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Science as a Public Good

Philip Moriarty

A change in culture

I have a confession to make. It's a difficult admission in the current funding climate for academics in the UK, but here it is: I am a scientist. Not an engineer. Not a technologist. And certainly not an entrepreneur. I pursue basic research into fundamental questions about the properties of matter on a variety of different length scales (ranging, in my case, from sub-atomic to sub-millimetre dimensions), in common with a very large number of my colleagues working in the physical and life sciences in British universities. Whether or not this research can be translated into a marketable product, exploited as profitable intellectual property (IP), or applied in technology is not what motivates me. My motivation, again in common with the majority of academic scientists in the UK,¹ lies in improving our understanding of nature, generating (not protecting) new knowledge, and disseminating my findings to other scientists, students and society at large.

Despite their regular claims to the contrary (which I dissect below), this 'traditional' view of the societal value of scientific research is now anathema both to Research Councils UK (RCUK), the umbrella organization for the seven research councils which fund the bulk of academic research in the UK, and to the Higher Education Funding Council for England (HEFCE). Since 2007 there has been a series of changes to RCUK funding strategies with the primary aim of inculcating a 'culture change' in academic science, so as to 'shorten the innovation chain' (Corbyn 2009). Government initiatives to make academia more 'business-facing' have, of course, a rather longer history, as also outlined below but described at length elsewhere (for example, Finlayson and

Hayward 2010; Langley and Parkinson 2009). In parallel with the changes to RCUK policy, HEFCE has introduced an analysis and ranking of socioeconomic ‘impact’ into its Research Excellence Framework – the primary vehicle for the assessment of academic research in UK universities and the determinant of the allocation of the so-called quality-related (QR) component of the HEFCE budget to UK universities.

In this chapter I will critique RCUK’s and HEFCE’s strategies to enhance the socioeconomic impact of scientific research (the so-called impact agenda) by their ‘incentivization’ of UK academics to target problems of direct short-term socioeconomic interest. Not only do the research/funding council strategies run counter to the ethos of publicly funded academic science, and significantly compromise the societal value (and trustworthiness) of university research, but they are, perhaps counter-intuitively, of *economically* questionable value.

The issues I raise are, of course, far from new; the arguments regarding the cultural, economic and societal value of *disinterested*, curiosity-driven research have been convincingly made for many decades by commentators and researchers in a broad variety of fields. My aim, however, is to place these arguments in the context of the current funding climate for academic scientists in the UK and to describe how changes to the policies and strategies of the UK funding bodies over the last five years will have dramatic and irrevocable effects on the ethos, trustworthiness, creativity and socioeconomic impact of university science.

Merton (1942) and Ziman (2000), in particular, have highlighted the central importance of the disinterestedness of scientists in attacking a research problem. While many might argue, with strong justification, that the traditional picture of objective, entirely rational scientists seeking the truth is far from an accurate portrayal of scientific activity (Ziman himself frequently disparages this as ‘the Legend’, for example), disinterestedness is nonetheless at the very heart of the scientific method. It is something that all scientists must strive to achieve if their work is to be trustworthy and of value to not only their peers but to science and society in general. As Ziman put it, ‘Disinterested science is essentially a moral enterprise sustained by a tacit ethos of mutual trust. This ethos is being fatally undermined by enforced cohabitation with instrumental research’ (2002: 399). As I will show in the following sections, not only are RCUK and HEFCE not concerned about the erosion of disinterested science in UK universities, they are actively driving its demise.

Of course, one can argue that the socioeconomic and sociopolitical ‘landscape’ in twenty-first century British society differs distinctly from that in decades gone by and that funding strategies that were workable in the 1970s, for example, may be rather less viable in 2011. But this rather misses the key point: the qualities and attributes of good science from the 1970s – or any other decade for that matter – are precisely the same as those in the twenty-first century². The ultimate goal of the RCUK/HEFCE impact agenda is not to improve the quality of UK science (which, by a variety of metrics, is already at the very least internationally competitive and, in a range of fields, of world-leading standing). Rather, it is to drive universities to become not only business-facing but *business-led*, involving an evolution of academic science from a public to a private good, and a concomitant focus on utilitarian, near-market and applied research. Remarkably, and rather cannily on the part of the funding bodies, this highly damaging corruption of the ethos of the university is ‘sold’ as being entirely in the public interest.

