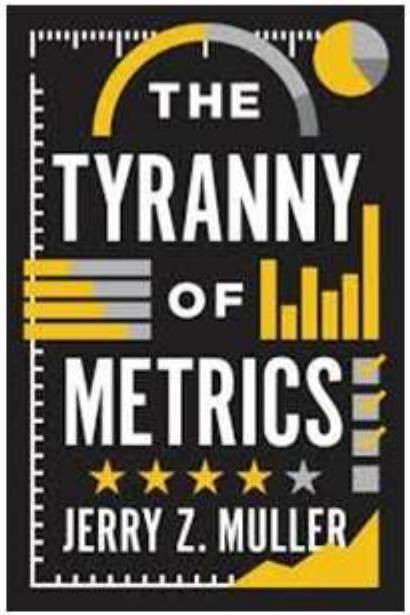
E. Popp Berman and D. Hirschman, The Sociology of Quantification: Where Are We Now?, Contemp. Sociol., vol. in press, 2017.

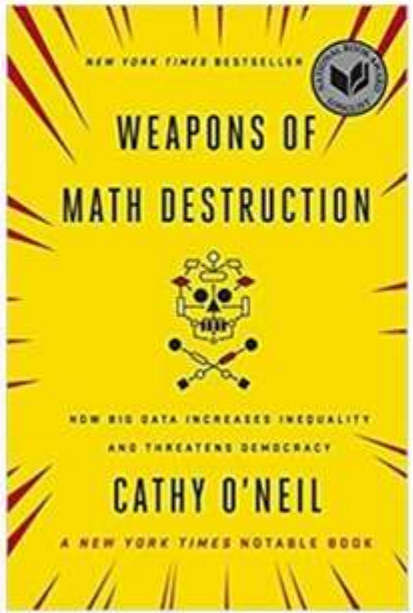
And an explosion of works, from within and without, from many disciplines

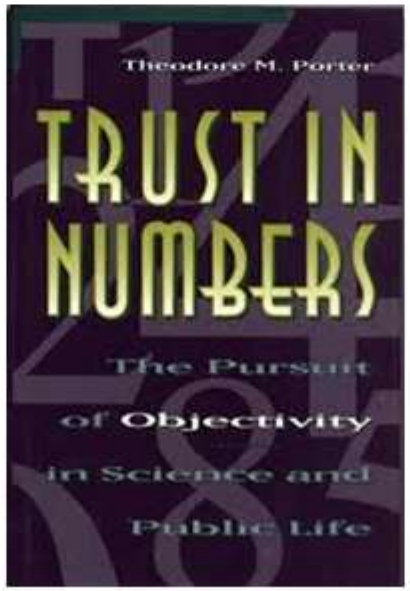
# Algorithms, models, metrics, statistics…



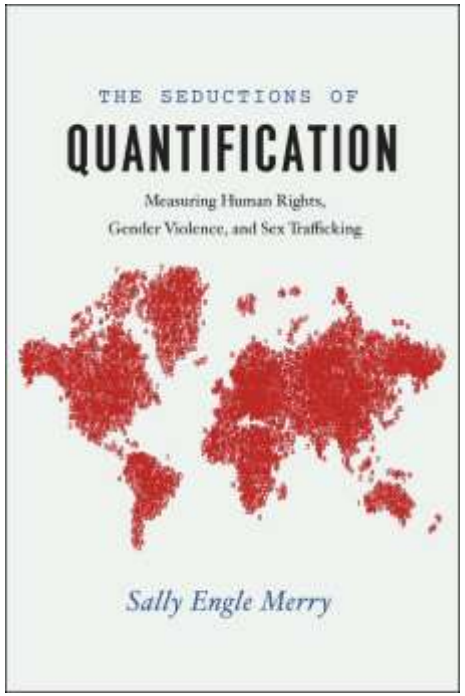



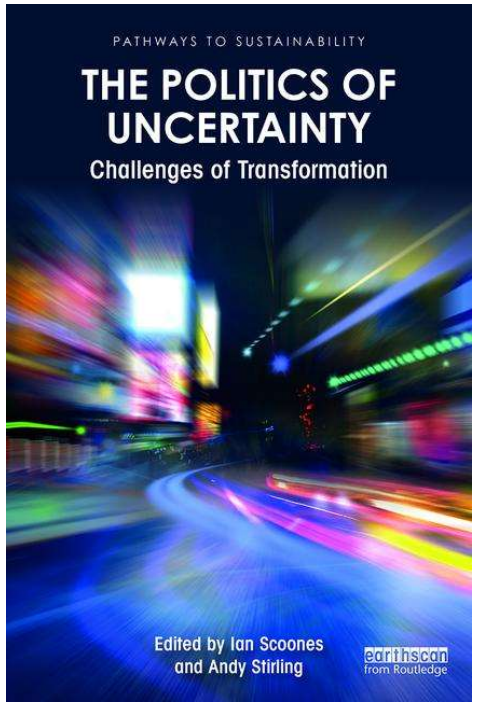



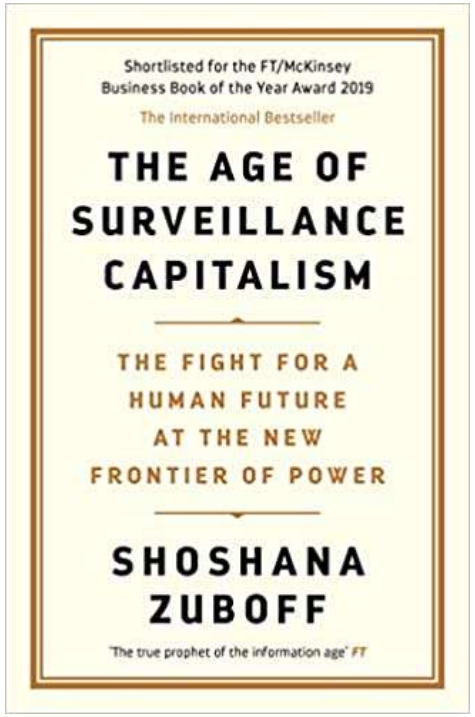


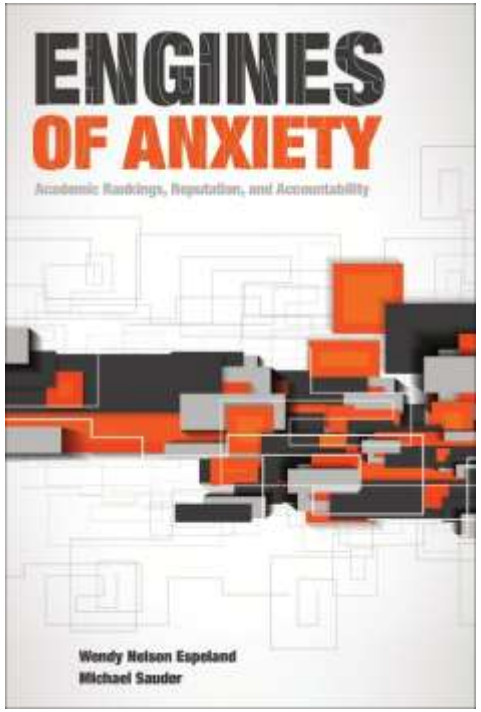


# Algorithms, models, metrics, statistics…



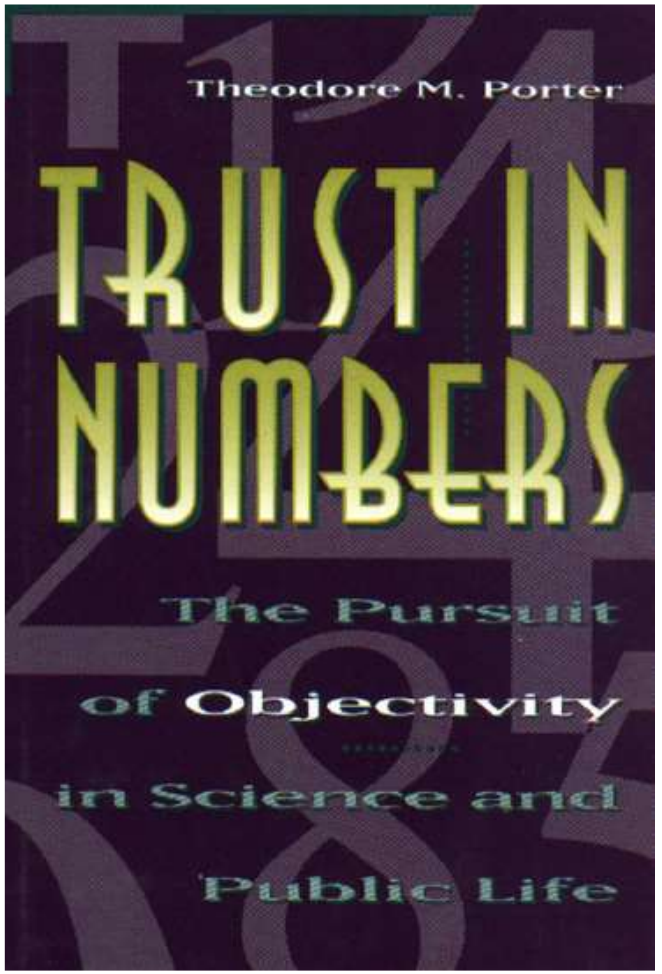
Numbers and their ‘reactivity’
(Espeland and Sauder, 2016)

Incumbent numbers affect what society will measure in the future (Merry 2016)

Numbers “create the environment that justifies their assumptions”
(O’Neil, 2016)

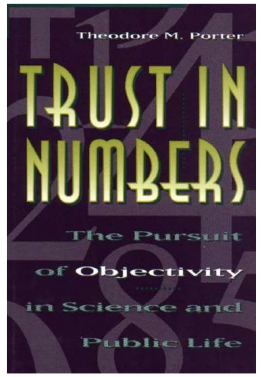
# Numbers and trust

Theodor
M. Porter



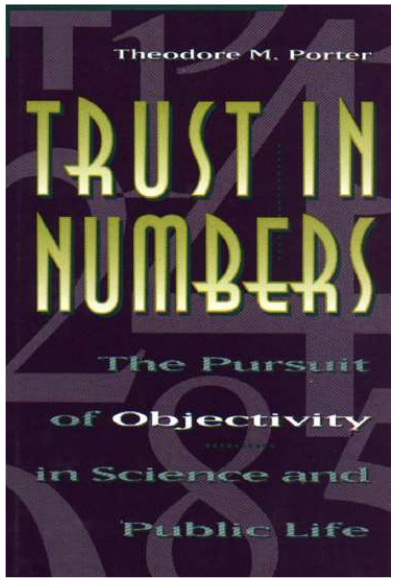

Theodore M. Porter, Trust in Numbers,
The Pursuit of Objectivity in Science and Public Life, Princeton 1995

p. 8: “The appeal of numbers is especially compelling to bureaucratic officials who lack the mandate of a popular election, or divine right.




Arbitrariness and bias are the most usual grounds upon which such officials are criticized.

A decision made by the numbers (or by explicit rules of some other sort) has at least the appearance of being fair and impersonal.”




p. 8: “Scientific objectivity thus provides an answer to a moral demand for impartiality and fairness.

Quantification is a way of making decisions without seeming to decide.

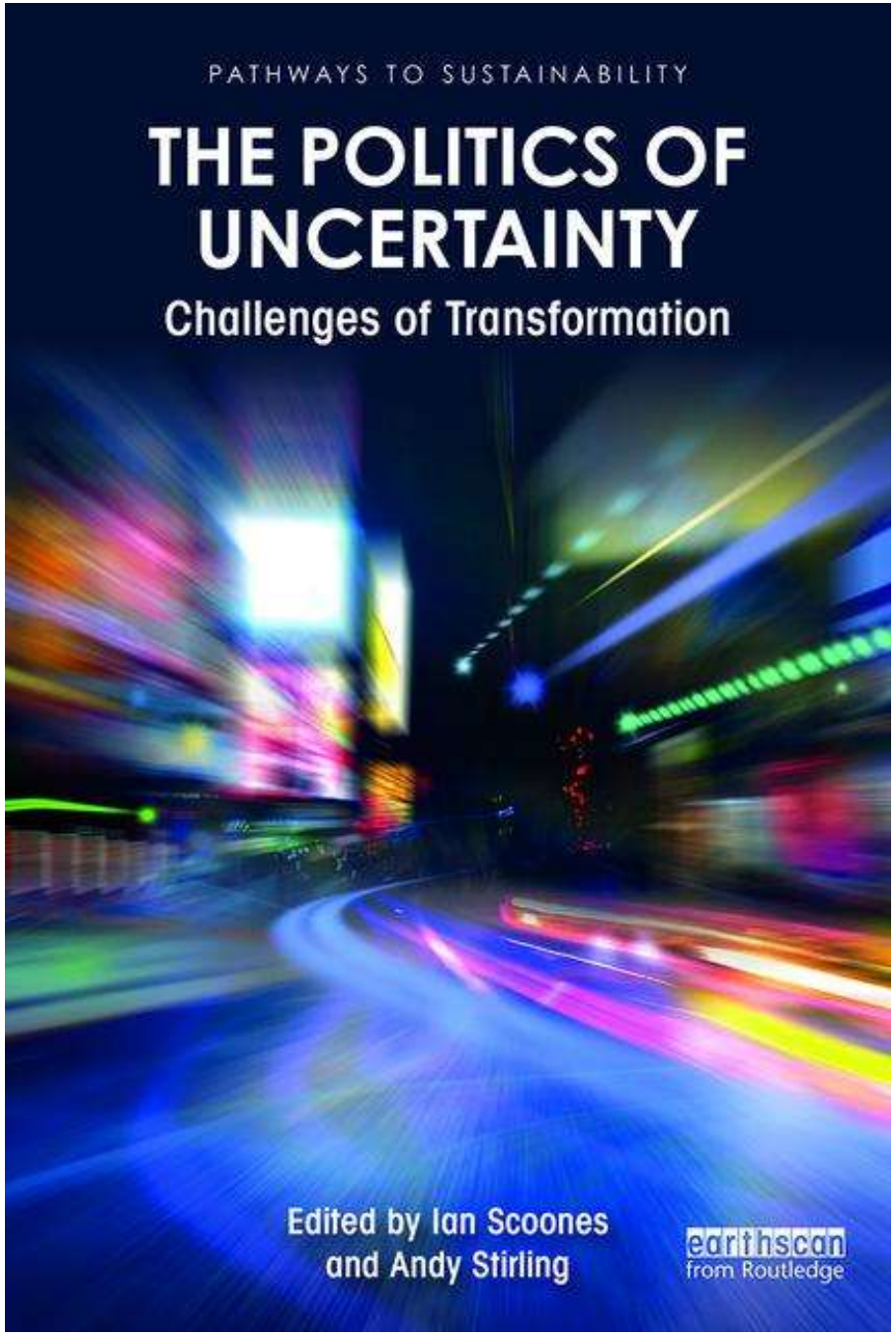
Objectivity lends authority to officials who have very little of their own.”

