

## ***Battle of Ideas* survey report:**

### **What are the barriers to science in the 21<sup>st</sup> Century?**

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This survey and report have been produced in preparation for the *Battle of Ideas* festival 27 and 28 October 2007, Royal College of Art, London. Tickets: 020 7269 9220 or [www.battleofideas.com](http://www.battleofideas.com)

### **What are the barriers to science in the 21<sup>st</sup> Century?**

In recent years, the UK government has trumpeted the importance of science. Tony Blair described himself as ‘born-again’ on the subject and Gordon Brown, while still Chancellor, opened up the coffers. But the money available to scientific research seems to come at a price. Scientists are increasingly expected to fulfil demands that are less about the pursuit of knowledge than the instrumental benefits – and potential ethical perils – of their research. Today’s scientists are expected to keep one eye on the ‘knowledge transfer’ potential of their work and another on possible risks. Questions about the likely benefits for the economy, healthcare or the environment are high on funding bodies’ minds, as are questions about the likelihood of ‘success’.

Are these reasonable demands to make of scientists? Should the public funding of basic science be tied to potential beneficial outcomes for society, or are we closing down possibilities by asking science to deliver prematurely? What barriers does science face in the 21st century and what can we do to challenge them? Is a more open-ended approach to the pursuit of knowledge possible, or indeed desirable?

The above are questions scientists and others will be debating at this year’s *Battle of Ideas* festival at the Royal College of Art, London on Saturday 27<sup>th</sup> and Sunday 28<sup>th</sup> October 2007.

In advance of this debate the Institute of Ideas surveyed a wide range of scientists about their views on these questions. This is a report of our findings.

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## Key findings

- Most scientists believe research councils and the government ‘adopt too instrumental an approach towards scientific research’ whilst universities are viewed more favourably. 84% of scientists who expressed an opinion answered ‘Yes’ to the question: ‘Does the government adopt too instrumental an approach towards scientific research in general?’ compared to only 16% who answered ‘No’.
- 47% of scientists think that the government places ‘too much’ emphasis on knowledge transfer and securing economic benefits from scientific research compared to 25% who think the emphasis is ‘too little’. Universities are more likely to be seen as having the emphasis ‘about right’ whilst opinion is divided over the research councils.
- 53% of scientists think the government places ‘too much emphasis on areas of research relevant to current government policy priorities (e.g. obesity, climate change, terrorism)’. Only 13% said the emphasis was ‘too little’.
- Approximately equal numbers of scientists think ethical oversight and regulation of scientists’ work has ‘gone too far’ (41%) or is ‘about right’ (40%). Only 10% responded that it had not gone far enough.
- 37% of scientists think that ethical oversight and regulation has had a negative impact on public perceptions of science, and only 15% think the impact has been positive. A further 31% think its impact is neutral.
- 85% of scientists think that ‘the disinterested pursuit of knowledge, free from external pressures’ is a desirable goal for university scientists in the 21st Century. But only 51% see this as a realistic goal.

## About the survey participants

This was a self-reported survey conducted between Monday 8 October and Monday 22 October\* using the web tool surveymonkey.com.

**204 surveys were completed.**

*Which of the following best describes your position?*

University or other academic institution	81%
Charitable or not-for-profit research organisation	6%
Commercial research organisation	3%
Other	10%

*Which of the following best describes your position?*

Institution or department head	10%
I run my own laboratory	22%
I have my own grants	17%
Postdoc	15%
Postgrad	12%
Other	24%

*Age*

15-24	5%
25-34	27%
35-44	22%
45-54	18%
55-64	16%
65+	12%

*Sex*

Female	28%
Male	72%

\*Note: additional qualitative responses received from a small number of scientists after these dates have been included in this report. Quantitative responses are for the 204 individuals who completed the survey during the time period specified.

## Have we become too instrumental in our approach towards science?

Most scientists believe research councils and the government ‘adopt too instrumental an approach towards scientific research’ whilst universities are viewed more favourably.

84% of scientists who expressed an opinion answered ‘Yes’ to the question: ‘does the government adopt too instrumental an approach towards scientific research in general?’ compared to only 16% who answered ‘No’. There were mixed views about universities and research councils.

‘Do universities, research councils and the government adopt too instrumental an approach towards scientific research in general?’

	Yes	No
Universities	47%	53%
Research Councils	62%	38%
<b>Government</b>	<b>84%</b>	<b>16%</b>

Whilst the majority of scientists who responded to this survey thought that the government was too instrumental in its approach to scientific research in general, they were prepared to consider specific requests to take account of other objectives beyond simply pursuing their curiosity and conducting good scientific research. This is clear in relation to their responses to questions about Knowledge Transfer and the economic benefits of science, and the funding of ‘policy-relevant’ research.

On a related note, 85% of scientists answered ‘Yes’ to the question ‘Is the disinterested pursuit of knowledge, free from external pressures, a desirable goal for university scientists in the 21st Century?’ compared to 15% who answered ‘No’. However, only 51% of scientists regarded the disinterested pursuit of knowledge as a ‘realistic goal’ for university scientists in the 21st Century.

### Knowledge Transfer and the expected economic benefits of science

Scientists are inclined towards thinking that the government places too much emphasis on knowledge transfer and securing economic benefits from research, whilst the universities have it ‘about right’ and opinion is divided over the research councils.

51% of scientists thought universities had the emphasis ‘about right’, compared to 30% who said they placed ‘too little’ emphasis on Knowledge Transfer and 16% who said ‘too much’.

Conversely only 18% thought the government had it ‘about right’ compared to 47% who thought they placed ‘too much’ emphasis on knowledge transfer and 25% who said ‘too little’.

‘Do universities, research councils and the government place too much or too little emphasis on ‘knowledge transfer’ and the importance of scientific research contributing to the economy?’

	Too much	Too little	About right	Don't know
Universities	16%	30%	51%	3%
Research Councils	32%	17%	43%	8%
Government	47%	25%	18%	10%

A number of scientists, whilst accepting the importance of more applied research, expressed passionate views about the long-term dangers of the current focus on economic or medical benefits. The conflation of science with technology was identified as problematic by some:

*“It can take generations for theory to produce tangible difference in people’s lives. Science and technology, are at least in my mind are entirely separate endeavours. Science is the pursuit of doubt when dealing with questions, technology is the desire to solve a day to day need, I don't see why scientists should have to have anything to do with the latter if they do not desire and it is not relevant to their question.”*

*“Theoretical work is often low priority, yet to design effective practical solutions to health problems, we often need to take a step back and understand what is going on rather than rushing in. Unfortunately, to get funding in health, you need to be perceived to be answering "big questions" e.g. "how can we stop the HIV pandemic?" even though an indirect approach (e.g. "what does sex mean to young people?") might be more illuminating.”*

*“The problem is that Science is built up of a collection of small projects, which eventually feed into something bigger. It seems to be the case now that every major project funded now has to have the answer for a big question before the research is even conducted.”*

*“Directed research has its place, but not when this is at the cost of curiosity-driven research. The real advances usually come unexpectedly from the latter.”*

*“Although I agree that applied research is necessary, there has to be a balance between fundamental and applied research. In the moment there seems to be too much emphasis on delivery and less on scientific excellence.”*

*“In my area, it is very hard to foresee what will pay off in either the long or the short term. I think scientists need to push the idea that increased understanding will underpin benefits to the community in the future, even though one cannot say with confidence which particular advances will pay off.”*

*“The best science comes from people who are supported as scientists pursuing knowledge (as funded by the Royal Society, the Wellcome Trust), not from scientists employed to complete a specific piece of science in a specified time (as funded by Research Councils, Government Departments). The former allows the latter, but the converse does not foster innovation.”*

*“Some basic research provides the foundation for applied research but some is purely for interest. As it is impossible to predict in advance which category any particular research project fits in, basic research is essential, but undervalued (as most does not contribute directly or indirectly to innovative new products).”*

Whilst much criticism has been levelled at the government, some have argued that the research councils have been too responsive to the government’s bidding. Others are concerned about the pressure universities are now under in this regard:

*“Efforts to achieve knowledge transfer need to be targeted at relevant technologies and ideas. Research Councils emphasise short-term, achievable programmes guaranteed to produce publishable research in 2-3 years, not longer term, higher-risk, broader more fundamental topics.”*

*“I turned down a position at one University because all the vice-chancellor asked me about in the whole interview was how many spin-outs I could make.”*

*“Government should listen more to industry and other stakeholders. The people to whom knowledge should be transferred are usually more enthusiastic about basic science than government.”*

*“So much knowledge transfer is fantasy - misleading public about potential. The "science by press release" will undermine UK science.”*

*“The pressure comes from Government - short term political gain, perhaps some short and medium term economical gain for "UK plc", but long-term disaster for the research base, our ability to train new generations of scientists, and then the economy. The RC respond to this pressure rather than resisting it, thinking it is a good way to increase their funding. The Universities and Institutes are still doing sufficient basic research (although their management may pretend otherwise), but they will not be able to hold out much longer. My own research is largely at a fundamental (basic) level, but it has led to clinical benefit. Some of our work could have been translated into biotech, but the mechanisms to encourage this all too often fail, and did so in our case.”*

Those who commented in support of the importance of emphasising Knowledge Transfer primarily commented on the need for the way in which it is conducted and supported to be improved:

*“Collaborative research has a positive impact on my research. I have the opportunity to collaborate with a big pharmaceutical company. They have*

*massive amount of data I can use for my research which results will be publish. Without this collaboration I would not have the opportunity to analyse this data and get insights into my research questions.”*

*“More work should be funded on less academically-glamorous but useful topics. Even research institutes, which used to be practical conduits for university research, have now largely become mini-universities instead. Part of the blame lies in the RAE & institute assessment exercises.”*

*“Knowledge transfer is important, but it is unclear how much this can be driven by initiatives and forced marriages: many of these come to naught; the most successful transfers come from the work of individuals who would probably do it anyway. Government puts too much emphasis on this, for obvious reasons; but so far Research Councils and Universities have not wasted too much resource on empty activity. This may not last of course.”*

*“There is a lot of talk about knowledge transfer, and insufficient thought about making use of knowledge. There are several barriers to this happening in the UK - especially academic attitudes to commerce, and commercial and regulatory barriers to start-up projects.”*

*“Links between pure and applied research need to be improved. While much lip-service is paid to interdisciplinary research the infrastructure is not there to support it. The separate research councils still need to work more flexibly with each other. Indeed, one research council with a single charter working through different divisions would be a better way to work. Environmental problems more than any other need interdisciplinary programmes - teams of specialists working together with strong links to government agencies and public bodies.”*

*“In my university department, we find that knowledge transfer is very effective for research areas near to business interests (mainly hydrocarbon and environmental industries). However, my own research is very "blue skies" (I study processes at active tectonic plate boundaries), and here there is little knowledge transfer to industry, though there are good opportunities for outreach to schools and public.”*

*“I feel that in theory knowledge transfer is encouraged, and this is good, but often via too complicated processes with too much admin involved. In practice I find that I sometimes have to make considerable effort to participate in knowledge transfer with other researchers.”*

*“The research councils often explicitly say that knowledge transfer and commercialisation of academic research is encouraged but this aim is undermined in the peer review process. Peer-review comments (via referees' reports and panel decisions) usually seem to back pure research over applied.”*

**The emphasis placed on funding policy relevant research (e.g. obesity, climate change, terrorism).**

53% of scientists stated the government placed ‘too much emphasis on areas of research relevant to current government policy priorities (e.g. obesity, climate change, terrorism)?’ compared to 22% who thought they had it about right and 13% who said the emphasis was ‘too little’.

Opinion was evenly divided over the approach of the Research Councils, with 39% stating the emphasis was ‘too much’, 38% ‘about right’, but very few (9%) thought that ‘too little’ emphasis was placed by them on areas of research relevant to government policy priorities.

Do universities, research councils and the government place too much or too little emphasis on areas of research relevant to current government policy priorities (e.g. obesity, climate change, terrorism)?

	Too much	Too little	About right	Don't know
Universities	20%	12%	52%	16%
Research Councils	39%	9%	38%	14%
Government	53%	13%	22%	12%

Comments on this question were generally critical, mildly or more often highly, of the idea of research being ‘policy relevant’ and the amount of emphasis currently placed on this:

*“Relevant means cherry-picking, both by academics and bureaucracies; we are becoming servants of pre-existing policies, or at least this is the danger.”*

*“I think that this is about the right balance for now within universities - after all we inhabit the same planet as the rest of you! So we are likely to be drawn to hot topics of this kind out of personal interest. My concern is that RCs and the government demand a particular kind of bang for their research buck, so that data can be turned into policy, which poses all sorts of potential threats to the validity and usefulness of those data.”*

*“The government seems obsessed with policy but often without considering, critically evaluating or applying evidence. Frequently policies seem to be formed with inadequate public consultation and work seems to fit foregone conclusions.”*

*“There is a constant temptation to "fit" what you want to do into the currently fashionable box, simply in order to get funding. With basic research, it's just not possible to tell what things will be socially/policy/whatever relevant in 10 years' time.”*

*“Makes funding of "blue skies" research in universities much more difficult to obtain. Today's relevance is tomorrow's obsolescence. Unintended*

*outcomes and serendipitous discoveries are of more importance in the long run. Applicable industrial research can be better done by the industry.”*

*“Science has to be driven by scientific curiosity not by governmental targets. There is too much politics in science today. Research councils distribute money not according to science needs but according to political priorities.”*

*“Yes, especially government pulls out all the stops. At the weekend it was obesity. Today it is middle class drinking. Who knows what tomorrow will bring? At the same time we have governments (national, local) that are closing down health visitor, recreational facilities, etc. It is no wonder that widespread cynicism prevails.”*

*“Real progress in research can only be made when the problems to be addressed are solvable! Throwing a lot of money at a problem, such as obesity, will not necessarily lead to any cures if the underlying causes are not understood or if appropriate techniques are not available. It is generally better to let scientists propose the topics of their own research, because they know what is tractable, rather than dictate from the top. The Research Councils know better, but some tend to bow to pressure from above, rather than listen to scientists. It is good "spin" to say that £millions are being spent to solve a problem of great public concern. They have no means to measure cost effectiveness. (N.B. Applied research is probably a little different.)”*

*“Research feeds poorly into government policy priorities not so much because of emphasis or funding, but because research is generally too slow to inform policy-making in current priority areas, and because Government policy is generally not evidence-based.”*

*“These 'fashionable' subjects will most likely fit in to strategies, and therefore affect funding. In this case opportunity to fund sound science in other areas is likely to be missed, and some important discoveries will also be missed. Shoe-horning science into topical subjects can have its place but also its limitations. Much of what is 'topical' is driven by the media (hype) which is driven by the need to make money, and this is not a sound basis for deciding scientific strategy. Current policy should have limited affect on scientific strategy because at the end of the day it is about politics and popularity and not about good science.”*

*“This tends to foster bandwagons (often moving far too fast in vacua devoid of real understanding). Fashion, however relevant to real problems, is no substitute for cogent arguments justifying the value of the work.”*

*“There has been a massive investment in climate related projects in recent years, and non have really got any closer to the answer. A scientist's success is measured on his research, if a scientist can produce a paper which says, Britain will heat up by 5 degrees in 100 years, then he's liable to get it into a high impact journal such as Nature. A scientist saying "well,*

*we can't really make any deductions" is liable not to. Therefore publications are driving science and not the other way round."*

*"Government initiatives targeting a specific area often don't fund the best science, simply the people most motivated to chase a ring-fenced pot of money. The research councils are generally good at taking a broad view of the current hot topic, so dissipate this effect somewhat."*

## **The importance of engaging with the public**

Scientists generally thought that universities, research councils and the government placed either 'too little' emphasis on 'public engagement' work or had it 'about right'; very few said the emphasis was 'too much'.

Do universities, research councils and the government place too much or too little emphasis on the importance of 'public engagement' i.e. scientists engaging in discussion with the public, whether directly or through the media, about the significance and implications of their work and any concerns members of the public may have?

