COMETS
CNRS Ethics Committee

OPINION n°2018-37

« WHAT NEW RESPONSIBILITIES DO RESEARCHERS HAVE AT THIS TIME OF DEBATE OVER POST-TRUTH ? »

Approved at the plenary session of 12 april 2018

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This Opinion reflects the deliberations of COMETS in March 2018 on a topical issue likely to be subject to reorientations in the coming weeks, particularly in the light of planned legislation. The opinion of COMETS as it stands does not prejudge any future modifications.

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I. AUTO- FORMAL INTERNAL REQUEST

Post-truth, alternative truth and fake news are terms that are increasingly present in the public debate, yet have emerged only recently in the vocabulary of certain politicians and media. Being founded on opinions and beliefs, they oppose the truth to which scientific reasoning refers.

Whether talking about a deliberate determination to query scientific facts for economic, political, ideological or religious motives, or whether qualifying an assumed indifference with respect to facts and criteria of truth relegated far behind the efficiency of opinions and discourse, this new “post-truth’ era which we are considered to have entered necessarily concerns researchers. What does this all mean for them? Should this new situation not lead them to be more careful about how their findings are interpreted among the general public? What attitude should they adopt when asserting their arguments so as to avoid arrogance? What are the most appropriate ways that a researcher can intervene on the public stage? What new challenges linked to the ethics of controversy, the upholding of trust, the new relations between politics and science, or the challenges of effective scientific communication, does this new cultural context raise?

In a world where scientific truth may be twisted by alternative studies initiated by 'merchants of doubt’, where the very notion of truth sometimes no longer appears relevant to political debates nor a necessary foundation for civic controversies, and where mistrust of the bodies entrusted with scientific authority spreads by taking advantage of the impact of social networks, what new responsibilities are emerging for scientists to shoulder?

II. ANALYSIS

A. Introduction: Science and post-truth – current status of the issue for the research community

1. A favoured arena for 'merchants of doubt'

It has long been known that science is a favourite stomping ground of doubt-mongers[1]. Remember the old, yet still topical, 'debates' over the toxicity of tobacco[2]. More recent ones on climate-change scenarios or the impact of endocrine disruptors[3] testify to the **deliberate obfuscation of the challenges, and distortion of scientific evidence by players funded by certain industries**. It is common to see industrial lobbies in the United States or Europe leverage the work of scientists that they themselves have funded in order to influence the public policies pursued by executive bodies. This is how untruths about perfectly well-established scientific facts, such as the human origin of climate change, have been able to take root. This untruth has potentially long-lasting and irreversible consequences, the first of which in the United States is the deregulation of the exploitation of fossil energy sources such as coal and shale gas.

Yet the battles of disinformation that are waged over public opinion are not always initiated by lobbies defending industrial interests. Scientists are increasingly faced with, and sometimes even give way to, **religious or ideological interests that seek to leave their mark on established scientific truth**.

2. Religious or ideological lobbies

Certain religious or ideological pressure groups may thus strive to widely publicise the work of self-proclaimed experts despite the fact that the scientific value of this work has never been recognised within the scientific community. Religious lobbying against proven scientific realities, such as the theory of evolution (called into question by different fundamentalist currents, from radical Islam to evangelical movements), is likely to have consequences on education and the transmission of knowledge to future generations, with the risk of a real impact on the budgets allocated to research in sectors such as life and health sciences, palaeontology or archaeology. The threats posed by the ingress of ideologies and beliefs into whole fields of human sciences are not always sufficiently recognised as such. There are also forms of ideological lobbying that distort scientific findings to promote a cause. According to local historical, political, economic or cultural conditions, the polemic being fuelled about scientific findings may or may not have a wide impact. This is the case, for instance, for GMOs in Europe or global warming in the United States. There are also pressure groups which, for various reasons that are not always rational, oppose vaccination. By stoking unwarranted fears, they may lead to a significant decline in vaccination coverage in major industrialised countries, with serious consequences on public health.

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[1] *N. Oreskes and E. M. Conway, Merchants of Doubt, 2010, Bloomsbury Press,*
[2] *Robert Proctor, Golden Holocaust, Origins of the Cigarette Catastrophe and the Case for Abolition, University of California Press, 2012*
[3] *See, for example: S.Horel, Intoxication, Paris, La Découverte, 2015*

3. Threats to science

There are many approaches from different origins that represent a threat to the scientific knowledge that could stand against vested interests, whether these be economic, political, ideological/moral or religious, to the detriment of the public interest.

In the United States, the threats became much clearer at the time of President Trump's election, with an American administration ready to cut grants to scientific organisations with which it was displeased—particularly in the field of the environment—or delete data from the servers of federal bodies that could have been used to argue against planned public policies. The depth and breadth of political opposition to science has in turn caused an unprecedented engagement among scientists[4]. The reaction of the international scientific community was unanimously expressed through the **March for Science** on 22 April 2017, a response to the stance taken through policies that are not founded on rational arguments or are driven by the pressure of industrial lobbies and the denial of scientific findings. The March for Science thus initiated a movement by inviting researchers to assert their engagement in order to defend scientific values, and even enter a political arena unfamiliar to many.