# Trust, authority and styles of quantification: two different stories

ECOLE NATIONALE
DES PONTS ET CHAUSSEES

US Army Corps of Engineers®

Porter's story: Quantification needs judgment which in turn needs trust …without trust quantification becomes mechanical,  a system, and 'systems can be played'.




Open access version here:

https://www.taylorfrancis.com/books/e/9781003023845

# The critique of Andrew Stirling:

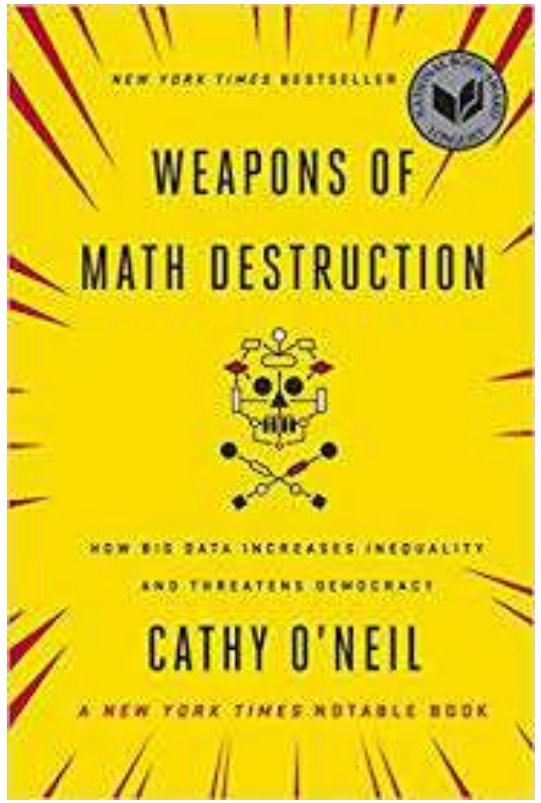
Andrew Stirling

"[…] rhetoric clamour [surrounds] 'expected utility', 'decision theory', 'life cycle assessment', 'ecosystem services' 'sound scientific decisions' and 'evidence-based policy'

[…] Each technique routinely delivers its answers with formidable levels of precision. Yet the resulting impression of accuracy is deeply misplaced"

# Alarm for Weapons of Math Destruction

Cathy O’Neil

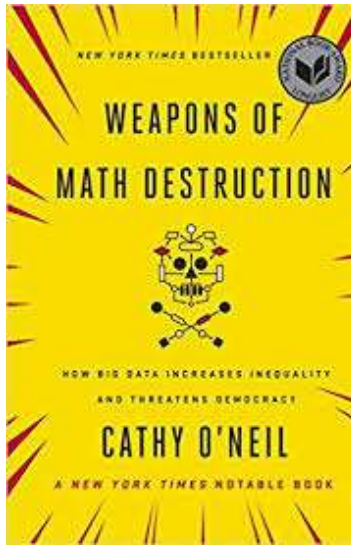



O’Neil, C. (2016). Weapons of math destruction : how big data increases inequality and threatens democracy. Random House Publishing Group.

# Opacity (also because of trade secrecy) of algorithms used to decide on recruiting, carriers (including of researchers), prison sentencing, paroling, custody of minors, political campaigns…

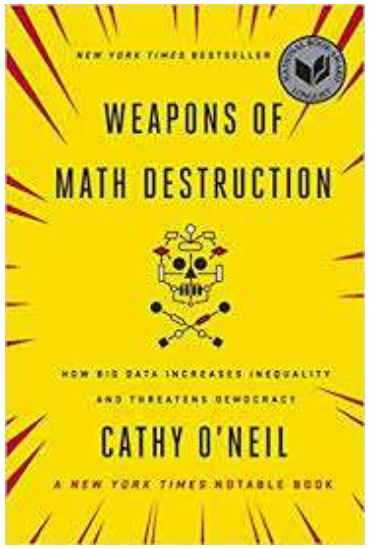
O'Neil, C. (2016). Weapons of math destruction : how big data increases inequality and threatens democracy. Random House Publishing Group.

Brauneis, R., & Goodman, E. P. (2018). Algorithmic Transparency for the Smart City. Yale Journal of Law & Technology, 20, 103–176. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3012499



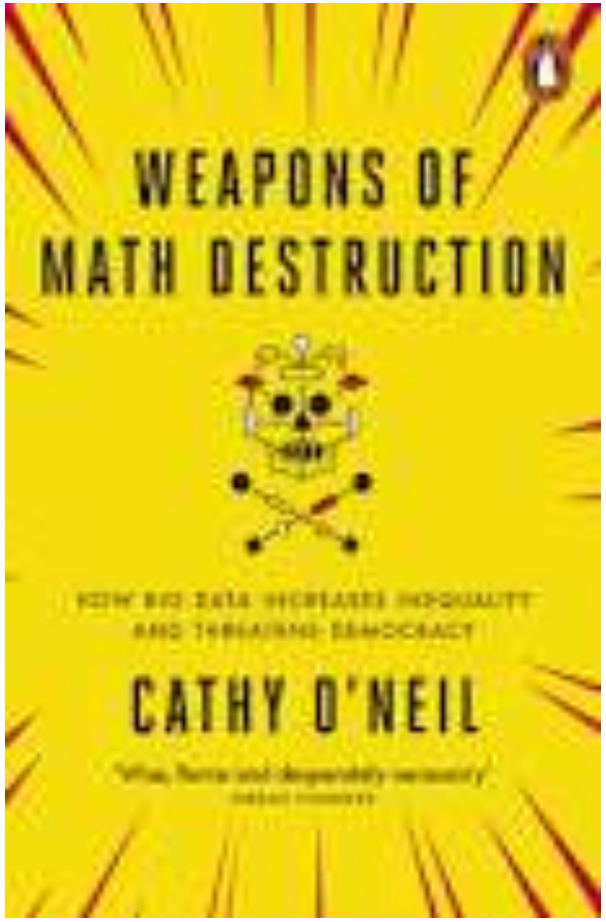
# Opacity coupled with opportunity for scale and damage and with non-appealability make them an instrument of oppression & inequality

Cathy O'Neil Google talk https://www.youtube.com/watch?v=TQHs8SA1qpk



# Weapons of math destruction: opaque, harm, scale

Cathy O'Neil

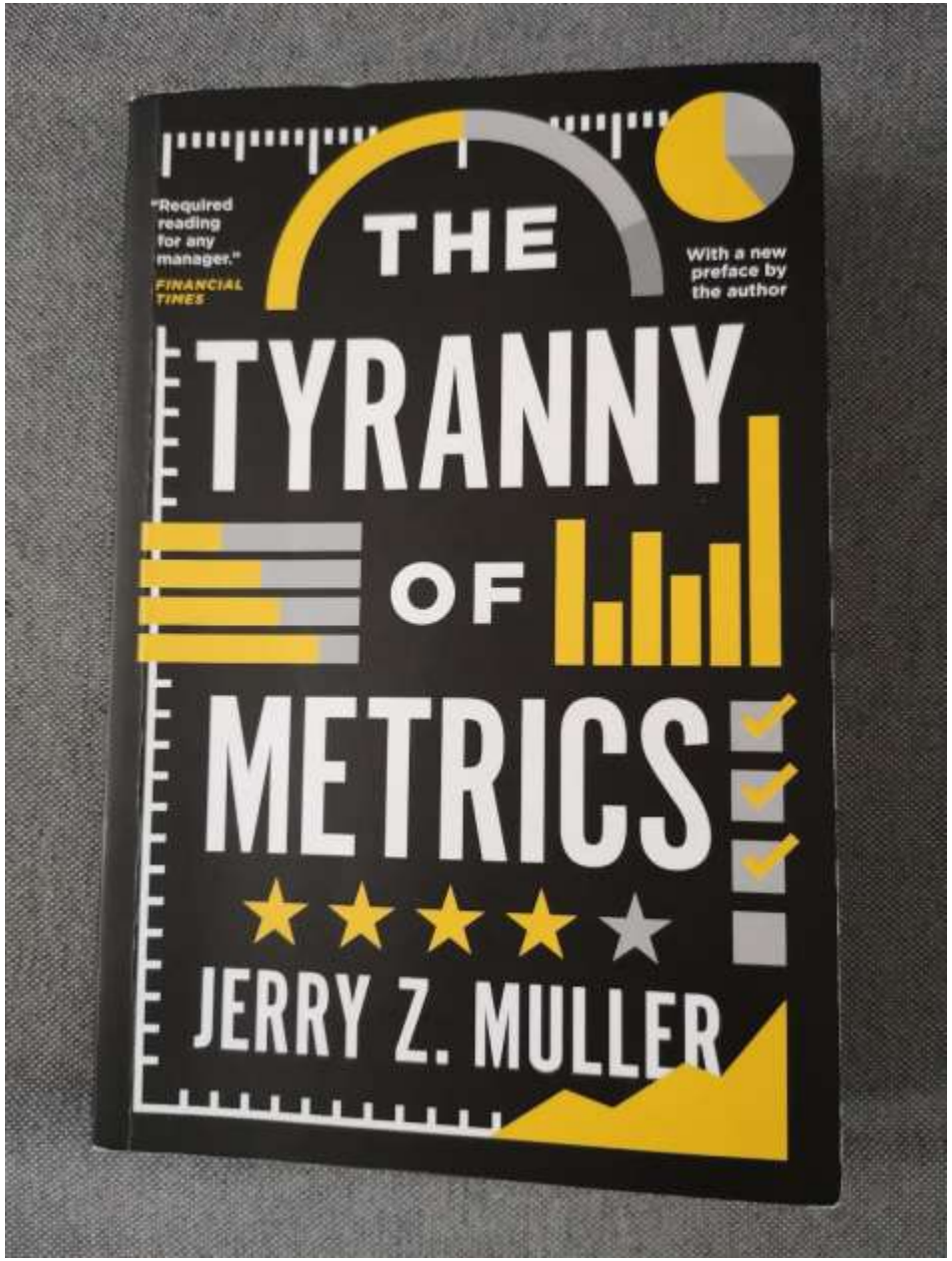


Charles Goodhart

p. 44 “Any … measures necessarily involve a loss of information … [and distorts behavior]” (Porter, 1995)

This is what we normally call Goodhart’s law, from Charles Goodhart. "When a measure becomes a target, it ceases to be a good measure."

Also known as Campbell's law (1976);
https://en.wikipedia.org/wiki/Goodhart%27s_law



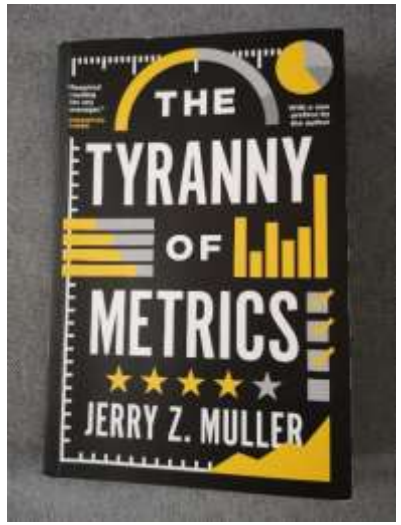

J. Z. Muller, The tyranny of metrics. Princeton University Press , 2018.

Metric fixation, or the irresistible pressure to measure performance

Gaming of metrics (recall Goodhart law)

“The calculative is the enemy of the imaginative”

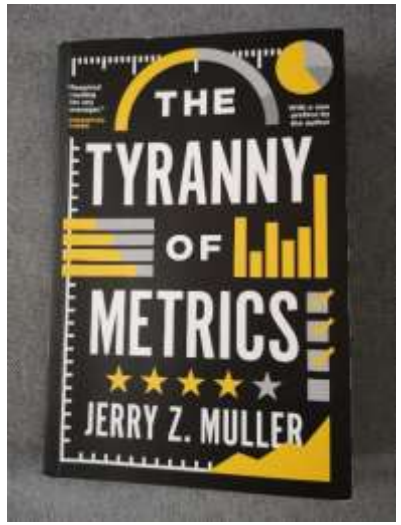
A wealth of case studies from education to war to medicine to foreign aid..



