Science and Technology Select Committee: Inquiry into Science Communication: RAS response

Declaration of interests

1. This is the official response from the Royal Astronomical Society (RAS) to the Committee inquiry into science communication. We have a total global membership of nearly 4,000, which includes active research astronomers, space scientists and geophysicists, as well as teachers, professional public engagement specialists, and journalists. All of these groups have involvement in science communication to some extent, so have an interest in the subject of the inquiry.

2. Although we award grants for public engagement work, we receive no direct public funding for this or our other activities, so have no direct financial relationship with government.

Introduction

3. In framing this submission, we have consulted with our governing Council, heads of university departments, our research active members, and our Astronomy and two Geophysics Forums.

4. The Science and Technology Facilities Council (STFC), the Natural Environment Research Council (NERC) and the UK Space Agency chiefly fund research in the UK in astronomy and geophysics. The European Union plays an increasing role through the Horizon 2020 programme, and in particular the European Research Council. All of these organisations support science communication and public engagement to some extent.

5. Active researchers in astronomy and geophysics are likely to be in receipt of grant funding from one of these bodies, and are encouraged to pursue public engagement activities. To answer the points asked by the committee, our submission refers to examples of this work.

The trends in attitudes to science, and public engagement with science

6. It is fair to say that the UK has more attention (if not financial resources) dedicated to public engagement in astronomy and space science than ever before. These sciences generate enormous public enthusiasm (with recent examples being Tim Peake's stay on the International Space Station, the March 2015 solar eclipse, the landing of the Philae probe on Comet 67/P Churyumov-Gerasimenko, the annual Stargazing Live programme and occasional National Astronomy Weeks), and the space and astronomy

research community sees work in public engagement as a normal part of the job. According to the 2010 RAS Demographic Survey[1] (we will be collecting data for the 2016 survey in the near future), academic staff spend about 5% of their time involved in public engagement.

7. Astronomy has at least three robotic / remote controlled telescopes available at least in part for schools use. The National Schools Observatory, Faulkes Telescope Project and Bradford Robotic Telescope are together used by thousands of school students each year (Bradford alone estimate 80,000 pupils per annum), at no cost to students or teachers.[2]

8. There are also many professionals who have dedicated roles in this area, based at science centres such as the Royal Observatory Greenwich, Armagh Planetarium, the Science Museum, Techniquest in Cardiff, the Glasgow Science Centre, Winchester Science Centre, and the National Space Centre in Leicester.

9. Finally, a vibrant amateur community underpins astronomy, and the many clubs and societies around the UK see public engagement as an important part of their role.[3]

10. Access to grant funding for public engagement work in astronomy and space science is relatively constrained, though even small awards enable community organisations in particular to reach large audiences.

11. STFC runs small (grants of up to £10k) and large (grants of up to £100k) awards schemes. It also allows researchers to spend up to 1% of their research grant on public engagement work. The UK Space Agency also has a small award scheme (Space for All, which is run annually with a total budget of £40k). The two organisations work with the European Space Education Resource Office (ESERO), which supports training for teachers and hosts an online repository of resources.[4]

12. The RAS has a dedicated Education and Outreach Committee and usually offers a modest level of financial support (a total of £20k for the regular grants line for education and outreach; although this is small scale, it is good value, with for example one past project funding radio programmes aimed at primary children, which reached an audience of 400,000 listeners. Exceptionally, as part of the commemoration of the 200th anniversary of the foundation of the Society, we have also committed a total of £1m to public engagement projects through the RAS200: Sky & Earth programme, concentrating on communities

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[1] "The Demographics and Research Interests of the UK Astronomy and Geophysics Communities 2010", S. McWhinnie. http://goo.gl/qJwwLd

[2] See http://schoolsobservatory.org.uk/, http://www.telescope.org/ and http://www.faulkes-telescope.com/

[3] The Federation of Astronomical Societies covers most local groups. http://fedastro.org.uk/fas/

[4] See https://www.stem.org.uk/esero

with low levels of participation in astronomy, space science and geophysics.[5] Projects will run until at least 2020, and support for them is contingent on these having a legacy plan.