	Too much	Too little	About right	Don't know
Universities	5%	51%	41%	3%
Research Councils	15%	40%	41%	4%
Government	18%	48%	25%	9%

However, in the qualitative responses to the survey an additional message arose that emphasised the dangers of institutions or government adopting too prescriptive an approach to 'public engagement' and attempting to 'sell' science to the public. A number of scientists commented critically on the way in which individual pieces of research were being promoted to the media and their importance inflated:

*"It's true that scientist could do more to engage with the public, but the Government seems to think good public engagement equates to good science. There are many good scientists who are not terribly good at explaining their work but this does not make them bad at doing science itself. Let them get on with it!"*

*"Politician types should observe the good work that academics and scientists do without officials spending time and resources of trying to prescribe what public engagement should be. Such attempts produce the opposite result."*

*"The public is a good feedback mechanism: if the research contributes to knowledge the public will be interested automatically. Active publicity from scientists raises concerns about the quality of their research. A good "product" does not need to be advertised it will raise interest by its*

*importance. Scientific publicity seems to be a sign of too many scientists and too little discoveries.”*

*“Too much emphasis is placed on interactions with the media, in the sense that there is pressure to inflate the importance or significance of individual pieces of research. Too little emphasis is placed on broadening understanding and appreciation of the role and importance of fundamental research and of the scientific ethos.”*

*“Dumbing down is the major problem. Not enough taking the intelligence of the public seriously.”*

*“The government's drive to increase public engagement through initiative such as the Beacon scheme (currently in final round of proposals) is manipulative, designed to interfere with how academics work and blur what academic work is about. The public engagement impetus derives from a lack of purpose within Research Councils and government and seeks to use universities as a proxy go-between between government and the electorate. It's good for academics to want to talk more broadly about their work, but there should be no necessity to do it. Within engagement activities, academics should be treated as experts rather than just another stakeholder.”*

*“In the past I have encountered strong resistance to proposals for scientists to speak up in favour of animal research. There seems to be a general feeling among scientists that public engagement, especially in controversial areas such as animal research, is best left to a few advocacy groups. This tends to distort the way these subjects are debated in public.”*

*“It is very important that scientists do engage with the public and the media. At the moment however the large emphasis placed by the Research Councils on this is fuelling a rise of 'sensationalistic' science.”*

*“Public engagement is useful and important, and many scientists enjoy it. It is not crucial to the legitimacy of the activities of science (save in one or two controversial areas), but it does potentially (a) root the university in its local community more effectively and (b) engage the scientists of tomorrow (school pupils). It fails when it promises what it cannot deliver (democratic steering of science).”*

*“I have the impression that governments often view public engagement of scientists in the context of giving black or white answers to the public on questions of health/food policy etc. Scientists should not fall into that trap. Politicians should be the ones to communicate with the public on matters of policy, and they should be advised by scientists.”*

*“Engagement is clearly important and the emphasis is not excessive. However, how it is manifested isn't always constructive. This probably comes down to the vast gap between 'science' as a body of information as used for developing technology (and presumably school science lessons)*

*and the pursuit of knowledge about the way the universe is that is scientific research. A gap that rarely seems to be bridged by the 'public understanding of science' industry, where the emphasis appears to be, as in the question here, on 'significance and implications' [i.e. principally technology] and 'concerns members of the public may have' [i.e. playing on fears, mostly stemming from a lack of engagement in the first place]. Engagement at the level of 'here's a load of things we don't understand', 'this is the creative and exciting process by which we're going about trying to understand them' seems missing, particularly from the biological sciences. At the social end of science in Archaeology it's there in TV excavations and it's there to an extent in climateprediction.net and the way physics is able to justify huge projects to find new particles. But understanding the fundamentals (and they can be fundamental, just as much as physics, given that biological levels of organisation are not deducible or trivial extensions of the underlying physics) of how cells, or evolution work, almost invariably gets turned into relevance to cancer, or some other putative technological outcome, or the risks, real or imagined, of genetic manipulation. And that's a lack of engagement with what's really going on in the science.”*

Others commenting on this question emphasised the barriers that exist to scientists involving themselves in ‘public engagement’, such as the lack of recognition or funds for such activity:

*“Public engagement activities need to count meaningfully towards promotion (within Universities) and grant awards (for Research Councils). Current situation is lip-service only, and the community needs to decide if they are serious about public engagement as a vital component of scientific careers or not. Policy objectives therefore need to be aligned.”*

*“There is no incentive at all for a serious researcher to get involved in public outreach - indeed such activities come at the expense of teaching/research and are unrewarded in terms of career progression or peer group and management esteem.”*

*“The rhetoric about the importance regarding public engagement does not earn the scientist and respect amongst their so-called scientific peers and therefore does not help in the development of a career.”*

## Ethics and regulation

Approximately equal numbers of scientists thought ethical oversight and regulation of scientists' work has 'gone too far' (41%) or is 'about right' (40%). Only 10% responded that it had not gone far enough.

'Has the increasing emphasis placed on the importance of ethical checks and balances on the work of scientists over the last decade (e.g. codes of conduct, ethical committee oversight, public consultation, regulation and laws) generally gone too far, achieved about the right level, not gone far enough?'

Too far	41%
Not far enough	10%
About right	40%
Don't know	9%

Written comments reflect divided opinions over whether the growth in ethical oversight and regulation is a positive thing.

A significant number of individuals critical of this development commented that too many of the instruments of oversight put in place were unnecessarily burdensome; indiscriminate between widely different research situations; and generally ineffective. A few individuals suggested responsibility for ethical conduct should rest with a head of department not external committees or bodies:

*"Absolutely any research has to achieve ethical clearance, even if it poses no risk to health or ones private beliefs. So ethical checks provide yet another (not always necessary) administrative barrier to pursuing research interests."*

*"Much clinical work carried out in the past on "stored samples" collected for diagnostic purposes is now not possible because of unrealistic rules which are dressed up as ethical considerations. The whole Alder Hey fiasco was blown up to a ridiculous level."*

*"Regulatory processes add a huge cost in expense but more importantly in time, most importantly the time costs are borne generally disproportionately by the most productive scientists. We work in a risk-averse, trust-avoiding culture that is deeply inconsistent with innovation."*

*"40% of my research grants went in administration and compliance. Ethical issues are too often an excuse for saying no. The head of a department should take responsibility for what goes on in his department. Getting ethical approval does not abrogate this responsibility."*

*"Too far in one area: the dreadful over-regulation of animal-based research. The Act of 1986 was perfectly sufficient and manageable without the increases in bureaucracy and oversight over recent years that have made the research expensive and sometimes impossible, and in general do not result in any increase in the welfare of the animals. For example, if*

*during an experiment I wanted to give a standard drug to an anaesthetized animal that was in danger of going into cardiac arrhythmia I would not be allowed to do so unless it was stipulated specifically in the licence. In other words it's better for the animal to die!"*

*"Ethical codes are essential but too often I worry that what should be ethical codes are more (religious) moral codes pursued by particular interest groups. That said we have some of the better ethical approaches in comparison to the rest of the world. There does seem to be an insane amount of administration going on, surely it would be better to spend more of this money actually on science..."*

*"Not in all areas. In certain areas it has gone too far, or threatens to do so. The European clinical trials directive is one example. From my experience talking to stem cell researchers, over-concentration on safety measures seriously risks neglecting the therapeutic efficacy of the stem cells. The two measures must be balanced."*

*"Human tissues and animal rights requirements are massively restricting our ability to conduct research to the detriment of animal welfare and human health."*

*"There is too much emphasis in ethical codes on (often trivial) rights for individuals and too little emphasis on public good. Ethical monitoring costs a huge amount of time and money, and conveys little benefit and some damage to the public good overall."*

*"Ethical approval for use of anonymised patient data is far too time consuming and under current regulations I wouldn't even be able to use my own personal data (an x-ray for example or an image of a histological section) without going through a lengthy ethics approval."*

*"The forms of regulation are not sensitive enough to the different types of research/topics and the types and level of risk. More professionally-based and project-specific forms of ethics governance could help reduce unnecessary delays and expense in enabling useful research and also in highlighting and managing project-specific risks."*

*"I wanted to put "too far" and "not far enough" because different types of research require different levels of ethical monitoring. For instance, to do research on NHS patients, you have to go through the same ethics approval process to do a couple of recorded interviews as you do for a large drug trial. The two are obviously totally different, and excessive bureaucracy limits small, qualitative studies. On the other hand, monitoring of ethical standards is not very thorough and once you have "ethics approval" nobody checks you are doing what you said you would do in your protocol. Ethics committees also sometimes act unethically (obstructing good research, taking ages to come to decisions, inconsistent responses to the same research proposal etc.)"*

*“Ethics is important - I would say that, obviously - and in many ways it is the modern version of "social responsibility of science" which has a long and honourable tradition for decades now. But what is daft and counterproductive is the bureaucracy in place to monitor it. Most of this does nothing to advance ethics in science, and a lot to bring it into disrepute.”*

*“It has gone MUCH too far. This is partly the scientist's own fault, because in the past they did not do enough to dispel public misapprehensions about their work and intentions, thereby allowing religious or animal rights fanatics to dictate the agenda. High ethical standards are very important, and every scientist accepts that, but the current regime is far too bureaucratic and burdensome, and always starts from the positions that scientists are presumed guilty and have to prove their innocence. Current practice is to my mind incompatible with article 13 of the EU fundamental rights charter, which guarantees freedom of scientific research. This fundamental right means that regulatory bodies imposing ethically motivated restrictions on scientist ought to be obliged to interfere only as little as absolutely necessary in scientific research, and streamline their procedures. That is NOT what's happening. There is a huge amount of irrelevant bureaucracy dressed up as 'ethics'.”*

*“The research ethics and research governance processes operating in the NHS at the time of my post grad research essentially delayed the submission of my PhD by one year (it took me one year's full time work to deal with the associated admin. to enable me to send out entirely non-threatening/controversial questionnaires to two members of staff in each Primary Care Organisation in the UK).”*

*“Ethical checks are being imposed due to a lack of trust between science and the society that it serves. This leads to all sorts of bureaucratic approaches (QA) to solve the problem which I believe is ultimately counterproductive.”*

Those in favour of the general trend towards greater ethical oversight and regulation over the last decade or so tended to cite improved ‘public confidence’ as the main reason for their viewpoint, though some of these individuals also expressed concerns about going too far:

*“It's essential that ethical questions are raised and addressed if publicly funded scientific research is to be supported.”*

*“The ethical base of science needs to be strengthened even further. We need something like a hypocritical oath so that press releases about science are honest and comprehensive.”*

*“While the ethical checks and balances can slow down research with paperwork or waiting periods, I feel that they are important. If there isn't supervision, someone will abuse the system and with the current public*

*attitudes towards science, research cannot afford even one case of abuse. I also think it's important that the public feels they can trust scientists and with laws and regulations, I believe the public is more trusting of research."*

*"Animal welfare codes of practice are not always upheld and this leads to public distrust."*

*"Humans tend to be lazy. Such ethical limitations should be regarded as source of innovation. They can lead to totally new approaches (e.g. animal welfare has led to many new innovations). Opposition to such restrictions arises from inflexible minds, which are not prepared to question current practices."*

*"Even stricter rules are necessary- and it is better to prevent than to cure."*

*"We have to maintain the confidence of the public; there is still much to do."*

*"It has been a struggle this past decade to get scientists to appreciate the ethical and moral dimensions of their work. At least the policies are there now, but individuals still moan."*

*"Nobody has ever measured what time and money the increased pressure of documentation and committee activity took away from productive scientific work! The anti-science lobby managed to block science by creating an unproductive administrator class whose activity has become the greatest impediment to progress."*

*"Scientists should be accountable for the work they do and this should be reflected in checks and reporting to the public, who fund the science. There is a risk of excessive bureaucracy detracting from scientist's ability to conduct research."*

In terms of the impact on ‘public perceptions of science’ of the increased emphasis on ethical oversight and regulation, more than twice as many scientists thought that the impact had been negative (37%) as thought that it had been positive (15%) with a further 31% regarding it as having had no impact. This result raises important questions with regard to the perspective often argued by regulators and the government that more oversight and regulation improves public perceptions of science.

Has the increasing emphasis placed on the importance of ethical checks and balances on the work of scientists over the last decade (e.g. codes of conduct, ethical committee oversight, public consultation, regulation and laws) had a positive or negative impact on public perceptions of science?

Positive	15%
Negative	37%
Neutral	31%
Don't know	17%

Many of the comments received broadly argued that extensive regulation of science gave off an impression that scientists had something to hide and therefore had a detrimental impact on public perceptions of science:

*The approach to a patient to seek their permission to allow their routine clinical data (no extra procedures/ not a trial) is now so formal as to make most patient's suspicious of the motives.*

*The link between the increased regulation of science and the increased negative public perception is somewhat ironic but perfectly natural.*

*The public has been sensitised by scare stories after Alder Hey which has severely disrupted our ability to get consent from relatives of sick patients or access to tissue samples post mortem or intra-operatively.*

*Often these checks make the public think something must be wrong; otherwise why check up so much. In my own case I have given up animal based research due to the bureaucracy & time wasting involved.*

*The general public has no idea of the Byzantine, arcane and frankly ridiculous level of bureaucracy that governs the way 'ethics' are implemented in biomedical research. If they did, they would probably be appalled by the waste of money this implies. What we would need is a non bureaucratic, efficient and transparent system which could reassure the public that there is effective oversight. That is not what's happening. Also, the gutter press will always try to whip up scare stories of 'abuses', and much of the current system is designed to push potential blame away, rather than encouraging frank, open and constructive debate about where the ethical boundaries should be drawn.*

*This is a very interesting question. I suspect that the public are often misled by the need for regulations, and become more rather than less suspicious of scientists and their motives.*

*The fact that it needs controlling implies it is dangerous but gives no information about what the dangers are or how more or less dangerous they are than everyday activities.*

*Given that there is a gap in public engagement and understanding when it comes to biological science, the increase in ethical checks seems to have reinforced a feeling that there is something dangerous or bad that needs regulating, without an increase in confidence due to whatever it is being regulated.*

*Negative because the constant harping on about ethics and regulation generates unease among members of the public: "there must be something dodgy about all this science if they have to keep such a careful watch on it". But the dodginess is in the watching, not in the science!*

*If you surround some class of activity with heavily restrictive legislation, high walls, guard dogs and minefields, it is not wholly convincing then to claim that the public can now relax, as it has been rendered harmless.*

*Some of it has been beneficial - e.g. the role of the HFEA in justifying and defending embryology - but some of it promotes cynicism. At least some "ethics" is just "corporate social responsibility" for scientists.*

*It is now assumed that scientists are up to no good and attempts to prove that we are behaving appropriately only enhance the belief that something is being covered up.*

*In my opinion the net effect of this regulatory culture has increased the demonisation of science.*

*You only set up laws when you think offences have been committed. And of course once the laws have been set up, it becomes easier to catch offences, which often can amount to a re-branding exercise of what in the past would have been controversial but, in the end, permissible behaviour.*

*The sins of the scientists are always exaggerated by the press and by the enemies/competitors of science. Sometimes it is better to wash the laundry in house. Science is under siege.*

*It is counter productive because the public sees this as endorsing the view that science is corrupt hence the way forward is legislation and policing. More expense less science as a meta-scientific community arises.*

*Probably negative because when non-scientists hear discussion of these issues they naturally infer there is a problem. It's not entirely unreasonable as there are a significant number of high profile frauds perpetrated by*

*people who are essentially crackpots. However, normal members of the profession have to convey extreme integrity and emphasise repeatedly that there are many internal checks that mean that wrong doing will be detected almost as soon as it gets into the public domain.*

Other comments were more supportive of the emphasis on ethics but suggested that lack of public understanding of the ethical and regulatory check and balances that exist, undermines the positive impact they have on public perceptions of science:

*The emphasis is good, but the issues and underlying science has not been communicated well to the public often leading to a prejudiced response.*

*I don't think that the public know anything about the ethical checks undergone by scientists. Only the shock stories make it into the popular press.*

*Despite the increasing code of ethics scientists and researchers have to abide by, there is still a continued stereotype of the "mad scientist". The public does not seem to be aware of how the nature of ethics has been built into modern scientific research and the lengths and justifications that are required for working with areas such as human tissue, animal experimentation or stem cells. While it is good, and preferable, to have a strong system of ethics operating in the sciences, the public must also be aware of this to help overcome negative opinion of the scientific establishment.*

*Public perceptions of science are far more influenced by the attitudes of the largely arts dominated media, who have ducked any serious understanding of what science is and isn't throughout their lives. As far as the perception of science gained from the media is concerned Mary Shelley said it all with Frankenstein two centuries ago and since then science is just minor variations on this basic theme. It is perceived that applications of science that are of benefit come from clever technocrats and have nothing whatsoever to do with the scientific process. The impact of whatever regulatory frameworks there are, is minimal compared to this.*

*I do not think that the general public has much of an idea as to how science is regulated and controlled. Most of the control of science is exercised at the level of funding and publication review: processes that are completely unknown to the general public. Even review by ethics boards is not in the sphere of public knowledge. The impression that science is not controlled at all is common currency, if not the majority view. I see this as a big problem, because it is hard enough to get most people interested in science, let alone how science is controlled.*

## **The disinterested pursuit of knowledge**

### **Is the disinterested pursuit of knowledge, free from external pressures, a desirable goal for university scientists in the 21st Century?**

*“Without the disinterested pursuit of knowledge, no major breakthroughs would be possible. Who else but the universities should provide an environment for free research?”*

*“The BEST breakthroughs came from non-commercial, free-thinking experts obsessing over little experiments - GMR, Josephson effect, quantum Hall effect, fractional quantum Hall effect, the LASER...need I go on? Forget industrial band wagons; physics is such a fertile field for future devices/areas/facilities, that we should have learned a long time ago to stop application-driven funding - it's putting the cart before the horse.”*

*“Freedom from external pressures is not necessary for all the research they do, but if there is no opportunity to do this, we will be very constrained in seeking out and discovering new areas.”*

*“But autonomy from outside pressures is not the only goal. University research will have to widen its remit especially as research council Institutes are merged with the Universities.”*

*“The desirability of the disinterested pursuit of knowledge is especially true of social science. The more silly the ideas that result, the more able people become at using or not using them appropriately.”*

