After the perhaps naive optimism surrounding science during the post-war period, there has been a clear backlash fuelled by widening scientific illiteracy and fears about nuclear war, environmental degradation and so on. These fears have found fertile ground in the general anti-expert, anti-establishment sentiments that have increased in the past decades, and on which several civic movements have capitalized. Nevertheless, these should certainly not be considered as backward-looking, populist movements that can be ignored. They are grounded in the economic and civilizational crisis that has been at work for some time and that has accelerated since 2008. They are motivated by a feeling that our way of life and socioeconomic system are not sustainable in their present form. They have also been fed by the manifest errors, manipulations or worse, made by the economic establishment. Suffice it to remind here that the subprime crisis of 2008 was born out of manipulations in the banking sector.

Such errors and manipulations have also been made in the domains of medicine and life sciences. Remember thalidomide, certified at the time to be harmless by Grünenthal, the firm that developed it. Remember the manipulations by the tobacco industry to promote smoking, knowingly hiding the link between smoking and lung cancer, and using willing scientists to testify to the innocuous character of smoking [2]. More recently, and on a smaller scale, there has been the Mediator drug scandal in France, where an amphetamine-derivative, supposed to be prescribed as an anti-diabetic, seems to have been used to promote weight-loss by people who contracted sometimes fatal pulmonary diseases as a consequence.

The mistrust of some anti-GMO movements towards the GMO industry should be seen in the light of these antecedents. It is certainly true that some of their objections are ideological and that their supporters often have only a superficial understanding of genetics and the way science is conducted, as illustrated by the destruction of experimental crops mentioned by Kuntz. On the other hand, the other side has also made errors, if not worse, as illustrated by the fact that evaluations of the risk of GMOs are mostly on the basis of studies conducted by the GMO industry itself. Manifest conflict of interest statements are also periodically surfacing, such as in the case of D. Bánáti, Chair of the European Food Safety Authority, who had to resign earlier this year when it was disclosed that she was closely linked to the GMO industry, or

when it appeared that the organism setting the standards to establish the harmless nature of neonicotinoid pesticides for bees (ICPBR) was sponsored by the makers of these neonicotinoids, who also participated in establishing the safety standards [3].

Of course, an apparent conflict of interest is not a proof of actual misbehaviour. But it can, together with the absence of independent evaluations, feed suspicions and explain the present allure of anti-GMO movements. Moreover, this antagonism, given the generalized suspicion of the public towards experts and the establishment, can lead to further tensions and the rejection of reasonable advances. The solution to avoid this and possible future scandals similar to what the tobacco industry faced, is clearly not to dismiss these movements as obscurantist and postmodernist anti-science movements, as suggested by Kuntz. Instead, they have to be heard for what they are—a genuine concern of the lay public that GMOs are a potential threat for biodiversity and human health, given that their harmless nature is not perceived to be established beyond doubt. Moreover, GMOs are often seen as being developed mainly to increase the profit of industry, rather than for the common good, which obviously does not increase their acceptability. The ambiguous treatment of these concerns by the industry, regulatory bodies, experts and politicians who balance between open disdain and acknowledgment does not contribute to persuading

these opponents. In fact, the only way to alleviate these concerns, and thereby make GMOs socially acceptable, is to have independent studies of their safety with publication of the resulting data and regulatory agencies that give no reason to suspect any conflict of interest.

The recent publicized data by the French toxicologist G.E. Séralini [4], although highly controversial, might have paradoxically contributed to raising the awareness of the need for independent evaluations not linked to the GMO industry. One can only hope that such studies, if really set up, will clarify and pacify the field.

CONFLICT OF INTEREST

The author declares that he has no conflict of interest.

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Why the postmodern attitude towards science should be denounced

Postmodernism is a philosophical, political, social and artistic movement. It is mainly defined by its suspicion towards the Enlightenment's faith in science, progress and the universality of reason. It has become a powerful movement that exerts a strong influence on academic thought in American and European societies, especially as it has become hegemonic in some institutions. Considering its influence on so-called 'science–society debates' and its criticisms formulated against the scientific method, it is legitimate, in turn, to analyse critically its claims and the consequences of these claims, especially those from the 'science studies'—also called

'science and technology studies'. This post-modernist, mainly sociological, discipline has gained momentum in the past few decades in its appreciation of science and technology; it uses specific concepts that create a specific vision of scientific research as a social activity.

An initial reflection concerns the shift from 'public understanding' of science to 'public engagement' in science. A typical delusion of the 'science studies' community is the belief that "knowledge co-production beyond the classic expert communities... can substantially benefit scientific design." In fact, science has become so complex and specialized

that co-production among scientists from various fields is becoming a difficult task. Therefore, when it comes to the layperson, even with the involvement of social scientists, co-production of knowledge is nothing more than a myth. Of course, examples of collaboration between professional scientists and ‘amateurs’ do exist, and can be mutually beneficial—when botanists collect seeds from plant species for conservation purposes or when amateur astronomers detect interesting phenomena in the sky. But note that in both cases there is no hidden political agenda. By contrast, for genetically modified organisms (GMOs), which are criticized for their industrial and commercial use, and for the alleged political consequences of their use, there are powerful political forces at work. Collaboration between medics and patients is often cited as a successful example, but this cannot be considered as an equal co-production of knowledge, as the two are not commensurate, neither psychologically nor factually: the patient, of course, is the only one who knows what sort of pain he feels, but the physician is the one who has the knowledge to diagnose the ailment and prescribe the remedy.