13. The Society also promotes public engagement through a dedicated staff member, who reached nearly 3,000 people in 2015[6], and our annual National Astronomy Meeting[7] always includes at least one day of sessions for public engagement professionals, teachers and schoolchildren. The same conference sees the presentation of our education medal for teachers, and from 2017 a new medal for more general public engagement.

14. At school level, the RAS supports and is consulted closely on the development of the GCSE Astronomy course, which is predominantly studied by school children in years 10 to 13 and some adults in around 350 centres around the UK. The Society awards certificates to the 12 best GCSE Astronomy candidates each year.

15. Many other learned societies have a strong commitment to public engagement, with dedicated staff and a grant scheme, and a notable example in our sector is the Institute of Physics (IOP), which operates on a much larger scale than the RAS. Opportunistic funding from private sector sources also sometimes complements the support from the public and third sector, often for set piece events such as science festivals and for 'permanent' facilities such as exhibits in museums and science centres.

16. Beyond the UK, the European Southern Observatory and European Space Agency commit significant resources to public engagement, as does the Europlanet network of planetary scientists. On a global scale, the International Astronomical Union has a section on Communicating Astronomy with the Public[8]. UK astronomers and space scientists contribute to all of these bodies.

17. In geophysics there is in contrast relatively little work in public engagement. One example is the School Seismology Project run by the British Geological Survey, and administered by the British Geophysical Association (BGA), a joint associate of the RAS and the Geological Society. In 2015 this engaged nearly 4200 participants and the associated YouTube video was viewed nearly 130,000 times.[9]

18. The Lancaster University-based Aurorawatch, which alerts people to possible displays of the northern lights, is a second geophysics project with a wide reach. As well as email subscribers, its Twitter feed currently has nearly 80,000 followers.[10]

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[5] See http://www.ras.org.uk/200
[6] C. McLoughlin, private communication.
[7] NAM 2016: http://nam2016.org
[8] See e.g. http://www.communicatingastronomy.org/
[9] Private communication, P. Denton, British Geological Survey.
[10] See http://aurorawatch.lancs.ac.uk/

19. In 2006 the BGA published a report on Geophysics Education in the UK[11], led by Prof Aftab Khan. It highlighted concerns from employers and universities about poor recruitment to geophysics programmes that means the UK lacks the graduates needed for essential industries in energy and mineral extraction, attributed to little awareness of geophysics in schools. The Khan report recommended the development of geophysics INSET courses for serving teachers, and support for a dedicated officer with a national role in promoting geophysics.

20. The main funding agency for geophysics in academia, NERC, has the same commitment to public engagement as STFC (both signed the Concordat for Engaging the Public with Research), so expects research grant holders to carry this out. It does not though at present operate a grant scheme. Given the findings of the Khan report, and the difficulties reported by employers in recruiting geophysics graduates, there is a strong case for changing this approach.

The balance of effort needed to increase public engagement in science by 'new audiences' and by the 'already interested'

21. Public engagement programmes should prioritise those groups who are currently underrepresented in STEM occupations and in higher education programmes. Many learned societies collect and analyse these data. For example, the RAS shapes its work in part by assessing the diversity of academic employees and students in astronomy, space science and geophysics, using data from UCAS, HESA, and surveys of UK researchers and our own membership. From these data the most glaring underrepresentation is in sex and ethnicity.

22. In the sciences we represent, there is a somewhat larger, and slowly growing, proportion of women than in physics as a whole (and even at school level girls make up 40% of the entrants to the GCSE Astronomy exam[12]), but women are still underrepresented, and there are very few in senior positions. For example, in 2014, UCAS data indicate that 22.5% of applicants to undergraduate physics programmes were female, whereas 'astronomy' courses are slightly better at recruiting women, who made up 29.7% of applicants. Geophysics was better still, with women comprising nearly 39% of applicants. Although the data are now four years old, we also found that women make up 27% of astronomy lecturers and 32% of geophysics lecturers, but that this declines to 7% and 8% of professors respectively[13].