Eroding the Mertonian norms

In a highly influential paper, Robert K. Merton laid down the attributes of what he termed the normative structure of science (Merton 1942). Merton initially put forward four sets of what he called institutional imperatives comprising the scientific ethos, namely universalism, commun(al)ism, disinterestedness and scepticism.³ It is worth quoting from Merton at length because it is remarkable just how valuable his insights remain seventy years after their publication. On the communism norm he wrote:

Communism, in the nontechnical and extended sense of common ownership of goods, is [an] integral element of the scientific ethos. The substantive findings of science are a product of social collaboration and are assigned to the community. They constitute a common heritage in which the equity of the individual producer is severely limited. An eponymous law or theory does not enter into the exclusive possession of the discovered and his heirs, nor do the mores bestow upon them special rights of use and disposition. (1942: 270)

Compare Merton's eloquent espousal of the common ownership of scientific ideas and discoveries with a number of statements in the RCUK response to the Lambert Review of business-university collaboration:

[The Natural Environment Research Council]'s interest in business-university collaboration is to support the transfer of knowledge from producers (NERC funded scientists) to business users ... NERC places a high priority on supporting links between NERC funded researchers and the business community, and business views are considered at all levels of decision making. (RCUK 2003: 19)

[A] focus of the [Particle Physics and Astronomy Research Council] PPARC⁴ is encouraging an entrepreneurial culture, particularly at the early stages of a research career ... to help commercialise ideas originating from PPARC funding – usually in the form of start-up companies. We would be happy to work with senior management and technology transfer offices in universities to help change the culture towards encouraging business links and entrepreneurship in physics departments. (RCUK 2003: 21–2)

[The Biotechnology and Biological Sciences Research Council] BBSRC takes the view that commercial activity is best performed by the research generator and therefore delegates responsibility for the identification, management and exploitation of IP arising from research supported by Council to the university or institute undertaking that research. (RCUK 2003: 6)

The contrast between the Mertonian norm of communalism and the research councils' drive to embed an entrepreneurial culture in academic science could not be more stark. This focus on commercialization, IP-derived income streams and entrepreneurship has developed and strengthened considerably since the Lambert Review in 2003. Following hot on the heels of Lambert's report came the publication of the Warry (2006), Leitch (Leitch 2006) and Sainsbury (2007) reviews. In each case, the emphasis was on developing the 'business-facing' character of British universities via the protection, rather than free dissemination, of scientific knowledge so that it could be commercially exploited as intellectual property.

What is particularly disturbing about RCUK's strong commitment to the development of an entrepreneurial academic culture is that the research councils were perfectly happy to abrogate all responsibility for the management and exploitation of IP to the universities and institutions/

companies involved in the research, despite that intellectual property having been generated from public funds disbursed by the councils. (See, for example, the final quote from the RCUK response to the Leitch review above.) It is only very recently that RCUK has attempted to address this issue by adding a statement to its expectations regarding the exploitation of intellectual property: ‘The Research Councils may, in individual cases, reserve the right to retain ownership of intellectual property and to arrange for it to be exploited for the national benefit in other ways’ (RCUK 2011). While including this proviso is laudable, a cynic might ask quite how often RCUK will ‘retain ownership’ of IP for the public good. In any case, Langley and Parkinson (Langley and Parkinson 2009) have provided compelling evidence that RCUK-funded research is increasingly driven by narrow commercial imperatives rather than being motivated by either scientific curiosity or the wider public benefit. In fact, public benefit is made equivalent to the contribution to economic growth organized in terms of private interest.

Although a discussion of RCUK and HEFCE funding policy in the context of all five Mertonian norms would be instructive, I would like to focus here instead on just one other norm, *disinterestedness*, given its central importance in the scientific method. It is the erosion of disinterested research – implicitly coupled, of course, with the demise of the norm of communalism – that is arguably most damaging to publicly funded science in the UK.

