

Aspects of Science in UK Culture

Report for the Science for All Expert Group

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1 Introduction

1.1 Objectives

The brief for this report was to:

- discuss, using case studies, how the perceived walls between the sciences and the arts can be broken down
- investigate the extent to which leading UK cultural institutions/initiatives embrace science within their respective remits

The impact of Web 2.0 on the science engagement agenda has also been examined.

1.2 Culture

Culture *n.* 1. the total of the inherited ideas, beliefs, values and knowledge that constitute the shared bases of social action (*Collins English Dictionary*)

Most British people would probably concur with this definition, though it is doubtful whether the majority would, unprompted, agree that it includes science. This is in marked contrast with some other European countries, notably France, where culture has a much broader meaning and where the term 'science' is interpreted much more generously than it is in Britain.

Yet, the meaning of culture appears gradually to be changing in the UK. Not only is the word used routinely to cover a wide range of activities ('high' art to 'low' art) but sometimes to include science. Tim Radford, who was science editor for *The Guardian* after several years as its Literary Editor, is adamant: 'over the past forty years, there has been a noticeable change. In the 60s, people in high places thought it smart to be sniffy about science, regarding it as something that boffins do, rather trivial in the big scheme of things. Real culture was supposed to be associated with great literature, opera and music. Now, most opinion-formers would not deny that the latest Dawkins or even the latest news from the Large Hadron Collider is part of our shared culture.' A.N. Wilson is spokesperson-in-chief for the opposition.

It would be well worth researching the common understanding of the word 'culture' in the UK, among all the social groups. Whatever the result, I believe that – in the spirit of the Collins definition – science *should* be perceived as part of culture. This report is written from that perspective. I have, however, tried to separate disinterested reporting from personal comments.

Throughout this report, I abbreviate 'science, technology, engineering and mathematics' by science, though I acknowledge that this blurs the unevenness of coverage of these disciplines in British cultural life. These disparities are well worth investigating.

2 Successful art-science collaborations - case studies

2.1 Contemporary art in the Natural History Museum & Science Museum

Over the past decade or so, the Natural History Museum (NHM) and the Science Museum have increasingly used high-quality contemporary art in their displays. Each museum has a policy on the use of art and has appointed an expert trained at the Royal College of Art (Bergit Arends at the NHM, Hannah Redler at the Science Museum). The reasons for featuring such art in displays include

- they can explore scientific questions in innovative ways, subtly probing ambiguities and subject areas that would otherwise be hard to treat
- art pieces can help transcend language barriers
- artists can introduce wit, humour and other elements unobtrusively into the interpretative strategy
- by employing high-quality artists, exhibitions can attract audiences who otherwise would only rarely visit a science venue
- such displays often lead to non-standard press coverage, which increases the breadth of the museum's profile

At the NHM, contemporary art ventures have played an important part in strengthening its brand identity. A special unit, working separately from the exhibition team, is funded to produce annual high-profile contemporary art exhibitions that were subsequently presented internationally. Among its successes are the exploration of kinship between animals and humans in 'After Darwin: Contemporary Expressions' and the permanent installation TREE by artist Tania Kovats (<http://bit.ly/ijSSv>), both marking the Darwin bicentenary. In 2006, 'The Ship: The Art of Climate Change' showed artists' responses to the threat of climate change, including works by major artists such as Antony Gormley, Ian McEwan, Siobhan Davies, and Alex Hartley, whose project, recently selected for the Cultural Olympiad, originated at the NHM.

The Science Museum now features sufficient contemporary art to enable the setting up of trail of exhibits for visitors, <http://bit.ly/2o02XG>. The surge in the deployment in this art in this museum began with the opening in 2000 of the Wellcome Wing, which featured a dozen high-quality works of art, including Anthony Gormley's 'Iron Baby', a life-size cast-iron sculpture of a newborn child lying on its stomach (displayed in the biomedical gallery 'Who am I?') Evaluation showed this and other interventions were very popular with all types of visitors, with the proviso that the relevance of the art pieces should be clear (contrary to the wish of several artists that their work should be self-explanatory). After the opening of the Wellcome Wing, Hannah Redler has led a contemporary-arts programme in the Museum, with several successes, such as the installation 'Listening Post', a 'dynamic portrait' of online communication, displaying uncensored fragments of text, sampled in real-time from public Internet chat-rooms and bulletin boards.

Observations: Interventions by contemporary artists have played an important role in enlivening and deepening the displays at these museums over the past decade. Internal evaluation reports demonstrate the effectiveness of including these artworks, not only for adults. In my view, it is important that the museums maintain this innovative approach to presenting content as they are one of the factors that keep British science museums ahead of their international competitors, most of whom have a conservative attitude to display strategy. The same could be said for science centres but it seems that virtually all such centres in the UK are so preoccupied with dealing with financial pressures that they few resources are left to invest in imaginative interpretation.

It is worth noting that some scientists and experts are sceptical of the amounts of money spent on these initiatives. In the opinion of Roger Highfield, editor of New Scientist, 'Science-art projects have enabled artists to win a lot of grant money for artists, but I'm not sure how much good they've done for science. They certainly don't enable hoi polloi to understand science'. In order for such scepticism to be effectively rebutted, it is essential to have public access to the projects' evaluation reports.

2.2 Science book prizes

There are hundreds of book prizes in the UK, most of them for fiction. So there are few opportunities for popular science books to be recognized in these competitions. The Royal Society and the Science Museum therefore made a valuable innovation in 1988 when they launched two Science Book Prizes, one for adults, the other for children, aiming to encourage 'the reading, writing and publishing of high-quality, accessible popular science' (<http://royalsociety.org/sciencebooks/>). This turned out to be a propitious year to launch the adult prize as it coincided with the publication of Stephen Hawking's 'A Brief History of Time', whose extraordinary sales initiated a renaissance of popular science publishing and made it respectable for first-rate research scientists to write popular books. Subsequently, the Prizes were sponsored, notably by Rhône-Poulenc (later by Aventis and the Aventis Foundation), enabling the prize money to be £10k for each of the two categories (with £1k for each of the other short-listed books). The high values of these winnings gave the prizes a high status among the UK's literary awards. More important, the publicity for the short-listed book (and, later, the winner) generated considerable publicity for science books and gave an annual focus for public discussions about the best popular science writing.