# Critiques of metrics

From the left: metric fixation promotes deskilling

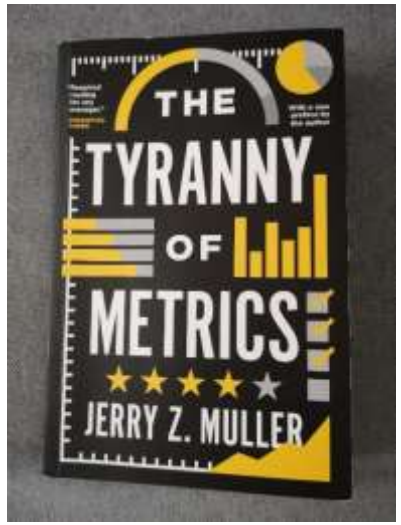
From the right (Friedrich Hayek): metric fixation reproduces features of the soviet system



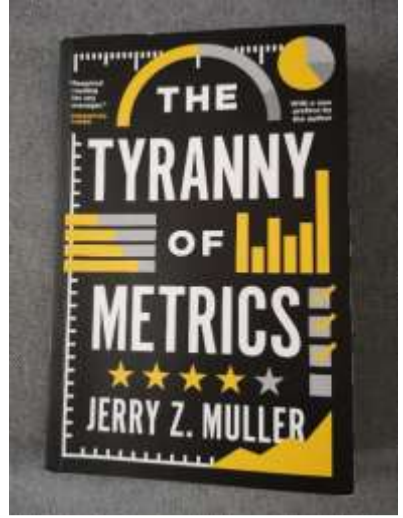
# Critiques of metrics

An epistemological critique: metrics privilege abstract and formulaic knowledge against practical and tacit knowledge

(Greek concept of metis)



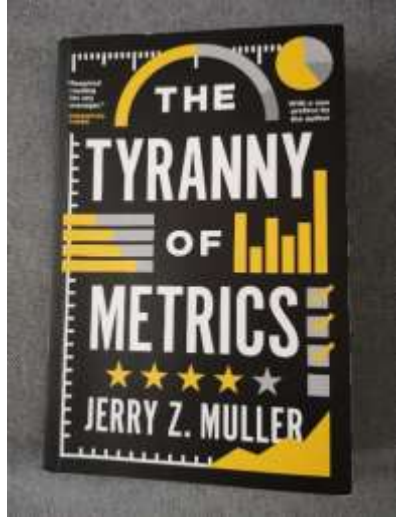
# Unintended consequences: a litany




- Goal displacement
- Short termism
- Diminishing utility
- Rule cascade
- Discouraging risk taking
- Discouraging innovation
- Rewarding luck
- Discouraging cooperation and common purpose
- Degrading work
- Time waste
- Loss of productivity

# A concluding remark

Considering all of the above keep in mind at every step that “the best use of metrics may be not to use it at all”

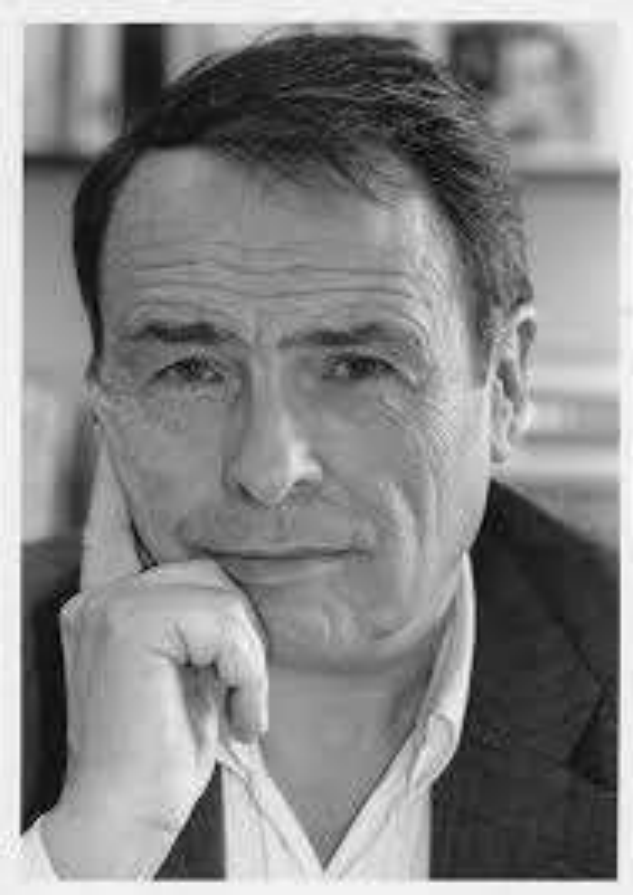


# Do we need a movement of resistance?

I. Bruno, E. Didier, and J. Prévieux, Stat-activisme. Comment lutter avec des nombres. Paris: Zones, La Découverte, 2014

# How to be a "statactiviste"?

1. Deconstruct existing metrics, including using irony (Pierre Bourdieu, *Les héritiers*).



La sociologie, ça doit être rigolo

(Sociology must be fun)

# How to be a "statactiviste"?

2. Gaming metrics (statistical judo) – use Goodhart's law to your advantage – or make the ruse public.

- Police statistics in NY

# How to be a "statactiviste"?

3. Bring to the surface what is hidden / unsaid/ excluded – new social classes, marginalization, minorities:

- ‘Creative class’ or ‘precarious intellectuals’?

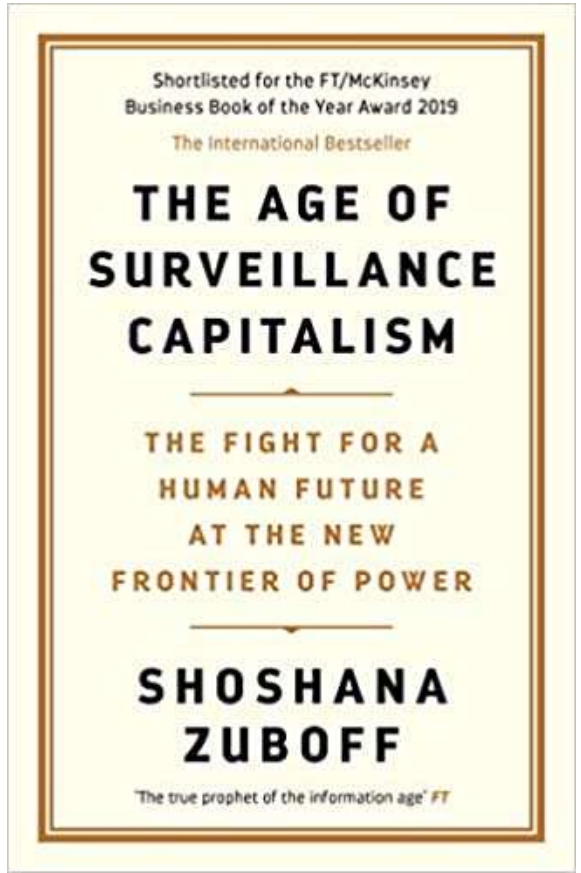
# How to be a "statactiviste"?

## 4. Measure something different.

- Suicides at France Telecom;
- BIP 40, a new French measure of poverty/inequality

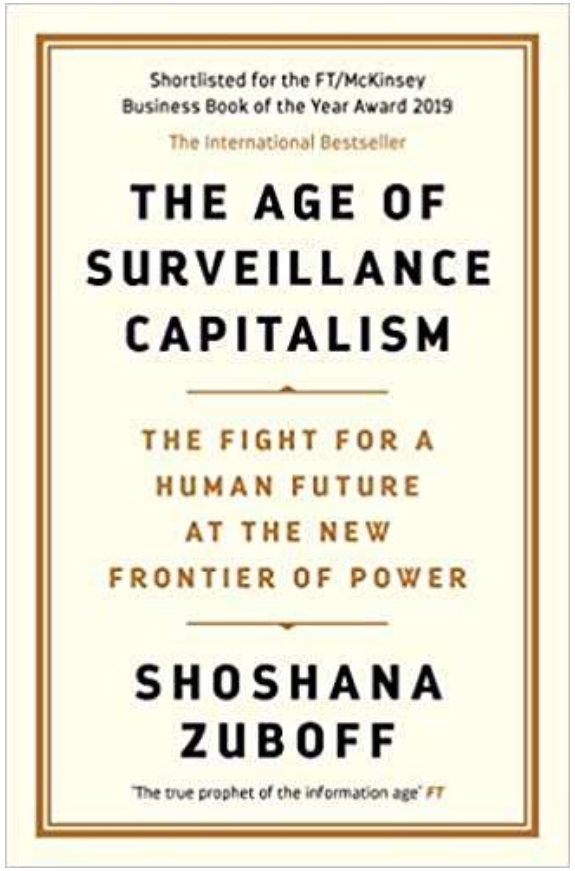
# Important:

"Quantification should not be abandoned to the advantage of exalting qualities, singularities, and the incommensurable. Such an abandon would be a tactical error"



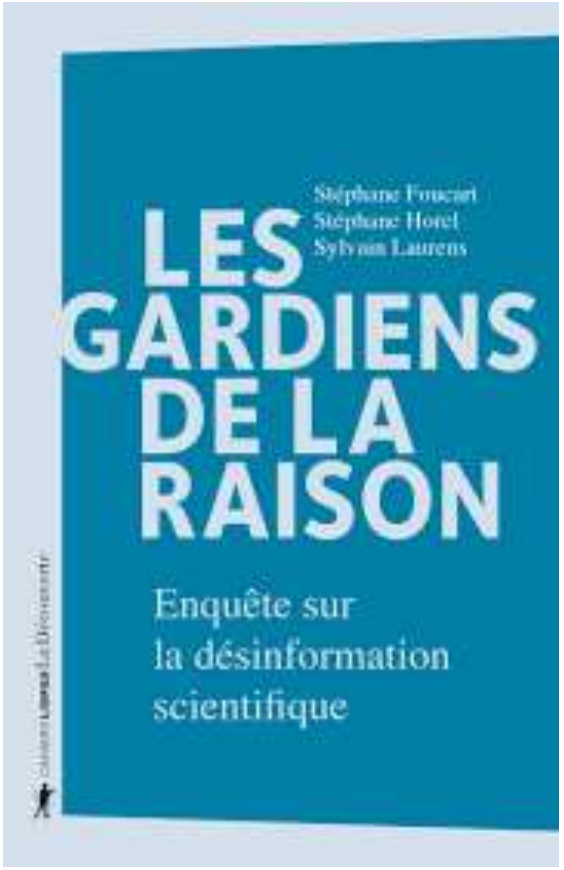

A project of domination of consumers and voters is made possible by artificial intelligence, big data & cognitive psychology