A key aspect of the disinterestedness norm is perhaps best summed up by the pithy proclamation attributed to Einstein: ‘If we knew what we were doing, it wouldn’t be called research, would it?’ Scientists involved in fundamental research are traditionally driven by curiosity – they carry out their work not to ‘engage with users’ nor to ‘generate impact’ but to address a question, or series of questions, about how nature behaves. If, in attempting to answer that question, they discover serendipitously a more interesting avenue of research then they should be free to ‘follow their nose’ and explore because no one knows where that particular line of enquiry might lead. Their research may, of course, ultimately have quite remarkable economic and societal spin-offs but that is not the original motivation for carrying out the work.

Basic scientific research – also variously labelled fundamental, or blue skies, or curiosity-driven science – is a process of exploration and discovery with, in the best cases, a strong dose of creativity and imagination added to the mix. The distinction between applied and

fundamental research is a vexed issue, with scientists themselves generally struggling to delineate the two activities (Calvert 2006), but it is certainly possible to distinguish between the extremes on the applied-fundamental continuum, i.e. between near-term activities targeted at addressing market-led technology development (that is, research which is closer to the 'D' component of 'R&D') and exploratory, disinterested science which is focused on answering fundamental questions about nature with little or no concern for potential applicability. The difficulty with attempting to attach labels such as basic/blueskies applied/curiosity-driven to these distinct types of science is that different sectors can have conflicting interpretations of the labels. For example, the 2009 'Global R&D Funding Forecast' by Battelle makes the important point that:

The term 'basic research' as interpreted and applied by industry is not the same as that employed by other sectors. In general, the term as applied in an industrial context is perhaps better defined as 'directed basic research', i.e. generally directed toward activities in support of the lines of business,⁵ rather than pure research that's directed toward establishing a baseline of knowledge. (2009: 11)

Charting the boundaries between 'pure' and 'applied' science is thus fraught with difficulties.⁶ For example, the oft-derided linear model is perhaps not quite as flawed a description of the 'innovation eco-system' – or, at least, certain key aspects of that system – as is traditionally thought (Balconi, Brusoni and Orsenigo 2010). Nonetheless, the Mertonian norms – particularly those of communalism and disinterestedness – remain as a set of guiding principles which can be used to broadly distinguish traditional academic science from the commercialized, entrepreneurial and near-market scientific R&D that is increasingly promoted (either directly or indirectly) by the UK research and funding councils. But to what extent do the Mertonian norms stand up to scrutiny in the twenty-first century? Are they seen by working scientists simply as a bygone relic of a largely apocryphal 'golden' age or are they viewed as an integral 'value set' for modern science? If the latter holds true, then there exists a striking and damaging conflict between the research councils' oft-stated aim to establish an entrepreneurial culture and the motivations of academic scientists.

Mertonian myths?

Anderson *et al.* (2010) have published the results of focus group interviews and national survey studies that have sought to elucidate the extent to which US scientists subscribe to the Mertonian norms. Theirs is an important and timely paper which, despite highlighting the limitations associated with any attempt to provide a definitive ‘normative structure’ for science (whether complemented by counter-norms or not), shows that subscription to the Mertonian norms amongst US scientists is very high (ranging from 73 per cent to 91 per cent of the scientists involved in their study). As Anderson *et al.* put it, ‘The Mertonian norms, as principles representative of the normative system of science, have been challenged, attacked, dismissed, contested, inconsistently referenced, and, in short, battered and bruised by controversy and careless application. They nonetheless have endured for over 65 years as part of the communal property of science’ (2010: 391).

Anderson *et al.* provide a helpful summary of the more high profile critiques to which they allude in the quote above, highlighting Mulkay’s criticisms (Mulkay 1976) in particular. Mulkay argued that Merton’s norms represent nothing more than the expectations of ‘outsiders’, i.e. they act simply to enforce a particular ‘external’ stereotype which does not really represent the scientific process – rather than providing an accurate picture of the social interactions and expectations underpinning the day-to-day activities of scientists. A significant number of sociologists have raised similar criticisms, to the extent that Hess, for example, has argued that ‘For decades the consensus among social scientists has been that, as descriptions of the norms that actually guide scientists’ action, Merton’s norms do not exist in any pervasive form’ (1997: 57). And yet Anderson *et al.* find that the Mertonian norms ‘resonate’ strongly with a large majority of the US scientists they surveyed (without, of course, those norms being explicitly ‘taught’ in the majority of cases). This appears at first glance to be somewhat paradoxical.

