Institution: The Department of History and Philosophy of Science (HPS)

Unit of Assessment: 32B

a. Context

The field of history and philosophy of science emerged in the context of public discussions about the 'two cultures' and the role of science in modern society. In the past two decades, HPS at Cambridge has taken active steps to bring the results of its research to wider publics and to encourage informed and critical debate. This has involved four main initiatives:

- fostering of long-term contacts with the mass media, particularly in radio and television;
- working closely with colleagues in museums in planning exhibitions and displays for the public;
- providing digital learning tools and resources for the broader public through the internet and social media and online teaching materials and activities for schools and universities;
- influencing government policy, training and public debate.

HPS has systematically and strongly supported these activities, not least because it was founded around an outstanding collection made available to the public, the Whipple Museum of the History of Science. The displays are based on detailed scholarly research, including exhibitions by academics and students on their work: but the Museum's most significant role is setting an agenda of public engagement for HPS as a whole. In recent years, this commitment to outreach has been facilitated by success in obtaining substantial grants from various funding bodies as well as private donors, which have included support, facilities and staff for reaching wider audiences.

Our research targets a diverse range of users. Policy makers are an important audience, and work in HPS is highly relevant for those concerned with bioethics and risk with regards to science and technology; in the wake of the second Gulf War, UK policy concerning antiquities has been informed by work in HPS. Much of the historical work has involved the provision of high-quality educational materials on the web, carefully designed to be relevant to secondary school teaching and to the university sector. This work has been highly successful and of direct significance for mathematics and science teaching in countries ranging from the United States to Iraq and China. We have been especially effective in reaching a wide public through involvement with museums, which has resulted in exhibitions on subjects including evolutionary science and the arts, the development of embryology, and the history of scientific instruments. Our largest audience is reached through mass media, where we have developed a range of strategic contacts; original research carried out in our department is regularly presented on radio and television, both nationally and internationally.

b. Approach to impact

Media: As the largest group of its kind in Europe, HPS has been in a position to make available to the public a wide range of expertise on scientific topics, from Babylonian mathematics and early astronomy to high-energy particle physics and evolutionary biology. Areas of expertise are signalled to the public and media on departmental and University websites. An efficient department office, and museum and library staff, deals with media requests and facilitates on-site location filming. Involvement with the media is favourably viewed and considered in academic promotions.

What has mattered most has been the encouragement of close contacts between members of HPS and individual producers, directors and editors. This has resulted in frequent appearances on documentaries dealing with issues in science and history, as is evident from the individual case studies. It has also (and unusually in this area) given academic staff a role in formulating major series. Dr Andrew Cunningham's 'Making of Modern Medicine', first broadcast in 2007 on BBC Radio4, was based on his own research publications and his lectures offered in HPS. Broadcast to great acclaim in 30 episodes of 15 minutes each, it established the potential of a format that has since been used on many other historical documentaries during the last five years. The series is downloadable and available as a BBC CD.

Involvement in the early stages of a series makes it possible to shape the overall design and message, so that the findings presented go beyond traditional heroic narratives, helping audiences to understand science as it is actually practiced. A notable example has been Prof Simon Schaffer's outstandingly successful 'Light Fantastic', a four-part television series on the history of our understanding of light since antiquity. The idea for the programme grew out of conversations between Prof Schaffer and the series producer, Paul Sen. As Sen has written, "It was a great privilege to work with Simon Schaffer. He has a rare ability to make the history of science seem fresh and relevant." 'Light Fantastic' has had multiple broadcasts between 2004 and 2010 on BBC4 and BBC2, and has been watched by several million people. The most recent programme

he wrote and presented was 'Mechanical Marvels, Clockwork Dreams', which attracted a live audience of 550,000 on BBC4 in June 2013. Both Prof Schaffer and Dr Patricia Fara have been regularly involved as consultants, notably for the 2013 radio series 'The Seven Ages of Science' on BBC Radio4, and for the six-part 2010 television series 'The Story of Science' on BBC2.

