UNIVERSITÉ DE LYON

Qu'est ce qu'un chercheur responsable aujourd'hui?

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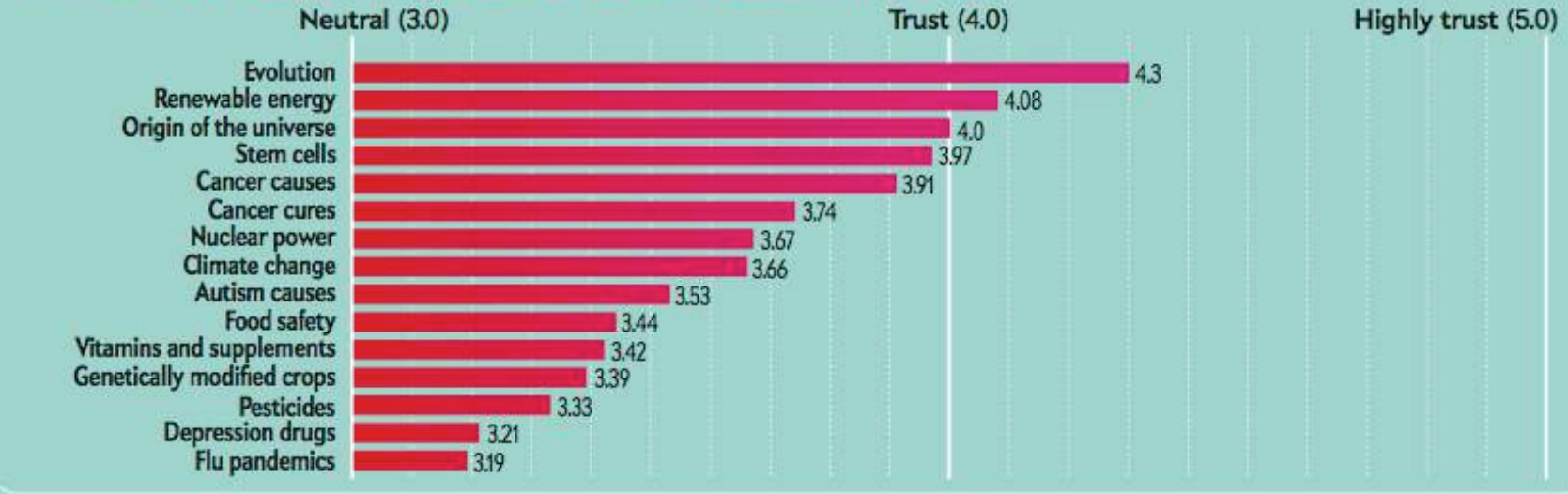
Journée Ethique et Intégrité scientifique, Jussieu, 31 janvier 2020

How Much Do People Trust What Scientists Say?

We asked respondents to rank how much they trusted various groups of people on a scale of 1 (strongly distrust) to 5 (strongly trust). Scientists came out on top by a healthy margin. When we asked how much people trust what scientists say on a topic-by-topic basis, only three topics (including, surprisingly, evolution) garnered a stronger vote of confidence than scientists did as a whole.

Whom do you typically trust to provide accurate information about important issues in society?

How much do you trust what scientists say about the following topics?



Scientific American / Nature 2010

Une confiance réaffirmée dans la science « en général » et le souhait d'être davantage et consultés sur les débats et les enjeux de la recherche

Pour chacune des affirmations suivantes, dites-moi si elle correspond tout à fait, plutôt, plutôt pas ou pas du tout à ce que vous pensez ?

Base : A tous

	ST CORRESPOND				
	Mai 2016	*Rappel Mai 2015*	*Rappel Avril 2013*	*Rappel Juin 2012*	*Rappel Mai 2011*
La science et la technologie apportent des solutions aux problèmes que nous rencontrons aujourd'hui	78%	*84%*	*78%*	-	*75%*
Nous devenons trop dépendants des avancées de la science et de la technologie	74%	*81%*	*77%*	-	*77%*
Grâce à la science et à la technologie, les générations du futur vivront mieux que celles d'aujourd'hui	65%	*65%*	*62%*	-	*56%*
La science et la technologie génèrent des changements trop rapides dans ma vie de tous les jours	44%	*45%*	*46%*	-	*44%*
La science et la technologie produisent plus de dommages que d'avantages	35%	*40%*	*37%*	-	*43%*
En France, les citoyens sont suffisamment informés et consultés sur les débats et les enjeux de la recherche	25%	-	-	*19%*	*19%*

Introduction

- Confiance → Responsabilités

- Mais responsabilité de quoi au juste ?

Introduction

- Confiance → Responsabilités

- Mais responsabilités de quoi au juste ?

  - Produire de la ***bonne*** science mais pas seulement...

  - Produire une science ***utile***

THIS WEEK

EDITORIALS

SPACE Battle of the planets could see a new moon **p.392**

WORLD VIEW Energy scientists must show their workings **p.393**

OPTICS Semiconductor camera has eagle-eyed vision **p.395**

Beyond the science bubble

Research leaders in the United States and elsewhere should address the needs and employment prospects of taxpayers who have seen little benefit from scientific advances.

One question dominated discussions at the annual meeting of the American Association for the Advancement of Science (AAAS) at the weekend. Researchers, journalists and science lobbyists squeezed into conference rooms, perched on recycling bins and sat on the floor between rows of filled chairs as they strained to listen to those who tried to offer a response. The question was phrased in various ways, but the variations all boiled down to: how should science and scientists respond to the administration of President Donald Trump?

The answers were numerous too — from political activism to better communication — and were met with cheers, applause and the odd standing ovation. Many scientists will have left the Boston conference with renewed hope, or at least a sense of combined purpose. They had an answer of sorts to their question.

But it's the wrong question. It is not Trump that scientists must respond to. The real question is what science can do for the people who voted for him. Exactly who did support him, and why, is still being debated by political scientists, but it's clear that many of those who voted Trump are those he canvassed in his campaign and credited in his inauguration speech. It is people who feel left behind by supposed progress and who have suffered a real or perceived collapse in their quality of life.

PERSUADING THE UNCONVINCED

One speaker at the AAAS meeting appropriately sharpened the challenge. There are two types of taxpayer: those who pay up voluntarily because they believe in the public good that the money generates, and those who pay only because they will be put in jail if they don't. How many scientists, he suggested, could confidently say their project was so important to people that those people should be thrown into prison for not supporting it?

Just telling the same old stories won't cut it. The most seductive of these stories — and certainly the one that scientists like to tell themselves and each other — is the simple narrative that investment in research feeds innovation and promotes economic growth. 'It's the economy, stupid', so the saying goes, and as nations become a little less stupid by pushing against the frontiers of knowledge, so the benefits of all this new insight spread from the laboratory to the wider population, as improvements in the standard of living and quality of life.

This comfortable story has all the hallmarks of a bubble waiting to pop. For a start, it always has a happy ending. The hero of various quests, science slays the dragon of childhood disease and retrieves the elixir, if not of everlasting life, then at least of increased lifespan. And ,like all good stories, this one comes with a pleasing twist: for when it sets off on its quest, science does not know exactly which good deeds it is planning to perform. Pure of heart and research, it is merely enough to send our science hero out into the world, with its consumables, overheads and a postgraduate squire paid for by donations from a grateful and trusting public.

This narrative is truthful enough to have sustained itself for many decades. From the famous discovery of the apparently useless laser that launched uncountable applications to how Einstein's theories of relativity underpin the Global Positioning System — these stories indeed make a case to Trump and his supporters that continued investment in science will help to create companies and jobs.