The reconciliation of the traditional sociological view of the Mertonian norms with the results of Anderson *et al.*’s study lies in the idealized nature of the CUDOS principles. As Anderson and her co-authors note, Hess qualifies the statement quoted above with the important observation that, ‘It is possible to salvage Merton’s delineation of the norms of science, but only as a prescription of how scientists should

behave ideally' (1997: 57). Kellog makes much the same point but rather more expansively:

Yet though Merton's particular form of analysis may seem outdated from one perspective, the norms he named in 1942 have persisted impressively in public understanding. We still tend to assume that science follows the Mertonian framework – or would, if social factors did not keep getting in the way. Of course claims should be evaluated on their merit, not on who made them; of course scientific knowledge should be open to inspection and evaluation; of course personal interests should be subordinated to the scientific enterprise; of course the institutions of science should pursue rigorous testing of hypotheses. Such views are hardly controversial; they represent the conventional wisdom about what we think, or what we hope, science to be. (The status of such views as conventional wisdom helps explain the widespread resistance among scientists to strong claims by the sociology of science, which are taken as attacking the realization, if not the ambition, of scientific practice.) (2006: 6)

Given Kellog's assertion that the Mertonian norms have 'persisted impressively' in the public perception of science, it is perhaps hardly surprising that Anderson *et al.* find that the majority of scientists strongly subscribe to them. While it may be difficult, in the face of a broad array of internal and external sociological factors, for scientists always to uphold the Mertonian ideals, one might at least hope that public funding agencies would aim to establish an academic environment that protects, rather than erodes, Merton's norms.⁷ This, however, is certainly not the case. Perhaps the most dispiriting aspect of the RCUK/HEFCE impact agenda is that, under the guise of greater public accountability, it fosters a culture in UK academic science that is at odds, to a greater or lesser extent, with each of the values represented by the CUDOS acronym.

CUDOS vs PLACE, Mode 2 vs Mode 1, 'Post-academia' vs Academia?

In *Real Science: What it is, and What it Means* (2000), John Ziman compares the norms of industrial science with those of academic science, neatly encapsulating the inherent friction between the two cultures in the 'PLACE' acronym (to contrast with Merton's 'CUDOS'). Industrial science is proprietary (as opposed to communalist); local (not universal); authoritarian (vs disinterested); commissioned (as opposed to original);

and expert (rather than sceptical).⁸ The contrast with academic science is striking; attempting to embed the PLACE norms within the Mertonian scientific worldview necessitates a convergence of diametrically opposed cultures and working practices. While one can, of course, convincingly argue that the industrial/academic science division is far from as clear-cut as the PLACE/CUDOS comparison would suggest, merging the two modes of research nonetheless requires a jarring clash of cultures.

Ziman referred to the convergence of industrial and academic science as *post-academic*. Others have used the term 'Mode 2' research (Gibbons *et al.* 1994), where 'Mode 1' is in essence what is described as academic or 'Mertonian' science. There are subtle, and not-so-subtle, differences between Ziman's concept of post-academia and Mode 2 research and it is worth spending a moment to disentangle the two. Helga Nowotny, currently President of the European Research Council and one of the authors of the seminal paper which introduced the 'Mode 2' concept, has eloquently described the differences between post-academic and Mode-2 research (Nowotny 2006). The key distinction is that Ziman saw the evolution of post-academic science as representing the death of the Mertonian norms, where instead of disinterested publicly funded scientists seeking after 'the truth' (however 'the truth' might be defined), in post-academia 'socio-economic power is the final authority' (Ziman 2000; 174), with scientific creativity and exploration eventually succumbing to external governmental and/or industrial pressures for near-term or near-market applicability.

