

Epilogue: publics, hybrids, transparency, monsters and the changing landscape around science

Stephen Turner

Science, science journalism and the academic study of science itself are grappling with rapid changes in the nature of their object in the three disciplines of science and technology studies, philosophy of science, and history of science. Science is no longer the familiar world of laboratories and chalkboards full of equations, with the public at a discreet remove, buffered by a set of benign images of unworldly scientists pursuing arcane interests. These images of science were captured by the Ronald Reagan movie *Bedtime for Bonzo* (de Cordova, 1951), which featured a charming scientist living with a chimpanzee to test his theories about nature and nurture. The science was individualistic, rather than a team effort; the scientist was a sincere and harmless seeker of truth and friend of humanity removed from ordinary concerns and bumbling in his human interactions, and the results were understandable in human terms, though largely without practical significance.

The disciplines studying science, journalists and scientists themselves upheld aspects of this image well into the 1960s. Science was a separate world of special practices and rituals, with an individualistic epistemology, in which science was ultimately a matter, as Michael Polanyi put it, of personal knowledge (1958). In this idealised image of science, it was governed by merit. Funding, self-promotion, and academic and scientific politics and conflict were neatly excised from the image of the scientist. Science occasionally challenged our sense of ourselves as humans, or our place in the universe, but for the most part it was hidden from the public and appeared in popular science magazines and boys' fiction as technology.

Elements of this image have been gradually chipped away, however incompletely, in the disciplines studying science. But scientists themselves, as well as their publics, have now progressed beyond chipping away at the image into consciously transforming it: 'opening' science. The sciences are being opened in many ways. The chapters of this book begin to address this change. As in all large-scale social change, it is difficult for the participants to understand: the old landmarks remain, chalkboards can still be found and laboratories are more impressive than ever, but the landscape itself has become strange.

Like the British landscape itself, the British science landscape is imbued with meaning and ancestral meanings that lurk below the surface, together with a few monsters. The issue of social class was central to the Great Devonian controversy of the early nineteenth century (Rudwick, 1985), which was itself the result of a novel form of public science – survey geology sponsored by the state. By the end of that century Karl Pearson was promoting a vision of modernity shorn of religion, with scientists as the new priests and the state, run by experts, as the new object of veneration (1888: 20, 130–131, 133–134). With it came a model for science education in which workers were taught elementary science with the goal of impressing on them the greatness of science and its authority. By the 1920s, fear of the effects of science led to calls for a moratorium on new discoveries by the Bishop of Ripon (Burroughs, 1927: 32). In the 1930s, under the influence of Marxism, a vast body of popular science writing promoted the idea that the full use of science was central to economic well-being, and that it was being held back by backward capitalist elites working through relations of production that had been made obsolete by the forces of production of modern technology. This was called – the title of one of the key texts of the era – *The Frustration of Science* (Hall, 1935), a concept endorsed by such major figures as Frederick Soddy and John Desmond Bernal.

Where was the public in all this? It was present, surprisingly. The geniuses of science were known to the public, discoveries were celebrated, and science education was initiated in Britain in the form of working men's institutes with lectures on elementary science, and there were best-selling books, such as *Mathematics for the Million* (Hogben, 1937) and the *ABC of Relativity* (Russell, 1925). There was a lively interest in amateur science: radio clubs, for example, sent

small donations to support Jodrell Bank, the array of radiotelescopes that was the first major achievement of post-war British science. And this produced a particular inflection on the relation of science and the public – scientists wanted support and deference, and also, especially in the leftist science writing of the 1930s, claimed to have a fundamental solidarity with the working class by ascribing scientific knowledge to craftsmen and identifying scientists with the ‘workers’.

These writings, directed at the public, promoted a model of public engagement of science that was not far removed from Pearson’s: scientists were workers, but workers whose capacity for rationalising production and economic life generally made them *primus inter pares* in the future planned society, in which science itself would be planned for the public benefit. The plan would be produced collectively by the trade unions, representing the productive units of the plan, coordinated at the top by science. Science itself was understood as technology, a form of rational engineering that could be effectively applied to the problems that had formerly been addressed by markets and politics.

The idea of planning was a fetish of the 1930s. It was opposed by liberal scientists and economists, with the scientists calling for the preservation of the autonomy of science and its freedom. They also rejected the equation of science and technology. In both cases, part of the justification was efficiency – ironically, an idea central to Pearson – that made free markets and free science superior to planned science. And they did not support the idea that science could replace politics. But, in one of those dialectical moments that history occasionally provides, this discussion was upended by a scientific, technological and planned achievement that produced a radically new problem on the status of science and its relation to the public: the atomic bomb project.