After the Aventis Trust ceased to sponsor the Prizes in 2007, it has proved a challenge to find funding at the same level. The Beecroft Trust supported the Prize in 2008 and this year, when the junior prize was dropped, owing to lack of funds. The number of entries this year, 122, was roughly same as its has been over the past decade, indicating continued strong interest from publishers. The reduced funding has been manifest through a much-reduced post-award publicity, diminishing the impact of the prize. Currently, the Royal Society is seeking funding for the adult prize next year.

In 2009, the Wellcome Trust introduced a prize to celebrate medicine in both fiction and non-fiction (<http://www.wellcomebookprize.org/>). The winner's prize was £20k, making the award one of the richest literary awards in the country, thus instantly commanding interest in the world of books. The prize has already demonstrated an ability to draw attention to first-rate books that have been widely ignored: not one newspaper had reviewed this year's winner, Andrea Gillies's 'Keeper'.

Observations: Contrary to the common impression, the market for popular science books is tiny – they account for roughly one per cent of books sales in the UK. Only a handful of these authors could earn even a modest living from writing. It is, however, true that several of these books each year have a disproportionate importance in promoting good science and in introducing scientists and other popularizers to media with a broader reach. Richard Dawkins, Simon Singh and Stephen Hawking exemplify this. Currently, space for reviews is diminishing at an alarming rate, especially in newspapers, and the market for books is becoming more cut-throat by the month, as booksellers concentrate ever more on titles that 'fly off the shelves'. The much-vaunted boom in popular science, as reflected in sales and high advances, ended several years ago.

Although most literary editors now recognize the value of popular science writing, a bias towards more-obviously literary subjects sometimes manifest itself, for example during lists of recommended reading, which feature popular science books only rarely (likewise science fiction).

So it is important for the science engagement community to support science book prizes and to ensure that they are well publicised.

Like many other literary awards, Science Book Prize has been criticised for its inconsistency, as it often misses books subsequently regarded as classics (Dawkins has never won it, as he often points out). Another point often made is that is unclear whether the prize is for populism or serious-minded literature; in practice, it turns out that the judges select a winner that tends to be in of these two broad categories. It is nonetheless undeniable that the prizes have given considerable publicity to popular science books over the past two decades. It was a blow when the junior prize was cancelled and when funding problems led to a sharp fall in the publicity after the announcement of the award. If the Prize were to cease altogether, there would continue to be opportunities to enter science books to high-profile awards such as the Samuel Johnson and Costa Prizes. However, the loss of the Prize would be a great loss to the promotion of high-quality science writing in the UK.

2.3 Science Gallery, Dublin

Launched in February 2008, the Science Gallery in the centre of Dublin is an initiative of Trinity College with a mission 'to ignite creativity and discovery where science and art collide'. The Gallery is a new type of science centre, with a strong focus on art-science symbioses, a modern look and a clear aspiration to appeal particularly to teenagers and adults through a programme of temporary exhibitions and events. In its first year, there were 130,000 visitors (more than 2.5 times the expected number) and an almost-equal number of hits on its website (www.sciencegallery.ie). During that year, the Gallery presented some 200 events and workshops, many of them complementing one of its five temporary exhibitions on topics ranging from fashion to neuroscience. The exhibitions have a populist feel (much more so than those at the Wellcome Collection) and intend to stimulate visitors with new ways of thinking about science-related subjects.

Compared with most family-friendly science centres, the Gallery has an edgy image, most evident in its marketing campaigns and its catering facilities – including a first-rate café – which make the place an appealing venue for young adults and students. The Gallery is working to build links with people in the local community, seeking to involve them in the development of the institution through open calls for collaboration. Particularly intriguing is the aspiration of the Gallery to shift from being mainly a content provider to a creative platform, from which a variety of outputs (including technological products) emerge.

Observations: Most striking about the Science Gallery is the energy and commitment of its staff, manifest in its exceptionally lively programme. For a centre that must appeal to families, it is extraordinarily bold in its image and aspiration. Much can be learned from this. The great majority science centres have a similar feel, with a strong appeal to young children (essential to cater for family- and school visits), with the result that the environment has little appeal to adults (alone or in groups). One of the key ingredients in the mix is the choice of topics of wide appeal, but treated in unusual, fresh ways, always with a strong visual element; another is the presence of young enablers on gallery (this is precluded in most such centres, owing to resource constraints). Finally, it is clear that the Gallery derives much of its palpable energy from local individuals, from Trinity College and other local organisations, giving them frequent opportunities to contribute to the organisation. The success of this venture is a testimony to the flair, imagination and drive of Michael John Gorman and his colleagues.

The underlying plans for the Gallery are clonable in any city that has a strong science university (or college) and a thriving arts community. It is one of the objectives of the staff to replicate itself in the coming few years in venues all over the world. Michael John Gorman is currently trying to bring this vision to fruition.

2.4 Wellcome Collection, London

Wellcome Collection is a suite of facilities located near Euston Station in London, including two long-term galleries, temporary exhibition space, public events, a reference library, a café and an adjacent bookstore. Focusing on medical science, art and cultural history, it opened to wide acclaim in June 2007 and has since maintained a reputation as a smart venue that provides original, adult-focussed programming. The Collection has a strong presence on the Web, where its prominent strap-line is 'a free destination of the incurably curious' (www.wellcomecollection.org).

Central to the Collection's provision are its events and exhibitions, run by a team of ten people led by Ken Arnold. There are typically two live events each week, most of them associated with the current temporary exhibition, popular themes (such as Darwin Year) or medical topics of high public interest, including a series of interviews conducted by the philosopher A.C. Grayling, the mid-day series 'Packed Lunch' and the early-evening 'Supper Club'. The average attendance of these talks is about ninety per cent of capacity. The exhibitions, including 'The Heart', 'Medicine Man' and 'Sleeping and Dreaming', are notable in the world of science communication for their boldness, their high production values and their focus on objects and original materials rather than interactive exhibits. The exhibitions 'War and Medicine' (<http://bit.ly/2wr4aB>) and 'Life Before

Death' (<http://bit.ly/5Ycy6>) were particularly daring, as they looked unflinchingly at X-rated subject matter of a kind only rarely addressed in science-focused venues, though often treated in art galleries and arts centres. In this way, Wellcome Collection has broken new ground in establishing a high-quality science-art venue.