Members of the HPS Department have been particularly active in contributing to 'In Our Time', which is among the most listened to and downloaded programmes on BBC Radio4, with a national audience of over two million. Appearing on a prime Thursday morning slot, it has had a major role in enhancing the public's understanding of historical and philosophical issues relating to the sciences. Since 2008, academics from HPS have appeared on more than two dozen programmes and have frequently advised the producers on potential topics. These programmes, and those from earlier years, are all available for online listening. As of April 2012 downloads were averaging 350,000 per month. Staff lectures and presentations on YouTube and the University's video and audio facilities have proved highly effective, several having been downloaded over 25000 times.

Museums: Museums are among the most significant means for communicating the history and philosophy of science. In the Whipple Museum of the History of Science, the Department displays and curates a major international collection of scientific instruments, models, prints and other objects. This unique resource serves both directly as a means for reaching wider audiences (between 2008 and 2012, averaging over 10000 visitors each year), and as a way of encouraging staff and students to use museums and exhibitions as a means for communicating their work.

Regular public events are held within the Whipple Museum. Important initiatives have included the 'Science of Musical Sound', which—as part of a dedicated research project— featured concerts and associated lectures, ranging from original songs sung in the Cavendish Laboratory to displays of early electronic instruments, as well as activities for local school groups and online interactives which allow users to conduct their own acoustic 'experiments'. Results of the research of numerous individuals (including University officers and research students) are communicated in the galleries, through exhibits and displays, as well as special activities for visitors; the newly-opened *Globes* gallery is the result of the research outputs of many. Our research-based displays have gained international, as well as national, attention, with important long-term effects (for example) on the outreach activities of the British Society for the History of Science. Together, the Museum, Library and Department provide encouragement and vital assistance to researchers involved in such exhibitions to maximise impacts and also to identify and record said impacts (some of which is done through formal museum-focused evaluation).

Museum exhibitions provide a major opportunity for presenting academic findings that are both original and accessible to a wide public. The approach developed in HPS has led to a variety of local, national and international initiatives. Dr Hopwood's research, together with that of others working on the Wellcome Trust-funded 'Generation to Reproduction' project, has underpinned a number of exhibitions, notably 'Exquisite Bodies' at the Wellcome Collection in London, and at the University Library in Cambridge. During the Darwin anniversary of 2009 Prof Secord was closely involved in advising on four significant public exhibitions in Cambridge, including the Fitzwilliam Museum's 'Endless Forms: Darwin, Natural Science and the Visual Arts'. This exhibition also opened at the Yale Center for British Art in New Haven, Connecticut and won 'Exhibition of the Year' award from *Apollo Magazine*. Prof Schaffer has had an important role designing and planning a number of exhibitions and museum projects, including in Paris, Cambridge and London.

Online Learning: A major aspect of HPS's approach to cultivating impact from its research is to enable the development of a significant body of free-to-view resources for university and school teaching. Particularly prominent are a number of major editorial projects located in HPS, which offer a combination of introductory and advanced materials. The 'Geography of Knowledge in Ancient Assyria' put texts and translations of four libraries from ancient Iraq on the web. The Wellcome-funded initiative on the medical casebooks of Simon Forman and Richard Napier has already made over 22000 records available, with international coverage of the releases. The 'Visible Embryos' project, also funded by the Wellcome, offers a high quality survey of the history of efforts to depict the developmental process. The Darwin Correspondence Project in Cambridge University Library, directed by Prof Secord through a 20% secondment arrangement since 2006, has put 7500 of Darwin's letters online, at the highest editorial standards. The Project has also made available major online teaching resources and a large scale initiative for using Darwin's letters for teaching in schools (especially Key Stage 3-5) has been trialled extensively and was released in April 2013. The Longitude Project includes a substantial JISC-funded effort to make the

records of the Board of Longitude available online, publicly launched in July 2013. As with the Darwin Project, these efforts are being developed in strategic coordination with the University Library's digital resources programme, which ensure long-term security and open access. The offices of the Darwin Project are located in the University Library and like all of our large editorial activities benefits greatly from its collections, services and exhibition facilities.