The shock of the bomb led to a new sense of the responsibilities of scientists for the consequences of science. The reaction was powerful: scientists organised to assert themselves and sought ways to control the nuclear menace. The anti-nuclear movement in science was paralleled by a powerful social movement, the Campaign for Nuclear Disarmament. This added a new element that simultaneously empowered scientists, placed them in the public eye and demanded something new out of them. But their reaction traded on the same image of science as the font of authority, and the idea that this authority extended to politics,

especially to a domain of politics outside the planning paradigm: international politics. The idea was still that scientists, not politicians, should be in control.

This sense evolved in the face of political reality, and new hybrid organisations were created, especially the Pugwash conferences devoted to the eventual elimination of nuclear arms. This still asserted the authority of science. On the website of the organisation we read that 'The mission of the Pugwash Conferences on Science and World Affairs is to bring scientific insight and reason to bear' (Pugwash Conferences on Science and World Affairs, n.d). But it did so by 'meetings and projects that bring together scientists, experts, and policy makers'. This may seem like a minor change, but it was nevertheless important. The older social relations of the science movement, with its reliance on the model of craft unions to organise scientific workers, owed its inspiration to the guild socialism of the 1930s and to the idea of exclusion. Pugwash, which had a highly active UK branch, was based on a recognition that science was not the only voice that needed to be heard in order for scientists to carry out their own responsibilities.

Nuclear weaponry was a novel issue with implications for the future of humanity: a monster. It was an intellectual challenge and a comprehensive one: it challenged basic ideas of security and the meaning of life, as well as the whole notion of warfare and national security. It took a long time for central political institutions as well as their intellectual coteries in the fields of international relations and security studies to even grasp the issues. And the positions that ultimately emerged were not especially friendly to scientists. The topic was so large and complex that it generated counter-expertise, and a whole panoply of actors – scientists speaking as citizens and sometimes politicians, self-proclaimed spokespersons for humanity, social movements, a bomb literature like the war literature of the past, and many more. We now have more monsters and more people who have a stake in science, together with opinions that diverge from those of scientists and more organised movements and currents of thought.

From this point on one can discern two movements: on the one hand, science, in the form of such things as evidence-based decision making, risk analysis and regulatory science, appears in more and more domains. On the other, the practitioners in these new domains are compelled to deal with the people who already occupy them or

who have a stake in them and special knowledge about them: the public, policymakers, and practitioners and participants in related social movements or causes. The new landscape was produced by these two directions of change. Science now consisted of much more than laboratories and chalkboards, but there was no guide to this new landscape; its meanings had to be constructed on the fly.

The merit of detailed case studies is that they tell us something new. They tell us where old templates and old expectations are wrong, and complicate the attempt to reduce novel phenomena to a simple formula. In the case studies in this volume we find many complications.

In the first part of this book, on transparency and openness, we can begin to see the larger outlines of the problem. Openness and transparency are ideas that conceal many different and potentially conflicting agendas, even agendas that are entirely opposed, such as the use of the concept to enable the powerful to engage in surveillance as well as to empower the disempowered by giving them access to the knowledge and practices of the powerful in order to monitor them. From the point of view of democracy, this means that transparency can cut in many different ways to diminish the privacy and therefore autonomy of subjects as well as those of the powerful, who use secrecy as a weapon (see Worthy and Hazell, 2013). Open access is an example of the complexities of the consequences of actual policies, as Stephen Curry shows. The simple motivation is to get the taxpayers access to the science they have paid for, and perhaps more quickly than can be done by the traditional journal model of publication. But one startling effect, as he points out, is that the distinctions between real science and something less real are being radically undermined by the rise of rapid response blogging, which blurs the line between academic criticism controlled by the journal system and sheer opinion. He gives the example of a blog response to the questionable claim by NASA to have found microbes on Mars, to which NASA declined to respond. But recent events have shown this blurring to be more pervasive. There is the long-running (and much despised by scientists) practice of blogs criticising the claims of climate science, together with the example of 'methodological terrorism' practised by critics of the work of Princeton psychologist Susan Fiske in blogs, and not through private channels or the journal system (*Association for Psychological Science*, 2016; Letzter, 2016; Singal, 2016). Non-response to criticism is no longer an option, if one's public reputation matters.