4. Fake news, social networks and conspiracy theories

These threats to science are part of a broader context where instances of **'fake news' and other 'alternative facts'** are springing up everywhere in the wake of European electoral campaigns and the extremist movements accompanying them. **Spread by social networks**, but manufactured on a scale well beyond that of individuals by social stakeholders seeking above all to take advantage of the opportunities afforded by the Internet to make money[5] from the buzz generated, this fake news covers the whole range of knowledge, from local news to politics, social phenomena or highly elaborate scientific theories. Even if attempts to assess the consequences of fake news on the result of recent elections tend to play down its decisive nature[6], the impact on public opinions particularly sensitive to a 'conspiracy' world view[7] is staggering among all age and social categories, but especially among young people. While this phenomenon is surely not new, it is the change in scale or the self-assured advocacy of 'alternative facts' within the Trump administration that may have led to talk of a 'post-truth' era[8] in which reference to truth is no longer a requisite for public discourse: **even when proven erroneous, the impact remains the same because the damage has already been done**. This is a new challenge to rational debate, whose methods of communication (rebuttal and demonstration) are losing their hold among the general public in response to this kind of 'intellectual irresponsibility' that all fake news has in common[9].

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[4] Numerous articles have been written on this subject. To illustrate, we may quote an article from Science magazine published on 16 March 2017 and entitled A grim budget day for US science: analysis and reaction to Trump's plan http://www.sciencemag.org/news/2017/03/grim-budget-day-us-science-analysis-and-reaction-trumps-plan

[5] The pay-per-click method applied to such networks is a vital source of funds. This may be illustrated by the prosperous economic activity in which the small town of Veles in Macedonia has specialised: the same website could thus spread fake news alternatively on both Trump and Clinton during the US presidential campaign (Allcott, Hunt, and Matthew Gentzkow). 2017. Social Media and Fake News in the 2016 Election. Journal of Economic Perspectives, 31(2): 211-36.)

[6] Among others, Allcott et al., op. cit.

[7] See, for example Luc Boltanski, Enigmes et complots : Une enquête à propos d'enquêtes [Mysteries and conspiracies: an investigation about investigations], Paris, Gallimard, 2012

[8] The Oxford English Dictionary crowned 'post-truth' word of the year in 2016. It actually appeared in 1992 in The Nation newspaper at the time of the Watergate scandal in order to explain how Americans had become used to refusing to see bad news.

[9] Mathias Girel, interview in Libération of 24 March 2018, http://www.liberation.fr/debats/2018/03/23/il-est-artificiel-de-construire-une-classe-d-experts-qui-s-opposerait-a-la-masse-des-citoyens-ignora_1638428

5. When scientific untruths are presented as an element of debate

What can be said when 'scientists' themselves contribute to the dissemination of untruths? The recent public stances taken by two professors of medicine—Nobel Prize winner Luc Montagnier and Pr. Henri Joyeux—have thus publicised scientific untruths whose impact on health may be particularly disastrous[10]. Climatologists experienced a similar situation when Earth science researchers, who were not climate experts, monopolised the media to deny the role of human activity in climate change[11].

6. Antidotes needed but inefficient against the proliferation of fake news

While traditional, 'serious' media may also help fuel scientific disinformation through catchy headlines and coverage of scientific subjects biased by buzz, they have nonetheless taken stock of the risk that the scale of post-truth phenomena is bringing to bear on their very purpose. This is why, in response to something that directly calls into question their business model, major media now use **fact-checking systems,** often automated models based on algorithms capable of filtering online information deemed reliable. Yet this is an extremely limited antidote that can only address a public still attached to 'truth value'[12]: only that part of the public persuaded by a conspiracy discourse but open to rational argument may be thus convinced to return to reason.

Furthermore, while obviously necessary, the denunciation of fake news may easily backfire, becoming a weapon for fake news creators to turn against their detractors: the most authoritarian leaders around the globe now qualify as fake news any information critical of their regime on the basis of the 'legitimacy' given by Trump to the use of this concept right from the start of his presidency. Accusations against the media are facilitated because purportedly reliable sources are not always error-free, a situation readily exploited by those behind fake news. **Indeed, the term 'fake news' is now more commonly used as a weapon with which to attack the press than as a rational argument against conspiracy theories**.

The difficulties peculiar to this concept of fake news should not, however, be either neglected or reduced to an issue of 'disinformation' that may be handled in its entirety through technological solutions. Yet this is the approach apparently favoured by the report funded by the European Community's CONNECT division[13], which defines disinformation as "all forms of false, inaccurate, or misleading information designed, presented and promoted to intentionally cause public harm or for profit"[14]. A whole range of scientific fake news made

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[10] See the press release common to the National Academy of Medicine and the National Academy of Pharmacy, which both denounce the 'deviation' of one of their members: "The National Academy of Medicine and the National Academy of Pharmacy have long been committed to vaccination, a practice disputed by certain currents of opinion despite its effectiveness and safety having been scientifically proven. At a time when public authorities have taken a much-needed and courageous decision to strengthen vaccination coverage in France, Professors Luc Montagnier and Henri Joyeux spoke during a press conference on 7 November 2017. The remarks they made, which are bound to lead to confusion among the parents of young children, are unfounded and must be refuted. The National Academies of Medicine and Pharmacy emphasise the emotional nature of the facts reported and strongly object to the statements made, that have absolutely no scientific foundation." (Translated from the original French). http://www.academie-medecine.fr/communique-commun-des-academies-de-medecine-et-de-pharmacie-sur-les-propos-de-luc-montagnier-sur-les-vaccinations/