23. Organisations like the Institute of Physics have put a good deal of effort into improving the recruitment and retention of women in physics and astronomy, but with limited success, particularly in shifting the stubborn statistic of just 20% of A level physics entrants and Scottish Higher physics entrants being girls. There are though early signs of positive changes from more recent

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[11] See http://goo.gl/0nJx1l

[12] C. Barclay, private communication

[13] RAS analysis of UCAS data, in preparation

projects, and if this continues the Society urges the government to consider supporting them on a national scale.[14]

24. Our sciences also see extremely poor representation of people from many black and minority ethnic groups, particularly those who were born in the UK. For example, the 2010 demographic survey found that 97% of British permanent academic staff in astronomy and geophysics are white.

25. Surprisingly there has until recently been little discussion on how ethnicity and also socioeconomic circumstances affect decisions on whether to pursue careers in STEM. This is changing, and the RAS for example now considers diversity as a whole[15], and supports public engagement programmes that address this.

26. Some approaches to public engagement take advantage of the history of specific groups. A good example is Islamic astronomy, where the Muslim world made major contributions from the seventh century onwards, and where calendars (and the start of Ramadan) nominally depend on sighting the crescent Moon. For more than a decade a multi-faith project has run as a collaboration between the Nautical Almanac Office, the Royal Observatory Greenwich, and then the Royal Astronomical Society, the Quilliam Foundation, and more recently STFC. This took astronomy and calendars to planetariums around the UK, with large attendances from the Muslim community in different cities.[16] Early Islamic science was also a feature of the 2015 International Year of Light, as that year marked the one thousandth anniversary of the optics theory of Egyptian scientist Ibn al-Haytham.[17]

27. The RAS also endorses the work of the ASPIRES project run by King's College London, and its findings that point to the need for early intervention in both schools and in families, in order to build 'science capital'. Public engagement strategies have too often focussed on adolescents, whereas the King's research suggests that intervention at primary school level and in 'informal' learning are vital too.[18]

28. Increasing engagement between the scientific community and many ethnic and socioeconomic groups has also been a key priority of the RAS 200 programme. The first five full projects addressed children and adults on the

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[14] See e.g. http://www.iop.org/education/teacher/support/girls_physics/current-projects/page_63825.html

[15] RAS Committee on Diversity in Astronomy and Geophysics http://www.ras.org.uk/about-the-ras/committees/249-ras-committees-terms-of-reference#CDIAG

[16] See e.g. http://astro.ukho.gov.uk/moonwatch/ for the legacy data project.

[17] An animation about anniversaries in light made for the International Year includes the work of al-Haytham. See https://youtu.be/8U_GEa4bM1M

[18] ASPIRES 2: http://www.kcl.ac.uk/sspp/departments/education/research/aspires/index.aspx

autistic spectrum, adult and child carers, Welsh language speakers, at risk adolescents and adult learners.

29. All of these RAS 200 projects are led by the communities they serve, a relatively new approach for our sector. We expect to be able to report on their impact in the next 12 months, and whether they have delivered an enduring attitudinal change in their participants.

30. Among our partners, STFC considers diversity in its public engagement grant schemes, and looks at the sex of participants, but not yet ethnicity, and we would welcome a shift by them and other government bodies that cover STEM to consider this a formal requirement.[19]

Any further steps needed by the media and broadcasters to improve the quality, accessibility and balance of their science coverage; and science coverage in broadcasters' programme making.

31. Space and astronomy are well represented in the broadcast media, and on the whole science reporters and programme researchers make the effort to contact experts in the UK when putting together items for broadcast, online and print media.

32. Large European agencies like ESA and ESO now have well resourced media teams, who understand the importance of providing high quality images and content. This pro-active approach has undoubtedly helped give missions like Rosetta / Philae the profile they deserve.

33. Despite this, there is still a perception that programme makers see NASA and other US institutions as the first point of contact, and that scientists based there are given more time than their counterparts in the UK. Part of this may be a result of the co-production of e.g. documentaries with US broadcast partners, who are keen to address a domestic audience.

34. This approach by broadcasters carries some risks for science communication, in that it may create the impression that the US is far more active in space and astronomy (and other sciences) than the UK and Europe, and so deter young people here from pursuing STEM careers. The Committee may wish to explore this point if they engage witnesses from the UK media.