Nowotny, while still a staunch and passionate advocate of blue-skies research, is rather more optimistic and, along with her colleagues, argues that curiosity-driven science is sufficiently robust to endure socioeconomic, governmental and industrial pressures. I, unfortunately, do not share Nowotny's optimism. Scientific curiosity, disinterestedness and creativity are all adversely affected by the UK research and funding councils' impact agenda, either directly via grant funding decisions or indirectly via universities' encouragement of academics to skew their research towards work which aligns more readily with RCUK/HEFCE strategic priorities and/or demonstrates a short-term impact that can be readily quantified. The indirect incentivization pathway is crucial: university management is entirely complicit in the erosion of the ethos of academic science.

The impact agenda: facilitating the expansion of post-academic science in the UK

In summary, the Mertonian norms are being systematically eroded in British academia via the RCUK/HEFCE ‘impact agenda’ (and associated policies) and the compliance of university management, facilitating a rapid acceleration in the development of a post-academic/Mode 2 culture. The Engineering and Physical Sciences Research Council (EPSRC) is an especially interesting case in this regard because, in addition to the requirement for grant applicants to describe the ‘pathways to impact’ of their research (as also expected by all other research councils), EPSRC explicitly stated as part of its 2011–2014 Delivery Plan that it will move from being a funder to a sponsor of research, ‘where [its] investments act as a national resource focussed on outcomes for the UK good’ (EPSRC 2011: 6). EPSRC’s evolution from funder to sponsor is an archetypal example of the inculcation of a post-academic culture in university science and thus warrants careful study.⁹ In order to understand the impetus for the funder-to-sponsor transition, it will be helpful to first briefly outline the history of EPSRC’s (and RCUK’s) strategy to embed an assessment of potential (socio)economic impact in the peer review process – the so-called ‘impact agenda’. The impact agenda and EPSRC’s adoption of the role of research sponsor are complementary aspects of the drive to ensure greater near-term ‘responsiveness’ of academic research to socioeconomic pressures. Ziman’s writings on the evolution of post-academic science, and his pessimism with regard to the extinction of academic science, can be seen as remarkably prescient in the context of the impact agenda.

The recent history of the UK government’s efforts to encourage industrial engagement with academic science is long and tortuously involved. Langley and Parkinson (2009) provide a helpful timeline of major milestones in the commercialization of UK universities, spanning the Faraday Partnerships scheme set up by the Department of Trade and Industry in 1991; the publication of Waldegrave’s *Realising our Potential* White Paper in 1993; the Roberts, Lambert, Warry, Leitch, and Sainsbury reports from 2002 to 2007 respectively; through to the creation of the Department of Business, Innovation and Skills in 2009 under the New Labour government. I will focus entirely on events since the publication of the Warry Report in 2006 which set in motion the research councils’

drive to accelerate the establishment of a ‘post-academic’ or ‘Mode 2’ culture via the impact agenda (Warry Report 2006).

The Warry Report was very clear in its ambitions regarding culture change in British academia (echoing Waldegrave’s aspiration to ‘to achieve a key cultural change... between the scientific community, industry, and government departments’ (1993: 5). Entitled *Increasing the Economic Impact of the Research Councils*, the key recommendations of the report were as follows:

Chairs of Research Councils should ensure that economic impact is given a high profile in Council strategy ... One of the Research Council chief executives should be nominated by RCUK to champion the work on economic impact across all Councils. (Warry Report 2006: 3) [This led to the creation of the ‘RCUK Impact Champion’ post.]

The Research Councils should influence the behaviour of universities, research institutes and Funding Councils in ways that will increase the economic impact of Research Council funding. (Warry Report 2006: 3)

RCUK should engage Government, business and the public services in a wide-ranging dialogue to develop overarching, economically relevant research missions. These missions should address major strategic challenges for the UK ... [and] be in areas where the UK wishes to become a world leader (e.g. Energy, Creative Industries and eScience). (Warry Report 2006: 4)

Research Councils [should] allocate a substantial part of their funding to programmes relevant to their user communities. These programmes should engage economic stakeholders; form part of each Research Council’s overall strategic plan; give greater prominence to follow-on funding to develop promising research results to a stage where they attract external investment. (Warry Report 2006: 4–5)

On the matter of peer review, Warry made the following proposals. Note the incorporation of a strong element of *user* review (which, as Finlayson and Hayward [2009] pointedly note, is not the same thing at all as *peer* review) and the remarkably naive suggestion that scientists and other academics can be trained to accurately assess – indeed, ‘score’ (i.e. rank) – the economic impact of grant proposals.