[11] See French climate farce in Nature, 2010: http://blogs.nature.com/news/2010/10/french_climate_farce.html

[12] See, for example: https://www.euroscientist.com/combating-fake-news-science/

[13] A multi-dimensional approach to disinformation — Report of the independent High level Group on fake news and online disinformation, Directorate-General for Communication Networks, Content and Technology, March 2018, ec.europa.eu/newsroom/dae/document.cfm?doc_id=50271

[14] "The analysis presented in this Report starts from a shared understanding of disinformation as a phenomenon that goes well beyond the term 'fake news'. This term has been appropriated and used misleadingly by powerful actors to dismiss coverage

up of rumours, misunderstood or poorly reformulated information, scientifically unfounded or insufficiently founded concerns widely disseminated by social networks, is thus not covered by this definition, which reduces fake news to intentional disinformation, while it may cause devastating damage that requires our full attention and responsiveness. In fact, while this report is right to insist on the need to involve all players and stakeholders in deliberations on how to detect and prevent fake news, assimilating fake news and disinformation leads this group of experts to propose mainly technological solutions based on the **promotion of transparency** and the **implementation of automated fact-checking systems**. It must be said that the representatives of industry participating in this study group—which included representatives of Google, Twitter and Facebook—benefit twofold from the analysis to which they contributed. Firstly, it enables them to evade their responsibilities in the spread of false rumours, a responsibility that is related to a pay-per-click **business model** and consequently the encouragement of clickbait, an issue that the report does not address. Secondly, it provides new opportunities for technological development that they are asking the European Community to fund, and academics to support.

7. Debate within the research community and communication of science in the public realm

As far as scientific information is concerned, the hunt for rigged evidence and filtering of false information is generally efficient *within the research community*, even though researchers themselves are not infallible. But the real question is to know whether the verification criteria that prove to be effective among researchers can mean anything to the general public and protect them.

It is often difficult for scientific communication addressing the general public to repair the damage to the perception of scientific challenges caused by citizens and decision-makers. Once distrust, doubt and deliberate obfuscation of risks have taken root in public opinion, the rational argumentation of mediation efforts and science popularisation sometimes bears no weight. One of the vital challenges for this deliberation over researchers' responsibilities in a post-truth context thus involves ways of making scientific communication more efficient in the public realm.

Social networks and blogs are also booming within the research community. Initially designed as a platform for discussing published research, PubPeer[15] has already proven its effectiveness in hunting down mistakes, scientific misconduct and fraud. By their acceptance of anonymity, post-publication peer reviews have helped shed light on the limitations of institutional certification procedures. Yet, paradoxically, this internal strength of science—self-criticism, transparency and self-correction—may fuel attacks against science[16] and with them, the risk of malicious intent and slander.

In a world where scientific truth may be distorted by alternative research initiated by merchants of doubt, where the relevance of the very notion of truth sometime appears to be swept aside to benefit a discourse or assertions that are more efficient in influencing public opinion, and where mistrust disseminates through the power of social networks, what new responsibilities do scientists and researchers have to shoulder? What does this debate over the 'post-truth' era imply for us?

Our considerations will focus on three sets of questions:

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that is simply found disagreeable. Disinformation as defined in this Report includes all forms of false, inaccurate, or misleading information designed, presented and promoted to intentionally cause public harm or for profit."

[15] https://pubpeer.com/

[16] Joseph Hilgard and Kathleen Hall Jamieson, Science as 'Broken' Versus Science as 'Self-Correcting': How Retractions and Peer-Review Problems Are Exploited to Attack Science, in Hall Jamieson et al. (eds), op. cit.

1. **How may we clarify and better delineate the area of legitimate controversy?**
2. **How may our insights bring a clearer understanding of the relationship between science and politics?**
3. **How may we restore the general public's confidence in science and equip ourselves so as to be more effective in our external communication?**

B. What is a scientific controversy?

1. Scientific controversies and 'alternative' knowledge

Let us recall that a real scientific controversy stems from disagreement between honest scientists driven by a sincere determination to reach the truth. The dispute may be over a scientific theory, the meaning of scientific theories, the interpretation of experimental facts or of observations, or the history of science and the first people to make certain discoveries. Once the terms of the dispute have been laid out, the scientists then try to resolve their disagreement through adversarial debates putting forward rational arguments founded on tangible facts and reliable evidence. Alongside the 'learned ignorance' formulated by researchers[17], scientific controversies have been the driving force behind scientific advances, and their positive role must not be overlooked.
In the case of 'alternative' knowledge used to fuel false controversies, untrustworthy 'facts' are alleged during one-way debates leaving no room for honest argumentation. 'Alternative' knowledge does not face up to scientific knowledge, but instead contradicts, denies or rejects it, making assertions without leaving any room for doubt, as if science could be reduced to a simple concurrence of contradictory opinions[18].

The proliferation of 'alternative' information and knowledge is problematic for both science and democracy. These 'alternative' proposals are most often found in life and health sciences, disciplines which—due to the multiplicity and variability of the parameters involved—may be subject to biased or improper interpretations[19], but are also found in physical sciences (e.g. the black hole about to swallow the Earth because of CERN experiments, the characteristics of 'chemtrails' left by aircraft[20], etc.), and social sciences. They often wrongly use the precautionary principle to stir up irrational fear among a population overwhelmed by its misunderstanding of the actual scientific phenomena implicated. Among these merchants of doubt, we are well aware of the power of industrial lobbyists; others have an ideological, moral or religious agenda; while still others spread ideas liberally across the worldwide web to make a fortune by surfing on the logic of the Internet and its 'buzz' factor.