The Wellcome Trust provides the Collection with an enviable budget of just short of £2m per annum, of which £0.8m is for programming. The total number of visitors annually is approximately 350,000, about half of whom are under the age of 44. About one visitor in twenty goes to Wellcome Collection specifically to use the café and bookstore (or both), facilities used by almost a third of all visitors.

Observations: The success of Wellcome Collection was by no means a foregone conclusion, as the public facilities set up by the Trust on the site in the early 1990s did not thrive. Low visitor numbers were then attributed to the location. In my view, the principal lessons to be learned from the Collection's achievement are:

- the importance of high-quality formative evaluation (the concept was researched in detail before plans were finalised)
- there is an adult audience (at least in a large city) for science topics of high human-interest when they are treated in daring ways in exhibitions and events
- science exhibitions do not necessarily have to be 'fun' – visitors appreciate serious content, well interpreted
- the value of taking an original approach to exhibition planning – not relying on formulaic ideas
- the value of working closely with the media (co-sponsors of events) and of investing in substantial marketing budgets
- the importance, for this type of venue, of providing an environment that will appeal to young adults (design, catering, décor)
- the wisdom of presenting exhibitions that take a fresh look at subject matter, often by working with artists
- the value of having someone of Ken Arnold's intellectual breadth and catholicity of interests at the helm of science-art projects.

All of this has been made possible by the munificence of the Wellcome Trust. Seen from a national perspective of most science-related institutions struggling to stay afloat financially, it is painful to see the difference that can be made by having generous budgets, wisely spent. The large national museums have reason to be envious as their resources are to a large extent committed in caring for their collections. The Trust has some objects of its own (pictures, prints, illustrated books etc.) but can, for example, freely borrow from the Science Museum, which cares for the Trust's rich collections.

One criticism of the Collection's cultural products is that it is another contribution to the super-serving of metropolitan intellectuals. In London, adult 'cultural activists' have a rich choice of science-related programming (e.g. from the Royal Institution, the Darwin Centre, the Dana Centre, Kings Place and the Institute for Contemporary Art). So it remains to establish art-science venues that attract audiences who would not normally visit cultural centres, especially ones outside London.

Several of the Collection's exhibitions have been presented in other venues (e.g. 'Medicine Man' at the British Museum). But there is plenty of scope to increase the touring component of the Collection's products, and this is currently being investigated.

In brief

2.5 The Arts Catalyst, London

Founded in 1993, currently located in London although operating nationally and internationally, The Arts Catalyst (<http://www.artscatalyst.org/>) seeks to commission art that engages with topical issues in science, especially in the life sciences. It is funded mainly by the Arts Council. What makes the Arts Catalyst distinctive is its mission to bring artists and scientists together in order to explore wide social, political and cultural contexts that are not normally examined in the media. Led by Nicola Triscott, the organisation's emphasis on innovative, multi-disciplinary projects that involve open-minded artists and scientists in order to engage the public, including parts of the community that are often left out, e.g. low-achieving school students. The Arts Catalyst has produced over 70 artists' projects and organised many other public events.

Among the Arts Catalyst's most successful projects was CleanRooms (2002-3), an exhibition that reflected on emerging advances in biotechnology. Works included Critical Art Ensemble's participatory performances, in which lab-coated representatives from the fictitious *GenTerra* company introduced their bio products and enabled participants to grow and release their own transgenic bio products. In another project, Space Soon (2006), the Roundhouse in Camden into a live rocket factory – Aleksandra Mir's towering slender 60-foot rocket *Gravity*, filling the main space, was constructed over five days from vast pieces of junk. Outside, Danish architects N55 and artist Neal White inhabited the *Space on Earth Station* conducting experiments into their terrestrial surroundings.

Observations: I find it surprising that science-focussed funders have not been more generous in supporting this organisation. Scientists should be more forthcoming in supporting Arts Catalyst's aim of bringing together scientists and artists to produce art that reaches beyond well-served groups in the community. Moreover, several of the ideas developed here could easily be replicated. I was struck by two comments made by Nicola Triscott. First, she points out that quite a few scientists think that art-science collaborations are mainly about presenting images generated in the course of science, whereas Triscott is mostly concerned to use these collaborations to shed light on big science-related issues. Second, Triscott notes that often schoolchildren who are conventionally seen as low-achievers are often especially creative in art-science activities as these students are less afraid than 'high-achievers' of getting the wrong answer.

2.6 FACT, Liverpool and Cornerhouse, Manchester

The Foundation for Art and Creative Technology (FACT) and Cornerhouse are two of the UK's leading arts centre, each funded in large part by the Arts Council and located in the centre of their respective cities. Both organisations are exceptionally imaginative and forward-looking, keen to collaborate with scientists. Yet such collaborations appear to be only a small part of their activities.

FACT (<http://www.fact.co.uk>) claims, with good reason, to be the UK's leading organisation for commissioning, exhibiting, promoting and supporting innovative artwork in film, video and new media. Founded in 1989, it has commissioned some 250 pieces of such work, and now has 350,000 visitors per annum, with a thriving international touring programme. Its director, Mike Stubbs, is eager to promote the centre's science-related work, of which the *Sk-interfaces* (2008) he is most proud. This project, part of the European City of Culture programme, explored the notion of skin as 'a place where art, science, culture and social culture meet' partly in collaboration with biologists at Liverpool University.

Cornerhouse (<http://www.cornerhouse.org>) is Manchester's centre for contemporary visual arts and film. Over the past few years, the centre has presented some projects relating to contemporary science and technology, notably the Arts Catalyst's 'Interspecies' exhibition (January to March 2009) and in events focussing on the recent movies, such as 'Creation' and 'Moon'. Last summer, the Cornerhouse delivered a series of technology taster sessions for young people, aiming to enable them to develop their technical creativity, not always possible in the school environment.

Observations: The proportion of science-related activities in these energetic institutions is small. It underlines how strongly science-related projects in contemporary art are focused on London. If the intention is to promote science as part of national culture, more needs to be done to encourage arts centres outside south-east England to address science-related issues and to collaborate with scientists.

2.7 Impact! Exhibition at the Royal College of Art

This promising exhibition, to be presented between 16–21 March 2010 at the Royal College of Art (RCA), showcases sixteen collaborations between designers and scientists (www.impactexhibition.org.uk). Commissioned by the Engineering & Physical Sciences Research Council (EPSRC), in partnership with the RCA and the National Endowment for Engineering, Science, Technology and the Arts (NESTA), the collaborations have been relatively unusual in the art-science field because they aim not only to bring designers and scientists together to shed light on each other's work, but most importantly to present the potential impacts of engineering and physical sciences research to a general audience in attractive ways.