The second most commonly heard comment concerns the claim that no opinion is better than any other—which is actually a criticism of mainstream scientists. Of course, ambiguity and diversity of opinion are both inherent to mankind. But this is where science begs to differ by trying to develop a discourse that goes beyond matters of opinion, to demonstrate and express matters of fact and proof. No one can claim that the scientific process is purely technical and objective; after all, scientists are human, and there are probably as many dishonest people in the scientific community as there are elsewhere. However, science strives towards objectivity through the implementation of method. One should not confuse, as ‘science studies’ sociologists tend to, science in the making and established science. The former can be built on scientific disagreement, but eventually the true facts are established.

The third critical analysis concerns claims of alleged “interests at work in science”. This typically postmodern attitude towards science should be denounced because it casts suspicion on scientific activity as ‘intending’ something other than what it ‘seems’ to be doing. This can be considered a direct attack on the honesty

and integrity of scientists as a professional group, as well as an attempt to discredit the scientific method. One should not confuse scientists (human beings) and science—a conceptual methodological process of accessing the truth in relation to the world. Some scientists might have disseminated false information on the health risks of tobacco, but the fact that smoking increases the risk of cancer has been proven by science. Following the ‘science studies’ approach, we would still be discussing, in stakeholder forums for example, what is cancer.

It is regrettable that, as soon as someone denounces attacks on science, some scientists feel the need to express *mea culpas* in the name of all scientists, past and present. What is at stake with relativists is that they introduce doubt into everything—truth, value, beauty and reason—that goes beyond sociology. It is unfortunate that some scientists tend to fall into that same trap, confusing the ordinary behaviour of human beings with the capacity of science, as a source of knowledge, to learn about the laws of nature. Relativist ideology is trying to undermine science and it might succeed, especially if scientists themselves express doubts about the honesty and the rationality of their own work. The same holds true for the naive acceptance by scientists of the misuse—by political ecologists, for example—of alleged conflicts of interest. In the case of real conflicts of interest, criticism is entirely appropriate, but the ‘outing’ of conflicts of interest is becoming a ‘weapon of mass destruction’, aimed at any relationship with industry. Meanwhile, activists exonerate themselves from such declarations, despite the fact that they are defending an ‘interest’ per definition, either in support of their own ideology, or even sometimes their interests in ‘green’ business.

The role of a scientist is not to engage in decisions concerning the ‘best interests of society’. This is, or should be, the role of politicians. A scientist’s role should be to communicate as honestly as possible about what we know and what we do not know. Contrary to the claims of postmodernists and political ecologists, the truth is that scientists do actually know a lot about GMOs. GMOs have been subjected to an unprecedented battery of scientific studies, conducted independently from the industry, which have dealt with all possible risks. Scientists are also aware of

what they do not know. Decision-making—which risk management strategy should be implemented, or which risks can or cannot be taken—is the role of politicians and has to be distinguished from risk assessment, which is a complex, highly technical, scientific process. It is essential not to drag scientists into the political field. It is also no less essential that politicians and political activists do not interfere with the scientific methods applied in risk assessment. Taking into account social, moral, political and economic opinions, or cultural frames for risk assessment, would mean that the scientific method is supplanted by ideology, as is often the case in the GMO dispute. As stated by the European Food Safety Authority’s Executive Director, Catherine Geslain-Lanéelle, in an interview with the French newspaper *Le Figaro* (published 14 November 2012): “If we managed fifteen years ago to shun industrials off the evaluation committees, it was not for NGOs involved in the fight against genetically modified crops [...] to take their place! That would be a regression, dangerously turning back the clocks” (translated from French by M. Kuntz).

Accusations of ‘scientism’ are repeatedly uttered against those who defend the scientific method. However, scientific considerations on risk analysis have nothing to do with ‘scientism’, a nineteenth century mystical belief that, to quote philosopher Ernest Renan, wanted to “scientifically organize humanity”. One should also note that ‘scientism’ relates to the ideas of Auguste Comte and others, who were convinced about the existence of a “social physics”, that is to say a ‘scientific’ study of man and society—in other words, sociology. Scientists do not—or should not—talk in the name of society. It is relativists and political ecologists who continuously—and illegitimately—do so, even in the name of ‘future generations’.

When postmodern sociologists claim to help science and scientists in their exchange with the socio-political world, it is legitimate to express doubt if the consequences might transform science into a social and political activity devoid of truth-seeking. It is also legitimate to analyse the way postmodern intellectuals are teaming up with ‘green’ ideology. Criticism of the latter does not mean dismissing public concern, but it is important to point out that some organizations create these ‘concerns’ due to their exceptional ability to use the

media and internet. They create a 'parallel science' with pre-established conclusions that induces confusion in people's understanding of scientific knowledge. Thus, a small minority exerts a major influence, not only on political decisions, but also on scientific risk assessment. This was exemplified when the Séralini scandal—a high-profile study published in September 2012 that claimed long-term health effects on rats after GMO consumption, which has been widely refuted by other scientists and scientific authorities—prompted politicians and French risk-assessment agencies to recommend even more long-term feeding studies on GMOs. Many of these have

already been performed and have revealed no health effects [1]; not to mention that farm animals have been fed on GMOs for the past 15 years with no observed negative health effects.

It is now clear from the experience with the GMO dispute that neither the 'participative' postmodernist approach, nor the 'parallel science' created by GMO opponents, has led to any benefit for science, for risk assessment or for the general understanding of these processes. Consequently, politicians and the heads of scientific organizations should explore other paths for other technologies that are being designated as bearing

'potential' risks, such as nanotechnologies or synthetic biology.

CONFLICT OF INTEREST

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