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Advancing Astronomy and Geophysics

Response by the Royal Astronomical Society to the Treasury-DTI-DfES consultation on Science and Innovation April 2004

The mission of the Royal Astronomical Society is the advancement of astronomy and geophysics. With a membership of 3000 we are the UK's leading professional body for astronomy and astrophysics, geophysics, solar and solar-terrestrial physics and planetary science, as well as the 'new' astronomies of astrobiology and astroparticle physics. We are the UK adhering body to the International Astronomical Union and are represented on the Science Council and the Parliamentary and Scientific Committee. This response has been written by the Society's President following consultation with its Council and other members.

We welcome the Government's concern for science, demonstrated through several consultations and the recent increases in funding. We welcome the further commitment that this consultation points to, and consider it particularly appropriate that DfES is also party to this exercise.

Q1. Are these the right areas for the Government and its partners to target over the next ten years? What are the underlying components of success in these areas and what roles do Government and other funders of the science base need to play in achieving these aims?

These are broadly the right areas, but note the gloss in the following points.

- Do we understand *why* the UK is less good at Knowledge Transfer (KT), less good at innovation than our international rivals?
- Applied research is important but we also need to recognise that 'blue skies', untargeted, basic research is required to underpin future generations of applied research. Beware of over-emphasising applied research at the expense of basic research.
- The educational issues are extremely important and urgent. See Q10
- We judge the 'science and the public' issues also to be very important. See Q12.

The underlying components of success:

- Science is a global activity – we play and recruit in a global market. There is justifiable concern that UK universities are not generously enough funded either to attract leading scientists from e.g. the USA, or to retain some of our own leaders of research..
- We agree that the infrastructure must be adequately maintained. However, if we are in a zero-sum game then better support of infrastructure means less research done. The UK cannot afford to do less research if it is to be competitive in the world market. Of particular concern is the possibility that it will be the charity funded medical research and the EU funded research which become much less attractive under the new full economic costing arrangements. Is this bias acceptable?
- There are concerns about the administrative burden of the Transparent Approach to Costing (TRAC) and full economic costing, as it is currently being set up, and how this will

detract from the doing of the science.

· A physics professor at a leading university recently observed that in his Department 'The best physics undergraduates are the women, and none of them stay in physics.' Whilst it is good that those with scientific training percolate through society (assuming that they are still positive about their scientific experience) we cannot afford this loss of the best talent. As the Greenfield Report showed, physics is not alone in losing women.

Further commentary on the Executive summary

· Short-termism is one of the enemies of sustained success and delivery. The punctuation produced by Spending Reviews and General Elections is not always helpful. A longer-term approach would be more constructive.

· Higher Education (HE) is pivotal – it is both the gatekeeper and the supplier of research. It determines the skills base of workers and the standard of qualification of graduates.

· Academia has moved a long way in recent years and is now much more open to knowledge transfer. However, it can still be difficult and time consuming to get initial funding for something that will not deliver in the short-term. It can also be difficult to persuade industry to undertake the R & D that astronomical research needs, even though such R & D work usually benefits the industry in the long term. One way to improve this situation is to involve industry at the earliest stages of project definition. This will provide them with a better chance of success when it comes to bidding to build major elements of large international projects.

· Academics' contracts typically do not regard KT activities as counting towards promotion.

· Recruiting post-doctoral researchers and young lecturers in recent years has shown how far we are falling behind other countries; many of these posts have gone to nationals of other European countries which appear to turn out better qualified PhD students (except perhaps in the area of geophysics). Some consideration could be given to extending the funded length of our PhDs to 4 years.

· The Dual Support system provides the opportunity for some 'seed corn' expenditure from the HEFCE QR funding to pump prime a full grant application.

· Consideration needs to be given to the possibility that charities and other funders of research cannot or will not pay a 'fair price' for the research they support. Arguably it already is the case that research activities which attract higher overheads are subsidising those activities which do not attract significant overheads. Furthermore, some funders require matching funding, which imposes arbitrary disadvantages for some institutions.

Q2. Which strengths of the UK science base could be further developed; what are the weaker areas that need to be addressed; and what are the risks to the UK's continued production of internationally competitive levels of research? What criteria should the Government use to help determine its overall commitment to science?

· It is important, indeed essential, to maintain strength across the spectrum of science. (See further comments under Q10 about the place of mathematics and modelling in modern science.)