35. In solid-Earth geophysics, there is very little media coverage. It is sometimes seen as a technically complicated discipline, but given the UK strength in the field it would be helpful to see it receive more attention.

The communications strategies being taken to encourage young people to study STEM subjects in higher and further education, and to encourage those people towards STEM careers.

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[19] See guidelines for applicants at http://www.stfc.ac.uk/files/pe-small-awards-guidance-notes-2014/

36. UCAS data indicate a significant growth in applications to physics and astronomy courses in higher education. Physics has seen an increase in accepted places of 73% since 2004, and astronomy a 78% increase since 2007.

37. Given that most of the growth in student numbers has been among younger applicants, this would on the face of it appear to be a success story, driven by a public enthusiasm for blue skies research (even in 2009 an IOP study reported that 53% of undergraduate students said astronomy attracted them to study physics at university[20]).

38. As physics degree programmes in higher education, including in astronomy, are still predominantly male, and have a low proportion of BME applicants, universities still have further to go in making the most of the potential pool of talent in wider society. In particular, without an improvement in the take up by girls of A level and Scottish Higher physics courses, it is hard to see how the number of women who continue in careers in these subjects can grow significantly across the whole sector, even if astronomy and geophysics have a somewhat better gender balance.

39. Communications strategies should therefore encourage students, particularly those from under-represented groups, to consider pursuing these subjects far earlier than the point (in year 9 for GCSE courses and in year 11 for post-16 studies) at which they make the choices that determine their subsequent path. The evidence from ASPIRES indicates that families have a crucial role in this, so the government should continue to encourage settings like museums and science centres to support parents and carers, particularly those from non-traditional backgrounds. The role of these centres can be to provide the 'non-formal' learning that more effectively inculcates STEM in participating families.

40. In schools, the revised careers guidance published in 2015[21] explicitly refers to STEM and states: "Schools should also ensure that, as early as possible, pupils understand that a wide range of career choices require good knowledge of maths and the sciences. Schools should ensure that pupils are exposed to a diverse selection of professionals from varying occupations that require STEM subjects, and emphasise in particular the opportunities created for girls and boys who choose science subjects at school and college. Schools should be aware of the need to do this for girls, in particular, who are statistically much more likely than boys to risk limiting their careers by dropping STEM subjects at an early age."

41. This should be a part of the 'communications strategy' of the government for young people, and online and broadcasting campaigns need to be supported by the direct exposure to professionals described in the guidance. Professional scientists, particularly those in areas like astronomy and geophysics, are well

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[20] See p.14 of http://www.iop.org/publications/iop/2009/file_38212.pdf

[21] See https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/440795/Careers_Guidance_Schools_Guidance.pdf

qualified to describe the options that result from advanced study of these subjects, and the prerequisites for pursuing careers in these areas.

42. Learned societies and similar bodies have carried out work that could complement this approach. For example, the RAS has created booklets setting out the wider impact of, and careers resulting from, qualifications in astronomy and geophysics, that we plan to adapt for use in schools[22]. Other subjects without an immediate vocational pathway could benefit from a similar approach, and the government communications strategy should include the options resulting from STEM qualifications outside of engineering and medicine.

The extent to which public dialogue and consultation is being effectively used by Government in science and technology areas of policy-making.

43. The Society was a partner in two recent 'public dialogues' in STEM, on space weather and on leap seconds, in both cases designed to shape the policy adopted by Government.

44. Space weather is the condition of the space and upper atmosphere environment around the Earth due to the interaction with radiation and particles from the Sun, and the time-varying solar wind.

45. Inclement space weather is caused by large amounts of electrically charged, magnetised gas leaving the Sun in so-called coronal mass ejections (CMEs), and as a result the Earth's magnetic field is disturbed. These 'storms' can disrupt a range of space- and ground-based systems, including navigation and communication satellites, and in the worst cases terrestrial power grids.

46. Recognising these risks the Government added space weather to the National Risk Register in 2012. Given the potential impact, and the lack of public awareness of the issue, BIS commissioned a public dialogue as part of its ScienceWise programme.[23] Topics in this included understanding the science, support for further research, and a discussion of appropriate mitigation and resilience measures.