Research Councils should ensure that:

- Peer review panels contain members expert in identifying work of potential economic importance;
- Reviewers' training includes the importance of economic relevance to the overall Council mission;
- Guidelines for reviewers are clear on how they should score the economic impact of bids and how this score is related to the other measures by which bids are assessed. (Warry Report 2006: 5)

Shortly following the publication of the Warry Report, RCUK carried out a consultation on the efficiency and effectiveness of peer review (RCUK 2006). On the matter of the Warry Report's recommendations on peer review of economic impact, RCUK asked the following questions and invited universities, learned societies, professional bodies, research institutes and so on to respond: 'Without compromising research quality, how could Research Councils develop the peer review process to ensure that potential economic impact is effectively reflected within proposal assessment? How can Research Councils ensure that reviewers have the skills, experience and information necessary to assess effectively potential economic impact?' (2006: 4)

The response to the consultation on the issue of the inclusion of economic impact criteria in peer review was overwhelmingly negative (RCUK 2007).¹⁰ For example, the University of Cambridge responded as follows: 'We find this part of the consultation somewhat baffling. ... To assess potential impact of a research proposal, beyond potential application (as is already done), before the research is undertaken, at the granularity of an individual proposal, is patently silly.' North of the border, the University of Glasgow was similarly baffled:

We believe the recommendations of the Warry report related to the peer review process to be worryingly naïve. The connection between a specific research project and economic impact is difficult if not impossible to evaluate. Economic impact itself is not a well-defined concept supported by a body of theory enabling the calculation of an economic impact factor. The economic impact of a research project may not be made for decades after the research has been completed, and often not in the research field itself.

The University of Nottingham was, if anything, even more perplexed

than both Cambridge and Glasgow: ‘This option appears to fly in the face of the purpose of “research” within universities ... could stifle highly imaginative, original and creative work, or lead to dubious, often irrefutable, claims in many areas of science – especially fundamental/“blue skies” research.’

But this was a consultation in the best New Labour sense of the term. Thus, the concerns voiced by the majority of the respondents regarding inclusion of economic impact criteria in peer review were effectively ignored by RCUK. EPSRC introduced an assessment of economic impact¹¹ into the peer review process in April 2009 (and was met with silence by those very many universities who had strongly criticized the inclusion of economic impact criteria as ‘patently silly’ and ‘worryingly naive’). From that date onwards all grant applicants have been required to submit a two-page ‘impact statement’ outlining how their research has the potential to ‘foster global economic performance, and specifically the economic competitiveness of the United Kingdom’, ‘increase the effectiveness of public services and policy’, and/or ‘enhance quality of life, health, and creative output’ (RCUK 2009). Moreover, applicants are expected to define ‘realistic timescales for the benefits to be realized’ (RCUK 2009). Following EPSRC’s introduction of the impact statement requirement, the other research councils followed suit.

The Mertonian norms are clearly heavily compromised by the requirement that scientists lay out the socioeconomic impact of their research in advance (with their proposals subsequently judged and ranked on the basis of alignment with those short-term/near-market objectives). The extent to which the disinterestedness norm has been eroded is perhaps best illustrated by RCUK’s ‘Top ten tips for completing the “pathways to impact” statement’ (RCUK 2010). Tip number one on this list is ‘Draft the Impact Summary very early in your preparation, so that it informs the design of your research.’ Similarly, tip five tells us that, ‘Most proposals aim to engage with beneficiaries and end users. Where possible, and for impact activities to be more effective, end users should be involved from the outset of the research design process to maximise the potential up-take and application of the research.’ In other words, define the outcomes, users and beneficiaries of your work and design the research project accordingly. This is not how scientific research proceeds; it is a prescription more in line with the ‘D’ component of a near-market R&D programme (and thus entirely consistent with RCUK’s stated aim to shorten the innovation chain).