*“This is not a question susceptible to a yes/no answer. It is about a balance between exclusive individual predilection (which is appropriate where the costs are borne in whole or in part by the individual) or where this work is considered to part of a salaried employment. In the UK the balance lies heavily on the side of 365 day 'employment' in the university sector, so that there is a muted capacity to engage in a 'disinterested pursuit of knowledge'. The pursuit of knowledge in this context is conditioned by other priorities. This is not the case in some other countries.”*

*“Obviously, in an ideal world the answer would be yes and we would all go off and research what we wanted. However, scientists in the UK are mainly employed by public institutions and as such are public servants (although I doubt many scientists see themselves as such). Public engagement is important and very positive when done well, knowledge transfer is hugely important for our economy and if there is a scientific issue that is in the headlines for some reason then why shouldn't that area get more money? People obviously are concerned or interested in it. So a bit of external pressure from outside I think because scientists are part of society and so should react to the concerns of society.”*

*“Major innovations and discoveries are best made in an environment of free research and science, pushed forward by the curiosity and inspiration of researchers”*

*“It would be nice to think so, but with the constant pressure to publish and the increasingly competitive way funding is provided, I don't see this happening. Research projects without a clear application or the possibility of providing short term benefits are very rarely funded. Until this changes, we will be in danger of failing to make key discoveries - something the English are known for.”*

*“There are many areas of basic research where there are no obvious immediate outcomes (other than increasing knowledge) and seemingly not much point to anyone out with the field. However, the knowledge gained from basic research is often what applied science builds on and narrowing down the range of basic research funded may inadvertently have a negative impact on the very applied science that supposedly is being prioritised.”*

*“The disinterested pursuit of knowledge is desirable, but only within reason. There are still finite resources and the public do have some right to decide on the research directions they are paying for, or at the very least to be aware of it. However, serendipity can't be foreseen so there should always be a diversity in research direction.”*

*“No pursuit of knowledge is disinterested. For the answer to your question see <http://iotd.patrickandrews.com/efficient-invention/> Curiosity driven research is essential.”*

*“That is an important goal of the University - but I think there should be more of a balance between that and research that's likely to produce tangible benefits quickly.”*

*“This is not a black-and-white issue. It should be possible for a scientist to choose a "pure" academic research career and not be penalised for this. However, in some subjects, the external pressures can be motivating - I think of medical research as a prime example. To not attempt the translation of basic medical research into new therapies would be wrong.”*

*“This is fundamental to human progress. There are, of course, innumerable examples of unanticipated benefits from research and scholarship. There is also a very strong cultural case that this, above all, is what universities are for, alongside education of our brightest and best.”*

*“It is essential, together with 'applied' work.”*

*“This is the only true research - the rest is "development" or engineering. Both are important but different from disinterested research.”*

*“There is clearly a need to understand basic science. This is never going to be done by profit-driven companies.”*

*“Where else will freedom from external pressures be possible other than the University? We should be able to afford to sustain this aspect of our culture which has existed for the past four centuries.”*

*“It is a desirable goal for some scientists, but not for all.”*

*“You never know what good will come out of something!”*

*“Yes, it is a desirable goal, as long as benefits that come from the work are exploited. This requires that the “disinterested” researcher (who doesn't really exist, of course) is able to link with others, and funds, that ensure translation to industry/clinic.”*

*“Not for all institutions of course, we have made a huge mistake by calling most tertiary educational institutions, “universities” and hence making valid distinctions more difficult.”*

*“This is still important if new unknown discoveries are to be made, but it's not always the case.”*

*“If the question being asked is, ‘should people research for research's sake?’, then I would say yes because that supplies the grounding for today's progress.”*

*“Of course it is.”*

*“I don't believe in the disinterested pursuit of knowledge! I also don't think that we should be immune from external pressures because we spend public money on research and so we need to be accountable in some way. But that doesn't mean that we should be asked to be accountable in the ways that we are, or that only certain sorts of research should be considered valid by those who hold the public purse strings.”*

*“Any researcher has to accept the moral implications and impact on society of his work. Research cannot be carried out in a vacuum.”*

*“Many of the most valuable scientific discoveries had absolutely no practical application at the time they were made. It's essential that the best scientists have the opportunity to pursue 'blue skies' research for at least part of the time. That doesn't mean that all university scientists should be bumbling away on their own pet projects - a lot of tedious incremental 'stamp-collecting' results are amassed in this way. I see a lot of this output when I referee manuscripts submitted for publication.”*

*“Although I think that an inquiring mind should be free to pursue knowledge that interests him/her, the reality is that the world is rife with 'problems', and at a very broad level many aspects of society (education, health, environment, etc) could benefit from having more information to inform decision making and policy developments.”*

*“It is desirable, but don't try and explain this to our principal!”*

*“But as a disinterested pursuit it cannot expect a higher level of funding than any other such activity. If it is to maintain its high level of funding from the taxpayer it must be geared to the taxpayer’s interests. Part of those interests will be simple knowledge generation but a part will also be concerned with immediate and applied interests.”*

*“It is not merely desirable, it is essential.”*

*“The notion of interest covers a large variety of issues that can hardly be overlooked in the centuries ahead.”*

*“It is desirable from the same kind of perspective that it was desirable to create a perfect society based on equal distribution of resources. Neither has ever existed.”*

*“I can't speak on behalf of universities in this respect, but it is absolutely necessary that the disinterested pursuit of knowledge is recognised as an important component of scientific progress, and funded. That does not mean that this research shouldn't be subjected to the normal checks and balances of ethics as such.”*

*“If the public is paying there should always be some pressure for academics to work for the public good. Disinterested pursuit of knowledge leads to self-important scientists pursuing unimportant lines of research at high cost.”*

*“It's not desirable, it's essential. The external pressures are not themselves disinterested, and there is no reason at all that they should be the right sort of pressures (and usually they are not).”*

*“This is a cultural progress of humanity!”*

*“It is a desirable goal, but not the only goal.”*

*“This is not for everyone and, indeed not my own type of research but it has a place and should receive some funding and recognition.”*

*“Indeed it is! But it should also be disinterested about the current theory and put it at stake! In medicine this is definitely not the case.”*

*“History proves the point.”*

*“It is desirable for some scientists. Directed research will be more common.”*

*“It should be by far the most important goal for university scientists.”*

*“The high status of science has to be rebuilt. Athena the Greek Goddess of Wisdom was a warrior and this means today that we have to fight against any oppressor of the science. In order to achieve this, science has to solve many*

*wicked global problems- first of all energy but really not fairy tales as hydrogen energy a la the Bush administration.”*

*“Such freedom can't be unlimited, but this must be part of any scientist's work.”*

*“Unquestionably so.”*

*“ There is too much emphasis on short-term goals to satisfy political and economic ends.”*

*“More so than ever! It is particularly important for public trust to make clear what external pressures may have affected particular pieces or areas of research.”*

*“I doubt that many of the scientific breakthroughs of the past could be made today. Research councils do not fund risky projects.”*

*“Popper and Kuhn have demonstrated that this is impossible.”*

*“I think so, but then I am probably distinctly old fashioned in my attitudes.”*

*“Does this question need to be asked? What has changed for the 21st C?”*

*“Of course! It's the knowledge and understanding, stupid. Seriously, frivolous research (e.g. in Sports Tourism say) is rubbish and should not be funded by peer review but much research that is innovative is not done because of preconceived ideas on the part of grant-giving bodies, journals and so on.”*

*“If such freedom doesn't exist in the University, research will be focussed on just some areas without much advance on others that may be important in the future. Furthermore, describing the world is the aim of science and I think I should not be biased towards just our own interests.”*

*“Absolutely.. we should be training minds to think well not produce well. People and ideas should be our export, not things.”*

*“It is not a yes/no question. Certainly for a few people it is desirable, but for most 'ordinary' (in Kuhnian sense) scientists a degree of oversight is probably appropriate.”*

*“Science should be valued as a purely cultural activity - after all enquiry is something very human. Also, many of the most important discoveries have arisen, often in an unpredictable way, from the simple pursuit of knowledge.”*

*“Fundamental research is necessary and serves society in itself but there will always be an eternal pressure to be ethical and to serve society.”*

*“I regularly read papers of great work but of little or no value to the environment or the public. Some 80% of what I research involved sifting the seed from the chaff.”*

*“I am not sure I follow this term "disinterested pursuit of knowledge". If you mean research without an economic interest as the driving force then certainly it is valuable and desirable!”*

*“Scientific enquiry is a cultural and creative activity. The generation of knowledge, the impact on the economy, the education of a new generation of scientists, are all 'side-effects' of this basic human activity that needs to be supported and promoted.”*

*“There is a tension between this pursuit and the teaching of many undergraduates.”*

*“It is desirable in the backhanded sense that I really believe that pursuing understanding unhindered is more likely to produce instrumentally useful outcomes than research directed to instrumental goals. It is also desirable in the general philosophical sense that it is desirable to understand more about the way the universe is at all levels, and science is a particularly good way of going about that.”*

*“I think it is essential. If we lose this, we will always be at the mercy of vested interests. I was tempted to add that another goal might be for researchers to study problems that are in the public interest, but I won't - because (a) it's not always clear what the public interest is (was the development of nuclear physics in the public interest - e.g. power - or not - e.g. weapons); and (b) even if the public interest is clear, we don't know ahead of time what is the best solution, which may rely on new science (to improve lighting in the 19th century, did you pursue the technology of candle making, or investigate electricity?).”*

*“It's only desirable as part of a "mixed portfolio" of research styles.”*

*“It is very much desirable. Research is about knowledge for its own sake. It is what brings young people to the excitement and rewards of discovery. It has been one of the prime movers of humankind.”*

*“If not in the universities, then where will such freedom exist? If all a university is is a cheap outsourcing venue for industrial R&D, then neither we want to do it, nor does industry think we're cost effective or good at it. We exist to do things industry and government cannot or will not, and to criticise and offer alternatives to industry and government.”*

*“It is a desirable goal, but not the only desirable goal – for instance, university scientists should also be pursuing research that benefits mankind.”*

*“What else is a university for?”*

*“In moderation, yes, particularly as future utility is difficult to predict.”*

*“It should not be inhibited altogether. Obviously, the taxpayer needs value for money in the form of research for the common good. However, who knows*

*what other discoveries are to be (incidentally) made by those who pursue knowledge for its own sake.”*

*“In universities especially we must safeguard this. The debate is really about the balance.”*

*“It sounds all well and good, but you are spending taxpayer's money, so you have to produce.”*

*“It's desirable for a 30% proportion.”*

*“Absolutely but this position needs to be earned by individual scientists working rigorously and effectively.”*

*“This should be the case for basic research. Freedom of thinking without unnecessary pressures leads to new discoveries that really benefit mankind. Keeping publishing under all sorts of pressures produces little original work, but wastes resources - looks good, but means little to nothing!”*

*“Not just desirable- essential.”*

*“If large external pressures are present this leads to the science becoming a social construction which is dangerous in that reality becomes forgotten.”*

*“There are lots of scientific questions that are interesting but which are unlikely to yield short term commercial gains. Similarly, because we face important social problems, it shouldn't be used as an excuse for pork barrel financing.”*

*“Science is part of society; it is modelled by society; and society must determine the priorities. This is not a popular view amongst scientists who see themselves as alternatives to God.”*

*“Yes, but it is almost impossible to get funding in an area that isn't the current astronomical fashion.”*

*“The disinterested pursuit of knowledge is a prerequisite for genuinely revolutionary research programmes. e.g. The genetics revolution had its roots in more than 20 years of basic research - in the present climate such basic research would struggle to attract funding. However some external regulation is necessary e.g. there will be a need for independent ethical regulation.”*

*“It is essential not only for science, but also for the very nature of the university, and in the long run for the nation.”*

*“The disinterested approach to research has, and will always, produce science that may not hitherto have been expected. Too focussed and biased an approach will limit the frontiers of science in ways it cannot be possible to imagine.”*

*“However, I always find that I learn more when teaching others than when trying to learn directly myself, so although the teaching aspect of a university scientist can be perceived as a burden, its benefits should not be neglected.”*

*“Just look at the benefit that free enquiry has generated. If this was not possible, we would be all dead.”*

*“University scientists' research will have more positive impact on public perception of science if a direct connection is shown to current and future issues affecting the public at large.”*

*“Scientists want to pursue their interests without having to kowtow to government and strategy the whole time.”*

*“There are plenty of other excellent research institutes subject to external pressures - universities can be one place free of such constraints to allow true freedom of enquiry.”*

*“It would be appalling if everyone with a position in university just followed their own ideas without peer review.”*

*“This will never happen as every science project is driven by funding, which destroys the science.”*

*“No such thing as disinterest! We are all driven by a need to achieve, to seek success and influence. It is naive even to think that it exists!”*

**Is the disinterested pursuit of knowledge, free from external pressures, a realistic goal for university scientists in the 21st Century?**

*“It depends on the science, of course, just how feasible it is in terms of investment costs but since future applicability is oft unforeseen the disinterested pursuit may come to satisfy knowledge transfer and economic goals.”*

*“It should be. knowing politicians and administrators it is likely not realistic. Other countries will take the lead.....”*

*“I think it is (or should be) a realistic goal even though the RC and government make us believe it is not.”*

*“Too much emphasis on appeasing government's policies via RAE funding and Research Councils catching a cold every time the government sneezes e.g. including getting ideas to the market when the ideas should be carefully tested before being released.”*

*“With some imagination it would be possible to provide some ring fenced funds to allow this, rather than have government dictate how all research funding should be allocated.”*

*“Probably not - John Ziman wrote about this in Nature back in 1996. It is still the best piece I've ever read on this and I've little to add to his thesis. (Ziman, "Is science losing its objectivity?" Nature Vol.382: 751-754)”*

*“In Germany research units at university more and more have to bring in their own money, which means they have write proposals for third party money, which again means they have less time to follow their genuine interests.”*

*“The dramatic under-financing of pure science (at least in Germany) forces universities to engage in politically desired projects.”*

*“Economic limitations mean that work done will always have be limited by outside issues.”*

*“Western governments are gradually slipping back into totalitarianism and managerialism. They don't like people who disagree with them, or can produce evidence that government policy is wrong.”*

*“The range of external pressures seems to be growing rapidly and scientists, while moaning about this process, seem to be bending to it rather than genuinely questioning what is driving this and if it is actually a good thing. For as long as scientists just accept these changes without question they are here to stay.”*

*“Yes, in that people do what they want and see justification in terms of benefit as a necessary hurdle to jump to get funding - their overarching goal being to further their own careers. No, in that you are somewhat limited by needing that justification. I would suggest that better analysis of the justifications*

*grant applicants provide, by the fund-awarding bodies, is the solution - it seems you can make them believe anything if you're a creative enough writer."*

*"Very difficult with Government pressure to link with business on the one hand and to provide quick solutions to policy needs on the other."*

*"To a certain extent it depends on your subject. Some have a more "pure" academic status - others, will have obvious routes to transfer knowledge. Those subjects that have a more applied basis, will inevitably be under more external pressure to transfer knowledge into products. This is not necessarily a bad thing in itself, it is all a matter of balance."*

*"Unfortunately, the nature of research funding now makes it virtually impossible to simply study what you think is interesting and important, irrespective of whether it is likely to produce short-term publications."*

*"Look where funding and political and institutional support comes from and the pressures to which they bend."*

*"It's unrealistic- at the moment, the short term funding projects etc. places enormous pressure on researchers to 'produce' and go for 'short term' projects, rather than invest time (and money) in longer term projects that may break into new frontiers."*

*"For some (perhaps only a few), but not all."*

*"I guess despite what I have said so far things are regulated as such whether it be by committees or funding bodies making this kind of research difficult."*

*"The external pressures can be minimised, but I'm not sure ever entirely eliminated."*

*"I think it's attainable, as long as there is no government interference."*

*"We need to hire senior university administrators who know what a university is for -- and that is not simply a 'knowledge factory'. This may eventually mean that potential university administrators will need to become credentialed in 'higher education management' or at least pass some accrediting board. Simply managing a company with large assets shouldn't cut it, nor succeeding as a dutiful state bureaucrat in a previous life."*

*"Governmental attitudes are 'commercial' and this view controls the 'philosophies' of universities."*

*"I see all the trends I have noted above simply amplifying."*

*"Research applied to solving an important technological problem can be extremely creative, and can create a vibrant atmosphere in which research students feel they are making a valuable contribution. Some 'blue-skies' research*

*is fine, but it's unrealistic to expect the public purse to fund research (which is very expensive) without any accountability on the part of the Universities."*

*"Probably not - and should it be completely disinterested if the researcher is supported through public monies? Research Grantees receiving public funds, I would think, would have some obligation to ensure their research will have a benefit to someone/ something/ somewhere (the public, the greater good, whatever), rather than just be a "cause I can" personal project and pursuit of a personal interest - that is what a hobby is."*

*"It is becoming increasingly difficult with restricted funding and ever increasing work loads."*

*"Once you have a scientific profession, careers depend on the ability to obtain resources. The way to obtain resources is to have as little impact on the ability of other key professionals to obtain resources as possible. This leads to tacit agreements to think about every problem in the same way, until enough people have retired."*