It is rare in a liberal democracy that political leaders directly contradict scientifically-established facts. Most of the time, even politico-industrial lobbies do not avoid referring to scientific truth but manipulate it, distorting evidence or the interpretation of data, and funding 'alternative' research that may then benefit not only from

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[17] *See Mathias Girel, Science et Territoires de l'ignorance [Science and the Realms of Ignorance]. Ed. Quae, 2018.*
[18] *See Gérald Bronner La démocratie des crédules [The democracy of the gullible], Paris, PUF, 2013*
[19] *Nature, 1,500 scientists lift the lid on reproducibility, M. Baker, 2016, 533, 452-454*
[20] *Virulent activist associations are convinced that governments are trying to control the climate and human health by spreading chemical substances in the air. This fake news has been denounced on numerous occasions. http://observers.france24.com/fr/20170921-chemtrails-theorie-complot-avions-poison-meteo-aviation-intox*

an overvaluation compounded by social networks, but also from the aura surrounding scientific doubt and the current value attributed to any approach claiming to be 'heterodox' or 'anti-system'[21].

2. From the heart of the scientific community to its interface with the general public

How do scientists handle within their own ranks not only the attacks by fake scientific news and attempts to disseminate controlled disinformation, but also the emergence of ideological opinions claiming to be scientific? How can and should they act in public in response to operations that damage their credibility, generate controversy, or challenge policies, and in response to the influence of imposters on public opinion? These are two different levels of questioning. The first focuses on the relationship to truth and doubt within the scientific community, and the second on the interface between science and the public, both of which may appear linked through the concept of 'controversy'. The word 'controversy', however, has different meanings: it may refer to a scientific debate between qualified researchers, to the perception of this disagreement in the media, social networks and the general public (with the risk of misunderstanding inherent to popularisation), or even to the artificial construction in the general public of dissenting opinions based on scientific evidence that has been manipulated. Insofar as the issues discussed in society are often fuelled by pseudo-scientific arguments, it is important to ensure that what really does come from scientists is clearly explained to the general public. Encouraging and developing deliberations on a few examples of scientific policy controversies could help develop a methodology for combating the influence of imposters on public opinion.

While most of the attacks on scientific knowledge that conflict with certain immediate interests come from outside the recognised scientific community, and while the very notion of a 'scientific community' remains sufficiently powerful and built around shared values and methods, the problem lies in knowing how to convince the public. The example of the 'controversy' on climate change is a good illustration: the controversy actually opposes a fairly homogeneous scientific community—that of climatologists—and some well-publicised speakers from outside this discipline. In the eyes of the general public, both sides claim to use the scientific method. In actual fact, within the climatology community, there is a well-established consensus on human activity's responsibility for climate change, and only scientists from other areas of expertise outside climatology may from time to time contradict this consensus. But for the non-specialised public, both groups are scientists vested with the same authority, disagreeing with one another[22]. Beyond the intentional distortion of scientific truth—which has become rare—it is the epistemology of scientific doubt (obviously emphasised) that may be exploited to cast doubt in the political arena. The controversy has in fact moved out of the strictly scientific arena and into the political one, because it is now about climate-change forecasting models based on the impact of human activity and directly linked to the shaping of suitable public policies.

On subjects relating to public health, the public no longer considers reliance on the scientific method—claimed by all the parties involved—as a guarantee of reliability, the general public having realised that there is a competing market for scientific expert appraisals. In the area of health, it almost seems as if 'disinterested' scientific research no longer has a role to play. Mistrust is so deeply-rooted and suspicion of constant collusion between researchers, regulators and players in the pharmaceutical or agri-food industries so widespread that the boundaries are sometimes blurred between citizen mobilisations quite rightly contesting the entryism of industrial players in expert assessment bodies designed to rewrite the rules of the European regulatory game (the case, for example, concerning endocrine disruptors or glyphosate) and citizen movements that reject on principle any scientific innovation that benefits industries with considerable financial stakes.

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[21] Stephan Lewandowsky and Dorothy Bishop, Don't let transparency damage science, Nature, 2016, 529, 459.
[22] See Sylvestre Huet Les Dessous de la cacophonie climatique [The hidden face of the climate confusion] Ed. La ville brûle, 2015

Thus, the denunciation of the profits made by pharmaceutical laboratories that market vaccines further fuels the rejection of vaccination. This rejection is nothing new, and actually goes back to early research on germs: it is based on the principled opposition of those who consider mandatory vaccination as a violation of their personal freedoms, and those whose 'laissez-faire' position led them to take a stand against quarantine measures. Yet the fear of vaccination is more especially fuelled by fake news spread to damage vaccinators (in certain countries, such as Pakistan in 2014[23]), or the procedure itself for ideological reasons—vaccines being accused of trying to change the very nature of humankind. Numerous anti-vaccination movements are the fruit of fraudulent publications, as was the case of mistrust about the vaccination for measles, mumps and rubella (MMR), accused of causing autism. This rumour still persists today, despite proof of the original publication's fraudulent nature[24].