In parallel with RCUK's 'Pathways to Impact' initiative, HEFCE modified its Research Assessment Exercise (RAE) to incorporate 'impact' as a criterion with a weighting of 20 per cent (the RAE was renamed the Research Excellence Framework, REF, in 2007). Echoing the research councils' response to the negative feedback it received on the question of introducing economic impact criteria in peer review, HEFCE dismissed a petition, organized by the University and College Union and signed by 17,500 academics (including six Nobel laureates), which called for the withdrawal of the inclusion of a consideration of impact in the REF. The petition argued that, 'The REF proposals are founded on a lack of understanding of how knowledge advances. It is often difficult to predict which research will create the greatest practical impact. History shows us that in many instances it is curiosity-driven research that has led to major scientific and cultural advances' (University and College Union 2009).

For the public good?

RCUK and HEFCE repeatedly make the argument that the impact agenda is simply a mechanism to enhance public accountability and to improve the return on taxpayers' investment in research. University researchers who oppose the impact agenda are cast by HEFCE/RCUK as reactionary ivory tower academics who are unwilling to accept that academic research must contribute to the public good – a deeply frustrating straw-man argument. I have argued that by compromising the Mertonian norms to the extent required by the impact agenda, the UK research and funding councils do not enhance the public good aspects of academic science. Instead, they are driving publicly funded university research ever-closer to the PLACE norms of industrial science. Far from improving accountability and transparency, this will embed a culture of intellectual property protection and commercial exploitation entirely at odds with the ethos of academia and, ultimately, compromising public trust in science (something increasingly significant in the light of risks of global warming and food sustainability).

But does a focus on protecting knowledge and intellectual property generated from publicly funded science, with all the associated compromises regarding the openness, reliability and trustworthiness of academic research, actually pay off in terms of economic benefit? Richard

R. Nelson, in a highly cited paper, considered the relationship between the market economy and the publicly supported ‘scientific commons’, highlighting that, ‘the perception of how the modern science system actually works has eroded the notion that it is important to keep science open’ (2004: 457). This is ‘a serious mistake’ and Nelson – a serious and sober commentator hardly given to fits of hyperbole – wants to ‘call the alarm’. Citing a number of classics in science funding policy – including Vannevar Bush’s *Science the Endless Frontier* (1945) and Polanyi’s ‘The republic of science’ (1967) – Nelson eloquently lays out the intrinsic tension that exists between the norms of the publicly funded science base and, as he puts it, the ‘capitalist engine’ of scientific advancement. While admitting that there are deficiencies in the Mertonian view of science, Nelson strongly argued that the communal (or ‘communitarian’) aspects of science are, as economists have long argued, key to extracting the greatest level of public value from university research. Nelson makes a very strong statement on the importance of maintaining science in the public domain: ‘To privatize basic knowledge is a danger both for the advance of science, and for the advance of technology’ (2004: 456).

Yet, as detailed throughout this chapter, the Research Councils UK argue that what is required of academic science is a culture change such that university researchers become more entrepreneurial and, thus, focus on the wealth-creating/spin-off/IP potential of their research. In the research councils’ view this somehow has the potential simultaneously to shorten the innovation chain and to ensure the integrity of curiosity-driven research. As Nelson and many others have pointed out, however, the two approaches to academic science – entrepreneurial/market-driven R&D vs open science carried out in the spirit of the Mertonian norms – are diametrically opposed and ‘enforced co-habitation’, to use Ziman’s description, dramatically undermines curiosity-driven research. What is perhaps less intuitive is that a focus on near-market deliverables and the privatization of the results of scientific research has the potential to be *economically* damaging, i.e. to reduce, rather than enhance, return on government investment in research. Due to the introduction, over thirty years ago, of legislation specifically targeted at enhancing the commercial uptake of academic research, i.e. the Bayh–Dole Act of 1980, US academia represents an important model system in which to analyse the merits and demerits of attempts to embed an entrepreneurial culture in academia.