· Engineering in academic circles seems to be one of the weaker areas, and it is not clear in which direction(s) it should move. All of mathematics and the physical and life sciences could be developed. The number of physical science university departments has shrunk markedly in recent years; arguably it is the weaker tail (mostly) that has disappeared. However, it does raise concerns about the funding of science and engineering in our universities, and the closures have left a number of universities scientifically lop-sided. It also raises concerns about the extent to which fashion amongst 17 year olds about which subjects to study at tertiary level affect the fortunes of university departments and hence the specialist research activity carried out in HEIs. We benefit greatly from astronomy being a popular science, and forming a bridge across to the perceived 'difficult' subjects of physics and maths.

· We are concerned that the introduction of variable fees would deter students from studying 'expensive' subjects like the lab-based sciences and engineering.

· The criteria listed in the box in 2.1 are useful criteria; needing watching are the numbers of people with research training and the percentage of GDP that goes into R & D. In addition we suggest monitoring the immigration/emigration of scientists, and the number of Nobel/Crafoord/Fields and other prestigious international prizes gained by scientists working in the UK.

Q3. In which key technology-based sectors does the UK have the potential to maintain and grow internationally competitive value added over the coming decade? What are the barriers to capitalising on our strengths and addressing areas of relative weakness in business innovation and R & D? How can investment in the UK science base and Government support for business R & D best contribute to that growth?

We are aware of

- Nanotechnology and miniaturisation
- Research may be needed on what are the barriers to converting scientific research into innovation and on to balance sheets.
- As mentioned previously, industry needs to be involved with academia at early stages in the definition and pre-build phases of projects. This is essential if our industry is to be competitive with, for example, France and Italy, where this practice is already established.

Q4. In order to inform decisions on the future investment framework, and building on the Research Councils' extensive consultations with stakeholders, in what areas are there opportunities for the UK research base to excel and contribute to the economy and society, which might form the basis of future strategic research programmes over the next ten years?

The parts of the research base that we are aware of are:

- Nanotechnology
- Miniaturisation, for example in relation to robotics and space missions.
- Chaos, complexity and large systems.

Q5. In the light of the changes to be made to the next RAE, how can funding mechanisms build on existing resources and research assessment reform to reward excellence and underpin sustainability?

- There are fundamental philosophical concerns about the RAE, some of which have been recognised and may be addressed next time. They are concerns about the assessment of multi-disciplinary activities, about how the impact of research activity is to be measured, about the assessment of applied research and about gender bias. Most significant for this consultation is the ill-recognised effect the RAE has of inhibiting paradigm shift, of encouraging conservatism.
- Innovation requires risk, but Research Councils are cautious, and with exercises like the RAE scientists have become cautious.
- There is a balance to be struck between responsive mode funding and planned strategic funding. Our impression is that at the moment funding is over-planned. This means that Research Councils cannot respond rapidly to discoveries or other unexpected developments. Thus we fail to capitalise promptly on the work of brilliant research scientists.
- To assist planning there should be no major sudden perturbations in funding

Q6. What are the main barriers or challenges to the achievement of a sustainable public research base in the medium term? What further action could the Government take, in partnership with universities and other funders of research, to create robust incentives on all parties to work together to deliver greater financial sustainability of the UK's research base?

- Recruitment and retention of good staff (academic, technical and support) in Universities. In addition a proper career structure for non-tenured research staff needs to be developed.
- Considerable infrastructure investment (in both teaching and research facilities) is still needed. Pulling forward the SRIF 3 and HEFCE Capital Project 4 rounds, perhaps as well as subsequent rounds, will speed this up.
- We accept the principle that infrastructure costs should be identified and infrastructure adequately funded. However the full economic costing procedures currently being proposed are too pedantic and over-detailed. For example, one University's attempt to simplify its procedures and reduce to 3 the number of space-charging bands has been

thwarted by the requirement that in full economic costing space-charging be 'robust' which is achieved by conforming to HEFCE's recommended 4-band model. It looks as if extra administrators will have to be recruited to handle this initiative. Universities may have to reduce the number of staff at the cutting edge of research to afford these extra administrators.

· Incentives; very important and probably under-rated. What the typical academic researcher wants is less administration and bureaucracy, more time to do research and more money for research (probably in that order). Personal financial rewards, kudos and accolades, whilst always welcome, probably come second. So keeping down the administrative burden (TRAC, RAE, Institutional Audit and other assessments and reviews, and the associated 'paper trails') would make a significant difference.