Yet there can be strong motivations for transparency even where there are fundamental conflicts. Carmen McLeod shows, in her discussion of the issue of research involving laboratory animals, how openness initiatives in various countries attempted, with partial success, to overcome the distrust of animal-rights activists. As she notes, this is one of the longest running and most intense of all conflicts between science and society, marked by anti-vivisectionist legislation and occasional violence. Here, an organised effort by scientists to open up research has been made, with the aim of reducing opposition and increasing public trust. But cherry-picked information and the kinds of rationalistic utilitarian arguments presented with this information may, as she shows, have no effect on trust itself. Evidence-based policy is one of the mechanisms by which so-called expert practices suspected of arbitrariness can be opened up to scrutiny in contested spheres. But what is evidence? As Roda Madziva and Vivien Lowndes show, in the case of an immigration officer's determinations of persecution, the evidence is itself subject to systemic biases and errors, leading to new kinds of contestation.

In each of these cases, transparency is a double-edged sword. It is assumed that transparency places everyone at the same level. But, in part because of the different viewpoints of those whose activities are being made transparent and of those who are assessing the activities, the result is often the opposite: more contention and less trust. These are, however, cases of hands-off opening up and transparency, without actual engagement, geared more to the relations of science with an abstract public, such as the simple making of scientific publications available through open access. A new dimension is introduced with the attempt to deal with the same kinds of issues through the self-conscious creation of new, hybrid, organisational forms.

Future Earth is a project of exactly this kind: an attempt to bring together different forms of sustainability knowledge and create both a new kind of science and a new social contract between science and society. As Eleanor Hadley Kershaw, in the first chapter of the second part of the book, devoted to responsibility and openness, shows, this project is, however, plagued by ambiguities resulting from its ambition. The extent to which it can be regulated and made coherent and the openness to diversity required by its remit are particularly ambiguous. This points to a problem that becomes apparent in the next part of the book, on expertise: whether it is possible to create such a new

science with a new relation to society without the limitations of normal disciplinary knowledge. She suggests that perhaps the tensions and ambiguities are a virtue that will help sustain the project.

Alison Mohr describes a revealing example of another organisational innovation: a project to provide for a transition from traditional energy sources to low-carbon forms of energy in the global South. The SONG project was an attempt to co-design off-grid systems in Bangladesh and Kenya. It was transdisciplinary and offered an active role for social scientists. The framework, nevertheless, was top down. What emerged were unanticipated conflicts over justice and differing aspirations for the future between generations and genders, in a setting in which community inclusion was required. Here, the unexpected conflicts over issues of justice worked to undermine the project itself.

These cases raise a fundamental question about monstrosity, and the monstrosity of the unsolved and unresolved, which animates these conflicts. As Stevienna de Saille and Paul Martin note, the anthropologist Martijn Smits, writing on novel technologies, says that monsters embody 'characteristics that make them both horrifying and fascinating at the same time' (p. 149). This produces simultaneous fear and attraction that can never be reconciled. They are thus especially mythogenic, which becomes apparent in the controversies over genetically modified organisms (GMOs) and the earlier controversy over recombinant DNA and the use of synthetically modified algae as a source of oil to replace palm oil by a natural food company named Ecover. In these cases, engaging the public was not enough: the imaginaries constructed around the products, which were fed by larger social imaginaries, prevented these monsters from being tamed. And the idea of responsible innovation itself may be an attempt to resolve irreducible contradictions intrinsic to the innovations themselves.

One apparent solution to the problem of resistance to innovations is public inclusion in decision-making processes themselves. In the next part, entitled *Expertise*, Sarah Hartley and Adam Kokotovich deal with an example of this: the formal requirements for public involvement in risk assessment; that is, opening up the risk-assessment process itself. These are not often met in practice. But why? As the authors show, in the case of the European Food Safety Authority, the bureaucratic division of labour purports to separate value issues from science

and allocate distinct roles for the public and science. But this means that the implicit value judgements that are part of the science are excluded from public control and scrutiny. And the chapter points to another important phenomenon. Risk assessment itself is a case in which a bridge discipline is created that is not purely scientific and becomes 'disciplinary' in character, with the effect of undermining its openness to the public, despite the formal machinery provided of public involvement.

Judith Tsouvalis's study of ash dieback shows the complexity of the entanglement of science with regulatory and legal regimes, and the way in which these regulatory regimes can be backward looking. This makes it difficult for novel scientific results to have an effect. But the study points to a result similar to that found by Hartley and Kokotovich. Particular bureaucratic and academic specialties with quasi-scientific status, such as 'biosecurity', figure in this case, and these hybrid fields mediate between the more traditional science of plant pathology and an interested public. On the one hand, this novel discipline empowers the public by giving it someone to represent it and its interests. But it does so in ways that disempower the public by narrowing the issues into technical ones and excluding the public's own voices.