3. The value and limits of controversies - good and bad doubt

How can we recognise a true scientific controversy? This question first requires careful thought about the vocabulary, i.e. the words that may be used to talk about it, as illustrated recently: examples include 'climate sceptic', which has a positive connotation due to the value attributed to doubt; as for 'negationism', recently used to indicate economics researchers, the word usurps the deeply morally disqualifying emotional impact of historical negationism while at the same time helping to trivialise the approach of those who deny the reality of the Jewish genocide. The increasingly widespread use of this word goes as far as to include the fact of there being a controversy.

The problem with constructing 'facts' (from truth and the interpretation of data) is a long-standing epistemological debate, particularly in the social sciences[25]. Their responsibility in generalising a postmodern philosophy[26] in which 'post-truth' reigns, amply supported by cognitive and cultural relativism, has thus been questioned. Yet without going so far as that, and without entering this debate, a detour into social sciences and theories of interpretation forces us to recognise that the problem of truth in certain disciplinary fields cannot be fully solved by fact-checking methods or validation of algorithm-operated data. This is how in social sciences the postmodern trend that queries the observer's interpretative burden can erode trust in scientists[27].

How can we equip ourselves to curb 'bad doubt', the doubt that has harmful consequences in the area of public policy or individual behaviour; and how can we pass on a taste for 'good doubt', the doubt that drives science forward at each rebuttal? Scientific truth is never definitive; it never ceases to progress, though not always steadily. The driving force behind the expansion of knowledge is doubt, which fuels rigour and

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[23] See, for example http://www.lepoint.fr/monde/pakistan-deux-vaccinatrices-anti-polio-tuees-par-balles-18-01-2018-2187711_24.php or https://www.nouvelobs.com/rue89/rue89-sante/20140215.RUE2103/au-pakistan-vacciner-contre-la-polio-est-une-guerre.html

[24] The hypothesis of a link between the MMR (measles, mumps, rubella) vaccination and autism dates back to Wakefield's fraudulent article in the Lancet in 1998, retracted in 2010. This affair was brought up again recently when Wakefield was first invited by Donald Trump in January 2017, then by European MP Michèle Rivasi in February 2017, thus endorsing his views among anti-vaccine groups at the crucial moment of France's ruling to make eleven vaccines mandatory.

[25] Gérald Bronner, Le Danger Sociologique [The Sociological Danger], PUF, 2017.

[26] The postmodern philosophy designates a set of works and discourse that mostly appeared in the 1960s, especially in France (particularly those gathered together by the Americans under the label 'French Theory'). This label refers to a collection of thoughts developing a strong criticism of the tradition and rationality peculiar to Western modernity and proposing new ways of querying texts and history.

[27] See in particular James Clifford, The Predicament of Culture: Twentieth-Century Ethnography, Literature, and Art,1988 (Harvard University Press). More recently, and mainly in the discipline of anthropology, the querying of distance between the thought of the person observing and that of the person observed (Eduardo Viveiros de Castro, Métaphysiques cannibales [Cannibal metaphysics], Paris, PUF, 2012), queries the very possibility of scientific analysis.

scientific exactness, and which must continue to be exploited within research while not fuelling those who trade with it inappropriately among the general public.

Is it necessary to share with the general public the needed step of controversy between scientists, knowing that it may be misinterpreted by the public? Should every last bit of truth be shared? As scientists, should we share our ‘partial truths’, knowing that the public may make bad use of them? If we do, how far do we go? Actually, the question is probably flawed, because we live in democratic, transparent societies where the very idea of knowledge being kept among experts is no longer acceptable. We see this whenever health and safety alerts receive media coverage: the general public interpret the delay taken before this coverage as the withholding of information, and an additional proof of its rightful mistrust of the institutions and people in charge of healthcare.

The importance of controversies should not, however, be neglected. Emerging or re-emerging subjects, such as the fight against radicalisation nowadays, give rise to fruitful controversies which round out current knowledge. It must be said that the controversy over many subjects never really comes to an end, especially in human and social sciences: in religious sciences, there is ongoing controversy over essentialist and functionalist approaches; in economics, the same is true of the relative importance of what is known as ‘structural’ unemployment and ‘cyclical’ unemployment.

The boundaries between scientists affiliated to certain vested interests and scientists morally convinced of the justification of the doubt they are sowing are sometimes blurred for reasons not to do with their relation to any interests, but with their conviction: when does life begin? And consciousness? How do we recognise (and define) death? For all these subjects that stimulate sometimes heated arguments, such as abortion or removal of organs after death, is there not some point in time when the most expert scientific knowledge gives way to moral conviction?

C. Scientists and activists? Relations between politics and science

1. Social demand

Beyond researchers' quest to push back the frontiers of knowledge, they are also required to respond to precise questions raised by society. They are equally faced with a 'social demand'. When this demand steers them to advise a public decision, i.e. to shift from establishing scientific knowledge to adopting public policies meant to take it into account, can they avoid the matter?

The question should actually be formulated more radically: if the duty to counsel, and even alert, society is part of a researcher's vocation, is there not a point in time when that researcher goes further and becomes an 'activist' by defending the choice of specific public policies? Or is the 'activism' of researchers nothing more than an extension of their duty to alert others within a specific area of expertise? What then of the accountability of a scientist consulted as an expert? Should ethical or political conflicts of interest be considered in the same way as financial conflicts of interest[28]?