But as this journal and others have pointed out, it is also clear that the needs of millions of people in the United States (and billions of people around the world) are not well enough served by the agendas and interests that drive much of modern science. There are plenty of reports that show, for example, how public investment in the Human Genome Project has paid off many times over and created firms and jobs, but rather than trickling down through society, these benefits of discovery science arguably deepen the pools of wealth and privilege already in place — creating expensive new drugs that most people cannot afford.

"The needs of millions of people in the United States are not well enough served by the agendas and interests that drive much of modern science."

It is right that more scientists should tell stories of the good their research can do. But it is more important and urgent than ever that researchers should question how these stories really end — and whether too many of the people they claim to act for don't really get to live happily ever after. Equally, they should focus more effort on how science education and scientific research can help the many whose jobs are going to be displaced by the very inventions that scientists are producing.

As they ponder their next move in response to the election of Trump, science organizations — universities, funders, supporters and the rest — should look harder at social problems and opportunities, and seek ways for science to help.

For example, some universities are increasingly engaging in climate-change adaptation. There will be employment opportunities in creating companies that help cities and other regional communities to protect themselves from climate change (whatever the sceptics may be saying), stimulated by the readily applicable and intellectually stimulating insights and improved decision-making that research will deliver.

More universities, for example, could follow the example of Michigan State University in East Lansing, in building stronger links with their local communities, and seeking to work with them to tackle research problems that affect their quality of life. These include monitoring soil and water quality, for example, and addressing the challenges of regional demographics, such as the large numbers of elderly people who live alone in some regions and how to deliver health care to them.

There is also a need to tell these stories compellingly — stories that are harder to tell and of less global impact than the hunt for fundamental particles or new materials. And the most important audiences may not be inclined to listen. But those audiences matter. ■

« Beyond the science bubble », *Nature*, février 2017

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22 FEBRUARY 2017 | VOL 542 | NATURE | 391

« The needs of millions of people in the United States are not well enough served by the agenda and interests that drive much of modern science »

« Researcher leaders in the United States and elsewhere should address the needs and employment prospects of taxpayers who have seen little benefits from scientific advances »

I- Introduction: Eléments de contexte

❖**RRI *Responsible Research and Innovation*** H2020

"Responsible Research and Innovation (RRI) implies that societal actors (researchers, citizens, policy makers, business, third sector organisations, etc.) work together during the whole research and innovation process **in order to better align both the process and its outcomes with the values, needs and expectations of society**."

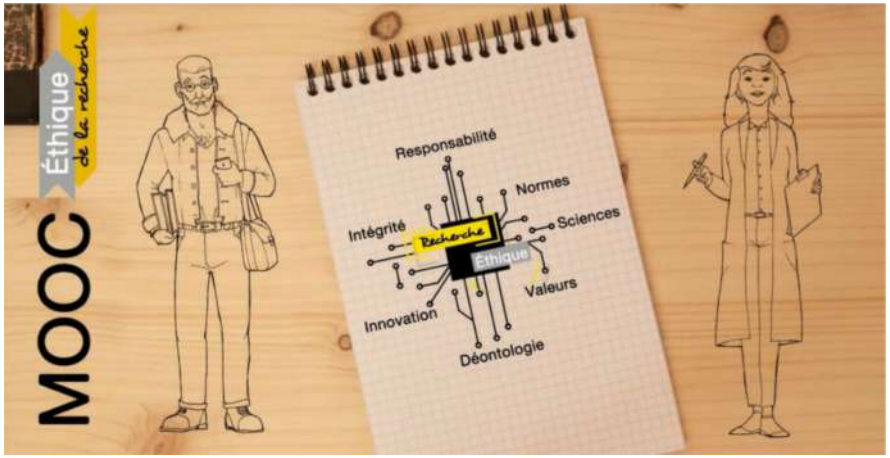
Implémentation :

-Actions sur des éléments thématiques : public engagement, open access, gender, ethics, science education

-Actions pour promouvoir la prise en compte des dimensions de la RRI par les institutions, agences de moyens, etc.

I-Introduction: Eléments de contexte

Remise en juin 2016 du rapport Corvol sur l'intégrité scientifique



Cycle « Science et Société »
CEA / LETI

I- Introduction: Eléments de contexte

IN FOCUS NEWS

POLICY

China introduces sweeping reforms against misconduct

Policies include creation of journal blacklist and assigning policing to government agency.

BY DAVID CYRANOSKI

China is getting tough on scientific misconduct. The country's most powerful bodies, the Chinese Communist Party and the State Council, introduced a raft of reforms on 30 May aimed at improving integrity across the research spectrum, from funding and job applications to peer-review and publications.

Under the new policy, the Ministry of Science and Technology (MOST) will be responsible for managing investigations and ruling on cases of scientific misconduct, a role previously performed by individual institutions. And for the first time, misconduct cases will be logged in a national database that is currently being designed by MOST.

Inclusion in the list could disqualify researchers from future funding or research positions, and might affect their ability to get jobs outside academia. The Chinese Academy of Social Sciences will oversee the same process for social scientists.

The policy also states that MOST will establish a blacklist of 'poor quality' scientific journals, including domestic and international titles. Scientists who publish in these journals will receive a warning, and those papers will not be considered in assessments for promotions, jobs or grants. A couple of such blacklists already exist, but rarely are they run formally by a government agency.

"Making it clear that articles published in 'bad' journals won't count towards assessment of performance sends a strong signal," says Paul Taylor, who heads a scientific-integrity programme at RMIT University in Melbourne. The plan to crack down on poor-quality and predatory journals is a good idea in practice, he says, but the ministry could find it difficult to identify problematic journals because some are more obvious than others — a challenge that curators of other blacklists have experienced. "It will be interesting to see the criteria that are developed to make these assessments," he says.

A start date for the reforms is yet to be announced, but is expected soon. Researchers in China and abroad say the policy will have considerable impact. "These new rules will make a major difference over time," says Xue Lan, a science- and innovation-policy researcher at Tsinghua University in Beijing.

Scientific misconduct is a significant problem in China, which has seen a steady stream of plagiarism cases, uses of fraudulent data, falsified CVs and fake peer reviews.

The Chinese Academy of Sciences will work with the science ministry to set standards.

HELD TO ACCOUNT

Xue says the reforms are more practical than previous policies, which were based on general principles, such as improving researcher ethics, and were therefore hard to implement. "They lay out an accountability system in a detailed way that has never been seen before," he says.

As part of the reforms, the science ministry will work with agencies such as the Chinese Academy of Sciences to create standards for determining misconduct, protocols for monitoring and investigating allegations, and rules for deciding on the severity of penalties according to the type of misconduct. The policy states that funding and jobs can be revoked. Although universities currently have these powers, some scientists say they are rarely applied. "The lifelong accountability system will make everyone afraid to commit academic misconduct," says Yu Haifiang, a mechanical engineer at Central South University in Changsha, who blogs about science-integrity issues. The rules will help to establish a good academic atmosphere, he says.

Science-policy researcher Tang Li from Fudan University in Shanghai also supports the reforms, although she worries that, if penalties are too harsh, it might prompt a backlash from researchers. She also warns that the ministry will need to protect whistleblowers and researchers who are wrongly accused — something that is happening more now that researchers can publicize accusations against each other online. Taylor would like to see some assurance that the investigative process that led to people being named on a misconduct database was fair and rigorous.

The new rules also state that institutions could have their funding revoked if they protect researchers who have conducted serious misconduct. Nicholas Steneck, a researcher in scientific integrity at the University of Michigan in Ann Arbor, says the plan to punish institutions and journals is unique, and the journal policy could be a model for other countries to follow.

The policy also includes a plan to overhaul how researchers are evaluated for jobs and research grants. The current system places significant weight on the number of papers a scientist has published. But some researchers have noted that this encourages corner-cutting and fraud. The new rules call instead for universities instead to consider quality as well as quantity, and to focus on overall innovation and impact as well as publication record.

