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COMMENTARY

Lab Work Goes Social, and Vice Versa: Strategising Public Engagement Processes

Commentary on: "What Happens in the Lab Does Not Stay in the Lab: Applying Midstream Modulation to Enhance Critical Reflection in the Laboratory"

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Abstract Midstream modulation is a form of public engagement with science which benefits from strategic application of science and technology studies (STS) insights accumulated over nearly 20 years. These have been developed from STS researchers' involvement in practical engagement processes and research with scientists, science funders, policy and other public stakeholders. The strategic aim of this specific method, to develop what is termed second-order reflexivity amongst scientist-technologists, builds upon and advances earlier more general STS work. However this method is focused and structured so as to help generate such reflexivity—over the 'upstream' questions which have been identified in other STS research as important public issues for scientific research, development and innovation—amongst practising scientists-technologists in their specialist contexts (public or private, in principle). This is a different focus from virtually all such previous work, and offers novel opportunities for those key broader issues to be opened up. The further development of these promising results depends on some important conditions such as identifying and engaging research funders and other stakeholders like affected publics in similar exercises. Implementing these conditions could connect the productive impacts of midstream modulation with wider public engagement work, including with 'uninvited' public engagement with science. It would also generate broader institutional and political changes in the larger networks of institutional actors which constitute contemporary technoscientific innovation and governance processes. All of these various broader dimensions, far beyond the laboratory alone, need to be appropriately open, committed to democratic needs, and reflexive, for the aims of midstream modulation to be achieved, whilst allowing specialists to work as specialists.

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Introduction

The experimental development of deliberate processes for generating scientific practices which are in some way better attuned to societal conditions and needs, has long been on the wish-list for scholars of science and technology studies (STS). A central part of this agenda has been the debate within STS about reflexivity. This has not been meant in the original rather self-indulgent 'post-modernist' sense, of self-consciously writing oneself as author into the narrative form of publications analyzing research in technoscientific arenas, but as an attempt to render scientific practices more openly reflective about (and thus also perhaps, reorienting) some of the key commitments driving and structuring science, and what shapes society in the name of science. This has not been to suggest that scientific practitioners do not reflect aloud and amongst themselves over such questions. Scientists engage in such reflexive activities continually (Waterton et al. 2001). But a key point is that they do so usually informally, within their own communities or networks, and not as a public matter. As with most other such work situations, the participants have naturally been their regular specialist workplace peers, for example in the laboratory. In addition, as Kuhn (1962, 1970) originally underlined in hard empirical form, scientific reflexive impulses or habits are structured and bounded, by culturally routinised and socially reproduced norms which do not even appear as such. Instead they have been internalized and are transmitted in training and socialization, as if they are givens—simply beyond question; natural, or inevitable. They are the *frames*, rather than the objects, of deliberate reflective thinking and practice.

Thus without suggesting that scientists are behavioural dupes who do not and maybe cannot engage in self-questioning and reflection about their own specialist practice and its relations with 'society', STS observer-participants in laboratory settings (as well as other actors and processes) can encourage the stretching of this normal scientific reflexive activity into new social and scientific issues, and to confront new questions and challenges. These can include—and can be deliberately designed and conducted in order to include—big and difficult questions such as: What societal visions directly or indirectly drive scientific research directions?[1] Or, how are pragmatic instrumental norms which, alongside societal interests and ambitions, shape technoscientific agendas and priorities, reconciled with public justifications of science as impartial and innocently curiosity-motivated?

[1] STS is not the only agent capable of inducing this further scientific reflection and potential 'self-reorientation' of science. Summarised below is an example, described in more detail elsewhere (Doubleday and Wynne 2011), of such a 'reflexive' public impact on science (UK plant sciences transgenics research). This reorientation was engendered not mainly by STS participation (though this did exist, in an *interpretive* public role) but by persistent and vigorous public controversy from about 1996 to 2004 that included direct action destroying publically funded scientific field-tests.