Dialogue with the public—as long as it aims to ensure the monitoring of scientific truths and how they are received—is one of researchers' responsibilities, and may partially justify their usefulness with respect to social demand. What we mean by mediation and strictly-controlled popularisation remains to be specified.

2. Better educate citizens and decision-makers about scientific reasoning

Because society needs to be capable of making reasoned choices, researchers should train their fellow citizens to use scientific reasoning while avoiding the argument of the expert's authority. This is more than a consensus on the 'contents of truth'; it is the sharing with the general public of a method allowing them direct access to the scientific method, which may foster a fruitful, democratic debate on public policies founded on scientific and technological advances.

This education of citizens should begin in primary and secondary schools. Initiatives designed to encourage and develop a scientific mind-set through practical exercises from an early age should be increased[29]. In secondary education (when relevant) and higher education, this scientific education of citizens would benefit from a greater focus on the history of sciences at the same time as that of basic scientific concepts. This non-purposive history of sciences would be illustrated with examples indicating the reasoning of the discoverers in order to reveal the wanderings, doubts and errors that together prompt scientific progress, instead of recounting a linear history giving a quite different impression.

Of all the ways to develop the dialogue between science and society in which researchers are invited to partake, let us recall the role of citizen science, which enables a growing fraction of the population to contribute to the collection of scientific data[30]. Through this method, participants become familiar with and take to the scientific approach. This appears to be a good means of training the public in the way scientists

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[28] *We may think of the challenges involved, for example, in bioethics, assisted suicide or surrogate motherhood.*

[29] *https://www.fondation-lamap.org/fr/page/105/principes-et-enjeux*

[30] *In this context, non-professionals collect data either passively, by wearing sensors for example, or more actively, by observing nature (e.g. birds or the stars), or even helping design experiments or demonstrate hypotheses, such as the Polymath website and mathematics blogs relayed by the French Mathematics Society. See the report on citizen science: Les sciences participatives en France, Etat des lieux, bonnes pratiques & recommandations [Citizen science in France: a review, good practices and recommendations] under the direction of François Houllier (2016)*

reason: these practices are developing quickly nowadays, even though they have different purposes and raise ethical queries[31].

Generally speaking, the need to become familiar with the scientific approach encompasses in particular people in a position of power, decision-makers and political staff, in addition to journalists who play a dual role by informing and leading public debate. The training of public decision-makers in research could also help moderate the weight of lobbies.

3. Help society make reasoned choices: expertise and alerts

Researchers must also enable people to better understand at which level their role of expert is played out. The expertise of researchers is vital for shedding light on controversies that cut across the whole of society and have a scientific component, especially when developing evidence-based public policies. However, their expert opinion is often difficult for others to accept; their conclusions may be distorted or counterbalanced by various pressures, whether economic or geopolitical[32]. On the other hand, a scientific expert assessment may be used to give scientific solidity to a dominant ideology or public policy. To avoid exposing itself to others' opinions, political leaders may be tempted to let expert groups make public decisions. In this case, the expert assessment carries more weight when the report is the fruit of a collective effort.

When in delicate situations, scientists must make known the uncertainties surrounding their assessment, make others aware of the limitations involved in interpreting statistics and probabilities, and stand apart from decision-makers, particularly in the use made of their report by the media. It should be recalled in this respect that the knowledge of scientists gives indications that help public decision-makers to make decisions, but that the scientists consulted must not themselves be held accountable for the decisions, or they may orient their assessment in one way or another according to the pressures exerted upon them or their own opinions[33]. This issue is even more important when science is not able to provide the deterministic evidence that may establish with certainty the consequences of one decision or another.

As long as they base their discourse on substantiated scientific arguments, the role of researchers in raising the alarm is particularly important in health and the environment, two areas in which it is often difficult for them to make their voices heard. It is enshrined in legislation[34] and part of the duties of researchers with respect to society. They must be constantly on the watch, for example to assess the development of resistance to certain medicines such as antimicrobials[35], the risk of including certain carcinogenic products in food packaging, or the consequences of atmospheric pollution on health. During a health crisis, they can help measure the severity of the alert, assess the context and thus avoid the political powers making disproportionate decisions. On the other hand, they can alert others to the risk of underestimating dangers (in the event of a natural disaster, for example). But how can we hear scientists when politicians must handle an online petition from users, or the intervention of famous people widely relayed by both mainstream media and social networks and, at the same time, the unpreparedness of its own agencies? The recent case of the reformulated Levothyrox medicine used to treat thyroid problems is a spectacular illustration. Without replacing dedicated public institutions, scientists should help inform the user through the most objective, rational arguments possible.

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[31] See COMETS Opinion 2015-31 of 25 June 2016, Citizen Science.
[32] Yves Bréchet and Gérald Bronner La Disqualification des experts [The Disqualification of Experts] published by Hermann, in the Public Debate (a collection from the Academy of Moral and Political Sciences), 2012
[33] See COMETS Opinion 2013-27 of 30 September 2013: Natural Risks, Assessment and Crisis Situations.
[34] See Article 20 of the French Act of 20 April 2016 on ethics and civil servants' rights and duties
[35] https://www.pasteur.fr/fr/centre-medical/fiches-maladies/resistance-aux-antibiotiques

4. Personal conviction, value conflict and ideological activism

Like any citizen, scientists may espouse a cause, but any claim relying on their status—and even more so their institution—aimed at backing up their activism on a subject even directly related to their expertise, does not exonerate them from the duty of recognising and disclosing their personal moral convictions, political leanings or religious beliefs that also come into play when making a public position statement. Of the factors that affect our shared search for truth, alongside traditional disqualifying factors such as conflicts of (financial) interest, it is necessary to point out the (largely underestimated) role of value conflicts. A healthy democratic debate on 'science and society' and related public policies must learn to recognise and better isolate these value conflicts from real scientific controversies. It would be beneficial to assess whether scientists' transparent recognition of their own ideological and moral leanings would have a positive impact on their credibility among their contacts, peers or the general public.