These long-term editorial projects are supported by a range of social media, notably blogs, including those from the Darwin Correspondence and Longitude projects. The Whipple Library has made its collections available through a book blog. HPS sponsors a special training session specifically to encourage effective blogging and tweeting; this has been run by Dr Vanessa Heggie, whose *Guardian* blog (shared with Rebekah Higgitt) is the most widely followed in the field. The aim is to encourage effective use of the medium to reach appropriate audiences.

Policy, Training and Public Debate: It has been a major goal of HPS since its foundation to enhance public understanding of the processes and nature of science, using approaches drawn from history, philosophy and the social sciences. The research conducted within HPS has had substantial impacts both in academia outside Cambridge and among the public at large. The books and articles produced over the past decade have had major impacts on the teaching of history and philosophy of science more generally. Dr Eleanor Robson's *Mathematics in Ancient Iraq* has become a standard text; Prof Tim Lewens's book on Darwin is often characterized as the best philosophical introduction to its subject; Dr Patricia Fara's *Science: A Four Thousand Year History* won the Dingle Prize for the best popular book in history of science and is widely used for teaching. The effect of HPS's work is enhanced through a carefully managed programme of international visitors (70 in the period 2008-13), who attend our lectures and seminars and make use of their experiences in their own teaching back in their home institutions. HPS has regularly facilitated large externally-funded projects that combine the possibility for serious academic work with subjects of wide public interest, ranging from debates about reproduction and fertility to the religious implications of evolution. These projects are systematically encouraged through provision of space, computing facilities and administrative support.

In terms of specific policy outcomes, HPS's commitment to museum work has led to significant involvement in UK national strategy for public galleries and collections. Prof Taub, Director and Curator of the Whipple Museum, is on the UK Spoliation Advisory Panel; she also advises several German museums, and the Volkswagon Stiftung, on museum strategies. Prof Schaffer served as a Trustee of the Science Museum Group between 2007 and 2011 and is currently on the Science Museum's Advisory Board. Dr Eleanor Robson is Chair of Council of the British Institute for the Study of Iraq and has been a leading voice in establishing UK policy on antiquities in the wake of the Iraq war. Members of HPS have developed strong links with the Centre for Science and Policy, which builds pathways to impact in the public policy world by connecting researchers to policy professionals. Since its programme of Policy Fellows began in 2011, many Fellows (mostly from UK and EU government bodies) have had meetings in HPS. This includes over 29 individual one-on-one meetings in the period 2010-13 with senior members of HPS staff, including Prof Tim Lewens, Prof John Forrester, Prof Jim Secord, Dr Anna Alexandrova and Dr Stephen John.

In recent years, HPS has become a major centre for bioethics and especially for policy-oriented work on the role of risk and trust in bioethics and technology policy. The work of Prof Tim Lewens has been fundamental to reports of the Nuffield Council on Bioethics. Lewens' contributions have led to invitations to give evidence to the Welsh National Assembly, thus shaping the Assembly's drafting of its human transplantation bill. Other aspects of this research have been reflected in the Human Fertilisation and Embryology Authority's advice to UK Ministers and have involved Lewens in consulting roles to industry. These are outcomes of a long-standing aim in HPS and the University to encourage informed debate about the role of science and medicine in public life.

