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Upstream engagement and the governance of science

The shadow of the genetically modified crops experience in Europe

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Synthetic biology represents a fusion of the pragmatic and the idealistic, which is motivated by the drive for a better understanding of biological processes, and the desire to deliver the social and commercial benefits that the science seems to promise (Tait, 2009). Most scientists working in universities and commercial companies are guided by a mixture of these motivations. However, in the background, a shadow looms over many of the life sciences, pointing to a complex and possibly difficult future—the question of public acceptance of the science and technology. Echoing this tension, many European governments, including the European Union (EU) itself, are caught between a desire to promote innovation, and the political need to accommodate a wide range of public-interest groups with precautionary concerns about environmental and health issues.

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The shadow over the life sciences is most substantive in the context of genetically modified (GM) crops—any discussion among scientists and policy-makers about future developments comes around, eventually, to the need to avoid a repetition of the European debate on GM crops and its outcome. Although this controversy was most virulent during the period from 1998 to 2002, it rapidly resurfaces in response to any positive or even neutral news item about GM crops.

The effect of this opposition to GM crops by public-interest groups should not be underestimated. Publications and reports that do not take an anti-GM perspective regularly come under attack. A recent explanatory review of a range of GM crop issues (Sense about Science, 2009) led to challenges related to the independence of the scientists who had contributed to it (Corbyn, 2009). The publication of a report showing that GM crop technology is attractive to some farmers (Lane *et al*, 2007a,b) also prompted challenges about the competence of the researchers (Corbyn, 2008), even though this work was subject to peer review by the UK Economic and Social Research Council. An example of continuing international opposition to the future involvement of GM technology in agriculture comes from a recent report by the International Assessment of Agricultural Science and Technology for Development (IAASTD, 2008). Those who were involved in the production of this report were aware of the extent to which it became dominated by the views of anti-GM activists in a way that seriously affected the outcomes and the advice to governments (Anon, 2008a,b; Chataway *et al*, 2008).

These examples do not imply that support for GM crops should be above criticism; however, they do demonstrate a lack of tolerance for any alternative views and a refusal on the part of anti-GM activists to consider alternative options involving this technology. There is a vast amount of web-based anti-GM activity, much of which tends to be reported relatively uncritically in the media, compared with the more hostile reception and accusations of bias that greet more neutral or positive news items.

The problems extend to the legal and judicial systems. Since 2000, activist groups have destroyed most GM crop trials in England, and the Scottish and Welsh regional governments now ban any trials in the open because of the perceived dangers associated with the technology. Legal decisions have further strengthened the freedom of activists to cause damage without suffering any consequences. In 2000, Lord Melchett and 27 Greenpeace activists, who had admitted to destroying GM crops in Norfolk, UK, were acquitted because the jury accepted that they acted in order to prevent the greater harm that would follow from allowing the GM maize crop to contaminate adjoining land. Their lawyer claimed that the defendants did not have to prove that a belief was right, only that it was honestly held. An opinion piece in *The Independent* newspaper at the time described this decision as "[…] a defeat for scientific truth" and predicted that, with this legal precedent, it would become impossible to conduct GM crop trials in the open in the UK (Anon, 2000). Under the English Criminal Damage Act 1971, the destruction of crops is only an offence if done "without lawful excuse" (section 5); this

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highly subjective defence is dependent on the belief of the defendant rather than on standards of reasonableness, and to that extent is inconsistent with general criminal law (J. Chalmers, Law School, University of Edinburgh, personal communication).

Against this background, the concerns of scientists and regulators working in potentially controversial areas such as synthetic biology are understandable. Many would like to draw a line under the GM crops experience and move on from it; however, it would be naive to presume that other powerful groups do not have an alternative agenda.

Given this heightened sensitivity to societal issues, social science funding has been channelled into studies of the ethical, legal and social implications of the life sciences (Stegmaier, 2009). One of the main outcomes has been the promotion of 'upstream engagement'—starting from the early decision-making on basic research funding—as the best option to avoid future conflicts over life-science research and its applications.

In the UK, the involvement of Demos, a political think-tank based in London with strong links to the current Labour government, pushed the notion of upstream engagement onto the political and scientific agenda, where it was accepted with few challenges as the best—indeed only—way to avoid the kinds of conflict that had arisen over GM crops. Its rationale is described as follows: "The task is to make visible the invisible, to expose to public scrutiny the assumptions, values and visions that drive science" (Willis & Wilsdon, 2004). It is surprising that upstream engagement has been accepted so uncritically by the scientific community, given the lack of equivalent scrutiny of the assumptions, values and visions of those who have demanded it.

An Editorial in *Nature* (Anon, 2004) claimed that the approach would improve public acceptance and, if managed properly, would not bring an end to any area of research. The Editorial also noted that the Biotechnology and Biological Sciences Research Council (BBSRC; Swindon, UK) was ahead of other research councils in setting up a permanent committee of non-scientists to give advice on strategy. Other research councils, such as the Engineering and Physical Sciences Research Council (EPSRC; Swindon, UK), have also developed strategies for social engagement (EPSRC, 2007).