*"It is increasingly difficult, but if we resign ourselves to the notion that it's not realistic, that will accelerate the loss of something vital."*

*"Governments are more than happy to spend large amounts of money on military or medical research, but little else."*

*"I hope!"*

*"It depends on the scientists perception of external pressures. A free mind cannot be restricted by financial or administrative constraints. But universities will need to be aware that they are dependent on such free minds and should develop their policies accordingly."*

*"It should be the ivory tower or benchmark for human advancement."*

*"Because the universities are often the only source of objective research."*

*"Someone has to fund it: 'pipers and tunes'."*

*"It has to be, science cannot be kind of servant of technology- they have many common goals but some different aims too. Science is UNDERSTANDING."*

*"Can't be unlimited, but this must be part of any scientist's work. There has to be a corner where scientists can pursue knowledge for its own sake."*

*"There can't be a complete absence of external pressure but it could be lessened."*

*"It has to be recognized that this type of research is, ultimately, very productive, despite what the Arts-qualified personnel in Westminster may think."*

*“If you want to be a successful scientist you must earn income for your University. The more income you generate, the more successful you will be. Is this how we wish to manage scientific enquiry. I don't think so.”*

*“Science is expensive and cannot be done without funding.”*

*“Of course the short-term wellbeing of society is also of great importance, and I don't quarrel with governments spending more money on that.”*

*“Not in today's funding situation.”*

*“But I always warn my younger colleagues to take an interest in the swirling currents of politics (in the broader sense) and implications for their work.”*

*“For a few universities. The RAE has substantially distorted things; although a focus on productivity and quality per se is desirable, the metrics are crude and discriminate against some long term desirable scientific goals (e.g. applied medical research).”*

*“Yes. Scientists can choose the science they do. They do not have to chase money. Ideas do not cost money and it is ideas that drive science.”*

*“But only sometimes. I think scientists with research that is applied to health, technology etc, have an easier time getting funding, general respect, positions etc. But I also think that the pursuit of knowledge is still a realistic goal.”*

*“So long as only very good people are funded to do it.”*

*“It is perhaps a realistic goal, but to achieve it will require a concerted effort by scientists in the face of increasing pressure by politicians for more applied research.”*

*“It is, but the funding is much less to areas not related to human health, which precludes its advance.”*

*“Abolish the citation index as a means of judging a scientist quality.... it doesn't. Get rid of the RAE completely... it is a barrier to the success of young scientists and a inhibitor to hiring people for they're teaching abilities in combination with their research ability. It is also incredible pressure on established scientist to publish regardless of quality. Visibility is what the RAE measures, not impact which is surely more important. Get rid of the complex rubbish associated with grant proposals... the 10 different essays you have to submit all saying what the research is intended to achieve, the insane amount of financial work, the endless forms. Why not make a preliminary statement that then goes out for review to specialists.. if this is passed then do all the rest of the crap once the ideas in the proposal are considered of worth. Why waste everyone's time before hand. ... I think the Leverhume trust have moved in this direction, the government bodies should take note.”*

*“Unfortunately, I think it will become increasingly difficult to avoid the external pressures. The whole system of financial support for science seems to favour targets and measurables, rather than intellectual curiosity.”*

*“Or at least, increasingly more difficult.”*

*“The majority of research is still funded in response mode with the main criterion being scientific excellence.”*

*“There should always be some space for disinterested pursuit of knowledge. If that is lost then the public will stop trust scientists overall.”*

*“If we are not to fund research from public funds we must permit and indeed encourage commercial investment in research. We should extend the patent periods to allow commercial organisations to recoup their costs.”*

*“Or perhaps not, but if you say no you have given up on one of the key principles of science. It depends of who is 'disinterested' - the scientists doing the work or the funders.”*

*“But it should be discussed whether it is appropriate for every university to be engaged in this pursuit.”*

*“No one is ever free from external pressures, nor every fully disinterested, and put like that it makes science sound like something one could in principle pursue in a vacuum. That's clearly wrong- science is almost exclusively about engaging with the external world. However, to the extent that it is possible to pursue understanding rather than instrumental goals, 21st century universities with the tradition of research they have inherited, their people and facilities, are the place to do it.”*

*“It has to be. In practical terms, that probably means that universities need very diverse funding streams. They should always resist any "strings" attached to funding, and be prepared to demonstrate this and to support staff who have genuine reasons to believe their research results or reporting is under pressure from funders.”*

*“It would be if university scientists could get their acts together.”*

*“If they don't mind fighting and poverty ...”*

*“It will always be part of the battle of ideas, and so it should be.”*

*“It's under pressure, but people still respect the ideal, both in industry and the universities. Government seems to see us as the solution to all their problems, if only we'd do what they want. But that is both unlikely and also self-defeating. Government agendas change too fast to guide long term enterprises like research.”*

*“If this were the only goal of university scientists, they would have much less funding than they do at the moment - research into areas which are profitable increases, in the long term, resource available for the disinterested pursuit of knowledge, and also research that benefits mankind but may not provide a commercial return.”*

*“Otherwise we will no longer have universities.”*

*“Increasingly rarely, given the current funding structures.”*

*“To many students, to much pressure on getting the next grant. No job security to do "blue sky" research.”*

*“But not without a sustained, well led campaign to persuade senior policy makers that, at a time of decreasing resources, we must do this--for historical reasons as the function of Universities, for educational reasons and for practical reasons; just look at the amazing developments coming out of pure research, e.g. monoclonal antibodies and genetically modified mice (i.e. the current Nobel prizes).”*

*“Unrealistic especially in Science. Money has to come from somewhere.”*

*“Well, I say yes as it should be, but RC's and government may choose differently. In that regard, it is "unrealistic". The question is not well put.”*

*“Not only realistic - but necessary to avoid research becoming trapped in local paradigms.”*

*“It's very difficult to be exclusively preoccupied with pure questions For example I work on plant disease and disease resistance; discoveries are bound to be interesting and might be useful. Scientists need to be smart about picking areas where that is feasible.”*

*“A balance need to be struck, science cannot totally divorce itself from politics but with the removal of tenure means that scientists cannot necessarily speak out for an unpalatable truth which over some issues is critical.”*

*“It's just a question of balancing different strategic interests. ie good applied projects running side by side with incisive attempts to understand important problems with no immediate application.”*

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*“The increased pressure from paymasters is unlikely to go away.”*

*“No because this government and the wake of Thatcherism has produced a bunch of audit-obsessed monkeys convinced that everything should have a tick box and be 'good value for money'.”*

*“Government is the major source of funding and needs to justify its investments by providing clear evidence of benefits accruing to society. This will ensure that achievable short-term objectives (rather than more speculative long-term projects) will attract government funding.”*

*“Too many pressures to justify the work and make it "valuable" and to try and show early results (that need much underpinning work, often poorly funded if at all).”*

*“Limited funding and state 'patronage' make it very difficult to do this, and all scientists have to accept that serious funding will only come with strings attached. Nevertheless it is a reasonable goal, and the duty of proper scientists always to aim for.”*

*“It is possible to maintain a balance between focussed and blue-skies research in the 21st century as long as the response to topical research areas e.g. climate change, does not become too politicised.”*

*“Observation of funding trends has become a major pre-occupation and distraction for research scientists. Lack of experience in this is a major impediment to obtaining funding by young research workers.”*

*“Just stop political interference and careerists and opportunists wasting resources of science.”*

*“Under present policies and practices, no.”*

*“Funding will become harder to acquire and research will need to show public benefit more, not less.”*

*“No, limited funding so strategic plans will have to influence much of the direction of the research as a selection criterion.”*

*“While the public purse provides funds, the public will demand accountability, which brings external pressures.”*

*“Sadly probably not because to do science now requires significant money and funding can only be justified politically if there are clear and tangible benefits. The pursuit of science as a cultural activity in itself is less acceptable to funding organisations than it once was, and I do not see a reversal in this trend.”*

*“As above, everything now has to be fully economically costed, which is ridiculous way of doing things. The thing about science is that it produces unexpected results, and in Earth Sciences at least, fully economically costing anything is killing originality and collaboration.”*

*“The 'disinterested pursuit of knowledge' isn't an adequate explanation for why one might not be visibly productive (papers/research students etc); or for lack of grant-raising: there is not (and should not be) a conflict between how*

*'blue skies' one's research is, and productivity. Of course, it might be hard to raise large grants at the beginning; and one might also labour without recognition and without the comfort of having many colleagues working in parallel."*

*"Certainly not for all university scientists although it should be for some."*

## **What should we ask of science in the 21st Century?**

*“We should ask how knowledge and the needs of professionals and consumers intersect.”*

*“Science should be relevant and useful for real life but not constrained too much by government agendas and current interests.”*

*“Applied science: solve specific problems of society (there are plenty of them: climate, water, pollution, over population) basic science: enhance our knowledge in all direction. On the long term basic science is vital. Allow science to be regulated by experts in the field, not by lawyers, administrators or other lay persons.”*

*“Blue sky research is still very much a trial-and-error approach and scientific progress is therefore hard to predict or control. Exceptions like the Human Genome Project, however, have given the government a different viewpoint and this viewpoint might limit future scientific progress if the RC/government will be trying to 'control' science too much.”*

*“Collaboration and exploration.”*

*“To work for the betterment of all people.”*

*“Less bureaucracy and administration e.g. filling in numerous forms of which this is one ! That would leave more time to get on with research.”*

*“Training people in the scientific method, allowing them to be able to assess information critically, quantitatively and with some idea of realistic risk. Providing a research infrastructure across a wide spectrum of science for the pursuit of knowledge, but also the means to respond as necessary to important questions in health, agriculture, transport etc.”*

*“ 1) To increase our knowledge of the world and universe at all scales. 2) To apply this knowledge to more practical issues such as a healthy environment, improved human health etc. etc.”*

*“A return to the values of basic science workers of previous centuries, with less manipulation by politicians and the media.”*

*“That it stops making inflated claims about itself.”*

*“The improvement of the human condition, in all its aspects.”*

*“To be true.”*

*“To keep up the good work! As someone who has just started their research career, personally, I would ask that people get their act together. I find the lack of professionalism among some researchers astounding. I split my time between*

*two departments and find that to be true in both. My friend finished her PhD and wanted to stay on in academia but was just fed up with the attitude people have and so got a job in industry.”*

*“What is the nature (social, biological) of humans? How did the earth’s biosphere develop and how will it develop in the future? How can scientific knowledge be better transferred into general knowledge and consequent human action? How can we reach a balance between human needs and environmental restrictions?”*

*“Continued advances in understanding that may (but not necessarily) impact on the treatment of disease.”*

*“There needs to be a lot more trust in proven researchers and time for them to research more complicated questions.”*

*“To continue to investigate and hopefully find answers that may lead to new ways to help humanity.”*

*“Independent and free research, not constrained by short term interest.”*

*“More money, more scientists, less bureaucracy. One month of the Iraq war cost about 10 billion US\$; the NASA budget is about 10 billion US\$.”*

*“We should ask that it both continue to provide practical solutions to pressing problems (e.g., climate change, medical research) but also be able to pursue the underlying pure research to support these areas.”*

*“We should ask scientists to carry on asking the questions that arise from their natural curiosity - 'Why does this happen?' 'What would happen if I did this?' - free from the need to justify every move.”*

*“To continue to be an exciting field of work.”*

*“Everything we want to ask.”*

*“To not be for commercial gain.”*

*“To ask significant questions about the workings of Nature in novel, rigorous ways.”*

*“Truth, however unpalatable.”*

*“I think that we should try to rebalance in favour of deep, long-term work, whilst still recognising the value of applied and directed research. The move to metrics, based on publications and grant income, may well make the current outcome-oriented climate worse.”*

*“Effort and exploitation of all possible means to answer necessary questions and to train younger scientists in how to recognise and tackle problems that can*

*be solved. Equally important is showing the public what must be done and why regardless of the often mischievous mistakes of the media.”*

*“First, to be easily understood and simulated by the public. Second, to raise awareness of basic research, that does not have application during the time the research is understanding (e.g. equal emphasis on clinical and non-clinical research) Third, engaging the public at different stages of the process of scientific research including the scientists' daily lives. Fourth, support of open-access for the future. There is one open-access public understanding of science magazine the IBScientific magazine. More support is needed for this magazine and for similar initiatives.”*

*“Exploration of nature and communication of the results to the public in an honest manner.”*

*“To bridge the gap between natural science and human/social science.”*

*“Widen our knowledge and perception of the world/universe, from research into space to protein structure.”*

*“More collaborations, team work Focus on aims and results, not only journal papers Open discussions in science.”*

*“Science should serve the society.”*

*“To be a vibrant aspect of our culture. To contribute overall (but not in all specific topics) to our quality of life.”*

*“New idea creation combined with the solving of practical problems for the good of the society we live in.”*

*“To continue to increase our knowledge, both specifically and non-specifically.”*

*“To produce new ideas that inform policy and engender activity in industry and healthcare.”*

*“To search for 'truth' and above all to admit to ignorance where it exists. Hence an ongoing and in-depth critique of public policy, where appropriate of course.”*

*“To explore the unknown but also to be transparent and accountable to the wider population.”*

*“What we've always asked of it - to give us more knowledge of everything around us.”*

*“To have a major impact on health and poverty throughout the world and not only to pursue goals of value only applicable to wealthy individuals.”*

*“Keep going and stop pressurising people to form their own groups. Give job security back.”*

*“To continue pushing the boundaries of our understanding.”*

*“Proper funding to deliver results.”*

*“To reinvent the idea of humanity, which is threatened by, on the one hand, merciless pan-Darwinism and, on the other, an over enthusiasm for uploading consciousness into advanced computers.”*

*“Intellectual honesty, concerning itself with the physical world as defined by the Royal Society in the late 17th century, open to be corrigible.”*

*“To be critical, open minded, reflexive, ethical, relevant (but a proper debate about relevance needs to be had) and accessible.”*

*“Science in the 21st century has not only become the pursuit of knowledge but also a major engine of the economy and one of the keys to maintaining the level of comfort we have come to enjoy. The demands that are asked of science in the 21st century are higher than at any other time in the history of modern science. It is perfectly reasonable to ask science to solve the problems facing society but also science must be given the freedom to explore new avenues.”*

*“To continue to question the preconceived, 'everybody knows' concepts presented as fact when they are beliefs. i.e. Kyoto protocol is good, chemicals are bad, natural substances are good etc. We must face the dangers of running out of natural resources, and science should seek the answers.”*

*“To generate knowledge, ideas and theory on those issues that plague the world today: environmental security/ maintenance, poverty, promotion of health, education, for all peoples, etc.”*

*“To provide the fundamental knowledge on the nature of life, the universe and everything.”*

*“The same as always: pursuit of knowledge!”*

*“More collaboration.”*

*“Science needs to recognise its limitations: that it cannot be separated from technology and that scientists do have a social responsibility for the outcomes of their research. The application of science needs to be much more integrated into real social needs and not merely exploited for short term gain by business.”*

*“To solve the big questions facing humanity - where we come from, how the universe works, how the human brain works, and thereby to enthuse and attract young people to study science; and to apply science for the benefit of society.”*

*“A balance between the free search for new knowledge and also an interest on developing useful knowledge.”*

*“Could 21st century science deliver anything like as radical a change in perspective as the theory of evolution by natural selection or general relativity?”*

*“To be honest, open and communicative.”*

*“Much the same as we are doing: advancing knowledge with some but not exclusive focus on social and economic needs and on the wider social benefits of a better informed society.”*

*“To improve the quality of the humanity.”*

*“We should ask of science a greater understanding of the processes that make up life on our plants. We should ask of technology the means to improve human and animal health and sustainability.”*

*“To excite a young generation of scientists.”*

*“More knowledge.”*

*“Always to better understand the world. To assess questions with political implications To help satisfy the needs of the society, be they economic, social or cultural.”*

*“We should seek to better exploit what we have but also guard against using funding initiatives to channel all efforts into government-selected areas at the expense of the broader picture.”*

*“Solutions for current problems.”*

*“We should not “ask”, we should simply let it flourish. We should let scientists follow any idea, however disturbing, and report the results, however discomfoting.”*

*“Honesty, vision and communication are vital to our position in the community as scientists. We must be able to truthfully explain why our research is valid and why people should care. Multidisciplinary science will also prove essential in the 21stC knowledge-based economy.”*

*“To maintain Britain’s level of innovation to allow us to compete with low wage economies by inventing, developing and producing high value products and services.”*

*“Free pursuit of knowledge; responsible transfer of knowledge to technology and human use.”*

*“Active public and community engagement, accessibility and dialogue.”*

*“To be at least as successful as it was in the former century. To get rid of some myths (e.g. string theory). To develop new modes of thinking. To not be*

*passive re: the vicious attacks of creationism and similar intellectual monsters.  
To help education to start to teach thinking.”*

*“Everything!”*

*“Responsiveness to problems, concreteness, clarity, solutions to real problems.”*

*“That the depth and impact of science penetrates all members of society and impresses upon them the central importance of scientific knowledge and understanding to the future of the planet.”*

*“To prepare us for the 22nd century.”*

*“A less pressurised existence. Fewer conflicts between teaching and research. Better human management.”*