c. Strategy and plans

Our strategy for the next 5 years involves a strong continuing commitment to reach wider audiences and shape public debate. This is a wider University policy, supported through two research facilitators within the School of the Humanities and Social Sciences and the work of the Office of External Affairs and Communications. In the Whipple Museum, a new permanent post of Assistant Curator has recently been filled by Joshua Nall, who will be in part responsible for working with academic researchers in HPS to create gallery-based and online displays and exhibits to make their work available to the public. A short-term Museum Learning Co-ordinator will help develop resources and research-led activities for various educational and public groups. We

have also had favourable initial responses to our proposals for a substantial expansion of the research facilities of the Whipple Museum, taking advantage of newly-free space in central Cambridge. This will make possible exciting new initiatives for public access to our research collections, as well as the findings and interpretations of researchers. Using its own resources, the Darwin Project has recently lengthened the contract of its professional outreach officer, Sally Stafford, who will be extending the work with schools (especially through the new Key Stage 3 requirement for the teaching of evolution) as well as among groups of mature learners, notably in connection with the University of the Third Age, Black History Month and related initiatives.

Most of our large grants will be continuing, with new resources forthcoming from the Casebooks Project, the Longitude Project, the Generation to Reproduction Project and the Darwin Correspondence Project. All of these have plans for further outreach, particularly through the web. To give only a few highlights, in 2014 a major tercentenary exhibition on longitude opens at the National Maritime Museum; Series 9 of Coast on BBC2 will broadcast a programme on longitude. Prof Schaffer is planning a new BBC4 television series on science, technology and urban life circa 1900, to be broadcast in 2014-15. The Generation to Reproduction's website has a rapidly developing presence, being prepared by its outreach officer. A major expansion of the outreach activities of the Casebooks Project is projected in the context of the current funding application. The Darwin Correspondence Project will complete its edition of over 15000 letters in 2022, making this vital resource (and the extensive supporting materials) available freely online for all.

More generally, HPS already has a website that for many years has served as a reference point, particularly through the online exhibitions and reading lists provided by the Library. Filmed versions of a number of seminars and conferences are already online (http://www.hps.cam.ac.uk/video/). History and philosophy of science is often cited as a subject in which open access courses can play a particularly significant role. In coming years, we plan to provide further online exhibitions, coordinated access to online lectures and seminars and the continuing provision of high-quality primary resources and supporting materials.

d. Relationship to case studies

The long-standing orientation of our department towards understanding the sciences and medicine has meant that our research activities routinely generate impact, from one-on-one discussions with policymakers to appearances on television programmes seen by millions of viewers. Over many years, researchers have been facilitated in presenting their work in an accessible form, whether through museum exhibitions, books for trade audiences, or free-to-view websites. The five case studies have consequently been selected from a wider range of possibilities.

Several of the cases demonstrate our commitment to working with the mass media, notably 'Scientific Machines and the Enlightenment' and 'Charles Darwin and Evolution'. These two projects have also been engaged in developing exhibitions and in changing the way science is presented in museums, as has 'Embryo Images', which offers an especially clear case of the way that academic research can shape museum displays. 'A Social History of Mathematics in Ancient Iraq' and 'Charles Darwin and Evolution' indicate our commitment to educational work in schools and universities. The outcomes of these projects are available for free public use on the web and in many instances (such as the availability of materials on the history of reproduction, and Darwin's writings and letters) the effect has been transformative. Our commitment to policy is apparent in many forms, including service on museum boards and bodies concerned with cultural restitution; it is most potently demonstrated in the case 'Risk, Trust and Bioethics', which outlines the advisory work of Prof Lewens and others in public policy, especially in relation to genetics.

The cases are diverse, as our policy has been to support academics in their choices of topic and approach, but they are all underpinned by the University and HPS's strategic efforts to ensure that research in our field shapes public discussion and policy debates about the sciences. Although quantitative data is sometimes available, the real measure of success in implementing our approach is at a more fundamental level. HPS has played a significant role in opening up science and medicine to public engagement, as recommended in the influential House of Lords Select Committee on Science and Technology's paper of 2000. This is evident in behind-the-scenes involvement in the media and a strong presence on the internet. It is also shown through presentations of our work (and that of our students) at public events, exhibitions and science festivals; in lectures to schools; and in the ongoing work of the Whipple Museum. Through these means, the expertise available in HPS has had a major impact in raising awareness of the perspectives that the humanities can offer on the natural sciences.