Efforts to change the culture of science in China will be key to reducing misconduct, says Yu. "As time goes on, these rules will go deep into the hearts of every researcher, allowing people to consciously resist academic bad habits." ■

Qu’est-ce qui est en jeu ?

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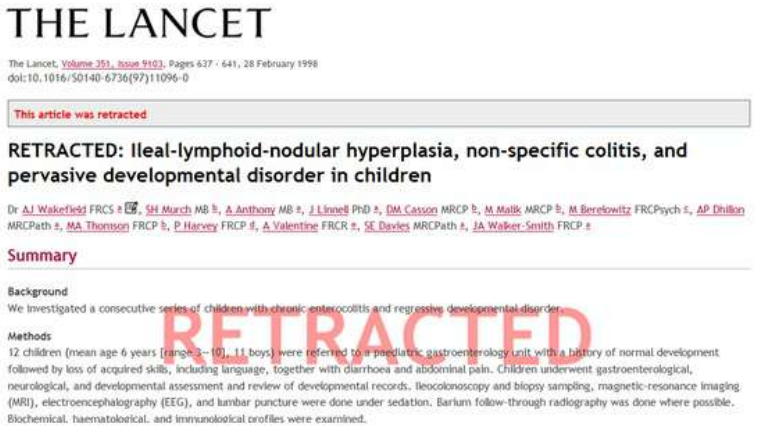
- Au-delà de la nécessité d’avoir des résultats fiables pour la bonne marche des sciences (pouvoir se faire confiance entre chercheurs) :


THE LANCET

The Lancet, Volume 351, Issue 9103, Pages 637 - 641, 28 February 1998
doi:10.1016/S0140-6736(97)11096-0

This article was retracted

RETRACTED: Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children

Dr AJ Wakefield† FRCS a, SH Murch MB b, A Anthony MB a, J Linnell PhD a, DM Casson MRCP b, M Malik MRCP b, M Berelowitz FRCPsych c, AP Dhillon MRCPath a, MA Thomson FRCP b, P Harvey FRCP d, A Valentine FRCR e, SE Davies MRCPath a, JA Walker-Smith FRCP a

Summary

Background
We investigated a consecutive series of children with chronic enterocolitis and regressive developmental disorder.

RETRACTED

Methods
12 children (mean age 6 years [range 3–10], 11 boys) were referred to a paediatric gastroenterology unit with a history of normal development followed by loss of acquired skills, including language, together with diarrhoea and abdominal pain. Children underwent gastroenterological, neurological, and developmental assessment and review of developmental records. Ileocolonoscopy and biopsy sampling, magnetic-resonance imaging (MRI), electroencephalography (EEG), and lumbar puncture were done under sedation. Barium follow-through radiography was done where possible. Biochemical, haematological, and immunological profiles were examined.

Qu’est-ce qui est en jeu ?

- Nouveau contrat avec la société : « La science repose sur l’engagement financier publique des contribuables, cet engagement de la nation envers le monde scientifique n’est pas irréversible » (T. Mandon)
  - Préserver le capital de confiance accordé aux chercheurs (en matière d’expertise notamment)
  - La science doit accepter de « rendre des comptes » - Répond-elle suffisamment aux attentes et besoins de la société ?

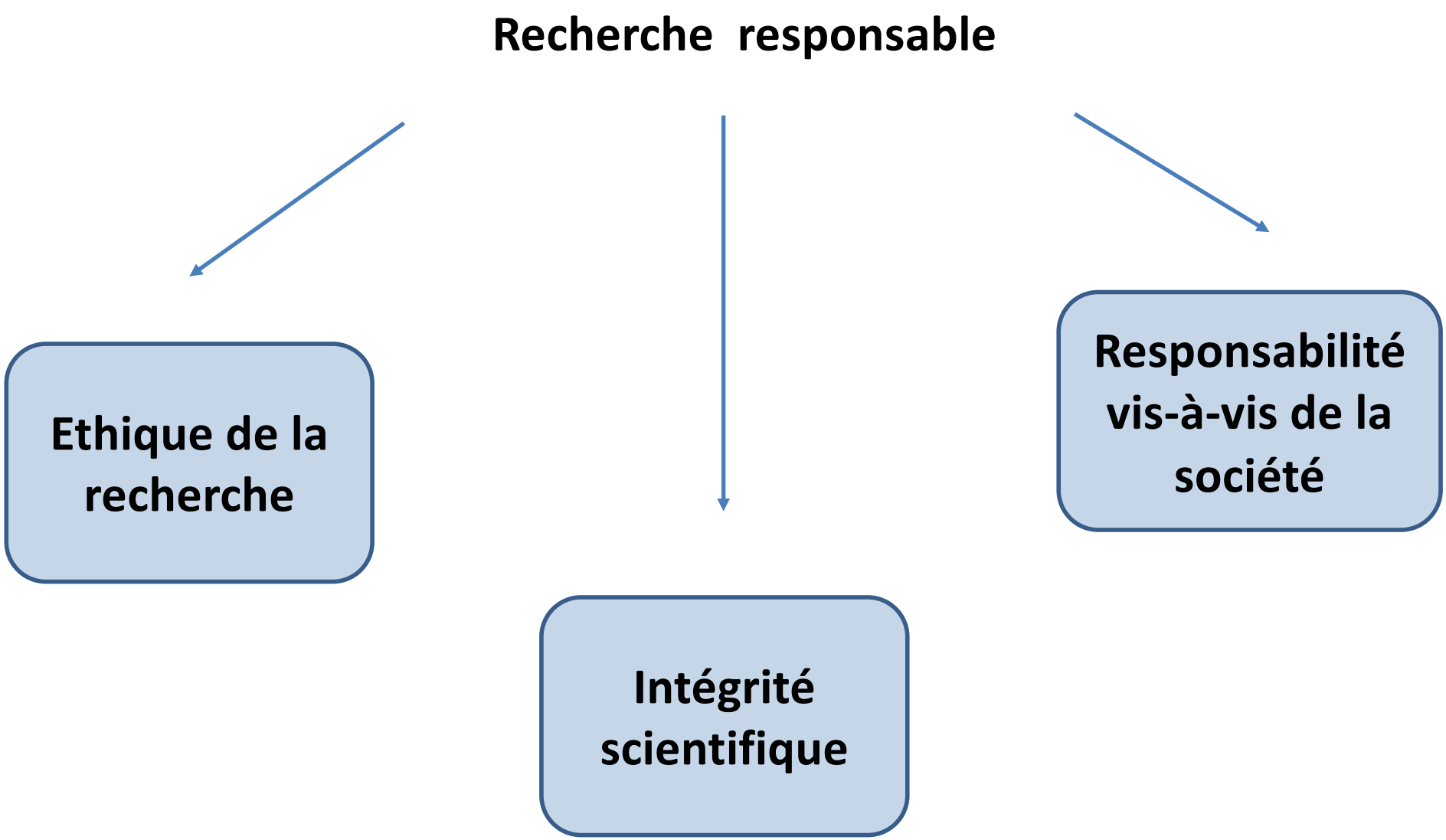
Au menu...