*“The scientists at the coal face are the ones who should be posing the crucial questions, not ‘us’.”*

*“Multidisciplinarity.”*

*“Continued progress.”*

*“That it improves the health and wealth of individuals.”*

*“Increasing knowledge, as always.”*

*“Allow scientists to pursue their own interests. They will be more driven and generate more new knowledge and understanding.”*

*“That science is closer to real problems and is better communicated to the general people and to political activities.”*

*“Some of it remains theoretical and some applied.”*

*“Truth, clarity and ethics: 1) the scientific method (observation, logic and experiment) provides the nearest we can get to truth, 2) but must set results in context and not over-claim.”*

*“Less politics, less jumping according to government targets, more creativity and less brainless collection of data.”*

*“Maximum creativity.”*

*“That it should continue to uphold the noble traditions and excellence of previous centuries.”*

*“That it becomes an explicit science of the gestures and processes leading to knowledge, not only the results!”*

*“To seek new knowledge, and to enjoy doing it.”*

*“To pursue knowledge without caring about the economic applications or social relevance of the resulting discoveries. This is best left to others, although scientists are as much entitled as other citizens to have their say about the applications of science.”*

*“To help increase our understanding of the way the world works to benefit all organisms.”*

*“To become more involved with the public. Science should be something children enjoy and have fun with. The public should know more about science and the wonderful things it has done for our lives.”*

*“In basic science, the same old questions- what are we like, what is our world like, what are other worlds like. In terms of applied science: How can we understand how to make things better in education , environment, health, economics, communications etc.”*

*“To continue to explore the natural world in an objective fashion guided by the Scientific Method. To improve the condition of humankind while protecting our environment by addressing the right problems, not just those that will earn financial reward. To present the objective facts without consideration of political or religious objections.”*

*“To continue discovering new things, but emphasise real-world applications, such as an equivalent of randomised controlled trials for policy ideas.”*

*“We must ask for a more interdisciplinary science and much more emphasis on e-science. Interdisciplinary science is the only way in which knowledge from one area can be effectively transferred to another area. It’s the proper way to face complex scientific problems. In addition we need to increase our participation in e-science projects, where the data is freely available providing solid bases for collaborative research. I think these are 2 basic, but not easy to achieve, things that scientists must take more seriously.”*

*“Nothing. Science is not a thing that can be forced to produce results. More money does not guarantee success in a particular area. If evolution has taught us anything it is that diversity is the key to survival. Let’s stop plugging all the money into faddy popular rubbish (read climate prediction, and other doom nonsense- any one remember how we were all going to die of SARS and bird flu).. and start spreading the love a little.”*

*“A 2-tier scientific community, with an elite free to do blue skies work but a majority focussed on applying some of the vast amount of unused knowledge (think genomic databases) that is currently proliferating.”*

*“A lot ! It will be the solution to many of the most significant problems we face, but it is also of immense cultural importance.”*

*“Nothing special. Science creates its own goals and drivers. It cannot be affected appreciably worldwide by outside influences.”*

*“Not to find ways of fighting climate change, but how to survive it.”*

*“That is captures the imagination.”*

*“1. Provide a vision for the future 2. Give solutions to the problems of our planet 3. Maintain a "human" face.”*

*“A halt to disastrous global warming. Clean energy resources at whatever economic cost it takes (the 'ask' is therefore of governments, not of science). No more chemical, biological or physical weapons. Info-sharing with developing countries (e.g. free-access journals etc). Full exploitation of adult stem cell research out of a respect for the life of genetically- unique individuals. Food production for all peoples of the world. A dialogue with faith groups to engage with the misconception that Science somehow has any bearing on theistic matters other than one of wonder.”*

*“To learn to communicate better with their ultimate 'customers'. Al Gore's film 'An Unfortunate Truth is a classic example of using a communicator to convey a message that scientists have failed to deliver.”*

*“Continue to ask interesting questions about the world and develop novel methods to address those questions in an independent and ethical way.”*

*“More emphasis on doing the work properly, with less competition to get funding. Otherwise in the long run, you'll just get lowering of standards”*

*“Insight into our world and our lives. The means to improve the way we live. The continuation of the enlightenment and the rational approach to the world.”*

*“Honesty and thoroughness. A return to moral behaviour, as opposed to just doing what is going to work best for your career or department.”*

*“Quality at the international level of attainment.”*

*“Nothing, as asking anything might become in itself an external pressure.”*

*“Understanding.”*

*“ The disinterested pursuit of knowledge, free from external pressures. Hopefully, this knowledge will turn out to be of value to society, but as I explain above, this must not be the primary goal. 2. The explanation of science and the scientific method to non-scientists, so they can make informed decisions in a democracy.”*

*“Pursuit of understanding of the universe plus development of the scientific bases for new and beneficial technologies - but note that scientists are not*

*themselves primarily technologists. Science mainly in the public sector leads to private sector development of useful technologies.”*

*“Advance human understanding of the world we live in and provide options for solving global problems that affect the human race.”*

*“To deepen our understanding of nature, thus contributing to the enrichment of culture and civilisation, while providing essential underpinning to the knowledge base for our technologies. To feed us and keep us in comfort and at peace.”*

*“Generally, more of the same. It has been a big economic driver (often unexpectedly - consider electricity since Faraday) and source of human pleasure and health (consider computers and antibiotics). Technological fixes to serious world problems (e.g. vaccines for malaria and AIDS, drought-tolerant crops) are also reasonable things to ask for.”*

*“To strive for increased knowledge.”*

*“To be as objective as possible. To be evidence based rather than policy or society driven.”*

*“Pure research on fundamental challenges about nature. Also applied science on genetics, major diseases and the global environment.”*

*“To do what it does best, to inspire and challenge and discover the novel and unexpected.”*

*“Science should ask important questions, and contribute to the future good; it should explain its findings with clarity, with evidence, and with honesty; it should respect ethical values; it should take responsibility for the foreseeable use to which it is put.”*

*“The same as we asked of it in the 18th century. To be bold. To dare to know. To challenge the unchallengeable.”*

*“Carry on with the excellent work! Scientific progress recently has been astonishing.”*

*“To continue to serve the nation by carrying out research identified as being for the common good while also making space for speculative research.”*

*“Answer some of the big questions without having to worry about shareholders.”*

*“The highest quality of basic research and appropriate vehicles for utilisation.”*

*“Translational research is important but basic science and pursuit of knowledge should not be devalued.”*

*“The ability of science to address problems both pure and applied research must be preserved.”*

*“The same as the past but more transparency is required regarding the funding of certain research areas - e.g., environmental research (climate change) and drug development and testing.”*

*“Realise the potential of genetic engineering.”*

*“Science should be increasingly felt to be part of the bedrock of human culture.”*

*“Very original research output, new discoveries and application of these discoveries! We should encourage publishing less, but high quality work; we should discourage measures such as the number of publications. We certainly should not evaluate the quality of a scientist based on how much he/she spends (grants), not how much he/she produces, in particular good quality work. Publication in Science and Nature magazines should not be used as a criterion to evaluate the quality of the work and the scientists!”*

*“Wherever human curiosity leads us.”*

*“It's too vague a question to have a sensible answer.”*

*“Something new. Something useful. Something interesting. Something surprising. Something challenging.”*

*“Science is a cultural domain, enquiring about the universe and our place in it - it is a problem-solving method; we've caused a lot of problems and need to come up with solutions.”*

*“That it can be pursued in freedom; total freedom of course is impossible but a distance has to be created such that it is disestablished from political pressure.”*

*“As in every other generation, we need science to understand the material and living world. Some such as global warming have clear long term implications that requires a multi-disciplinary approach but nobody can be certain any one approach will be successful. However, universities ought to be sponsoring people who are prepared to do original work on topics that are not already being discussed by the newspapers.”*

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*“Responsibility and service.”*

*“I think that depends on your favourite research area.”*

*“The private sector exists to provide the solutions to the problems we face. The universities exist to explore the spaces in which the problems are solved, to help us better understand the world we live in and to facilitate critical thinking.”*

*“More of the same, surely - it works!”*

*“A twin-track approach: blue-skies research should be encouraged and unanticipated discoveries appreciated... applied research will always have a place, but should not drive the agenda so much that it compromises the ability of science to explore.”*

*“To free itself from the shackles of government interference so that it can once again become the disinterested pursuit of knowledge.”*

*“All areas of interest, without prejudice.”*

*“To continue to expand our knowledge and understanding of the Universe (taken in a general sense), and to continue to combat in the same context, ignorance, prejudice, and wilful belief in nonsense (from creationism to beauty products).”*

*“What we have always asked... that scientists are free to pursue their ideas without pressure to produce results others want or the threat (direct or otherwise) of reduced funding if results are not what others may want for their own ends.”*

*“Open-ended investigation of issues that individual researchers find fruitful.”*

*“To save us from ourselves.”*

*“To secure the lives of people and our environment.”*

*“That it continues to have a positive impact on society, focussing on environmental issues to ensure current technology can continue to play a role in everyday lives and that scientists work ethically.”*

*“To improve knowledge and standard of living for all, protect the environment and wildlife.”*

*“Fundamental understanding of natural systems leading, with luck, to innovations for the benefit of humanity (which will also include other occupants of this planet). University scientists should be free to think outside the box in ways that Government departments, commercial enterprises, etc. don't feel able to.”*

*“To unite the human sciences and develop a scheme to really understand human behaviour.”*

*“If I knew that I would be doing it!”*

*“The same thing we have asked of it in the 19th and 20th centuries, ‘explain why things happen’!”*

*“To follow the science. Commercial activity is a natural offshoot of a vibrant basic research community.”*

*“To solve the big problems of energy, climate, cancer, poverty.”*

*“To deliver ideas and explanations for the world around us, and to provide workable solutions to the problems of the world. Then we must take full responsibility for getting these solutions implemented by engaging in the entire educational, public outreach and political processes whenever and wherever we are.”*

*“A little bit more understanding of the value of other ways of looking at the world - the arts, literature, religion - not as alternative but as complementary. Plus the highest ethical standards. All in return for more understanding from the public and policy makers as well as more money!”*

## **What are the barriers to science in the 21st Century?**

“It is very difficult to get funding and ethical approval for even quite innocuous experiments. In healthcare, even to observe professionals at work, one needs the approval of not only the professional, but also of the institution and all patients they care for.”

“Funding difficulties; inappropriate uses of research findings / lack of public & media understanding of research.”

“The decline in science education in schools. The "nerdy" popular image together with (i) the failure of popular culture to value intellectual pursuits, and (ii) the acceptability of scientific illiteracy in high culture. And, oddly, technological progress: the complexity of e.g. modern car engines stifles interest in "how things work".

“Over regulation by non-experts. Financial constraints. Litigation culture (nobody is prepared to take responsibility). Loss of common sense in the discussions of many scientific issues. In the UK: serious lack of students with suitable mathematical and scientific education.”

“Incestuous peer review - the sub-clustering of physicists who love each others work to the exclusion of inspired new comers.”

“Media distortions, government's and the public's pre-conceptions have lead to many good but non-mainstream ideas becoming suppressed.”

“Funding lack of good education for up and coming generations public perception.”

“A major barrier in English speaking countries is the weakening of the discipline needed to encourage and develop the mathematical and experimental skills on which the basic sciences are founded. Technology conflicts with basic science for human and financial resources. Technology is currently winning at the expense of basic science.”

“Over-population. Over-government. Incompetent government.”

“An increasingly mechanistic approach to the creation and dissemination of knowledge. What the long tail theory of distribution tells us is there are consumers for knowledge everywhere, and the means of distribution now (or will) exist to supply and satisfy them. However, the boundaries of those responsible for 'science' follow older and more prescriptive patterns. There is an obvious and unhelpful disjunction here.”

“Lack of humility amongst science policy makers.”

“The publics distaste for research they don't like the sound of. The attitude of scientists who don't see science as part of a bigger picture, a lack of vision from within the science community is I think what I mean.”

“Bureaucracy under funding of education/universities political and religious repression of scientists in too many countries information and media overkill: who will read books and science texts.”

“Recruiting and retaining the next generation of scientists.”

“Trust and investment in experienced scientists. Too many post docs fall off the career path to make way for young, inexperienced scientists (cheaper I presume). It is very rare for a lab. to have sufficient expertise in its post docs. Time and money is wasted permanently training. Why should I promote science as a career to children? I cannot offer them realistic careers that have long-term benefits.”

“Too much red tape and paperwork. Ethical constraints on waste tissue hamper research. Funding is often given to the latest area of interest/government incentive.”

“1. Despite Sunday speeches, the importance of Science is not understood by the political leaders. They applaud Nobel Prizes, but allow 80 students per Professor (in Germany). This creates the public feeling that Science is of no real importance, is a nice-to-have only; Thus there is no public understanding of the basics, even of our every-day-life. Science is complex and will be more so in the future. Only if the general public (in the developed countries) is made interested and informed, it will be science-friendly; if not the non- or misunderstanding of science will be a barrier. 2. Increased funding and deregulation would reduce barriers to science. 3. Wars always are barriers to science (and art). 4. Poor education and basic supplies (water, food, schools) in developing countries are barriers of science. 5. Most visibly now in developed countries, fundamentalism is going to become a serious barrier of science. 6. Fundamentalism will become a serious barrier in Islamic countries if the Islam does not undergo a "Century of Enlightenment" ("AUFKLÄRUNG").”

“Poor public understanding and attacks on scientific progress from, e.g., fundamentalist religious groups.”

“Funding mechanisms. You need to say what you are going to do - if you knew that, it would not be research!”

“The increasingly instrumental demands placed on science risk killing this natural curiosity. It is possible that scientists will, to some extent, internalise the instrumental demands placed on them and lower their own expectations of what sort of questions they can legitimately ask and expect to be funded for. When you have had to justify your research in terms of value for money, benefits to society, ethics, etc countless times you start to think in those terms. Even in science we seem to be increasingly quick to mock research for which there is no obvious answer to the question 'What is it for?' and this attitude may be more damaging than external pressures in the longer term.”

“Fashion. Funding. Misconception.”

“Not really barriers, but a threat viz the biphasic society where many lay people and politicians are scientifically ignorant and hence might withdraw funds/support. In clinical research the present meddling of the government in the education, progression and working practices of medics.”

“Misinformed general public e.g. thinking cloning and stem cell research involves directly manipulating human life forms.”

“Our reliance on Science, as the only way to generate new knowledge, is not appreciated.”

“The current academic training system!!!! We are churning out more, lower-quality, PhD's, because of academia's demand for cheap, disposable labour. Long-term, the brightest students will be turned away from academic research when they see no career prospects. This will affect industry too, because it's harder to judge good applicants from an increasing pool, and many are turned off science altogether (as opposed to getting a good research training in academia, then entering industry). The current funding and tenure system is basically designed to advance a careers of the chosen few, who then get to pursue their research based on their own agenda, not on what's good for scientific progress. We need more intelligent funding application review strategies, and possibly a change to the overall structure of academia, to combat this.”

“Lack of desire to know the true answers but rather to reinforce beliefs, prejudices, etc.”

“Increasing specialisation and the avoidance of risk will make for a lack of major steps forward, in favour of incremental progress along obvious directions.”

“Support - financial and political. Excessive susceptibility to short term political and extremist pressures.”

“Commercialisation of science ( a double-edged sword). A decrease in the number of people willing to live the scientist's life. The gap in recognition of scientists at a junior age by non-scientists.”

“Too much emphasis to enlarge previously successful institutions and limiting funds for new, small and previously weaker institutes in research.”

“Educational failure early in life, superstition in adults and ignorance.”

“Making governments understand that short term investment is not supporting science. Engaging the public, e.g. increase the number of young people with good scientific knowledge and approach to science. Generating scientists that can work in large teams and have multidisciplinary insights.”

“Time limits in funding and contract length Publication pressure Individualism and competition.”

“Balance between the norms of a scientific community and the attitudes of the funding organizations.”

“The call for micro justification. Overheads brought by collaboration to offset specialisation.”

“I think that Science is more highly valued than ever, and it has probably never been able to do good science. Science has also never been more competitive, with excellence in science being a matter of international prestige for nations.”

“Funding and the publication system. Too much emphasis is given to publication and whether a few large journals agree that a topic is important or "sexy" at the time of submission and this has a major impact on funding and whether or not work gets done / followed up!”

“Reduction in participation by students. Many of the best students go into medicine rather than science. Science is not always perceived as an exciting and rewarding career.”

“The usual - greed, ideology, search for power with help of science; excessive communication may help but also makes the testing of ideas. /findings more difficult. Can science be democratic?”

“Arrogance in the scientific community.”

“Time and money....not enough of the former because not enough of the latter.”

“Mostly funding and commercial priorities. Although I suspect it will be a lack of good scientists due to the above and the financial rewards available outside science. I am also concerned about many young scientists having little experience of independent thinking having been overly directed through their school, undergraduate and, even sometimes, their PHD years.”

“The PC world gone extreme. Encourage rules to be broken

“Overcoming the popular perceptions that it is as faith-based as religion.”

“Lack of funding and proper number of academic positions.”

“Interest in applications.”