There are 16 research projects in this exhibition, from a wide range of sciences, engineering and technology, including:

- Doctoral Training Centre for Nuclear Fission Research, (Nuclear FiRST). *Collaboration between designer Zoe Papadopoulou and researchers and students at the Universities of Manchester and Sheffield*
- Detecting infectious organisms: a concerted approach using genomics, molecular engineering and nano-enabled technologies *Collaboration between designer Susana Soares and Newcastle University scientists*
- Fair Tracing: Empowering producers and consumers by providing enriched information about the roots of goods and services *Collaboration between designer Nicolas Myers and researchers at the University of Bradford, Anglia Ruskin University, and Sheffield Hallam University*

After the RCA exhibition closes in March 2010, the organisers hope that the exhibits will be presented at other venues up and down the country. This may include science festivals and conferences.

It is not an accident that the EPSRC is helping to drive this initiative. Second only to the Wellcome Trust, the EPSRC has done more than any other research funder to invest in science-art collaborations, which are viewed as a particularly successful part of its public engagement programme (these initiatives have been evaluated but the results are available only from the Principal Investigators).

Observations: This is an exciting, imaginative project. Although the standard of science-related exhibitions in the UK is slowly increasing (witness the standard of the displays at the Royal Society's summer soirée), there remains a great deal of room for improvement. This project takes several topics that present considerable challenges to the exhibition developer, so it will be fascinating to see the results of these collaborations with leading designers. I hope that this will be the start of a long process that will result in many imaginative exhibitions that bring contemporary scientific and technological ideas to a wide public. It will remain, however, to address the challenge of organising exhibitions that reach audiences all over the country; as such touring displays are usually prohibitively expensive. Perhaps, in the long-term, it will be worth investing in collaborations in which the aim is to present recondite research as a viral Youtube sequence (e.g. the famous Large Hadron Collider rap) and Web 2.0 applications involving public participation.

2.8 NESTA

Soon after the arrival of its CEO Jonathan Kestenbaum, NESTA changed direction and began to focus strongly on 'making innovation flourish', through various initiatives (<http://www.nesta.org.uk/home>). The aim is to help foster innovation, by piloting schemes, identifying ones which are demonstrably successful and then helping them to thrive on their own.

Science-art collaborations are no longer a substantial part of the organisation's work (the NESTA Fellowship scheme, which supported several scientists and artists interested in the overlap between the disciplines, has been discontinued). However, NESTA continues to support a few science-art collaborations that seek directly to foster innovation, as proven by evaluation. Rachel Brazil is responsible for overseeing these initiatives.

One organisation that NESTA has supported (with funding of £150k) is Free Radicals, led by Helen Storey and Tony Ryan, a group of academics who seek to solve problems in innovative ways (<http://bit.ly/8XwC0i>). This venture is currently being evaluated. NESTA also supported the Impact! project, though its main aim in facilitating the exhibition is rather different from that of the EPSRC: NESTA is specifically interested in whether the scientists' collaborations with designers and artists have been productive and provided any stimulation of scientific ideas with the potential of leading to genuine innovations.

Observations: What is notable about NESTA's priorities is a determination to produce materially productive outcomes from collaborations between artists and scientists. (This has been done in the software industry, notably by Google and Mathematica, organisations that put a high premium on getting technical experts to work with designers in order to produce user-friendly interfaces). NESTA's hard-headedness offers a valuable perspective on these collaborations and could lead to results that would impress critics who take a utilitarian approach to science-art ventures. Keep an eye on the art-science projects it judges to be successful.

2.9 University College London's object retrieval project

'Object retrieval' was a mass-participation project organised by Simon Gould, Contemporary Projects Curator at University College London (UCL) between 15-21 October 2009. It was based on a simple idea, developed in collaboration with the artist Joshua Sofaer: focus on an object chosen from the University's pathology collection, and encourage the exploration of the object by people from their own personal or professional perspective for an entire week 24/7. The object was a toy car, confiscated from a child's home because of fears that its paint might cause lead poisoning. The toy was displayed in the middle of the Main Quad on Gower Street, the most prominent location in the University.

The aims of the project, funded by a one-off £30k grant from the Wellcome Trust, were to (<http://www.objectretrieval.com/>):

- demonstrate the value of interdisciplinary research
- explore the challenges faced by museums to interpret objects in a constantly shifting society
- use art as a means to allow people to stand outside of their own personal and professional bounds and take a fresh look at something they thought they already knew about.

The project appears to have been a palpable success, involving hundreds of university researchers and thousands of members of the public, who worked to produce a deep understanding of the object from as many points of view as possible. Final judgement must await the evaluation report, but it seems fair to say provisionally this project flourished because of the drive of the project leader, Simon Gould, and the charismatic intelligence of the artist Joshua Sofaer.

Observations: The success of this project is remarkable, especially in a university like UCL, with a strong focus on research – one would imagine that staff would not want to waste a minute working on projects outside their own discipline, but that expectation turned out to be naïve and pessimistic. Part of the reason for this is, perhaps, that UCL is taking very seriously its role as one of the six 'Beacons of Public Engagement', that is one the universities funded to improve the quality of science engagement with the community. It would be easy to replicate this kind of project (in universities and museums) and thus promote inter-disciplinary research and public engagement, perhaps in collaboration with other media (it could be the basis of a television series or a series of podcasts). If the evaluation demonstrates the project's success, this simple idea could be replicated. (It bears some resemblance to the project launched recently between the British Museum and Radio 4).

3 Science in some of UK's leading cultural institutions

3.1 Department Culture, Media & Sport and its initiatives

On DCMS's website (<http://www.culture.gov.uk/>) the strap line does not explicitly mention science:

'We aim to improve the quality of life for all through cultural and sporting activities, to support the pursuit of excellence and to champion the tourism, creative and leisure industries'.

Yet DCMS has as good deal of influence over the provision of science for the UK public through the Department's arms-length overseeing of the governance of the BBC, through the funding of the libraries, archives, national science museums, and other initiatives such as the UK City of Culture and the Cultural Olympiad associated with the 2012 Olympics & Paralympics. These comments mainly address the latter two projects, as they can be regarded as test cases of whether science is regarded as being part of 'culture', as DCMS interpret the word.