Q7. How could funding for universities provided by Government and other funders create stronger incentives for the effective creation, management and usage of the research base infrastructure over the next decade?

· Much of the current research funding is in the form of investment in research projects. Consideration should be given to more investment in talented people – more special funding (e.g. Royal Society-Wolfson merit awards, Leverhulme Fellowships) for the most able. Holding on to our most able people (both junior and senior) should be a high priority.

· Ensure that funding is 'joined up'. E.g. avoid the scenario where new labs are built with SRIF money but there isn't Research Council funding for the research staff to work in those labs, or where shiny bits of kit are provided but there are not the longer term technical staff to run them. Too often there is capital provision but not adequate operating costs and even more rarely is there provision to sustain the initiative at the forefront through up-grades of equipment.

Q8. What is the optimal means of developing access to large research facilities at national and international level? How should funding of large facilities be prioritised?

· Large facilities are very important to the astronomical community. The great majority of our research facilities fall into this category, and are also international. They have been achieved when the Research Councils, DTI, OST have heard the collective voice of the astronomical community. The Royal Astronomical Society can effectively serve as this voice and should be regularly consulted by such bodies in these matters.

· NERC runs a number of marine research vessels and has a large suite of national facilities that the geophysical community makes much use of. These are effectively exploited and make a big difference to our research effort. They also allow UK scientists to 'buy into' international projects by bringing facilities to the table (ships, geophysical field equipment).

· It is important to ensure that the 'domestic' budget is adequate to allow UK researchers to exploit the large international facilities we belong to. In particular, it is necessary to have the funding to respond to Announcements of Opportunity for the provision of instrumentation for, or significant upgrades to, the facility. Such major activities often involve collaboration with UK industry.

· In prioritising the UK's funding of new large scale facilities, one must consider the fit with our strategic science objectives, areas within the project in which the UK can provide a major impact, the cross-fertilization it would provide with industry in the construction phase and the general public interest in the outcomes of the project.

Q9. The Lambert Review was based on extensive consultation during 2003. Reactions to the analysis and proposals set out by the Lambert Review, and in particular to the Government's proposed response, are very welcome.

· Yes, intellectual property issues are difficult – we are glad that this has been recognised and that action is being taken.

· We see a tension between achieving international standing and servicing regional links; they are rather different in their scale and in their aspirations. Is the tension of a degree that the two are not possible in a single institution?

Q10. Following the 2002 review by Sir Gareth Roberts of the supply of scientists and engineers and the Government's response, what is the emerging evidence on the prospects for the supply and demand of science, technology, engineering and mathematics skills? What further steps could the Government take to ensure that the supply of these skills is responsive to the demands of the economy over the coming decade? How could women and other low participatory groups be more encouraged to pursue higher education in science, technology, engineering and mathematics and to pursue careers in these areas?

· We are extremely concerned about maths and physics education in secondary schools, particularly maths. The issues were well highlighted in the Adrian Smith report, and we hope that they will be taken very seriously. This is our Achilles tendon, with immense ramifications for the scientific health of the country if we do not get it right quickly.

· Meanwhile, the need for mathematics skills is growing rapidly. Areas which traditionally have been largely maths-free, such as biology, environmental science, now need maths skills, statistical skills and modelling skills as the subjects become more quantitative.

· Teaching students from other countries shows us that the education we provide in maths and physics is falling markedly behind that provided in other EU countries. This is also becoming true at PhD level.

· Female scientists. See our response to Q1. There is serious under-utilisation of the female scientific talent – which is worse in the UK (and other English-speaking countries) than in many other countries in the world. (See the International Astronomical Union's membership analysis at **www.iau.org/Organization/member/mship_statist.html**). This international comparison suggest that the issue we are faced with is a cultural one, and not one to do with the ability of women to do science. It must be in part associated with the image of science in the UK.

· As the proportion of scientists who are female increases perceptions will change – science is growing accustomed to the intellectual presence of women and familiarity will breed acceptance. Women are beginning to change the culture in science, and not simply doing all the adapting themselves. However, the changes are happening very slowly, and it will be decades before parity is achieved if waiting is all we do.