Schuurbiers (2011) offers some valuable case experience as well as important analytical insight into these potentially transformative scientific processes, assisted in this instance by STS. As a partner to the Arizona State University Socio-Technical Integration Research (STIR) program (http://www.cns.asu.edu/stir/), Schuurbiers uses what is called "midstream modulation" (Fisher et al. 2006).[2] His work is also aimed at enhancing the capacity of science—as a vital and powerful but deeply misunderstood social institution—to detect, reflect upon openly and collectively, and *respond to* the signals to which it is relentlessly subjected, from society in all its glorious variety. In a democratic society which needs a healthy and responsive, versatile science, this enhanced sensitivity and attunement to democratic forces and needs is a crucial quality which cannot be taken for granted, nor can it ever be finally designed; but it must be worked at, continually. This is a potentially transformative program, for society and for science, for which there is also arguably an urgent need.

At the same time, other elements of science beyond the laboratory, both institutional and epistemic, need similar interventions, not only for themselves, but also as a necessary condition of the successful achievement of the worthwhile and important larger aims of the STIR program, which are about the broader challenges of better and more democratic attunements of science in society. In other words, there are significant actors and conditions in the external context of laboratory science which shape those scientific practices themselves, and the innovations which come from them. Unless these broader contextual conditions are also changed so as to establish the forms of accountable reflexivity which the STIR program has initiated, the enhanced reflexivity of the lab science component itself may not be sufficient to alter innovation trajectories so as to better achieve the public good, as an open-ended dynamic process.

In reporting and discussing the strategic aims, methods and findings of the two cases he describes, Schuurbiers also explains the useful distinction between 'first-order' and 'second-order' reflective learning (Schuurbiers 2011). First-order

[2] This term refers to the "upstream–downstream" language of varying public engagement with science exercises. As the author of this terminology as used in this context, I should note that this was a simple distinction between engagement processes which allowed citizen groups to engage in exchanges over the issues at the consequences, risks, or impacts stage, or at the earlier, more formative stages of the whole life-cycle of research→innovation→impacts. It was an avowedly schematic and crude term, to distinguish this downstream phase and its different agenda, from upstream where research is being conducted, with broad aims, and expectations and promises of downstream impacts. In contrast to those of the downstream phases, the salient upstream issues—often pointed to by publics involved in conventional public engagement processes—are more immediately about front-end purposes, priorities, imagined outcomes and alternative trajectories, than about assessing impacts or risks. Thus 'midstream' notionally lies in the middle of such phases; but since most innovation processes are nearly always upstream and downstream at the same time (for example, because 'downstream' impacts often lead to responses which initiate simultaneous new 'upstream' research, or at least, concerns and questions), midstream could also encompass 'mixed-stream' situations. When I introduced these ideas (e.g., Wynne 2002) I also recognised the obvious point that most science-derived innovation is invariably multi-stream. Midstream modulation is a useful elaboration of this whole approach, because it recognises the crucial distinction between 'upstream' and 'downstream' questions and issues, while avoiding the misunderstanding of these as mutually exclusive.

reflexivity here can be seen as a more limited and instrumental form of self-questioning and learning (e.g., about the priority of one experimental alternative option, over others), which does not necessarily reach into and challenge the more entrenched cultural habits and 'givens' which structure and channel scientific work in different ways according to the particular and variable contexts of any such work. An example of such a second-order reflexive issue would be to address whether precision and experimental control are always appropriate and natural epistemic priorities in defining good science, as compared to realism (as far as possible) in laboratory-experimental representation of real-world conditions. Unlike first-order reflexivity, such a question challenges the typical entrenched cultural commitments defining scientific knowledge-practices in many fields seen as definitive for technological innovation, and for public policy and regulation (for example, risk assessment: see Wynne 1989; Jasanoff 1990).

Thus in second-order reflexivity scientists may come to challenge their own established routines of thought and practice, and also crucially, the various external forces which shape these (something first-order reflexivity does not expose to question). Without this second-order dimension, reflexive laboratory discourse may simply reproduce and reinforce particular and often problematic underlying ethical, social, and political commitments of the science being conducted (e.g., the enactment of the economic interests and purposes of particular industrial factions, as if these are naturally given, when different social purposes and needs could be reflected in R&D agendas). The strategically-informed engagement which Schuurbiers, as an STS exponent conducted with two different laboratory engineering research teams, aims more ambitiously at the critical reflection involved with second-order reflective learning, even though as he noted, the more modest and comfortable first-order phases are necessary as a condition of possibility for the more challenging and potentially disruptive stages of second-order reflexivity.