The DCMS, small compared with most other government departments, is responsible for the high-profile portfolios of sport, media and the huge industry of tourism. So it is almost inevitable that it will not be easy for science to have a strong voice. Perhaps with this in mind, Michael Dixon (Director of the NHM) reviewed the appointment of a part-time Chief Scientific Adviser was reviewed in a detailed report published in June 2007 (<http://bit.ly/8tQeig>). After discussion, this post was established and Anita Charlesworth recently took up the position. She is supported by a Science & Research Advisory Committee, chaired by Dixon. On 5 November this year, she gave an interview to members of the 'Science for All' group; the following is based mainly on that interview and the material made available on the DCMS's website.

UK City of Culture: This initiative seeks to build on the success of the European City of Culture project, though the two are independently organised. The European project had no science dimension, that is, success did not depend on a candidate's ability to deliver any science-related activities. The DCMS is currently overseeing a competition that has resulted in twenty-two cities vying to be the UK city of culture in 2013 (<http://bit.ly/2tknE5>). The documentation indicates that the UK model is following the European one in not giving any initiative to develop science-related activities. In the 5 November interview with 'Science for All' group, Anita Charlesworth was frank in noting that this was an oversight and that she would do her best to ensure that it did not happen again.

Cultural Olympiad: The DCMS's central aim for the Olympics is for the British team to win the maximum number of medals. The support of scientists is acknowledged by DCMS to be crucial to the achievement of this objective, but there appear to no high-profile initiatives driven by DCMS to highlight this in the mainstream media. This Culture Olympiad venture 'puts Culture at the heart of the Games – encouraging participation and celebrating the cultures that make up the UK' (<http://bit.ly/zzslV>). From the website and other materials produced by the London Organising Committee of the Olympic Games (LOCOG), there is no evidence that the Committee regards science as a worthwhile part of national culture. Of the ten cultural projects chosen by LOCOG, none is any significant way about science. Members of the science engagement community spent months working with LOCOG trying to develop such a project, but in vain.

Although the LOCOG collaboration failed, it is pleasing that RCUK is working with Podium, the Further and Higher Education Unit for the 2012 Games (<http://www.podium.ac.uk/>). Their activities (including Great Debates at Brunel University) will provide valuable opportunities to promote the crucial role of science in modern sport.

Observations: These two examples indicate – but do not prove – that the DCMS's commitment to including science as part of culture is more honoured in the breach than in the observance. It is

important to draw this to the attention of the Department's Science & Research Advisory Committee and to find other ways of putting pressure on the Department to ensure that science is regarded within the concept of culture and not simply as an instrumental set of tools. It would be strategically wise to address the question of science in culture among all politicians and leading civil servants; it is likely that very few of them would classify science as part of culture.

Finally, I cannot resist remarking that the millennial funding of, on the one hand, Tate Modern, and on the other, the Wellcome Wing at the Science Museum was a clear example of the bias towards arts institutions over science-related ones. Whereas DCMS generously funded the extension of the Tate in perpetuity, the Department refused to give any additional grant-in-aid to fund the Science Museum's extension (this may also have been true of the Darwin Centre, but I have not been able to confirm this – officials are cagey). This was underlined by Sir Neil Cossons in an edition of Radio 4's Front Row in June 2000.

3.2 BBC TV

Even with increasing popularity of the Internet, television remains by far the most popular medium in the UK. The daily reach of this medium is roughly 45 million (almost 80 per cent of the population), of which approximately 33 million people view BBC 1 and 2 (<http://bit.ly/6vq3cQ>). It is important, however, to note that gross figures tend to obscure trends – especially among people – to prefer other information channels.

According to the BBC's research data, three in five people in the UK say that their main source of science is from television. The overwhelming majority of this science is provided by the BBC (whose policies for individual television and radio channels are given at <http://www.bbc.co.uk/info/statements2009/television/bbcone.shtml>). There is, by comparison, little science on the other terrestrial channels: virtually none on ITV, little on Channels 4 and 5, and not much of substance on Sky (though occasionally Channel 4 presents a classic science programme, such as 'Surgery Live' and 'Inside Nature's Giants'). Only the most popular branches of science and engineering feature on the cable channels (e.g. natural history on Discovery and boys' toys engineering on Sky).

Although it is common among scientists to lament the standard of science on the BBC, many of these complaints refer to false comparisons with pre-cable, pre-Internet times, when the audience were much less fragmented. According to John Lynch, BBC's soon-to-depart Head of Science, 'Science on BBC television has never been in better shape than it is now'. He and others (on and off the record) note that the governors and top executives at the BBC (Chairman Sir Michael Lyons, CEO Mark Thomson and Head of Vision Jana Bennett) vigorously support science programming. It is hard to argue against the proposition that, across BBC channels 1, 2, 4 and Children's BBC, there has never been more science on UK television and that it has never been better targeted.

The strengths of science on BBC television include the provision of science on BBC1 general-interest shows with wide audiences, notably 'The One Show' and 'Jimmy's Food Factory'. In addition to the unique Attenborough blockbusters, there are occasional one-off specials and series, e.g. the coming 'Invisible Worlds', which will bring science to large numbers of viewers. 'Bang Goes the Theory', in effect the replacement for the technologically-inclined 'Tomorrow's World' returns next year, along with shows that will encourage mass participation in science experiments.

On BBC2, 'Horizon' continues, with a markedly less dense style of presentation. Next year, there will be a series provisionally entitled 'The History of Science', fronted by One-Show-presenter Michael Mosley, timed to coincide with Science Year.

BBC 4 features the most intellectually demanding television, including series such as Jim Al-Khalili's 'Science and Islam'. This kind of material provides what many scientists regard as 'serious science', thus leading to their accusation that such science has now been relegated to minority channels. This ignores the point that BBC has to ensure high audiences on its main television

channels in order to justify the licence fee. To achieve such audience numbers is no simple matter: today, the average age of viewers of BBC1 is over 50.

One of the challenges for BBC television is to attract the under-35s. This applies to science as well as to other topics. The BBC is addressing this by taking special care to broadcast these programmes (e.g. 'Bang Goes the Theory') at times especially convenient to their target audiences and to maximising the number of links to the content through other information channels, e.g. the websites.