Inequality, power asymmetries and the world of surveillance capitalism




Chapters 11 & 12

Instrumentarian power



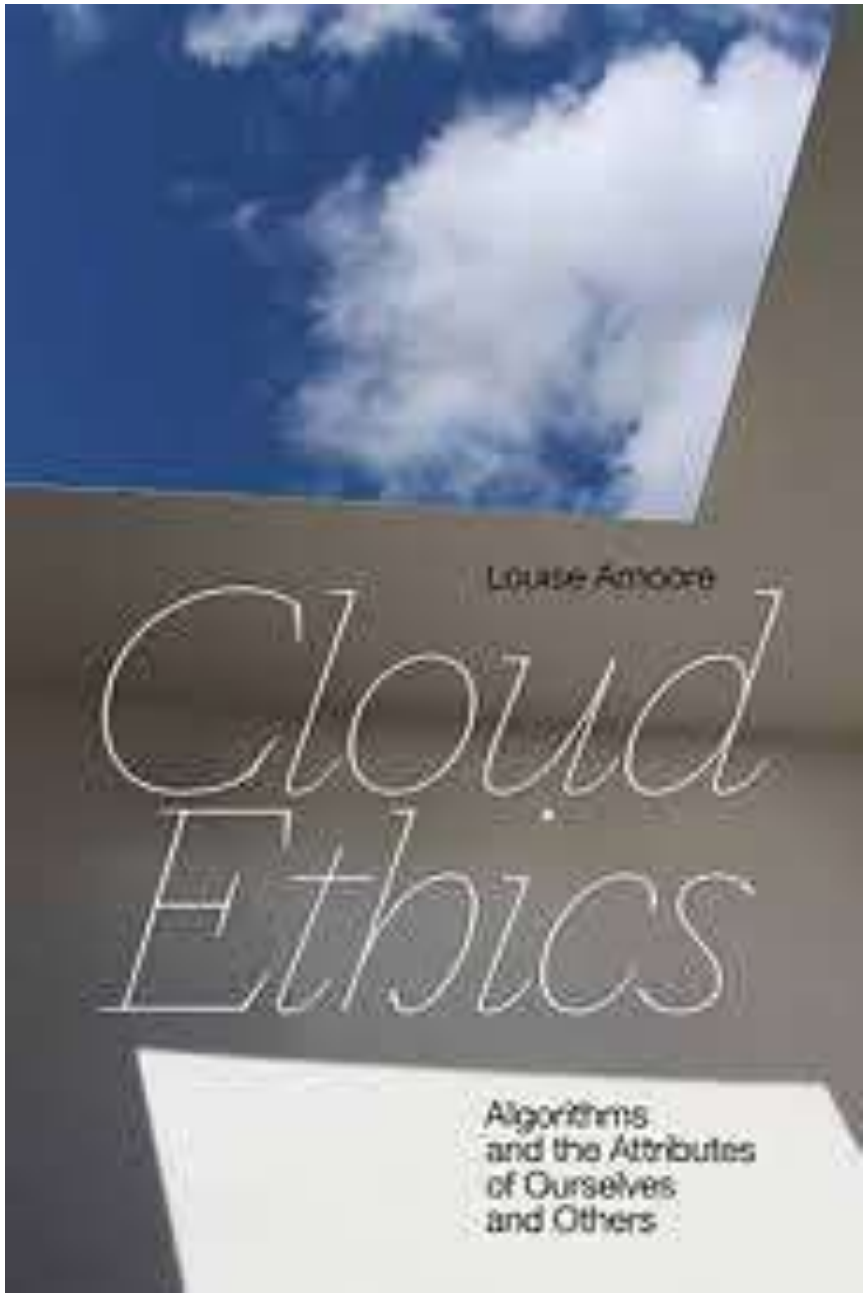

Chapter 10

*Néorationalism d' importation*

*La trollisation de l'espace public*

# Cognitive psychology and evolutionary psychology

# A project of domination?

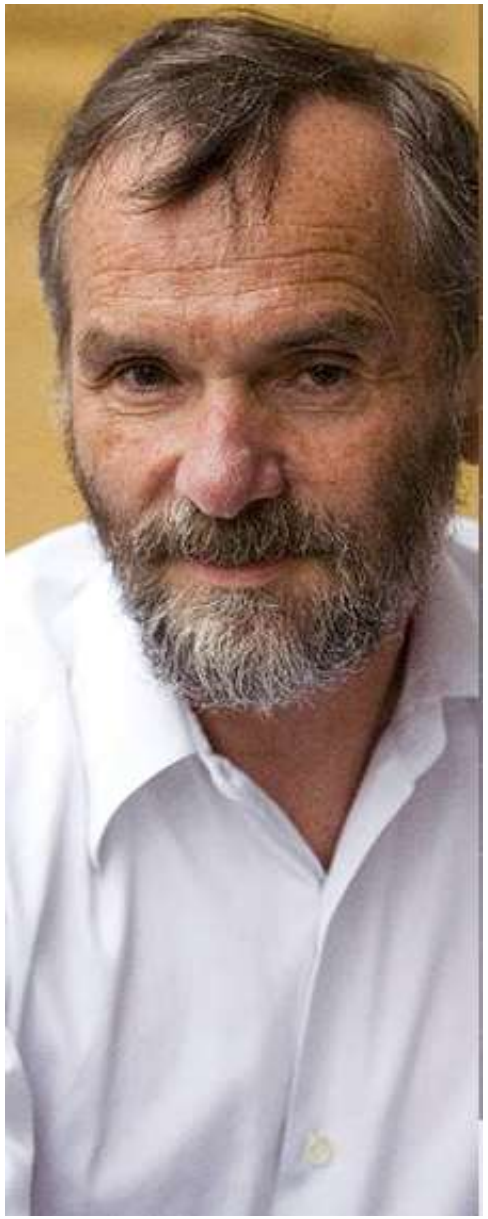



Making algorithms ‘good’ or ‘transparent’ is beyond the point. Algorithms create new norms of good or bad.

Algorithm = ethicopolitical arrangement of values, assumptions, and propositions about the world

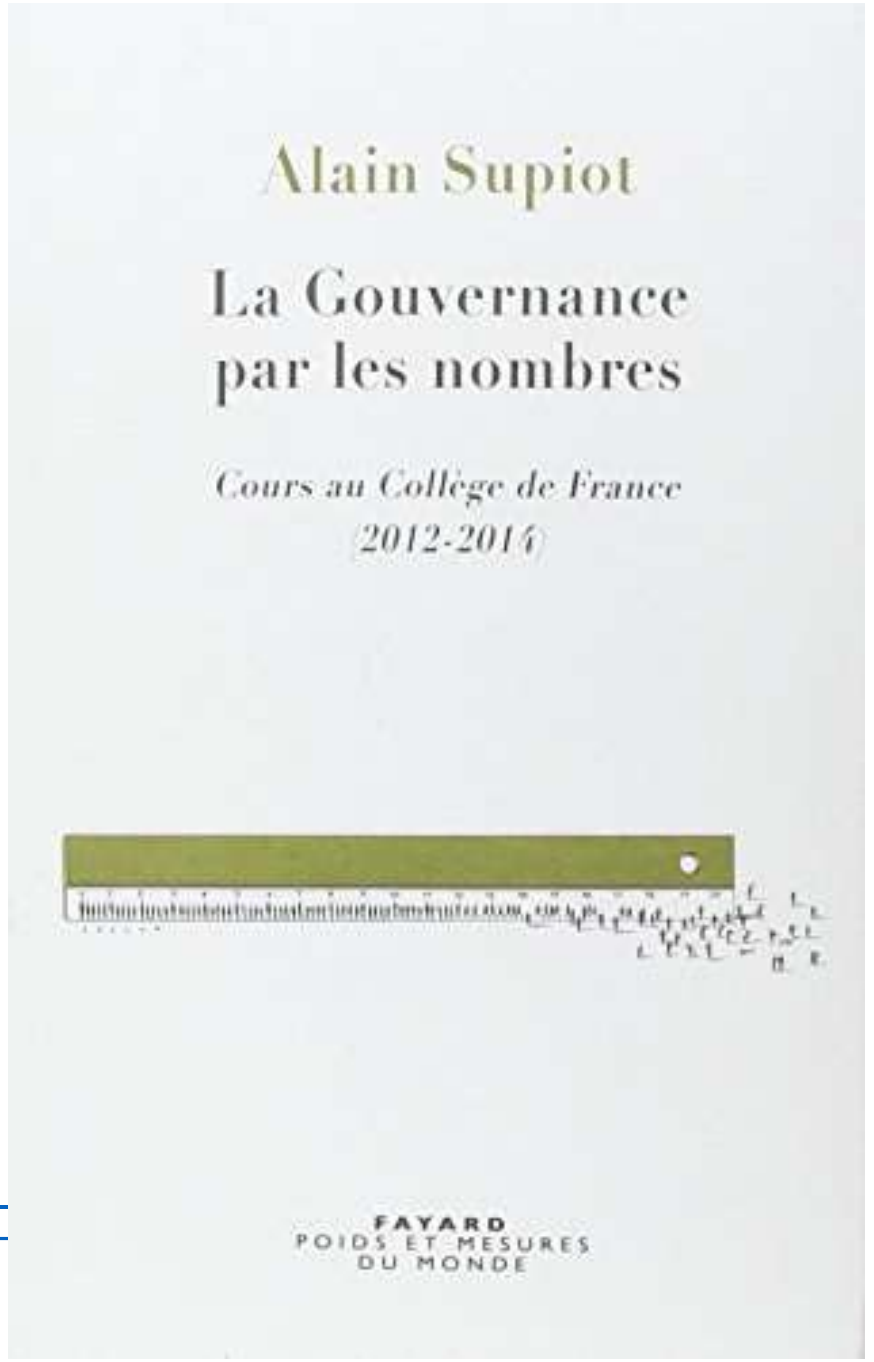
Louise Amoore

# Alain Supiot

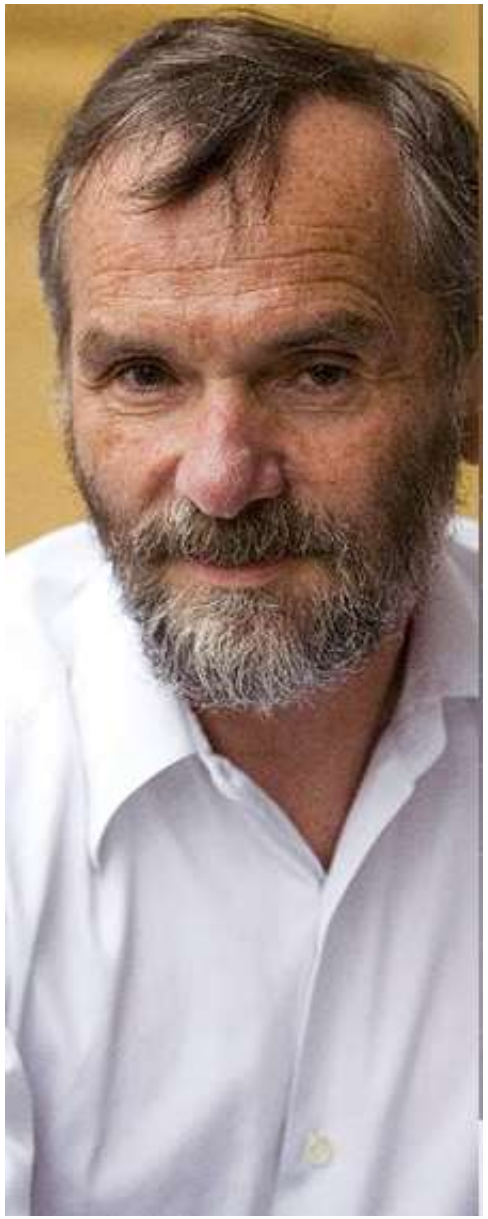


An indictment of the Total Market and the normative uses of economic quantification

https://www.college-de-france.fr/site/en-alain-supiot/Governance-by-Numbers-Introduction.htm



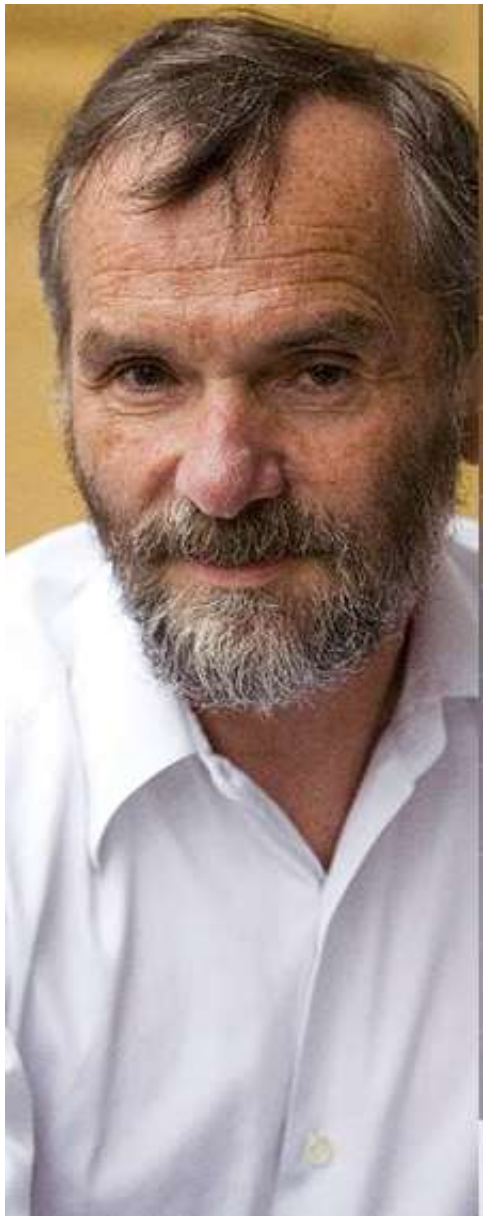
# Alain Supiot



…we have entered the era of the cybernetic imaginary, which revives the West's age-old dream of grounding social harmony in calculations.

Repudiating the goal of governing by just laws, this new discourse advocates in its stead the attainment of measurable objectives efficiently

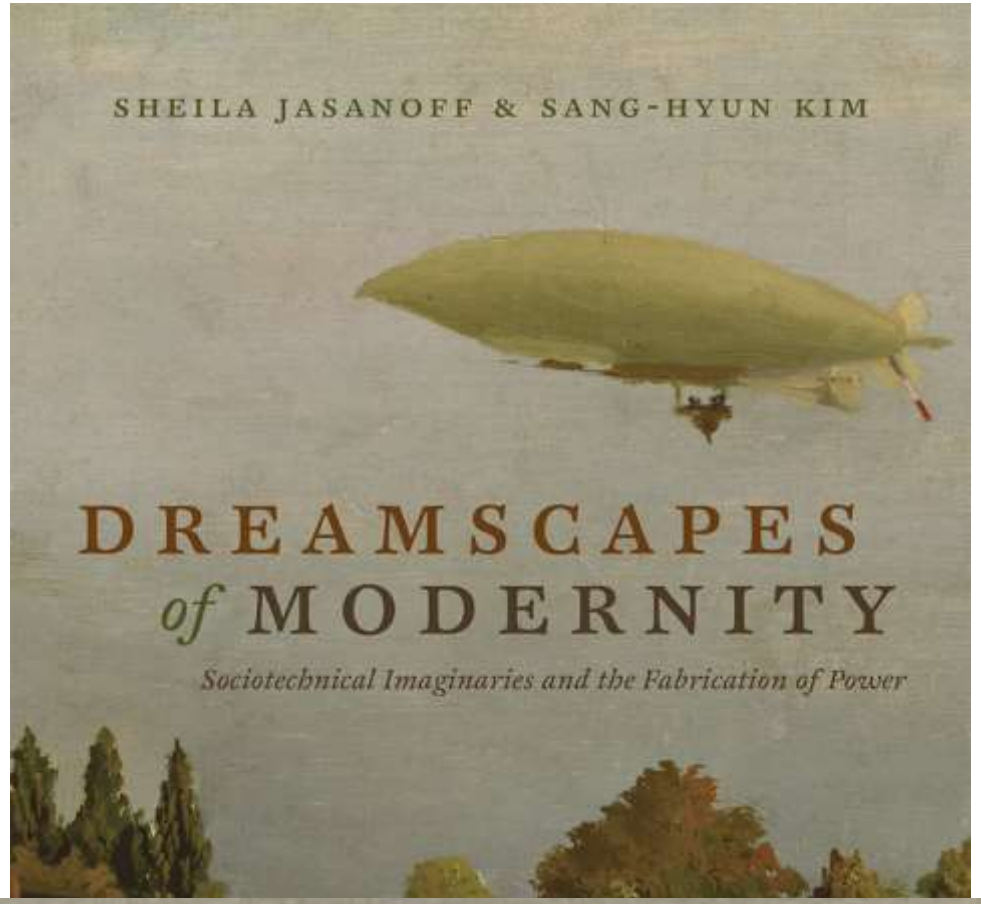
# Alain Supiot



… This leaves no option open to populations or countries than to ride roughshod over social legislation, and pledge allegiance to those stronger than they are