Societal issues leach into science and help constantly readjust its agenda, though there is a risk of exaggerating the priority to be given to certain lines of research. Social sciences are particularly vulnerable to the risk of highly ideological activists within education and research establishments confusing social or political 'controversies' with scientific controversies.

D. Trust and truth - for more effective communication

The ethics of scientific research must tackle the "relativisation of truth" (Pierre Rosanvallon) and "skeptical attacks" (Carlo Ginzburg) that are on the rise due to the Internet's ripple effect[36]. To be successful, these ethics need to be deeply rooted in the ability to discuss matters in all good faith, with full intellectual honesty and with a shared interest to pursue truth using universally-recognised tools and criteria of validity combined with a thorough approach founded on the scientific method, with its verification procedures for each discipline. It is not possible to defend the renunciation of the concept of truth due to the risk of fuelling cultural and cognitive relativism, which has already wreaked havoc in human and social sciences.

1. Fact-checking systems: necessary but inadequate

The use of automated fact-checking systems, which oscillate nowadays between simply tagging or actually censoring fake news, is already clearly inadequate to tackle the political risks of post-truth regimes. Trusting such systems to negate the influence of the main scientific disinformation or rumours on the general public is obviously unrealistic.

While it is important for research to deconstruct scientific misinformation, verification techniques have a mixed impact on the clarification of political and social controversies in order to have a sound democratic debate.

Two levels need to be distinguished:

- Within the scientific community, the widespread development of peer reviews obviously helps clear matters up within disciplines and makes for a healthier debate over scientific controversies. From this viewpoint, researchers' checking activities could be better recognised as part of their mandate and viewed more favourably: this would have the immediate effect of containing public dissemination of issues resulting directly from easily-identified scientific fraud. Scientific social networks and researchers' blogs provide a new sounding board for widespread peer reviewing[37]; they help to overcome the deficiencies and clumsiness of institutional assessment procedures. It is nonetheless true to say that anonymity here—just as elsewhere on the web—fuels questionable or ill-intentioned practices. To focus only on defamation, you only need to make an accusation to permanently tarnish the reputation of a colleague, or ruin an ongoing research project through a short-cut that avoids legitimate assessment bodies.

- Outside the scientific community, it must be said that the denunciation and deconstruction of scientific misinformation rarely achieves what it sets out to do once the public's trust has been shattered. The example of public mistrust about the vaccination for measles, mumps and rubella (MMR), which led to a drop in vaccination coverage with lethal repercussions among the population, is a reminder that all this began with a fraudulent scientific publication whose rejection by the scientific community was not enough to quiet the persistent rumour of a link between the vaccine and autism.

[36] *https://www.college-de-france.fr/site/pierre-rosanvallon/symposium-2018-02-27-09h00.htm*
[37] *See the COMETS Opinion of 5 April 2016, Discussion and moderation of scientific publications on social networks and in the media: ethical issues.*

2. The limitations of deconstruction

Generally speaking, a one-off rebuttal is rarely effective against fake news: while "it is possible to rectify, decode or deconstruct […], various observations tend to show that, while necessary, a one-off rebuttal is inadequate if not supported by the main facts, if it does not tackle the subsequent objections raised, if it does not show how the myth came into being […] it is more effective to occupy the same areas disseminating this 'information'"[38].

Furthermore, the denunciation of hidden agendas, interests or lobbies, is not enough to combat the effects of the public's mistrust of scientific discourse. It may even fuel it, just like in politics: from time to time there emerges a cynical reflex that, in the same vein as the 'they're all rotten' addressed to politicians, results in a 'they're all on the payroll' addressed to scientific experts. In an original work on debunking, two science psychologist researchers explain that what is more important than trying to attack false beliefs is to understand what people know and what they are thinking; 'how' and how strongly they think it. They point out that "debunking a myth can actually strengthen it"[39].

3. Building up public trust

Although science is still highly respected in public opinion, it may be necessary to consider the public's trust of science and scientists discipline by discipline: the researcher still benefits from a certain authority and is considered trustworthy by society[40] (in terms of credibility and competence, researchers are far more sheltered from the public's mistrust than journalists and politicians, even if they have been affected by the general mistrust of elites), but this trust has been eroded on subjects such as nuclear energy or public health, the latter being an area where the whistleblowers are often consumer associations rather than scientists, and where they raise the alarm via the media or social networks. It is vital for the scientific community to discuss what initiatives should be taken to build up this trust, to be more worthy of it, and to counter the loss of credibility of scientific discourse in response to the viral nature of rumours spread over social networks.

One of the demands made by the March for Science was to create an international, institutional and scientific opposition force with more than just an advisory capability to counter the political, economic and religious interests that creep into science. Yet can science still be seen by populations worldwide as a disinterested value shared by all and above each other's interests and moral values? In response to the cynical political discourse that says that there are only ever 'interests versus interests', is disinterested truth still a value able to stir people? Is 'scientific value', founded on the thirst for knowledge above all vested interests, still worth something among the general public?