Observations: The provision of science on UK television by the BBC is outstandingly good. (It would be useful to see international comparisons of this to see if there is any truth in the oft-made assertion that BBC television's science is among the best in the world). This stems from the evidently strong support for science from the BBC's governors and senior management. I have been impressed with the energy of Kim Shillinglaw, the new Commissioning Editor for Science and Natural History, who is determined to maintain the quality and quantity of science that BBC television introduces to the UK public. Scientists have long complained of drawing the attention of BBC producers to the latest science, so I hope that the new 'buddying scheme' is a success.

Among the challenges I see are:

- reaching the under-35s with well-targeted science
- keeping a reasonable amount of serious science on BBC2. I am one of those who are dismayed by the sight of comedians presenting Horizon, whose average intellectual level has dropped so far that I suspect many viewers feel disenfranchised. (I would like to see the audience feedback these ultra-populist Horizon programmes, but it is not available)
- the provision of science that does not fall into the most popular categories, e.g. natural history and human health.
- expanding the web archive of science-related content beyond the popular topic of natural history
- more realistic portraits of scientists in the most popular programmes – few programmes that correctly depict scientists typically as ordinary people, with interests outside their specialities (this would do much to dispel the caricature narrowness of scientists)
- the featuring of scientists in programmes of a broad cultural interests – in cultural and political television programmes, it is still rare to see a scientist (again, this would dispel the image of scientists who are interested only in their own field)

But the most important point is to support the BBC's campaign to maintain the level of the licence fee income and the renewal of its charter in 2013. If either of those campaigns is lost, the quality and quantity of non-specialist science in the UK media would plummet.

3.3 BBC radio

The highest density of science coverage among the BBC radio stations is on Radio 4. This station reaches approximately twenty per cent of the entire UK population (http://www.rajar.co.uk/listening/quarterly_listening.php). Science is now thriving on this channel under the aegis of the dynamic new Commissioning Editor Mohit Bakaya, for whom 'science is as the humanities in helping us to understand our changing world.' Popular science series such as 'Leading Edge' and 'Material World' continue and the new comedy series 'Infinite Monkey Cage', with Robin Ince and Brian Cox. The controller Mark Damazar personally commissioned 'Big Bang Day', when the entire station focussed for the on the Large Hadron Collider for the entire day on 10 September 2009, when the machine was launched. This experiment was widely judged a success and unlucky not to receive a Sony Award, and Damazar is keeping an eye open for a day focussing on another science-related event.

The two most popular series on radio to treat science unapologetically as a part of culture are Melvyn Bragg's 'In our Time', which features a high proportion of science-related themes, and 'Start the Week', where Andrew Marr frequently discusses scientific topics alongside other subjects in the cultural spectrum. Podcasts have considerably extended the reach of both programmes.

Encouraging plans are afoot on Radio 4 to portray scientists more realistically, as people who have interests and concerns outside their own specialities.

Science fares less well, however, on the other BBC radio networks, notably on Radio 1 and 2, which together reach close to half the entire UK population. On Radio 2, for example, the science coverage appears to be limited mainly to health and environment stories on 'The Jeremy Vine Show' and occasional, light-hearted spots on 'The Chris Evans Show'.

Observations: By and large, science is well covered on Radio 4 (and gets a fair crack of the whip on the World Service) and all the signs are that this will continue. It would be worth comparing this with the science coverage in other countries. In the US, science coverage on National Public Radio (in many ways the counterpart of Radio 4) is presented in 'Science Friday', though sometimes it features in daily talk shows such as 'On Point' and 'Talk of the Nation'. The extent and quality of this science coverage does not approach Radio 4's.

What is worrying is the exiguous coverage of the subject on Radios 1 and 2. It appears that a minority of the country is given first-rate science coverage, while the rest is offered little science on the BBC, and even less on the commercial stations. (This is to a large extent a matter of supply and demand; if radio were dominated commercial imperatives, then there would be virtually no hope at all of reaching the present audiences of Radios 1 and 2.)

3.4 BBC online (in brief)

The establishment of the post Head of Vision, responsible for television and online content and their integration, underlines the BBC's intention to harmonise the content and delivery from these two platforms. The post is held by Jana Bennett, who has overseen the simultaneous development of the broadcast channels and web content, such as iPlayer. This harmonisation is still in its early stages and several large projects are afoot (most of them confidential, hence the brevity of these comments). For now, Bennett cites Wildlife Finder as a particularly strong example of the BBC's online science output (<http://www.bbc.co.uk/wildlifefinder/>), linking to strong television material and providing an online library for use in formal and informal education.

Observations: I am very optimistic that excellent developments are afoot with BBC online. Apart from the targeting of programmes (and promotional material) to young audiences, there is huge potential for archiving science material and for making it available. It is important to put pressure on the BBC to develop these public-service facilities, even in times of financial stringency.

3.5 British Council

On its website, the British Council's strap line is: 'connecting the UK to the world and the world to the UK, we are the UK's international cultural relations body' (<http://www.britishcouncil.org/new/>). This underscores the Council's focus on funding activities that share the UK's knowledge and cultural perspective in order to build long-term relationships and trust, rather than on the past priority of trumpeting the UK's achievements.

The Council has a science unit, led in London by Lloyd Anderson. The existence of such a unit should not be taken for granted: of all the European national institutes for culture, the British Council is the only one that has a science department (<http://www.eunic-europe.eu/EUNIC-website/>). The size of the Council's science budget is, however, only about £9m out of a total grant-in-aid of £198m (compared to an expenditure of £30m on the arts).

In the 1990s, the bulk of events organised by the Council's science unit involved British scientists going on foreign tours, giving lectures and talking with opinion formers and colleagues in the host country. Over the last decade the balance has shifted towards promoting discussions about the British experience of public-science engagement, a field in which the UK is often regarded an international leader. The Famelab format, for example, has been cloned with great success in south-east Europe and the Council has run a popular programme of Café Scientifiques all over the

world. It also runs a web portal for science communication professionals (www.britishcouncil.org/talkingscience).

Observations: The science budget of the British Council is paltry. An organisation with the broad cultural aims of the British Council should surely spend more than five per cent of its budget on science. A relatively low proportion of the events organised by the science unit involve scientists talking about their work or in discussion with experts from other branches of culture. Likewise, there is a good deal of scope to increase the use of digital social networking technologies in multinational events on the Web. It would be strategically wise for the Council to develop more programmes that exploit the potential of the Web, e.g. by piloting multi-cultural events that involve scientists and members of the public coming together using interactive technology. There should also be far more opportunities for scientists to participate in the Council's cross-cultural activities, including its tours.