# And yet …

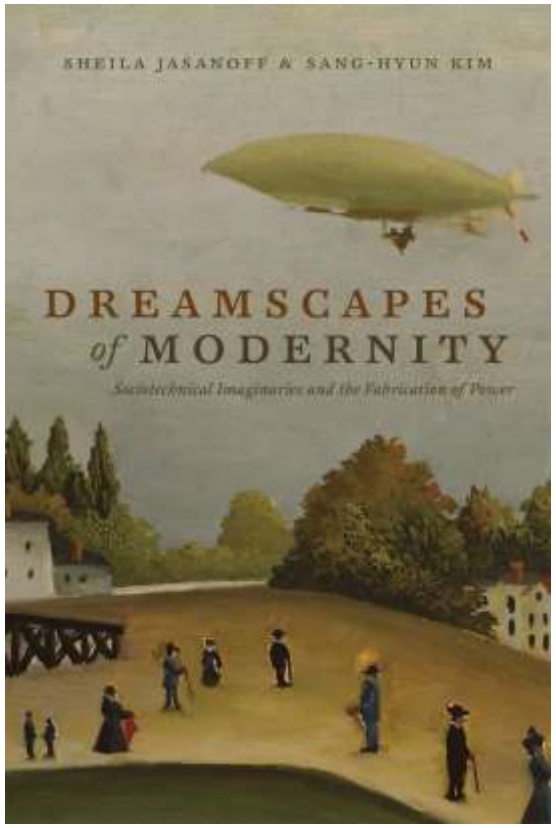
# Sociotechnical Imaginaries



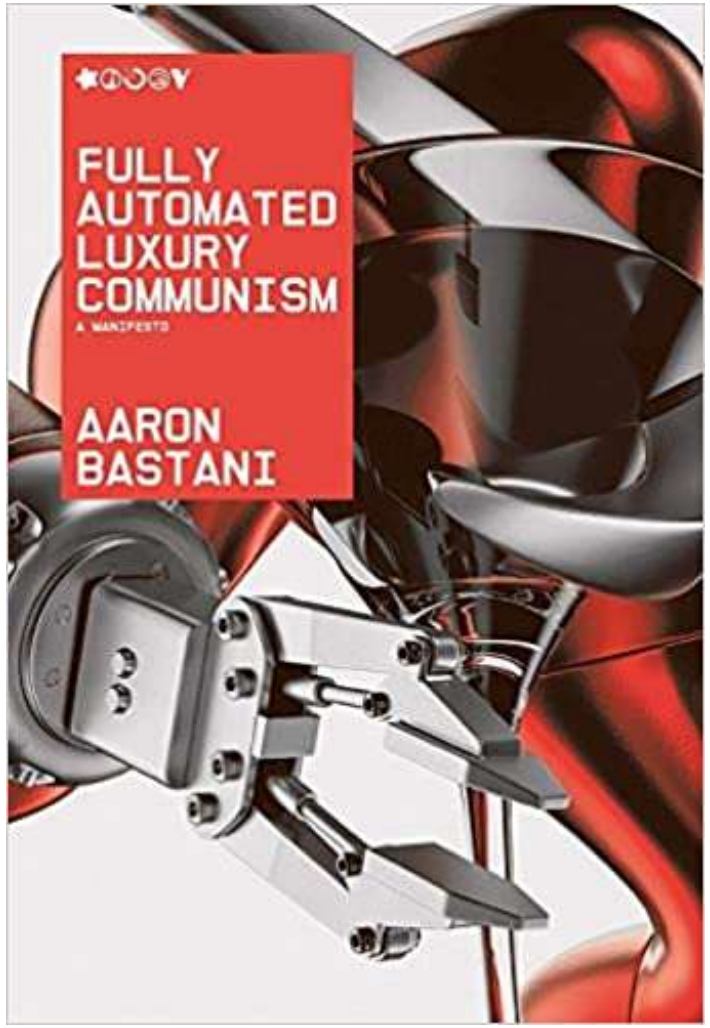
Sheila Jasanoff

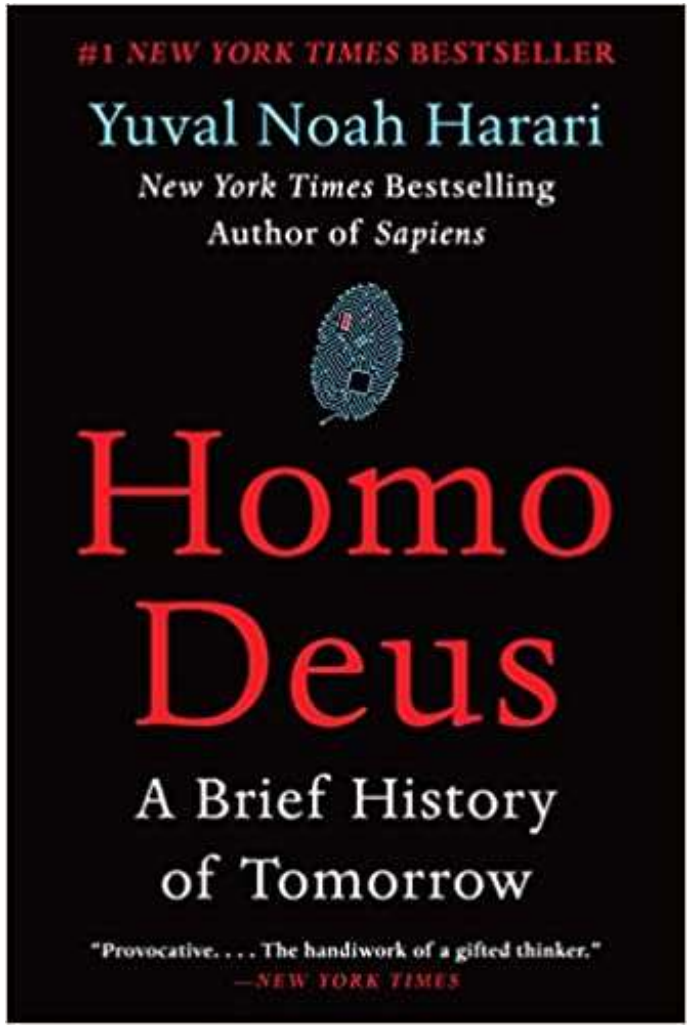
DREAMSCAPES
of MODERNITY
Sociotechnical Imaginaries and the Fabrication of Power

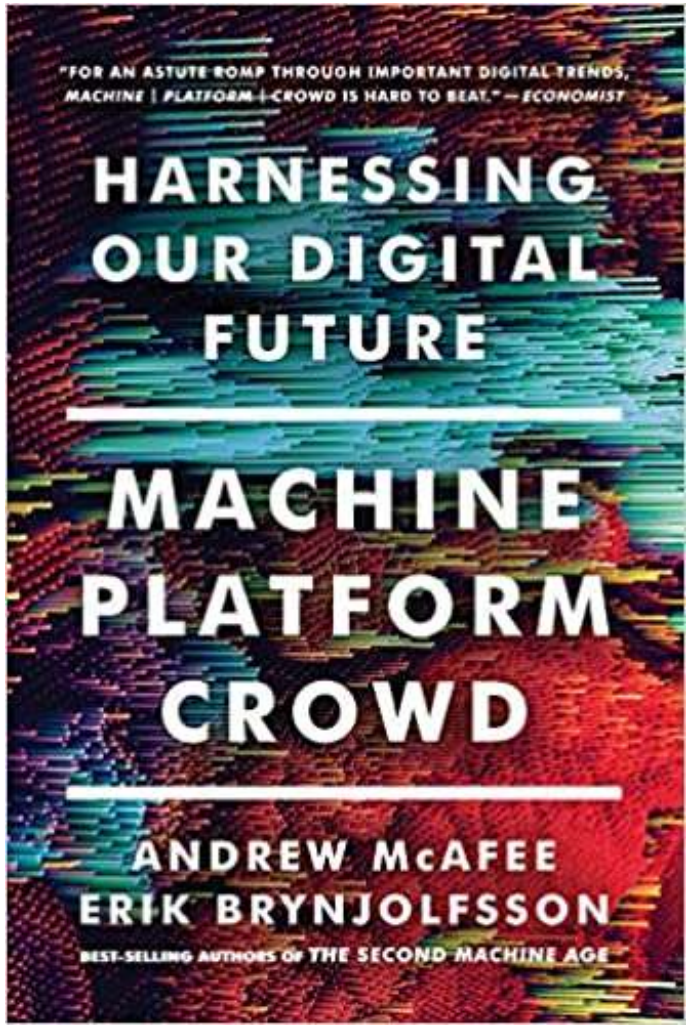
# How visions of scientific and technological progress carry with them implicit ideas about public purposes, collective futures, and the common good



Sheila Jasanoff


FULLY AUTOMATED LUXURY COMMUNISM
A MANIFESTO
AARON BASTANI


#1 NEW YORK TIMES BESTSELLER
Yuval Noah Harari
New York Times Bestselling
Author of Sapiens
Homo Deus
A Brief History of Tomorrow
"Provocative. . . . The handiwork of a gifted thinker."
—NEW YORK TIMES


"FOR AN ASTUTE ROMP THROUGH IMPORTANT DIGITAL TRENDS, MACHINE | PLATFORM | CROWD IS HARD TO BEAT." —ECONOMIST
HARNESSING OUR DIGITAL FUTURE
MACHINE PLATFORM CROWD
ANDREW McAFEE
ERIK BRYNJOLFSSON
BEST-SELLING AUTHORS OF THE SECOND MACHINE AGE

Good news!

# Which is the prevailing sociotechnical imaginary for quantification?

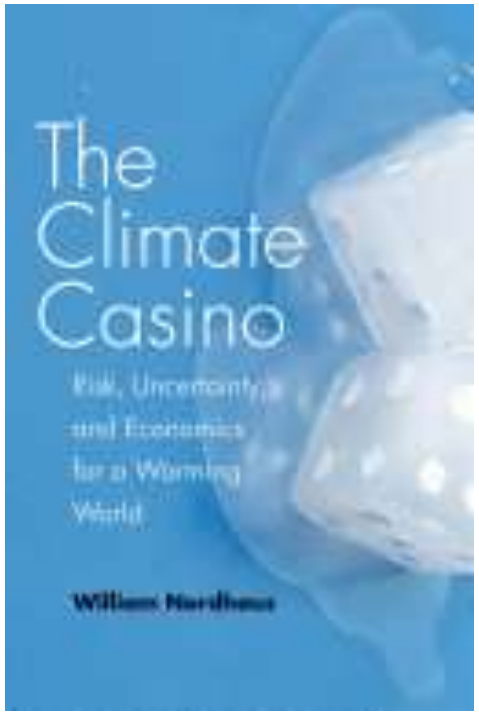
One where policy can be neatly designed given the right amount of computation?

# ‘Decisionism’ is mainstream

“Often, immersion in the facts often makes value disagreements feel much less relevant” (C. Sunstein)

Cass Sunstein, winner of the 2018 Holberg Prize

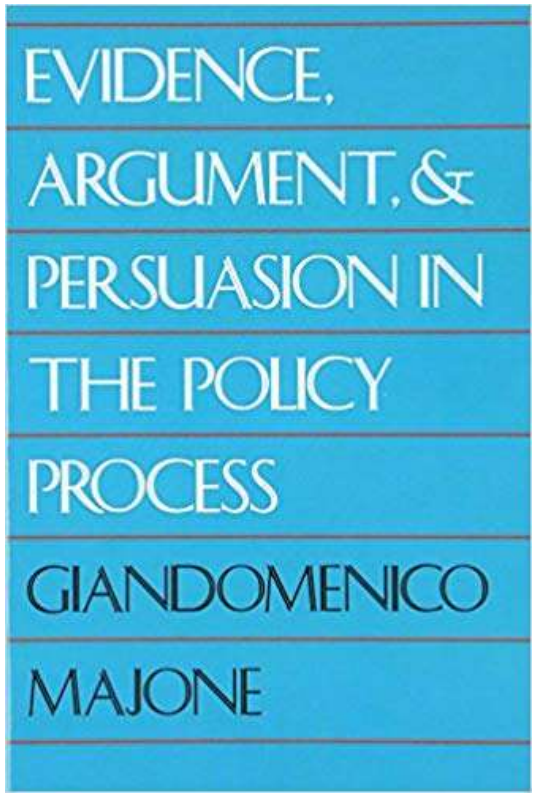
One of the winner of Nobel prize for economics 2018 was Willem Nordhaus, for his work on the economics of climate change.



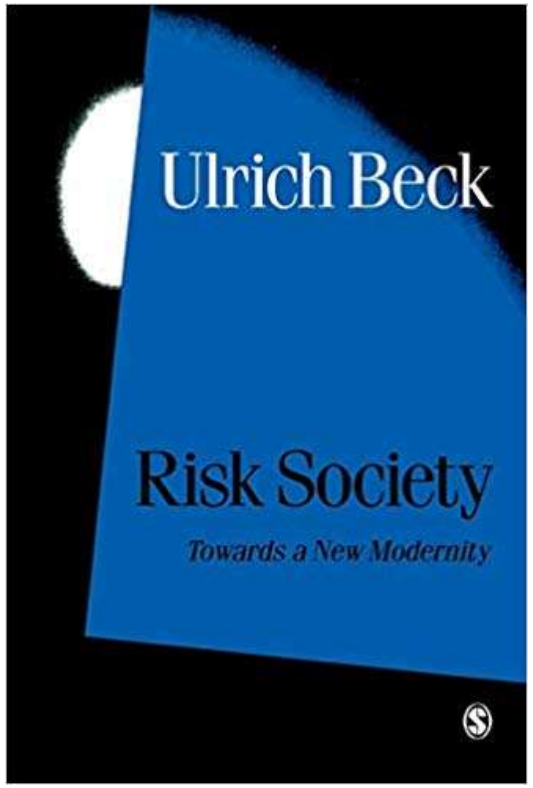
Cost benefit analysis to the year 2100?