US Congress passed the Bayh–Dole Act to address what was perceived

to be a major problem with the commercialization of (federally funded) academic research, namely state ownership of intellectual property rights. Bayh–Dole allowed universities, and federally contracted research carried out by other types of institution, to patent inventions arising from publicly funded research. While Bayh–Dole was heralded in some quarters as a boon to the US economy and society in general, there has been a steadily increasing number of papers that have questioned whether the university invention ownership model for which the Act legislates has actually driven greater economic efficiency or has improved the public value of discoveries and inventions arising from academic science and engineering. Nelson was far from an enthusiastic fan of Bayh–Dole, arguing that, ‘long prior to Bayh–Dole, the American university research system had a well known record of strong performance in doing research that contributed to technical progress and industrial development, and strong efforts in technology transfer. The latter almost always was accomplished without the university claiming any intellectual property rights’ (2001: 16). Nelson made strong economic arguments that intellectual property rights should not be associated with fundamental discoveries, even calling for patent law to be rewritten so as to prohibit universities from patenting the results of basic research. In a remarkably strongly worded editorial in 2004, the *Lancet* echoed Nelson’s concerns, stating that ‘academics have a choice – to develop their entrepreneurial skills or to maintain a commitment to public-interest science – and we do not accept that the two options are mutually compatible’ (James *et al*, 2004).

Nelson’s strong criticism of Bayh–Dole was followed by a considerable number of similarly critical papers and books (including Washburn 2005 and Greenberg 2007). Fabrizio (2007) puts forward strong evidence that a focus on university patenting slows, rather than accelerates, knowledge transfer to industry. Kenney and Patton (2009) identify a series of deficiencies in the Bayh–Dole model and put forward two possible solutions – vesting ownership of any invention with the inventor or, more radically, to place information regarding all publicly funded inventions and discoveries in the public domain. They are stinging in their criticism of those policy-makers who attempt to mimic the US university invention/patent ownership model and disagree strongly with the Organisation for Economic Co-operation and Development (OECD)’s *Turning Science into Business: Patenting and Licensing at Public Research Organisations* report (2003), which claims that there is

a pressing need to generate support for university patenting and related activities. A similar ‘urgency’ regarding patent and spin-off generation from academic research is found in almost every European Commission document focused on the European Research Area in the context of the multibillion euro Framework Programmes. It is therefore perhaps not too surprising to note that there is a strong focus on patent and spin-off generation in the physics case study examples selected from the Research Excellent Framework Impact pilot study (HEFCE 2010).

Ironically, the key motivation for the introduction of the impact agenda is that university scientists are expected to ‘pick up the slack’ for deficiencies elsewhere in the UK innovation system. But innovation, as typically understood by the government and industry, cannot be driven by ‘Mertonian’ science (whose orientation is much too long term). Scientific research in academia is of course a key source of innovation but currently not on timescales that are sufficiently customer- or ‘stakeholder’-focused for industry and government. It is the short-term incremental innovation identified by Kline and Rosenberg (1986) that private industry (and therefore government) is so keen to foster in universities. The fine words of David Willetts, UK Minister for Universities and Science, regarding the fundamental role of academic research in improving the ‘absorptive capacity’ of society (quoted in Jump 2010) have been quickly forgotten in the drive to make university science more ‘business facing’.

While it is perhaps not so surprising that politicians do not appreciate the benefits of university science – and, indeed, higher education in general – as anything other than a key contributor to the ‘knowledge-based economy’ – what is perhaps most dispiriting about the impact agenda is the extent to which the research councils and, most worryingly of all, universities themselves have abandoned any commitment to truly disinterested, curiosity-driven research ‘whose applications may take time to emerge, if [they do] at all’ (to quote David Willetts again). Before drawing up yet another strategy document aiming to ‘incentivize’ academics to maximize the value of the intellectual property they ‘generate’ and/or deliver maximum impact from their research, each vice-chancellor and pro-vice chancellor in the UK should be obligated to read and reflect on Boulton and Lucas’s words on the societal role of the university:

Universities are not just supermarkets for a variety of public and private goods that are currently in demand, and whose value is defined by their

perceived aggregate financial value. We assert that they have a deeper, fundamental role that permits them to adapt and respond to the changing values and needs of successive generations, and from which the outputs cherished by governments are but secondary derivatives. To define the university enterprise by these specific outputs, and to fund it only through metrics that measure them, is to misunderstand the nature of the enterprise and its potential to deliver social benefit. (2008: 17)