However, if a broader base can be constructed, it would provide the possibility of a more effective STS intervention program. Much of this requires one to ask about how the laboratory, as the selected key site,—and this is clearly an appropriate first target for such initiatives—is situated in the wider range of activities, actors, interests, and relationships which constitute science and its distributed networks of stakeholders and innovation funders, practitioners, and affected publics. The value of seeing—and attempting to render accountable and responsive—science in this broader perspective is illustrated, by using an ostensibly very different example drawn from far beyond any laboratory, even though its effects impinged upon many such scientific sites. The case is an important element of the larger and long-standing controversy in the United Kingdom and Europe over genetically modified (GM) crops and foods, with science in the dock along with the global corporate commercial promoters of GM, and the government which pursued their agenda, in the name of science and public safety. I use this example to underline a larger point, and to indicate a need to identify the multiple such beyond-the-laboratory sites and engagements which could complement and synergize with the midstream laboratory engagements which STIR has valuably introduced.

Science Policy as a Complementary Site for Midstream Modulation?

The deep and resilient public resistance to GM crops and foods in Europe has been well-documented, including direct action campaigns to destroy GM field and (in the UK) farm-scale trials in several countries (Marris et al. 2001; Levidow and Carr 2010). In the UK this culminated in 2003–2004 with the government-orchestrated *GM Nation?* public debate, with a coincident GM Science Review chaired by the UK government chief scientist, and a Cabinet Office review of the broad economic implications of UK policy acceptance or refusal of GM crops and foods.

In the midst of this heated debate, with many of its scientific constituency in research institutes and universities as well as its own advisory boards centrally involved in these exchanges, the key UK public funder of plant and crop sciences research, the Biotechnology and Biological Sciences Research Council (BBSRC—previously the Agriculture and Food Research Council) convened a blue-ribbon expert *Crop Sciences Review* panel, which issued its report in April 2004 (BBSRC 2004). As described by Doubleday and Wynne (2011), this report made unprecedented explicit reference to the need to take public concerns about existing trends (that is, GM trends) in plant sciences and agricultural technologies into account. It acknowledged the need to differentiate the agenda of UK research and development (R&D) funding in this field, from the GM imaginary of future global agriculture and food, and attendant scientific R&D agendas, advanced by the increasingly concentrated and powerful global private corporate seed and agrochemicals giants. These had dominated plant-crop sciences funding and corresponding imaginaries for the previous decade or more. The BBSRC Review also explicitly recognized the need to give greater priority to non-GM (non-transgenic) plant and crop R&D, while still developing and using state-of-the-art plant genomics.

Taking its cue from social sciences research on public attitudes in the European Union (e.g. Marris et al. 2001) which had emphasized that GM's association with intensifying private control of the global food chain and its essential resources (seed, and knowledge in the form of intellectual property rights) was a key factor in public concerns about GM crops and foods, the 2004 Crop Sciences Review was also replete with references to public concerns, and the need for BBSRC to be seen to be responding to these in its science policy commitments. The 2007 BBSRC Crop Sciences Initiative (BBSRC 2007) began this re-direction and diversification of UK R&D, and potentially a corresponding re-orientation of this whole R&D field towards new technological (and social) innovation trajectories, and new agricultural and related policies. Crucially, as part of this different vision, new users and stakeholders were also included, even though some of the most important of these stakeholder knowledge-practitioners, such as public plant breeding specialists as a key bridge between laboratory and field, or lab scientist and farmer, had been virtually eliminated in the previous decade, thanks to the government privatization of the UK Plant Breeding Institute in 1990[3] (Webster 1989).

[3] One of the unrecognised benefits for science and society of more vigorous and not top-down-orchestrated forms of public engagement with science is that the unnoticed inherent flexibility of science