“The barriers come from within science itself -- especially when promising theories are turned into dogmatic world-views that can become the basis for policy. But perhaps the most serious barrier science faces is that its classical mission of universal knowledge at any cost falls foul of a Darwinian world-view that values knowledge only in terms of its local reproductive advantage. Science at its best is much riskier than what Darwinism would consider 'sustainable'. The attacks on GM crops and animal laboratories are just the beginning of a larger

resistance to overambitious science that will come from a broadly eco-Darwinian perspective.”

“I am not in the business of forecasting.”

“Lack of funding without strings, perceptions that only hard science is good science, pressure to be 'relevant' in narrow and circumscribed ways, teaching and admin loads in universities.”

“The barriers facing science in the modern age are mainly, I feel, the growing gap between scientists and the general public. Science is being demonised and asked to save the world at the same time, while the scientific knowledge of the average person is not keeping pace with the knowledge required to understand the science.”

“Lack of money. The way the media interprets what is done and the priorities set by Govt pressure groups.”

“The quality of scientific education in schools is now so appalling that we risk not having competent scientists in the 21st century.”

“Disconnect between the public decision makers (i.e., elected officials, parliament, opinion leaders, etc) and the knowledge that does exist. Perhaps a lack of funding - what else is new. Increasing demands on personal time (for all, not just scientists); the increasing expectation that scientists will not only generate knowledge but disseminate it to the right people as well, with little accompanying support to make those expectations a reality (lack of skills training on how to deal with the media, how to prepare policy briefs; knowledge of who to talk to, provision of funds for Open Access publishing, etc).”

“Public and government misconceptions leading to increased bureaucracy, reduced time and reduced funding in the right areas and unrealistic expectations.”

“A drive for industrial applications; too much paperwork.”

“Funding, short-term contracts in particular - how can you embark on an exciting project in just 2 years with all the pressures of writing papers and applying for funding for the next project.”

“Funding, staff, difficulty of international communication.”

“One of the most serious is the rise of fundamentalism both in its religious and secular forms.”

“Insufficient funding. The rise of irrationality.”

“Still, the political pressures (both inter and intra scientific communities).”

“Scientists.”

“Confusion with technology. We live in a world where technology is omnipresent and the boundary between science and technology is increasingly blurred. Even some bioethicists think that we shouldn't make the separation when considering the ethical aspects of certain research. I disagree, though it is a hard point to press. It is important not to lie to the public by dressing science up as technology, or basic research as applied research. Continually claiming the impending cure for cancer, for example, increasingly falls on deaf ears. It is also important not to change science into technology thinking that that will speed progress towards certain aims. It will do the opposite.”

“Lack of suitable funding.”

“Too much direct involvement at high political levels, so that scientific funding is increasingly tied to initiatives that must always be packaged as new and exciting. We already had a lot of public money wasted on the "e-science" initiative a few years ago - still nobody knows what e-science is but £100M was spent on it. Too much focus on novelty means that not enough attention is paid to the basic reality of slow and steady progress, and core areas such as maths and statistics are neglected. For example, the grasp of quantitative experimental design by today's scientists is woeful, meaning that a lot of money is wasted on inefficiently-designed experiments. But this is not a sexy area and does not attract interest or funding.”

“Political interests.”

“Anti -GM movement Public apathy and lack of interest in science.”

“Media misunderstanding and funding based on 'spin'.”

“A-priori-s.”

“Economical, financial external pressures

“Over-regulation and paperwork, over-hyped areas.”

“Job security for postdocs in academia. This makes it hard to plan for the future and puts strains on family and personal life. I want to remain in science but may have to move into the commercial sector because of job security.”

“Too many people do research without contributing to new knowledge. Financial resources will be limited and will need to be distributed by regarding the epistemological aspects of the projects more rigorously.”

“Over regulation, politically correct grant giving bodies.”

“The woeful standard of British scientific education. The general public's lack of knowledge leads to irrational and uninformed fear.”

“Insufficient research funding and venture capital, coupled with a lack of political strategy.”

“Unrealistic expectations that science has ready answers for all human problems: global warming, obesity, cancer, etc...”

“Systematic social inequalities supporting over-emphasis on commercially-driven rather than community-driven aims and processes.”

“Human Stupidity and irrational thinking Moneytheism Intellectual perversities as post-modern relativism.”

“Funding.”

“ Too much regulation - market orientation - unscientific fluff.”

“Too little funding flexibility to develop scientific research and ideas development for its own sake. Limited perception of the school curriculum and science within that context creates a restriction on the opportunity to pursue scientific thought and process in depth; inevitably this reduces the potential pool of science students in higher education and creates the cycle of reduced awareness of the centrality of science.”

“Public misunderstanding leading to political indifference.”

“Lack of status in the general public. Low pay for many (considering the qualifications of most scientists). High pressure. Recruiting young bright minds.”

“Under funding. Insufficient value being placed on scientific advice at ministerial level. There is no lack of committees and reports, but there is a serious lack of implementation.”

“Difficult to obtain blue-sky research funding.”

“Funding, technology and public opinion.”

“Wasting resources on endeavours identified in 17. such as defence.”

“The dominance of ‘insiders’ and overemphasis on applied science.”

“Politicians placing ever changing short term goals onto science. It is fickle and means science progresses more as a random walk rather than with real direction.”

“Old researchers. No interest from young people in a research career.”

“Lack of teaching in schools. Lack of funding in universities. Many universities are shutting pure science departments.”

“Bias and misunderstanding - whether intentional or otherwise.”

“Funding, low career perspectives, public perception in some areas, too much politics.”

“Scientific research is too expensive and takes too long. too many barriers to participation/contribution.”

“The public should ultimately decide.”

“Failure to invest for the longer term: insistence that all projects have a "payoff" within a very short timescale.”

“Science limiting itself to selling ready-made theories for the sake of a consumer economy instead of creative knowledge engines.”

“Availability of funding. Attractiveness of careers. Effective co-ordination of large-scale projects. Fostering innovation and creativity. Micromanagement (large scale political priority setting is appropriate; micromanagement is not).”

“The fact that politicians and bureaucrats believe (wrongly) they understand what science is and that they think they are entitled to decide what kind of research should be funded and what kind should not.”

“Religion. Politicians. Ignorance. Greed. Selfishness.”

“1) short-termism on behalf of investors keeping industrial R and D a low proportion of GDP (esp. in the UK) 2) poor science education in schools due to poor training and esteem and conditions of science teachers 3) shrinking physical and engineering science in British universities 4) growing influence of religion of all kinds 5) growing influence of new age mysticism and complimentary bollocks - see Gillian McKeith, crystals, acupuncture, hypnosis etc 6) media dumbing-down.”

“The increasing threat from world views which reject the scientific method, and are gaining increasing popularity among the educated classes in the developed world. Political interference, particularly that seeking to commercialize science further or to restrict funding for original research. The failure of scientists to unite in the face of campaigns by single issue protest groups.”

“Stable funding structures to attract a wide range of scientists.”

“Both political and economical interests preclude scientific development in many different areas. However, I believe that religious indoctrination (e.g. religious classes during the primary school) preclude the formation of a critical mass devote to science. Even more, this reinforces movements defending ideas lacking scientific evidence, such as "intelligent design". If we want to improve science we must think seriously about the way we educate our children. Religions precludes science, and so all the advances it can provide us with.”

“Media hype, public hysteria, and a government that listens to it when determining science policy... The judging of the quality of a scientist by a) how many grants they've attracted and b) by their citation index. Both of these things are increased if said scientist will inflate their findings to the point of madness. Nothing is more quotable than a ridiculous end member. But it builds careers. The continual corruption of the peer review system by journals, who are more interested in making a splash than publishing something that will stand the test of time. I read recently that the average life span of a paper published in Nature before it is completely discredited is Six Months.... and getting a paper in Nature almost guarantees career success... why... because of the citation index... genius...”

“As ever, fundamentalism, lack of understanding & obscurantism. maybe the much of the public will never understand a lot of science & we should not expect them to. scientists themselves should be wary of making over inflated claims for their work & stop talking about breakthroughs all the time.”

“At the moment it is top down management (by government and administrators), rather science and scientists deciding what they should do.”

“Money of course, as ever. But also imagination.”

“The short-termism of funding - projects have to be self contained and achievable in (very) short time spans - unrealistic in an ever increasing complexity of science.”

“Fear and cynicism.”

“The lack of a common global goal, strong external economic pressures.”

“War. Poverty. Greed of scientists and governments when it comes to ethics. In the realisation that interdisciplinary science has brought the biggest advances in the last ten years, some universities are offering non-traditional courses. We must beware that the scientific basics are not diluted. True interdisciplinary research comes when experts in their own discipline join forces. High school science in the UK is under attack from those seeking to reform the curriculum to free it from 'teaching to the exam'. Some proponents of a discovery-lead curriculum which includes academic and vocational freedom, inadvertently devalue a formal scientific 14-19 training for all, which I think threatens to limit school-leavers' ability to engage with public understanding of science.”

“The lack of graduates of sufficient calibre coming out of our universities. I have been trying to employ a suitable graduate for some time and although many have excellent qualifications, no one to date has the interpersonal and communication skills required.”

“Keeping people informed of the science that is being published. The volume of scientific papers published is at a record high, keeping abreast of advances within and across disciplines is nearing an impossible task.”

“Too much pressure for science at all levels to be goal or disease orientated. A lot of bad science is encouraged by too much focus on what the science can do for you instead of trying to address the question of interest. Also too much pressure to publish in top journals. Grants and jobs depend on it, but the publishing procedure is not fair or transparent.”

“Complacency of public - hypocritical anti-science ideas when they also benefit from it. Media reporting is AWFUL - scientists are either saving mankind or destroying it. Science communication should be more important and not just restricted to academics or YOUNG researchers.”

“Re-emergence and strengthening of religious and anti-science movements. The lack of scientific literacy amongst opinion formers, the media and the public. Irresponsible and sensational media.”

“Ignorant people in position of power, lack of funding.”

“Public ignorance and government short-termism.”

“Democracy, funding, and sympathetic institutions that can rise above the pressures of modern metrics.”

“The lumping of science and technology which gives a disjunct between the process of science and the values put on it which are more usually associated with technology arising (be that advances in medicine or ethical dilemmas). A process that doesn't help technology either, as argued in the Reith lectures a couple of years ago.”

“A very important one would be declining educational standards, for two reasons: 1. This would mean an increasingly limited supply of new scientists (the UK is already experiencing this to some extent, especially in mathematics and physics); and 2. It makes it harder for the general public to understand, discuss and support science (e.g. the debate on anthropogenic global warming).”

“Prejudice and ignorance on the part of sections of both the public and the ruling classes; political manoeuvring by those classes as well as by pressure groups of all sorts.”

“Misrepresentation by the media and misunderstanding by the general public. Bad science informing the general public.”

“Resources directed at inappropriate targets which bring benefit to few. Conservatism and fashion in research funding.”

“Hmmm ... this could take a lot of space ... let's just say, lack of imagination, lack of a sense of wonder, and a sense of history ... ignorance, prejudice, incompetence, a lack of willingness to learn, a lack of humility in admitting mistakes, correcting and learning from them.”

“A resurgence of religion, superstition and fear of religion. These erode the government's ability to support long-term science.”

“Funding, the career structure within science that means that many good junior scientists are lost due to lack of opportunities, poor wages!”

“Lack of funds in academia.”

“Economic and commercial pressures. Scientific ignorance from politicians and decision makers.”

“Easy attractions of the entertainment culture, declining rigour in secondary education, short termism and managerialism in research funding.”

“Ignorance, greed, laziness.”

“Admin, government, instrumentalism, codes of conduct, regulations, bills, fear.”

“There aren't any that couldn't be overcome with more funding and less red tape.”

“In academia: \*narrow-viewed assessment of scientists performance - activities outside of publishing (e.g. teaching, public engagement) receive little incentive. \*Problems with public understanding of science indirectly affecting funding levels and priorities. \*limitations in funding, often short life-span of grants, 'fashions' in funding allocation priorities \*unsatisfactory wages and job security - probably a factor in recruitment/retention problems.”

“The ever increasing rise in target driven research (i.e. research that brings in prestigious income). There is nothing wrong with this goal as much of the public money is aimed at carrying out research for the common good. But do we run the risk of neglecting areas that have not yet borne fruit.”

“The golden triangle with its funding bias.”

“Poor quality or poorly led and managed research (e.g. the mess over FMD) The pressure on politicians to work on a purely short term basis. Loss of public confidence in handling the societal and ethical issues which will continue to arise.”

“Economic pressures and drives to make science profitable forces research into narrow fields and increases the pressure on scientists to produce positive results at the cost of integrity and quality.”

“Whilst I recognise the importance of applying science to problems in the outside world, I am concerned that particularly in universities, the scope for doing pure research without any immediate pay-off must be protected. This ultimately leads to new advances in applied research. If universities cannot do this, who can?”

“Too many people universities and research managers chasing too little money.”

“Scientific progress is met with caution, not celebrated unequivocally. We're under as much pressure to discuss the potential problems of what we do as we are to actually produce the goods.”

“As the career of university scientist becomes increasingly unattractive, the escalating age-profile of departments will make them unsustainable. It is clear that young scientists are aware of the chronic stress besetting heads of laboratories. I believe that the principal problem relates to the failure to provide permanent technical support within laboratories. This policy became almost universal about 15 years ago. It means that there is rarely long-term continuity within research groups. Crucial techniques and expertise are frequently lost when short-term members of a group leave.”

“There are no barriers to "science", but there are many barriers to good science. Looking for money and more money has been the major tasks of most scientists, so they have little time to do good science. Some research requires loads of money, but others do not, yet using research income as a measure of a scientist has become progressively important by more and more employers. Isaac Newton and Albert Einstein did not have to raise money to prove their being genius. Let us think about this simple thing!”

“Bureaucracy”

“Media dissemination. Media comprehension. Too much funding for large projects (funding agencies too lazy / keen to give away money in large blocks). Income based upon previous funding gained rather than performance (i.e. original publications). Short (3 year) postdocs. Should be a minimum of 5 years. Too much funding thrown at expensive and unproductive medical research - especially wasteful association studies. Poor university management / silly, ego-driven initiatives / pointless surveys and auditing exercises.”

“There's never enough money. Also, not enough recruitment of talented individuals into research rather than say financial services, the legal profession or medicine UK culture is dominated by scientifically illiterate people who did PPE at Oxford.”

“That it is being corrupted by the market and the media; although the later has sometimes opened up a debate where one is truly necessary and things can become swept under the carpet.”

“Widespread understanding of sciences mission. Already we can see that the general public think the whole purpose of biomedical research is to find cures and physics for making gizmos to communicate idiocy of various kinds. Do they think we are all going to live to be 200? Similarly, we have invented communication systems of astonishing sophistication and yet it is impossible to find any material worth watching on television.”

“Some scientists and the continuation of the white coat syndrome.”

“In astrophysics there has to be room for individual researchers to do their own thing and I don't think there is because funding always has to be attached to a big project. That's a shame because you can get some very interesting internationally recognised results by having ideas off the beaten track.”

“Tied funds - i.e. research funds requiring limited range of outputs.”

“Too much 'top-down' micro-management of research. A good current example is 'New Dynamics of Ageing', in which groups are forced into unnatural consortia in order to get funding to carry out projects whose inter-disciplinary nature has not grown out of the underlying science, but the prejudices of the bureaucrats. Religious or political fundamentalism (e.g. in the case of stem-cell research in the USA, or genetic engineering in Germany).”

“Lack of investment. Lack of understanding of what science is. Expectation that science is equated with certainty, when in fact it thrives off of uncertainty. The Bush-Rove doctrine, which disregards facts and objective debate in favour of deliberate misinformation and spin. Science has no place but exploitation in such a doctrine.”

“Poor scientific education in general and completely inadequate practical skill development in school and university. Too much emphasis on peer reviewing of papers and grant proposals. The drive for publishing in high impact journals. Such activities curb originality.”

“Poor applicants and ingrained prejudice. And of course limited funds.”

“A largely ignorant general public who have not received a basic education in science; a wilfully ignorant and uninterested media who rarely give proper and informed attention to science; far too many university graduates in general and non-rigorous subjects who have risen to positions of influence where their lack of rigorous thought process are detrimental to science and many other aspects of modern civilisation.”

“Top-down control by government management of funding; Poor funding; lack of scientific representation in government; misdirected over-sensitivity to ethical issues driven by unemployment by philosophers.”

“Political interference and international business interests generating wars and hampering progress for personal gain.”

“Public disengagement.”

“Lack of funding and depleted enrolment figures for science undergraduates.”

“Lack of interest from today's young people - not taking STEM subjects at A level and university, lack of Physics teachers.”

“Funding, strategy, communication, politics, self-advancement of an elite.”

“Time wasted by unnecessary administration.”

“Closed-minded scientists beaver away in their own corner, unwilling or unable to appreciate the bigger picture.”

“Religion and unachievable expectations. The slow creep of religion into education is a worrying trend, as is the idea that science will solve our problems (e.g. climate change) without significant personal effort.”

“Funding and legislation.”

“A weak UK science base (levels of general science awareness coming out of schools); too much 'busy work' and not enough 'scholarship' within science disciplines.”

“Short term expediency, looking for the softer options, not being brave enough about tackling the bigger, longer term problems with energy.”