# From Ulrich Beck to Giandomenico Majone: the technique is never neutral

Ulrich Beck
(1944 –2015)




1989




1992 (1986)

ELSEVIER

Environmental Science & Policy
Volume 106, April 2020, Pages 87-98

The technique is never neutral. How methodological choices condition the generation of narratives for sustainability

Andrea Saltelli [a, b], Lorenzo Benini [c], Silvio Funtowicz [a], Mario Giampietro [d, e], Matthias Kaiser [a], Erik Reinert [a, f], Jeroen P. van der Sluijs [a, g, h]

# In a context of crisis

# On the radar: October 2013

Futures

Volume 91, August 2017, Pages 5-11

# What is science's crisis really about?

Andrea Saltelli [a, b], Silvio Funtowicz [a]

Futures

Volume 104, December 2018, Pages 85-90

# Why science's crisis should not become a political battling ground

Andrea, Saltelli

Silvio Funtowicz

# Failed replications, entire subfields going bad, fraudulent peer reviews, predatory publishers, perverse metrics, statistics on trial …

June 21, 2017

October 27, 2017

# … misleading science advice, institutions on denial, a new breed of science wars

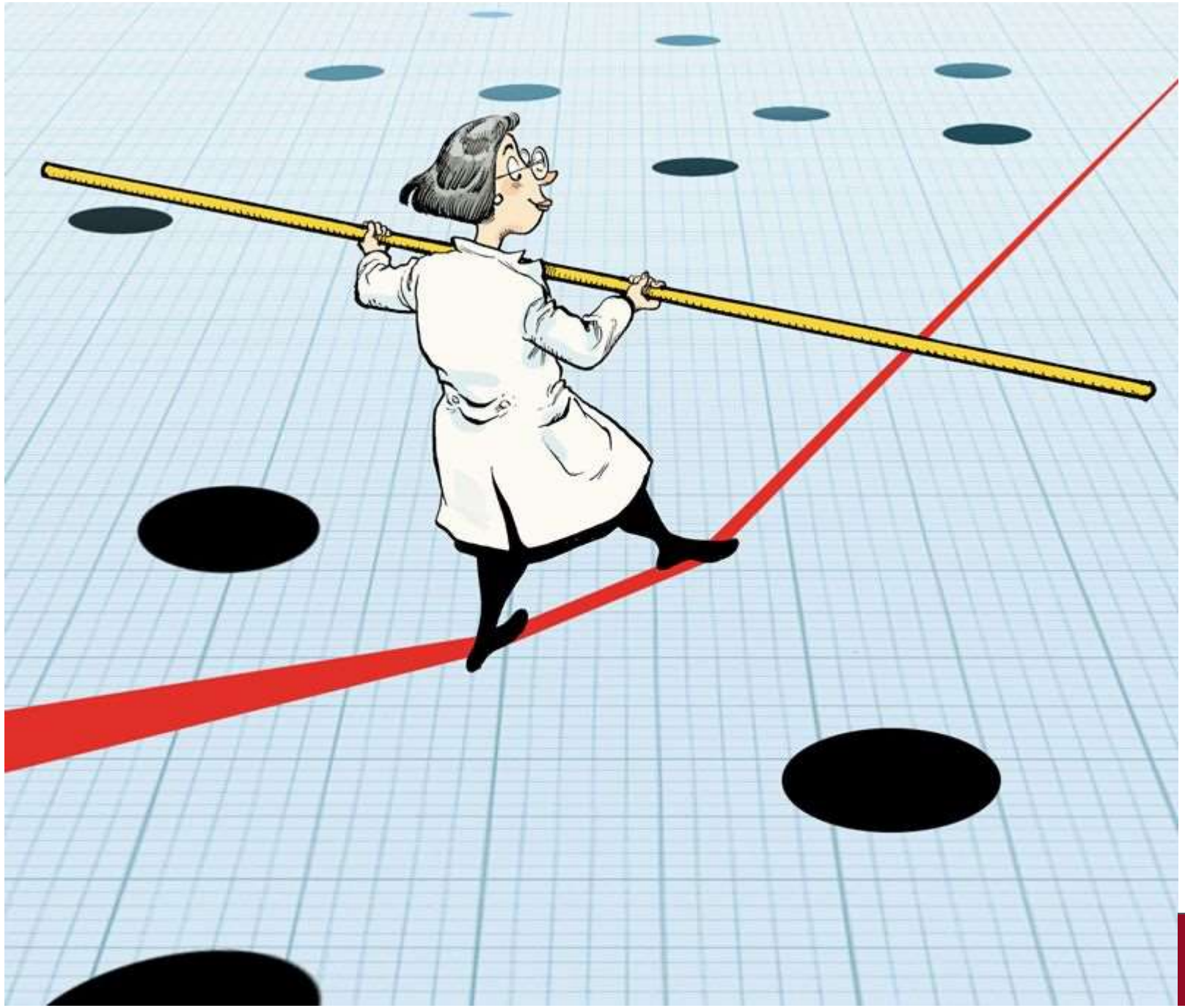
**Opinion: Is science really facing a reproducibility crisis, and do we need it to?**

Daniele Fanelli

PNAS March 12, 2018. 201708272; published ahead of print March 12, 2018. https://doi.org/10.1073/pnas.1708272114

"The new "science is in crisis" narrative is not only empirically unsupported, but also quite obviously counterproductive"

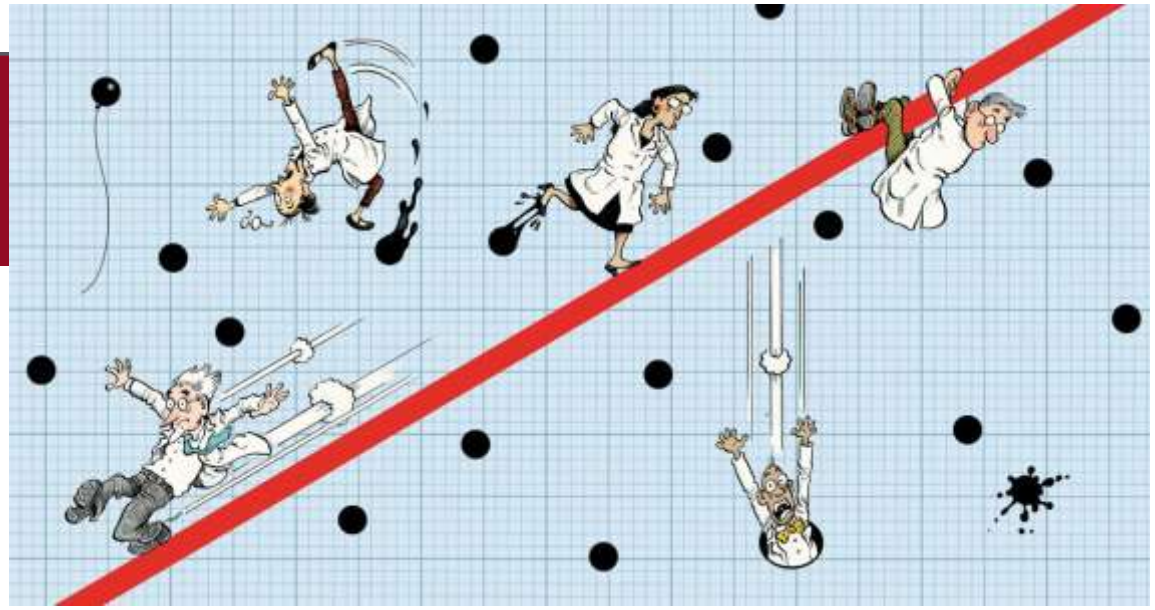
# Statistical and mathematical modelling



# Crisis in statistics?

nature
International journal of science

nature
International journal of science

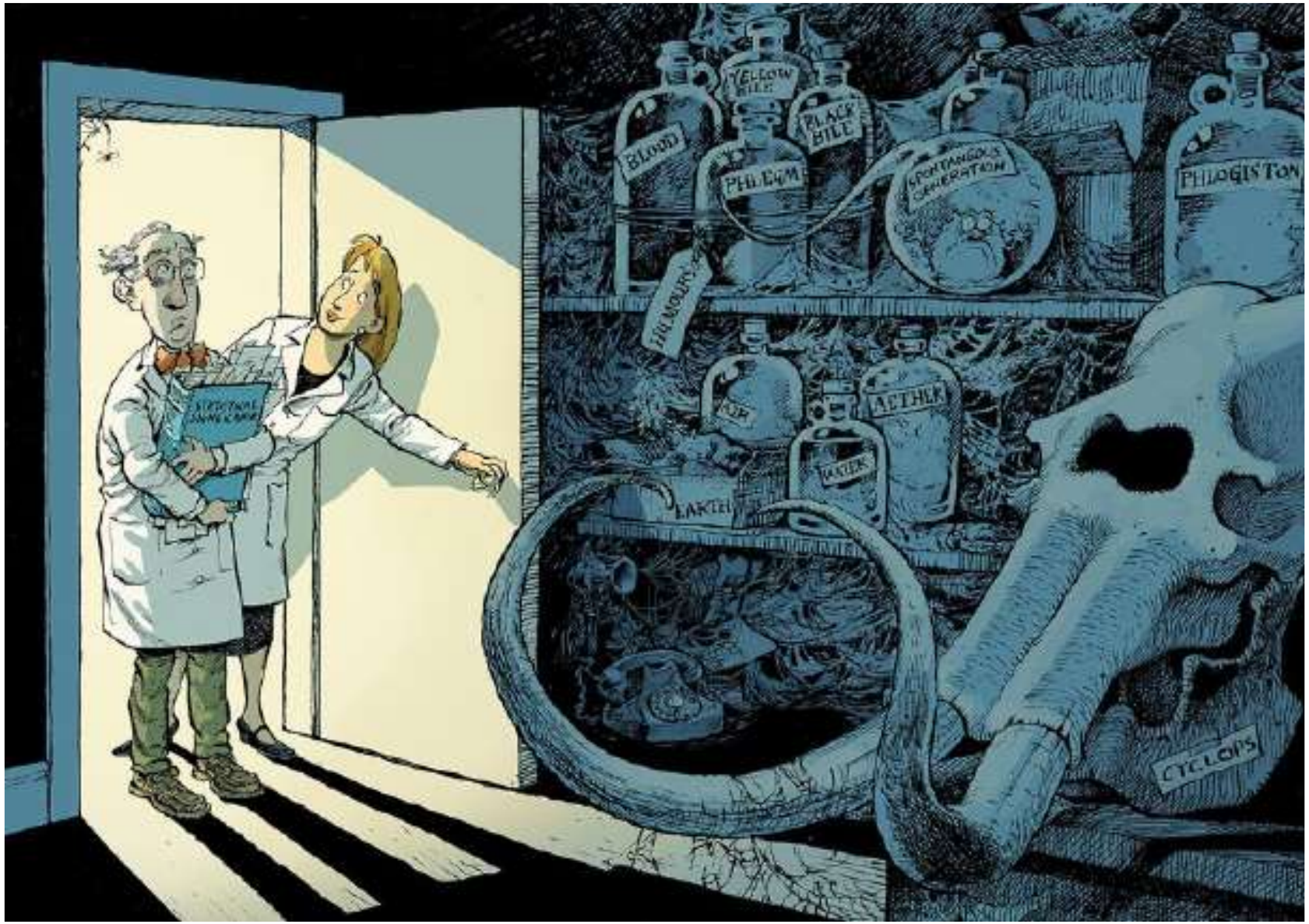


COMMENT · 28 NOVEMBER 2017

# Five ways to fix statistics

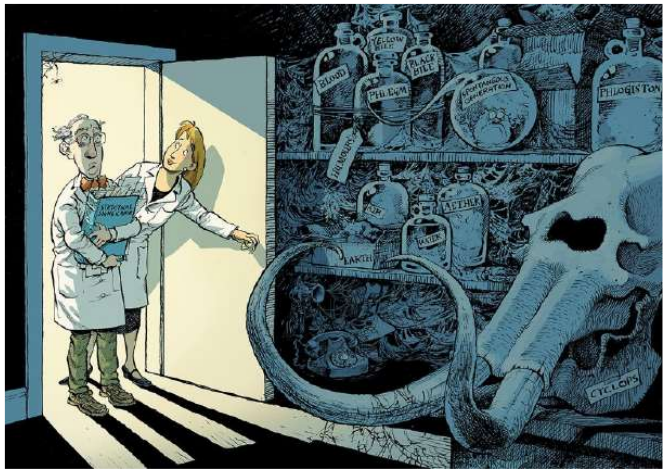
*As debate rumbles on about how and how much poor statistics is to blame for poor reproducibility, Nature asked influential statisticians to recommend one change to improve science. The common theme? The problem is not our maths, but ourselves.*

Jeff Leek ✉, Blakeley B. McShane, Andrew Gelman ✉, David Colquhoun ✉, Michèle B. Nuijten ✉ & Steven N. Goodman ✉