I. Distinction entre intégrité scientifique, éthique de la recherche et responsabilité sociétale.

II. Intégrité scientifique, confiance et objectivité scientifique

III. Responsabilités des chercheurs en matière d'impacts sur la société

IV. Responsabilités des chercheurs dans le choix des priorités de la recherche


Recherche responsable
Ethique de la recherche
Intégrité scientifique
Responsabilité vis-à-vis de la société

Intégrité scientifique : une prise de conscience assez tardive

Quelques repères chronologiques :

1992 Création aux Etats Unis de l'Office of Research Integrity (ORI)[13]
1999 Création à l'Inserm d'une délégation à l'intégrité scientifique. Mise en place en interne d'une délégation autonome, avec procédures claires, connues de tous, capable de traiter les allégations[14]
2005 Charte européenne du chercheur[15]
2010 The Singapore statement on research integrity[16]
2010 Rapport sur l'intégrité scientifique de JP Alix transmis au MESR[17]
2011 The European code of conduct for research integrity[18]
2012 Colloque « L'intégrité scientifique, enjeu de la recherche »[19]
2015 Charte nationale de déontologie des métiers de la recherche[20]
2016 Colloque de Bordeaux : « L'intégrité scientifique, parlons-en ! »[21].

- 1 à 2 % des publications frauduleuses (soit environ 20 000 articles)
- 423 allégations de méconduites en 2012 aux USA dont 29 ont fait l'objet de poursuites pénales

Extraits rapport Corvol (juin 2016)

Typologie des manquements à l'intégrité scientifique
(d'après rapport Corvol, 2016)

- Fabrication, falsification des résultats et plagiat (FFP)
- Les conflits d'intérêt
- Les signatures des publications
- Les pratiques questionnables de recherche

Typologie des manquements à l'intégrité scientifique (d'après rapport Corvol, 2016)

- **Pratiques questionnables de recherche (PQR). « Zone grise » (rapport Corvol)**

  - Embellissement des données
  - Omission ou sélection de résultats
  - Emiettements des publications
  - Utilisation incorrecte des tests statistiques
  - Sélection baisée des citations
  - Non-conservation des données ou utilisation sélective
  - Appropriation du sujet de thèse par l'encadrant, etc

II- Intégrité scientifique, confiance et objectivité scientifique

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- Moins minimalement... Produire de la bonne science, c'est produire des résultats *objectifs et non biasés,* c'est-à-dire ?

II- Intégrité scientifique, confiance et objectivité scientifique

❖ Moins minimalement... Produire de la bonne science, c'est produire des résultats *objectifs et non biasés,* c'est-à-dire

- Valides pour tous (intersubjectivité)
- Non biaisés, c'est-à-dire non influencés par des croyances ou préférences
- Qui représentent le monde *tel qu'il est*

Sources de l’objectivité en science ?

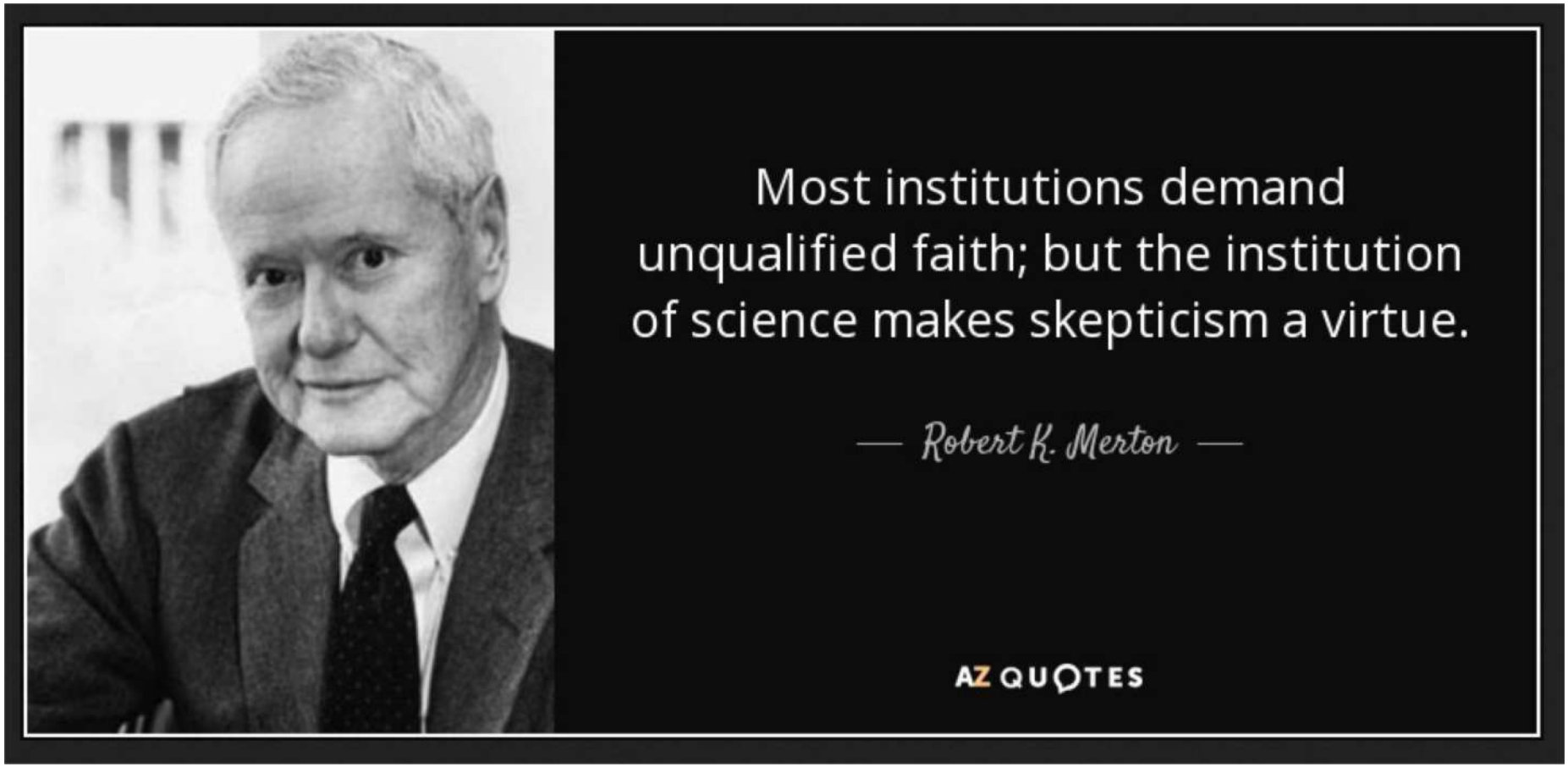
Sources de l'objectivité en science ?

"Usual suspects":

- ❑ Attitude individuelle du chercheur
- ❑ La méthode scientifique (justification empirique)
- ❑ Vue sociale de l'objectivité scientifique

Vue sociale de l’objectivité

- **Robert Merton (1910-2003)**

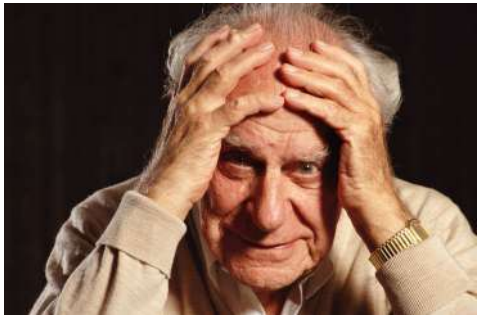


Vue sociale de l'objectivité

◆ **Robert Merton (*The Normative Structure of Science*, 1942)**

- **Communism** – the common ownership of scientific discoveries, according to which scientists give up intellectual property 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;
- **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.