The issues we have encountered so far have typically involved conflicts between broader notions of participation and top-down models of public understanding of science, which involve the acceptance of the special authority of science. There is also a tropism toward disciplinarianism. The same tropism is evident in the development of the novel discipline of climate science. But climate science from the start had a policy objective and sought to influence public policy. It became spectacularly successful in this respect. But how? The film *An Inconvenient Truth* (AIT) by Al Gore (Guggenheim, 2006) represents an instructive case. Gore spoke both to, and on behalf of climate science, and for the people to the politicians. But the Gore story presents even more ambiguities. Gore created himself as a new type, a prophet-politician-activist-explainer of science, and the mediatisation of global warming shows new aspects of the relation between the public and science. The public needs, as Gore understood, to be created – to be formed, enlightened and energised as a force. And he succeeded by creating a phrase, 'an inconvenient truth', which, as Warren Pearce and Brigitte Nerlich explain, became instantly recognisable and part

of the language. But Gore's efforts also produced a counter-politics and a scientific counterpublic, made possible by the exaggerations that made *AIT* so successful.

Gore's movie is a solution to the problem of including the public. We can think of these cases as failed or only partially successful attempts at hybridisation and openness, but none of them were self-conscious attempts to open science or create a new relation between science and the public. Instead they were attempts to achieve goals or values of different kinds, from different perspectives and sources of knowledge, but in concert with one another, and in doing so they required the invention of particular forms, such as new discipline-like bodies of publicly valuable knowledge, or new templates that could be used to mobilise public sentiment. This differs from a self-conscious pursuit of novel forms of hybridity in the name of openness as a value, or out of a desire to bring science and the public together under a novel, organised intellectual structure.

But what is the public? Sujatha Raman, Pru Hobson-West, Mimi E. Lam and Kate Millar approach this problem through the issue of minority perspectives. As they note, discussions of the pluralisation of the public into unruly and competing perspectives has led to a neglect of the processes by which the public interest is itself constructed. In the case of animal research in the UK, where this is an especially salient issue, the construction involves opinion polls that serve to sideline protesters. The example of Canadian fisheries policy and the Canadian Government's legally adjudicated conflicts with First Nations' interests and conceptions shows how these minority viewpoints are marginalised, but also how they might be inserted into broader discussions of the public good.

What if science itself is the monster? This is the problem posed by the oldest of these conflicts, the conflict between religion and science, explored in the last part of the book, devoted to faith. In the two final chapters the theme is taken up by Fern Elsdon-Baker and by David Kirby and Amy Chambers, who make an interesting point about the ways that this conflict has been both managed and inflated. Elsdon-Baker discusses the construction of creationism as an alien doctrine threatening scientific progress and social progress. But as she shows, few people adhere to the full menu of the creationist doctrine, and ethical concerns over the doctrines of eugenics and practices of forced

sterilisation have historically fuelled opposition to a Darwinian world view. The inflated bogey of creationism is a monster that obscures these and other moral concerns. Kirby and Chambers reveal a history in which the Catholic Church in the USA endeavoured to influence the image of science through the mechanisms of quasi-voluntary censorship agreed to by Hollywood. Its concerns were various, but many of them involved the idea that science could replace God or lead to a future without God. It was the opposition of religion to science itself that especially perturbed it: the Church sought instead a kind of accommodation in which the limits of science were acknowledged and a place for religion retained. These chapters show that the binary oppositions between science, which Elsdon-Baker describes as a 'nebulous object', and its various 'others' are unstable and constantly being constructed and reconstructed. This is a lesson of the other chapters as well. Once we look closely at such things as the public, they, too, fragment and disappear.

When Hadley Kershaw alludes in her title to the Leviathan, the Hobbesian monster created by our actions in the form of a mysterious act of collective willing, it is a reminder that science is not the only creator of monsters. The state, with its inhuman power, the 'mortal God', as Hobbes put it, is also one of those things that has 'characteristics that make them horrible and fascinating at the same time'. Science routinely produces such results: whether it is the horrors of the treatment of laboratory animals or the idea that we have inadvertently, through our normal daily actions, produced the collective catastrophe of anthropogenic global warming, science is a special and prolific source of monsters. Openness and transparency are the supposed cure for this sense of the monstrous: they make science less alien. We can tame these monsters by turning them into ordinary objects of expert knowledge; for example, by making risk into the sort of thing that can be subjected to a bureaucratic regime, with a hybrid discipline of risk assessment and a special provision for public input. Or we can mediate the oppositions that give rise to the monsters and which the monsters in their dual nature embody by constructing and reconstructing them, or by creating social and epistemic movements, such as Future Earth, in which the oppositions become prosaic organisational problems. But in the end these devices create new monsters that are as alien as the old ones.

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