“Public distrust and disinterest, not helped by poor (and badly funded) science teaching in schools and a very arrogant attitude by a vocal small minority of scientists.”

“Medical science in particular is hugely affected by the restrictions on using human tissue and the barrier to in vivo work in animals.”

## **What are the key barriers you face in conducting your scientific research?**

**If they are to do with funding, briefly explain how you experience this problem. Please also describe the range of constraints you face beyond the question of funding.**

*“Most of my current research is done with nurses, midwives and allied health professionals. I have heard it said that such people don't really make decisions, but rather they do as they are ordered. It is hard to get funding to show how decisions are made by these professionals with this attitude.”*

*“Time constraints. Too much admin/teaching/bureaucracy. Too little time for actually doing research. Too much directional funding towards big collaborations for well defined foreseeable aims. Constant change of rules, constant reduction of support for researchers ....”*

*“My barrier is different from the points indicated in this survey: 1) Not enough good PhD students that are properly educated (especially in the UK) and are willing to work for 'young' or 'starting' scientist. Barrier is that we are not allowed to take on non-UK students using UK funding. 2) The number of independent 'young' scientist has increased a lot over the last 5 years and we are competing for funding, while established researchers still retain most funding (perhaps rightly so). 3) Under fEC, Universities only expect the academics to bring in funding. Almost no emphasis is given to quality research anymore (unless it bring in funding). The situation improved a bit with the upcoming RAE, but might well deteriorate again after the RAE is complete.”*

*“It would help to reduce barriers for me if application driven criteria for funding proposals was removed. The Department of Energy have already done this. The UK needs to follow suit.”*

*“Research only counts when it ties into existing and popular paradigms. Therefore it's difficult to obtain funding, but also difficult to get published and recognition.”*

*“Lack of funding on inter and multidisciplinary work. Only ESRC /NERC acknowledge this and put limited funding into it e.g. 20 PhD places for the UK in any one year is not very many!”*

*“University scientists have to deal with carrying out a research programme, which is a full-time job, with another full-time job of teaching during term time. Little recognition is given to efforts in teaching in terms of promotion or research funding allocation. This is not sustainable in the long term.”*

*“It is hard for me to get the funding I really want because my track record is not good enough. For many years I was funded on a wide range of projects so papers in inconsistent topics. I now have funding from EU & FSA but this does not carry the kudos I would like if I could get a response mode grant and I cannot do the more basic research I would prefer to be doing.”*

*“NHS ethics committees greatly impede my research, which is non-invasive and concerned with fundamental issues (though in the long-term it may have clinical relevance). Those that I have dealt with see themselves as trying to decide whether the science proposed is good enough to outweigh the potential harm. This is wholly inappropriate for non-invasive non-commercial basic science. Ethics committees should not be encouraged to see themselves as guardians of 'good' science; academic journals and funding bodies do that well enough.”*

*“In social science, ageism. Ask questions off the government's perceived message, or ones regarded as irrelevant to the careers of mono-disciplinary midgets and other conformists and your thinking will be opposed or ignored. {Or either people agree with you but attribute your insights and statements to more established/fashionable people who merely tacitly acknowledged them years after you, or who take no interest in them at all}. [This as actually happened to me, when someone who later came to work with me had originally misattributed my work to one of the household gods of the area under scrutiny. If this is what the good guys do, heaven help us with the bad ones... although the latter may simply be less competent).”*

*“Funding - lack of serious consideration of trans-disciplinary work. If you can get it, have a look at the British Ecological Society Bulletin, August 2007 for an excellent set of pieces edited by Alison Holt and Tom Webb. It's pps 1- 13.”*

*“Funding in my case is not the problem. The problem is accommodating to the norms of what is 'desirable research', or to put it another way, research within the paradigm. My interests lie in an area where the paradigm is changing and hence the 'benchmarks' no longer describe or depict the nature of the field.”*

*“Funders unable to evolve their strategy developed by practice. The almost total erosion of the Haldane principle.”*

*“Funding is my key barrier as my supervisor has none and I have to go to another department to use their equipment. I think my supervisor is the other barrier to my research. Nothing is thought through properly so I get conflicting instructions.”*

*“Increasing budget cuts of universities decreasing technical and administrative support (increasing reduction of personal) too much focus of funding organisations on hype issues.”*

*“Funding - with funding rates at a low level the process becomes something of a lottery. Many good projects do not get support.”*

*“Distractions from short term contracts limits my potential. We are highly qualified and yet we are not guaranteed a consistent wage. We are expected to move around but many people have families and partners with permanent contracts, making it impossible to move. Commitment and dedication can be assessed.”*

*“The long drawn out process of obtaining ethical approval, particularly if you only want to slightly alter a procedure you have used previously. This is particularly so with waste tissue.”*

*“1. Needed would be enduring funding and flexibility. The freedom to spend funds where required in the course of a project, to swiftly adapt spending to the necessities and not as had been requested long before. Certainly, the spending has to be justified, but retrospectively. 2. The always tighter and more detailed regulations and ever increasing number of questionnaires, invented, compiled and e-mailed by administrators who never have done science themselves. In all, the distrust and as the result, the decreasing scientific freedom.”*

*“The focus if funding is a major issue. The move away from funding microbiology necessitated a change of field. It is galling that the government should at once be pledging to tackle the MRSA/C.difficile problem whilst also slashing funding for bacteriologists. it is also my understanding that this is not a special case, and that the Research Councils are being prevented from funding important work in other fields.”*

*“It is not possible to do high quality research as a set of projects. Projects may be fine for the D of R&D, but not for the R. If it can be managed by a project manager, then it is not research!”*

*“Applications for funding and for ethical approval are very lengthy and take a considerable amount of time to complete. The 'non-scientific' justifications for the research (communication, clinical impact, etc) seem to take up at least as much space as justifying the science (is it actually a well-designed study) and more effort seems to go into making the application sound as if it will tick the right boxes rather than thinking about the scientific rationale sometimes. I am fortunate to work in a currently fashionable area, autism research, which means it is perhaps easier for me to justify my research than someone studying similar mechanisms in typical development or in another disorder. I suspect colleagues in other areas may have more difficulty finding funding than we do.”*

*“The present system of funding is on a spiral following 'to them that has it shall be given and to them that has not it shall be taken away...' This stifles innovation and increases wastage of funds and is in direct conflict with the requirement of universities to educate well a broad range of students.”*

*“I do not deal with the funding side of the project I work in but am well aware of the constraints.”*

*“Too many people attempting to do derivative, i.e. not interesting, work -and thus wasting enormous amounts of cash. Bureaucracy costs a fortune in 'protecting' public money, when it would be better safeguarded by funding only small numbers of trusted experts.”*

*“The current academic system. PI's are asked to do too much, so I as a postdoc teach their students, write their papers and grant applications, all at the*

*expense of my own research, becoming less employable as the years go by. Talented researchers at the PhD and postdoc levels are undervalued and abused. Science needs good and dedicated teachers, yet the only way you can get a university teaching position is through research success, whereupon you don't have time to have a significant teaching load and pan it off onto postdocs or onto older lecture staff who have lost their grant funding. Funding-wise, I only have funding for a few years at a time - this in itself is good - but job-wise, the current funding system makes it harder for PIs to hire experienced staff (will only provide money for a junior position), so the more experience I get, the less secure I am - that's a ridiculous waste of the resources that have been spent training me, especially when I am still making a huge contribution, just not one that's as visible than my PI's. Funders and universities need to allocate funds for this job, which lots of people are doing but nobody acknowledges. I am sure I will eventually be forced out of research - despite everyone I have worked for saying I am one of the most talented students / postdocs they have come across."*

*"Short-term funding, focussed on policy needs. Pressure to deliver science for the benefit of 'UK PLC' that often means just IP and spin-off companies."*

*"I work in an interdisciplinary subject (between biology, maths, computing) and in general there are problems when research falls between the divisions created between disciplines. For example between research committees in one research council and between research councils (BBSRC, EPSRC). More needs to be done to remove these barriers..."*

*"Pressure to publish, bring in grants and teach more students can easily lead to a culture in which we don't have time for curiosity. It's the industrialisation of research, almost, with a tendency to focus on quick wins. At University level, the spread of managerialism, and the emergence of an administrative culture almost entirely divorced from the academic workforce, leads to the undermining of academic autonomy and professional responsibility. There is a long way to go before this entirely destroys the distinctive freedoms which go with academic life, but we are on the slide. I only hope that this can be reversed by a realisation that a university can actually perform better if there is a focus on fully engaging and supporting the people who work there, rather than "managing" them."*

*"Distaste for my profession by much of the medical profession and lack of support by government for toxicology has driven most jobs and almost all training out of the country. This is due in part to the furore over animal experimentation and in part to the relative disdain amongst medics and vets for such a very applied, part industrialised discipline."*

*"Funding is always an issue especially when you weigh basic research and clinical research in medicine. Another key barrier is a focus on high impact factor publications (e.g. nature, science and cell and their families of journals) in grant applications, fellowship applications and getting open-ended contracts. I suggest citation should also be added you may have published in cell (impact factor 25) and had 20 citations since 2005 and published in on cogene (impact factor 6) in same year but had 35 citations."*

*“Too much pressure from universities to make departments profitable is a big problem and headache. Income is too low for the workload and pressure.”*

*“1) Funding- constant updates and reports to fill in; administrative work associated with the funding itself 2) the short term nature of funding.”*

*“Continuing need to 'deliver' and to shape research funding requests into the 'giver's priorities.”*

*“Fixed term contracts. Combining family and part-time science. Publication pressure. Individualism in science.”*

*“Funding: they are looking for a concrete result in a short term. Dialogue: we think and speak differently. It is very difficult to communicate.”*

*“Pressures on time owing to parallel activities.”*

*“Funding is always an issue, but rarely an insurmountable one. If one is over-focused on a particular idea, then it can seem insurmountable, but it rarely is!”*

*“Difficulties in recruiting the best researchers.”*

*“Political interference.”*

*“Too much work. I gave up looking for funding when I became a 'climate sceptic' and went into editorial work, even advocacy instead. Soon to retire.”*

*“At this stage in my career, the key barrier I believe is a system of short-term contracts which means I am reluctant to get involved in long-term projects as my career will not benefit from it. I must work on projects that will give me publishable results within 2-3 years. I'm not sure this always results in the best quality science.”*

*“Lack of people with real dedication and motivation. Also, a mass of regulations and the paperwork that goes with it.”*

*“It is funding. If you have no job security and no money for consumables you can't do the research to back up your proposal. Also a post doc should not be ruled out for a job because they are too old and hence too expensive. It should not be that they HAVE to find their own funding. Once one has funding they must take on students as quickly as possible.”*

*“I am quite low paid! It is quite difficult to remain motivated when less qualified people are off earning huge amounts of money for less academically interesting subjects, by converting to law or accountancy...”*

*“Lack of job stability.”*

*“Access to research material.”*

*“I don't face any serious barriers personally but the focus on citation counts and other metrics in future research assessment exercises is potentially very damaging to free inquiry, and need to be rethought -- if not resisted -- now while they're still on the drawing board.”*

*“Constraints: teaching and admin in the main. Funding: difficult for me to turn my small scale, highly sensitive and qualitative research which is not 'relevant' in the ways the RCs and the government define relevance into fundable work. I have succeeded with one small seminar series grant and we are bidding again for some actual research support to another council but I am not optimistic!”*

*“Increased teaching and administrative loads mean I have little time to spend on writing applications for grants, so funding is an issue. When I am successful in raising grant income, it is difficult for me to find sufficient time to concentrate fully on research.”*

*“I guess boils down to a skills shortage - resulting in increasing feelings of overall time pressures, lack of personnel, technical and financial resources. Also there is a need to develop organizational cultures that support knowledge generating and dissemination practices.”*

*“Time - there are not enough hours in the day to do all the teaching and admin required, and compete on the international stage.”*

*“Too much paperwork.”*

*“Post-docs are expected to move around the country to get work from contract to contract - I do not think this is reasonable or promotes a good work/life balance. More long-term contracts/permanent contracts should be available for post-docs. Also erosion of funding means there is always cut-backs on technician staff so do not get good levels of support in the lab. e.g. I get paid the equivalent of £15/hour to wash glassware and other menial tasks - this does not seem cost-effective or the best allocation of resources.”*

*“Funding is my main problem. It is difficult to get funding on cultural issues and other 'soft' topics. Another constraint is the expectation for many short publications, rather than producing fewer, comprehensive publications.”*

*“Difficulty in planning for long-term projects; too much concentration on short-term applications.”*

*“As I live in a developing country, the major barrier is the society has not "sensed" a great need for scientific outcomes.”*

*“Plagiarism.”*

*“A lack of contacts between the political and the scientific worlds.”*

*“Realistically there have to be restrictions of funding. The main barrier is the management of universities by external managers rather than a collegiate approach, and the RAE, which has been counter-productive and distorts the research process.”*

*“Low rates of success in funding particular for junior scientists with little proven track record (hard to get off the ground). Other pressures (e.g. teaching) taking away from research time. The RAE, diverting attention away from doing research and towards outward short term indicators of success.”*

*“Funding - very difficult to start up a programme in an 'unsexy' area on science – i.e. none available ('big pharmacies' are the only people who have helped us and we are not researching any of their products!). Ethics approval has been a nightmare. We get no help from our hospital trust - shifting sands of funding.”*

*“Administrative bureaucracy and lack of funding for public outreach policy.”*

*“Too much time spent on internal and external regulation.”*

*“As a veterinarian I am interested in the way a being regains its natural (healthy) balance. Current medical methods aim at "hiding" symptoms of an unbalanced organism. This certainly improves the acute condition, but it generally does not solve the origin of the problem. Methods that claim to solve the origins of such problems exist in various forms. Often they appear esoteric and totally detached from scientifically plausible mechanisms. However, sporadically they are successful. I personally am investigating Qi-Gong which is an old Chinese medical practice. My experience so far has extended my understanding of physiology in a complex organism way beyond what I was taught at university. Great experiments could contribute to the establishment of a coherent theory that would explain phenomena encountered in Qi-Gong without leaving scientific grounds. However, complementary methods in medicine are regarded as unscientific and thus not worth investigation. This rather religious rejections inhibits any possible evolution of the current theory. As I would like to conduct scientific research in this field, I am personally concerned by this prejudice and have to finance all my investigations privately.”*

*“No overt barriers at all, but fashion means that some sorts of research, such as on intelligence, is less likely to receive support.”*

*“Being mistreated by my employer, sanctioned by the research council. Insulting pay (PhD students now take home almost as much as post docs) and the removal of our right to a redundancy payment are not the best way to get world class science out of an already demoralised workforce.”*

*“We have proved that the key to animal and human health and well-being depends upon the quality of nutrition. This in turn can only come from top quality soils. Those in government who should be listening to us either do not understand or are working to another agenda.”*

*“Peer review of proposals is more of a lottery than it should be. But I don't have a solution to this problem!”*

*“The artificial requirements imposed on young academics in order to evaluate excellence with increased bureaucracy which requires instant results could become a barrier for original thinking, risk taking, and long term view necessary for scientific research.*

*“Commercially-driven funding prioritises pharmaceutical and technological and (some specific) disease-related topics, restricting the potential for exploring human and social consequences for wellbeing or community-controllable innovation.”*

*“Funding, time, administrative overload as HoD, increasing dirigist policies of successive governments.”*

*“Funding: a small and simple project lasting a year with one junior member of staff costs 100k+ It is very difficult to obtain large sums of money for small projects so junior staff suffer. Senior staff are more likely to be given large grants but they are also more likely to be doing non-innovative work.”*

*“Funding is the main problem., All of the funding opportunities for which I am able to apply must have some form of end-user objectives in mind. The overwhelming majority of available funding requires private money which is matched by government funds. The squeeze on Defra finances and narrowing of their remit to climate change (and very little else) has had a major negative impact. Private companies are only willing to fund in areas of direct benefit (e.g. improved crop quality); unfortunately Defra are no longer prepared to provide matching funds in these areas.*

*“Insufficient funding of course: too much competition.”*

*“Bureaucratic regulation.”*

*“a) recruiting bright people to an uncertain poorly paid and stressful career  
b) retaining good scientists against recruitment by industry and overseas c) Time and energy involved in gaining funding. Generally applications to research councils have about a 20% chance of funding, with no mechanisms for iterative improvement and resubmission. The application process itself is largely a sham; successful grant applications are generally those which have already been extensively done (to provide pilot data) with the money then used to gain funding for the next. It works, sort of, but at enormous cost in time. Every grant application takes many weeks to prepare, and several must be submitted each year. The grant process also involves me in a considerable expense of time in refereeing other applications d) Regulatory constraints*

*“Recruiting good staff. Judging what to do next to keep my CV looking good whilst doing something that interests me. Trying to persuade the institute head that what he wants me to do and what I want to do are compatible.”*

*“The constraints placed by animal legislation. Safety at work has also become a huge issue and consumes a lot of time. The RAE has been a mammoth waste of time, that has occupied the valuable time of the very people who we should be encouraging to get on with their research. It has resulted in various types of game-playing (recruitment of 'stars', etc.) and a distorted picture of what scientific productivity is, because people measure what they can measure, not what matters. But with this said, the major problem is under funding. This has reached the stage when it only takes a single adverse comment from a referee or panel member to throw an application out. I had one rejected recently for which all the referees admitted that it was important medically, timely, and we were the only group in the world capable of doing it!”*