This important science policy shift is an example of "uninvited public engagement" (Wynne 2008), in which scientists in committee rooms, not laboratories, make intelligent and accountable responses to societal signals of concern and need—and accordingly changed the science they choose to fund. Thinking of laboratory-practised midstream modulation, these science policy commitments on the part of the UK's public crop and plant sciences funding body, to a more diverse scientific research agenda, also changed what went on in scientific laboratories—what agenda was defined, what specific scientific questions were posed, what experiments were done, what expected outcomes were imagined and materialized, and what social reference groups—stakeholders—beyond the laboratory were recognized, engaged, and given scientific influence as significant others. Unlike public engagement practices which are usually one-off events, such changes are more lasting, and in principle continuous, even though possible retrenchments or reversals are always possible. Laboratory cultures and their forms of reflexive discourse are altered by these kinds of deliberate and strategic institutional changes of directions, priorities, and their driving imaginaries (Latimer and Skeggs 2011). Although yet to be empirically investigated, most likely also changed in subtle ways by this science policy shift (itself induced by uninvited publics), was the dominant scientific imagination of 'the public' and 'the public interest' for which public science was supposed to be funded (Stengel et al. 2009).

Although the UK GM illustration is very different from the engineering science laboratory settings in which Schuurbiers (2011) did his productive form of STS disruption of established routines within science, it does highlight the point that other, *extra-laboratory* factors, situations and agents, such as funders, client-users, and mobilized affected publics, are also important influences, on both the laboratories and their preoccupations, and science as it interlaces with society. These effectively set the scene in which scientific laboratory research is already shaped before it comes to be enacted in the laboratory itself. In both of these cases, and in the full range between, midstream modulation and STS at large wish to induce habits of more informed and more democratic collective critical reflection and commitment. One therefore can—and needs to—ask, to what extent can one form of engagement be developed, without at the same time needing to develop the other(s)? How can these complementary forms of engagement be envisaged and encouraged as mutually-interacting and mutually-supportive reflexive learning activities?

Footnote 3 continued
to respond to new signals—including new questions and concerns—can be brought into play. As a result, potentially new innovation trajectories and their associated social benefits can be generated by science. Practically-speaking, this involves deliberate experimental attempts to introduce new kinds of stakeholders to relevant areas of science, and to be open to resultant change in the sciences involved. For this point, see the report from Genome British Columbia (2011), on strategic integration of social sciences and humanities with genomics and related scientific research.

Enhancing the Effectiveness of Midstream Modulation: Some Proposals

The laboratory engagements which Schuurbiers and other STIR participants conducted, in an admirably experimental and learning spirit, have clearly helped to extend the typical focal agenda of whatever reflexivity normally prevails in those scientific contexts. Whether this is temporary, or more permanent, remains a question perhaps worth monitoring at some point. I would suggest that this depends substantially upon whether those surrounding and interacting institutional actors and settings can be imbued with similarly strategic forms of disruption, whether midstream modulation, or uninvited public engagement, or other related kinds of intervention. This is not to say that the different protestors involved in the UK GM controversy were strategically aiming for the redirection of BBSRC plant sciences funding which did occur partly thanks to their interventions. This also took intelligent scientific institutional responses, to interpretations of public concerns offered by social scientists (Marris et al. 2001; Wynne 2001).

A key issue here is how such extensions would be made something of a more permanent feature of these and other typical scientific laboratory and broader innovation cultures. An important and contributory question is how they would also be made more visible and effective, in terms of their impact on not only laboratory collectives and their practical cultural processes, modes of interaction, etc., but also in terms of (a) what goes into such laboratories—funding and promotion of some R&D priorities and not others; expectations, promises and imaginations of aimed-for outcomes; pressures from influential users and stakeholders to respond to emergent opportunities, flexibilities or challenges in some ways and not others; and (b) what comes out of laboratories—knowledge technologies, imagined applications, uses, and markets; skills oriented towards particular imagined outcomes, etc., and which enter into society as crucially influential social-shaping forces. What happens in those laboratories is clearly influenced by both of these, and is interconnected in multiple ways.

Addressing the wider topic of what is science, introduced above, could be the key to this broader ambition. The successful if as yet inevitably small-scale engagement of laboratory researchers in such second-order reflective learning focuses on inducing and accentuating tensions and conflicts amongst scientists—rather then between those scientists and their surrounding and mutually-structuring networks of multiple 'significant others', such as: other scientists with whom they interact and are interdependent for many inputs and resources; funders and patrons, public or private; users and other stakeholders in the knowledge and innovation processes of which these lab scientists are an essential part, but who also depend upon those users and stakeholders; professional societies of various sorts, and perhaps also relevant trade bodies who, like funders and users, also act in a quasi-regulatory fashion on the laboratory work and its managers; NGOs and other civil society organizations which may have specialist interests and concerns about the scientific work being done; and so this list extends, ever more diffusely, into 'society' at large and its values, concerns, and power-structures etc. However one can see in this outline schema that the 'science' which shapes and reshapes society here, needs a range of other actors of the kinds indicated above, like industrial beneficiaries,