4. Communicating more effectively

The disinterestedness of researchers cultivating the quest for truth certainly does not allow them to retreat into themselves and disengage from public affairs, nor stop communicating science to the general public.

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[38] Mathias Girel, "Ignorance stratégique et post-vérité" [Strategic ignorance and post-truth] in Raison Présente, issue no. 204, page 93 (Translated from the original French).

[39] J. Cook and S. Lewandowsky (2011), The Debunking Handbook. St. Lucia, Australia: University of Queensland. 5 November. ISBN 978-0-646-56812-6. [http://sks.to/debunk]

[40] See, for example the detailed survey carried out by IPSOS with magazines La Recherche and Le Monde in 2013 (http://www.lemonde.fr/sciences/article/2013/05/21/les-francais-confiants-dans-la-science-moins-dans-les-chercheurs_3386052_1650684.html). See too Mathias Girel, Science et Territoires de l'ignorance, [Science and the Realms of Ignorance], op. cit.

What stance can scientists take with respect to the public so that their arguments and methods of validation weigh more heavily in the balance?

Improving the communication skills of researchers—including on social networks—in order to foster more effective scientific communication is currently a task of general interest[41]. It requires communication sciences to make a specific contribution geared to national characteristics.

Research bodies are making a significant educational effort to inform the public about sensitive topical subjects. To further improve mediation between science and the public, it might be worth developing ways of helping journalists enhance coverage of scientific subjects. Although the media's coverage agenda is increasingly dictated by social networks, we must be able to rely on journalists to handle social controversies with a discerning, rational and cautious approach undergirded by scientific data. This means working alongside academies to help improve the knowledge of AJSPI[42] journalists by holding symposiums, lectures and debates, by providing them with data and by facilitating access to laboratories, etc. in addition to replying to their questions—often raised in an emergency situation—which is often difficult to do taking into account the complexity of the subjects. It should be noted that this effort should concern not only journalists working on scientific articles, but those covering societal, political or social subjects.

[41] See especially the recent report by the US National Academies of Sciences, Engineering and Medicine. 2017. Communicating Science Effectively: A Research Agenda. Washington, DC: The National Academies Press. doi: 10.17226/23674-. which looks at how science can be communicated effectively, particularly on subjects that are controversial in the public arena, and suggests allocating significant resources to this area.

[42] The AJSPI (Association des Journalistes Scientifiques et de la Presse d'Information [Association of Scientific Journalists and the Information Press]) is a very dynamic, open and lightweight structure (200 members) founded 40 years ago.

E. Conclusions

The research community can make more efforts to clarify controversies so as to make them more fruitful and less detrimental. For each subject, a better distinction should be made between the political and social controversy on the one hand and the scientific controversy per se. Increasingly frequent and structured citizen mobilisations on scientific alerts show how important it is to help citizens understand these controversies so that they can take their rightful place in the debate.

While the ability to apply a quality filter to self-proclaimed scientific ‘truths’ is currently an ethical and political challenge, it must be a priority in science education, with consequences no doubt on syllabuses and methods. The first few years of higher education, which is attracting increasing numbers of a specific age category, may offer the opportunity of teaching the ‘informed public’ to find their way around these controversies by pointing out the value of ‘good’ scientific doubt while clearly distinguishing what is a matter of assessment and what concerns opinions, beliefs or values. Earlier in the school system, insisting more on the acquisition of scientific validation methods and the acceptability criteria of the scientific approach itself, even for the assessment exercises that secondary school pupils have to carry out, would no doubt be better geared to transmitting the ideals of the scientific community to people of all levels in a post-truth era of liberal democracy.

III. RECOMMENDATIONS

Research institutions should recognise the combat against disinformation, fake news and distortion of scientific truth as a priority.

In this 'post-truth' era, researchers should not retreat but instead better assume and control their communication with the general public.

COMETS therefore recommends research institutions to:

1. encourage researchers to react in response to fake news in their respective areas of competence;
2. organise ways of tackling fake news and scientific disinformation by bringing into deliberations partners from each of the institutions concerned and media representatives;
3. invest in the communication of their results and train researchers in effective, honest and rigorous communication practices, including communication over new media;
4. better appreciate the value of the dissemination of research and well-guided scientific popularisation when assessing the scientific activity of researchers;
5. increase recognition during career supervision of researchers' checking activities when assessing the scientific findings of colleagues in order to spot mistakes and denounce fraud, which discredit research and are likely to be picked up on by manufacturers of ignorance;
6. work on consolidating the scientific training of public decision-makers by participating for example, in training modules on the scientific approach at ENA and other suitable institutions;
7. help enhance the scientific knowledge of journalists working for the press and other media by suitable means in partnership with the AJSPI, academies and journalism schools;
8. develop research on the best way of teaching the scientific method to primary and secondary school pupils, and of educating students about the history of sciences and controversies;
9. foster citizen science so as to train the public on the scientific approach and reasoning;
10. recall the role and limits of responsibility of scientific experts in the shaping of public policies and decision-making;
11. avoid ignoring the role of personal moral convictions, political leanings or religious beliefs among scientists brought into the public debate as experts and speakers;
12. recall the importance of scientists' whistleblowing role.