Table 1 | Problems in applying upstream engagement to life sciences

Problems with prediction	
At the stage of funding basic scientific research (timescale, >15 years)	It is impossible to know, when the funding of scientific research is being discussed, what the outcome will be It is impossible to know what future developments will arise from the research and what their risks might be
Developing innovative products or processes based on proven research outcomes (timescale, >10 years)	Most of the ideas that seem feasible at this stage will fail Innovation usually requires inputs from research in a range of disciplines (that might have been blocked or delayed by outcomes from other engagement initiatives)
Foresight	We are extremely poor at the long-range prediction of technology futures
Problems with stakeholder engagement	
Group think	The views of small groups will be easily swayed by participants with strong opinions or by those leading the engagement
Issue framing	Given our ignorance about the future, engagement can be a process of fictitiously framing new science and technology in the minds of the public
Recruitment bias	It is difficult to persuade uncommitted citizens to participate in hypothetical discussions about science and innovation a long time in the future—those who engage are likely to have a specific agenda
Conflict	Where there is polarization of views, engagement can lead to increased levels of conflict
Engagement focus	Some topics—for example, nanotechnology—are too broad and multifaceted to allow meaningful engagement
Engagement fatigue	There will be insufficient time and resources to engage on every relevant issue and people will become cynical about the process
Labile public opinion	People who do not already have strong opinions will change their minds over relatively short timescales, and much more so over 10–15 years

Decisions [about scientific research] will vary, depending on public-opinion shifts in response to the latest events, amplified or modulated by media campaigns

The response of the BBSRC to calls for more upstream engagement includes a set of conditions for research funding published in the general guidance from research councils: "[The] BBSRC has a responsibility to ensure that its funds are used ethically and responsibly. Potential applicants should consider whether their work is likely to give rise to societal concerns […] or other aspects of potential public concern. BBSRC committees and peer reviewers will consider whether submitted applications could raise ethical or other societal issues. Key information from applications so identified will be made available in confidence to the Bioscience for Society Strategy Panel [which includes public societal representatives]. The Panel may ask […] for changes to the conduct of the proposed work" (BBSRC, 2009).

Such guidance could steer potential applicants away from areas of research that are known to be contentious to some interest groups; however, there would be no way to discover whether this is, indeed, happening and therefore no way of challenging the claim made in the *Nature* Editorial that this would not bring an end to any area of research.

Social science researchers working on programmes related to ethical, legal and social implications as part of the life sciences have made strong claims for their relevance—"[…] public engagement is a non-negotiable clause of scientists' license to operate" (Stilgoe & Wilsdon, 2007)—and have made reference to nanotechnology engagement as a "[…] test case

Fig 1 | *Newton* by William Blake. Reproduced with permission of Tate.

for democratising science" (Toumey, 2006). Phil Macnaghten and colleagues have argued that engagement represents an extraordinary opportunity to build a robust prospective role for the social sciences in shaping the future of nanotechnology research and innovation processes (Macnaghten *et al*, 2005).

The main critique of upstream engagement so far has been related to its failure to be genuinely open and participative (Levitt, 2005; Wynne, 2006)—that is, we need more and better engagement. However, to be robust it must also be resilient in the face of future challenges, and a more fundamental criticism is that its advocates have failed to take account of the processes by which life-science discoveries are translated to useful products and processes. Relevant factors include the following: uncertainty about the nature and timescale of research outcomes, particularly for interdisciplinary projects at the frontiers of scientific knowledge; ignorance of the practical applications that could arise from this knowledge; and certainty that, whatever the outcomes, the route to a commercial product or a public benefit will be long and expensive.

As shown in Table 1, decisions based on early engagement will be taken in ignorance of future scientific outcomes, development possibilities, and public attitudes and preferences. Upstream engagement therefore cannot be a straightforward solution to the difficulties of making decisions about which research to fund and which products to develop in the life sciences.

Upstream engagement has been described as offering 'compressed foresight', whereby highly uncertain socio-technical prospects are presented as imminent and known (Williams, 2006). The author observes that "[…] social scientists are becoming intermediaries in the mobilisation of public sentiment [and] […] this somewhat privileged position places a special responsibility on STS [science and technology studies] researchers to consider their commitments with great care." Harry Collins has been similarly critical of this mainstream social science research agenda: "[…] the prospect of a society that entirely rejects the values of science is too awful to contemplate" (Collins, 2009). However, such reflexivity is unusual in the social sciences—we rarely hear calls for more understanding of the social construction of the social sciences.

