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Advancing Astronomy and Geophysics

17th September 2009

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House of Lords Science and Technology Committee
Setting science and technology research funding priorities

Submission from the Royal Astronomical Society

The Royal Astronomical Society (RAS), founded in 1820, encourages and promotes the study of astronomy, solar-system science, geophysics and other closely related branches of science. The RAS organises scientific meetings, publishes international research and review journals, recognises outstanding achievements by the award of medals and prizes, maintains an extensive library, supports education through grants and outreach activities and represents UK astronomy nationally and internationally. The Society has more than 3000 members (Fellows), including scientific researchers in universities, observatories and laboratories as well as historians of astronomy and others.

The RAS is pleased to offer the Committee written evidence on this important topic and would be happy to give oral evidence on request.

1. **What is the overall objective of publicly-funded science and technology research?**

The Society strongly endorses the vision for science set out in 2008 by the then Science Minister in the DIUS 'Science and Society' consultation. We agree with the need for a society that is excited by science; values its importance to our social and economic wellbeing; feels confident in its use; and supports a representative well-qualified workforce.We would add the broad cultural value of science to this vision. Scientists endeavour in the broadest sense to establish our place in the Universe, whether in distant galaxies, the heart of the nuclei of *atoms or the development of life. These endeavours are at the heart of public engagement with and enthusiasm for science.*

Publicly funded S&T is required to meet these aims since other sources of funding, especially in the commercial sector, are tied to specific and usually shorter-term objectives. Through research which is not linked to near market outcomes, in addition to social and public benefits, there are longer term economic benefits from applications resulting from discoveries arising from fundamental research. The areas of science that will deliver these long-term benefits cannot reliably be predicted, so, because investment returns in any one area are highly unpredictable, governments must provide most of the funding. By the same token governments should avoid choosing which areas of basic science to fund on the basis of perceived or potential benefits; instead they should continue to rely on the traditional criterion of scientific excellence as judged by peers.

2. How are public funds for science and technology research allocated? Who is involved at each level and what principles apply? Where appropriate, is the Haldane Principle being upheld?

The Society does not wish to comment on the facts of the allocation process. However there is ongoing concern amongst Fellows regarding the way in which research funding is aligned (or not) to the Haldane Principle, particularly in light of the requirement to cite economic impact in applications for research grant funding from the Science and Technology Facilities Council (STFC). Some reassurance on this has been provided by senior staff in the Council, but it nonetheless seems to demonstrate that there is an erosion of scientific excellence as the highest priority in decisions on funding. There is also the argument that the apparently emerging 'top down' approach to science funding is very much at variance with the classical Haldane Principle.

The RAS also urges the Committee to recognise the need to support long term large international consortia such as the Integrated Ocean Drilling Programme (for geophysics), the European Southern Observatory (ESO – a key astronomy facility) and space programmes. If the UK withdraws from these consortia because of funding constraints or related considerations, then the facilities themselves may be vulnerable and British scientists are likely to be denied access to the data they produce.

3. How are science and technology research priorities co-ordinated across Government and between Government and the relevant funding organisations? Who is responsible for ensuring that research gaps to meet policy needs are filled?

One specific area the RAS wishes to comment on is the funding of space activity. As a loosely defined partnership the British National Space Centre (BNSC) has not been an effective body in its promotion or coordination of this work. The RAS therefore believes that an independent space agency would be an appropriate response, provided it is not set up in a way that reduces funds that are currently directed towards research.

4. **Is the balance of Government funding for targeted versus response-mode research appropriate? What mechanisms are required to ensure that an appropriate and flexible balance is achieved? Should the funding of science and technology research be protected within the Research Councils or Government departments? How will the current economic climate change the way that funds are allocated in the future?**

Commenting on the ***overall*** *balance in the science budget is outside of the remit of the RAS. However, we believe that the decision making process for that funding balance should be open and transparent and the reasoning behind the strategies adopted should be made public. The RAS endorses the key principles set out in Lord Drayson's recent speech to the Royal Society and would suggest that what follows from those excellent principles is not that UK science investment should "favour those areas in which the UK has clear competitive advantage" but that it should favour those areas that are essential for the development of UK science and particularly those in which the UK needs to be competitive in the long term.*

A healthy research base requires a balanced portfolio of investment, including adequate resources for pure, fundamental science. This certainly applies to astronomy and astrophysics, which is an area of enormous public interest (demonstrated by the global success of the current International Year of Astronomy), attracts young people at all levels into science (not just astronomy – direct evidence for this was supplied in the RAS contribution to the recent RCUK Review of UK Physics led by Professor Wakeham), draws on a wide range of scientific disciplines, has a superb record of technical innovation and, above all, is an area in which the UK continues to excel.

Geophysics, the other area of interest to the RAS, has a clear and direct impact on the UK economy in areas including mineral resources, energy supply, and mitigation of the effects of global warming.

The present economic climate is already having an impact on research activity. The recent detrimental shift in the sterling / euro exchange rate and change in Net National Income that together determine international subscription rates (for example to CERN or the European Southern Observatory) have had a direct and negative impact on the funds available for UK-based research at STFC and NERC, at least.

Looking forward, the RAS welcomes the decision of the Government to ring-fence the science budget but is concerned that this commitment may not last into the future. We urge the Government to continue to use scientific excellence as the principal consideration for decisions on research funding and to consult fully with the scientific community on the allocation of resources.