47. The dialogue was led by STFC, with support from NERC, as both research councils support aspects of space weather research. Its steering group included experts from National Grid, Lloyds, the Met Office, the Cabinet Office, and the RAS.

48. Several tools were used to deliver the aim of the dialogue, which was to have an interaction between the public, and scientists and other stakeholders and policy makers. These included regional workshops in Edinburgh, Wrexham, Reading and Jodrell Bank (thus covering urban and rural settings), where

[22] See http://www.ras.org.uk/publications/other-publications/2294-beyond-the-stars
[23] See http://talkspaceweather.com/

representative samples of volunteers took part in in-depth activities over several days, and online surveys open to everyone.

49. The exercise showed that it is straightforward to communicate space weather risks to the public, that this is much appreciated, and that it will be a valuable contribution to society's resilience against space weather. The findings from the dialogue[24] and independent evaluation report[25] summarise its success.

50. Leap seconds, the other topic for a public dialogue where the Society was an active partner, are introduced on average every 18 months, to compensate for the long term slowing of the rate of rotation of the Earth. With atomic clocks, the limitations of the Earth as a timekeeper are apparent, so civil time is resynchronised to mean solar time through the use of leap seconds.

51. They are, however, problematic in GPS systems, computer operating systems, financial transaction software and other time critical applications, so there have been various proposals to abolish them and shift instead to civil time based on atomic clocks.

52. This is subject to international negotiation, and the UK recognises the cultural impact of such a change, and that stakeholders including the public should be consulted.

53. The leap second dialogue served a similar purpose to its space weather counterpart. Its partners included academia, industry, civil society and faith groups, whose representatives helped shape the dialogue process to allow public participants to consider the consequences of a change to the time system.

54. In general, the feedback from this and the space weather dialogue was very positive. The public welcomed the chance to be involved, and the opportunity to shape public policy.

55. One issue with this, which the Committee might wish to explore, is that although the process was thorough, and the ScienceWise team made every effort to ensure that the composition of people in the focus groups represented society as a whole, the online surveys attracted a low response. For example, just 200 people took part in the survey on leap seconds, and 71 completed the online questionnaire on space weather. As the respondents were self-selecting, the Government should thus be cautious about the results of the online surveys, which may be an issue for other public dialogues on STEM subjects unless steps are taken to grow the size of the response.

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[24] http://www.ralspace.stfc.ac.uk/RALSpace/resources/PDF/SWPDFinalReportWEB.pdf

[25] http://www.sciencewise-erc.org.uk/cms/assets/Uploads/STFC-Evaluation-Report2.pdf

The strategies and actions being taken by Government to foster public engagement and trust of science more widely, and high quality reporting of science in the media

56. In astronomy, STFC has undoubtedly demonstrated good practice in public engagement, and set a good example to the STEM sector as a whole.

57. STFC also has a strong media communications team, responsible for giving recent breakthroughs in science a high profile, such as the LHC and the Higgs Boson, the landing of Philae on Comet Churyumov-Gerasimenko, and the detection of gravitational waves.

58. NERC has a less obvious commitment in this area, though the media profile of its work is improving, and we strongly recommend that it take steps to address this, such as introducing a grants line for public engagement, to tackle the issues raised by the British Geophysical Association and other groups.

59. At the level of BIS itself, the strategy is less clear, at least in engaging the majority of organisations that actually deliver public engagement. Our colleagues at the National Schools Observatory, a major astronomy education project, also report that there is still little dialogue between BIS and DfE, despite the Science and Technology Committee asking for this to happen in its report in 2011, and STFC agreeing with this recommendation[26]. The two departments need to do further work to communicate the value of cutting edge science to young people in particular, and to make more apparent the opportunities and diverse and interesting careers that STEM subjects can lead to.

60. With a plan of its own for public and media engagement in astronomy, space science and geophysics, the RAS works with some, but not all of the organisations above (our relationship with BIS is less strong). The Society is very willing to share resources and evidence on good practice in science communication, as well as being an active partner in relevant national programmes.

[26] See http://www.publications.parliament.uk/pa/cm201012/cmselect/cmsctech/1425/1425.pdf