Vue sociale de l'objectivité



« Assez paradoxalement, l'objectivité est étroitement liée au caractère social de la méthode scientifique, du fait que la science et l'objectivité scientifique ne résultent pas (et ne peuvent résulter) des tentatives d'un savant individuel pour être « objectif », mais de la coopération amicalement-hostile de nombreux savants. L'objectivité peut être décrite comme l'intersubjectivité de la méthode scientifique »

(Karl Popper, 1945)

Vue sociale de l'objectivité

« Une vérité qui a subi l'épreuve de la discussion dans un champ où des intérêts antagonistes, voire des stratégies de pouvoir opposées, se sont affrontés à son propos, n'est en rien affecté par le fait que ceux qui avaient intérêt à la découvrir. ... Si la vérité se présente comme transcendante ... c'est parce qu'elle est le produit d'une validation collective accomplie dans les conditions tout à fait singulière qui caractérisent le champ scientifique, c'est-à-dire dans et par la coopération conflictuelle mais réglée que la concurrence impose et qui est capable d'imposer le dépassement des intérêts antagonistes et, le cas échéant, l'effacement de toutes les marques liées aux conditions particulières de son émergence »

Bourdieu, *Science de la science et réflexivité*, 2001

- Social view of scientific objectivity gives scientists special responsibilities as regards:

  - Proper functioning of “organized skepticism”

  - Inclusiveness: the more diversity you get in scientific communities, the more efficient “organized skepticism” will be

III - Responsabilités en matière d’impacts sur la société ?

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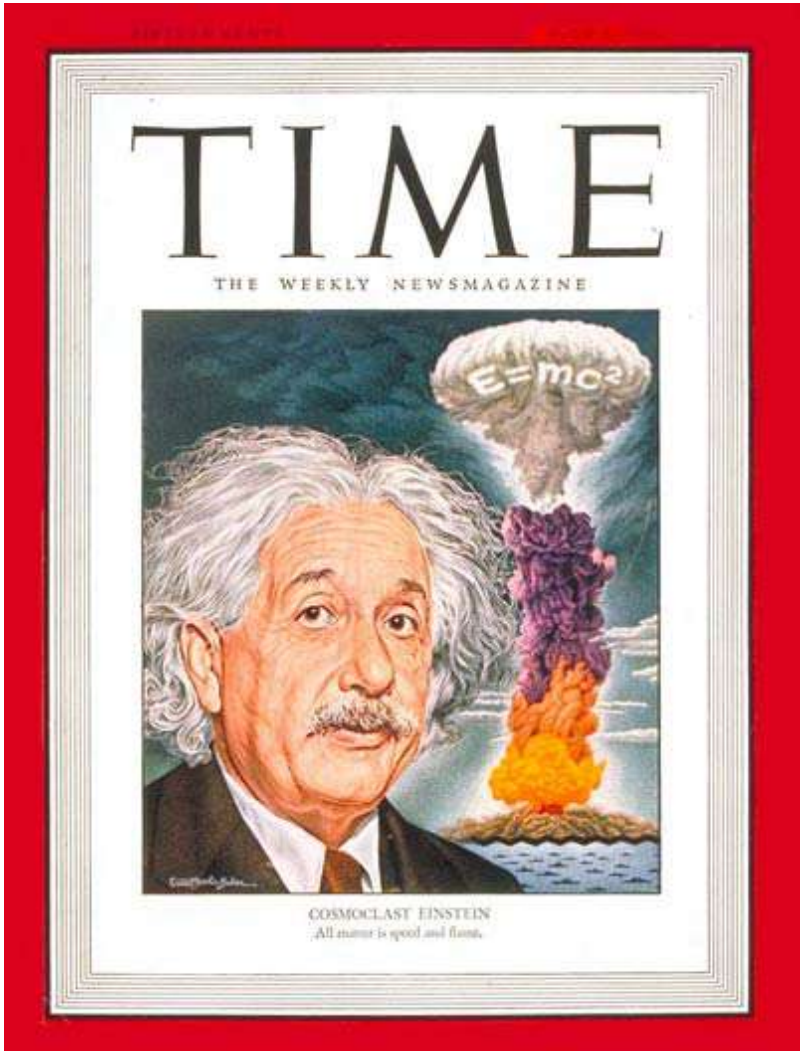
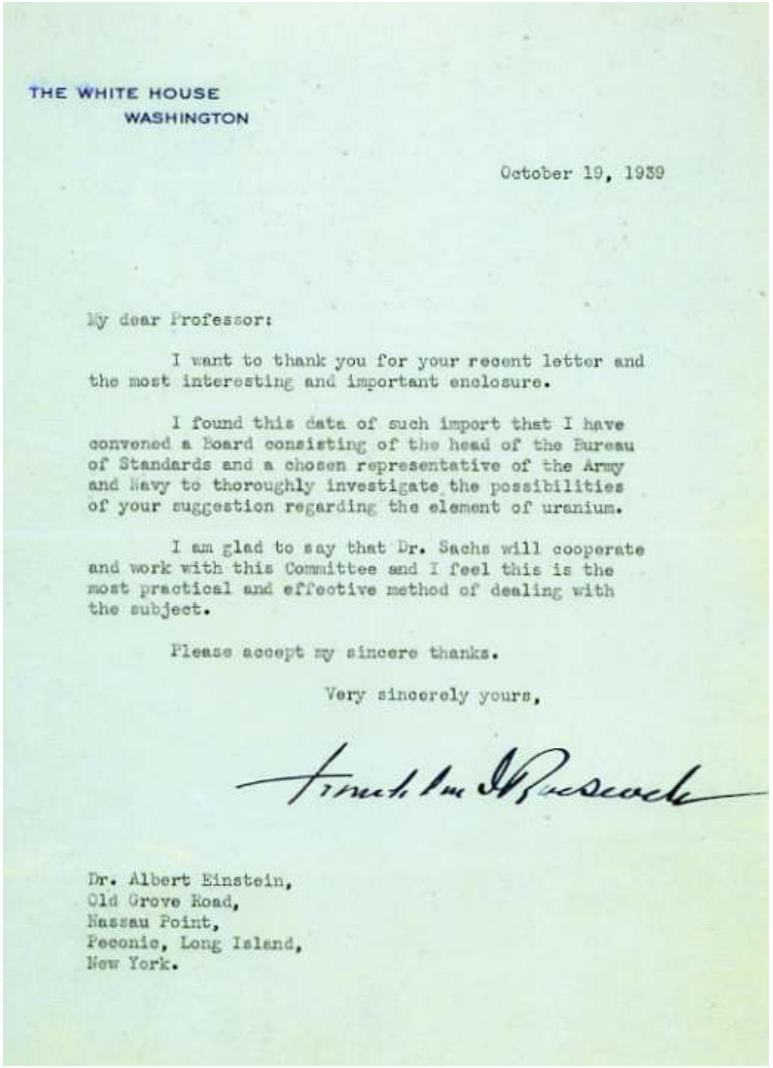
❖ La question a commencé à sérieusement se poser... :

III – Responsabilité en matière d'impacts sur la société ?





THE WHITE HOUSE
WASHINGTON

October 19, 1939

My dear Professor:

I want to thank you for your recent letter and the most interesting and important enclosure.

I found this data of such import that I have convened a Board consisting of the head of the Bureau of Standards and a chosen representative of the Army and Navy to thoroughly investigate the possibilities of your suggestion regarding the element of uranium.

I am glad to say that Dr. Sachs will cooperate and work with this Committee and I feel this is the most practical and effective method of dealing with the subject.

Please accept my sincere thanks.

Very sincerely yours,

Franklin D. Roosevelt

Dr. Albert Einstein,
Old Grove Road,
Nassau Point,
Peconic, Long Island,
New York.

II – Responsabilité en matière d'impacts sur la société ?

❖ <u>Arguments pour une réponse négative</u>:

La science est neutre !

La production de connaissances doit être maintenue séparée de ses applications

« When the rockets go up, who cares where they come down?