Insights from the psychology of decision-making are also relevant here, including the phenomenon of 'group think', in which one dominant and committed individual can, at least temporarily, sway most other group members to their way of thinking (Eiser, 1986); the focus group or small workshop is the preferred approach to upstream engagement, making it particularly subject to such biases. In the nanotechnology field, particularly in the UK, several engagement exercises have included activists who were involved in opposition to GM crops (Wood *et al*, 2007). As Jack Stilgoe has noted, the role of non-governmental organizations (NGOs) in stakeholder engagement is often to shape the public debate according to their alternative interests and values (Stilgoe, 2006).

Interactions among opinions, beliefs, values and preferences in a plural democratic society are a great deal more complex than can be described here. Throughout the history of scientific endeavour there have always been tensions between those who work to promote scientific understanding of the world and those who would constrain or prevent it.

The image of Sir Isaac Newton shown in Fig 1 echoes the experiences of Nicolaus Copernicus and Galileo Galilei at the hands of the Roman Catholic Church, and expresses the criticism by William Blake of the disciplined reasoning that allowed Newton to understand planetary motion, which was seen as his desire to order the universe. In contrast to the nakedness and vulnerability of the image created by Blake, *Master of the Universe* by Eduardo Paolozzi (Fig 2) is a more powerful, almost 'armour-plated', depiction, although it is also ambiguous about the scientific endeavour. Paolozzi has been quoted as saying that "[…] the race towards destruction is colossal" (Pearson, 1999).

Current reactions to developments in science and technology should therefore be seen as part of a long continuum whereby radical new developments have provoked public anxiety. The tension between scientific endeavour, which is seen as the basis for human progress, and contrary opinions ranging from mild reservations to entrenched opposition, will continue, and upstream engagement is one of its latest manifestations.

If engagement is to satisfy the demands of its proponents who want evidence that

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its outcomes are influencing decisions, and at the same time these proponents are influencing engagement in a manner that is critical of the scientific agenda, restriction of some scientific projects is inevitable. As Collins implies, the social science agenda within which upstream engagement is located can be seen as taking us deeper into a mire where we will have no solid evidence base for making decisions about scientific developments (Collins, 2009). Decisions will vary depending on public-opinion shifts in response to the latest events, amplified or modulated by media campaigns.

Public dialogue, in terms of allowing people to contribute to ongoing debates about relevant issues, is to be encouraged. More problematic, given the concerns outlined in Table 1, is the expectation that the outcomes of these dialogues should contribute to decisions about scientific research at the upstream stage, or should be used to discourage developments, based on opinion rather than the best available evidence of potential benefits and risks.

Most organizations that have undertaken or taken part in engagement exercises have reported it to be a positive experience. However, the process has yet to be tested in the context of a concerted challenge. Given the continuing intransigence of the GM crops problem in Europe and the caveats summarized in Table 1, we should not be surprised if the claimed benefits of upstream engagement do not stand the test of time.

Upstream engagement has brought some new voices to decision-making. It has empowered activist groups working through NGOs, which now have a formal role in many decision-making committees, whereas before they were outside trying to make their voices heard. However, as the influence of activists has increased, the role of industry and other professional groups has declined, and the voice of ordinary citizens is still not being heard. Neither situation is satisfactory and the claim that these new approaches to decision-making are more democratic is not being borne out.

Conflict related to life-science developments will inevitably arise from a complex mixture of uncertainty, power politics, conflicting societal interests, values and ideologies, and commercial competition. For many questions there will be no societal consensus about whether we should develop particular technologies. There will always be differences of opinion, and upstream engagement seems likely merely to substitute one set of dominant opinions for another set that is no more universal and, if anything, is less based on scientific evidence than the previous one.

Fig 2 | The bronze statue of Sir Isaac Newton situated in the grounds of the Scottish National Gallery of Modern Art in Edinburgh, UK. The statue is titled *Master of the Universe* and was sculpted by Eduardo Paolozzi in 1989, based on a famous drawing by William Blake. Photograph by Joyce Tait.

Where then might we look for answers to these problems? Engaging in a wider dialogue across a wider range of social science disciplines and professional functions would be a good starting point, in order to bring in expertise in innovation systems, regulation, governance and economics. Many societal discussions about the desirability of life-science innovations seem to ignore the fact that the technology will be regulated and will need to be proven safe before it reaches the market. Such discussions also need to take account of the role of markets in revealing whether people want a particular technology. We should ask under what circumstances it is necessary or valid to undertake expensive and premature engagement to decide what products citizens should be allowed to purchase in 10–15 years.

It would be unwise to presume that upstream engagement will not unnecessarily restrict the activities of scientists and of companies that could deliver products that people will want. It is also unwise to presume that engagement will help us to avoid conflict or making mistakes with some developments.

We should therefore be working urgently to find acceptable approaches that encourage equitable dialogue across all societal groups, scientists, industry, regulators, NGOs and citizens. We should develop 'rules for engagement' that set standards for the quality and breadth of evidence that is brought to the discussions, and that encourage a willingness to listen to and accommodate, where possible, the views of others. We should also consider carefully the circumstances in which it might be necessary or valid to allow the values and interests of one group to restrict the freedom of choice of others.

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