*“At application stage I often need to demonstrate an application or outcome with economic impact. This is short-termism. I require freedom to get on with the new science first, and applications will follow later.”*

*“The main problem is the inability of the funding received to provide for the equipment required. Beyond that I have not encountered any other major constraints in my chosen area of research aside from access to the needed journals but that, once more, comes down to money.”*

*“Intellectual deficiencies; funding has never been a problem.*

*“Funding is insufficient and badly oriented.”*

*“Too many cabals of good-old-boy networks ensure the money is carved up leaving genuinely good scientists, who do not fit into their idea of deserving, out in the cold. Make at least some of the peer reviewers of funding blind, i.e. don't let the reviewer know who's work s/he is reviewing.”*

*“Funding is always a problem. Fitting with your colleagues to receive not enough money. Making proposals and hoping they are approved. If we are lucky to have one proposal accepted, you have to run all the work, as a researcher, as well as a manager with all the specific rules of the funding programme.”*

*“I restrict myself to cheap experiments that I can conduct without funding. I also try to avoid the hassle of ethics committees.”*

*“I am lucky in being retired and chiefly interested in ideas and data, neither of which require funding. In many respects, particularly the existence of the internet and electronic libraries, there has never been a better environment for such research. The biggest constraints come from pressures of time and distractions - such as answering online questionnaires when I could be getting on with research!”*

*“In order to get funding you have to squeeze into the councils priorities. Number of funded grants is decreasing but the councils waste money on initiatives according to politics. Difficulties to find good people - PhD*

*studentships are open to British students only and they are often simply not good enough.*

*“It goes too slow.”*

*“With the large explosion in population of scientists, we have lower average quality and too many people afraid of genuine innovation. We also lack "generalists" - those who think across disciplines and are willing to think out of the box.*

*“Funding raising is killing my initiative in research. funding is too strongly dependent on lobbying and of incompetent reviewers.”*

*“Time - I don't have enough of it! Effective leadership and time management skills missing in my training, now on a very steep learning curve.”*

*“The main constraint is that funding is more or less through large programmes which are devised and run by non-scientists (or by scientists who have stopped doing research).”*

*“Massive. When I started my university career I could conduct a decent research programme and have graduate students working with me without any grants. I ended my career when my departmental allowance for paper and photocopying was greater than the funds available to do research! I developed an reasonable international reputation in two very different areas without having obtained a grant at any time for either. But when "performance indicators" are based on £ rather than ideas then science suffers.*

*“1) Huge increase in bureaucracy to get funding. The new FEC system in universities is cumbersome beyond belief 3) Ethics committees - no light touch here. Again a great deal of silly paper work. 4) Not enough money generally- 20-30 % of good grants to research councils only get through past triage and refereeing stages and of these only half funded. Its worse for European Res Council. 5) Bandwagon me too research is preferred over innovative paradigm shifting work. 6) recruiting good young technicians, PhD students and postdocs into academic research. Their career prospects suck so they go into other sectors - and not even manufacturing which would be ok but sales "marketing" and finance.”*

*“I'm not keen to stay in research after my PhD due to the uncertainty of jobs.”*

*“All money in the Earth Sciences seems to be drifting to climate science. All other branches of the subject are busy trying to reinvent themselves as service industry to the climate bandwagon. If I want to work within climate record I can get a post doc tomorrow, but if I'm interested in anything else it is almost impossible. This means that more poorly qualified students are able to get on the ladder, just because they are taking on someone else's question, while more able young scientists are unable to find work as they have their own ideas and agendas and don't just want to just jump onto the latest fad.”*

*“Focus of research councils on a few areas that are sometimes politically driven, e.g. biofuels.”*

*“My Institute is faced with a particularly bad example of interference from "on high". This has been at times very disruptive to my research. Funding is always a problem, although I am better off than many. But student stipends and scientist's salaries are insufficient (in the UK and in many, but not all other countries), especially compared to many other professions. Career progression is very tough and it is a very competitive occupation, demanding dedication and many hours. All these factors can put people off from entering research or staying with it as a career.”*

*“Government commitment to stop vandalism of GM crops coupled with a commitment to punish those who take the law into their own hands.”*

*“Although we will all complain about having to compete for funding, there is no real alternative that will provide the quality checks that are essential when spending other people's money.”*

*“My company is confined to work which is of potential commercial value to agricultural businesses. Although I do some work in schools and colleges, this is purely voluntary and applications for grants and support are normally constrained by a mountain of clerical demands.”*

*“Student recruitment. There is now only one recognised Quaternary Science masters level program in the UK and with the research council (NERC) restriction on nationalities that can apply to studentships I am very limited in my pool of applicants. The limited number of masters programs means that the skill base of applicants is restricted. More programs of a smaller size at different institutions would increase the diversity of skills the skills base. Widening entry criteria would be the other way to solve this problem.”*

*“The main constraint is funding. There are too many good scientists and not enough funding. Either increase the funding or decrease the number of scientists being trained. Also salaries are not very competitive compared to other careers with comparable training. When you choose to be a scientists you are sacrificing your earning potential for long hours. Luckily it's a job I love, but I would like to be a little more comfortable while I do it.”*

*“I am not actually a 'proper' scientist - I don't apply for funding - just get shifted around where the funding is - to save money of course. Hardly inspires you to work hard!”*

*“Funding is always the limiting constraint. More money would allow more research”*

*“Lack of funding for problems that are interesting and relevant, but are not perceived as topical (read fashionable) at this specific time. Large multiplicity of roles that academics need to take on in Universities.”*

*“To be 'successful' I have to avoid looking at it in terms of barriers and constraints and have some sort of idealistic trust that if I propose good science and can back it up with evidence that I am able to do good science (principally by means of publications), it will, eventually, get funded. This idealism tends to break down a little when it hits bureaucracy. Bureaucracy mostly impacts on me in terms of research council applications and local university administration.”*

*“Yes, no. I is funding! The success rate for proposals in my field to NERC is approximately 20% or even less; it is well below 20% for the US National Science Foundation at present. Proposals are rated alpha 5 (highest) to alpha 1 (lowest), and ANY alpha grade project is supposed to be worth funding; in practice, the funding cut-off at present is within the alpha 4 grades. At this level, there is a high degree of chance in whether one's alpha 4 proposal falls just above or just below the threshold. The next most important constraint is the availability of good manpower. It is becoming increasingly difficult to recruit good PhD students and post-doctoral fellows.”*

*“A lack of funding for the translation of novel findings into practical applications.”*

*“I don't undertake scientific work - I try to advise on public policy, in the various (and numerous) areas where modern biotechnology is relevant. Working as an independent with adequate pensions and simple habits, my constraint is time and health, not money. Barriers? Foolish legislation, now set in concrete (at local, national, European and global levels), and unwillingness of political leaders (or leading writers in the popular media) to admit and correct mistakes, and to embrace learning and innovation.”*

*“Fortunately, in the UK, there has been an extraordinarily sensible approach to stem cell research in which regulation has served to permit the best progress. Funding is, of course, always a limiting resource and always under threat, but currently seems to be at a tolerable level. Compared to the situation in the USA, where currently funding levels have been slashed by tax cuts and the Iraq war, the UK is doing well by science. One other barrier is that scientists are not always paid well enough to attract the best and the brightest.”*

*“Funding - I am about to start attempting to get a fellowship, however I am aware how competitive they are and I know that if this fails I may have to consider options outside of science.”*

*“NERC proposal acceptance rates are below 10% (whatever they may say), which is non-sustainable.”*

*“My pure research is being affected by lack of funding.”*

*“At a personal level, shortage of time; failure to concentrate and prioritise firmly enough; failure to write things off. In organisations, lack of confidence and honesty, coupled with / causing excessive bureaucracy; lack of scientific understanding in those making decisions about funding.”*

*“Risk assessments. Always need to do a risk assessment.”*

*“My most serious problem is that there are never enough hours in the day. By the time I've done my teaching and my paperwork there is not enough lab time left. Research is meant to be my most important activity, but it does not come with deadlines, as teaching and administrative paperwork do.”*

*“Currently the barrier is my finding suitable post-doctoral opportunities, probably a combination of shortage of funding in field and issues of career insecurity (short-term contracts and requirement to repeatedly move globally with limited choice of job location).”*

*“Because of my teaching load, I have made the decision to combine my teaching and research efforts by pursuing pedagogical research. There seems to be a lot of recent interest in this form of research with funds available. However, I can perform much of my research without funding. Yet the University seems not to recognise unfunded research as this does not help meet income targets. So I have to spend time raising unnecessary funds for my research. This does not seem to be the best way of providing the tax payer with value for money.”*

*“Not enough money to go around and it's a bit of a boys club in getting grants. If your theories are not quite with current thinking, then you can forget it.”*

*“Funding - applying for it is so time consuming.”*

*“Funding issues related to priority being given to currently popular fields is a problem if you are not working in such a field. The pressures to make research translational as no/little value is given to basic research.”*

*“Funding is a very significant barrier; I am struggling to get grants renewed, even when they have resulted in numerous publications and when they have scored highly in peer review. There appears a desire to support "high-profile" research projects, leaving whole areas neglected. Unfortunately, "high-profile" areas rapidly become worked out; if other areas are not maintained, the whole science base is ultimately undermined.”*

*“Too little joined-up thinking amongst the different research funders. In some cases excessive caution (aiming to preserve the 'status quo').”*

*“So far, difficulty in attracting high quality researchers for posts.”*

*“It would be expensive to provide every research group with a permanent laboratory manager. However, I believe that productivity would be more than doubled and the career would be perceived as significantly more attractive by young scientists. I should point out that at least 50% of the PhD viva examinations I undertake involve candidates who have already left science and started a new career in finance.”*

*“Funding is important, but I can also do original research without much funding, yet pressured/forced to spend much time writing failing grant applications is the real problem. I will get no funding, and have little time for research. What is the result? The simple answer - waste! Administrators don't understand "Time is money", but only "money is money"!*

*“Attempts at micromanagement.”*

*“Funding! Because I have been dismissed from my University Chair purely for being too old, I am not even eligible to seek grants from most of the plausible sources. There are Departmental funds that in principle are available for exactly my purposes but I have no control of them and they are diverted to other purposes. A technical barrier is that I use a reflecting telescope and there is nowhere in this country where the principal mirror (36 inches in diameter) can be re-aluminized.”*

*“Pressure to work in well-funded areas or research.”*

*“My lab is relatively well funded; my principal problem is recruiting talented individuals.”*

*“I have a number of problems with Steve Fuller's view that science is a social construction, but when the great and the good of any profession get the power they don't like to see young Turks get a chance to question their work. This makes the research that is funded risk averse. This must be detrimental to the pursuit of science.”*

*“Conservatism, nepotism, failure to appreciate policy-relevance. The worst offender is the EC. It is scandalous how decisions over topics and research grants are taken.”*

*“I've done internationally recognised research as a post-doc and started up international collaborations in a multidisciplinary research area which has not been explored before. The results have produced new ways of measuring things and have an impact which affects much of galactic astronomy. Other work of mine has been given a half page hearing in an Annual Reviews of Astrophysics paper. The research has also fed back into Earth Sciences. It is also very cheap because the facilities to do more already exist - the different disciplines just need an ideas person to make it work. I have been applying for jobs and fellowships since October 2004, and was made redundant in Feb 2006. I have two young children (4 years and 18 months old) and a husband who also works in Astrophysics, also on short term contracts. I have come second for 3 out of the four jobs for which I have been short listed. Fellowship committees have never been interested in short listing me. It doesn't help that there are no Fellows of the Royal Society in a closely related field. My husband's contract runs out in 2.5 years and he will be in a similar position - they don't tend to make lectureships for astronomical instrumentation people who do their other research in Physics so he's pretty worried too. Somebody has to earn some money to look after the family so I'm just about to leave astrophysics to work on something unrelated in*

*the oil industry. I have 12 years experience in astrophysics research and a unique set of skills. How angry with the system would you be?"*

*"Most funding is available through the government to answer questions facing scientists today. To gain funding to think through the problems the government will be facing next year, in relation to the same problem is not available - we are always solving last year's problems. Why?"*

*"Not so much funding, as continuity of funding, so that good people have to leave the lab. However, I'm a firm believer in a competitive peer-reviewed funding system, so I don't moan (well, not much). Sometimes, space is a problem, as when the department expands to fill its building, and there is a lag before more space becomes available."*

*"Too many targets! Too many pointless audits! Not enough trust. Scientists deliver more when allowed to be scientists, not when expected to be paper-pushing middle managers! That is what government is for. The lack of investment for UK research is pathetic!"*

*"It is very difficult to attract funding. This means that it is difficult to write papers and thereafter there is a vicious circle of increasing teaching load, less time to write grant proposals and therefore even less chance of getting funded. There's too much emphasis on administration and form filling - both teaching and research exercises. Poorly trained final year students undertaking mundane projects because they cannot cope with more demanding ones. This prevents speculative experiments from being done. A lack of well-qualified post-graduates (if and when research posts become available)."*

*"As an early-stage researcher I cannot apply for funding as I have not yet a strong enough research history or enough papers, so I am forced into post-docing which is temporary, intermittent and whimsical. The appeal of a simpler career path within industry is beckoning, as is the stability. Besides funding there is still inherent discrimination."*

*"Space access is very expensive and can only be done by international efforts. This has worked very well in the past, but the purchasing power of current funding has decreased by about 40% over the past 10 years-thus space missions are becoming rare."*

*"As a postdoc, who has had three funding proposals rejected, this is currently the main barrier for me in conducting scientific research. The process to apply for funding is time-consuming and complicated, and the process by which funds are allocated is not transparent, e.g. I have only received limited feedback from one proposal as to why the proposal was rejected."*

*"Administrative burden; lack of professional management support; lack of talent coming into science in the UK. Xenophobic policies which do not allow the payment of UK government PhD scholarship living costs to EU nationals, which is illegal and causes a huge loss of talent coming into the country."*

*“Peer-review funding appears to have just as much to do with name and status as with scientific excellence. I don't think there is a better system for allocating funds than peer-review, but we should not pretend it is perfect. Stronger, less-flexible guidelines in funding programmes may result in results that more accurately reflect the intention of the programme than the networks and prejudices of the funding panel.”*

*“Lack of acknowledgement financially as well as the feeling that politicians say thank you, well done and then don't listen to you a minute longer.”*

*“The career structure for scientists is appalling and many excellent scientists will have to stop being researchers, or will chose to leave. Emphasis on publication of positive results and the peer review system will lead to more bias towards established scientists. There is often some 'spin' on results. Papers are not always produced with the aim of furthering knowledge and disseminating results but for the benefit of the career of the person publishing. Big names are often more likely to get funding and good publications because of the name not the science- this is wrong!”*

*“Additional time comes with additional pairs of hands, up to the point when supervising other pairs of hands is less productive than doing it oneself. The perpetual struggle to acquire funds for this, plus the admin that comes with each new grant, sometimes makes it seem barely cost-effective. I do not regard teaching as a constraint, but a fundamental purpose of universities with huge intellectual rewards. But we have to fight against simplistic yardsticks of productivity to maintain this.”*

*“I do interdisciplinary research. The Research Council encourage this, especially in the Social Sciences, but it is often very difficult to communicate ideas to people in different branches of the social sciences.”*

*“Funding - too many scientists after limited funds.”*

*“Theoretical physics (I study quantum cosmology) is never likely to have practical uses, which makes it hard to compete with, for example, fusion projects etc. that have a specific practical aim.”*

*“Short term contracts and grant periods. A lack of continuity of employment for researchers (and me). The lifetime of a project from start to finish is much longer than the 3 year span of a typical grant.”*

*“A lack of funding, job security; the usual.”*

*“Yes, funding - it is very difficult as a young researcher to acquire funds, often the panels that control funding have personal control over funding directions which are often narrow and reflect there own research interests and may exclude new perspectives.”*

*“Within my discipline, there is too much short-term 'metric chasing', and grant success rates are too low to be good for the discipline (a 20% success rate*

*means that there are a lot of good, fundable ideas out there which are not being supported).*”

*“It can be impossible to get funding for really advanced ideas. All my funding has come following successful demonstration of ideas, inefficiently and on a shoe-string and therefore much more slowly, often several years after funding was originally requested for the work. Agencies, and especially the committees that decide such things are risk-averse, have no vision of how important longer-term investment in really new ideas are critical to staying ahead of institutes (e.g. Caltech, CNRS, Max Planck Institutes) that have their own funding decisions to make. In the UK, every grant is resubmitted several times before funding happens, and funds are distributed in small amounts around the community, often for remarkably mediocre work.”*

*“I reinvented my career when I realised that I was more effective as a science communicator than a research scientist - I now have a mixture of lecturing, writing and research (scientific and educational) which I love, but I find it very difficult to get recognition or funding.”*

*“Medical science in particular is hugely affected by the restrictions on using human tissue and the barrier to in vivo work in animals.”*