That's not my department, says Werner von Braun. »

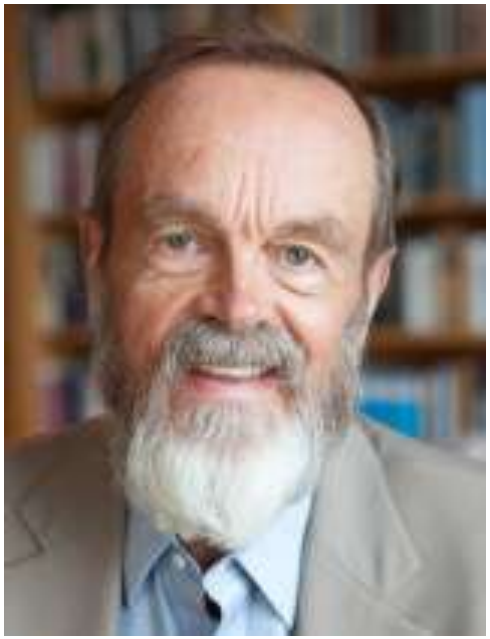
Tom Lehrer

II – Responsabilité en matière d'impacts sur la société ?

"Let's be enthusiastic for science again. It can bring us a lot of things. Distrust is often justified but of the interface between men and science. Not of science itself, **which is neutral**."

Nobel prize winner Jules Hoffman

III – Responsabilité en matière d'impacts sur la société ?



"The sciences seek to establish truths about nature. How the resultant knowledge is used is a matter for moral, social, and political debate, but it is intrinsically valuable for us to gain knowledge. If the circumstances in which knowledge is applied are likely to generate harmful consequences, then that is a sign of defects in the social milieu that surrounds the sciences"

Philip Kitcher, *Science, Truth and Democracy*

- **Cette séparation est-elle valide ?**

Un exemple de graphe de signification

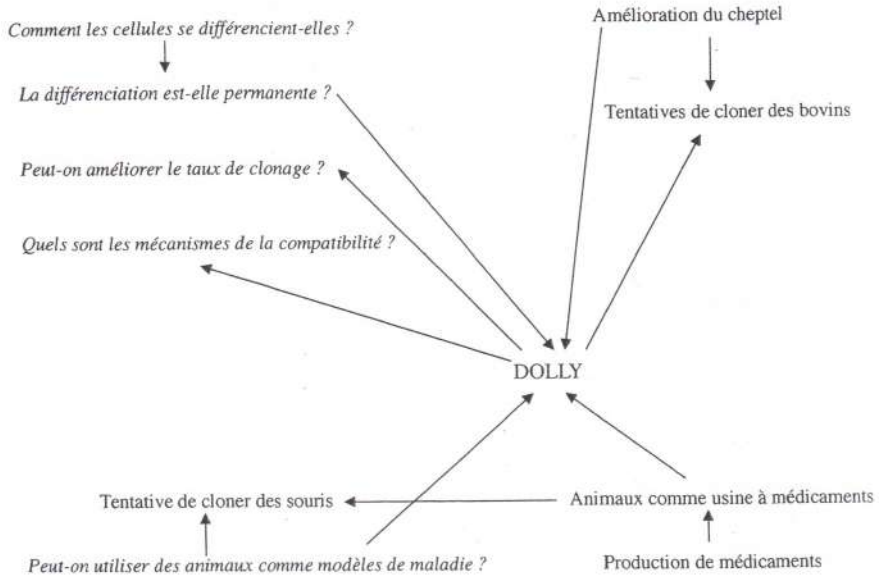


Figure 2. Une représentation de l'enquête scientifique centrée sur Dolly

Extrait de Science, vérité et démocratie de P. Kitcher (PUF, 2010)

III – Responsabilité en matière d'impacts sur la société ?

❖ <u>Difficultés/interrogations soulevées par une réponse positive</u>

➢ Problèmes soulevés par l'évaluation morale de cet impact. Qui doit le faire ? + Absence de consensus

Exemples: *geo-engineering*, nanotechnologies, nucléaire, recherche sur le QI, etc.

III – Responsabilité en matière d'impacts sur la société ?

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Exemples: *geo-engineering,* nanotechnologies, nucléaire, recherche sur le QI, etc.

➢ *Qui* au juste est responsable?

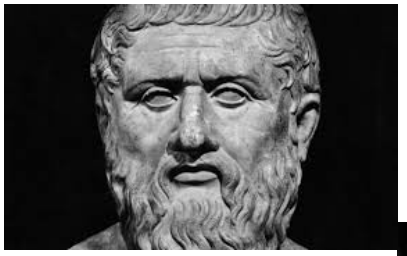
Le chercheur individuel, la communauté, les bailleurs de fond, les décideurs politiques ?

IV- Responsabilités des chercheurs dans le choix des priorités de la recherche

Quels objectifs pour la recherche ?

- Mise en perspective historique : deux conceptions des objectifs de la science

Désintéressée



Utilitariste

Vannevar Bush

« Le progrès scientifique est une clef essentielle de notre sécurité en tant que nation, de l'amélioration de notre santé, de l'augmentation du nombre d'emplois, d'un niveau de vie plus élevé, et de notre progrès culturel. »

Science, The Endless Frontier, 1945

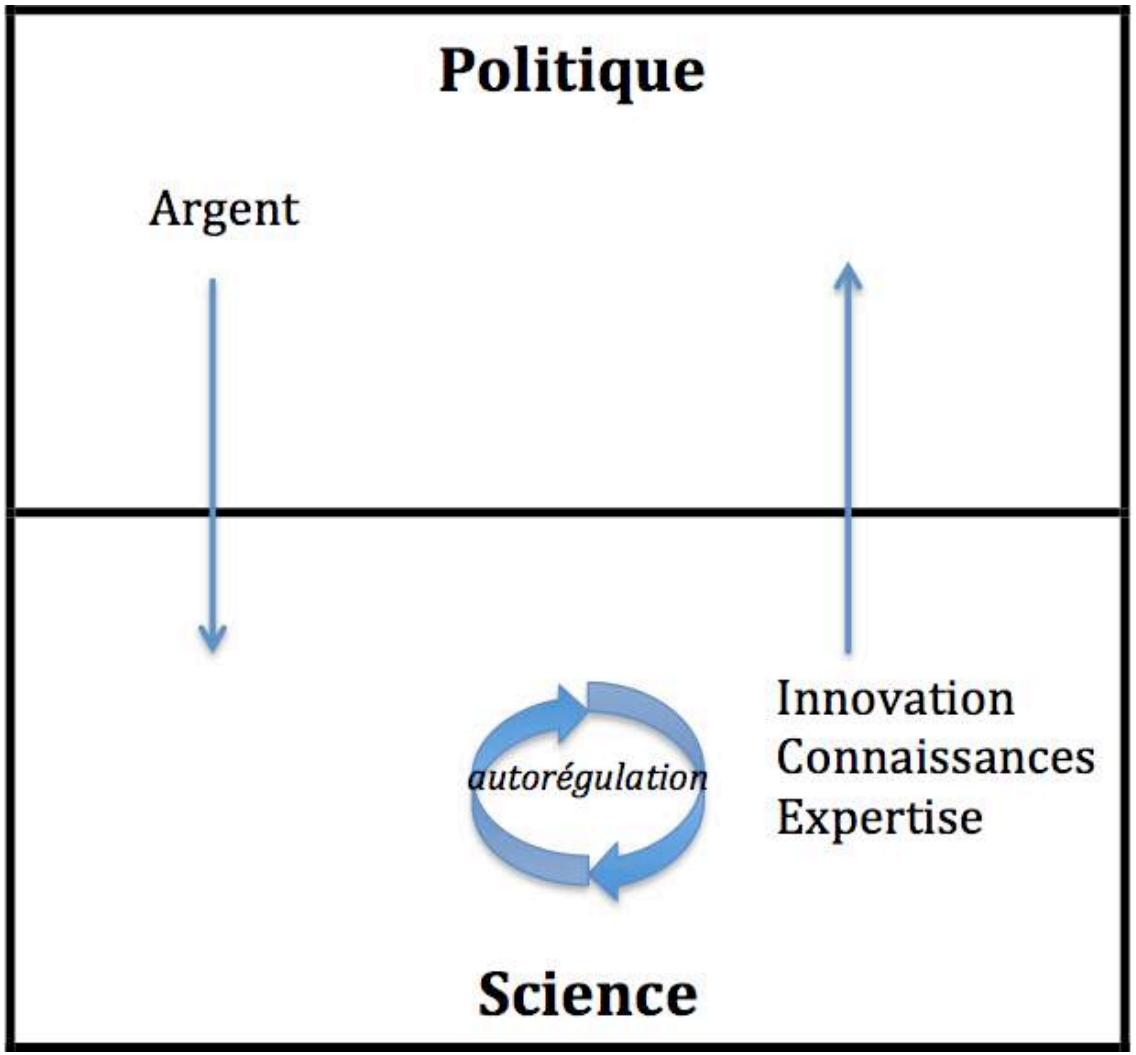
Il était une fois... L'autonomie comme condition de l'utilité