3.6 British Library

The British Library is the UK's national library. Funded by the DCMS, the Library seeks to be the national memory by collecting printed and digital materials and by making them available to all-comers, especially researchers.

The Library is a 'deposit library', obliged to collect a hard copy of every book published in the UK and the Republic of Ireland (only the Library of Congress has a larger collection). In 2003, the Library has collected digital copies and hopes that legislation will be passed in the next two years to give a statutory right to collect a copy of all published digital material.

Twenty years ago, the Library had a reputation as an austere Museum of the Book that would turn away even some bona fide scholars. Over the past decade, however, it has changed its image to a much more open institution that aims to be supportive of researchers (seventy per cent from higher education) in all aspects of culture, including science (<http://www.bl.uk/science>) and focuses on responding to the needs and wants of this group. The most important trends over the past decade are, predictably, the increase in demand for on-line access to data, and less obviously, the wish of science researchers to pursue inter-disciplinary work.

The increasing prominence of science in the Library's activities was signalled in 2006 when it appointed a Head of Science, Technology and Medicine, Lee-Ann Coleman, who now has fourteen staff. One focus of the department is the delivery of the online, free-to-access database of biomedical research publications (www.ukpmc.ac.uk); another is the provision for the public of the Talk Science series, each in the Café Scientifique.

Observations: It seems to me that the British Library gives science an appropriate priority, and that it is making good progress in making available its material in digital form. There is a good deal more work to be done in publicising the Library's new openness, even for researchers. It would also be worth making the e-portals of the Library more attractive for users outside the academic community, including members of the public who are interested in the history of science.

3.7 British Museum

The British Museum does not have a formal mission statement. But it is fairly clear what the Museum seeks to do: shed light on past cultures and the relationships between them. Science is part of this, though most visitors would not be able to deduce this from the displays, which do not give science a special pleasure place, except as an indispensable conservation tool (science and conservation are run in the same department). Yet science is on the Museum's cultural agenda (the President of the Royal Society advises on the appointment of the DCMS's quota of the Museum's trustees, <http://bit.ly/60o4HY>).

Observations: The external consensus is that, under the leadership of Neil MacGregor, the Museum has acquired a fresh energy and confidence, manifest in a wide variety of exhibitions and programmes, all of them underpinned by a high standard of scholarship. However, it is regrettable

that science has such a low profile in the Museum. The value of science is implicitly assumed in the displays, for example in giving reliable ways of dating historical material and interpreting data. However, it is doubtful whether many of the Museum's visitors leave it with an improved appreciation of the importance of science in the world's cultural development over the past four centuries. A single permanent exhibition on this subject at this address could put this right. For sure, most visitors and cultural commentators would not expect to see such a display at this address.

3.8 Heritage Lottery Fund

The Heritage Lottery Fund (HLF) was set up by in 1993 to use the proceeds of the National Lottery to transform and sustain the UK's heritage (<http://www.hlf.org.uk/english>). It is independent of government, with its own board of trustees – a QUANGO. The National Lottery Act made it plain that the UK's scientific heritage was as eligible for funding as every other aspect of national heritage culture. The HLF began to award grants began in 1994. Now, fifteen years later, it is now fair to ask whether scientific heritage projects have been awarded a reasonable share of the funds available.

Since 1994, the Lottery Fund has awarded £4.4 billion to almost 30,000 projects, in amounts ranging from several hundred pounds to several million. It is difficult to assess the proportion of this sum given to science-related projects, as it is not possible to separate projects directly connected with science from those that have an association with it. However, if one excludes the funding of parks and the restoration of natural environments, then I believe that it is possible to obtain a sense of the level of the funding of heritage-related science projects from the following areas (compiled from a much more extensive list provided by HLF):

Science-related museums: £98 million to 53 projects submitted by 15 scientific organisations including the national science museums (the Natural History Museum and the National Museum of Science & Industry). The HLF has awarded about £15 million to other projects all over the UK, including: the Museum of Science & Industry, Manchester; Derbyshire's museums to acquire and present collections relating to the Industrial Revolution; Herschel House, Bath (HLF grant £13,100) for a programme of activities and exhibition around the 2009 Year of Astronomy; Hunterian Museum, Glasgow, to restore the Kelvin Gallery.

Archives: Roughly £13 million to fifteen organisations, including University College, London for work on its Galton collection and the University of Cambridge to purchase Newton's documents.

Scientific skills of biological identification, recording and monitoring: £11m to about 180 projects, to develop scientific skills of biological identification, recording and monitoring.

Scientific organisations funded or assisted: Includes

- Royal Botanic Gardens at Kew (£3.3m) and at Edinburgh (£3.4m)
- Royal College of Surgeons (c. £600k) and Edinburgh (£40k)
- Wellcome Trust (support successful project to acquire Francis Crick's papers for the UK, £900k)
- Environment Agency (£8.2m)

Observations: In my view, the HLF has given science-related heritage projects a fair slice of the available resources.

4 Comments on the future impact of the Web

Informed debates about the behaviour of 'old media' in the age of the Web usually conclude that 'Nobody *really* knows what they're doing' or words to that effect. The old media have to adapt, but no one knows how – witness, for example, the apparent slow death of the printed newspaper, which most commentators believe will have disappeared by 2030. In that domain, strategists are concentrating on how to preserve not newsprint but the practice of journalism. For those who want to see science treated as part of culture, it has long been obvious that the Web is potentially a boon, though it is far from clear how best to use it in conjunction with other media. There is certainly no shortage of initiatives to try to make the most of the Web's potential in science-education and –engagement, e.g. President Obama's last week (<http://bit.ly/6a6RTO>).

We are living in a period when a Web brand can go from red hot to cold in few months, for example Myspace, regarded four years ago as a shrewd Murdoch purchase, now pitied as a niche music site. Twitter, financed mainly by venture capital, is booming but seems not be based on a viable business model, so some analysts are sceptical of its chances of long-term survival.

The following notes briefly address a particular aspect of the debate about the Web – how it is being used in order to engage young audience with science. Two case studies are examined: how Channel 4 has boldly adopted a bold web strategy to do this, and how some museums are experimenting with this technology, especially in projects aiming to reach an audience it has only rarely managed to address – young adults.