· The RAS has an active Women's Group, has a good track record for the percentage of its Officers and Council members who are female, and encourages the organisers of its scientific meetings to have an adequate number of the speakers and session chairs who are female. More bodies which organise meetings could adopt a similar policy.

· It is also important to collect statistics on the number of women at the various levels. The public reporting of such data would help focus attention on the issue. Industry, with better organised appraisal, clearly stated criteria for promotion and more structured careers, appears to be a better employer of women. HR policies and procedures which help women also help men progress; it is important that line managers such as Heads of Departments have good interpersonal skills (including EQ). Managers who are sensitised to the issues and aware of the consequences could do much to change the culture.

Q12. What should the role of Government be in improving the interaction between science and society? Are there areas where the Government could improve the promotion of science in society? How can we improve public confidence in the Government's use of science? What should we be aiming to achieve in this area in the next ten years?

· Our area of science does not excite the same level of public concern as does/did MMR, BSE, GM, Foot and Mouth. Nevertheless it is important that we recognise the increasing expectation on the part of the public that they can dialogue with scientists, and perhaps even have an increasing say in the disposition of funding.

· There have been a number of recent initiatives, both national and regional, in the area of new science centres and exhibitions. This is a positive step; however, as with the new special schemes in science such as SRIF, thought needs to be given as to how these centres are to be replenished and up-dated to keep them abreast of the rapid advances in research.

· Involvement with public engagement/public understanding of science is still a very low priority for many academics. Participation in this sort of activity does not enjoy the recognition or provide the career progression that it merits. Furthermore, many that are active in the area still think that lecturing *at* the public is sufficient. Our colleagues need

to be persuaded that the agenda for such encounters should not be set only by the scientist. While members of the public may need some information, they should also have the opportunity to take the agenda where they wish, and dialogue with the scientist.

· Recognising and communicating the human dimension of science is important.

· Scientists need to engage with the public and together face the issues that science raises.

· Government can help by demonstrating that science is embedded in its decision-making, and that it is rigorously honest in its use of scientific advice. This was not overly demonstrated by its rather dismissive attitude to the excellent report on Light Pollution produced by the House of Commons Science and Technology Committee in 2003.

· More recognition, perhaps through prestigious awards, of the work done in the science and society area would help.

· We also deplore the intimidation and harassment by activists of scientists working in more sensitive areas, and are concerned that the democratic expression of opposition should not become threatening behaviour or even damage to life or property.

Q17. What are the public service objectives and priorities for science and research over the next decade to contribute to policy development service delivery and wider economy? How can the wealth creation potential of investments in R & D across different Government programmes be increased?

· Continue to use high-quality science and research and expert and independent advice to deliver evidence-based policies.

· Respect the integrity and independence of the advice given – do not misrepresent or highjack it.

Q18. How can the Government best secure greater synergies between research funding, investment and strategies across different public programmes, and link the Government's overall objectives for research outputs with the capabilities in the UK science base?

· Achieving greater synergy is perhaps one of the biggest challenges. The Council for Science and Technology should be the body to advise; is it not felt to be working?

· There is also an issue to do with speed of response. Government machinery is often felt to work very slowly when it really needs to respond more quickly to scientific concerns such as global warming, light pollution. It can be done, as the response to Foot and Mouth demonstrated; can lessons be learnt from that experience?

Q19. How can Government and the Regional Development Agencies and their equivalent in the Devolved Administrations help integrate funding of science research on a predominantly national basis with development and delivery of regional economic strategies? In particular how can Government and RDAs strengthen partnership working to facilitate more effective knowledge transfer and research collaboration?

· As noted earlier, there is a significant tension between the UK being a major player on the world scientific scene, and the regional agenda. We are unclear that the interaction will be constructive for either activity.

· More consultation between the bodies that set national science policy and objectives, and the RDAs would be beneficial, since local initiatives can only flourish in the long term if both are consistent.

Q20. Are there barriers facing business and the science base in effective engagement with EU research programmes? How can the UK more effectively influence and benefit from EU research funding and policies? In what ways can action at a Community level add value to UK science and innovation policies? How can national and community funding complement each other more effectively?

· See our extensive response to the House of Commons S & T Committee's enquiry on UK Science and Europe: Value for Money? (This evidence is available at http://www.publications.parliament.uk/pa/cm200203/cmselect/cmsctech/386/386we04.htm)

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