Vannevar Bush

«Le progrès scientifique résulte du jeu libre des esprits qui travaillent sur des sujets de leur propre choix, guidés par leur curiosité à explorer l'inconnu. **La liberté de recherche doit être préservée dans toute forme de soutien gouvernemental de la science**. »

Science, The Endless Frontier, 1945

Modèle en cascade (ou modèle linéaire) du contrat social de la science



Adapté de D. H. Guston, *Between Politics and Science*, 2000.

« Beyond the science bubble », *Nature*, février 2017

THIS WEEK

EDITORIALS

SPACE Battle of the planets could see a new moon p.202

WORLD VIEW Energy scientists must show their workings p.203

OPTICS Semiconductor camera has eagle-eyed vision p.205

Beyond the science bubble

Research leaders in the United States and elsewhere should address the needs and employment prospects of taxpayers who have seen little benefit from scientific advances.

One question dominated discussions at the annual meeting of the American Association for the Advancement of Science (AAAS) at the weekend. Researchers, journalists and science lobbyists squeezed into conference rooms, perched on recycling bins and sat on the floor between rows of filled chairs as they strained to listen to those who tried to offer a response. The question was phrased in various ways, but the variations all boiled down to: how should science and scientists respond to the administration of President Donald Trump?

The answers were numerous too — from political activism to better communication — and were met with cheers, applause and the odd standing ovation. Many scientists will have left the Boston conference with renewed hope, or at least a sense of combined purpose. They had an answer of sorts to their question.

But it's the wrong question. It is not Trump that scientists must respond to. The real question is what science can do for the people who voted for him. Exactly who did support him, and why, is still being debated by political scientists, but it's clear that many of those who voted Trump are those he canvassed in his campaign and credited in his inauguration speech. It is people who feel left behind by supposed progress and who have suffered a real or perceived collapse in their quality of life.

PERSUADING THE UNCONVINCED

One speaker at the AAAS meeting appropriately sharpened the challenge. There are two types of taxpayer: those who pay up voluntarily because they believe in the public good that the money generates, and those who pay only because they will be put in jail if they don't. How many scientists, he suggested, could confidently say their project was so important to people that those people should be thrown into prison for not supporting it?

Just telling the same old stories won't cut it. The most seductive of these stories — and certainly the one that scientists like to tell themselves and each other — is the simple narrative that investment in research feeds innovation and promotes economic growth. 'It's the economy, stupid,' as the saying goes, and as nations become a little less stupid by pushing against the frontiers of knowledge, so the benefits of all this new insight spread from the laboratory to the wider population, as improvements in the standard of living and quality of life.

This comfortable story has all the hallmarks of a bubble waiting to pop. For a start, it always has a happy ending. The hero of various quests, science slays the dragon of childhood disease and retrieves the elixir, if not of everlasting life, then at least of increased lifespan. And like all good stories, this one comes with a pleasing twist: for when it sets off on its quest, science does not know exactly which good deeds it is planning to perform. Pure of heart and research, it is merely enough to send our science hero out into the world, with its consumables, overheads and a postgraduate squire paid for by donations from a grateful and trusting public.

This narrative is truthful enough to have sustained itself for many decades. From the famous discovery of the apparently useless laser that launched uncountable applications to how Einstein's theories of relativity underpin the Global Positioning System — these stories indeed make a case to Trump and his supporters that continued investment in science will help to create companies and jobs.

But as this journal and others have pointed out, it is also clear that the needs of millions of people in the United States (and billions of people around the world) are not well enough served by the agendas and interests that drive much of modern science. There are plenty of reports that show, for example, how public investment in the Human Genome Project has paid off many times over and created firms and jobs, but rather than trickling down through society, those benefits of discovery science arguably deepen the pools of wealth and privilege already in place — creating expensive new drugs that most people cannot afford.

"The needs of millions of people in the United States are not well enough served by the agendas and interests that drive much of modern science."

It is right that more scientists should tell stories of the good their research can do. But it is more important and urgent than ever that researchers should question how those stories really end — and whether too many of the people they claim to act for don't really get to live happily ever after. Equally, they should focus more effort on how science education and scientific research can help the many whose jobs are going to be displaced by the very inventions that scientists are producing.

As they ponder their next move in response to the election of Trump, science organizations — universities, funders, supporters and the rest — should look harder at social problems and opportunities, and seek ways for science to help.

For example, some universities are increasingly engaging in climate-change adaptation. There will be employment opportunities in creating companies that help cities and other regional communities to protect themselves from climate change (whatever the sceptics may be saying), stimulated by the readily applicable and intellectually stimulating insights and improved decision-making that research will deliver.

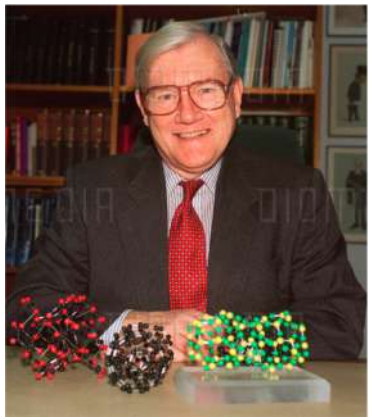
More universities, for example, could follow the example of Michigan State University in East Lansing, in building stronger links with their local communities, and seeking to work with them to tackle research problems that affect their quality of life. These include monitoring soil and water quality, for example, and addressing the challenges of regional demographics, such as the large numbers of elderly people who live alone in some regions and how to deliver health care to them.