# Throw away the concept of statistical significance?

nature
International journal of science



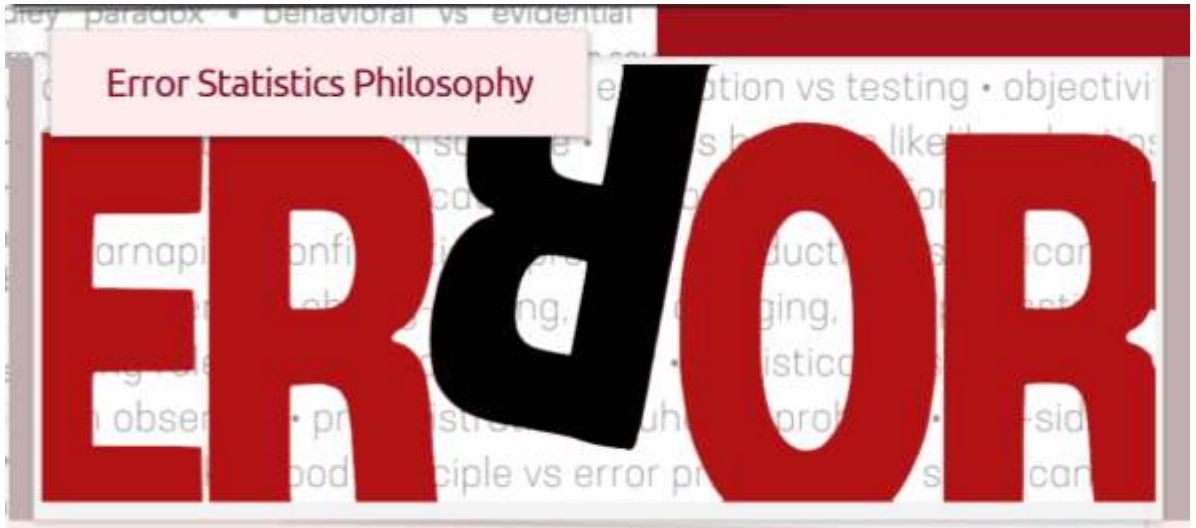
COMMENT · 20 MARCH 2019

# Scientists rise up against statistical significance

*Valentin Amrhein, Sander Greenland, Blake McShane and more than 800 signatories call for an end to hyped claims and the dismissal of possibly crucial effects.*

Valentin Amrhein ✉, Sander Greenland & Blake McShane

See the discussion on the blog of Andrew Gelman https://statmodeling.stat.columbia.edu/



Statistics in the wake of the reproducibility crisis

# Statistical wars?

# Is mathematical modelling affected?

nature COMMUNICATIONS

Comment | Open Access | Published: 27 August 2019

## A short comment on statistical versus mathematical modelling

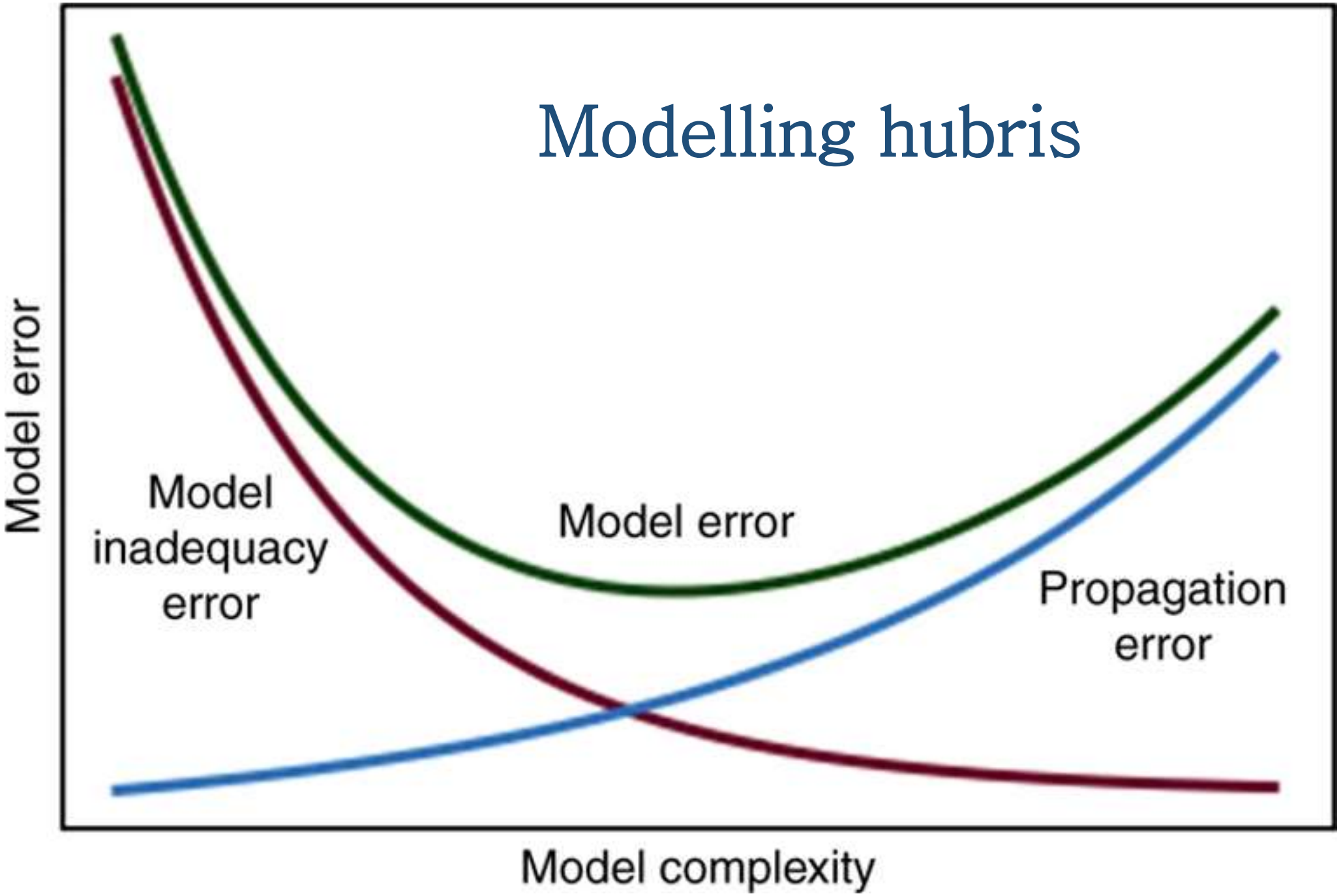
Andrea Saltelli

Unlike statistics, modelling is not a discipline …

# … mathematical modelling cannot do this:

Wasserstein, R.L. and Lazar, N.A., 2016. 'The ASA's statement on p-values: context, process, and purpose', The American Statistician, Volume 70, 2016 - Issue 2, Pages 129-133.

# Modelling hubris



COMMENT · 24 JUNE 2020

# Five ways to ensure that models serve society: a manifesto

Pandemic politics highlight how predictions need to be transparent and humble to invite insight, not blame.

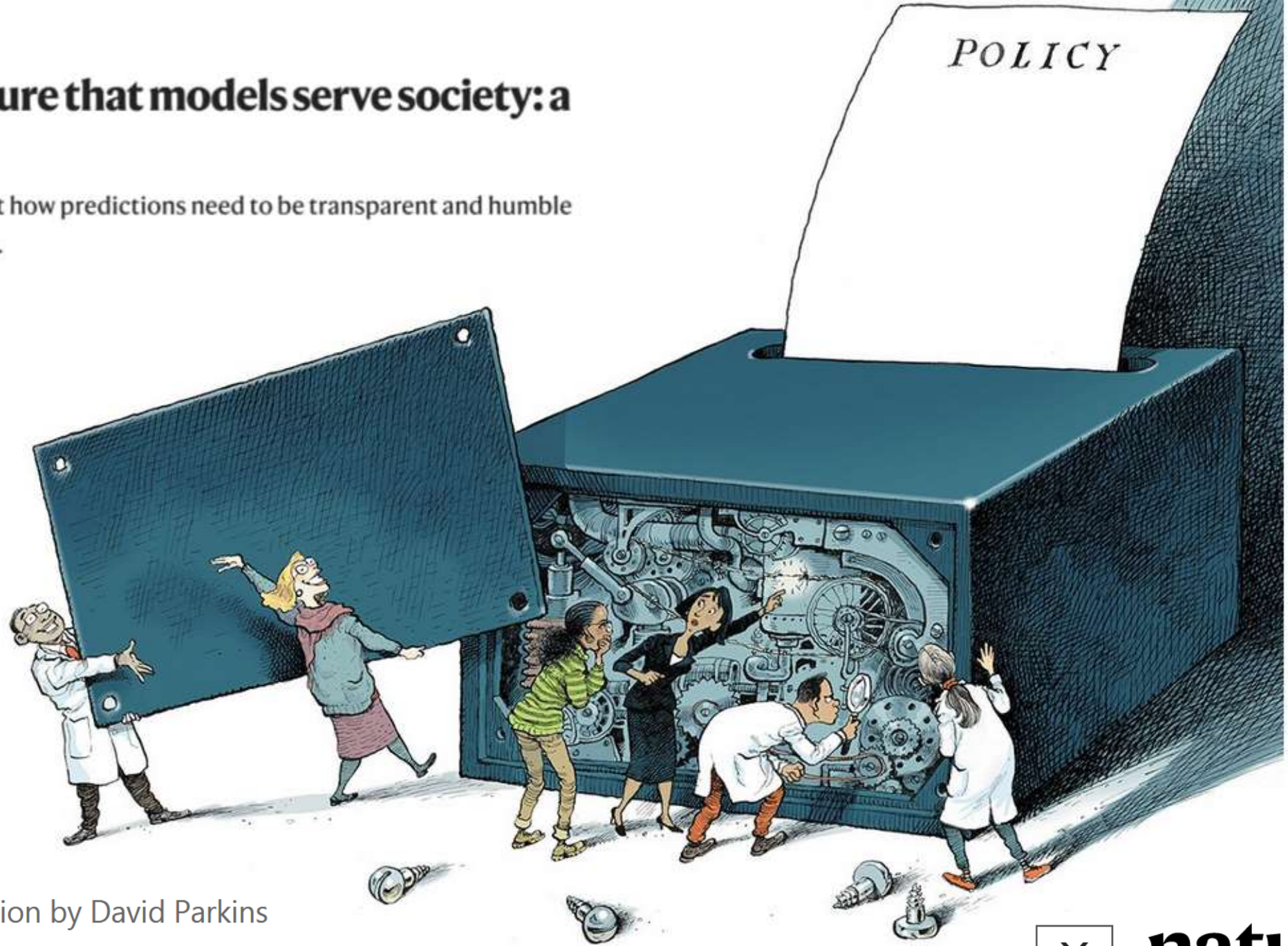



Illustration by David Parkins

nature

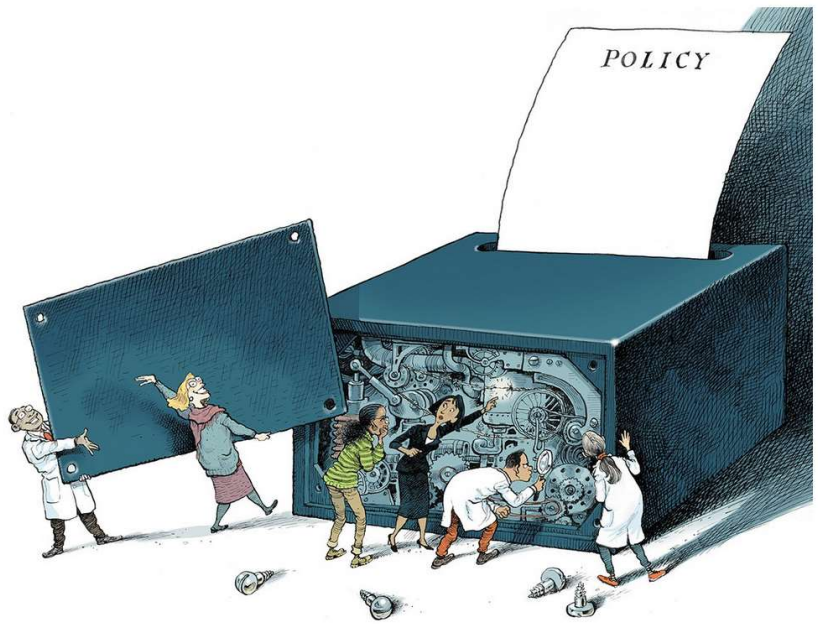
COMMENT · 24 JUNE 2020

nature

# Five ways to ensure that models serve society: a manifesto

Pandemic politics highlight how predictions need to be transparent and humble to invite insight, not blame.