4.1 Channel 4

In January 2008, Janey Walker, Managing Editor of Commissioning at Channel 4, took one of the boldest decisions taken in the media in recent years. As the Channel was failing to reach the audience of 14–19 year-olds with science-related programmes broadcast in mornings, Walker transferred the entire budget to on-line programming. Her aim was to make programmes that would reach the target audiences through channels that would most appeal to them. The content was to be concentrated not on the school curriculum but on 'life decisions' that teenagers have to make, focussing particularly on females (especially undeserved by science-related content).

This experiment, part-funded by the Wellcome Trust, has been a great success. One strand of programming, Routes, concentrates on genetics, addressed in an edgy website (<http://www.routesgame.com/home/>) and in five Youtube documentaries, which have had some 525,000 unique users and 1.6 million page viewers. The use on this site of game-interfaces, strongly appealing to its potential users, is outstanding. Part of the success has been due to seeding promotional material on the website www.miniclip.com, popular with the target audience. In another strand, 'The Science of Scams', the illusionist Derren Brown and young scientist-presenter Kat Akingbade investigate psychic phenomena (<http://bit.ly/8koc5U>). The Youtube clips had 290,000 hits, many of the viewings followed by on-line discussion.

Observations: This Channel 4 initiative is extremely impressive. It demonstrates what can be achieved when a target audience is reached with appealing content, imaginatively interpreted through a channel popular with the audience (the Web). These successes should be publicised in the science engagement community, particularly to institutions who tend to channel funds into projects in print media and television – both of which appear are less appealing to young people than is often realized.

4.2 Science museums & science centres and Web 2.0

Over the past decade, there has been a gradual trend in science museums and science centres towards the production of dialogue-based exhibitions and events (less didacticism, more audience involvement). Some of the more forward-looking interactives now have games-based interfaces, which have proved popular with audiences, especially young ones, very familiar with high-tech game technology.

The websites of these museums and centres have, however, been slow to implement opportunities to make them more involving for audiences, through Web 2.0 technology. There have been some isolated successes in this area, for example, the Dana Centre's invitation to its on-line visitors to set up their own events, within reasonable boundaries of content. The Science Museum's Dave Patten is a notable innovator in this field.

It is striking that much of the innovative thinking about the potential of Web 2.0 for museums has come not from the UK but from some surprising sources:

Nina Simon's blog (New Zealand) <http://museumtwo.blogspot.com/>

Seb Chan's blog (Powerhouse, Australia) <http://www.powerhousemuseum.com/dmsblog/>

Walker Arts Center media blog, Minneapolis: <http://blogs.walkerart.org/newmedia/>

Put bluntly, although science museums and science centres in the UK are well aware of the challenges they face in this area, few have the resources to address them as speedily as they – or, probably, their audiences – would like.

Personal comments

It seems to me that science museums (and, to a lesser extent, science centres) are wary of social networking on the Internet as it tends to involve ceding, albeit temporarily their authority and control. The best experiments in this field have been small-scale and conducted sensitively, avoiding the worst fears of museum executives. Yet I believe that new Web technology will, eventually, change the relationship between science museums (and centres) and the public.

Most of these organisations are short of funds. Although outreach is invariably a high priority, there is usually too little money to finance touring exhibitions (always extremely expensive) or bold Web 2.0 development programmes. There is an argument for funders to switch their focus from funding conventional exhibition programmes to encouraging Web 2.0 experiments. This could do much to help science museums and science centres to develop in effective ways.

Appendix: People contacted during the preparation of this report

I should like to thank the following experts, whom I interviewed in connection with topics covered in this report. I have not named the people to whom I spoke briefly or off the record.

Anderson, Lloyd (Head of Science, British Council)	25 November
Arends, Bergit (Head of Contemporary Art, NHM)	5 November
Arnold, Ken (Head of Public Programmes, Wellcome Trust)	2 November
Bakaya, Mohit (BBC Radio 4)	10 November
Bauer, Martin (Head of Methodology Institute, LSE)	3 November
Bennett, Jana (Director of Vision, BBC)	25 November
Bloomfield, Robert (Head of Innovation, NHM)	5 November
Brassell, Tim (British Academy)	3 November
Brazil, Rachel (Development Manager, Innovation Programmes, NESTA)	27 November
Brookfield, Karen (Heritage Lottery Fund, Deputy Director of Policy)	16 November
Charlesworth, Anita (Head of Science, DCMS)	5 November
Cohen, Deborah (Editor, Science Unit, BBC Radio 4)	6 November
Coleman, Joanna (Senior Programme Manager, Public Engagement, EPSRC)	24 November
Coleman, Lee-Ann (Head of Science & Technology, British Library)	23 November
Entwistle, George (Controller of Knowledge, BBC)	11 November
Feinstein, Alice (Producer, 'Start the Week', BBC Radio 4)	25 November
Gorman, Michael John (Director, Science Gallery, Dublin)	28 October
Gould, Simon (Contemporary Projects Curator, UCL)	5 November
Henderson, Mark (Science editor, The Times)	10 November
Highfield, Roger (Editor, New Scientist)	6 November
Jackson, Sir Roland (Chief Executive, BSA)	28 October
Jamieson, Lisa (Events Manager, Wellcome Collection)	29 October
Keir, Scott (Science Communication Officer, Royal Society)	4 November
Leslie, Kerry (Head of Public Engagement, RCUK)	11 November
Locke, Matt (Commissioning Editor for Education, Channel 4)	26 November
Lynch, John (Head of Science, BBC TV)	13 November
Mayfield, Heather (Head of Exhibitions, Science Museum)	26 October
Mazda, Xerxes (Head of Learning, British Museum)	2 November
Newman, Joanna (Head of Higher Education, British Library)	16 November
Patten, Dave (Head of New Media, Science Museum)	17 November
Patterson, Lesley (Head of Science & Society, RAE)	27 October
Radford, Tim (formerly Science Editor and, before that, Literary Editor of The Guardian)	30 October
Redler, Hannah (Head of Contemporary Art, Science Museum)	27 October
Shillinglaw, Kim (Commissioning Editor for Science & Natural History, BBC)	16 November
Sillars, Laura (FACT, Liverpool)	6 November
Stubbs, Mike (Director, FACT, Liverpool)	6 November
Tinline, Phil (Producer, 'In Our Time', BBC Radio 4)	11 November
Triscott, Nicola (Director, Arts Catalyst)	13 November
Ware, Nick (TV consultant)	10 November