5. **How is publicly-funded science and technology research aligned and co-ordinated with non-publicly funded research (for example, industrial and charitable research collaborations)? How can industry be encouraged to participate in research efforts seeking to answer societal needs?**

Astronomy and space science attracts little non-public funding, although the Leverhulme Trust has given welcome support to planetary science.

In general, much geophysics research requires a very long term (multi-decadal, at least) view of global and local processes, which is unlikely to receive reliable support from charitable or industrial sources and so requires public funding. Some geophysics attracts industrial funding of research. The fiscal conditions under which oil companies may bid to exploit UK petroleum resources should encourage long-term funding. Some oil-industry funding has been long-term, for instance the Edinburgh Anisotropy Project, via a large consortium of oil-industry partners. Initiation and maintenance of such consortia is, though, a burden on the project scientists. Shorter-term projects such as the 2002 NERC Ocean Margins LINK programme provided welcome co-ordination of basic science and industrial interests in a strategic area in which the UK excels. Outside the oil industry, funding is closely tied to the immediate needs of the funders and is usually short-term, so academics have difficulty making an educational opportunity of it. Non-oil commercial geophysics enterprises have limited and unpredictable finances, often linked to tight-deadline civil engineering projects or minimum-cost efforts to comply with environmental legislation. Incentives to research in vital areas of environment and natural hazard must come from the government, via both regulatory conditions and targeted financial support, and with minimum bureaucracy.

The value of government-funded research by students is not just in the actual outcome but in the development of skills desired by the industry. The 2006 Khan Report into geophysics education found that employers valued twice as highly skills in theoretical and practical geophysics as "transferable" skills such as team working.

6. To what extent should publicly-funded science and technology research be focused on areas of potential economic importance? How should these areas be identified?

While it is HMG's responsibility, following consultation with stake-holders including the scientific community, to set strategic priorities for science investment, we do not believe that an overly prescriptive top down approach will necessarily be effective in identifying research that will meet immediate economic goals. Funding scientific research is not like investing to win Olympic medals, where specific short-term objectives can be set and achieved. In contrast, science advances on a broad front and has indefinite horizons that require a long-term vision. Short-term strategies tend to be backward looking and targeted funding does not guarantee success when the goal is to be 'ranked no. 1 or no. 2 in the world'.

The Society believes that it is better to concentrate on funding excellence and on ensuring that the funding is sufficient to achieve the ambitious scientific goals that should be set. We also draw the attention of the Committee to the economic impact of curiosity-driven research, where serendipitous discoveries are made that cannot be foreseen at the outset of these research programmes.

Former researchers use their training to contribute in many sectors of the economy. In a survey recently initiated by the Society, more than 80 former postgraduates in astronomy and space science came forward, explaining how *their training has been of enormous benefit in their careers - from teaching and science communication to start-up software companies, defence, business consultancy, climate change research, medicine and finance.*

Within the fields of astronomy and space science, the UK is a member of large international collaborations including the European Space Agency (ESA) and the European Southern Observatory (ESO). These give UK businesses access to worldwide markets at the cutting edge of technology. Examples include e2v Charge Coupled Devices (CCDs) and other imaging devices used by all major collaborations and space agencies (as well as in digital cameras and medicine), Surrey Satellite Technology and EADS-Astrium, a major global player in the world satellite business.

Data handling, storage, management and access are areas of growing importance in all fields, and astronomy is no exception. The international astronomical community is developing advanced tools through the Virtual Observatory (and the UK AstroGrid project) with the goal of making the world's huge astronomical data banks transparently useable, in just the same way that the World Wide Web makes documents all over the world feel part of a single interlinked system.

In geophysics much of the technology used has an immediate economic and societal benefit. As well as the familiar examples of resource exploration and management, any geoengineering proposals (such as to mitigate climate change) will depend on the work of geophysicists.

7. How does the UK's science and technology research funding strategy and spend compare with that in other countries and what lessons can be learned? In this regard, how does England compare with the devolved administrations?

In the area of astronomy, space science and geophysics the UK has benefitted from increased investment over the last decade and took some positive steps such as joining ESO. However, in common with most other European states the UK investment in Research and Development is still well below the 3% target set at Lisbon in 2007.

The last published guide to comparative expenditure in astronomy and space science was made by Woltjer in 2006 and suggested that the UK spent somewhat less on research in this area than France, Germany and Italy. However tt remains difficult to make confident international comparisons on investment, particularly by subject area, as the structure of funding bodies varies so much between countries. In the process of preparing evidence for the RCUK Review of Physics, the RAS contacted organisations including UNESCO and the OECD and was not able to obtain this information. The RCUK Review panel attempted to do this too and were also unsuccessful.It would be helpful for the Committee to pursue this line of inquiry so that in future sensible comparisons between nations can be made.

In comparing England with devolved administrations it would seem that the Scottish Government has been particularly pro-active in encouraging scientific research and generating new synergies amongst Scottish universities and research centres by establishing joint research pools such as ECOSSE (subsurface science and engineering); SCCS (carbon storage); SAGES (geosciences, environment and society) and SUPA (covering many areas of physics and astronomy).

David Elliott
Executive Secretary