Andrea Saltelli ✉, Gabriele Bammer, Isabelle Bruno, Erica Charters, Monica Di Fiore, Emmanuel Didier, Wendy Nelson Espeland, John Kay, Samuele Lo Piano, Deborah Mayo, Roger Pielke Jr, Tommaso Portaluri, Theodore M. Porter, Arnald Puy, Ismael Rafols, Jerome R. Ravetz, Erik Reinert, Daniel Sarewitz, Philip B. Stark, Andrew Stirling, Jeroen van der Sluijs & Paolo Vineis

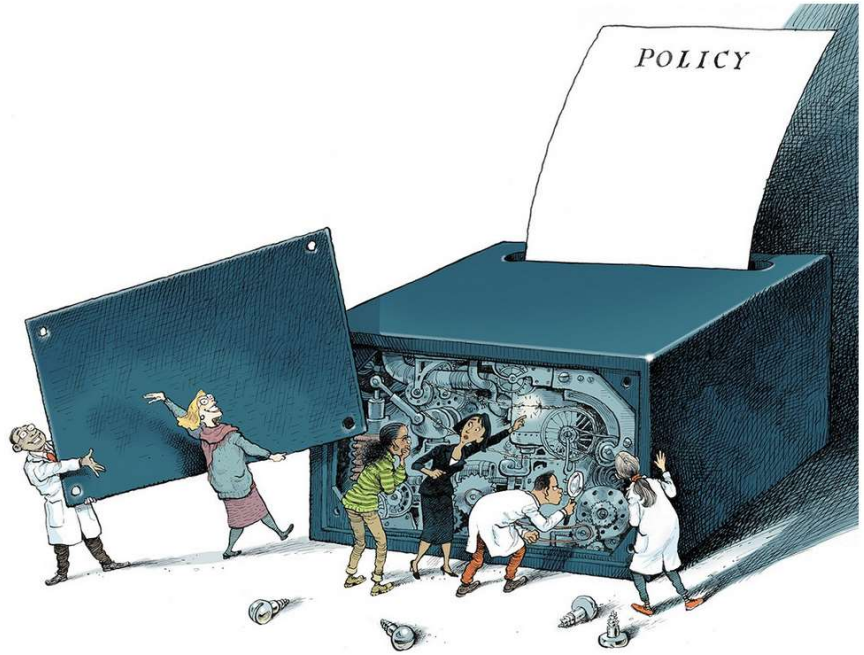


## Mind the assumptions

Assess uncertainty and sensitivity

## Mind the hubris

Complexity can be the enemy of relevance




## Mind the framing

Match purpose and context

## Mind the consequences

Quantification can backfire

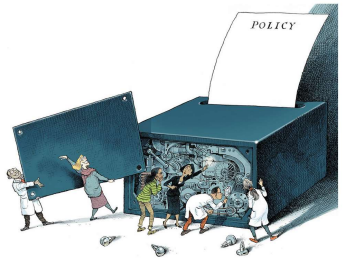
## Mind the unknowns

Acknowledge ignorance

**SUPPLEMENTARY INFORMATION**

**1. Additional information and references** >260 references

# COVID-19 policies dictated by ‘science’ with several digits precision in the presence of fundamental uncertainties



# Undocumented research code used as a policy tool (chameleon models)

Pfleiderer, P. Chameleons: The Misuse of Theoretical Models in Finance and Economics. *Economica* **87**, 81–107 (2020).

# Why ethics of quantification is needed now


**Andrea Saltelli**
Open Evidence Research, Universitat Oberta de Catalunya, Barcelona, Spain

**Antonio Andreoni**
UCL Institute for Innovation and Public Purpose; South African Research Chair in Industrial Development, University of Johannesburg, South Africa

**Wolfgang Drechsler**
Tallinn University of Technology, Estonia;
UCL Institute for Innovation and Public Purpose;
Davis Center at Harvard University, United States

**Jayati Ghosh**
University of Massachusetts Amherst, United States;
UCL Institute for Innovation and Public Purpose

**Rainer Kattel**
UCL Institute for Innovation and Public Purpose

**Ingrid H. Kvangraven**
Department of Politics, University of York

**Ismael Rafols**
Centre for Science and Technology Studies, Leiden University, the Netherlands

**Erik S. Reinert**
Tallinn University of Technology, Estonia;
UCL Institute for Innovation and Public Purpose

**Andy Stirling**
Science Policy Research Unit, University of Sussex

**Ting Xu**
School of Law at the University of Essex



IIPP UCL Institute for Innovation and Public Purpose

WORKING PAPER
WP 2021/05

UCL

… our world is structured by numbers, visible and invisible, where truth is conveyed and reality constructed

Numbers are seductive, performative, confer to their masters' epistemic power and legitimacy

Governing the modern state, or even contesting it, without numbers is impossible

Numbers are the prevalent means to express value in our societies … Access & production of numbers reflect and reinforce power imbalances

IIPP UCL Institute for Innovation and Public Purpose

WORKING PAPER
WP 2021/05

# What recipes for an ethics of quantification?

Futures
Volume 116, February 2020, 102509

Essays

## Ethics of quantification or quantification of ethics?

Andrea Saltelli

⊞ Show more

https://doi.org/10.1016/j.futures.2019.102509

Get rights and content

Under a Creative Commons license

open access

Humanities & Social Sciences Communications

Article | Open Access | Published: 19 August 2020

## From sociology of quantification to ethics of quantification

Andrea Saltelli & Monica Di Fiore

*Humanities and Social Sciences Communications* **7**, Article number: 69 (2020) | Cite this article

**852** Accesses | **25** Altmetric | Metrics

# Ongoing (2020) research on ethics of quantification – there was an SVT symposium in December 2019

Tools and practices to:

- tame modelling hubris,
- make quantifications interpretable, conveyable in plain English,
- and context/purpose specific
- models as tools not as masters

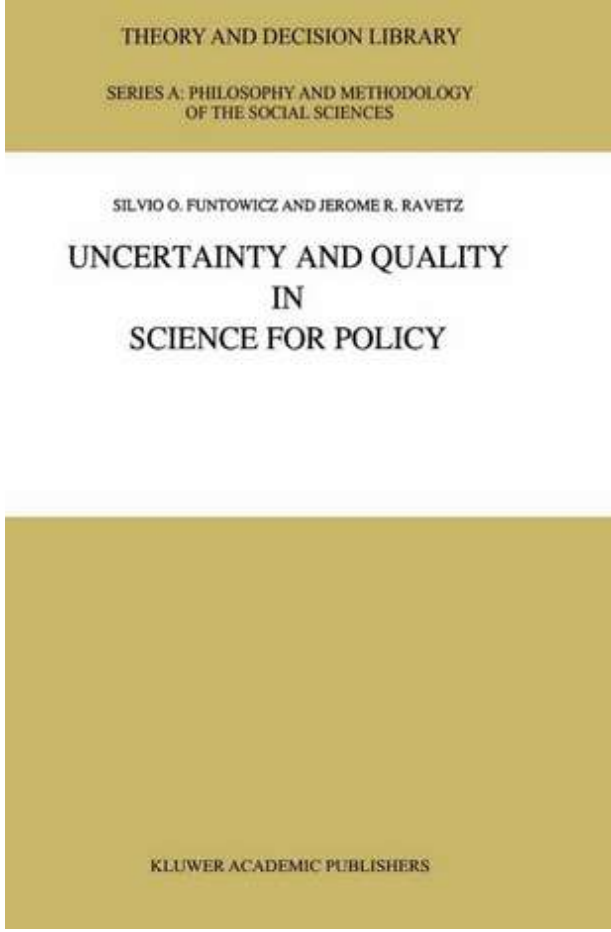
# NUSAP

Numeral, Unit, Spread

+

Assessment (qualitative judgement on quantification)

Pedigree (qualitative assessment of mode of production and anticipated use)



# Example Pedigree matrix parameter strength

| Code | Proxy | Empirical | Theoretical basis | Method | Validation |
|---|---|---|---|---|---|
| 4 | Exact measure | Large sample direct mmts | Well established theory | Best available practice | Compared with indep. mmts of same variable |
| 3 | Good fit or measure | Small sample direct mmts | Accepted theory partial in nature | Reliable method commonly accepted | Compared with indep. mmts of closely related variable |
| 2 | Well correlated | Modeled/derived data | Partial theory limited consensus on reliability | Acceptable method limited consensus on reliability | Compared with mmts not independent |
| 1 | Weak correlation | Educated guesses / rule of thumb est | Preliminary theory | Preliminary methods unknown reliability | Weak / indirect validation |
| 0 | Not clearly related | Crude speculation | Crude speculation | No discernible rigour | No validation |

Jeroen van der Sluijs

http://www.nusap.net/

# Sensitivity Auditing

*Int. J. Foresight and Innovation Policy, Vol. 9, Nos. 2/3/4, 2013* 

# What do I make of your latinorum? Sensitivity auditing of mathematical modelling

Saltelli, A., Guimarães Pereira, Â.,
Van der Sluijs, J.P. and Funtowicz, S.

Ângela Guimarães Pereira

# The rules of sensitivity auditing

1. Check against rhetorical use of mathematical modelling;
2. Adopt an “assumption hunting” attitude; focus on unearthing possibly implicit assumptions;
3. Check if uncertainty been instrumentally inflated or deflated.

4. Find sensitive assumptions before these find you; do your SA before publishing;
5. Aim for transparency; Show all the data;
6. Do the right sums, not just the sums right;
7. Perform a proper global sensitivity analysis.

# Poor quantifications: an examples

# Too much is being read in the OECD-PISA data

IJCED
19,1

20

Received 14 December 2016
Revised 17 February 2017
Accepted 24 February 2017

## Do PISA data justify PISA-based education policy?

Luisa Araujo
*Department of Human Capital and Employment, European Commission Joint Research Centre Ispra Sector, Ispra, Italy*
Andrea Saltelli
*University of Bergen, Bergen, Norway and Universitat Autonoma de Barcelona, Barcelona, Spain, and*
Sylke V. Schnepf
*Competence Centre on Microeconomic Evaluation, European Commission Joint Research Centre Ispra Sector, Ispra, Italy*

International Journal of Comparative Education and Development
Vol. 19 No. 1, 2017
pp. 20-34
© Emerald Publishing Limited
2396-7404
DOI 10.1108/IJCED-12-2016-0023

Through PISA, the OECD has (a) gained epistemic authority and (b) framed a trajectory for education

Research Policy 40 (2011) 165–177

Contents lists available at ScienceDirect

Research Policy

journal homepage: www.elsevier.com/locate/respol

# Rickety numbers: Volatility of university rankings and policy implications

Michaela Saisana*, Béatrice d'Hombres, Andrea Saltelli

*Econometrics and Applied Statistics, Joint Research Centre, European Commission, Enrico Fermi 2749, 21027 Ispra, Italy*

University ranking are volatile …

Journal of the Royal Statistical Society

SERIES A Statistics in Society

*J. R. Statist. Soc.* A (2013)
**176**, *Part* 3, *pp.* 609–634

… and methodologically unsound

# Ratings and rankings: voodoo or science?

Paolo Paruolo

*University of Insubria, Varese, Italy*

and Michaela Saisana and Andrea Saltelli

*European Commission, Ispra, Italy*

# Literature on mathematization of economics and of the social sciences

Wolfgang Drechsler

Erik S. Reinert

Paul Romer

W. Drechsler, “On the possibility of quantitative-mathematical social science, chiefly economics,” *J. Econ. Stud.*, vol. 27, no. 4/5, pp. 246–259, 2000.

E. S. Reinert, “Full circle: economics from scholasticism through innovation and back into mathematical scholasticism,” *J. Econ. Stud.*, vol. 27, no. 4/5, pp. 364–376, Aug. 2000.

P. Romer, “Mathiness in the Theory of Economic Growth,” *Am. Econ. Rev.*, vol. 105, no. 5, pp. 89–93, May 2015.

EARTH
OVERSHOOT
DAY
ABOUT
BLOG
SOLUTIONS
STEPS TO #MOVETHEDATE
NEWSROOM
FOR KIDS & TEACHERS
SUBSCRIBE
EARTH OVERSHOOT DAY WAS JULY 29
On That Day, Humanity Exhausted The Biological Resources Our Planet Can Renew This Whole Year. Check Out Solutions Below So We Stop Increasing The Global Ecological Deficit.

# At 8.00 am?

# We use 1.75 planets
# Or 17.5? 175? 1,750? …Infinity?

# How many plastic bottles are we allowed to throw in the sea in a year?

Try replacing plastic bottles with extinction of a species, or collapse of a fishery, or a Fukushima,…

Move the date forward 5 days every years suggests Mathis Wackernagel

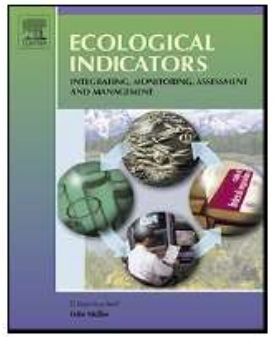
The Ecological Footprint suggests compressing sustainability to a single metric (acres of equivalent land). CO2 emissions from energy demand dominate the output.

Ecological Indicators 46 (2014) 610–621

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind



# Footprints to nowhere

Mario Giampietro [a,c], Andrea Saltelli [b,*]

[a] Institute of Environmental Science and Technology (ICTA), Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain
[b] Institute for the Protection and Security of the Citizen (IPSC), The European Commission, Joint Research Centre, TP 361, 21027 Ispra, VA, Italy
[c] Catalan Institution for Research and Advanced Studies (ICREA), Passeig Lluís Companys, 23, 08010 Barcelona, Spain

Giampietro, M., and Saltelli, A., 2014, Footprints to nowhere, Ecological Indicators, 46, 610–621.

Goldfinger, S., Wackernagel, M., Galli, A., Lazarus, E., Lin, D., 2014, Footprint facts and fallacies: A response to Giampietro and Saltelli (2014) “Footprints to Nowhere”, 46, 622–632.

Giampietro, M., and Saltelli, A., 2014, Footworking in Circles, Ecological Indicators, 46 (2014) 260–263.

Alessandro Galli , Mario Giampietro , Steve Goldfinger, Elias Lazarus, David Lin, Andrea Saltelli , Matthis Wackernagel , Felix Müller, 2016, Questioning the ecological footprint , Ecological Indicators, 69, 224–232.

All the story

# Stop here

@andreasaltelli

# Assignment

Take one of the four CUDOS; one student will argue pro while another will argue against, like in court.

Make sure you don't take all the same principle!

**Communalism** – the common ownership of scientific discoveries, according to which scientists give up intellectual property rights in exchange for recognition and esteem (Merton actually used the term Communism, but had this notion of communalism in mind, not Marxism);

**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;

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

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

# The End

@andreasaltelli

## What issues for an ethics of quantification?

-The issue of trust.
-A defence against abuse
-To prevent consequentialism in scientific quantification
-To moderate excesses of optimism about the merits of quantification
-For the non-neutrality of the techniques; for the non-separability of facts and values
-For the need to contextualize any quantification
-To deter quantification hubris

## What recipes would be offered by an ethics of quantification?

-A license not-to-quantify
-Taming hubris: memento Figure 1.
-Make use of the existing disciplinary arrangements
-Make quantifications interpretable, conveyable in plain English and context specific; use existing pedigrees
-NUSAP
-Sensitivity auditing