funders and directors of research, or government science policy directors, besides the laboratory scientific researchers, to also adopt, in a learning spirit, the reflective processes which midstream modulation has effected in these laboratories. Undoubtedly, this will need an extended variety of methods and processes, and it will be more difficult to achieve as these are often more overtly political arenas. Any such laboratory is always ensnared in as well as resourced by surrounding networks of other bodies such as funders and users or other stakeholders. These may have no interest or perceived freedom to engage in second-order collective reflections oriented towards critical ethical, social or political questions addressing what should count as responsible, i.e. desirable, innovation for society. Nevertheless, despite the difficulties, this extension is I suggest, a necessary further horizon.

Thus, building upon a multiplication of the laboratory-level forms of engagement already developed so well, a next step for this program would be to identify, then invite, persuade, or challenge, such broader bodies as outlined above, to engage in similar processes. In the larger arena of technoscience in society, social groups of different kinds may already be mobilized to attempt to enact such politically, intellectually, and ethically enlightened scenarios, without STS assistance; but others will also be attempting to curtail them. As the small UK GM case indicated, such surrounding bodies beyond the laboratory itself also shape science, and laboratory cultures, and science's impacts on society, through a larger politics of science and technology, and more diverse bodies of salient knowledge, in which STS also needs to intervene in measured ways. A key and perhaps intensifying feature of this political world is that so many powerful actors scramble for their fragile authority by calling themselves and the public issues "scientific", and trading policies, private profits, products, services, ideologies, aspirations, and values, in science's 'innocent' (and supposedly, a priori authoritative) name. This so-called 'unpolitical' scientized politics impinges eventually if indirectly on scientific worlds, as for example in the UK BBSRC 'public engagement' case, no matter what forms of reflection those worlds are or are not enacting.

Part of the point of such exercizes as midstream modulation must then also be to identify what kinds of tacit aims, imaginaries, expectations, interests, and assumptions are being packed into and yet communicated as if only 'science', to identify those unspoken normative commitments, and to debate these for what they are. One important extra aim of laboratory midstream modulation could therefore be to identify the extent and form of such extra-laboratory commitments already buried in what comes into and shapes the laboratory, in the form of R&D funds and attached conditions as to what R&D is done and what is not done; other rewards and encouragements; expectations; and priorities; then to engender intra-lab debate on the acceptability of or alternatives to such normative commitments, and include alternative or additional stakeholders who might be involved in such society-shaping matters, as these impinge on the esoteric world of the laboratory. This would provide important bridges between the lab-focused and broader programs of 'second-order' reflexive learning and change which STIR and STS aspire to.

Thus, here is proposed a bold challenge for further developing STIR and midstream modulation. STIR has been a very well-conceived and effective STS research and intervention program, in constructive collaboration with scientists. In

order to move it to the next stage, the relations of particular laboratories and their 'significant others' beyond, i.e., peers of different kinds, funders, 'regulators' of various kinds, users, other stakeholders affected by their work all of these significant others discovered empirically, or imagined by those actors, should be identified. Then, working outwards, the most salient of those bodies, such as R&D funding councils, industrial sponsors and users, whichever appear most relevant, should be asked also to engage in similar (re-tuned according to circumstances) forms of reflexive critical engagement and learning. Some of this could also include structured and modulated exchanges between such different actors. Midstream modulation should also include the imaginative discovery of new stakeholders, who might bring new ideas and imaginings of what is desirable, necessary, and possible, under perhaps new social and institutional conditions. Realistically, refusals and evasions, and gaps in these social or knowledge-actor 'maps' would appear, and would at least have to be documented, and maybe practically addressed. Salient collective learning and productive struggle would be under way.

With some complementary focus and efforts of this kind, the valuable progress which STIR, and midstream modulation have made, in their carefully structured, strategically STS-informed, and boldly experimental learning manner, could not only be sustained, but enhanced. Science, and society, and STS itself, would be modestly—perhaps even immodestly—enlightened and transformed in the process.

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