There is also a need to tell these stories compellingly — stories that are harder to tell and of less global impact than the hunt for fundamental particles or new materials. And the most important audiences may not be inclined to listen. But those audiences matter. ■

« The needs of millions of people in the United States are not well enough served by the agenda and interests that drive much of modern science »

« Just telling the same old stories won't cut it. The most seductive of these stories – and certainly the one that scientists like to tell themselves and each other – is the simple narrative that investment in research feeds innovation and promotes economic growth"

➢ **Pilotage thématique de la recherche**



“The nature of all politics and politicians means it is easier for our pay-masters to feel comfortable about the proclaiming of programmes relating to Energy, Health, Materials, Climate Change, the Hydrogen Economy and so on, rather than to announce, let alone trumpet, that money is available for scientists to follow their curiosity in their own disciplines”

Sir J. Cadogan (dans un manifeste signé par 41 membres de la Royal Society, 2014)

« Jamais une découverte scientifique n'a été obtenue en tentant de résoudre un problème social urgent et ce n'est pas par hasard (…). La science ne peut fonctionner qu'en élaborant elle-même ses propres questions, à l'abris de l'urgence et de la déformation inhérente aux contingences économiques et sociales. C'est à ce prix, en passant par des détours parfois surprenants, que certaines questions peuvent, souvent après de multiples re-formulations, être en partie résolues. L'électricité n'a pas été inventée en cherchant à perfectionner les bougies. »

Les états généraux de la recherche 2004

« Je qualifierais de Lyssenkisme rampant l'incitation permanente, à travers les programmes déclinés en questions sociétales, à mobiliser les savants autour de grandes causes industrielles ou humanitaires (…). Un certain nombre d'exemples démontrent à l'envie que les découvertes récentes les plus porteuses d'espoir pour la médecine ont été faites dans un esprit de **pure curiosité** cognitive (…). Citons notamment le phénomène d'**interférence à ARN**, mis en évidence à partir d'expériences sur la couleur des pétales des pétunias »

A. Prochiantz (Administrateur du Collège de France), colloque de rentrée 2013 du Collège de France (Science et Démocratie)

❖ Epistemological resistance: the “unpredictability” argument

- Unpredictability is valued as the hallmark of pioneering, creative research: major discoveries – or so the story goes - are often unplanned ones, which then open whole new domains of inquiry

- The orientation of the inquiry by external* considerations is deemed epistemically counter-productive and vain: one should not attempt to predict the unpredictable

    - But the “unpredictability argument” is not sound from an epistemological point of view (see Bedessem and Ruphy 2019)

* External consideration: utility in light of the needs and concerns, both practical and epistemic, of society (by contrast with questions *internal* to the dynamics of a scientific inquiry)

Produire de la science **utile**

◆ Deux conceptions historiquement en compétition sur la façon dont la science doit être gouvernée pour être utile à la société

1) **Production d'un réservoir de connaissances pour de (futures) innovations** (exemple type : le laser)
   - ➢ Science non finalisée, autonome

2) La science doit être orientée pour répondre à des besoins *spécifiques* de la société
   - ➢ Limitation de l'autonomie de la science / choix de grandes priorités ("défis" ANR / H2020 / Idex…)

« It is not that science did not deliver in so many ways over so many years, but rather that different times require different types of accountability. »

Neal Lane (ancien directeur de la *National Science Foundation*, conseiller de Bill Clinton pour la science et la technologie)

<u>Hypothèse générale à discuter :</u>

Perte d'autonomie : « revers de la médaille » d'une « société de la connaissance » où la recherche et l'innovation sont placées au coeur des projets de développements de la société ?

- Attentes beaucoup plus ciblées, plus pressantes aussi...
- Davantage de compte à rendre
- Passage d'un régime d'offre à un régime de demande

- ❖ Quid of the legitimacy of a shift of the very aims of science, toward solving targeted, exogeneous issues?

- ➢ The legitimacy of this form of limitation of scientific autonomy is **a political issue** (it is not up to scientists or for that matter to philosophers of science to decide)

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◆ Deux conceptions historiquement en compétition sur la façon dont la science doit être gouvernée pour être utile à la société

1) Production d'un réservoir de connaissances pour de (futures) innovations (*cf* V. Bush)
   - ➢ Science non finalisée, autonome

2) **La science doit être orientée pour répondre à des besoins *spécifiques* de la société**
   - ➢ Limitation de l'autonomie de la science / choix de grandes priorités ("défis" ANR / H2020 / UGA Idex…)
     - ➢ Qui doit décider de ces priorités (dans une société démocratiques) ?

Dans la vraie vie…

Conseil stratégique de la recherche

(auprès du premier ministre)

Mission: “identifier et proposer un certain nombre de grandes priorités scientifiques et technologiques afin de préparer et construire le futur de la France”

Qui est impliqué dans ces choix en matière de grandes priorités scientifiques?

- **Composition du *Conseil stratégique de la recherche*** (26 membres)

  - Majorité de très éminents chercheurs (surtout des sciences de la nature)
  - Quelques représentants de grandes compagnies (Orange, Total, EADS, etc.)
  - Trois élus

  Et… une romancière, Marie Darrieussecq (represente les citoyens?)

Conseil stratégique de la recherche

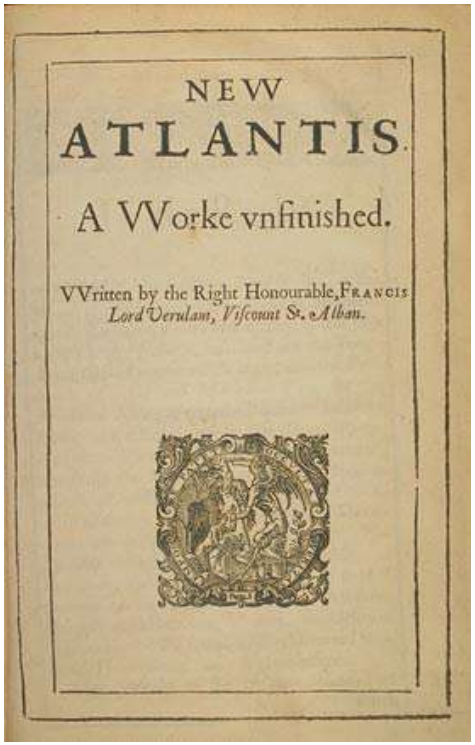
Cette composition est-elle satisfaisante ?

- Rappel sur les objectifs de la science: à l'origine d'innovations attendues par la société et qui répondent à des demandes sociales, pas seulement produire de nouvelles connaissances.

  - Les scientifiques sont-ils légitimes pour définir ces besoins ? (option élitisme épistémique)

Option « élitisme savant non égoiste » : la maison de Salomon de Francis Bacon (1627)

- Premier rapport de politique scientifique : plan d'une organisation sociale et institutionnelle de la science


NEW
ATLANTIS.
A VVorke vnfinished.
VVritten by the Right Honourable, FRANCIS
Lord Verulam, Viscount St. Alban.

Un groupe restreint d'individus (les scientifiques) est en mesure de définir ce qui, objectivement, est dans l'intérêt de tous en matière de développements scientifiques et technologiques.

- Forme "d'élitisme savant non égoïste" qui est loin d'avoir disparu…

Conseil stratégique de la recherche

Cette composition est-elle satisfaisante ?

- Les scientifiques sont-ils légitimes pour définir ces besoins ?
  - **Le modèle de Francis Bacon est-il encore tenable dans nos sociétés *démocratiques* ?**

- **Alternatives plus démocratiques:**
  - L'option "Leave it to the market" ?
  - Nos représentants élus ?
  - Quid des citoyens ?

- Arguments en faveur d'une implication des citoyens dans la définition des grandes priorités scientifiques et technologiques:

  - Les citoyens sont affectés dans leur vie quotidienne par les développements scientifiques et technologiques (tests génétiques, nanotechnologies, OGM, etc.)

  - La recherche est (au moins partiellement) financée par leur argent (impôts)

    - **Les citoyens n'ont-ils pas leur mot à dire ?**

L’option d’une participation directe des citoyens dans la définition des grandes priorités de la recherche est-elle satisfaisante ?

Comparaisons option représentants élus / participation *directe* des citoyens ?

❖ Cons (représentants élus)

- Le “temps politique” incompatible avec le temps de recherche
- Les politiques scientifiques ne font pas vraiment partie des programmes politiques sur lesquels les citoyens votent
- Danger de la “tyrannie de l’ignorant” (de meilleurs téléphones portables et de la recherche contre le cancer)

❖ Cons (participation directe des citoyens)

- Le spectre de la “tyrannie de l’ignorant” (?)
- Manque de représentativité politique des citoyens impliqués
- Manque d’intégrabilité dans nos systèmes existants de démocratie *représentative*.

➢ Quel rôle pour le chercheur ?

Merci